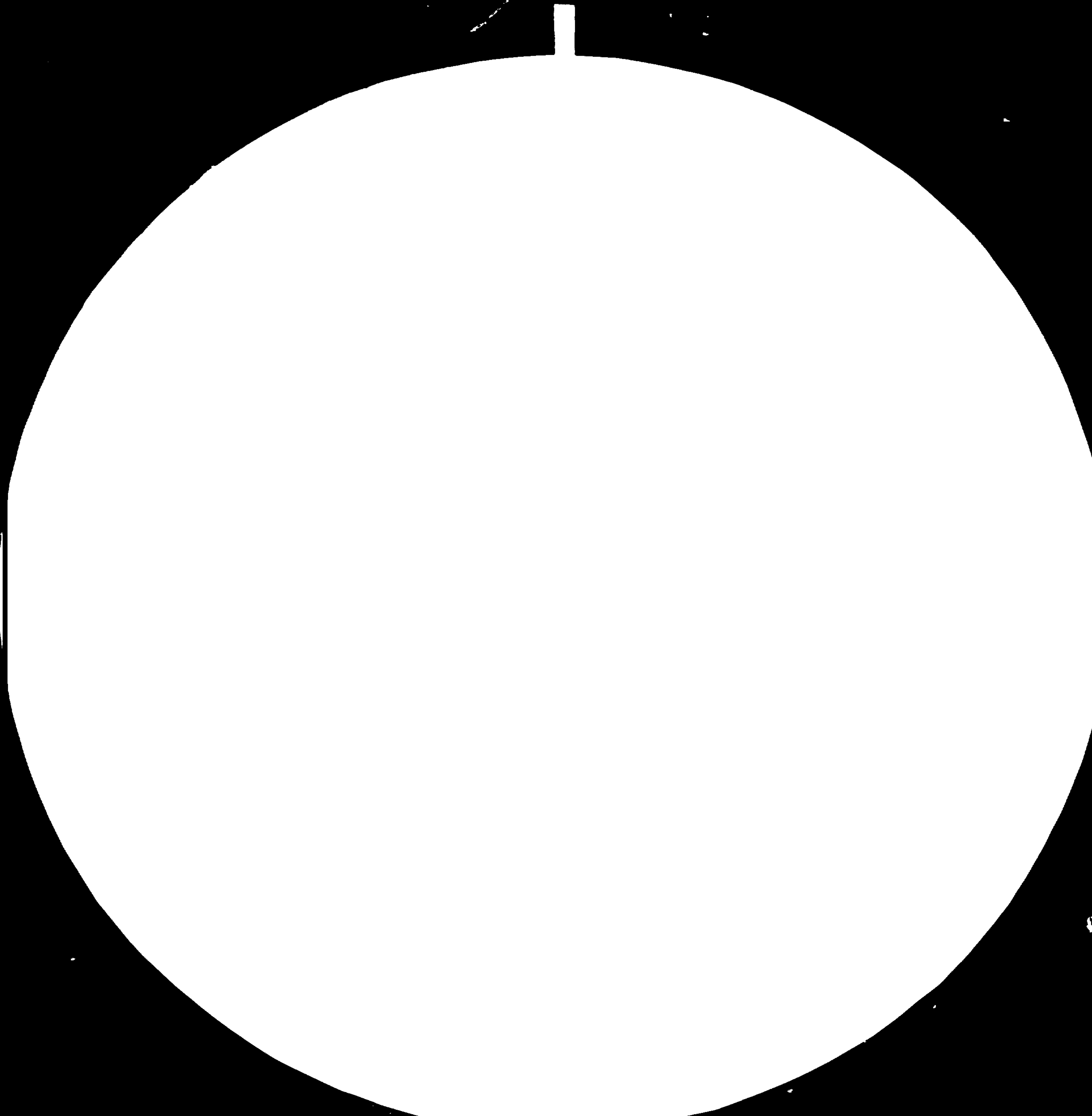
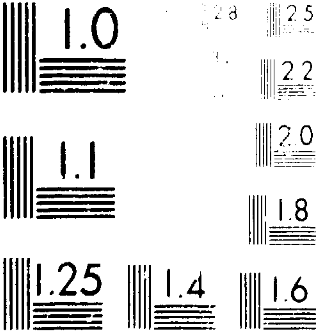
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org





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United Nations Industrial Development Organisation

FEASIBILITY STUDY IN NIGERIA AND ZAMBIA ON THE ESTABLISHMENT OF A COPPER FABRICATION PLANT IN NIGERIA

VOLUME 1 : NIGERIAN MARKET STUDY

Final Report

Prepared by Metra Consulting Group under Contract 80/154 (Project Number: DP/RAF/79/006)

METRA CONSULTING GROUP LIMITED

St. Mary's House
42 Vicarage Crescent
London SW11 3LB

TELEPHONE: 01-223-7634
TELEX: 919173 MCGLDN G

The views expressed in this report are the views of the consultants and do not necessarily reflect the views of the Secretariat of the United Nations Industrial Development Organisation

Many of the tables presented in this report are based on data collected by Metra during interviews or on previous knowledge of specific industrial sectors. In many cases, a single table combines data from a number of sources. Other tables are forecasts made by Metra and based on data presented previously. In these cases no reference is given on the text.

In other cases a complete table is based on data obtained during interviews from a single source, but quoting unpublished data. In these cases the name of the Organisation or Company is given where appropriate.

Where the source is published information, the name of the source is given together with a reference to the Bibliography shown in Appendix B.

CONTENTS

Continued ...

Contents Continued ...

CONTENTS - TABLES

Continued ...

Contents - Tables - Continued ...

Continued ...

Contents - Tables - Continued ...

Continued ...

Contents - Tables - Continued ...

Continued ...

Contents - Tables - Continued ...

Continued ...

Contents - Tables - Continued ...

Continued ...

Contents - Tables - Continued ...

Continued ...

Contents - Tables - Continued ...

CONTENTS - FIGURES

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August 1982

ABBREVIATIONS

The following abbreviations have been used throughout this report.

LME	London Metal Exchange
Comex	Commodity Exchange (New York)
SKD	Semi-knocked down
CKD	Completely knocked down
NEPA	Nigerian Electric Power Authority
NNPC	Nigerian National Petroleum Company
RE	Rural Electrification
FMI	Federal Ministry of Industries
FMNP	Federal Ministry of National Planning
KV	Kilo Volts
GNP	Gross National Product
GDP	Gross Domestic Product
MW	Megawatt
KwH	Kilowatt Hour
GwH	Gigawatt Hour
V	Volts
MVA	Mega Volt Ampere
KVA	Kilo Volt Ampere
kg	Kilogramme
km	Kilometre
g	Gramme
HT	High Tension (Cables)
MT	Medium Tension (Cables)
LT	Low Tension (Cables)
sq.	Square
p.a.	per annum
p.m.	per month
p.w.	per week
hp	Horsepower
BSD	Standard Barrels per day
DDB	Dodecylbenzene
PVC	Polyvinylchloride
AC	Alternating Current
DC	Direct Current
k.cal	kilo-calories
KW	Kilowatt
ft.	Feet
ins.	Inches
m	metres
cm	centimetres
mps	metres per second
od	outside diameter
wt	wall thickness
amp	Ampere

rpm	revolutions per minute
fpm	feet per minute
BTU	British Thermal Units
SCF	Standard Cubic Feet
fob	free on board
cif	carriage, insurance and freight
₦	Naira
$	Dollars

1. INTRODUCTION

This project has been carried out under the terms of contract 80/154 between United Nations Industrial Development Organisation (UNIDO) and Metra Consulting Group. The project DP/RAF/79/006 was initiated in response to a request from the Governments of Nigeria and Zambia to UNIDO to provide assistance in carrying out a project entitled "Feasibility Study on the Establishment of a Copper Fabrication Plant in Nigeria".

Under the terms of the above mentioned contract four report documents are to be submitted. The first report is concerned with the demand for copper and copper alloy semi-finished products in Nigeria. Subsequent reports will cover:

Export Market Opportunities

Feasibility Study

Executive Summary

The demand for copper and copper alloy products in Nigeria is expected to rise rapidly over the next five to six years as new industries develop and by 1986 the total volume of copper and copper alloy products required is expected to have reached just over 30,000 tons, as shown in Table 1.1

TABLE 1.1 : REQUIREMENTS FOR COPPER AND COPPER ALLOY SEMIS - ALL NIGERIAN INDUSTRY - 1986

Sector	Copper (Tons)					Copper Alloy (Tons)				Castings (Tons)
	Wire	Winding	Rod	Strip	Tube	Wire	Rod	Strip	Tube	
Electrical Engineering	16,425	1,405**	88	346	27		209	1,171	3	
Domestic Appliance	232*	401*		34	513		53	117	20	8
Transport	273*	85*	3	396			4	878	605	
General Engineering	7			5		56	518	3,901	600	369
Construction					1,197		788	275		406
TOTAL	16,432	1,405	91	781	1,737	56	1,572	6,342	1,228	783

* Excluded from final total as also included in Electrical Engineering Sector.

** Of this total, some 300 tons is heavy wire for transformer windings.

2. ELECTRICAL ENGINEERING INDUSTRY

In any industrial country the major user of copper is the electrical engineering industry which, for the purposes of this report, we have taken to encompass all electrical and telecommunication products including the wire and cable used in other industrial sectors.

We begin with a review of the power generation and distribution industry and of the data on the import and manufacture of wire and cable. These sections are followed by analysis of consumption of various types of cable by different sectors of industry.

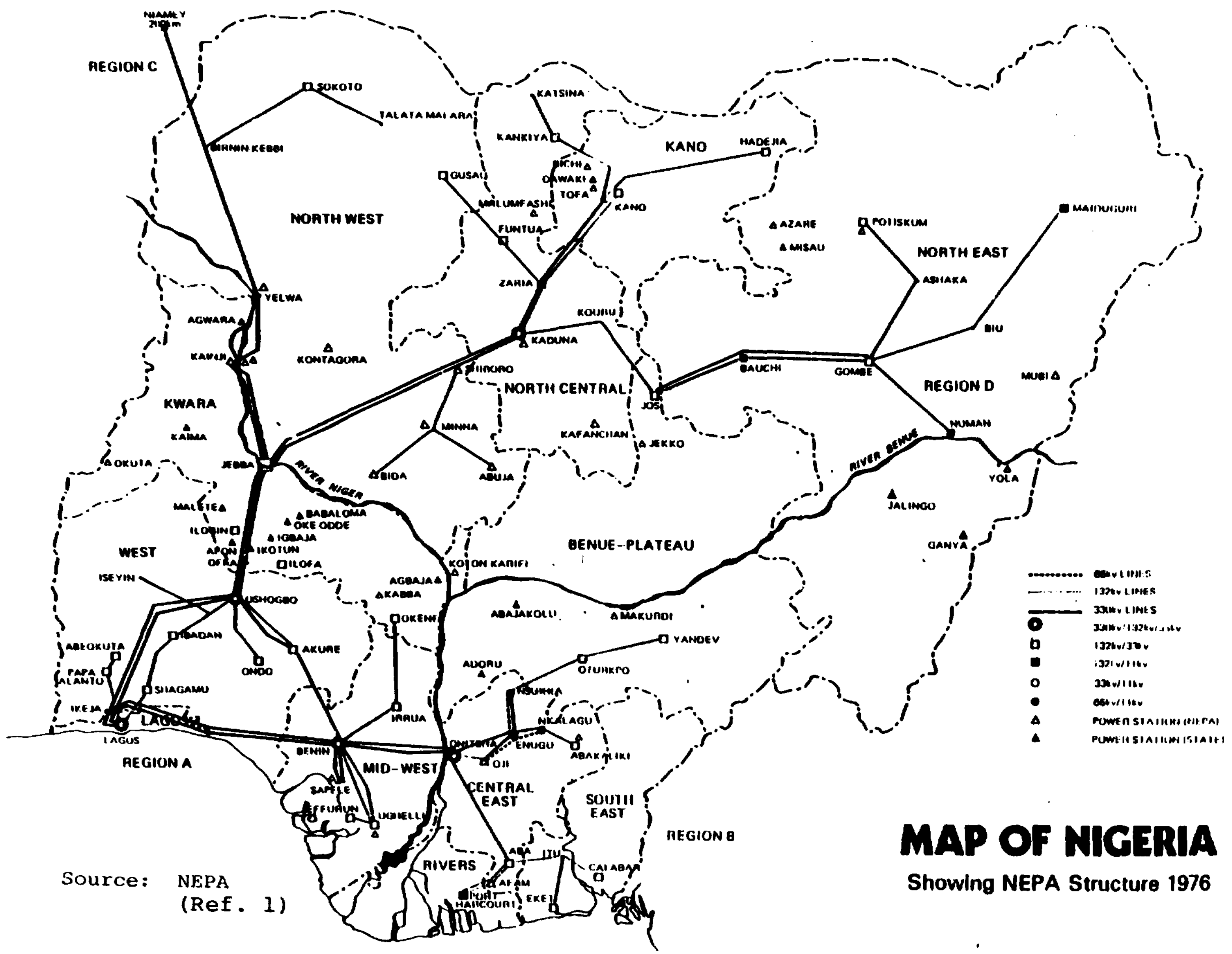
2.1 Power Generation, Transmission and Distribution

Electricity Generation, Transmission and Distribution in Nigeria is mainly under the control of the Nigerian Electric Power Authority (NEPA) with the exception of an insignificant proportion handled by Nigerian Electric Supply Company (NESCO) which operates in Plateau State. NEPA is responsible to the Federal Ministry of Mines and Power. In addition each state now has a Rural Electrification Board (REB), set-up with the aim of generating and distributing electric power to selected rural areas. The REB's are responsible to their state governments and so selection of priorities is delegated to state rather than central government.

During the 1970's energy sales increased by a factor of almost seven giving an annual average growth rate of over 20%. This very high growth rate led to inevitable problems of reliability and NEPA has had, and will continue to have, a hard struggle to keep pace with demand. Because of the unreliability or unavailability of supplies almost every industry and many individuals have installed their own generating plant either for continuous service or as a standby. Most industries have enough standby capacity to continue production even with a complete failure of the NEPA supply.

Many of the major towns are already connected to the national grid although there are still some isolated undertakings which will be largely phased out by 1985. NEPA is planning vast expansion of the national grid. Figure 2.1 shows a map of the grid as it was in 1976 and Figure 2.2 shows the grid structure planned for 1986 when all state capitals and many other towns will be connected. This expansion will involve building of 330 and 132 KV lines. Estimates of the length of lines to be built are given in Table 2.1.

FIGURE 2.1

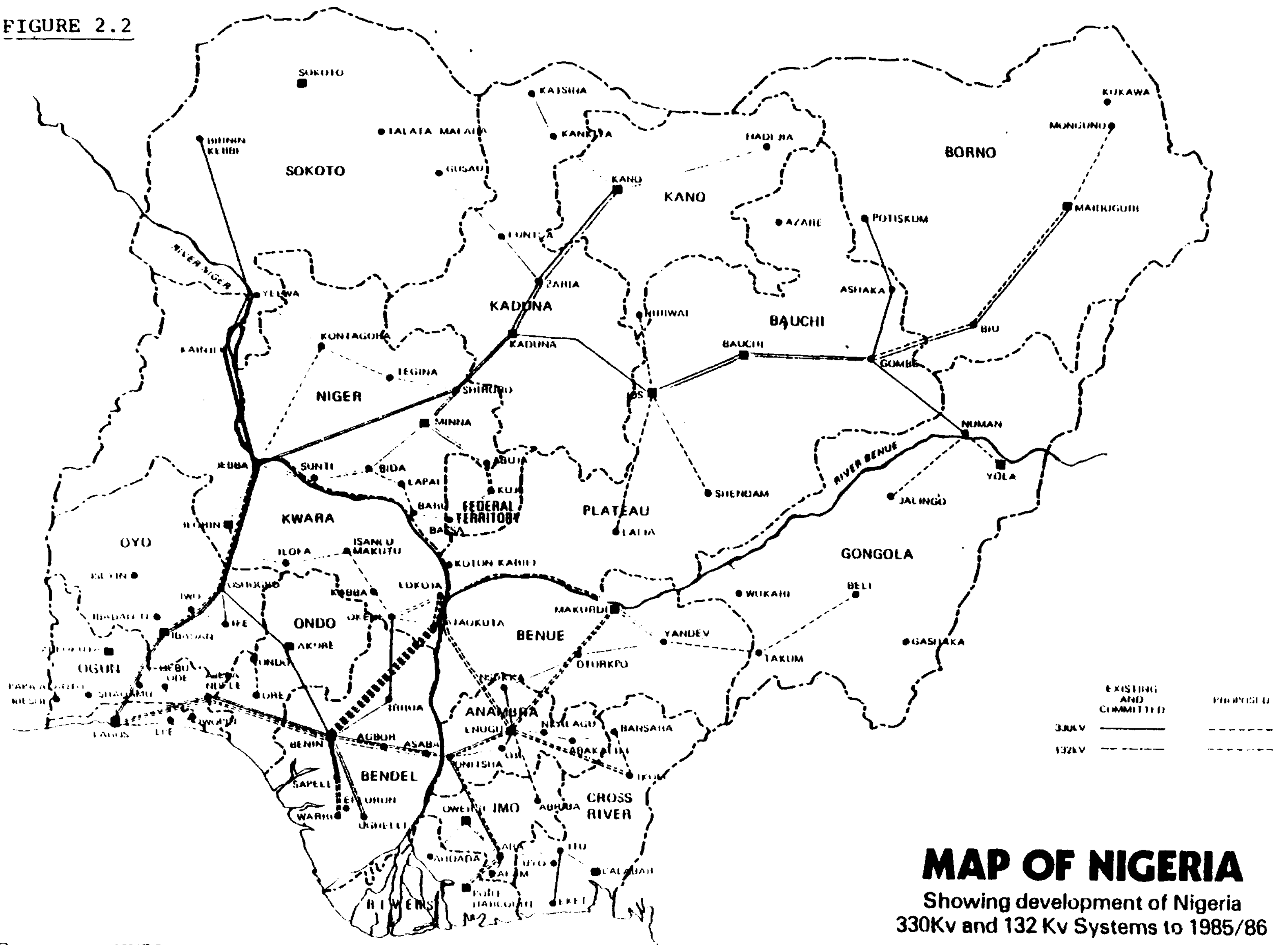


MAP OF NIGERIA

Showing NEPA Structure 1976

Source: NEPA
(Ref. 1)

FIGURE 2.2



MAP OF NIGERIA
Showing development of Nigeria
330Kv and 132 Kv Systems to 1985/86

Source: NEPA
(Ref. 1)

TABLE 2.1 : ESTIMATES FOR CONSTRUCTION OF TRANSMISSION LINES BY NEPA (km)

Year	330 KV		132 KV	
	Total	New	Total	New
1975	1,341	530	1,341	379
1976	1,871	242	1,720	844
1978	2,113	200	2,564	600
1979	2,300	200	3,200	600
1980	2,500	200	3,800	600
1981	2,700	200	4,400	800
1982	3,300	600	5,900	1,500
1983	3,950	650	7,300	1,400
1984	4,300	350	8,600	1,300
1985	4,520	220	9,900	1,300
1986	4,760	240	10,500	600

Source: NEPA
(Ref. 1)

REB schemes consist of small power stations (mainly 0.5-2.0 MW) and 33KV and 11KV transmission and distribution systems. As these small systems multiply they will be interconnected and eventually linked to the main NEPA grid. NEPA will then take responsibility for supply and maintenance. The generators in the power stations can then be moved and set-up in a new location. Although Rural Electrification Boards have been in existence for a number of years their efforts are only just beginning to bear fruit.

In addition to the State Rural Electrification schemes there are a number of NEPA schemes designed to cover larger areas which are remote from the existing grid and which it is not yet economic or practical to connect to the grid.

For some years the major source of power has been the hydro electric station at Kainji, but this is now being supplemented by thermal stations (either steam or gas turbine) fueled principally by natural gas. Major stations at Sapele, Afam and Ughelli are already in operation and will be expanded in due course. Further hydro electric stations are either under construction or planned at Shiroro and Jebba.

The generating capacity of various power stations planned by NEPA is shown in Table 2.2. Many of the new installations are well under way - for example, at Shiroro, Sapele and Afam - but, other projects particularly the new Lagos thermal station, are likely to be delayed and there will be (even by NEPA's most optimistic forecasts) a continuing shortage of power at peak times for some years to come unless a high level of serviceability can be maintained. At present 30% of power comes from the hydro electric station at Kainji. By 1985 42% of power will be generated by hydro electric stations and the balance by thermal plant fuelled by oil or natural gas.

NEPA operates a ten year rolling plan and were therefore able to furnish us with detailed information on the likely developments in the power supply industry up to 1989. Some of the data obtained from NEPA is summarised in Table 2.3. The figures up to 1978/79 are actual performance figures, those for subsequent years up to 1989 are NEPA forecasts except for estimates of the number of consumers where the NEPA data stops at 1984. We have assumed that the number of customers will continue to increase at 14% per year. All the figures for 1990 are Metra estimates based on NEPA data for the previous year.

TABLE 2.2 : NEW GENERATING CAPACITY PLANNED BY NEPA - TOTAL GRID CAPACITY (MW)

Stations	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Kainji (H)	760	760	760	760	760	760	760	760	760	760
Ijora (G)	60	60	60	60	60	60	60	60	60	60
Sapele (S)	580	696	696	696	696	696	696	696	696	696
Sapele (G)	-	300	300	300	300	300	300	300	300	300
Afam I & II (G)	150	150	140	130	95	95	95	95	95	73
Afam III (G)	96	96	96	96	96	96	96	96	96	96
Afam IV (G)	-	75	450	450	450	450	450	450	450	450
Delta I & II (G)	156	156	156	156	130	130	130	130	130	110
Delta III (G)	120	120	120	120	120	120	120	120	120	120
Shiroro (H)	-	-	-	300	600	600	600	600	600	600
Jebba (H)	-	-	-	90	270	540	540	540	540	540
Lagos (S)	-	-	-	-	200	600	1,000	1,200	1,200	1,200
Kaduna (S)	-	-	-	-	-	-	150	450	450	450
OJI (S)	-	-	-	-	-	60	60	60	60	60
1. TOTAL INSTALLED CAPACITY	1,922	2,413	2,778	3,158	3,777	4,507	5,057	5,557	5,557	5,515
2. GRID CONNECTED MAXIMUM DEMAND	1,203	1,561	1,923	2,316	2,872	3,286	3,818	4,435	5,159	6,048
3. DESIRED GRID RESERVE (0.35 x (2))	421	546	673	810	1,005	1,150	1,336	1,552	1,805	2,116
4. GRID FIRM (1) - (3)	1,501	1,867	2,105	2,348	2,772	3,357	3,721	4,005	3,752	3,399
5. GRID RESERVE (1) - (2)	719	852	855	842	905	1,221	1,239	1,122	398	-533
6. RESERVE SURPLUS OR SHORTFALL (-) (5) - (3)	289	306	182	32	-100	71	-97	-430	-1,407	-2,649

H = Hydro Station G = Gas Station S = Steam Station.

Source: NEPA

TABLE 2.3 : NEPA PERFORMANCE AND FORECASTS

	1973	1974	1975	1976	1977	1978
Total Installed Capacity (MW)	600	606	606	876	1026	1026
Grid Maximum Demand (MW)	320	440	500	570	700	880
Firm Capacity (total-reserve) (MW)	420	450	450	720	790	820
Surplus/Deficit (Firm Cap-Max Demand) (MW)	40	10	-50	150	90	-60
Energy Sales (GWh)	1620	2000	2653	3233	3792	4037
Annual Increase in Sales (%)	23.5	32.7	21.9	17.3	6.5	9.2
Total Customers ('000)	350	390	440	500	600	710
[2]Annual increase in customers (%)	11.4	12.8	13.6	20.0	18.3	12.7
Sales/Customer ('000 KWh/yr)	4.6	5.1	6.0	6.5	6.3	5.7
New Customers per year ('000)	-	40	50	60	100	110
Proportion of total customers (%)						
Residential				81.6	82.4	83.2
Commerical				17.9	17.1	16.3
Industrial				0.51	0.49	0.46
Proportion of Total Sales (%)						
Residential					41.5	41.3
Commercial					21.8	22.6
Industrial					36.7	36.1

[1] Metra Estimates [2] Metra Estimates from 1984 onwards. All other data from N

Source: NEPA

1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1767	1922	2413	2778	3158	3777	4507	5057	5557	5557	5515	
1030	1203	1561	1923	2316	2872	3286	3818	4435	5159	6048	
1410	1501	1867	2105	2348	2772	3357	3721	4005	3752	3399	
380	298	306	182	32	-100	71	-97	-430	-1407	-2649	
4408	5480	7111	8759	10588	13085	11965	17392	20206	33502	27551	32234
24.3	29.6	23.2	20.5	23.9	14.4	16.2	16.2	16.3	17.22	17.0	-
800	910	1040	1190	1360	1550	1767	2015	2296	2617	2984	3403
13.8	14.3	14.4	14.3	14.0	14.0	14.0	14.0	14.0	14.0	14.0	-
5.5	6.0	6.8	7.4	7.8	8.4	8.5	8.6	8.[illegible]	9.0	9.2	9.5
90	110	130	150	170	190	217	248	281	321	367	429

NEPA sources.

The growth in energy sales will depend on the success of NEPA in bringing new plant on stream and maintaining equipment in a fully operational condition. The percentage increases in energy sales planned over the next four years are ambitious and there is certain to be some shortfall. However, the expected number of new consumers (which largely determines consumption of copper) is more modest and even if they do not have power at all times such installations will probably go ahead, many consumers making up the shortfall themselves with standby generating equipment. We have therefore used the NEPA projections of the numbers of new consumers as a basis for some of our estimates of copper consumption described in later sections of this report.

Since energy sales are estimated to rise faster than the number of consumers the consumption per customer will also rise from 1980-1990 (as indeed it has done in the past). However, even if generating capacity does not rise as rapidly as planned it is probable that the number of consumers will continue to rise at the forecast rate. Meanwhile the consumption per consumer will rise less rapidly than predicted, but the number of new consumers is the important parameter for this report.

As well as NEPA consumers there will be consumers connected to Rural Electrification Schemes. The NEPA figures do not include these consumers. States plan to connect new consumers at a rate of 10,000 per year during the 4th Plan. Such high figures are unlikely to be achieved in the early stages of the plan, but even at an initial rate of only 3,000 per year there will be 57,000 new consumers per year throughout the country. The rate of new connections could accelerate rapidly because more and more people in previously electrified areas will be able to afford the installation and more areas will be covered. NEPA have estimated that new connections to the grid will increase at 14% per year. We estimate that new connections to RE schemes will grow at a more modest rate of 10% giving 130,000 new connections per year in 1990. Details are given in Table 2.4.

Detailed analysis of copper consumption in various sectors of the electricity industry, particularly cable, switchgear and transformers is considered later in the appropriate sections on each sector.

TABLE 2.4 : ESTIMATED NUMBERS OF CONSUMERS CONNECTED TO RURAL ELECTRIFICATION SCHEMES

Year	Consumers ('000's)
1977	39
1978	43
1979	47
1980	52
1981	57
1982	63
1983	69
1984	76
1985	83
1986	92
1990	134

2.2 Wire and Cable Imports into Nigeria

Nigerian Trade Summaries include under category 723-10 "electricity, insulated wire and cable". This should include almost all imports of copper wire and cable except that forming part of equipment in other categories and uninsulated copper wire or cable (of which there will be very little since it is no longer used as an overhead conductor).

The category will include very little aluminium wire since almost all of this is uninsulated overhead power cable. The relevant import data is given in Table 2.5. The change in unit price is consistent with overall inflation and changes in the price of copper on the world market.

TABLE 2.5 : IMPORTS INTO NIGERIA OF INSULATED ELECTRICAL WIRE AND CABLE

Year	Tons	Values '000 ₦	Price ₦/ton
1976	20,370	26,157	1,280
1977	20,650	48,144	2,331
1978	28,231	74,755	2,648
1979*	21,378	66,380	3,105

* Figures up to June 1979 only are available. The figure for June has been doubled to give the annual total quoted.

Source: Nigerian Trade Summary (Ref. 2).

Wires and Cables can be divided into four categories each of which are treated separately in the end-use analysis. The types are:

Building wire	-	used for internal domestic and industrial wiring and flex for appliances. It operates at up to normal mains voltage and is usually PVC insulated.
Power Cable	-	used at above 220V and may be armoured. The main end users are NEPA or their contractors, REB's, streetlighting and some industries.
Winding Wire	-	used for winding or rewinding of motors, generators, transformers coils etc. It is usually resin or enamel insulated.
Telecommunications Cable	-	used for telephone systems and often armoured.

The Nigerian statistics do not differentiate between types of wire and cable, but do give countries of origin. We have selected all major sources and collected export data from each of these countries - the results are given in Table 2.6. Some difficulty was experienced in separating products into different categories as classifications vary fron one country to another and some exports are listed as unspecified. The figures for 1980 were in many cases incomplete and have been increased pro-rata to give estimates for a full year. The figures for "other" countries, where exports statistics were not available, have been estimated from Nigerian data on import from those countries.

TABLE 2.6 : WIRE AND CABLE EXPORTS TO NIGERIA (tons)

Country	Type	1977	1978	1979	1980	Period Covered in 1980
UK	Building	3,961	2,727	534	1,203	
	Power	2,599	3,477	867	1,941	
	Winding	81	106	52	202	
	Telecoms	3,401	3,824	2,125	1,594	
	TOTAL	10,042	10,134	3,578	4,940	FULL YEAR
US	Building	15	81	21	9	
	Power	33	25	113	213	
	Telecom	3,899	1,807	1,752	770	
	TOTAL	3,947	1,913	1,886	992	JAN-SEPT
West Germany	Building	400	280	96	75	
	Power	2,886	1,832	1,679	480	
	Winding	43	25	21	-	
	Telecom	1,071	2,076	2,154	2,100	
	TOTAL	4,400	4,213	3,950	2,655	JAN-SEPT
Italy	Building	1,987	2,392	1,000	490	
	Power	58	255	87	29	
	Winding	1	-	-	-	
	Telecom	10	1	-	-	
	TOTAL	2,056	2,648	1,087	519	JAN-NOV
Japan	Building	79	251	767	146	
	Power	103	659	969	345	
	Winding	1	-	-	-	
	Telecom	1,121	772	2,460	1,792	
	TOTAL	1,304	1,682	4,196	2,283	JAN-NOV
France	Building	201	778	1,731	253	JAN-NOV
Benelux	Power	-	100	63	-	
Canada	Unspec	42	157	-	-	
Spain	Unspec	553	532	425	400	
Sweden	Unspec	181	261	249	24	JAN-SEPT
Switzerland	Unspec	128	110	28	-	
"Others"	Unspec	1,000	1,825	824	1,000	
TOTAL		23,854	24,353	18,553	13,066	

Source: Exporters Trade Statistics
(Ref. 3)

Table 2.7 lists total exports of wire and cable from the country of origin to Nigeria by type, and for comparison gives the Nigerian import fitures. The agreement between import and export statistics is good bearing in mind that the periods covered by data from different sources varies and that exports will be counted as they leave the country of origin but will not be included in imports until they have been cleared by the customs in Nigeria.

Table 2.8 shows cable type as a percentage of the total imports (excluding unspecified). Table 2.9 gives a mean of import/export data distributing the unspecified category pro-rata among the other types.

The data will be discussed in detail later, but shows sensible trends. Imports of building wire particularly, and, to a lesser extent, power cable are declining as local manufacture increases while telecommunications cable imports remain, for the moment, steady. The data on winding wire may well not be accurate as a disproportionate amount will probably have been included in the unspecified category.

TABLE 2.7 : CABLE EXPORTS TO NIGERIA BY TYPE (tons)

Item	1977	1978	1979	1980
Building Wire	6,643	6,509	4,149	2,176
Power Cable	5,679	6,348	3,778	3,008
Winding Wire	126	131	73	202
Telecom Cable	9,502	8,480	8,491	6,256
Unspecified	1,904	2,885	1,528	1,424
TOTAL	23,854	24,353	18,019	13,066
Imports from Nigerian Summary	20,650	28,231	21,378	n.a.

Source: Exporters Trade Statistics
(Ref. 3)

TABLE 2.8 : CABLE EXPORTS TO NIGERIA BY TYPE AS A PERCENTAGE OF THE TOTAL

Item	1977	1978	1979	1980
Building Wire	30.3	30.3	25.2	18.7
Power Cable	25.9	29.6	22.9	25.8
Winding Wire	0.6	0.6	0.4	1.7
Telecom Cable	43.2	39.5	51.5	53.8
	100.0	100.0	100.0	100.0

Source: Exporters Trade Statistics
(Ref. 3)

TABLE 2.9 : CABLE IMPORTS TO NIGERIA BY TYPE - ADJUSTED FIGURES (TONS)

Item	1977	1978	1979	1980
Building Wire	6,740	7,970	4,960	2,430
Power Cable	5,760	7,780	4,510	3,350
Winding Wire	130	160	80	220
Telecom Cable	9,620	10,390	10,150	7,000
TOTAL	22,250	26,300	19,700	13,000

Source: Exporters Trade Statistics
(Ref. 3)

Table 2.10 shows exports of wire and wire rod to Nigeria based on export data from the supplying countries. The majority of the wire rod will have been supplied to the local wire and cable industry as their raw material, while the wire itself can have gone to a variety of other uses. Unfortunately a breakdown of the category into wire and rod was only available for 1979.

The cable industry in Nigeria manufactures building wire, lower voltage power cable and aluminium overhead conductors.

There were three companies in operation by the end of 1979, two of which began production in 1978, one in 1979. Since then a further factory, principally manufacturing wiring harnesses for the automotive industry, has begun production. The production by the industry of copper cables (in terms of copper content) is also listed in Table 2.10. For 1979, the only year for which complete data is available, 2,858 tons of rod were imported and the cable industry is estimated to have consumed 2,050 tons. These figures are reasonably consistent bearing in mind that 1979 was a difficult year for all businesses and stocks of raw material will certainly have been accumulating during the period. The agreement serves to confirm the estimates of cable production obtained from the manufacturers.

TABLE 2.10 : EXPORTS OF WIRE ROD TO NIGERIA AND PRODUCTION OF CABLE (tons)

Year	Exports of wire and wire rod	Production of Cable in Nigeria		
		Building Wire	Power Cable	Total*
1977	1,858	300	-	330
1978	3,899	720	-	2,050
1979	2,858**	1,040	1,760	3,080

* includes 10% for scrap
** rod only

Source: Export Statistics (Ref. 3)
CAMAM (Ref. 4)

2.3 Building Wire

Building wire includes all wire and cable used at or below normal mains voltage in residential, industrial and commercial buildings. The products vary from flex for lighting through lightweight wiring cable to heavy duty connections for industrial plant, electric motors and furnaces etc. It also includes wiring or leads which form part of other manufactured goods (such as refrigerators or air-conditioning units) data for which is taken from other sections of this report.

All building wire used in Nigeria uses copper as the conductor and this will continue for the foreseeable future. Aluminium is used in some countries to a major extent, India is an example. It has been tried in the US but was largely unsuccessful. Aluminium cable is less flexible than copper and is hence more difficult to install. The main problem, however, is that being less malleable it is not compatible with conventional screwed connectors which tend to work loose and the arcing which can result represents a significant fire hazard. In our opinion small cables with aluminium conductors will not come into general use in Nigeria. The copper content of building wire varies with type of cable. Table 2.11 give the copper content of various cables as a percentage of total weight.

In terms of cable length the most commonly used cables are 1.0mm^2 and 2.5mm^2 flat twin and earth and even in terms of total cable weight they still represent the majority of all usage. We estimate that the average copper content of building wire is 40%.

Estimates of the number of new connections to be made by NEPA up to 1990 were shown previously in Table 2.3. The majority of building wire will be used in new installations although as time goes on the proportion required for rewiring will increase. New wiring will be required in new houses in already electrified areas and in existing housing when power is brought to the area.

In addition to the new consumers connected to NEPA there will be others connected to State Rural Electrification (RE) schemes. The rate at which RE develops will vary from state to state, but estimates of the numbers of consumers have been given in Table 2.4.

TABLE 2.11 : COPPER CONTENT OF BUILDING WIRE

Type	Nominal Area of Conductors mm2	Total Cable Weight kg/km	Conductor Weight kg/km	% Weight of Copper
Flex 3 core	0.5	59	14	23
	1.0	83	27	33
	2.5	166	68	41
Flat Twin & Earth	1.0	69	27	39
	2.5	116	54	46
	6	246	130	53
	16	547	342	62
Flat Twin	1.0	54	14	26
	2.5	99	45	45
	6.0	207	108	52
Circular, Three	10.0	500	270	54
Core, Unarmoured	25.0	1080	675	63
Circular, Three	10.0	940	270	29
Core, Armoured	25.0	1770	675	38

Source: Nigerchin (Ref. 5)

Table 2.3 shows the total number of NEPA consumers and the percentage in each of the sectors, Residential, Commercial and Industrial in the period 1976-78. From this data we can calculate the number of consumers in each sector in 1978. It is predicted that during the 4th Plan Industrial GDP will grow at 15% per annum and Commercial GDP at 10%. It seems reasonable to assume that the numbers of new consumers in the industrial and commercial sectors will grow at the same rate as whe whole sector. The number of new residential connections can then be calculated by difference from the NEPA total for all new consumers. (It would not be reasonable to assume that new residential consumers will grow at the same rate as the Housing GDP (ie 8%) since many of the new connections are into existing houses.) The results of the calculations are shown in Table 2.12.

Two features worthy of comment arise from the figures in 2.12. Figures in Table 2.3 show a decrease of the proportion of both industrial and commercial consumers relative to residential consumers in the period 1976-78. The forecasts in Table 2.12 reverse this trend for the industrial sector, a feature which seems entirely consistent with the increased emphasis being placed on industrialisation during the 4th plan.

The second point of note is the relationship between numbers of connections to new housing and those into existing building. In areas which have been electrified for some years most connections will be to new houses as a high proportion of existing houses where owners can afford electricity will already be connected. In newly electrified areas most connections will be to existing houses. As the distribution network spreads to more remote areas the proportion of connections going into existing buildings will increase (until a point is reached where nearly all houses are connected, but this will not be for a very long time . It has been estimated elsewhere that the number of modern houses being built in 1981 will not exceed 30,000 units and that this will rise at about 8% per annum giving 65,000 new houses per year in 1990. The proportion of new NEPA connections going to existing houses will therefore rise from 72% in 1980 to 82% in 1990. In view of the spread of NEPA to more remote areas the present proportion of connections to existing housing and the rise in 1990 seems reasonable.

From the data in Table 2.3 we can calculate the relative power consumption of the three classes of consumer in 1978 as shown in Table 2.13.

TABLE 2.12 : NEW NEPA CONNECTIONS BY SECTOR ('000's)

Year	Industrial	Commercial	Residential	Total
1977	0.440	16.3	83.3	100
1978	0.516	17.9	91.6	110
1979	0.582	19.7	69.7	90
1980	0.669	21.7	87.6	110
1981	0.769	23.8	105.4	130
1982	0.885	26.2	122.9	150
1983	1.018	28.8	140.2	170
1984	1.170	31.7	157.1	190
1985	1.346	34.9	180.8	217
1986	1.547	38.4	208.0	248
1987	1.780	42.2	237.0	281
1988	2.047	46.4	272.6	321
1989	2.354	51.1	313.6	367
1990	2.707	56.2	370.1	429
Average Growth Rate	15%	10%	12.2%	11.9%

Source: Metra/NEPA

TABLE 2.13 : RELATIVE POWER CONSUMPTION IN DIFFERENT SECTORS 1979

Sector	Number	Power Consumed GWh	Power/Consumer MWh	Relative Power Consumption
Residential	590,000	1,667	2.825	1.0
Commercial	115,000	912	7.930	2.8
Industrial	3,266	1,457	446.111	158.0

Source: NEPA (Ref. 1)

TABLE 2.14 : NEW CONSUMERS IN THOUSANDS OF RESIDENTIAL EQUIVALENTS

Year	NEPA			Rural Residential	Total "Residential Equivalents"
	Industrial	Commercial	Residential		
1977	69	46	83	39	237
1978	80	50	92	43	265
1979	92	55	70	47	264
1980	106	61	88	52	307
1981	122	67	105	57	351
1982	140	74	130	63	407
1983	161	81	140	69	451
1984	185	89	157	76	507
1985	213	98	181	83	575
1986	244	108	208	92	652
1987	281	118	237	101	737
1988	323	130	272	111	846
1989	371	143	314	122	950
1990	427	157	370	134	1088
Average Growth Rate	15%	10%	12.2%	10%	12.4%

By multiplying figures in Table 2.12 by the appropriate factor from Table 2.13 we have calculated the number of new consumers in "Residential Equivalents" as far as power consumption is concerned. The results are given in Table 2.14, including all NEPA new connections and RE customers (which are all assumed to be residential). This calculation assumes that the factors given in Table 2.13 remain constant over the whole period. The data in Table 2.14 gives an average rate of growth of new consumers in "Residential Equivalents" over the period 1977-1990 of 12.4%.

Confirmation of this estimate can be derived as follows. From the data in Table 2.13 it can be shown that the total number of consumers in 1977 was 1,163,000 residential equivalents. Allowing for the annual increases (Table 2.14) but excluding RE connections the figure will have risen to 7,464,000 by 1990 giving an average annual increase of 15.3% for total power consumption. This compares well with a figure of 14.5% derived from the NEPA data in Table 2.3.

Assuming that a new industrial or commercial "residential equivalent" uses as much cable as a real residential unit we can estimate the total demand for building wire from the consumption in a single unit. Estimates vary considerably as to how much cable is used per household, but a concensus of a number of expert opinions gives a figure of 200m of 2.5mm^2 flat twin and earth as a good average. In reality consumption will vary from consumer to consumer, but we have not made any distinction between different levels of consumption by consumers of different types as we do not believe the data would justify such a level of sophistication. In practice many of the new consumers in rural areas will use less than cable than urban consumers when first connected, but as time goes by they will extend their systems hence compensating for the low level of consumption by other new consumers in the same area.

The weight of the conductor in 2.5mm^2 twin and earth cable is 54kg/km. The consumption of copper in building wire calculated on this basis is given in Table 2.15.

Imports of building wire were given in Table 2.9. The range of wires in use will have an average copper content of 40% (see Table 2.11) so that we can calculate the copper content of imports. The figures are given in Table 2.15.

TABLE 2.15 : CONSUMPTION OF COPPER IN BUILDING WIRE ('000's) tons

Year	Imports[1]	Local Production[2]	Total	Estimated Consumption of Copper from Residential Equivalents
1977	2.7	-	2.70	2.56
1978	3.20	0.30	3.50	2.86
1979	1.98	0.72	2.70	2.85
1980	1.00	1.04	2.04	3.32
1981	-	1.74	-	3.79
1982				4.40
1983				4.87
1984				5.48
1985				6.21
1986				7.04
1987				7.95
1988				9.03
1989				10.26
1990				11.75

1 Nigerian Trade Summaries (Ref. 2)

2 CAMAM (Ref. 2)

The Cable Manufacturers Association of Nigeria (CAMAN) has estimated consumption of copper by local manufacturers of building wire and these figures are also shown in the table. The total of imports and local production is significantly below the estimate requirements 1980. This we consider is partly because the CAMAN estimates were conservative and designed in part to justify the maintenance of import restrictions and tariffs to protect local manufacturers. However, the figures do justify the claim by manufacturers that a considerable part of the market is being supplied by cable smuggled in without paying import duty. Manufacturers estimated that 30% of the mar et was supplied in this way and that the proportion is growing. We therefore conclude that our estimates in Table 2.15 are realistic.

The disparity was probably also aggravated by a steady rundown of stocks during the recession in the construction industry. This is confirmed by the current high level of activity in the cable making industry which is now struggling to build up stocks and satisfy demand for the much more buoyant construction sector.

Table 2.16 shows the relationship between consumption of copper and requirement for semis for the production of building wire in 1986 by which time we assume that all building wire requirements will be satisfied by local manufacturers.

TABLE 2.16 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - BUILDING WIRE 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
*Copper Rod	7822	10	782	7040	100	7040
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip						
Alloy Tube						
Castings						
Total						7040

* Wire Rod

2.4 Power Cable

The principal users of power cable are NEPA and their contractors. Secondary and increasingly important usage will come from RE schemes which are only now really getting of the ground. Finally there will be some usage of power cable in larger industrial premises and for street lighting. Data from NEPA on cable consumption is incomplete since their figures do not include cable bought directly by their contractors. RE schemes are only just getting going and past data is of little significance. The consumption of power cable in industry can only be estimated from import and local production figures while data on street lighting is in many respects incomplete.

All overhead cable used by NEPA is made of aluminium (ACSR is used for all high voltage lines). Copper is used for some of the interconnections in substations and for all underground cables at 440V, 11KV and 33KV and in particular for connections (feed pillars) from overhead lines (11KV) to distribution transformers.

Apart from feed pillars, underground cable is only used to a limited extent and only in urban areas where it is necessary because of the congestion of buildings, roads and other services. It will be used increasingly in the future for aesthetic reasons. Data was available from NEPA on purchases of cable for the years 1977-80, but this only related to direct purchases and did not include purchases by contractors. The figures are therefore a severe underestimate of total NEPA requirements. More complete figures were available for cable installations and feed pillars, but for 1980 only as shown in Table 2.17.

TABLE 2.17 : NEPA CABLE INSTALLATIONS IN 1980

Type	Quantity M	Size	Copper Weight tons
LT underground	68,214	4 x 185mm^2	454
HT underground	57,891	3 x 185mm^2	289
Feed pillars	526 x 39	4 x 185mm^2	105
Total			857

Source: NEPA

The weights of copper are calculated assuming a conductor of 185mm^2, the size used almost universally for both LT and HT applications.

The figures above do not include copper cable connections, control wires and earthing grids used in substations. No precise data was available on those, but it was estimated that this accounts for an additional 60% on the figures for underground cable giving a total consumption by NEPA in 1980 of 1,370 tons of copper.

It would be convenient if ratios from other countries of copper consumed per new connection or per unit of additional capacity could be used as a check on the total. However, the electricity industry is changing, or has already changed rapidly from copper to aluminium overhead conductors in almost every country, but each is in a different stage of the change so that, even apart from demographic differences, the use of such ratios is likely to be an artificial exercise. Nigeria has reached the stage where aluminium is used in almost all the applications where it is practicable and it is unlikely that the trend towards aluminium will go any further unless there are substantial technological developments.

Although underground cable can be made with aluminium conductors the cables are thicker and more difficult to install and join, consequently giving little or no saving in cost. In line with a consistent policy of using proven technology and striving for reliability there is little chance of copper being further replaced in Nigeria in this sector.

During 1981 and 1982 each Rural Electrification Board will consume 20 tons per year of copper in power cables and this figure will rise to 60 tons per year from 1983-1985. Figures for 1980 were not available but in view of the effort being put into rural electrification it seems likely that the purchases during 1980, allowing for forward buying and including earthing rope, was in the region of 26 tons per state giving a total over the whole country of 494 tons.

Responsibility for the installation of street lighting is divided between state and federal governments. In all of the larger towns cable is underground and street lighting represents a significant use of copper cable and will continue to do so with improving standards of urban amenities in towns and with the development of the New Federal Capital. Data obtained from the federal ministry of works and state governments indicates a consumption during 1980 of 400 tons of copper in street lighting cables.

The copper content of power cable depends on whether or not it is armoured and also to a secondary degree on the size. Table 2.18 shows copper content for a series of cables.

TABLE 2.18 : COPPER CONTENT OF SELECTED POWER CABLES

Cable Type	Conductor area mm^2	Cores	Total Weight kg/km	Coppper Weight kg/km	Percent Copper
Unarmoured	50	4	2,320	1,800	77
	120	"	5,400	4,320	80
	185	"	8,320	6,660	80
Armoured	50	"	3,600	1,800	50
	120	"	7,710	4,320	56
	185	"	11,100	6,660	59
Unarmoured	185	1	2,100	1,665	79
Armoured	185	1	3,000	1,665	55

Source: Nigerchin (Ref. 5)

The commonest size of cable in use in Nigeria is $185mm^2$ either 3 or 4 core. About half of this is armoured. The average copper content of cable imports has been taken to be 40% to allow for the cable mix and drums and packing materials. From the data in Table 2.9 we have calculated the copper content of imports and this is shown in Table 2.19.

From data supplied by cable manufacturers we have estimated the production of cable in Nigeria in 1979 and 1980 and these figures are also given in Table 2.19. The totals shown will be close to actual consumption, but there will be some differences because of changes in stock levels.

TABLE 2.19 : COPPER CONTENT OF POWER CABLES

Year	Imports	Local Production	Total
1977	2,304		2,304
1978	3,112		3,112
1979	1,804	1,137	2,941
1980	1,340	1,758	3,098

We have already given estimates of copper consumption in power cables for NEPA, Rural Electrification and street lighting. The consumption by industry will make up the balance and the figure has been calculated by difference from the total of imports and local production. The figures are summarised in Table 2.20.

TABLE 2.20 : CONSUMPTION OF COPPER IN POWER CABLES IN 1980 IN DIFFERENT SECTORS

Sector	Tons	Percentage
NEPA	1,370	44
Rural Electrification	494	16
Street Lighting	400	13
Industry	834	27
Total	3,098	100

The high proportion of cable used by Industry is consistent with the growth in the sector and the fact that NEPA capabilities are severely overstretched so that industry undertakes many installations for itself which might otherwise have been done by the power authority. From Table 2.19 it will be seen that there was little growth in consumption over the period 1977-80 because of the economic recession during these years. The recession is now over and the cable manufacturers are forecasting a rapid growth in demand for their products averaging 25% over the 4th plan period and probably slowing down during the second half of the decade. Production in Nigeria during the first half of 1981 was 50% up on levels for the previous year, but this will have been offset by reductions in imports. The overall growth in the demand will be much lower.

The relationship between investment in an industry and expansion of production can be expressed in terms of the Lang equation.

$$F_i = K (F_p)^x$$

where F_i = index of investment

F_p = index of production

x = Lang factor which has been shown to be between 0.6 and 0.7 for a very wide range of circumstances.

K = a constant for each industry

The values of x given above are primarily applicable to expansion of an industry, rather than to creation of new industries. In a situation where a proportion of investment is in new projects the factor will be closer to 1.0.

Over the period 1980-1990 power sales are forecast by NEPA to grow at an average rate of 19.4% (Table 2.3). Applying a Lang factor of 0.65 the growth of investment in distribution should be 12.2%. We have "predicted" investment levels assuming this growth rate and the values agree well with NEPA estimates of growth in investment up to 1986 as shown in Table 2.21.

TABLE 2.21 : NEPA ESTIMATES OF INVESTMENT IN DISTRIBUTION AND "PREDICTED" VALUES (billions of Naira)

Year	NEPA estimates	"Predicted" investment at 12.2% growth rate
1981	95	95
1982	123	107
1983	159	120
1984	140	135
1985	165	151
1986	172	170

Source: NEPA/Metra

We have assumed that NEPA consumption of copper in power cable will grow at a rate of 12.2% over the whole of the period 1980 to 1990. Rural Electrification has ambitious plans which would suggest a growth rate of 25%, but we consider it unlikely that such a growth rate can be sustained in view of manpower shortages and financial constraints. We consider it more probable that investment in RE will proceed at a similar rate to that of NEPA.

The growth of investment in street lighting is difficult to predict and will be erratic as particular individual schemes are implemented. The rate of growth will be higher than that for the economy as a whole as efforts are continuing to develop infrastructure in general and in this case such investment will improve urban amenities, road safety and general security. We have assumed that development of street lighting will increase at 16% per year and that a Lang factor of 0.9 will apply since most schemes are essentially new projects. Consumption of copper will therefore increase at 14.8% per annum.

According to the 4th plan guidelines industrial GDP will increase at 15%. Part of the investment will be in new projects and part in expansion of existing projects. Assuming a Lang factor of 0.8 consumption of copper will therefore increase at an annual rate of 11.8%.

Assuming the growth rates discussed above we have calculated the consumption of copper in power cables in each sector and the results are given in Table 2.22.

This forecast has made certain assumptions, the most debatable one being the cable consumption by NEPA. However, the figures for imports and local production for 1977-1980 are self consistent and we are confident that the total contains no significant error. Furthermore since the assumed growth rates for the three sectors are not widely different any error in the allocation of usage between the three sectors will have only a small effect on the forecast overall totals.

TABLE 2.22 : FORECAST CONSUMPTION OF COPPER IN POWER CABLES BY SECTOR, 1980-1990 (TONS)

Year	NEPA and RE 12.2% pa	Street Lighting 14.8% pa	Industry 11.8% pa	Total 12.5% pa
1980	1,864	400	834	3,098
1981	2,091	459	932	3,482
1982	2,347	527	1,042	3,916
1983	2,633	605	1,165	4,403
1984	2,954	695	1,303	4,952
1985	3,314	798	1,457	5,569
1986	3,719	916	1,629	6,264
1987	4,172	1,051	1,821	7,044
1988	4,682	1,207	2,036	7,925
1990	5,894	1,590	2,544	10,028

While expansion of the cable industry will undoubtedly increase and will be capable of producing all cable required up to 1KV and most of that at 11KV by 1986, only a small part of total requirement for 33KV cable will be manufactured locally. We estimate that 60% of power cable requirements will be made in Nigeria in 1986 and the consequent demand for semis is shown in Table 2.23.

TABLE 2.23 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - POWER CABLE 1986

Item	Total Semis Required Tons	Scrap		Total Semis Required Tons	Copper Content	
		%	Tons		%	Tons
Copper wire Winding wire *Copper rod Copper strip Copper tube Alloy wire Alloy rod Alloy strip Alloy tube Castings	4178	10	418	3760	100	3760
Total						3760

* Copper wire rod

2.5 Telecommunications

Over the years Nigeria has invested considerable sums in telecommunications, but it is only very recently that results have been obtained and the telephone system is now showing substantial signs of improvement.

The system is planned with a series of secondary and primary centres and then local exchanges connected to individual subscribers. All transmissions between secondary and primary centres and local exchanges will be by microwave links which do not use significant quantities of copper (cable connections between exchanges are limited to one or two cases where two or more exchanges are in the same building). Copper cable is used principally for the external line plant (ELP) between local exchanges and individual subscribers. It is the policy of P&T to stay with copper conductors for the foreseeable future on the basis that simple, proven technology will give a higher degree of reliability. They do not envisage changing either to aluminium conductors or to the more sophisticated laser/optical fibre systems currently under development in some parts of the world. Apart from ELP, copper is also used in dropwires (connections from ELP cables into buildings), for inside wire and for internal wiring on private (PABX) systems.

In 1975, at the beginning of the 3rd Plan it is estimated that there were 52,000 lines in operation. The Plan envisaged a total of 750,000 lines by 1980, but between 1975 and 1978 only a further 12,000 lines were added. Targets were then adjusted and a contingency plan introduced with the aim of providing a total of 87,000 lines by mid 1979 and a further 101,000 lines by January 1980. This target was subsequently rescheduled to January 1981. Current estimates by P&T are that the present number of operational lines is about 100,000 and that the target of 188,000 will now be reached by the end of 1981.

P&T had requested a budget of ₦6 billion for investment during the 4th Plan, but this has recently been reduced to ₦2.4 billion during evaluation of the plan by the National Assembly. P&T may, however, raise additional funds from overseas loans.

Against this constantly shifting background of targets, achievements and budgets one must be extremely cautious in estimating the requirement for telephone cable. There can, however, be no doubt that with only one telephone per 800 population there is scope for enormous growth before telephone availability reaches the levels found in many other countries (see Table 2.24). There is no doubt that growth will occur, the problem is to assess the dates by which various stages of the plans will be realised.

TABLE 2.24 : INHABITANTS PER TELEPHONE IN VARIOUS COUNTRIES IN 1977

Country	Inhabitants per telephone
World	9.6
Africa	100
Nigeria	800 (current est.)
Chad	10,000
India	3,000
Zambia	90
Ivory Coast	77
Brazil	24
Korea	19
France	3.0
West Germany	2.7
UK	2.4
Japan	2.3
US	1.4

Source: UN Statistical Yearbook (Ref. 6)

The contingency plan which called for 188,000 lines by 1980 is now complete in the Lagos area and is nearing completion in the rest of the country. The next stage (apart from completion of transmission network) is the installation of "147" other exchanges. There are only 141 of them, but they are still referred to as the "147" plan. Some of these are in operation and work on others is well in hand. It is estimated that all of the "147" exchanges in the Lagos area will be completed by the end of 1982 and all those throughout the rest of the country during the present plan period.

The "147"s will provide exchanges of varying capacity between 500 and 10,000 lines and will cover all major towns, state capitals and local government headquarters. The exchanges are distributed between the P&T technical areas as shown in Table 2.25. The next stage of the plan is to complete the "147"s. These are 500 line exchanges planned for the more significant rural towns and villages not connected under earlier plans. In addition there will be 146 "149's"* with a total capacity of 73,000 lines. It is unlikely that all of these will be installed during the current plan and no estimates put the likely achievement at above 50%.

Exchanges are designed on a generous basis with 1.5 pairs of primary cable and three pairs of secondary cable for each line of exchange capacity in order to give flexibility when connecting actual subscribers. Primary cables are laid in PVC ducting and are unarmoured. Secondary cables are laid straight in the ground and are armoured. All cable at present is paper insulated and jelly filled with PVC insulation. Most conductors are 0.5mm diameter but some 0.65 wire is used. The policy is to stay with this type of cable as the skills are already available for its use and the introduction of more sophisticated cables would, it is considered by P&T, lead to a deterioration in reliability.

During the next five years installed exchange capacity will rise at a greater rate than the number of subscribers. Sufficient ELP is installed to deal with the full capacity of the exchange, but only in certain areas will there be enough people who can afford to be connected to take up all the exchange capacity. In addition the incentive to be connected will not be high until the transmission network is more complete and reliable connections are available over a wide area. However, some exchanges, particularly in Lagos and to a lesser extent Ibadan are filled up almost as soon as they are complete and there is no doubt that further exchanges will be needed in these in these areas even before the end of the 4th Plan. For example the Ikoyi, Lagos Central, Victoria Island and Ebute Metta exchanges are already full. Exchanges outside the main urban areas are expected to fill up less quickly and it is estimated by P&T that 10% of the lines will be taken up during the first year and 7½% in subsequent years on which basis exchanges would not need to be expanded for 13 years. This seems an optimistic assumption for all, but the more remote areas.

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* See later for more detailed description

TABLE 2.25 : DISTRIBUTION OF "147" EXCHANGES

Area	Capacity (lines)					Total Exchange	Total Lines ('000's)
	10,000	5,000	2,000	1,000	500		
Lagos	3	-	-	1	3	7	32.5
Ibadan	6	4	16	5	7	38	120.5
Benin	1	1	5	14	1	22	39.5
Enugu	3	9	13	15	1	41	116.5
Kaduna	1	2	7	4	1	15	38.5
Bauchi	-	3	7	7	1	18	36.5
	14	19	48	46	14	141	
Lines ('000's)	140	95	96	46	7		384

Source: P&T

The exchange capacity to be installed during 1981-85 (ie the 147's plus half of the 149's) is 420,000 lines. It was estimated that new subscribers would be connected at a rate of 55,000 per year in 1981 rising at about 10% per annum to 80,000 by 1985. This would give a total of 334,000 new connections during the period consistent with the planned installation of ELP and an overall total of some 430,000 installations. At the end of that period the number of subscribers will still be 200 per telephone.

Beyond 1985 the rate of growth will depend on funds available and the priority given to telecommunications but we would expect the growth in the number of new subscribers to continue at a similar rate until 1990 by which time the number of subscribers will still be only 1% of the population. The estimate of total and new subscribers is given in Table 2.26.

TABLE 2.26 : ESTIMATED NUMBERS OF TELEPHONE CONNECTIONS AND TELEPHONE POPULATION 1980-1990

Year	Total Telephones installed ('000's)	New Installation in year ('000's)	Population Millions	People Per Telephone
1980	100	-	84.8	848
1981	155	55	86.9	560
1982	215	60	89.1	414
1983	281	66	91.4	325
1984	354	73	93.7	265
1985	435	81	96.1	221
1986	524	89	98.6	188
1987	621	97	101.1	163
1988	728	107	103.6	142
1989	846	118	106.3	126
1990	976	130	109.1	111

Data supplied by P&T for the cable requirements for a typical 1,000 line exchange is given in Table 2.27.

TABLE 2.27 : CABLE REQUIREMENTS FOR A TYPICAL 1,000 LINE EXCHANGE

Cable Type	Conductor diameter MM	No. of pairs	Length M	Pair km	Weight of copper Kg
Unarmoured cable	0.5	100	1,000	100	350
		200	3,125	625	2,188
		800	275	220	770
	0.65	200	625	125	750
		600	8,750	5,250	31,500
Armoured	0.5	300	1,438	430	1,505
		400	1,125	450	1,575
		600	3,125	1,875	6,563
	0.65	100	625	63	378
		200	1,000	200	1,200
		300	1,875	563	3,378
	0.5	10	5,000	50	175
		20	1,755	35	123
		30	1,313	40	140
		50	1,875	94	329
		100	1,813	181	634
		150	3,500	525	1,838
		200	1,438	288	1,008
Self-supporting cable	0.5	10	1,443	14	49
		20	1,079	21	74
		30	450	13	46
		50	794	40	140
		100	1,078	100	350
Total				11,303	55,063

Source: P&T

The data from Table 2.27 indicates a consumption of 11.3 per km per line and reflects in part the generous allocation of spare line capacity in the design of the ELP and in part the widely scattered areas covered by many exchanges. The additional investment in this spare capacity will eventually be recouped since, when exchanges are expanded, less additional ELP will be needed than would otherwise be the case.

We estimate that the consumption of cable will continue at the rate of 11.3 per km per subscriber until 1985, but will then decline as expanding exchanges use proportionately less cable until by 1995 the figure will have fallen to a more normal figure of 6.3 per km per subscriber.

Each subscriber uses an average of 100m of dropwire which is copper coated steel containing 30% by volume of copper. This represents a consumption of 1.14kg of copper per subscriber. In addition, each subscriber uses 30m of inside wire with a diameter of 0.65mm or 0.18kg per subscriber.

From these figures we have estimated the consumption of copper in telephone cables as shown in Table 2.28.

Table 2.29 shows the copper content of a range of telephone cables. A reasonable average for the cables used in Nigeia is 50%. On this basis the copper content of cables imported into Nigeria over the period 1977-1980 has been calculated as shown in Table 2.30 from the data in Table 2.9.

The forecast consumption in 1981 is consistent with the import figures for 1980. A great deal of cable consumed in 1981 will have been imported during 1980. The figures for earlier years are not apparently consistent with the lines actually connnected. However, during this period there was a great deal of activity with cable being imported for projects which were consistently delayed and even when implemented showed no results in terms of subscribers connected. During the period considerable amounts of ELP were laid, but could not be put into operation because exchanges were not complete and the transmission system inoperative. Taking these factors into account we consider that the estimates of consumption are corroborated by import statistics although complete quantities correlation is impossible without detailed stock records from P&T and their contractors, none of which exist.

TABLE 2.28 : CONSUMPTION OF COPPER IN TELEPHONE CABLES (tons)

Year	Total new Subscriber ('000's)	Pr.Km/ Subscriber	Copper in ELP 5kg/pr.km	Copper in Dropwire 1.14kg/subs	Copper in Inside wire 0.18kg/subs	Total Copper
1981	55	11.3	3,108	63	10	3,181
1982	60	11.3	3,390	68	11	3,469
1983	66	11.3	3,729	75	12	3,816
1984	73	11.3	4,124	83	13	4,220
1985	81	11.3	4,577	92	15	4,684
1986	89	10.8	4,806	101	16	4,923
1987	97	10.3	4,996	111	17	5,124
1988	107	9.8	5,243	122	19	5,384
1989	118	9.3	5,487	134	21	5,642
1990	130	8.8	5,720	148	23	5,891

TABLE 2.29 : COPPER CONTENT OF PAPER INSULATED, JELLY FILLED TELEPHONE CABLES

Cable Year	Conductor diameter mm	Cable pairs	Total weight kg/km	Copper weight kg/km	Copper content percentage
Unarmoured	0.5	200	1,100	700	64
		400	2,000	1,400	70
		800	3,900	700	72
Armoured	0.5	200	3,100	700	23
		400	5,100	1,400	27
		800	8,800	2,800	32
Unarmoured	0.63	400	3,000	2,240	73
		400	7,100	2,240	33

Source: Pirelli (Ref. 7)

TABLE 2.30 : COPPER CONTENT OF TELEPHONE CABLES IMPORTED INTO NIGERIA

Year	Copper Content (Tons)
1977	4,751
1978	4,240
1979	4,246
1980	3,126

PABX systems use 0.5mm conductor all in copper. During 1980 total consumption was 10,000 per km or 35 tons per year of copper. The rate of increase in the past has been very slow, but is expected to increase rapidly now that the public telephone network is improving. Growth rates of 25% can be expected for the next three years slowing down to be more in line with general economic growth as the backlog of suppressed demand is absorbed. Table 2.31 shows our estimates of growth rate and consumption.

TABLE 2.31 : CONSUMPTION OF COPPER IN PABX CABLES

Year	Consumption tons	Estimated Growth Rate %
		15
1980	35	25
1981	40	25
1982	50	25
1983	63	22
1984	79	19
1985	96	16
1986	114	13
1987	132	12
1988	150	12
1989	168	12
1990	188	

There is as yet no production of telephone cable in Nigeria, but a plant is under construction in Kano which will use 1,000 tons per year of copper by the end of 1982. The size was selected during planning of the project to supply 30% of the Nigerian market implying a total market of 3,333 tons per year. This figure correlates well with our estimate of 3,469 tons per year during 1982.

By 1986 all but the largest telephone cables will be manufactured in Nigeria and we estimate that by 1986 70% of cable required will be manufactured in Nigeria. The relationship between copper consumption and semis requirement is shown in Table 2.32.

TABLE 2.32 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - TELEPHONE CABLES 1986

Item	Total Semis Required Tons	Scrap		Total Semis Required Tons	Copper Content	
		%	Tons		%	Tons
Copper wire Winding wire Copper rod * Copper strip Copper tube Alloy wire Alloy rod Alloy strip Alloy tube Castings	3920	10	390	3530	100	3530
Total						3530

* Copper wire rod

2.6 Other Wire

- Winding Wire

Winding wire, or magnet wire, is used in a variety of applications including:

- Transformers
- Electric Motors (manufacture and repair - also incorporated into other equipment)
- Generators (manufacture and repair)
- Vehicle components (starting motors, alternators, coils)
- Electronic equipment (transformers, coils, chokes)
- Fluorescent light fittings (chokes, starters)

Consumption of winding wire in each of these products has been estimated in other parts of this section except for those products listed in Table 2.33 and these can be brought into this section to give a complete picture.

The consumption of winding wire in the transport and domestic appliance sectors is summarised in Table 2.33.

TABLE 2.33 : CONSUMPTION OF WINDING WIRE IN THE TRANSPORT AND DOMESTIC APPLIANCE INDUSTRY - NIGERIA 1986

Item/Sector	Consumption of Winding Wire Tons
Transport	85
Domestic Appliances	401

- Motor Vehicles

Copper wire is used in the wiring of motor vehicles and the consumption of copper is estimated in Section 4. A summary of the figures excluding winding wire is given in Table 2.34.

- Domestic Appliances/Electronic Equipment

Domestic appliances are considered in Section 3. Copper wire is used for flexible leads and internal wiring. Estimated consumption, excluding winding wire, is summarised in Table 2.34.

TABLE 2.34 : CONSUMPTION OF COPPER (EXCLUDING WINDING WIRE) IN MOTOR VEHICLES AND DOMESTIC APPLIANCES

Item/Sector	Consumption Tons
Transport	273
Domestic Appliance	232

Converting the above mentioned consumptions in semis to be processed will yield the volumes shown in Table 2.35.

TABLE 2.35 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - OTHER: WIRE AND WIRE OF VEHICLES AND DOMESTIC APPLIANCES 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	505	10	51	454	100	454
Winding Wire	486	10	49	437	100	437
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip						
Alloy Tube						
Castings						
Total						891

2.7 Other Electrical Equipment

- Generating Equipment

It is most unlikely that large generators such as those installed by NEPA will be built in Nigeria in the foreseeable future. The manufacture of such equipment is a very specialised business and only a few companies throughout the world possess the necessary skills and know-how. Indeed there are only about twelve companies in the world capable of building such equipment and demand in Nigeria will never be large enough to justify establishment of manufacturing facilities.

Demand for smaller equipment (up to 5MW) is considerable. Generators are used for baseload by customers in remote areas where no public supply exists and in other areas for standby power to cover deficiencies in the public supply. Demand has been kept up by the inability of NEPA to maintain a reliable supply and our earlier discussion (Section 2.1) suggests that such problems will continue for a long time to come. However, as more and more of the country is electrified and as supply begins to exceed demand there will be a drop in sales of generators. We do not, however, see this situation arising before 1990 as even then NEPA are forecasting a shortfall in their grid capacity.

Sales of generating sets in Nigeria from 1974-78 are shown in Table 2.36. Growth in the market is substantial but erratic and figures cannot be used as the basis of a trend extrapolation. The breakdown of sales by capacity is given in Table 2.37. Most sets are small and used for domestic standby. Of medium sizes most are used by industry for standby. The larger sets are used by government for baseload and the data may include some NEPA and RE purchases. The total new capacity estimated is similar to the total of NEPA firm capacity. This reflects the difficulty experienced by most consumers in obtaining a reliable supply.

The rate of growth of demand for generating capacity will reflect the growth of public spending and individual purchasing power but will be dominated by the growth of industry. The rate of growth will eventually be offset by improvements in the NEPA supply but not within the period under consideration. We estimate that demand for generators will increase at 20% per annum until 1983 and will then fall to 15% by 1990.

TABLE 2.36 : SALES OF GENERATORS

Year	Units
1974	7,500
1975	17,400
1976	14,000
1977	33,000
1978	31,000

TABLE 2.37 : BREAKDOWN OF GENERATOR SALES BY CAPACITY (1978)

Size	Units	Capacity MVA
Less than 75KVA (Average 3KVA)	29,871	90
75-750 (Average 80KVA)	2,547	200
More than 750KVA	582	410
Average 0.75MVA		
	33,000	700

The consumption of copper in a generator ranges from 0.76kg/KVA capacity for a 1MVA set to 3.0kg/KVA for a 2KVA set. A weighted mean for the sizes and numbers on the Nigerian market is 0.9kg/KVA.

Some generators are assembled in Nigeria from PKD sets at present but semis will not be required by the industry until such time as armature winding is undertaken by the local manufacture. By 1985 small sets, up to 5KVA, will be made in Nigeria. We do not see generators of sizes above 50KVA being manufactured in Nigeria until well into the 1990's.

The copper used is almost exclusively winding wire. In addition there is some wire used for repair of generators. Estimates of frequency of rewinding vary, depending very much on the local reliability of NEPA. Larger units, which are used under more controlled conditions and which are less often subjected to overload, are damaged less frequently. At present many damaged generators, particularly small ones, are scrapped completely. As the industry develops more rewinding will be done in Nigeria and a greater proportion will be repaired. We estimate that the demand for copper for repair will be 5% of the consumption in new equipment.

By 1986 we estimate 30% of generators up to 75KVA will be manufactured in Nigeria. The demand for copper and consumption of semis is summaried in Table 2.39.

TABLE 2.38 : INSTALLED CAPACITY OF NEW SMALL GENERATORS 1978-1990 AND COPPER CONSUMED IN THEIR MANUFACTURE

Year	Total Capacity MVA	Copper Tons	
		New Units	Repair
1978	700	630	32
1979	840	750	38
1980	1,000	900	45
1981	1,200	1,080	54
1982	1,450	1,300	65
1983	1,740	1,570	79
1984	2,070	1,860	93
1985	2,450	2,200	110
1986	2,860	2,570	129
1987	3,320	3,000	150
1988	3,820	3,440	172
1989	4,390	3,950	198
1990	5,050	4,550	228

TABLE 2.39 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED -- GENERATOR MANUFACTURE AND REPAIR 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire	471	15	68	403	100	403
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip						
Alloy Tube						
Castings						
Total						403

- Transformers

The only significant users of transformers are NEPA and the REB's. We have estimated NEPA demand from their plans and that of the REB's from the requirements of a selection of the REB's. Numbers and total ratings are given in Tables 2.40 and 2.41.

There is at present no manufacture of transformers in Nigeria, but a plant is now being set-up to manufacture secondary distribution transformers (11/.415KV). There are plans to expand production to include 33/11KV transformers for primary distribution but it is unlikely that transmission transformers will be manufactured in Nigeria in the foreseeable future.

The consumption of copper in transformers can be related to the number, operating voltages and power capacity of the units. For secondary transformers the consumption averages 545t/MVA although the figure can vary by 25% for individual designs. For primary distribution transformers the figure is 361t/MVA.

Technology is being developed to use aluminium to replace copper in transformer windings, but there are no plans to do this in Nigeria and it seems probable that NEPA will continue to specify and use the more conventional products for the time being in the interests of reliability.

NEPA plans show a fluctuating demand for transformers and in reality requirements will smooth out as projects run one into another. There are no firm plans at present byond 1986, but we have estimated demand assuming continuing growth although there is no guarantee that the plans up to 1986 will themselves be implemented in their entirety. We have estimated demand for transformers taking a cautious view of the probable extent of completion of NEPA plans, and allowing for growth in the next plan period. Our estimates are given in Table 2.42 together with the copper required for their manufacture.

TABLE 2.40 : REQUIREMENT FOR TRANSFORMERS BY NEPA AND REB'S - NUMBER

NEPA	1981	1982	1983	1984	1985	1986
330/132KV, 150MVA	8	8	8	6	2	-
132/33KV, 30MVA	38	60	60	46	46	32
132/11KV, 30MVA	14	14	28	28	28	22
11/415KV 0.3MVA	3,500	5,100	5,800	5,400	5,500	5,800
REB						
33/11KV 1.0MVA	30	40	50	60	70	80
11/415KV 0.2MVA	150	200	250	300	350	400

Source: NEPA

TABLE 2.41 : TOTAL CAPACITY OF TRANSFORMERS (MVA)

NEPA	1981	1982	1983	1984	1985	1986
330/132KV, 150MVA	1,200	1,200	1,200	900	300	-
132/33KV, 30MVA	1,140	1,800	1,800	1,380	1,380	960
132/11KV, 30MVA	420	420	840	840	840	660
33/11KV, 15MVA	30	150	240	180	210	225
11/415KV, 0.3MVA	1,050	1,530	1,740	1,620	1,650	1,740
REB						
33/11KV, 1.0MVA	30	40	50	60	70	80
11/415KV, 0.2MVA	30	40	50	60	70	80

Source: NEPA

The capacity of secondary distribution transformers to be installed is almost double that of the primary transformers. We have assumed that growth in demand of the former will be at a modest rate of 7% while that of primary transformers will grow at a higher rate until consumption reaches the same figure as for secondary units.

Copper is used in transformers primarily in the form of winding wire and copper strip, but there is also rod used in the secondary windings together with tube used in cooling. The consumption of each product is shown in Table 2.42.

Plans are in hand to manufacture transformers in Nigeria but production is unlikely to be more than 40% of requirements of secondary distribution transformers by 1986. The consumption of copper and semis is given in Table 2.43.

- Switchgear

Heavy switchgear for power stations is usually supplied by the main equipment contractors and is unlikely to be made in Nigeria. Switchgear for the distribution system up to 33KV will probably be manufactured in Nigeria.

Equipment for up to 11KV is already being manufactured by GEC who produce up to 100 units per month. Copper consumption in bussbars is 3.8 tons per annum at present but they have plans to increase the range of products up to 33KV. At present all copper components are imported and the degree to which local products can be imported will depend very much on the development of the rest of industry.

Demand for switchgear will follow a similar pattern to that for transformers and our estimates for semis consumption, taking into account normal design parameters and rates of consumption, are given in Table 2.44.

By 1986 we estimate that 20% of switchgear will be manufactured in Nigeria and consumption of copper and demand for semis is summarised in Table 2.45.

TABLE 2.42 : REQUIREMENTS FOR TRANSFORMERS AND COPPER SEMIS IN NIGERIA

Year	Total Capacity of Distribution Transformers MVA		Winding Wire and Strip (Tons)	Copper Tube (Tons)	Alloy Rod Tons of Copper
	Primary	Secondary			
1981	500	1,000	715	11	18
1982	600	1,070	788	12	20
1983	720	1,145	871	14	22
1984	864	1,225	965	15	24
1985	1,037	1,310	1,071	17	27
1986	1,244	1,402	1,195	19	30
1987	1,500	1,500	1,339	21	34
1988	1,605	1,605	1,433	23	36
1989	1,718	1,718	1,533	24	39
1990	1,838	1,838	1,640	26	41

Source: NEPA

TABLE 2.43 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - TRANSFORMERS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire	333	10	33	300	100	600
Copper Rod						
Copper Strip	333	10	33	300		
Copper Tube	7	20	2	5	100	5
Alloy Wire						
Alloy Rod	8	20	2	6	60	4
Alloy Strip						
Alloy Tube						
Castings						
Total						609

TABLE 2.44 : CONSUMPTION OF COPPER SEMIS IN SWITCHGEAR (TONS)

Year	Copper				Alloy			Total Copper
	Wire	Rod	Strip	Tube	Rod	Strip	Tube	
1981	25	230	35	47	37	15	8	397
1982	27	254	39	52	41	16	9	438
1983	30	281	43	57	45	18	10	484
1984	34	311	47	63	50	20	11	536
1985	37	343	52	70	55	22	12	595
1986	42	384	59	79	62	25	13	664
1987	47	430	66	88	69	28	15	743
1988	50	460	70	94	74	30	16	796
1989	54	494	75	101	79	32	17	852
1990	57	528	80	108	85	34	18	910

TABLE 2.45 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - SWITCHGEAR 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire	9	10	1	8	100	8
Copper Rod	84	15	9	75	100	75
Copper Strip	13	15	1	12	100	12
Copper Tube	20	20	4	16	100	16
Alloy Wire						
Alloy Rod	14	15	2	12	60	7
Alloy Strip	6	20	1	5	60	3
Alloy Tube	3	20	1	2	60	1
Castings						
Total						122

- Electric Meters

No electric meters are yet made in Nigeria but a company has just been established which plans to manufacture the single and three phase electric meters and consumer units (circuit breakers). Initially all components will be imported. A single phase meter uses 700 grams of copper and a circuit breaker uses 280 grams. Three phases units use 2,800 and 1,120 grams respectively. Most of the demand is for brass strip.

Demand for meters will match the rate of connection of new consumers (to NEPA and RE). Residential and most commercial connections will need single phase meters and circuit breakers, while most industrial consumers will use three phase meters. The numbers of new consumers of each type have been given in Table 2.12 and are given again in Table 2.46 together with estimated consumption of copper in the brass.

TABLE 2.46 : CONSUMPTION OF COPPER IN ELECTRIC METERS AND CONSUMER UNITS

Year	Three Phase 000's	Single Phase 000's	Consumption of Copper Tons
1981	152	35	247
1982	185	27	287
1983	209	30	323
1984	233	33	357
1985	264	36	400
1986	300	39	447
1987	338	44	405
1988	384	48	565
1989	436	53	635
1990	504	58	721

By 1986 half of the meters and circuit breakers needed in Nigeria will be manufactured locally. The consumption of copper and demand for semis is summarised in Table 2.47.

TABLE 2.47 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - ELECTRIC METERS AND CIRCUIT BREAKERS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip	333	25	83	250	60	150
Alloy Tube						
Castings						
Total						150

- Electric Motors

Electric motors are not yet manufactured in Nigeria although GEC have recently begun assembly of motors in the range 1-2hp and hope to extend this up to 7.5hp in the near future. They have capacity for up to 600 motors per week. It is likely that a wide range of motors will be manufactured in the future particulary for domestic appliances and small motors (less than 25hp) for industrial equipment. Motors for domestic equipment are covered in another section of this report.

Imports statistics for motors are given in Table 2.48. The figures are not easy to interpret. The low figure for small motors in 1977 may reflect over-supply from the previous year and the drop for large motors in 1978 is probably caused by the onset of the recession.

Consumption of copper depends on size and design of the motor as shown in Table 2.49. Unfortunately, no data exists on the distribution of motor sizes within the two categories listed. However, this is not as serious as it might seem since the copper content of small motors is proportionately higher. The data in Table 2.49 covers a size range of 152 while copper content rises by only a factor of 15.

We consider that the number of motors less than 25hp imported in 1978 (Table 2.48) is low because of the recession and estimate that by 1981 the figure will be at least 30,000 and that it will then grow at 12% per annum - slightly below the planned rate of growth for the industrial sector. We have furthermore assumed that the average size of motor will be 4hp. In Table 2.50 we have set-out forecast demand for motors and the consequent consumption of copper semis in the manufacture of motors up to 25hp. Larger motors need not be considered since they will not be manufactured in Nigeria.

TABLE 2.48 : IMPORTS OF ELECTRIC MOTORS

Year	Less than 25hp	More than 25hp
1976	43,500	14,500
1977	10,412	21,500
1978	15,482	7,049

Source: Nigerian Trade Summaries (Ref. 2)

TABLE 2.49 : CONSUMPTION OF COPPER IN ELECTRIC MOTORS

HP	Watts	Copper (kg)	Copper (kg/hw)
⅛	90	0.63	7.0
¼	180	0.90	5.0
½	370	1.18	3.2
1	750	1.58	2.1
2	1,500	1.58	1.05
4	3,000	2.70	0.90
10	7,500	5.48	0.73
19	14,000	9.24	0.66

Source: GEC

TABLE 2.50 : CONSUMPTION OF COPPER AND COPPER SEMIS IN ELECTRIC MOTORS UP TO 25HP (TONS)

Year	No. of Motors	Winding Wire	Copper Rod	Brass Rod	Brass Strip	Total Copper
1981	30,000	63	9	6	3	81
1982	33,600	71	10	7	3	91
1983	37,600	81	11	8	4	102
1984	42,100	89	13	8	4	114
1985	47,200	99	14	9	5	127
1986	52,900	112	16	10	5	143
1987	59,200	124	18	12	6	160
1988	66,300	139	20	13	7	179
1989	74,300	157	22	15	7	201
1990	83,200	175	25	17	8	225

TABLE 2.51 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - ELECTRIC MOTORS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire	37	10	4	33	100	33
Copper Rod	4	20	1	3	100	3
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod	3	20	1	2	60	1
Alloy Strip	2	20	1	1	60	1
Alloy Tube						
Castings						
Total						38

By 1986 only 20% of motors up to 25HP will be manufactured and these will tend to be at the lower end of the size range. The consumption of copper and demand for semis is summarised in Table 2.51. In addition to winding wire used in manufacture wire will also be used in rewinding of motors. This we estimate will be 5% of the total consumption. This is included in the totals in Table 2.51.

- Generation and Transmission Accessories

There are many miscellaneous accessories used in connection with generation and transmission such as sealing caps, junction boxes and fuse boxes etc, which use copper alloys. These account for a maximum of 100 tons per annum of brass in various forms. The volumes of most products are low and it is unlikely that they could be economically produced in Nigeria with the exception of sealing caps.

Sealing caps are simple brass pressings which are made from brass strip and are suitable for local production. The present consumption is estimated to be in the region of 80 tons per annum and will rise at about 15% in line with the investment in transmission. The consumption of brass is shown in Table 2.52.

TABLE 2.52 : CONSUMPTION OF BRASS IN GENERATION AND TRANSMISSION ACCESSORIES, (TONS)

Year	Brass	Copper Content
1981	80	48
1982	92	55
1983	106	63
1984	122	73
1985	140	84
1986	161	97
1987	185	111
1988	213	128
1989	244	147
1990	281	169

TABLE 2.53 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - GENERATION AND TRANSMISSION ACCESSORIES 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip	198	20	27	161	60	97
Alloy Tube						
Castings						
Total						97

All these caps could be manufactured in Nigeria by 1986 and the consumption of copper and demand for brass is summarised in Table 2.53

- Wiring Accessories

The demand for wiring accessories is closely related to the increase in consumption of power for domestic lighting and appliances and to the demand for building wire. Very few of the accessories are currently manufactured in Nigeria, but a new factory is being established in Kano (Flamma Assemblies) and a second one at Nize near Onitsha (GMC) which will make accessories, among other things.

There will be a rapid move into this area and it is probable that most of the more standard items will be manufactured locally by 1985.

The main products in this group are given in Table 2.54 together with the weight of copper alloy per unit and their estimated share of the market.

TABLE 2.54 : COPPER ALLOY CONTENT OF ELECTRICAL ACCESSORIES

Item	Copper alloy/unit gram	Share of Market
Lampholders	5	22
Ceiling Roses	5	13
Plugs	35	18
Sockets	25	20
Switches	15	14
Junction Boxes	10	13
Total	16.5*	100

* Weighted Mean

The weighted mean of the copper alloy content of the units is 16.5 grams. This compares with 7.5 grams estimated in a previous study for Iran where two-pin plugs and sockets are used as opposed to the three-pin units used in Nigeria. The figure for UK is 24.6 grams, but this includes control boxes which are considered elsewhere in this report.

Fittings are used by new consumers and by existing consumers. We estimate that new domestic consumers will use an average of 30 pieces. Not all of these will be fitted immediately, but will be staggered over a year or two as the benefits are appreciated and cash becomes available. In addition, existing consumers will use an average of five fittings per year. We have calculated the consumption of alloy based on the figures for residential equivalents calculated earlier (see Table 2.14) and the figures are given in Table 2.55.

TABLE 2.55 : CONSUMPTION OF COPPER AND COPPER ALLOY IN WIRING ACCESSORIES

Year	Millions of pieces	Alloy Content tons	Copper Content tons
1981	25	412	247
1982	28	462	277
1983	32	528	317
1984	36	594	356
1985	41	677	406
1986	47	776	466
1987	53	875	525
1988	60	990	594
1989	68	1,122	673
1990	77	1,271	763

We estimate that 50% of these fittings will be manufactured in Nigeria by 1986. Table 2.56 summarises the consumption of copper and demand for semis in this sector.

TABLE 2.56 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - WIRING ACCESSORIES 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod	184	25	46	138	70	96.6
Alloy Strip	357	30	107	250	70	175.0
Alloy Tube						
Castings						
Total						271.6

- Electric Lamps

Two companies, Phillips and Polamp have been set-up to manufacture electric lamps in Nigeria, but Polamp appear at present only to be importing despite the fact that imports are banned.

Because of the ban on imports of filament lamps Philips should be supplying the whole market but there is an indeterminate volume being smuggled. Our estimate of the market is given in Table 2.57 allowing for 30% being smuggled at present and basing forecasts on estimates from Philips. There is considerable uncertainty in the estimate since the proprotion of smuggled lamps is unknown. The estimates are, we consider, conservative and even by 1990 consumption is less than one for every two people in the country or ten per consumer.

90% of lamps are of the pin type and only 10% are screw type. Present production is 40% with brass caps and 60% with aluminium caps. Philips consider that the higher cost of the former is offset by longer life and that the split will remain constant for some time.

TABLE 2.57 : MARKET FOR FILAMENT LAMPS AND CONSUMPTION OF COPPER

Year	Millions of Lamps	Brass Strip Tons	Copper wire Tons
1981	15.0	39	5
1982	16.8	44	5
1983	18.9	49	6
1984	21.1	55	6
1985	23.6	61	7
1986	26.5	69	8
1987	29.7	77	9
1988	33.2	86	10
1989	37.2	97	11
1990	41.7	108	12

Brass is used for caps (40% of production) and copper is used for two leads in each lamp. Consumption of brass and copper in lamps is given in Table 2.46.

Philips are also assembling fittings for fluorescent tubes. The demand for these is growing rapidly and estimates of demand are shown in Table 2.58. Copper or alloy are used in fittings for wiring, the choke, starter, choke holder and tube holder and the materials are unlikely to change. All of these components are currently imported, but manufacture could be done in Nigeria and facilities are likely to be developed. The copper contents are shown in Table 2.58.

TABLE 2.58 : THE MARKET FOR FLUORESCENT TUBE FITTINGS AND CONSUMPTION OF COPPER

Year	Thousands of units	Wire	Winding Wire	Copper Content Brass Strip
1981	170	9	51	5
1982	204	11	61	7
1983	245	13	74	8
1984	294	16	88	10
1985	349	19	104	11
1986	412	22	124	13
1987	483	26	145	16
1988	559	30	168	18
1989	644	35	193	21
1990	734	40	220	24

We estimate that by 1986 80% of lamps and 50% of fluorescent fittings will be manufactured in Nigeria.

The consumption of copper and demand for semis is summarised in Table 2.59.

TABLE 2.59 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - LAMPS AND FLUORESCENT FITTINGS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	19	10	2	17	100	17
Winding Wire	69	10	7	62	100	62
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip	95	20	19	76	60	46
Alloy Tube						
Castings						
Total						125

- Batteries

Two companies are currently making batteries in Nigeria, Berec and Union Carbide, and these companies will be able to supply the whole of the market in the near future. Currently they face severe competition from smuggled goods which they believe accounts for 40-50% of the market. This market is presently estimated at 350 million units and is presently growing at a rate of 20% per annum.

The only component made of copper is the nickel plated brass cap which weighs 0.36 grams per battery. The cap would be manufactured in Nigeria if brass strip were available. Table 2.60 gives the estimated demand for batteries and the consumption of copper and brass.

TABLE 2.60 : THE MARKET FOR BATTERIES AND CONSUMPTION OF COPPER

Year	Millions of units	Brass tons	Copper Content tons
1981	350	126	76
1982	420	151	91
1983	504	181	109
1984	600	216	130
1985	708	255	153
1986	828	298	179
1987	960	346	208
1988	1,114	401	240
1989	1,281	461	277
1990	1,460	526	316

We estimate that by 1986 50% of battery caps will be manufactured in Nigeria. The consumption of copper and demand for semis is summarised in Table 2.61.

TABLE 2.61 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - BATTERIES 1986

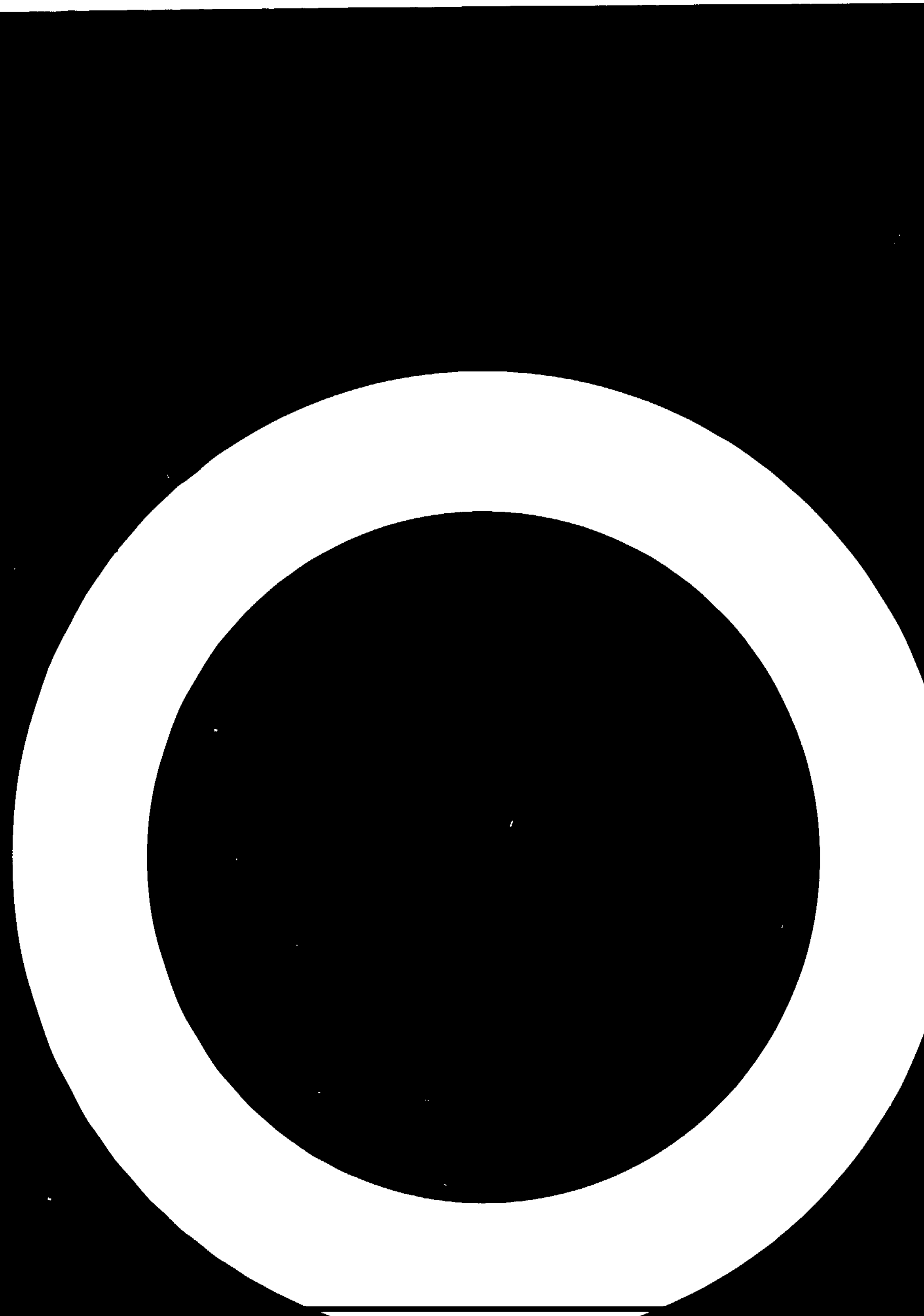
Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip	180	20	30	150	60	90
Alloy Tube						
Castings						
Total						90

2.8 Summary

The requirements for each type of semi (including scrap) in each sector of the electrical engineering industry are summarised in Table 2.62. The figures are for semis which we estimate will be consumed by manufacturers in Nigeria and do not include the semis content of imports.

TABLE 2.62 : SUMMARY OF DEMAND FOR COPPER AND ALLOY SEMIS BY NIGERIAN MANUFACTURERS OF ELECTRICAL ENGINEERING PRODUCTS AND COPPER CONTENT OF ALL PRODUCTS (TONS)

	Copper Semis 1986					Copper Alloy Semis 1986					1986 Copper Content of local Manufacturer
	Wire	Winding Wire	Rod	Strip	Tube	Wire	Rod	Strip	Tube	Casting	
Building wire	7822										7040
Power cable	4178										3760
Telephone cable	3920										3530
Transport/Appliances	505	486									
Generators		471									403
Transformers		333		333	7		8				609
Switchgear		9	84	13	20		14	6	3		
Electric meters								333			150
Electric motors		37	4				3	2			38
Generation accessories								198			97
Wiring accessories							184	357			326
Lamps	19	69						95			
Batteries								180			90
Total	16444	1405	88	346	27		209	1171	3		



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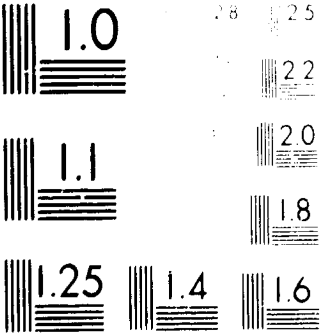

1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

3. DOMESTIC APPLIANCE INDUSTRY

3.1 Introduction

The assembly of domestic appliances in Nigeria began on a significant scale only some five or six years ago. Since that time there has been a quite rapid growth both in the number of units locally assembled and in the number of companies involved in the assembly/manufacturing activity in this sector. As a result of Government policy, which is primarily to operate an open policy in this area of industry, a large number of companies have made investments in this sector. To date, however, annual production volumes for all of the companies are such that by international standards units are relatively small and companies have tended to remain at the basic assembly stage rather than becoming more involved in the local manufacture of appliances. Likewise, there has been no significant growth of the local component manufacturing sector in most product areas and whilst it is the Government's desire to increase local content it would appear that without more firm action, results in this area will be relatively limited.

3.2 Methodology

In this section of our report, each individual domestic appliance has been considered separately, irrespective of whether or not it is manufactured in Nigeria at the present time. For each domestic appliance an assessment has then been made as to whether or not the appliance will be manufactured in Nigeria in the forthcoming five year period and if so, which components of the appliance would be locally manufactured. On the basis of this assessment, the total consumption of copper and copper alloy products has been calculated for all products/ components to be manufactured in Nigeria.

The basic methodology we have adopted for forecasting demand for the various appliances has been to utilise all existing data and to consider as many alternative approaches as are possible, based on available data, in order to ensure obtaining the most consistent forecasts possible. Where appropriate, basic forecasts have been modified to take account of impinging factors where these could act as constraints on development of a particular sector (an example in this respect is where the number of households with electricity is a constraining factor on demand, for example for refrigerators).

In general, the starting point in preparing forecasts has been an analysis of available import statistics. This has been followed by a review of the historical growth of local manufacture. Onto this data we have superimposed the future plans of manufacturers viz-a-viz unit output, capacity and capacity expansion and manufacturers' own expectations with respect to market size. Furthermore, where possible, account has been taken of the type and price of products to be manufactured in the future, particularly where these are at variance with present practices.

Ideally, we would have liked to reinforce this analysis with further analyses based on the purchasing power of the various socio-economic groups within the country. However, the lack of basic data on household expenditure, ownership of appliances, etc., has meant that we have been unable to do more than make global estimates in this respect.

For many appliances, where unit consumption of copper and copper alloy semi-finished or finished products is very low, one cannot justify the effort required to prepare precise forecasts and in such cases, we have tended to adopt global figures for total demand.

3.3 Domestic Refrigerators

At the present time there are some 10 companies in Nigeria involved in the assembly of domestic refrigerators. In addition there are a number of other companies who have applied for, or been granted, manufacturing permits by the Government and who will be establishing assembly facilities over the next few years.

The major portion of refrigerators assembled in Nigeria are of the smaller European-type (as opposed to American-type) units. Precise data is not available on the breakdown of the production by unit size, but in general some 50% of current assembly in Nigeria is for small (ca. 6 cu.ft.) units, with a major portion of the remaining 50% of local assembly being refrigerators in the 8 cu.ft., 10 cu.ft., and 12 cu.ft. size categories.

Imports of domestic refrigerators, as can be seen from Table 3.1, grew progressively through the early 1970's before levelling off and then slightly declining as local assembly developed.

TABLE 3.1 : NIGERIAN IMPORTS OF DOMESTIC REFRIGERATORS

Year	Number
1970	5,451
1971	19,009
1972	19,149
1973	40,339
1974	45,600
1975	52,838
1976	62,401
1977	105,138
1978	103,639
1979	40,000

Source: Nigerian Trade Summaries (Ref. 2)

Precise data on local production is extremely difficult to obtain since no central source of up-to-date statistics are available and as such we have had to base our estimates in this area on the results of our own field-work programme in Nigeria. Based on the latter source we estimate that local assembly has grown from a few thousand units in 1978 to around 100,000 units in 1980. Thus, based on this local production data, and the above mentioned import statistics, we estimate that over the past four years, the total market for refrigerators has been as shown in Table 3.2.

TABLE 3.2 : DEMAND FOR REFRIGERATORS IN NIGERIA

Year	Imports	Local Assembly	Total
1970	5,451	-	5,451
1971	19,009	-	19,009
1972	19,149	-	19,149
1973	40,339	-	40,339
1974	45,600	-	45,600
1975	52,838	-	52,838
1976	62,401	5,000	67,401
1977	105,138	20,000	125,138
1978	103,639	32,000	135,639
1979	40,000	95,000	135,000

Source: Nigerian Trade Summaries (Ref. 2)

Both for forecasting purposes and in order to estimate future scrappage rates, it is necessary to establish the refrigerator "park" (i.e. the number of refrigerators currently in use in Nigeria) and in the absence of household survey data recording ownership levels, we have been obliged to estimate this on the basis of imports and the number of units assembled locally. We have analysed imports back to 1970, made general estimates of annual import levels in early years, along with an estimate of the possible number of refrigerators in use in the mid-1960's. Based on the above mentioned approach we have estimated a total number of refrigerators in use in Nigeria at the end of 1964 of 45,000 units. From this base we have then built up the annual park and estimated annual scrappage rates in the manner described below and shown in Table 3.3. Before discussing the methodology employed, it is worth mentioning that the accuracy of the above mentioned figure is not particularly important since any errors will rapidly diminish as time passes and annual new demand increases.

The rate and absolute volume of units scrapped has been calculated on the one hand on the basis of information supplied by manufacturers and distributors in Nigeria, and on the other hand, from experience gained in other developing countries. Based on the above, we estimate that the average life of a refrigerator in Nigeria is of the order of 12 years. We have then assumed that the number of units scrapped in the first four years after purchase is so small as to be insignificant whilst all units are scrapped by the end of Year 21. With regard to annual scrappage rates, we have assumed that these follow a normal distribution. On this basis we have calculated annual scrappage rates as shown in Table 3.3. From this table it can be seen that whilst scrappage is a relatively insignificant part of total demand in the earlier stages of market development, subsequently it becomes extremely important. In the case of Nigeria, we anticipate replacement demand (through scrappage) becoming particularly significant in the late 1980's and beyond. By 1985 annual rates will have risen to over 30,000 units per year, whilst by 1990 the rate will be approaching 125,000 units.

The present level of ownership of refrigerators in Nigeria is still relatively low. Based on the estimates of the total park shown in Table 3.3, coupled with the best estimates we have been able to obtain on the number of households in the country (in this respect we have taken the figures in the PRC Housing Study - some five million households in 1980) the present level of ownership of refrigerators is of the order of 10%. Thus the "potential" future demand is extremely high, but several factors will serve to limit this and much more modest annual growth rates are expected than might appear at first sight. Income and its distribution will clearly be a limiting factor. However, the number of households served by the Electricity Authority could be a far more important limiting factor. Based on available data from NEPA the total number of households with electricity was 590,000 at the end of 1977. With annual increases of only some 100,000 customers for the three years through to the end of 1980, the total number of households with electricity rose to 900,000. Whilst the total number of households owning a refrigerator is still some 100,000 below this number, the trend is to narrow the gap.

TABLE 3.3 : SCRAPPAGE RATES - REFRIGERATORS NIGERIA

Year	No. Sold	SCRAPPAGE IN YEAR													
		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1965	45,000	85	102	130	150	212	250	340	425	540	670	830	1,011	1,462	1,713
1966	5,000	-	-	-	-	-	-	5	10	40	90	180	320	480	655
1967	7,000	-	-	-	-	-	-	-	7	14	56	126	252	448	672
1968	9,000	-	-	-	-	-	-	-	-	9	18	72	162	324	576
1969	10,000	-	-	-	-	-	-	-	-	-	10	20	80	180	360
1970	6,000	-	-	-	-	-	-	-	-	-	-	6	12	48	108
1971	19,000	-	-	-	-	-	-	-	-	-	-	-	19	38	152
1972	19,000	-	-	-	-	-	-	-	-	-	-	-	-	19	38
1973	40,000	-	-	-	-	-	-	-	-	-	-	-	-	-	40
1974	45,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975	52,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1976	67,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1977	125,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1978	135,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1979	135,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1980	170,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1981	200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1982	230,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983	250,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1984	275,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1985	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1986	330,000	-	-	-	-		-	-	-	-	-	-	-	-	-
TOTAL SCRAPPAGE		85	102	130	150	212	250	345	442	603	844	1,234	1,856	2,999	4,314

TABLE 3.3 : SCRAPPAGE RATES - REFRIGERATORS NIGERIA (CONTINUED)

Year	No. Sold	SCRAPPAGE IN YEAR											
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1965	45,000	1,963	2,205	2,410	2,513	2,643	2,643	2,513	2,410	2,205	1,963	1,713	1,462
1966	5,000	720	720	655	480	320	180	90	40	10	5	-	-
1967	7,000	917	1,008	1,008	917	672	448	252	126	56	14	7	-
1968	9,000	864	1,179	1,296	1,296	1,179	864	576	324	162	72	18	9
1969	10,000	640	960	1,310	1,440	1,440	1,310	960	640	360	180	80	20
1970	6,000	216	384	576	786	864	864	786	576	304	216	108	48
1971	19,000	342	684	1,216	1,824	2,489	2,736	2,736	2,489	1,824	1,216	684	342
1972	19,000	152	342	684	1,216	1,824	2,489	2,736	2,736	2,489	1,824	1,216	684
1973	40,000	80	320	720	1,440	2,560	3,840	5,240	5,760	5,760	5,240	3,840	2,560
1974	45,000	45	90	360	810	1,620	2,880	4,320	5,895	6,480	6,480	5,895	4,320
1975	52,600	-	53	105	421	947	1,894	3,366	5,050	6,891	7,574	7.574	6,891
1976	67,500	-	-	68	135	540	1,215	2,430	4,320	6,840	8,843	9,720	9,720
1977	125,000	-	-	-	125	250	1,000	2,250	4,500	8,000	12,000	16,375	18,000
1978	135,500	-	-	-	-	136	271	1,084	2,439	4,878	8,672	13,008	17,750
1979	135,500	-	-	-	-	-	136	271	1,084	2,439	4,878	8,672	13,008
1980	170,000	-	-	-	-	-	-	170	240	1,360	3,060	6,120	10,880
1981	200,000	-	-	-	-	-	-	-	200	400	1,600	3,600	7,200
1982	230,000	-	-	-	-	-	-	230	460	1,840	4,140	8,280	14,720
1983	250,000	-	-	-	-	-	-	-	250	500	2,000	4,500	9,000
1984	275,000	-	-	-	-	-	-	-	-	275	550	2,200	4,950
1985	300,000	-	-	-	-	-	-	-	-	-	300	600	2,400
1986	330,000	-	-	-	-	-	-	-	-	-	-	330	660
TOTAL SCRAPPAGE		5,939	7,945	10,408	13,403	17,484	22,770	30,010	39,539	52,713	70,427	94,540	124,624

TABLE 3.4 : CHANGE IN OWNERSHIP OF REFRIGEPATORS IN SELECTED COUNTRIES

Country	1967 %	1977 %
Austria	47	90
Belgium	42	88
Denmark	72	93
Finland	42	95
France	63	92
Germany	64	92
Great Britain*	50	88
Italy	54	94
Netherlands	41	96
Norway	53	86
Spain	36+	74
Sweden	84	95
Switzerland	61	94
Iran	7.5	
USA	99	
Australia	98	
Japan	65+	
Portugal	39	
Eire	32	
Greece	27	

* Includes Fridge/Freezer combinations

+ 1968 figures

The present level of ownership of refrigerators in Nigeria at somewhat under 10% is slightly higher than the ownership level in Iran in the late 1960's but significantly below even the less developed European countries in the mid-1960's as can be seen from Table 3.4.

Based on the available data annual forecasts of demand have been made as shown in Table 3.5. Two forecasts have been made with the lower of the two being adopted. The higher forecast cannot be achieved without a greater number of electricity connections being made, indeed even on the lower forecast the refrigerator park is above the number of NEPA residential consumers from 1984 onwards as can be seen from Table 3.6.

TABLE 3.5 : FORECAST OF DEMAND FOR REFRIGERATORS

Year	Forecast Demand	
	Medium	High
1981	200,000	200,000
1982	230,000	230,000
1983	250,000	260,000
1984	275,000	300,000
1985	300,000	350,000
1986	330,000	400,000

TABLE 3.6 : TOTAL NUMBER OF RESIDENTIAL ELECTRICITY CONSUMERS v. REFRIGERATOR PARK

Year	Refrigerator Park	Residential Electricity Consumer
1977	444,000	590,000
1978	581,000	725,000
1979	711,000	842,000
1980	873,000	979,000
1981	1,063,000	1,139,000
1982	1,280,000	1,322,000
1983	1,513,000	1,580,000
1984	1,766,000	1,757,000
1985	2,036,000	2,016,000
1986	2,326,000	2,311,000

As was mentioned earlier a large part of the total demand for refrigerators in Nigeria is demand for small 6 cubic feet and 7 cubic feet units. This pattern is expected to continue in the future although a slight trend towards more medium size units (8 cubic feet to 10 cubic feet) is expected.

At the present time, there is little local content in Nigerian produced domestic refrigerators. Most are brought in as SKD or CKD units or in component form with local manufacture being limited to some press work, welding, painting and local fabrication of the plastic liners. Other than a few simple operations (cutting wire to size, etc.), the only other activity carried out in Nigeria in this sector is the assembly operation. Whilst some companies have plans for slight modifications in this respect (moving SKD to import of components) no company would appear to have any interest in actual manufacture of components although several acknowledge that they may subsequently be obliged to become involved in this area if the Government, through import licensing or similar means, force them to do so.

In terms of the usage of copper and copper alloy products in domestic refrigerators, the most important single component is the compressor which has an important quantity of winding wire in each unit. In addition, each domestic refrigerator contains a short length of copper tubing, a relatively small level of consumption of copper alloys in switches and connection pieces and a length of mains cable.

The mains cable, copper tubing and the major portion of the switches and contact points could be supplied from a local source by the mid-1980's (the mains cable could probably be provided in the next few years, whilst the copper tubing and brass products would be a function of establishing a new brass mill products industry in the country). The largest copper consumption, however, as was mentioned above, is the compressor unit. To our knowledge there are no plans for the local manufacture of this component in Nigeria. Furthermore, since the minimum economic plant size is of the order of 500,000 units per year, we do not anticipate any local manufacturing plant being established before the second half of the 1980's. The use of copper and copper alloys in 1986 will therefore remain somewhat limited. Total consumption in 1986 is estimated to be as shown in Tables 3.7 and 3.8.

TABLE 3.7 : USE OF COPPER AND COPPER ALLOYS - DOMESTIC REFRIGERATORS 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Tube	100					33						
Switch/Contact							15			5		
Compressor Motor*	800		264									
Mains Cable	110	36										
Total		36	264			33	15			5		

* Assumed compressor will not be manufactured locally - this total has therefore been excluded form the data contained in Table 3.8.

TABLE 3.8 : CONSUMPTION OF SEMIS, SCRAP AND METAL USED - DOMESTIC REFRIGERATORS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	40.0	10	4.0	36	100	36
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube	36.7	10	3.7	33	100	33
Alloy Wire						
Alloy Rod						
Alloy Strip	7.1	30	2.1	5	70	4
Alloy Tube						
Castings						
Total						73

In estimating these quantities we have assumed an average size of refrigerator of 8 cubic feet. It is worthy of note that if the refrigerator compressor was to be produced, the total annual consumption of winding wire which would be generated would be around 260 tons per year.

3.4 Refrigerated Display Cases and Freezers

The use of refrigerated display cases is limited to the industrial and commercial sector in Nigeria. Freezers, however, are used in both residential and commercial establishments. The local market for domestic freezer units (including those which go to small shops and businesses) is, however, relatively small and we estimate that in 1980 the total demand in this area was no more than 10,000 units of domestic type freezers and 5,000 units of refrigerated display cases.

The manufacture of refrigerated display cases tends to be carried out on a very small scale in simple workshops and similar establishments. Individual companies produce only a handful of units each week and the main manufacturing operation comprises simple metal-working and assembly. Individual units contain relatively short lengths of copper tube and again a compressor unit. Local manufacture of these larger compressor units, however, cannot be envisaged in Nigeria in the foreseeable future and as such copper consumption will be limited to the mains cable and the above mentioned copper tube. The same will apply, insofar as copper consumption is concerned, to domestic freezers although some of the refrigerator companies do have plans to manufacture these units in their refrigerator manufacturing facilities. Again, however, the possible usage of local semi-finished and finished copper and copper alloy products is extremely limited as can be seen from Tables 3.9 and 3.10.

3.5 Air-Conditioning Units

The development of this sector in Nigeria has been not too dissimilar to the domestic refrigerator sector described above. The market for air-conditioning units rose quite rapidly from 1974 through 1978 at which time the Government tightened regulations on import of completely built-up units. Today some eight or ten companies are involved in, or are planning, local assembly/manufacturing operations in this area.

TABLE 3.9 : USE OF COPPER AND COPPER ALLOYS - REFRIGERATED DISPLAY CASES AND FREEZERS 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Display Cases												
Compressor	1740		14									
Cable	170	1										
Cooling Unit	2150					17						
Switches/ Controls							30			0.3		
Freezers												
Compressor	1280		26									
Cable	150	3										
Switches/ Controls							20			0.4		
Tube	140					3						

Assumptions

Based on local production in 1986 of 20,000 freezers and 8,000 display cases.

TABLE 3.10 : CONSUMPTION OF SEMIS, SCRAP AND METAL USED - REFRIGERATED DISPLAY CASES AND FREEZERS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	4.4	10	0.4	4	100	4
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube	22.2	10	2.2	20	100	20
Alloy Wire						
Alloy Rod						
Alloy Strip	1.0	30	0.3	0.7	70	0.5
Alloy Tube						
Castings						
Total						20.5

Assumption

All compressor units imported.

The total market for air-conditioning units rose from some 32,000 units in 1974 to around 95,000 units in 1978 as can be seen from Table 3.11. In the earlier years the entire demand was met by imports whilst latterly locally assembled units have played an increasingly important part in meeting total demand. As can be seen from Table 3.11, imports peaked at some 73,600 units in 1977 and have fallen quite significantly since that time. Against this, local production has risen quite rapidly and although there has been some slow-down in the rate of growth in 1970 and 1980 indications are that this short term situation will soon change and a more rapid growth rate is envisaged in the future.

TABLE 3.11 : IMPORTS AND LOCAL ASSEMBLY OF AIR-CONDITIONING UNITS

Year	Imports	Local Assembly	Total
1971	16,392	-	16,392
1972	17,347	-	17,347
1973	18,106	-	18,106
1974	32,000	-	32,000
1975	58,970	-	58,970
1976	32,133	-	32,133
1977	73,631	18,000	91,631
1978	69,773	25,000	94,773
1979	50,000*	40,000	90,000*

* Estimate
Source: Nigerian Trade Summaries (Ref. 2)

At the present time, some 85% of all domestic air-conditioning units are of the room or window type. Split units account for no more than 10% of all air-conditioning purchases in Nigeria, whilst package units today account for little more than 5%. Whilst the importance of split units is expected to continue to increase in the future, in the early 1970's almost all air-conditioning units imported were of the window type, it is anticipated that even by the mid-1980's room air-conditioning units will represent somewhat over 80% of total demand in Nigeria. The latter is important in the context of this project as the relative quantities of copper and copper alloy products contained in these units varies quite significantly from one type of system to another.

The local assembly of domestic air-conditioning units in Nigeria began in the mid-1970's. Initially, the rate of growth of the local industry was relatively slow but following Government curbs on import licences for finished units in 1978 and 1979, the number of locally assembled units has risen rapidly. This trend is expected to continue in the future and whilst the Government will doubtless permit a small volume of completely built-up units or SKD units to be imported in the early 1980's, we anticipate that by 1985 locally produced units will account for 80% of total demand.

At the present time, there are some half-dozen companies assembling air-conditioning units in Nigeria. A similar number of companies are interested and/or have plans for starting local assembly over the forthcoming two to three years and, as such, by the mid-1980's there could be as many as eight or ten companies involved in this sector. To some extent this fragmentation of the industry could result in a much lower level of local manufacture than would otherwise be the case, although even by the mid-1980's volumes in total will still be insufficient to envisage the local manufacture of the main component (compressor unit) of these units.

As far as the division of the market by product size is concerned, this is somewhat difficult to establish precisely since statistics do not cover this aspect. From our discussions with manufacturers and distributors we estimate that the major portion of the market is in the 12,000 BTU to 15,000 BTU segment, with as much as 60% of all units sold falling within this range. A further 20% of units are in the range of 9,000-12,000 BTU with the balance generally being of the order of 17,000 BTU.

As far as existing manufacturing activities are concerned the major portion of local content comes from simple metal-working (in relation to fabricating the cabinet), a small amount of trim items and the assembly operation. Some of the local companies do plan to manufacture locally the evaporator units from imported copper tube and aluminium foil. By 1985 it is not unreasonable to assume that the major portion of evaporators will be locally manufactured and indeed except for switches, the compressor and the fan motor, the major portion of all other components will be locally fabricated.

As far as copper containing items are concerned, in a window-type unit (with compressor) the main items are the electric motor within the compressor, the fan motor, copper tubing as used in the evaporator/condenser unit, the copper tube from the compressor unit and the wiring from the mains supply and within the unit (between supply compressor and fan motor).

Based on our forecasts of local production of room air-conditioning units in 1986, shown in Table 3.12 the quantities of the various copper and copper alloy products have been estimated in Tables 3.13 and 3.14 On these totals, all except the copper shown as being required in the form of winding wire for the fan motor and the compressor will be required in Nigeria in semi-finished form. We believe that by 1986 the compressor unit will still be imported as a finished component although the electric motor should be produced locally.

TABLE 3.12 : FORECAST DEMAND FOR ROOM AIR-CONDITIONING UNITS 1981-1986*

Year	Imports	Local Production	Total
1981	50,000	60,000	110,000
1982	50,000	80,000	130,000
1983	50,000	110,000	160,000
1984	50,000	150,000	200,000
1985	40,000	170,000	210,000
1986	40,000	200,000	240,000

*Share of total which are window-type units are expected to decrease from 85% in 1981 to 80% in 1986.

TABLE 3.13 : USE OF COPPER AND COPPER ALLOYS - ROOM AIR-CONDITIONING UNITS (WINDOW TYPE) 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Compressor	980		156									
Fan Motor	610		98									
Main Cable	330	53										
Tube	2426					388						
Switch/Control							40			6		

Assumption

160,000 of the 200,000 air conditioning units produced in Nigeria in 1986 are window type units.

TABLE 3.14 : CONSUMPTION OF SEMIS, SCRAP AND METAL USED - ROOM AIR-CONDITIONING UNITS (WINDOW TYPE) 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	58.9	10	5.9	53	100	53
Winding Wire	108.9	10	10.9	98	100	98
Copper Rod						
Copper Strip						
Copper Tube	431.1	10	43.1	388	100	388
Alloy Wire						
Alloy Rod						
Alloy Strip	8.6	30	2.6	6	70	4
Alloy Tube						
Castings						
Total						543

Assumptions

1. Fan motor produced locally.
2. Compressors all imported.

3.6 Washing Machines

At the present time there is no manufacture or assembly of washing machines in Nigeria. One or two companies have examined this sector but as yet have not made a firm decision to go ahead. The reason for this reluctance is a reflection of the relatively limited size of the market for this product in Nigeria and the need to have a reasonable volume even for a viable assembly operation. Imports of washing machines have shown some growth through the 1970's but are still far below a real "take-off" point.

At the present time, ownership of washing machines in Nigeria is extremely low and probably totals no more than 40,000 units, equivalent to less than 1% of households within the country. Because of the relatively low level of ownership at the present time, and the extremely limited annual demands, we do not expect any local manufacture or assembly to commence prior to 1985. Beyond this date local assembly could commence but we doubt that it will entail major component manufacture within the time horizons being considered in relation to this project.

As can be seen from Table 3.15 we anticipate a relatively modest growth rate in the years up to 1985. We must, however, emphasise that experience in other countries is that a take-off in this product area can occur quite rapidly (over a very short period of time) and once the development process reaches a certain stage, ownership of refrigerators, washing machines and television sets are all of approximately the same order. Indeed, a comparison of ownership levels in, for example, the less developed countries of Europe in the 1960's, as shown in Table 3.16, would suggest that the rate of growth within this product area in Nigeria could possibly be higher than we have indicated particularly in the second half of the 1980's.

TABLE 3.15 : IMPORTS OF WASHING MACHINES AND PROJECTED DEMAND

Year	Import	Demand
1975	2130	
1976	2760	
1977	942	
1978	3553	
1979	3800*	
1980		4000
1986		7500

*Estimate based on fieldwork interviews and data for first quarter

Based on the above mentioned level of demand in 1986 it is unreasonable to expect any local manufacture of washing machine components. It is possible, and indeed probable, that by 1986 local assembly of washing machines will have commenced in Nigeria. Activity will, however, most probably be based on import of SKD or CKD units with local content being limited.

For the purpose of calculation of consumption of copper and copper alloy semi-finished products in this sub-sector we have considered all copper containing components in Tables 3.17 and 3.18 but have only included the mains cable in the totals for the sector for 1986.

TABLE 3.16 : GROWTH IN OWNERSHIP OF WASHING MACHINES IN SELECTED COUNTRIES

Country	1967 %	1973 %	1975 %	1977 %
Austria	39	62	70	79
Belgium	68	74	75	75
Denmark	36	56	60	63
Finland	53	59	64	68
France	42	64	69	75
Germany	44	79	84	86
Great Britain	60	68	71	73
Italy	41	76	79	83
Netherlands	75	65	85	87
Norway	48	74	75	78
Spain	35	62	68	70
Sweden	55	80	80	83
Switzerland	64	35	37	40
Portugal	21			
Eire	41			
Greece	35			
Japan	72*			
USA	95*			
Iran	4+			

* 1968 figures
+ 1971 figures

TABLE 3.17 : USE OF COPPER AND COPPER ALLOYS - WASHING MACHINES 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Main Cable	160	1.2										
Motors	910		6.8									
Heating Element	300					2.3						
Switches/ Controls	90				0.7		110			0.8		

TABLE 3.18 : CONSUMPTION OF SEMIS, SCRAP GENERATED AND METAL USED - WASHING MACHINES 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	1.3	10	0.1	1.2	100	1.2
Winding Wire	7.6	10	0.8	6.8	100	6.8
Copper Rod						
Copper Strip	1.0	30	0.3	0.7	100	0.7
Copper Tube	2.6	10	0.3	2.3	100	2.3
Alloy Wire						
Alloy Rod						
Alloy Strip	1.1	30	0.3	0.8	70	0.6
Alloy Tube						
Castings						
Total						1.2*

* By 1986 assumed only mains cable is supplied to local assembly plant(s). Other copper containing items will continue to be imported.

3.7 Television Sets

There is, today, a quite extensive network of television transmission stations within Nigeria. Plans are in hand to further extend this network so that it covers not only the more populated centres of the country, but also the major portion of rural villages and more outlying communities. The system is no longer limited to black and white transmission, with colour transmission services having begun in certain areas in 1975 and being progressively expanded throughout the country. It will, however, be the mid-1980's before colour transmission covers the major portion of the country.

Assembly of television sets in Nigeria is a relatively recent event. Following a rapid expansion in the volume of imports, the Government decided in 1976 to introduce controls on import licences and by 1978 companies were becoming increasingly obliged to bring in sets in kit form. Initially units were brought-in in SKD form with programmes being set down for a progressive move to CKD with some local manufacture of components and/or sub-assemblies. Today the major portion of television sets sold within the country are built-up locally from CKD units, although many of the companies involved in this sector complain of units being smuggled into the country either in the form of SKD kits or as completely built-up units. The extent to which this latter aspect is a significant problem, and could indeed influence consumption of copper semi-finished products is difficult to assess. However, it is our opinion that it probably is a factor in less than 20% of the total demand and as such is at a level at which the Government can deal with given adequate time.

As can be seen from the data in Table 3.19, imports of television sets rose quite rapidly between 1974 and 1977 but have subsequently fallen, in-part as a reflection of Government control on a foreign exchange availability, and in part as a reflection of the growth of a local assembly industry. Furthermore, there is evidence that in 1977 there was significant "over-importing" with actual sales in the year being significantly below the level of imports.

Since 1974 small quantities of colour television sets have been imported and whilst the volume has increased quite rapidly in numerical terms it is still relatively small. The high cost of colour sets in Nigeria is likely to sustain this situation for several years to come and whilst colour sets will account for an increasing share of total demand, we believe it will be the second half of the 1980's before this type of unit becomes predominant.

TABLE 3.19 : NIGERIAN IMPORTS OF TELEVISION SETS

Year	Imports
1974	21,000
1975	62,122
1976	126,321
1977	180,000
1978	62,485
1979	60,000

Source: Nigerian Trade Summaries (Ref. 2)

In an attempt to build-up as realistic as possible a picture of total demand, we have made reference to the export statistics of Japan (and indeed other countries) who are supplying the major portion of SKD and CKD kits to Nigerian companies. Based on this analysis, and available import data for completely built up units, we have developed the demand picture presented in Table 3.20.

TABLE 3.20 : IMPORT STATISTICS FOR TV's FROM JAPAN TO NIGERIA 1974-1978 AND TOTAL IMPORTS 1979 AND 1980

Year	Colour TV's	Black & White TV's	Chassis Kits for TV's	Total From Japan	Estimated Total Nigerian Imports
1974					
Quantity	3	10,548	11,131	21,681	32,521
FOB US $	17,745	1,390,463	862,088	2,270,296	3,405,444
1975					
Quantity	2,637	55,359	20,953	78,949	118,423
FOB US $	700,711	7,008,604	2,264,619	9,973,934	14,960,901
1976					
Quantity	6,314	68,278	23,252	97,844	146,766
FOB US $	2,044,917	8,242,369	2,933,918	13,221,204	19,831,806
1977					
Quantity	28,309	110,736	24,948	163,993	245,989
FOB US $	9,157,982	13,843,136	3,643,846	36,644,964	39,967,446
1978					
Quantity	9,700	77,000	27,000	113,700	171,153
FOB US $	2,808,329	6,815,961	4,180,814	13,805,104	20,707,656
1979					
Quantity	10,000	50,000	60,000		120,000
1980					
Quantity	15,000	150,000			165,000

Source: Japan Export Statistics (Ref. 3)

TABLE 3.21 : LEVELS OF OWNERSHIP OF TELEVISION SETS

Country	TV Sets in Use (000)		TV Sets per 1000 Capita		% Households with TV	
	1969	1976	1969	1976	1969	1977
Mexico	2,553		52		28.7	
Argentina	3,100		129		47.0	
Chile	400	710	42	68	22.5	
Brazil	6,500	10,525	72	96	36.5	
Venezuela	800	1,431	-	116	42.3	
Indonesia	75	325	0.6	2.3	0.3	
Israel	-	475	-	137	-	
Japan	21,879		2.4		83.4	
Lebanon	420	425	-	144	43.7	
Pakistan	80	350	0.7	4.8	0.4	
Turkey	25	1,769	0.7	44	0.4	
Austria	1,277	1,772	173	236	52.0	90
Belgium	2,000	2,646	207	268	62.2	92
Finland	987	1,714	210	363	69.2	95
Greece	86	1,165	10	126	3.7	
Italy	9,016	12,377	170	220	61.0	85
Netherlands	2,869	3,774	223	274	82.5	93
Spain	5,500	6,640	167	185	66.8	80
United Kingdom	15,792	17,729	284	317	85.3	99
Yugoslavia	1,546	3,463	76	144	30.4	
Australia	2,649	4,785	215	351	75.4	
New Zealand	239	813	222	259	31.8	
Philippines	350	800	9	18	5.7	
Thailand	241	761	7	18	3.9	
Portugal	352	723	37	76	14.8	
Iran	-	1,720	9	51	8.0	
Nigeria		105		1.6		

As can be seen from Table 3.21 the level of ownership of television sets in Nigeria is still extremely low when compared with the situation in other countries. Whilst, however, a tremendous "potential" demand exists, we believe this will be constrained in the shorter term by Government controls on foreign exchange for import of this type of item coupled with constraints resulting from the number of households with electricity, covered by television networks and most importantly, in a position to afford a television set. In the latter respect, it is perhaps worthy of mention that the prices of television sets in Nigeria are significantly higher than in many other countries (although it should be added the general price level is not out of line with that found in many other developing countries) and, as such, the problem of purchase becomes an even more difficult one for a medium to low income family.

Considering the growth of demand over the forthcoming period, we anticipate a relatively slow growth in the early 1980's with a higher growth rate prevailing in the later years of the decade.

Based on the available data, and taking due account of the above mentioned factors, we anticipate that demand for television sets in Nigeria will develop as shown in Table 3.22.

Turning to the question of copper consumption in this product area, the major portion of copper in this type of unit is in the various coils, transformers, and chokes, many of which are presently being wound in Nigeria (or companies have plans for setting up such facilities in the near future), along with the printed circuit boards and electric leads from the mains supply. In addition, of course, there is the aerial cable, although this has been dealt with elsewhere in this report. Whilst coils, transformers and chokes will all be manufactured in Nigeria in the mid-1980's we believe it is unreasonable to anticipate local production of printed circuit board and as such have excluded the small copper consumption in this area from our totals.

TABLE 3.22 : FORECAST DEMAND FOR TELEVISION SETS IN NIGERIA

Year	Units
1981	215,000
1982	230,000
1983	250,000
1984	270,000
1985	300,000
1986	320,000
Colour sets are expected to account for the following volumes:	
1981	25,000
1982	30,000
1983	45,000

With a progressive move towards a more extensive use of integrated circuits within television sets (and indeed other consumer electronic products) the volume of copper per unit is likely to slightly decrease in the future and we have assumed that unit consumptions will be some 15% lower at the end of the decade than is the case today.

Based on existing consumption patterns and manufacturing metho's, we estimate that by the mid-1970's the total consumption of the various copper and copper alloy products in television sets will be as shown in Table 3.23 and 3.24.

TABLE 3.23 : USE OF COPPER AND COPPER ALLOYS - TELEVISION SETS 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Main Cable	85	27										
Internal Wiring	80	26										
Switches/ Cables	80			26			80			26		
Transformers/ Chokes	110		35									

* Printed circuit board has been excluded as it has been assumed this will not be produced in Nigeria by 1986.

TABLE 3.24 : CONSUMPTION OF SEMIS, SCRAP GENERATED AND METAL USED - TELEVISION SETS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	56.7	10	5.7	51	100	51
Winding Wire	28.8	10	2.8	26	100	26
Copper Rod						
Copper Strip	32.5	20	6.5	26	100	26
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip	32.5	20	6.5	26	30	18
Alloy Tube						
Castings						
Total						121

3.8 Radios and Other Audio Equipment

The radio and other audio equipment segment of the consumer electronics market in Nigeria is a sector which is complicated by a number of different factors. On the one hand, particularly since 1978 when most of this type of product was placed on the prohibited list for imports (as completely built-up units), there has been an increase in smuggling and illegal imports. As such, official import statistics under-record the actual level of imports. In addition, there are several complications regarding classification of products in this sector since the import classification used by Nigeria tends to be a relatively simple one and has not been designed to categorise the variety of audio, hi-fi, etc., type equipment available today. For convenience, therefore, we have dealt with this whole group of products under a single heading and have tended to use export statistics of the major supplying countries to Nigeria as our major data source.

Without doubt, there is within Nigeria, a particularly good market for audio equipment and local companies carrying out assembly have grown rapidly in recent years. Whilst the statistical data contained in Tables 3.25 and 3.26 show that since 1978 demand would appear to have fallen, the picture is largely distorted by the fact that many people (both commercial companies and private sector individuals) imported large stocks in anticipation of the products being placed on the prohibited import list.

From the available data it is clear that the product which has exhibited the highest rate of growth is the radio cassette. Against this, tape recorders have exhibited an extremely slow and almost negligible rate of growth over the period.

Whilst accurate data is not available on the number of radio sets in use, estimates would place this at around 6 million units in 1980. Based on a total of more than 12 million households within the country at the end of 1980, it can clearly be seen that there still exists an enormous theoretical potential in this area. The experience of other developing countries is such that ownership of radio sets tends to grow quite rapidly in the earlier stages of development, provided a reasonable transmission network is established within the country. In the case of Nigeria, where radio transmitters and

TABLE 3.25 : HISTORICAL DEMAND FOR AUDIO EQUIPMENT (UNITS)

Item	1975	1978	1979	1980
Radios	486,950	952,000	275,000	375,000
Recorders/Cassette Players/Radio Cassettes	765,700	723,500	750,000	750,000
Gramophone/Record Players	153,308	176,129	132,000	195,000
Hi-fi Equipment	185,494	291,272	392,000	514,000

Source: Nigerian Trade Summaries (Ref. 2)

TABLE 3.26 : HISTORICAL DEMAND FOR AUDIO EQUIPMENT ($000)

Item	1975	1978	1979	1980
Radios	7,700	9,100	4,300	6,935
Recorders/Cassette Players/Radio Cassettes	36,000	56,400	13,500	45,800
Gramophones/Record Players	10,000	17,800	13,000	24,000
Hi-fi Equipment	6,200	22,000	33,000	69,000

Source: Nigerian Trade Summaries (Ref. 2)

indeed radio stations, are operated on a State basis, the coverage tends to be extremely good for a country at Nigeria's stage of development. Thus, based on the type of progression indicated by comparison with the countries for which data is presented in Table 3.27 demand for radios and other audio equipment in Nigeria can be expected to exhibit a quite high rate of growth.

TABLE 3.27 : OWNERSHIP OF RADIO SETS

Country	Ownership per 1000 Inhabitants			
	1960	1968	1969	1976
Argentina	167	381	-	-
Brazil	66	63	61	-
Peru	101	-	134	129
India	5	18	19	24
Israel	195	229	-	189
Finland	276	358	365	461
Greece	85	113	-	300
Ireland	174	296	-	300
Portugal	95	146	147	161
United Kingdom	289	318	324	706
France	241	312	314	330
Australia	222	220	-	770
Iran	45	93	70	63

Turning to the local industry, whilst this has, in many respects been in existence since the late 1960's, it is only over the past few years that the industry has really grown. Presently there are some 8 or 10 companies involved in the manufacture/assembly of audio equipment and the more important producers are shown in Table 3.28.

TABLE 3.28 : MAJOR MANUFACTURERS/ASSEMBLERS OF TELEVISION SETS

Company	Brands
Ojomo Industries	Kingwood
Lilibon	Talung
Pan-electric (mainly TV's)	National Panasonic
Philips (mainly TV's)	Philips
Sanyo*	Sanyo
Joas Industries	Sony
Adebowale	Sanusi
Zabadne*	Akai

* Greatest degree of manufacture

Local production of equipment (which is primarily assembly from SKD or CKD units) is estimated to have been as shown in Table 3.29.

TABLE 3.29 : ESTIMATED ANNUAL PRODUCTION OF AUDIO EQUIPMENT IN NIGERIA IN 1980

Product	Units
Turntables	100,000
Amplifiers	200,000
Cassette Decks	170,000
Tuners	50,000
Speakers	170,000
Cassette/Radio) Radio/Car Radio)	200,000

As was mentioned above, in reality manufacture is at the present time primarily an assembly operation. Recently a number of companies have become increasingly involved in the manufacture of chokes and coils as well as cabinets, trim and other plastic components. One problem in this respect, which was mentioned by several of the companies contacted, was that they were not given adequate guidelines by the Government regarding the question of what they should manufacture in order to comply with the Government's requirements. Thus, some of the companies which are involved more in true manufacture, resent their competitors being able to continue to import SKD units and undercut them in the market place.

For the purpose of this exercise, we have asummed, however, that by 1985 this question will have been resolved and all companies within the industry will be manufacturing at the same level of local content and will be producing all coils and similar components within Nigeria. Local production is expected to rise as shown in Table 3.30 with the existing manufacturers producing the major portion of this total. We have assumed that some of the more sophisticated and high quality hi-fi equipment will continue to be imported at even that time. Based on the above unit volumes, the consumption of copper and copper alloy semi-finished products has been calculated for typical units and the total requirement for these products is summarised in Tables 3.31 and 3.32. We have assumed that winding wire of the quality required for this sector of industry will beavailable in Nigeria by the mid-1980's. However, we recognise that production of such quality products (both in terms of gauge and enamel finish) is quite complex and will require modern equipment and technical support from an international producer.

TABLE 3.30 : FORECASTS OF DEMAND FOR AUDIO EQUIPMENT - 1986

Product	Units
Turntables	180,000
Amplifiers	300,000
Cassette Decks	250,000
Tuners	100,000
Speakers	180,000
Radio/Radio Cassette) Car Radio)	400,000

TABLE 3.31 : USE OF COPPER AND COPPER ALLOYS - AUDIO EQUIPMENT 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Cables and Wiring	130	26										
Switches/ Controls							30		15	27		
Chokes/Trans-formers	85		59									

TABLE 3.32 : CONSUMPTION OF SEMIS, GENERATION OF SCRAP AND TOTAL METAL USED - AUDIO EQUIPMENT 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	28.8	10	2.8	26	100	26.0
Winding Wire	65.6	10	6.6	59	100	59.0
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod	18.8	20	3.8	15	70	10.5
Alloy Strip	38.5	30	8.5	27	70	18.9
Alloy Tube						
Castings						
Total						114.4

3.9 Domestic Cooking Appliances

For the purpose of this study, cooking appliances can be divided into four categories, namely:

- Electric cookers
- Gas ranges
- Gas cookers
- Other cooking equipment

This division is essential because both the overall quantities of copper and copper alloys used and the specific form or type of semi-finished product required varies from one product group to another. Indeed, it is worthy of note that such variations occur not only between the various product groups mentioned above, but also within a particular product group, in part as a reflection of quality but in part also as a result of varying designs, etc. The variations within an individual product group, coupled with the fact that the above mentioned product groups compete with one another, makes forecasting for this type of product extremely difficult. Indeed, this latter problem is further compounded in the case of Nigeria by the total lack of statistical data on any or all of the above mentioned groups. In Nigerian import statistics, cooking appliances are included in a number of miscellaneous categories and thus it has been impossible to develop a reliable time series for this product group.

The use of domestic cooking appliances in Nigeria is largely confined to the urban areas and even here a significant part of cooking is carried out on open fires. In rural areas, the latter is the main form of cooking. In order to prepare estimates of historical and present demand for the various product types, and the way in which these are expected to change in the future, we have in the course of fieldwork held discussions with manufacturers, distributors and importers of this type of equipment.

Before considering each of the above mentioned appliance groups in turn, it is worthwhile to mention that we acknowledge that changing habits in the form of cooking (and hence type of equipment used) will be closely linked with developments in other areas (most importantly in terms of new housing but also availability of electricity, gas etc.) and in preparing forecasts in each of the sub-sectors we have made reference to developments in these areas, developments which in general are detailed elsewhere in this report.

a) Gas Ranges

A limited manufacturing activity for this type of product does exist in Nigeria today, although the major portion of units purchased are imports from the Far East and other low cost producers. At the present time we anticipate the total volume of units imported and/or locally produced to be around 150,000 per annum, with the major portion of these being two-burner models. Traditionally, the burners on this type of product were brass, but today the major portion are pressed steel. In a few cases these are castings, either iron or brass, but the trend is away from non-ferrous consumption and away from castings and this trend is expected to continue in the future.

Looking to the future we anticipate a slow, perhaps 5% per annum rate of growth through to the mid-1980's and, unless legislation is introduced by the Government prohibiting imports of this type of product, we believe the major portion of demand will continue to be met by imports.

Assuming that the Government were to introduce legislation prior to 1986, prohibiting imports of completely built up units, this would in reality have little effect on the consumption of copper and copper alloy products since the major components which would consume copper semi-finished products are unlikely to be made in Nigeria before the end of the 1980's. The manufacture of taps, cocks and fittings is a relatively high volume business and in all probability by the mid-1980's total volumes in Nigeria will be insufficient to justify a viable manufacturing unit in the country.

We have estimated the consumption of copper and copper alloy semi-finished products in gas ranges in 1986, assuming that by this time only some 15% of all units have brass burners and/or burner caps. Likewise, we have assumed that brass taps and cocks account for 70% of the total with other materials being used in the remaining units. The relevant data for consumption of copper and copper alloy products is presented in Tables 3.33 and 3.34.

TABLE 3.33 : USE OF COPPER AND COPPER ALLOYS - GAS RANGES 1986

Item	Number Required	COPPER (Tons)					COPPER ALLOY (Tons)					CASTINGS (Tons)
		Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Tap	8,000						70		56			
Burner Cap	120,000						85					10
Union	200,000						35				7	
Nut/Coupling	1,000,000						15		15			
Pipework	200,000						60				12	

TABLE 3.34 : CONSUMPTION OF SEMIS, SCRAP GENERATED AND METAL USED - GAS RANGES 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip						
Alloy Tube	14.1	15	2.1	12	70	8.4
Castings				10	65	6.5
Total						14.9

Assumption

Taps, unions, nuts and couplings not produced in Nigeria by 1986.

b) Gas/Electric Cookers

The total market for cookers (with oven) in Nigeria is extremely limited. We estimate that in 1980 the market totalled no more than 20,000 units. Because of the relative unreliability of NEPA the trend is away from electric cookers to gas cookers or to combination-type units.

The future demand for cookers is expected to exhibit a somewhat higher growth rate than is the case for gas ranges and we anticipate that throughout the 1980's the average rate of growth will be of the order of 10% p.a. Based on this assumption and the assumption that all units will be either gas or combination units (we have assumed 80% gas and 20% combination), the requirements for copper and copper alloy semi-finished products have been calculated and are presented in Tables 3.35 and 3.36.

It is, we believe, not unreasonable to assume that all these units will be manufactured in Nigeria by 1986.

c) Other Cooking Stoves

Unlike the situation in many other developing countries, kerosene is not used extensively for cooking with open wood burning fires being preferred. Furthermore, the trend in recent years has been to manufacture kerosene stoves using materials other than copper and copper alloy products. As such, we have not attempted to forecast demand for this type of product, or to address the question of local manufacture since as a copper consuming sector volumes will be negligible.

3.10 Water Heaters

The major portion of water heaters purchased in Nigeria at the present time are units which have been imported in completely built up form. Import statistics, however, show extremely eratic patterns and we suspect there has been some error in recording. For example, annual imports would appear to have gone from some 38 units in 1976 to 44,000 units in 1977 and 67,000 units in 1978. We believe the earlier figure is incorrect and is probably a recording in tonnage as opposed to unit number.

TABLE 3.35 : USE OF COPPER AND COPPER ALLOY PRODUCTS - COOKERS 1986

Item	Number Required	COPPER (Tons)					COPPER ALLOY (Tons)					CASTINGS (Tons)
		Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Taps	150,000						78		12			
Burner Caps	85,000						90					8
Unions	37,000						60				2	
Nuts	240,000						15		4			
Pipework	18,500						50				3	
Thermostat*												
Mains Cable		11					300					
Swiches/Controls							45			2		
Elements						4	110					

* Will continue to be imported

TABLE 3.36 : CONSUMPTION OF SEMIS, SCRAP GENERATED AND METAL USED - COOKERS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	12.2	10	1.2	11	100	11.0
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube	4.4	10	0.4	4	100	4.0
Alloy Wire						
Alloy Rod	22.9	30	6.9	16	60	9.6
Alloy Strip	2.5	20	0.5	2	70	1.4
Alloy Tube	5.9	15	0.9	5	70	3.5
Castings	8.0	-	-	8	65	5.2
Total						34.7

Over the past few years a limited amount of local assembly has been carried out in this product area and a more rapid growth is expected in the future.

As far as future demand is concerned, we estimate a rate of growth of the order of 10% p.a. through to the mid-1980's with a parallel development of increased local content taking place.

The units are primarily gas and/or kerosene type units and neither are major consumers of copper or copper alloy semi-finished products. The relevant quantities of these products have been summarised in Tables 3.37 and 3.38. We have assumed that by the mid-1980's a large part of total demand will be met from locally manufactured components. We should emphasise, however, that the reculator, which is the most important item in terms of consumption of copper and copper alloy on kerosene units and the values on gas units, will not be manufactured in Nigeria in this time frame. Thus, whilst the major portion of these units will be locally assembled, the major copper consuming items will continue to be imported for the foreseeable future.

3.11 Electric Fans

Under this heading we include both table and ceiling fans although the latter is a rapidly declining sector not just in Nigeria, but worldwide. Furthermore, the relatively high humidity in many parts of Nigeria has meant that an electric fan is not a particularly good cooling device and, as such, the market for these products has not grown as rapidly as it has in other developing countries where relative humidity levels are significantly lower.

Again, in this area our efforts have been hampered by the lack of available statistics and we have been obliged to make estimates based on our fieldwork within the country.

At the present time we estimate that annual sales of all types of electric fans are of the order of 100,000 units per year. The major portion of these fans are imported from Japan and other Far Eastern suppliers. Whilst one or two local companies have begun assembly of these units, it is primarily from SKD kits. Further-

TABLE 3.37 : USE OF COPPER AND COPPER ALLOY PRODUCTS - WATER HEATERS 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Kerosene												
Various fittings							55		5.5			
Regulator*												
Gas												
Copper Coil	5808					14.5						
Fittings							86		2.1			
Valve*							-					

Assumptions

- Local production in 1986 will total 125,000 units of which 100,000 units will be kerosene and 25,000 units gas.

- * Valves will be import; regulators will be imported.

TABLE 3.38 : CONSUMPTION OF SEMIS, GENERATION OF SCRAP AND TOTAL METAL USED - WATER HEATERS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube	16,1	10	1.6	14.5	100	14.5
Alloy Wire						
Alloy Rod	10.9	30	3.3	7.6	70	5.3
Alloy Strip						
Alloy Tube						
Castings						
Total						20.8

more, local companies complain of low priced imports making local assembly extremely difficult and a relatively unviable operation.

At the present time probably little more than 10% of total demand is met by locally assembled units and whilst such units can be expected to account for an increasing share of the total, the trend is unlikely to accelerate towards local assembly without further Government action being taken in this area.

The demand for electric fans will in part be constrained by other competitive, albeit more expensive, cooling systems. The development of the air-conditioning unit assembly industry in Nigeria is likely to result in only a very limited growth in demand for electric fans. We have assumed a growth rate of 7% p.a. through to 1986 and 5% p.a. beyond, with local manufacturing accounting for some 80% of total production by the end of the decade.

Insofar as demand for copper and copper alloy semi-finished products is concerned, it is the electric motor of these units which is the major copper consuming item. Minimum economic volumes for manufacture of electric motors are of the order of 250,000 units p.a. and thus, without a motor manufacturing plant being established for production of units for other appliances, the manufacture of this component for fans alone would probably not be viable. However, the ubiquitous nature of electric motors means that in all probability a facility will be established in Nigeria by the mid-1980's and we have therefore assumed that the major portion of these motors (which are amongst the most simple to manufacture) will be produced within the country. Thus, on this basis, and the above mentioned assumption, the total requirements for copper and copper alloy semi-finished products in this sub-sector of industry in the mid-1980's has been calculated and is presented in Tables 3.39 and 3.40.

TABLE 3.39 : USE OF COPPER AND COPPER ALLOY PRODUCTS - ELECTRIC FANS 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Motor	0.68		170									
Switches/Controls	-						0.07			17		
Mains Cable	0.11	27										

TABLE 3.40 : CONSUMPTION OF SEMIS, GENERATION OF SCRAP AND TOTAL METAL USED - ELECTRIC FANS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	30.0	10	3.0	27	100	27
Winding Wire	188.8	10	18.5	170	100	170
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip	24.3	30	7.3	17	70	12
Alloy Tube						
Castings						
Total						209

3.12 Other Appliances

In addition to the above mentioned appliances there are a variety of other appliances which are today imported into Nigeria. The more significant of these are flat-irons, vacuum cleaners and small appliances such as mixers, blenders, juicers etc. Annual imports of these items are relatively small and we do not foresee any likelihood of significant local manufacture of these appliances before the end of the 1980's. Furthermore, since each of these appliances is a relatively small user of copper, the electric motors in vacuume cleaners, and the small appliances being the most significant copper consuming items. The latter can only viably be made in large quantities, and as such, even if local assembly of the above mentioned items was to commence before the end of the 1980's manufacture of components, and more particularly the motor, is highly improbable.

3.13 Summary

The overall usage of copper and copper alloy semi-finished products within the domestic appliance sector in 1986 has been summarised in Table 3.41. Bearing in mind that copper consumption within this sector is today probably no more than 40 tons, the high rate of growth which will take place in this sector is readily evident. This pattern has been experienced in several other developing countries as they progressively increase the level of industrialisation with this sub-sector of industry being one of the earlier sub-sectors to be developed in terms of assembly, manufacture and local production of components. In making our forecast of industrial development we have assumed that the government will continue it's policy of progressive increase in local content, particularly within the domestic appliance and luxury goods sectors, and as such acknowledge that if this policy is changed the level of component manufacture outlined within this report is unlikely to be achieved as local companies will of preference assemble imported components rather than either manufacture them or purchase them locally.

TABLE 3.41 : SUMMARY OF DEMAND FOR COPPER AND ALLOY SEMIS BY NIGERIAN MANUFACTURERS OF DOMESTIC APPLIANCES 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Domestic refrigerators		40				37				7		
Refrigerated Display cases and Freezers		4				22				1		
Room air-conditioning units (window type)		59	109			431				9		
Washing machines		1	8		1	3				1		
Television sets		57	29		33					33		
Audio equipment		29	66						19	39		
Gas ranges											14	
Cookers		12				4			23	3	6	8
Water heaters						16			11			
Electric fans		30	189							24		
Total		232	401		34	513			53	117	20	8

4. TRANSPORT INDUSTRY

The transport industry is in many countries the second or third most important sub-sector in terms of copper consumption. Within this sector of industry the most important category is road transport. Indeed in developing countries it is frequently the only segment of significance with rail, marine and air transport accounting for extremely small shares of total copper consumption. Indeed within Nigeria the air transport equipment sector is still not sufficiently developed to have any bearing on this study. Likewise the marine sector, which was studied in the course of the project, will count for only minimal copper consumption with the railway sector still a relatively small consumer, but worthy of consideration.

4.1 Motor Vehicles

The automobile industry in Nigeria has over the past five years undergone significant development. Today there are two companies assembling passenger cars, four companies assembling commercial vehicles along with a number of smaller and more traditional companies also involved in commercial vehicle assembly.

- Passenger Cars

Two companies, Peugeot and Volkswagen, are active in the assembly of passenger cars. Both companies commenced operation in the mid-1970's and have, over the past five years, not only increased their total volume of output but also increased the level of local content in their products.

Demand for passenger cars rose quite dramatically in the early 1970's, although, in part as a result of government controls and foreign exchange, annual registrations of new cars over the past three years have been significantly below the level reached in 1977 as shown in Table 4.1.

TABLE 4.1 : NEW CAR REGISTRATIONS - NIGERIA

Year	Number	Year	Number
1971	8,548	1976	73,224
1972	24,374	1977	90,950
1973	27,794	1978	67,392
1974	40,830	1979	61,679
1975	71,049	1980	75,413

As can be seen from Table 4.2 the two local manufacturers, Peugeot and Volkswagen, have progressively increased their share of new car registrations. This, however, is not entirely a reflection of the development of local manufacturing activity since both these companies, in addition to their locally assembled cars, market units which are brought in, in completely built-up form. In Table 4.3 imports of cars by category are detailed. From this table it can be readily seen that import rose rapidly in the early 1970's peaking at 76,756 units in 1975. Since then there has been a progressive decline, in part as a reflection of tighter foreign exchange controls in recent years resulting from government monetary policy.

In spite of the rapid growth in demand for motor vehicles during the past few years, Nigeria still remains relatively under-developed in terms of the total number of vehicles in use. Precise data on the growth of the passenger car parks is not available but we have made estimates based on available data and these are contained in Table 4.4 based on the scrappage rates shown in Table 4.5.

Comparison of the present level of ownership with that found in other countries is shown in Table 4.6 and from this the position of Nigeria on a world scale can readily be seen. Indeed, the data contained in this table has been plotted in Figure 4.1 and from this the relationship established as part of our technique for forecasting future demand for passenger cars within the country.

TABLE 4.2 : NEW CAR REGISTRATIONS BY LEADING COMPANIES - NIGERIA

Year	Peugeot	Volkswagen	Datsun	Others
1976	24,423	17,224	10,575	21,002
1977	37,193	24,307	10,768	18,682
1978	24,961	25,457	7,036	9,938
1979	34,931	19,143	3,244	4,361
1980	47,140	22,861	-	5,412

TABLE 4.3 : IMPORTS OF PASSENGER CARS - NIGERIA

Type	Year									
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Less 1200cc	1,007	5,069	15,921	15,130	20,080	24,750	26,562	14,955	7,605	3,867
1200cc-1750cc	3,018	7,516	18,261	17,687	24,350	30,498	26,041	25,580	26,674	17,394
1750-2750	1,090	2,349	3,799	4,747	9,430	21,164	21,435	28,375	15,703	3,991
2750-3500	100	89	100	52	80	142	82	455	102	221
3500cc plus	31	27	12	117	140	212	236	99	27	217
Total	5,246	15,050	38,093	37,733	54,080	76,756	74,329	69,414	50,111	25,690

Source: Nigerian Trade Summaries (Ref. 2)

TABLE 4.4 : PASSENGER CAR PARK - NIGERIA

Year	Total Passenger Car Park
1965	20,000*
1970	35,000
1971	43,212
1972	67,091
1973	94,150
1974	133,899
1975	203,353
1976	274,241
1977	361,882
1978	424,683
1979	480,208
1980	547,508

* Base estimate

TABLE 4.5 : SCRAPPAGE RATES PASSENGER CAR PARK - NIGERIA

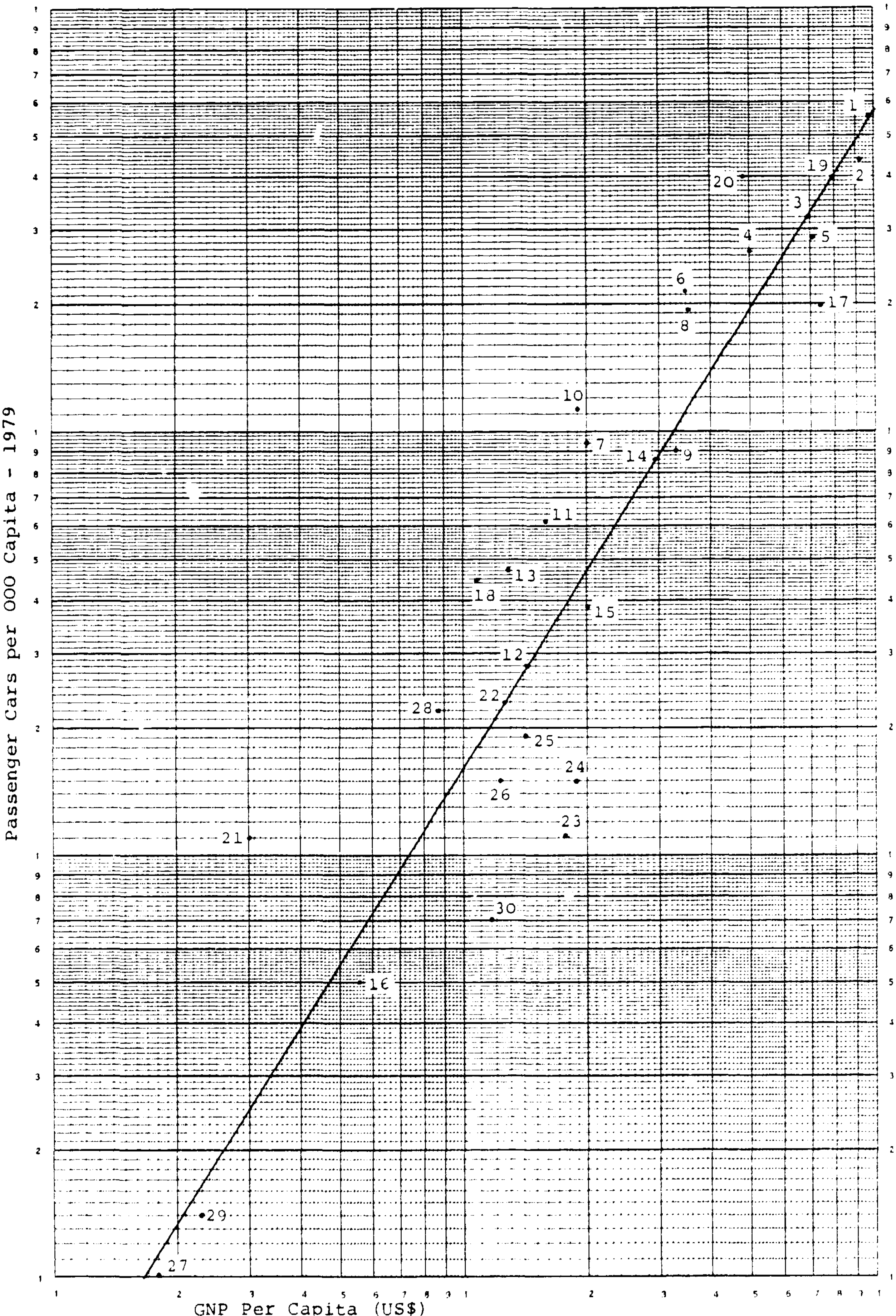
YEAR	DEMAND	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1965	20000*	40	48	93	78	100	126	160	202	254	316	388	480	566	688	806	924	1038	1134	1216
1966	3500		5	13	18	25	35	48	65	87	115	149	186	224	259	285	296	285	259	259
1967	4000			6	15	21	29	32	55	74	100	131	169	212	256	296	326	339	326	296
1968	4500				6	17	32	25	45	62	83	112	148	190	238	288	332	366	381	366
1969	4800					7	18	19	35	48	66	89	120	157	203	254	307	355	391	407
1970	5200						7	12	27	37	52	71	96	129	171	220	276	333	384	423
1971	8548								32	44	62	85	117	158	213	280	362	453	547	632
1972	24374								34	90	127	175	243	334	451	607	799	1031	1292	1560
1973	27794									39	103	145	200	278	381	514	692	912	1176	1473
1974	40830										57	151	212	294	408	559	755	1017	1339	1727
1975	71049											99	263	369	512	710	973	1314	1747	2330
1976	73224												102	271	381	527	732	1003	1355	1823
1977	90950													127	336	473	655	909	1246	1682
1978	67392														94	249	350	485	674	923
1979	61679															86	228	321	444	617
1980	75413																106	279	392	543

TABLE 4.6 : PASSENGER CARS - VEHICLES IN USE, GNP AND OWNERSHIP

Country	Nos	Vehicles in Use (Cars) - 1979	Population (000) (Mid-yr est. 1978)	Passenger cars per 000 Capita	GNP Per Capita 1978 (p)
USA	1	120,485,000	218,373	552	9,700
Canada	2	10,300,000	23,568	437	9,170
EEC	3	82,729,599	259,629	319	6,930
United Kingdom	4	14,926,571	55,918	267	5,030
Austria	5	2,138,678	7,498	285	7,030
Ireland	6	682,958	3,234	211	3,470
Portugal	7	912,000	9,653	94	2,020
Spain	8	7,057,521	36,655	193	3,520
Greece	9	839,341	9,325	90	3,270
Argentina	10	2,950,000	26,371	112	1,910
Brazil	11	7,250,000	119,430	61	1,570
Chile	12	300,000	10,734	28	1,410
Mexico	13	3,080,000	65,470	47	1,290
Venezuela	14	1,200,000	13,965	86	2,910
Iran	15	1,400,000	35,849	39	n.a.
Nigeria	16	400,000	81,039	5	560
Japan	17	22,667,297	114,053	199	7,330
Malaysia	18	600,000	13,300	45	1,090
Australia	19	5,657,200	14,366	394	7,920
New Zealand	20	1,274,150	3,187	400	4,490
Angola	21	75,000	6,739	11	300
Algeria	22	400,000	17,701	23	1,260
Romania	23	235,000	21,853	11	1,750
Iraq	24	180,000	12,216	15	1,860
Taiwan	25	325,000	17,139	19	1,400
Turkey	26	658,667	42,925	15	1,210
India	27	577,343	643,896	1	180
Colombia	28	551,711	25,136	22	870
Pakistan	29	347,201	77,337	4	230
Republic of Korea	30	241,422	36,616	7	1,160

Source: SMMT/World Bank
(Refs. 8 & 9)

FIGURE 4.1 : PASSENGER CARS IN USE v GNP (PER CAPITA)



Source: SMMT/World Bank (Refs 8 & 9)

TABLE 4.7 : IMPORTS OF COMMERCIAL VEHICLES

Year	Dual Purpose	Buses	Trucks and Lorries		Special	Total
			3 Tons	3 Tons		
1970	2242	635	5158	3645	13622	25302
1971	3247	1047	5040	6126	4090	19550
1972	3726	1291	3485	3877	2387	14766
1973	6839	113	5175	5137	3126	20390
1974	10200	2300	6000	7500	4300	30300
1975	19179	4308	7265	11019	6069	47840
1986	28587	8977	10643	25182	10304	83693
1977	30967	11645	6928	33375	13433	96348
1978	10170	12496	10497	20086	6095	59344
1979	-	-	8534	9302	1009	-
1980	-	-	-	-	-	-

Source: Nigerian Trade Summaries (Ref. 2)

TABLE 4.8 : LOCAL PRODUCTION OF LIGHT COMMERCIAL VEHICLES (UPTO 2 TON)

Company	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Federated Motors	2400	2400	2400	2400	2400	6000	6000	6000	6000	6000
SCOA	-	-	6000	6000	7000	10000	13000	13000	13000	13000
Leyland	-	-	300	1000	3300	3900	4900	4900	4900	4900
VW	-	-	-	-	-	-	1500	1500	1500	1500
Total	2400	2400	8400	9400	12700	19900	25400	25400	25400	25400

TABLE 4.9 : LOCAL PRODUCTION OF COMMERCIAL VEHICLES (OVER 2 TON)

Company	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Federated Motors	9480	9480	9480	9480	9480	6000	6000	6000	6000	6000
Leyland	-	-	400	800	2485	3250	3400	3400	3400	3400
National Trucks	-	-	-	400	3000	4000	5000	5000	5000	5000
Steyr	-	-	-	3000	4000	4400	4840	5324	5856	6440
Mercedes	-	-	-	2000	6000	6000	6000	6000	6000	6000
Total	9480	9480	9880	15680	24965	23650	25240	25724	26256	26840

TABLE 4.10 : COMMERCIAL VEHICLE REGISTRATIONS, 1977-1980, NIGERIA

Group	Year	Jan-Mar 1st	Apr-June 2nd	Jly-Sept 3rd	Oct/Dec 4th	12 Months Total	% of Commercial Vehicle Total
4 x 4 (0-2 tons)	1977	1,606	1,416	1,569	1,792	6,383	6.9
	1978	2,035	875	842	1,229	4,981	6.2
	1979	901	1,292	752	380	3,325	5.5
	1980	674	956	1,811	1,520	4,961	5.2
Other (0.2 tons)	1977	13,279	10,411	13,216	11,415	48,321	51.9
	1978	14,888	10,126	7,039	8,401	40,454	50.3
	1979	8,702	7,232	5,735	5,357	27,026	44.8
	1980	7,850	6,647	9,066	10,153	33,716	35.3
2-5 tons	1977	2,384	3,135	3,701	2,137	11,357	12.2
	1978	2,511	2,758	2,080	1,297	8,646	10.8
	1979	1,023	657	1,002	991	3,673	6.1
	1980	902	864	808	1,302	3,876	4.1
5-10 tons	1977	4,329	3,577	3,364	2,845	14,115	15.2
	1978	4,283	2,765	1,963	1,707	10,718	13.3
	1979	1,325	1,068	1,014	1,765	5,172	8.6
	1980	1,889	1,242	1,589	1,244	5,964	6.2
Over 10 Tons	1977	861	649	304	386	2,200	2.4
	1978	629	385	110	220	1,344	1.7
	1979	191	343	245	348	1,127	1.9
	1980	188	208	244	176	816	0.9
Artic	1977	949	1,034	1,091	653	3,727	4.0
	1978	1,180	1,081	1,108	884	4,253	5.3
	1979	579	283	585	693	2,140	3.5
	1980	677	837	711	825	3,050	3.2
Bus 0-20 Seats	1977	485	1,032	1,475	1,774	4,766	5.1
	1978	1,073	1,669	2,114	3,131	7,987	9.9
	1979	4,685	2,794	3,655	5,070	16,204	26.9
	1980	9,813	7,768	10,652	12,798	41,031	43.0
Other Bus	1977	736	429	350	658	2,173	2.3
	1978	656	447	371	512	1,986	2.5
	1979	414	449	391	367	1,621	2.7
	1980	484	418	584	543	2,029	2.1
Total	1977	24,529	21,683	25,124	21,660	93,096	
	1978	27,255	20,106	15,6[illegible]7	17,381	80,369	
	1979	17,820	14,118	12,279	14,971	60,288	
	1980	22,477	18,940	25,465	28,561	95,443	
Percent of Year Total	1977	26.5	23.3	27.0	23.3		
	1978	33.9	25.0	19.4	21.6		
	1979	29.6	23.4	22.2	24.8		
	1980	23.6	19.8	26.7	29.9		

Source: Association of Motor Traders

- Commercial Vehicles

Turning to commercial vehicles, the imports of commercial vehicles have been summarised in Table 4.7 whilst local production of light commercial vehicles is shown in Table 4.8 and for heavy commercial vehicles in Table 4.9 Based on the above data, coupled with data on registration contained in Table 4.10, estimated scrappage rates and estimates of the total commercial vehicle park in the mid-1960's, the present commercial vehicle park and its growth has been calculated and this is shown in Table 4.11. For completeness scrappage rates and estimates of the number of commercial vehicles scrapped is contained in Table 4.12.

To develop estimates of scrappage rates for commercial vehicles is much more complex than is the case for passenger cars. This situation results in part from the changing mix of vehicle type (particularly between light commercial and heavy commercial vehicles) and because in different countries vehicles are subjected to different conditions viz-a-viz roads etc. As can be seen from Figure 4.2 commercial vehicle scrappage rates relative to the overall growth in the commercial vehicle vary quite widely from one country to another. For Nigeria we have assumed a scrappage rate of some 4% of the park in the above mentioned calculations and, as can be seen from this diagram, this corresponds quite well with the scrappage rates which would be expected. This level of scrappage has been assumed constant for the period under consideration.

- Forecasts

Turning to the future, market forecasts for the various types/categories of commercial vehicle have been prepared in collaboration with companies in the industry in Nigeria. These forecasts have been summarised in Table 4.13. For ease of calculation we have assumed that by 1986 the total demand for commercial vehicles is not from locally assembled or locally manufactured units. We acknowledge that a small number of "special" commercial vehicles will continue to be imported but, against this, by 1986 the vehicle industry in Nigeria could have begun to export small quantities of product, in particular to neighbouring countries.

As far as local production of passenger cars is concerned, the two Nigerian manufacturers have detailed production plans through to 1986 and these are shown in Table 4.14.

TABLE 4.11 : COMMERCIAL VEHICLE PARK

Year	Total Commercial Vehicle Park
1970	80,000
1971	96,350
1972	112,889
1973	135,203
1974	177,635
1975	218,370
1976	293,328
1977	374,691
1978	440,072
1979	482,757
1980	558,890

TABLE 4.12 : COMMERCIAL VEHICLE SCRAPPAGE RATES - NIGERIA

Year	Scrappage
1971	3,200
1972	3,854
1973	4,516
1974	5,408
1975	7,105
1976	8,735
1977	11,733
1978	14,988
1979	17,603
1980	19,310

FIGURE 4.2 : COMMERCIAL VEHICLE SCRAPPAGE RELATIVE TO GROWTH IN PARK

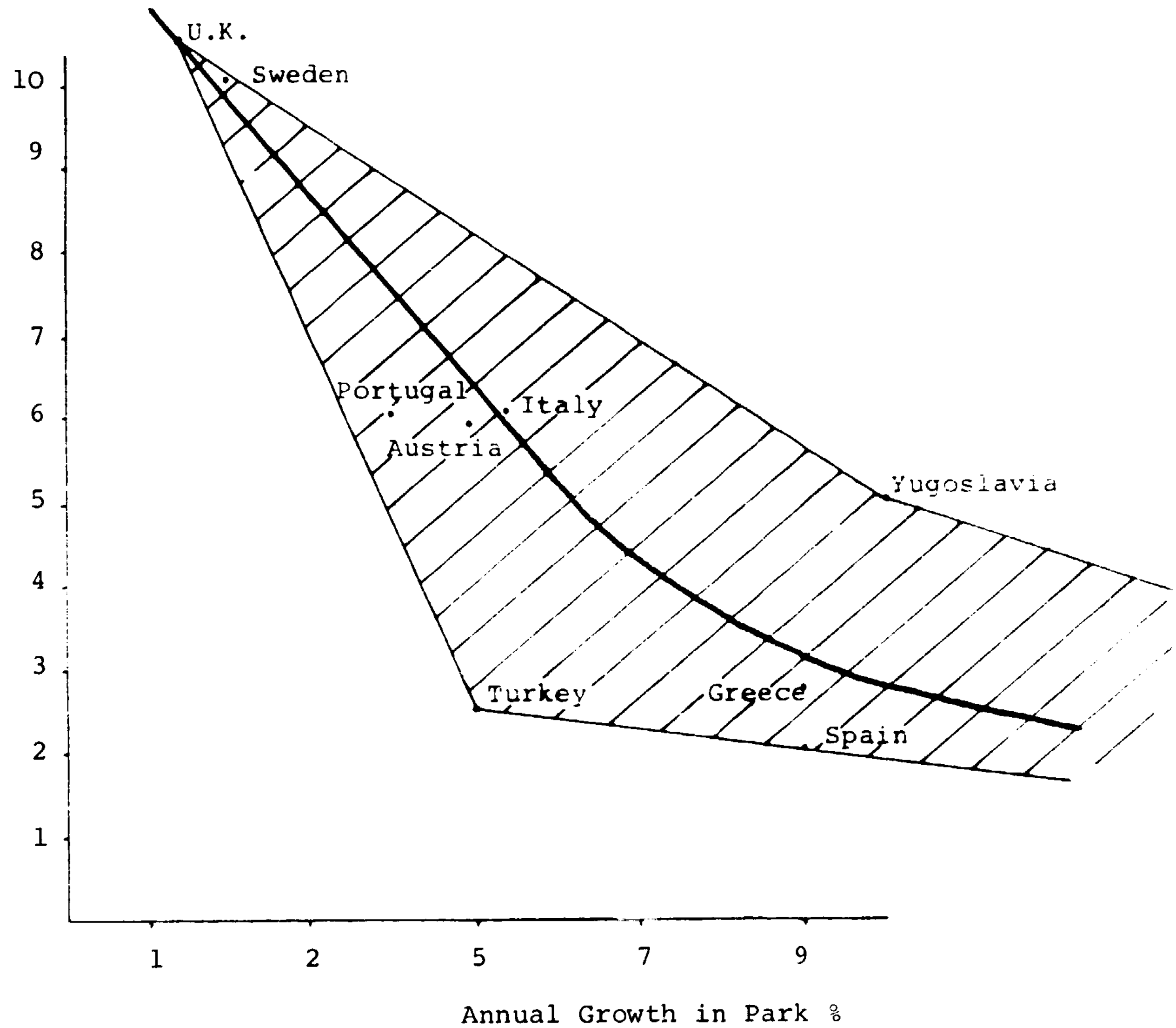


TABLE 4.13 : COMMERCIAL VEHICLE MARKET FORECASTS

Type	Annual Growth Rate %	1981	1982	1983	1984	1985	1986
0-2 Ton 4 x 4	4	5,870	6,100	6,350	6,600	6,860	6,950
0-2 Ton 4 x 4	8	40,608	43,857	47,365	51,154	55,247	60,000
2-5 Ton	7	5,992	6,411	6,860	7,340	7,854	8,100
5-10 Ton	10	8,800	9,680	10,648	11,713	12,884	14,000
10 Ton +	8	1,188	1,283	1,386	1,497	1,616	1,800
Artic	10	3,212	3,533	3,887	4,275	4,702	5,000
0-20 Seats	8	42,900	46,300	50,000	54,000	58,000	62,000
Over 20 Seats	9.5	2,847	3,117	3,414	3,738	4,093	4,300
TOTAL		111,417	120,281	129,910	140,317	151,256	162,150

TABLE 4.14 : PLANNED PASSENGER CAR PRODUCTION BY PEUGEOT NIGERIA AND VOLKSWAGEN NIGERIA

Company	Annual Production (Units)					
	1981	1982	1983	1984	1985	1986
Peugeot Nigeria	55,000	56,000	55,000	55,000	55,000	56,000
Volkswagen	26,500	26,500	32,000	33,000	35,000	35,000
Total	81,500	81,500	87,000	88,000	90,000	91,000

In addition Leyland Nigeria plan to produce 2,500 Range Rovers per year from 1981 onwards.

Total demand for passenger cars will, however, be significantly above the level of local production although the extent to which the government allocates foreign exchange for passenger car imports (and funds to the car loan scheme), is extremely difficult to establish.

Based on an overall growth in demand for passenger cars of 15% per annum from 1980 onwards, the following annual imports will be required:

Year	Units
1981	5,000
1982	18,200
1983	27,700
1984	42,900
1985	61,700
1986	83,500

Whilst the level of passenger car imports is somewhat academic insofar as this project is concerned (since they will not lead to any demand for copper or copper alloys in the shorter term future) the above figures do serve to demonstrate the potential for further development of this sector in Nigeria. Such development could take place by permitting a third company to commence operations in this sector in Nigeria or probably more beneficial in the longer term by expanding the existing local manufacturing facilities.

In developing the forecasts for consumption of copper and copper alloy products in this sector we are concerned only with locally manufactured items and in this sector, where gestation periods are quite long, we must therefore restrict ourselves to those activities already planned or in existence.

- Copper Consumption

Within motor vehicles there are a number of components which contain copper and/or copper alloy semi-finished products. In the following paragraph each of these is dealt with individually.

- Radiators

The total number of radiators required is largely a function of the number of vehicles produced, although account must be taken on the one hand of replacement demand and, occasionally, of vehicles which have air-cooled engines. Indeed, the latter is significant in Nigeria, where the Volkwagen "Beetle" is produced.

At the present time, there is one company manufacturing radiators in Nigeria. This company, which is a joint venture involving the French company Chausson of France, has been established to serve the requirements of Peugeot Nigeria and to produce replacement radiators for Peugeot cars. The existing facility of this company (Radiators Nigeria Ltd) gives it a total production capacity of some 70,000 units per year with annual output expected to be around 65,000 units each year. At the present time, this company does not have any plans to manufacture radiators for other vehicles, although it could quickly increase for example, if a significant volume of light commercial vehicle radiators were required, it could quickly increase its production capacity to meet this demand. We have, therefore, assumed that by 1986 this company, or a second company coming into this sector, would be able to meet the total requirement for light commercial vehicle radiators and passenger car radiators for both original equipment and replacement demand. We have assumed that by 1986 some

50% of the total production of Volkswagen will be units with water-cooled engines while the balance will be air-cooled. Likewise, we have assumed that the share of light commercial vehicles (up to two tons) with air-cooled engines will be no greater than 10% of the total new units produced.

As far as other vehicles are concerned, we have assumed that all will have water-cooled engines. Again, we have assumed that radiators could be made in Nigeria by 1986 either by the existing manufacturing company or by a new company entering this sector, and on this basis and the average weights of copper and copper alloy products in the various types of radiator as shown in Table 4.15, estimates of demand for copper and copper alloy products in this sub-sector have been calculated and are shown in Table 4.16. Making normal allowances for scrappage, the total quantities of copper and copper alloys which must be processed is as shown in Table 4.17, which also identifies the potential copper consumption within this sector.

- Electrical Equipment

Apart from the wiring harness, manufacture of electrical equipment for motor vehicles has as yet not started in Nigeria. One company, however, Magnetti-Morelli, along with local partners, plan to be in production with a range of electrical equipment by 1983-84. This company plan to manufacture:

Starter Motors
Alternators
Ignition Coil
Wiper Motors
Voltage Regulators

The company have targetted the full range of Nigerian assembled cars and commercial vehicles (including agricultural tractors) as their market with an additional 10-12% per annum going to the replacement market. The company is linked with Fiat and plans to commence its operation manufacturing the above mentioned components for Fiat trucks and tractors assembled in the National Truck Manufacturing Company at Kano.

At the present time, one company, Nocaco, is supplying a small number of wiring harnesses to Peugeot, but by 1986 it would appear reasonable that this company and/or similar companies will be supplying the major portion of

TABLE 4.15 : AVERAGE WEIGHTS OF COPPER AND COPPER ALLOYS IN RADIATORS

Vehicle	Brass Strip kg	Brass Tube kg	Copper Strip kg	Total Weight kg
Peugeot	1.54	1.17	-	2.71
Vannettes	1.91	1.43	-	3.34
Trucks : 3 - 5 tons	4.90	3.68	-	8.68
5 -10 tons	4.08	3.05	3.05	10.18
10 -15 tons	4.40	3.20	3.30	11.00
15 -20 tons	5.37	4.01	3.91	13.29
Over 20 tons	7.67	5.97	5.93	19.57
Buses	7.07	5.05	5.00	17.12
Minibuses	4.90	3.60	3.50	12.00

TABLE 4.16 : CONSUMPTION OF COPPER AND COPPER ALLOYS IN VEHICLE RADIATORS - NIGERIA 1986

Vehicle Type	Number	Brass Strip (tons)	Brass Tube (tons)	Copper Strip (tons)	Total (tons)
Peugeot Car	66,000	101.6	77.2	-	178.8
Other Cars	20,000	30.8	23.4	-	54.2
Vanettes	70,000	133.7	100.1	-	233.8
Trucks : 2 - 5 tons	8,100	39.7	29.8	-	69.5
5 -10 tons	14,000	57.1	42.7	42.7	142.5
10 -15 tons	6,800	36.5	27.2	26.5	90.3
Minibuses	62,000	303.8	223.2	217.0	744.0
Buses	4,300	30.4	21.7	21.5	73.6
Total		733.6	545.3	307.7	1586.7

TABLE 4.17 : CONSUMPTION OF SEMIS, SCRAP GENERATED AND METAL USED-VEHICLE RADIATORS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip	362	15	54	308	100	308
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip	863	15	129	734	70	514
Alloy Tube	605	10	60	545	70	382
Castings						
Total						1204

TABLE 4.18 : USE OF COPPER AND COPPER ALLOY PRODUCTS - MOTOR VEHICLE ELECTRICAL EQUIPMENT

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Wiring Harness												
Car & light commercial	940	141										
Heavy commercial vehicles & Buses	2000	60										
Terminals												
Car & light commercial vehicles	80				12							
Heavy commercial vehicles	300				1							
Starter Motor												
Car & light commercial	94			2	12		10		2			
Heavy commercial vehicles & Buses	220			1	6		25		1			
Ignitition Coil												
Car & light commercial	123		18									
Heavy commercial vehicles & Buses	200		6									
Alternator												
Car & light commercial	350		53									

ASSUMPTIONS:
90,000 passenger cars; 60,000 light commercial vehicles; 30,000 heavy commercial vehicles and buses.

TABLE 4.19 : CONSUMPTION OF SEMIS, SCRAP GENERATED AND METAL USED - MOTOR VEHICLE ELECTRICAL EQUIPMENT 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire	223.3	10	22.3	201	100	201
Winding Wire	85.6	10	8.6	77	100	77
Copper Rod	3.3	10	0.3	3	100	3
Copper Strip	34.4	10	3.4	31	100	31
Copper Tube						
Alloy Wire						
Alloy Rod	4.3	20	1.3	3	70	2
Alloy Strip						
Alloy Tube						
Castings						
Total						314

demand for wiring harnesses within Nigeria. For the purpose of this exercise we have assumed that all wiring harnesses will be locally sourced by 1986, as far as locally assembled vehicles are concerned.

Likewise, we have assumed that the terminal for the wiring harnesses will also be made locally, either by the wiring harness manufacturers themselves or by companies specialising in small electrical fittings and connectors.

Based on the assumption that all wiring harnesses for vehicles assembled in Nigeria in 1986 are produced locally, and/or alternator, starter motor and ignition coils for passenger cars and light commercial vehicles are also locally fabricated, along with 30% of requirements for buses and heavy commercial vehicles, the total requirement for copper and copper alloys in vehicle electrical products will be as shown in Tables 4.18 and 4.19.

- Motor Vehicle Carburettors

These components are, of course, used only in petrol engined vehicles as those (commercial) vehicles fitted with diesel engines employ fuel injection systems.

At the present time it is not known whether or not these components will be manufactured in Nigeria prior to the late 1980's. Should local manufacture commence, the requirement for copper and copper alloy semi-finished products per carburettor will be as shown in Table 4.20.

TABLE 4.20 : USE OF COPPER AND COPPER ALLOYS CARBURETTORS

Item	Type of Semi	Weight g
Float toggle and butterfly	Brass strip	57
Top spindle Jets Needle valve Butterfly spindle	Brass rod	130
Baskets and washers	Copper strip	10
Total		197

Scrap ratios tend to be high at 40%, for the machining of the jets, spindles etc., and 30% for other components which are pressed from strip. In total, local production would generate a demand for some 30 tons of semi-finished products in 1986. This requirement has not been included in the overall totals as no definite plans for local manufacture are known.

- Gearboxes

Most cars are equipped with a four speed gearbox containing three selector forks and four synchro-cones. The size and hence the weight, of these components is dependent upon the engine capacity (or power and torque produced) in the vehicle. In fact, the average weight of vehicle selector forks varies between 340g and 2kg for a vehicle of over 10 tons gross weight. In addition, many of the larger vehicles have gearboxes with perhaps six forward and two reverse gears. On the other hand, there is a trend towards the reduction of the copper alloy content through improved design, increased alloy strengths and perhaps most important, substitution. As no plans exist for local manufacture of gear boxes, for commercial vehicles or passenger cars, we have ignored this item in our forecasts of demand for copper and copper alloy products.

- Thermostat

Although no plans have been uncovered for the production of vehicle thermostats in the near future, it is felt that this component could well be manufactured locally by 1986. Should this be the case, it seems probable that a major portion of the total requirement could be met for local sources.

Vehicle thermostats are manufactured entirely from brass strip. Allowing for the larger sizes required for commercial vehicles the average weight of a thermostat is 110g with an average copper content of 77g. Scrap ratio in the manufacture of thermostats is generally estimated at 30%. Assuming that thermostat manufacture in Nigeria meets the requirements of passenger cars and light commercial vehicles locally assembled, there will be a total consumption of brass strip of 10.5 tons in original equipment manufacture. The consumption involved is summarised in Table 4.21.

TABLE 4.21 : COPPER CONSUMPTION IN THERMOSTAT MANUFACTURE - 1986

Component	Brass Strip	Scrap		Metal Used	Copper Content	
	Tons	%	Tons	Tons	%	Tons
Body pressing	15.0	30	4.5	10.5	70	7.4
Total						7.4

- Fuel Pumps

As is the case with thermostats, no concrete plans are known for the manufacture of fuel pumps in Nigeria. Whilst it appears feasible to assume that by 1986 mechanical fuel pumps could be manufactured locally, in the absence of more concrete plans we have decided to exclude this item from our forecasts for copper and copper alloy product demand.

- Other Vehicle Components

In addition to the components dealt with separately in the preceding pages, the manufacture of motor vehicles involves various other copper or copper alloy containing components. Table 4.22 indicates the average weight of the more important of these components. Amongst these, it is unlikely that either instruments or sintered bronze bearings will be produced locally before 1986. Manufacture of all other components theoretically should be possible without undue problems. All are therfore candidates for the Nigerian industry by that date, but we have excluded all from our forecasts of copper demand. It is worthy of note that, amongst these components, substitution is likely to have its effect in Nigeria as elsewhere. In particular, the use of copper in gaskets is expected to disappear from new models. Similarly, copper tube is being replaced by "Bundy" tubing in most applications. Brake and clutch rivets are, of course, rendered obsolete by the advent of bonded components. In the case of both drain plugs and drain cocks, the loss is one of direct substitution, steel being used for a number of these components.

TABLE 4.22 : AVERAGE COPPER CONSUMPTION PER VEHICLE - OTHER COMPONENTS

Item	Copper (g)				Copper Alloy (g)				
	Wire	Strip	Rod	Tube	Wire	Strip	Rod	Tube	Powder
Tyre Valves	-	-	-	-	480	40	130	-	-
Sintered Bronze Bearings	-	-	-	-	-	-	-	-	850
Gaskets and Seals	-	830	-	-	-	-	-	-	-
Instruments	-	-	-	-	-	110	-	-	-
Instrument and other tube	-	-	-	20	-	-	-	-	-
Brake and Clutch Rivets	-	-	-	-	320	-	-	-	-
Drain Plugs, Banjos and nuts	-	-	-	-	-	-	640	-	-
Drain Cocks	-	-	-	-	-	-	400	-	-
Miscellaneous	-	-	-	-	-	-	125	-	-
Total	-	830	-	20	800	150	1295	-	850

Note: These items are not necessarily present in every vehicle but represent the average for a total motor vehicle industry.

- Other Road Transport Equipment

Under this heading the main items are motorcycles and bicycles. The market for motorcycles has grown rapidly since 1978 and recently the government have insisted on companies establishing local manufacturing facilities. To date, three companies manufacturing motorcycles have been established along with a fourth company which assembles the Vespa motor-scooter. A fifth company is presently exploring the possibility of local manufacture of motorcycles. The market for motorcycles in Nigeria is dominated by the Japanese companies, with Suzuki commanding some 39%, Honda some 28%, Yamaha 27? and Kawazaki 6%. The total market in 1980 stood at some 250,000 units. The three leading names in this market, namely Yamaha, Honda and Suzuki, are now all tied in to local assembly activities. Yamaha are assembled by Yamoco, a division of John Holt, Honda are assembled by Honda Manufacturing and Suzuki by Boulos Enterprises. Each of these companies has installed a capacity to assemble around 100,000 units per year and most will achieve this level by around 1984, based on existing plants.

Whilst it is known that the government would like to see vertical integration in to component manufacture in this sector, most companies feel that local manufacture of engines and other components is unlikely to happen before the late 1980's or early 1990's. Thus, whilst there are several components in which copper and copper alloy products are used beyond wiring and a few other simple components (connectors for lamps etc.,) it appears unlikely that any significant copper consumption will be generated from the local manufacture of components for the motorcycle and motor-scooter sector.

Likewise, the manufacture of bicycles in Nigeria is being developed, but again the product contained few copper containing components, and these are unlikely to be locally produced in the foreseeable future.

4.2 Railways

The extent of the Nigerian Railway Corporation intermediate gauge system has been expanded considerably since its inception, as a means of transporting export commodities from the north of the country to the port. Today, however, the efficiency of the railway remains relatively poor, although it has been improved as a result of the contract awarded to Rail India Technical and Economic Services who took over management and training for the railway authority in 1978.

The Fourth National Development Plan calls for a massive rehabilitation programme with an investment of ₦1500 million in the system over the planned area. Development of the railway is regarded as a high priority project, as several of the major government investments, such as the steel complex and others, depend on the successful development of the rail system for their own success and operation. A total of ₦300 million has been allocated to acquire additional locomotives and rolling stock and to upgrade the existing telecommunications system and track. The major project under the plan, however, is construction of a new standard gauge line from Port Harcourt to Ajaokuta along with the 300km double track section between Port Harcourt and Oturkpo. The total investment in this project is ₦1.2 billion.

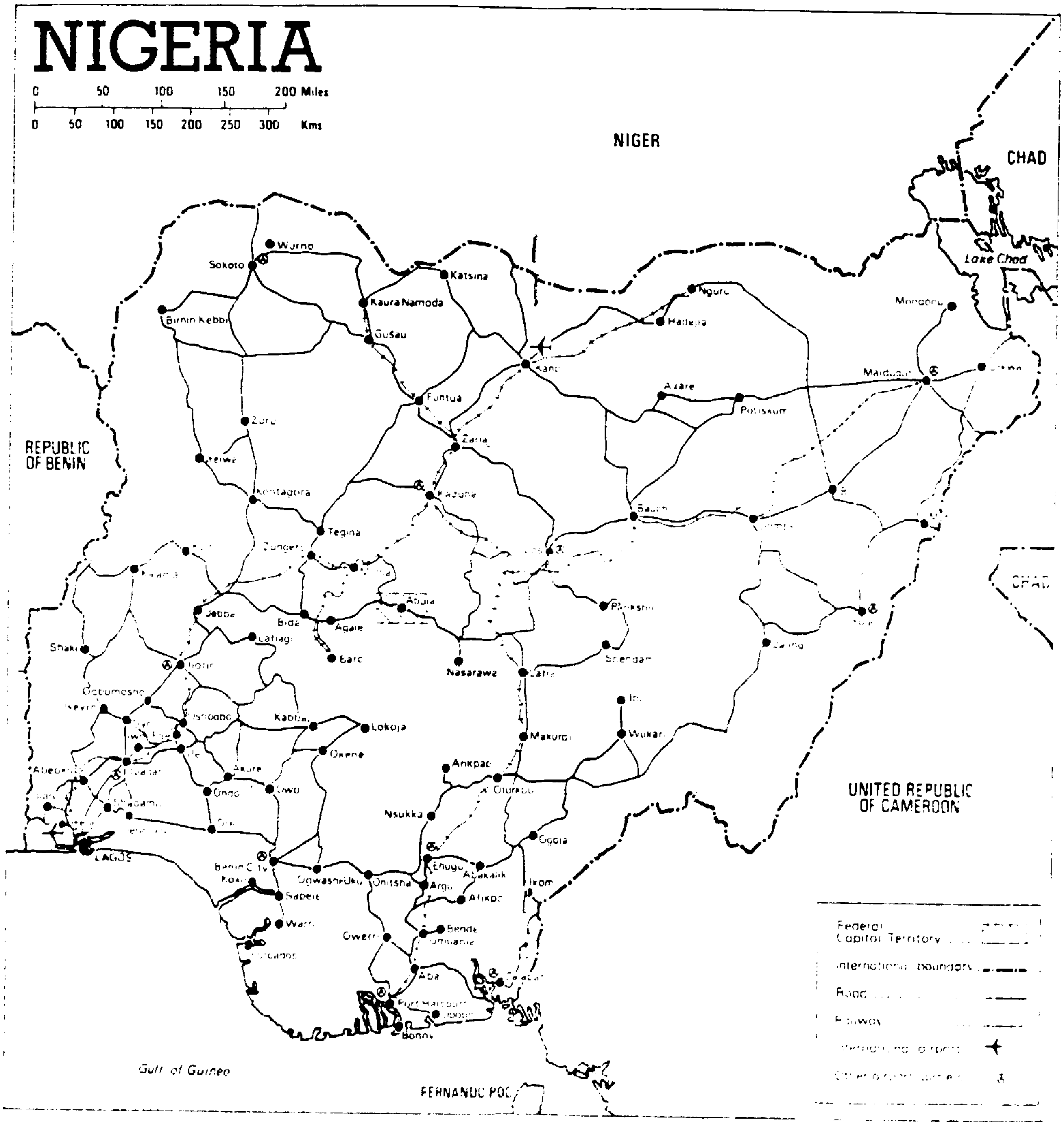
In the longer term, the Nigerian Railways Corporation intend to convert all their track to standard gauge beginning this programme in the eastern region of the country. The present railway system within the country is shown in a Figure 4.3.

As far as copper consumption is concerned, since none of the lines are to be electrified, the most significant usage of copper in this sector need not be considered in Nigeria. Thus it is telecommunications and signalling equipment (mainly cable) which will be the most significant area in terms of copper consumption, as there are no plans for the manufacture of rolling stock in the forseeable future.

Some consumption of copper and copper alloy products will arise for maintenance purposes, with the main item being thick copper wire (sometimes referred to as rod or bar) for armature winding in the traction motor. Present consumption within the railways company for this purpose is, however, relatively low, even assuming a greatly expanded fleet of locomotives annual consumptions in excess of 20 tons per year are not anticipated. Thus, it is in the area of signalling equipment that the greatest potential exists.

The use of copper and copper alloy products in signalling equipment is a function of the basic system which is used. Plans in Nigeria are that the new signalling equipment and telecommunications equipment for the railway company will rely heavily on a microwave system, and, as such, annual consumption of copper and copper alloy products will be extremely small. We have, in the course of this survey, been unable to obtain precise data on the plans of the railway authority to implement their expansion programs, particularly as it appertains to signalling. In the absence of more comprehensive data we have estimated an annual

FIGURE 4.3 : NIGERIAN RAILWAY SYSTEM



Source: NRC

requirement for some 50 tons of copper in the form of signalling wire and cable from this sector in 1986.

4.3 Marine Engineering

Whilst the marine engineering sector is an important user of copper and copper alloy in developed countries, in Nigeria it would appear that, within the foreseeable future, this industry will account for only minimal quantities of copper and copper alloy products. Construction of new vessels is limited at the present time, and is likely to remain so until beyond the mid-1980's, to small craft and in this case all engines and other marine hardware is imported in finished or completely built-up form. Thus consumption from this sector for copper and copper alloy products will be restricted to small quantities for maintenance purposes and, as such, we consider the quantities so small as to be insignificant in the context of this project.

TABLE 4.23 : SUMMARY OF DEMAND FOR COPPER AND COPPER ALLOY SEMIS IN NIGERIAN MANUFACTURES - TRANSPORT SECTOR 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Radiators					362					863	605	
Electrical Equipment		223	85	3	34				4			
Thermostat										15		
Railways		50										
TOTAL		273	85	3	396				4	878	605	

5. GENERAL ENGINEERING INDUSTRY

The General Engineering Industry is very fragmented and it is impossible to identify and quantify all the potential applications of copper and copper alloys. However an initial estimate of the sector's importance will put the matter in perspective. In Europe the consumption of copper as copper or alloy in general engineering is about 16% of total copper consumption, most individual countries falling in the bracket 14-18%. The proportion in Nigeria is likely to be considerably lower since most general engineering products are imported and it will be many years before the engineering industry is sufficiently developed to make a full range of products. Table 5.1 sets out the use of copper in different applications in the engineering industry in the UK as a percentage of the sector total and as a percentage of total copper consumption. It should be noted that the unidentified applications represent only 3.8% of total consumption.

During the course of the present study we have considered the following applications:

- Pumps
- Engineering Valves
- Screws and Fasteners
- Coinage
- Process Plant
- Brass Ware and Bronzes
- Gas Bottles
- Other items with negligible consumption

We were unable to obtain any data on defence industry requirements which may be significant users of brass sheet and strip. For example one round of rifle ammunition for each member of the armed forces would consume about 10 tons of brass and 1,000 75mm shell cases about two tons of brass.

Basic data on a number of the other sectors was unobtainable because of the fragmented nature of the end uses and because data on imports was not available in sufficient detail to separate out the required products. Engineering valves and screws and fasteners particularly fell into this category. However, based on the data in Table 5.1 the combined total of these would not account

TABLE 5.1 : COPPER AND COPPER ALLOY CONSUMPTION IN THE UK GENERAL ENGINEERING INDUSTRY

Application	% of Sector Total	% of Total Copper
Pumps	7.0	1.0
Valves	17.0	2.3
Fasteners	10.6	1.5
Bearings	3.8	0.5
Refrigeration and Air Conditioning	2.8	0.4
Machine Tools	0.7	0.1
Process Equipment	11.6	1.6
Coinage	10.7	1.5
Defence	8.6	1.2
Others	27.2	3.8
	100.2	13.9

Source: CIDEC
(Ref. 10)

for more than 6% of total copper consumption and in practice the total is likely to be much less. Where we have been unable to obtain any data on a particular application in Nigeria we have made estimates based on our experience in this industry in other developing countries.

For example we have observed several similarities between Nigeria and Iran. The development of the Iranian economy shows certain parallels to that of Nigeria. Both were originally based on subsistence agriculture but then development was accelerated with the addition of oil revenue to the economy. However developments in Iran occured about 11 years earlier than in Nigeria. Comparing the periods 1967-70 for Iran and 1978-81 for Nigeria the total GDP for Nigeria is approximately 2.8 times that for Iran but per capita GDP is very similar. The percentage of GDP derived from oil is also very similar. However the proportion of GDP from manufacturing is 40% higher for Iran and since this is the most important sector as far as engineering products are concerned we have taken this as the basis for the correlation. Iranian GDP for manufacturing in 1970 was $2.5bn while for Nigeria in 1981 the figure will be $5.0bn (both in 1977 dollars). We have therefore assumed, in the absence of other data, that consumption of copper in products in Nigeria in 1981 will be twice that in Iran in 1970. Even if this assumption were in error by as much as 50% it would lead to an overall error in copper consumption of less than 2% of the total. Some comparative data on the development of the two economies is shown in Table 5.2.

A similar comparison could be made between Brazil and Nigeria although in this case the "time gap" is even longer.

5.1 Pumps

Considerable numbers of pumps are used in Nigeria mainly for water supply and to a lesser extent in industry. There are no manufacturers of pumps at present and we did not identify any planned projects.

Table 5.3 shows the number of pumps imported and their unit weight and unit cost. Unfortunately there is no breakdown by type and size available. The increase in unit price is partly a consequence of inflation but, taken with the increase in unit weight, suggests an increase in the average size of units.

TABLE 5.2 : COMPARISON OF IRANIAN AND NIGERIAN ECONOMIES

Year	Nigeria Iran	1978 1967	1979 1968	1980 1969	1981 1970
Total GDP ($,bn)	Nigeria Iran	43.3 15.4	46.9 16.9	50.9 18.7	55.2 19.2
GDP Nigeria/GDP Iran		2.8	2.8	2.7	2.9
GDP from oil (%)	Nigeria Iran	16 21	21 20	27 21	27 23
GDP of manufacturing sector (%)	Nigeria Iran	7.4	7.9	8.5	9.1 13.0
Per capita GDP $	Nigeria Iran	538 578	568 621	601 670	635 685

Source: UN Statistics, (Ref. 6)
Nigerian 4th Development Plan (Refs 11 & 12)

The proportion of copper used in pumps depends very much on the application. Deep-well pumps, usually electrically driven, have a bronze body and impeller. These pumps are used in boreholes and can vary enormously in size. In view of the current emphasis on water supply in the remote areas of the country the demand for this type of pump will grow considerably particularly in the North. We estimate that the demand for deep-well pumps will average 150 units per state in 1981 and that the copper alloy content will be 50% of the total weight. Most of the other pumps which are mainly ferrous will have a much lower copper content - copper being used primarily in bushes and bearings and will average only 2% of the pump weight. We estimate that the consumption will increase at 10% pa. Table 5.4 gives the total copper consumption in pumps assuming mainly alloys containing 85% copper in deep-well pumps and 60% in other pumps.

TABLE 5.3 : IMPORTS OF PUMPS BY NUMBER AND VALUE (INCLUDING MOTORS)

Year	Number	Unit Weight kg	Unit Cost ₦
1976	109,921	62	170
1977	102,310	74	247
1978	115,323	97	327

Source: Nigerian Trade Summaries (Ref. 2)

TABLE 5.4 : COPPER ALLOY CONSUMPTION IN PUMPS (TONS)

Year	Deep-Well Pumps	Other Pumps	Total
1981	200	215	415
1982	270	238	458
1983	242	260	502
1984	266	286	552
1985	293	315	608
1986	322	346	668
1990	472	505	977

TABLE 5.5 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - PUMPS (1986)

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod						
Alloy Strip	48	30	13	35	60	21
Alloy Tube						
Castings	46	30	14	32	85	27
Total						48

Since there is as yet no pump manufacturing industry in Nigeria and no known plans for the immediate future we do not foresee more than 10% of pumps being manufactured by 1986. Estimated demand for semis in 1986 is given in Table 5.5.

5.2 Engineering Valves

There is currently no manufacture of engineering valves in Nigeria and there are no known plans to set-up manufacturing facilities. No import statistics or other data are available. Basing forecasts on the method described earlier we would expect demand in 1981 to be approximately 8,000 tons. The rate of growth is likely to be linked to that of the industrial sector and we would expect demand in 1986 to be 16,000 tons. Of this total only a small proportion will be non-ferrous valves and in view of the continuing substitution of non-ferrous valves by ferrous ones we would not expect the total to be above 8% giving 1,280 tons in 1986. The copper content of valves will average 75%. The consumption of copper in valves is given in Table 5.6.

TABLE 5.6 : COPPER CONTENT OF NON-FERROUS VALVES

Year	Tons Valves Non-Ferrous	Tons Copper
1981	640	480
1982	736	552
1983	846	635
1984	973	730
1985	1,119	839
1986	1,287	965
1990	2,251	1,688

We would not expect more than 10% of these valves to be manufactured in Nigeria by 1986. The semis requirements for this volume are given in Table 5.7.

TABLE 5.7 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - ENGINEERING VALVES (1986)

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Tons
Copper wire						
Winding wire						
Copper rod						
Copper strip						
Copper tube						
Alloy wire						
Brass rod	70	40	28	42	60	25
Bronze rod	1	15	-	1	90	1
Gun metal castings	100	25	25	75	85	64
Brass castings	23	25	6	17	60	10
Total						100

5.3 Screws and Fasteners

Again no import data is available on brass/copper screws, nuts, bolts etc. Basing our forecasts on estimates and data from other countries we calculate consumption of fasteners in 1981 will be 72 tons rising to 144 tons by 1986. The rate of growth assumed, 15%, is based on the planned growth rate for the construction industry and the industrial sector, which are the main consumers of the products. Forecasts of consumption are given in Table 5.8.

TABLE 5.8 : CONSUMPTION OF COPPER AND BRASS FASTENERS

Year	Tons
1981	144
1982	166
1983	190
1984	219
1985	252
1986	288
1990	507

Although there is no significant manufacture in Nigeria of these products at present, it is the type of industry which should be developed and we expect that 50% of these products will be manufactured in Nigeria by 1986. One company is already planning to manufacture copper rivets for brake shoes for which the demand is about 20 tons. Based on production ratios and norms prevaling in the UK in this sector, we have calculated the demand for semis and this is shown in Table 5.9.

TABLE 5.9 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - SCREWS AND FASTENERS (1986)

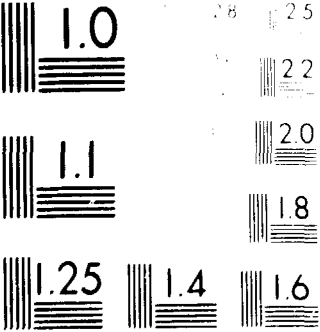
Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Tons
Copper wire	7	10	1	6	100	6
Winding wire						-
Copper rod						-
Copper strip	5	35	2	3	100	3
Copper tube						
Alloy wire	56	30	18	38	60	23
Alloy rod	79	15	12	67	60	40
Alloy strip	45	35	16	29	60	17
Alloy tube						
Castings						
Total						89

5.4 Coinage

The Security Printing and Minting Company in Lagos is responsible for the minting of coins in Nigeria. In the past they have bought in all coin blanks from the UK. There are one billion coins in circulation and they hold stocks of 13.6 million. There are not enough coins in circulation but the Central Bank do not seem anxious to order more.

The number of coins minted at present is 10 million 5 kobo coins and 40 million 10 kobo coins per year. They have not minted 1 kobo coin for some time. The rate of production is unlikely to increase as inflation will reduce the demand for small coins. Twenty-five kobo coins were issued but have proved unacceptable and it therefore seems unlikely that any new coins, either 50k or ₦1, will be introduced. The 10k coins each weigh 4g and 5k coins weigh 2.76g each. The "silver" coins all contain around 75% copper.

83.08.31


1.0
2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

If alloy strip were available they would consider local purchases at the right price. Assuming production continues at the same level then the consumption of copper and semis will be as given in Table 5.10. All of this alloy needed could be purchased in Nigeria by 1986.

TABLE 5.10 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - COINAGE (1986)

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Tons
Copper wire Winding wire Copper rod Copper strip Copper tube Alloy wire Alloy rod Alloy strip Alloy tube Castings	268	30	80	188	75	141
Total						141

5.5 Process Plant

There will be considerable installation of plant, particularly in the petroleum and petro-chemical industries, but also in the steelworks at Ajaokuta, for cement plants, paper mills and food and beverage factories and in power generation for NEPA.

In the following sub-sections, planned developments in each of the sub-sectors are reviewed with the potential for local copper and copper alloy products being assessed at the end of this section.

5.5.1 Petroleum

Exploration for oil began in Nigeria as long ago as 1937. Drilling started in 1951 and the first significant recovery was made in the Niger Delta in 1956. By a remarkable coincidence, October 1960 marked not only Nigeria's independence but also its self-sufficiency in crude oil.

Nigeria now ranks as one of the leading members of OPEC with an output fluctuating between 2.0 and 2.4m bpd (OPEC's total runs to around 24m bpd). Figure 5.1 shows fluctuations in production since 1973. The surplus of oil on the world market during the middle of 1981 has led to a cutback in production to little more than 1.0m bpd, together with some reduction in price. This may be only temporary but if prolonged could have a serious impact on revenues and the whole of the current development plan.

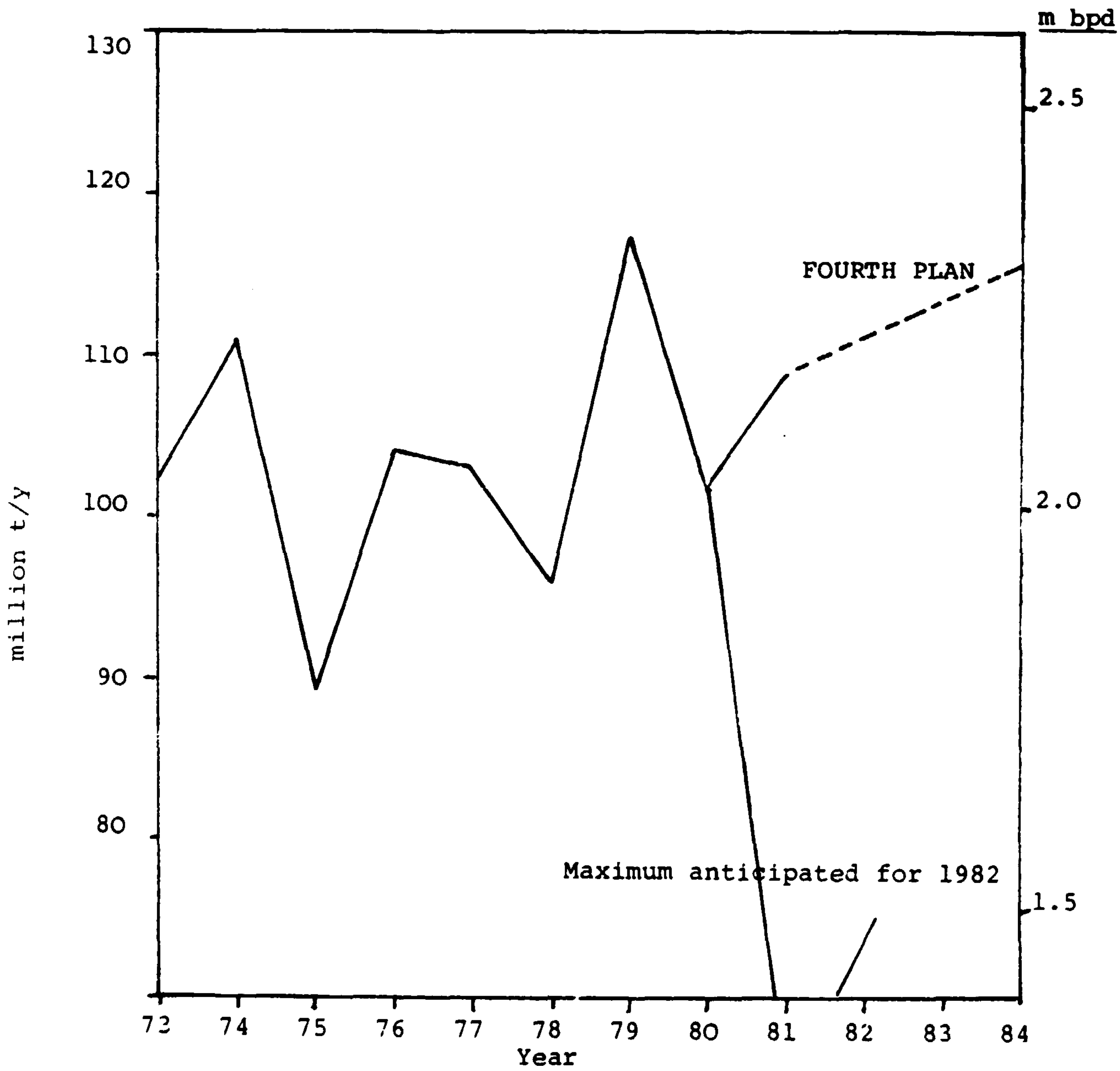
The Delta, still Nigeria's only oil-producing region, contains a network of pipelines connecting about 150 producing fields to give export terminals, namely Forcadoes, Escravos, Bonny, Brass River and Qua Iboe.

The oil is generally light in gravity and contains very little sulphur, attributes valued by many refiners. Indeed, Nigerian crudes are regarded as amongst the most desirable and thus command prices at the top end of the OPEC's scale, namely 25% above the base price for Saudi "marker" crude.

Oil has become the source of 90% of Nigeria's export earnings, 80% of government revenues and one-third of the gross domestic product.

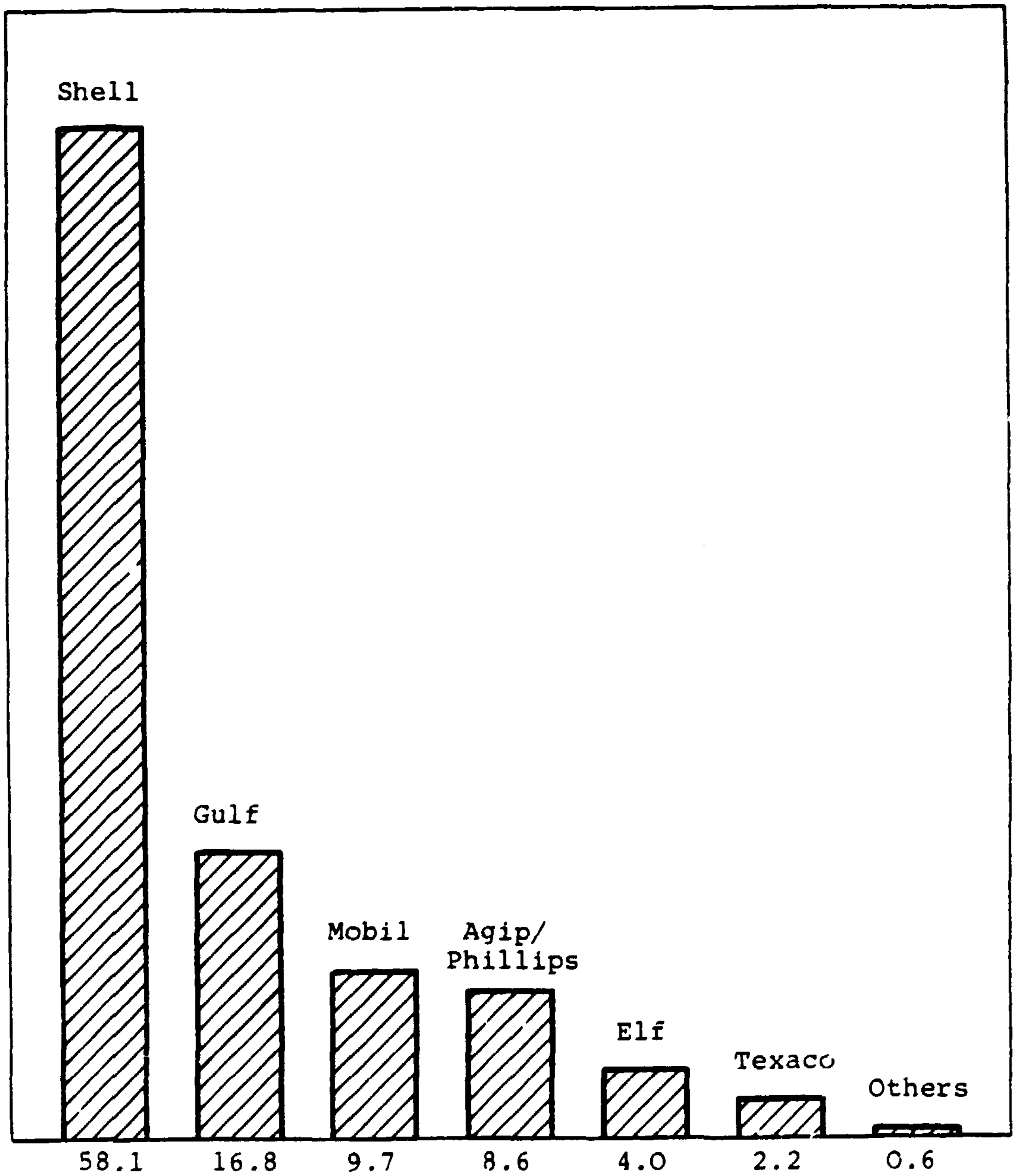
Essentially, six multi-national companies produced altogether an average of 2.04m bpd in 1980. Figure 5.2 shows their shares of the output. These companies operate in partnership with the Nigerian National Petroleum Corporation (NNPC), the state-run giant which controls all activities in the fields of oil, natural gas and petrochemicals. NNPC owns 80% of Shell in Nigeria and 60% of the other companies and receives, in lieu of profits, proportionate shares of the outputs. The oil producers buy back some of this crude.

FIGURE 5.1 : RECENT AND PLANNED OIL PRODUCTION



Sources : United Nations and Fourth National Development Plan 1981-1985

FIGURE 5.2 : PRODUCERS OF NIGERIAN OIL AND SHARE OF OUTPUT : Percent



Note :

'Others' comprise Ashland, Pan Ocean and Tenneco-Mobil

The Fourth Plan does not envisage production going beyond 2.4m bpd, a level which has already been achieved in the past, although it may be difficult to sustain.

The budget for the Fourth Plan includes ₦750m for direct exploration by NNPC, mostly in the Niger Delta, Anambra and Chad basins and NNPC may have become an oil producer in its own right by 1985.

The oil production sector will continue to require significant quantities of capital equipment. Water injection schemes, to boost reservoir pressures and thus increase recovery rates are planned, along with the above mentioned development of new fields. The major portion of this equipment will be purchased overseas. However, significant quantities of power and telecommunications cable will be required and some of this could be sourced from local industry in the late 1980's.

Nigeria today has three refineries, namely at Port Harcourt, Warri and Kaduna, with a combined rated capacity of 260,000 bpd. The Fourth Plan provides for a further 240,000 bdp. Table 5.11 gives particulars of existing and planned refinery capacities.

TABLE 5.11 : NIGERIAN OIL REFINERIES

Location	Year of Start-up	Rated Capacity (bdp)		
		Existing	New	Total
Port Harcourt	1965	60,000		60,000
Warri	1978	100,000	20,000	120,000
Kaduna	1980	100,000	20,000	120,000
Undecided	1985?		200,000	200,000
TOTAL		260,000	240,000	500,000

Source: NNPC

The oil refinery at Port Harcourt is owned 80% by NNPC and 20% by Shell since the nationalisation of BP's share. NNPC has 100% ownership of the other two refineries.

Chiyoda Chemical Engineering and Construction Company Limited of Japan built the newest refinery capable of producing gasoline, butane gas, kerosene, diesel oil, fuel oil, wax and asphalt as well as lubricating oil and greases. Located inland at Kaduna, it receives crude oil from Gulf's Escravos fields by a 600km pipeline. The plan is to feed the products into an extensive pipeline system which will distribute gasoline, butane gas and diesel fuel to major population centres throughout the country.

The Fourth Plan provides for a fourth refinery with capacity for 200,000 bpd of crude, as well as for 20,000 bpd additions to Warri and Kaduna. The old refinery at Port Harcourt will merely receive such routine maintenance as is needed to keep it in production. The total refinery programme has been estimated to cost about ₦1.5bn. It remains to be seen to what extent these objectives can be achieved. The fourth refinery will be export oriented and located on the seaboard, possibly in Cross River State, but appears to have been accorded a rather low priority. In any case, investments in capital equipment will continue through most of the 1980's.

With all three refineries operating at their rated capacities, Nigeria may have a surplus of some products for export, but at least gasoline will continue to be imported to meet ever-growing demand until the fourth refinery comes on stream. The outline of the Fourth Plan predicts a domestic demand of 440,000 bpd in 1985. Meanwhile, Nigeria has the balance of its crude refined overseas.

In addition to the above mentioned projects, other major projects proposed for the oil sector within the framework of the Fourth Plan include :

- The establishment of additional storage depots (₦15m).
- Improvement of pipeline depots and pump stations (₦15m).
- The establishment of central maintenance facilities (₦20m).
- Provision of transport facilities (₦25m).
- Safety and security programmes (₦30m).
- An anti-pollution programme (₦30m).
- A petroleum research centre (₦10m).

The above in general will not be important projects in terms of copper consumption as much of the "demand" for copper will be in products which, as yet, are not manufactured in Nigeria. Furthermore, most of these products are unlikely to be produced in Nigeria during the 1980's under present industrialisation plant.

5.5.2 Natural Gas

In common with many other OPEC countries, Nigeria has made much less progress with the exploitation of its gas reserves than with its reserves of oil. Production of natural gas, all of it associated with oil, is running at around 18,000m cubic metres annually, but all but a few per cent of this is flared off.

Oil companies are expected to find a use for their associated gas by 1984 or to shut-off production to prevent flaring. Yet oil reservoir conditions in Nigeria are rarely right for re-injection.

Proven associated and non-associated gas reserves stand at 2,100bn cubic metres and further exploration may prove total reserves in excess of 3,000bn cubic metres. In comparison, NNPC estimates a total domestic consumption in the 20 years beyond 1985 of the order of 540bn cubic metres. In the next century, gas may well dominate Nigeria's hydrocarbon industry.

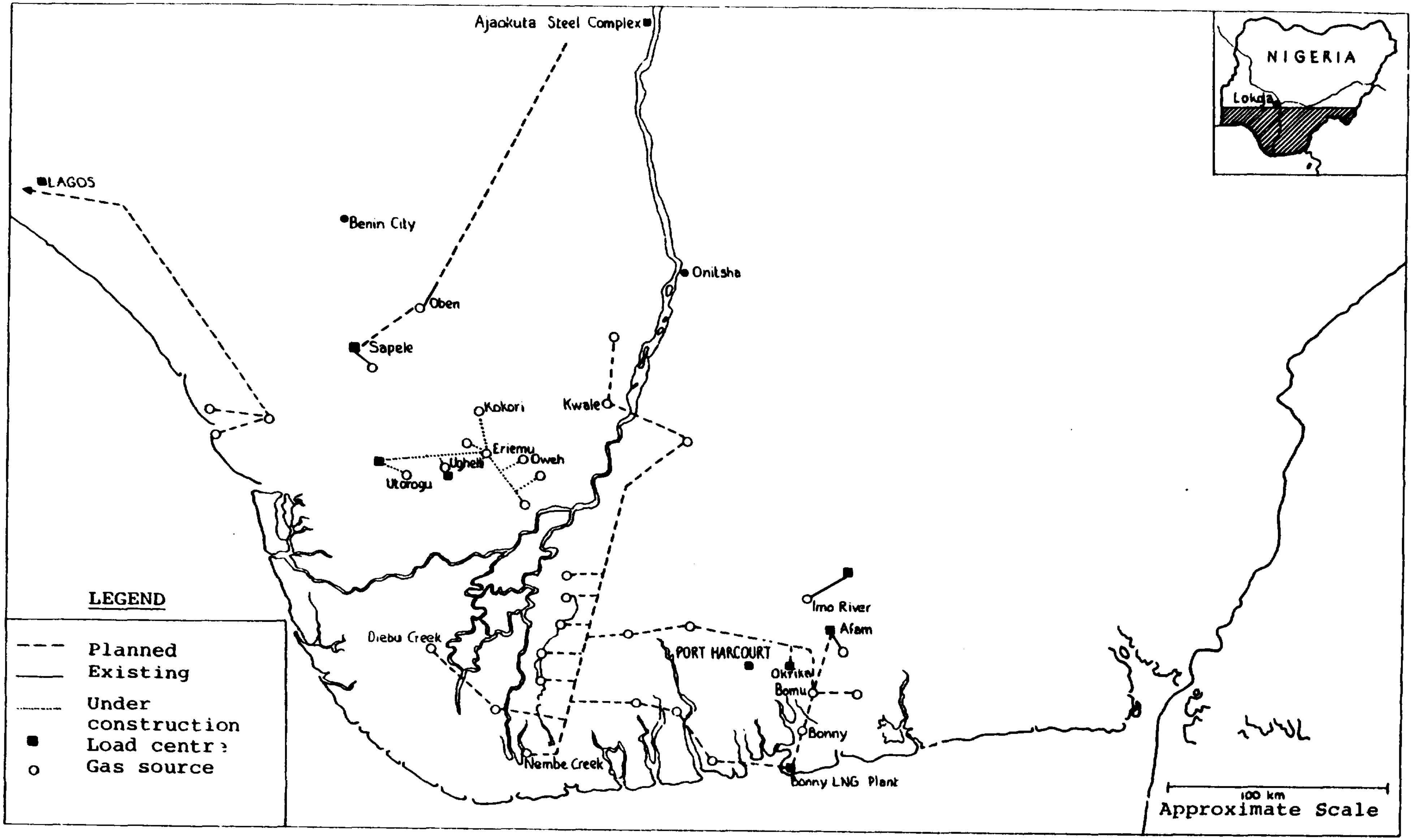
The idea of gathering much of the flared gas and liquefying it at Bonny for export has been under consideration for some years. Such an immense project would entail an investment of some ₦8,000m according to 1980 estimates, including the pipeline system, the liquefaction plant itself and specialised LNG tankers. To make it viable, the Government would have to enter into contracts for the sale of all gas produced over a 20-year period, the expected life of the reserves concerned. Negotiations with West European and American buyers did reach an advanced stage in 1980 and three consortia of West European, American and Japanese engineering groups were invited to tender for a 16,000m cubic metre/year scheme. However, the new civilian government considers this project too gigantic to implement alongside the other major projects to be executed during the Fourth Plan period. It therefore decided to delay any decision on the project until 1984, when the steel and petro-based complexes should have got beyond being a major drain on investment funds. There is still an outside chance of an earlier start to enable Nigeria to participate in the expected boom in LNG demand in the mid/late 1980's.

There have been various alternative proposals made on how Nigeria could develop its gas industry. Elf recently suggested that Nigerian gas could be piped across the Sahara into the Algeria-Italy pipeline which is due to start up in 1982 and will connect with the West European consuming grid. This scheme would be cheaper than the liquefied natural gas project mentioned above, but the idea has met with a cool reception.

Meanwhile, the government has started using natural gas for electricity supplies and making it available as fuel to industry, and intends to use it as a feedstock for a fertiliser complex. The pipeline system being developed for these purposes in shown in Figure 5.3.

Sapele already has a 700MW steam turbine power station which burns gas from nearby fields. A further 300MW will be added in 1981. Other thermal power stations exist at Affam and Iughelli (Delta). A large thermal power plant with an ultimate capacity of 1,200MW is to be built in the Lagos area, using piped gas from the Escravos fields. The initial stages for 800MW could consume 4,000m cubic metres annually.

FIGURE 5.3 : GAS PIPELINE SYSTEM



The planned pipeline to Lagos would also supply industrial consumers in that area. Fuel-intensive industries at Aba and Ughelli already receive natural gas. The Delta Steel complex nearing completion at Aladja will be the first large-scale industrial user of natural gas, to be followed by the nitrogenous fertiliser complex near Port Harcourt.

Figure 5.3 demonstrates clearly that the natural gas transmission system is still in its infancy. In the future, Nigeria will doubtless make far more use of this abundant source of energy and petro-chemical feedstock. The network of pipelines will relentlessly spread northwards to industrialised areas, although the time schedule set for the various gas-based projects in the Fourth Plan may prove rather optimistic despite the deferment of the LNG plant. Engineering work on capital projects in this sector will go on throughout the 1980's and probably well into the next decade.

5.5.3 Petro-Chemicals

After 20 years of oil production Nigeria still finds itself without a petro-chemical industry. It is difficult to understand why the country did not move more quickly, like other OPEC countries, to develop basic petro-chemical industries when the price of oil soared in 1974. The country still has no production of olefins and aromatics and is a huge importer of synthetic resins and fibres, both as intermediates for industry and as finished products. But the inevitable development of this sector has finally begun and must accelerate in the years to come.

A number of process units which will make products mainly for indigenous use are already under construction in association with the Warri refinery, and others will be attached to the refinery at Kaduna. They include facilities for carbon black, hexane, benzene, other solvents, ethanol, formaldehyde and a range of paraffins. The existing vegetable oil, paint, adhesive and detergent industries all stand to benefit from these developments. A 35,000 t/y polypropylene project in the course of implementation at Warri should stimulate the plastics and carpet industries. NNPC will use a relatively novel process developed by El Paso Polyolefins Company of the USA.

The Government considers a nitrogenous fertiliser scheme as its key project in the shorter term in the chemical sector. The project involves a 1,000 t/d ammonia unit and a 1,500 t/d urea unit based on natural gas as feed-stock, and a 1,000 t/d NPK compounding plant. In view of its expected contribution to the Government's Green Revolution Programme, this scheme has been accorded very high priority and is to be executed speedily with completion at Onne near Port Harcourt scheduled for 1984. US contractors are responsible for the project and US equipment and services will total US$300m.

The above project should go a long way towards meeting the requirements of the agricultural sector, which could not obtain more than 117,000 tonnes of fertiliser in 1979/80 through the Federal/State importation and distribution scheme. To meet 1985 targets, farmers will need 43,000 tonnes.

Another petro-chemical project reportedly under consideration, primarily aimed at export markets, concerns a 310,000 t/y ethylene cracker, also based on natural gas, with downstream units for the production of :

- 120,000 t/y low density polyethylene
- 60,000 t/y high density polyethylene
- 130,000 t/y vinyl chloride
- 120,000 t/y PVC
- 88,000 t/y caustic soda
- 80,000 t/y chlorine

The cracker was to use feedstock extracted from gas prior to liquefaction. Now that the LNG plant has been deferred for a few years, it remains to be seen whether this scheme will likewise be deferred or whether it will proceed on a less ambitious scale.

Chiyoda of Japan, who recently completed the Kaduna refinery, is adding a bottled LPG plant using refinery streams. A synthetic detergent plant has also been proposed for Kaduna.

Like natural gas transmission and utilisation, the development of a petro-chemical industry is as certain as tomorrow's sunrise and will call upon technological leaders in this field to provide a wide range of expertise and equipment. Past experience of large public sector projects indicates, however, that the objectives of the Fourth Plan may well prove too ambitious and that some of the targets set for 1985 may not be reached until later in the 1980's. Long delays usually occur particularly during contract negotiations and in the provision of infrastructure.

5.5.4 Other Chemical Products and Pharmaceuticals

Chemicals other than the petro-chemicals have been equally neglected, but for better reasons, i.e. relatively limited markets and lack of raw materials. The Fourth Plan provides, however, ₦80m for a sulphuric acid plant, and the PVC scheme already mentioned will, of course, require a caustic soda/chlorine facility.

As in other industrial areas in Nigeria, the 1970's have seen from emphasis on consumer goods than on intermediates. Indeed, with a few exceptions, local producers have confirmed their operations to blending and/or packaging. In the longer term a greater emphasis on intermediates is likely.

Today, few farmers can afford adequate supplies of herbicides, insecticides and pesticides. The majority of smallholders do not even know how to apply them correctly even if they were given to them. The State governments are looking to develop schemes for making agro-chemicals available to all, ensuring their safe use, in order to achieve the targets set for food production by the Central Government. Hence one can expect significant growth in demand for such products in the 1980's.

Pharmaceuticals and toiletries are widely available in Nigeria. Furthermore, ambitious plans exist for extending the national health service, which offers a good market potential for ethical drugs. Presently, turnover in pharmaceuticals in Nigeria is estimated at ₦200m a year and is growing rapidly. About 85% of the country's needs are imported although about ten out of the 35 multi-national companies active in Nigeria have begun modest local production.

Early in 1981, Continental Pharmaceuticals Limited started production of pharmaceuticals, cosmetics, toiletries and plastic packaging materials. Its large modern complex near Lagos entailed an investment of ₦9m and can probably be regarded as the first integrated Nigerian factory in this sector. The company is wholly Nigerian owned and manufactures own brands as well as the products of leading US forms on a franchise basis.

Nigerian Hoechst Limited has a drug manufacturing factory under construction at Otta in Ogun State and A.J. Seward, a division of IAC, opened a ₦13m cosmetics factory near Lagos in 1981, the largest toiletry factory in Africa.

Chemical and Allied Products Limited, associated with ICI, propose to manufacture some pharmaceuticals in Apapa and crop protection chemicals in Ibadan. The Fourth Plan provides ₦20m of public funds for two medium-sized pharmaceutical industries.

Other companies manufacture soap and other toiletries (e.g. Lever Brothers Nigeria Limited), polishes (e.g. Johnson Wax Nigeria Limited), etc. Oils and fats used in such products usually come from Nigerian crushers and palm oil mills and developments in all these subsectors is expected over the next decade.

Almost all paints and many other protective coatings used in Nigeria are now compounded locally, usually with technical back-up from leading foreign interests. The building of the new Federal capital and the construction boom elsewhere in connection with large industrial projects should generate a high demand for paint throughout the 1980's and present good opportunities for suppliers of components such as resins and pigments as well as of process equipment for development of these industries locally.

With regard to plastics, there are many companies, large and small, manufacturing a great variety of moulded, extruded, blown and foamed products, coatings, etc. Resins will continue to be imported until the petrochemical industry has caught up with production units for polyethylene, PVC, polypropylene and polyurethane. This industry mushroomed in the late 1970's and continues to grow. Imports are expected to rise to approximately 250,000 t/y by 1983.

5.5.5 Iron and Steel

Development of a basic iron and steel industry is a project considered for many years and eventually launched in the latter half of the 1970's. The programme is extremely ambitious and may well spill over into the years beyond the Fourth Plan. For the period of the present Plan, the Steel Department of the Executive Office of the President has been allocated ₦3,000m of Federal Funds to meet government contributions to the cost of financing projects in this area.

The programme as a whole consists of four schemes, namely a direct reduction complex, a blast furnace complex, three rolling mills for round products and one or more rolling mills for flat products. External loans for the first three of these reportedly amount to ₦173m, ₦149m and ₦80m respectively.

Delta Steel Company's direct reduction plant at Aladja near Warri, built on a turnkey basis by an Austro-German consortium, is nearing completion and expected to be commissioned in 1982. With an annual capacity of 1m tonnes, it is of modest size compared with similar natural gas-based facilities in other parts of the world but lends itself to future expansion once it has demonstrated its viability. Although Delta will roll some finished products itself, its main activity will be the supply of steel billets to Oshogbo, Jos and Katsina (all down-stream processing plants).

The blast furnace complex of Ajaokuta Steel Company will have an initial capacity of 1.3m tonnes of round steel products. The contract for civil works has been awarded and construction is progressing. The project has been plagued by delays and estimated costs have shot up to ₦7,000m. Again this project is being developed on a turnkey type basis.

The light section and wire rod mills are now scheduled for start-up by the end of 1983, to be followed by the remaining units in 1985, but further delays may occur, possibly for want of adequate infrastructure. Ajaokuta is located on the River Niger in Kwara State, about 150km north of Onitsha. To facilitate the economical transportation of heavy inputs and the distribution of outputs, the Inland Water Ways Department of the Ministry of Transport proposes to have the river dredged and the Nigerian Railway Corporation will build a standard gauge line from Port Harcourt, but neither of these projects has as yet made much headway.

Rolling mills for 210,000 tonnes per year of rod and bar each will be built at Oshogbo, Jos and Katsina using billets from Delta Steel Company except Katsina, which will produce much of its own steel from scrap. The mill of Oshogbo Steel Company, already under construction, will cost ₦78m and involves German technology and finance.

In addition to these schemes, the US Export-Import Bank has authorised a loan for the construction of a 100,000 t/y mini-steel mill in Lagos State. Pennsylvania Engineering Corporation will undertake the project as a joint-venture partner with the State government. The new company, LAPEC Nigeria Limited, will produce rod and bar from scrap.

Other projects have been announced and will continue to make news as the two primary steel complexes near completion. It remains to be seen how much rolling capability will actually materialise.

The rolling mill for flat products will cost about ₦2,350m and has been scheduled for implementation towards the end of the Fourth Plan period. However, the projects so far discussed already impose a heavy burden on the authorities concerned so that one may see little progress on this scheme before 1985.

Nigeria estimates that its steel consumption will rise to 4m tonnes a year by 1985 and that it could reach 6m tonnes in 1990. Thus, when the Ajaokuta plant approaches its design capacity the two integrated complexes will still only meet half of the demand. One therefore can expect continuous ongoing investments for plant in this sector throughout the 1980's.

5.5.6 Cement

In the mid-1970's Nigeria had to import considerable quantities of cement to keep its construction activity moving and these imports blocked ports and caused considerable problems. Since then Nigeria has developed its ports and tripled its own cement-making capacity. Capacity now exceeds 5.2 million tonnes per annum and the country has eight separate cement plants. Table 5.12 details the status of the industry at the beginning of 1980 and Figure 5.4 shows the location of the various companies.

TABLE 5.12 : NIGERIA'S CEMENT INDUSTRY

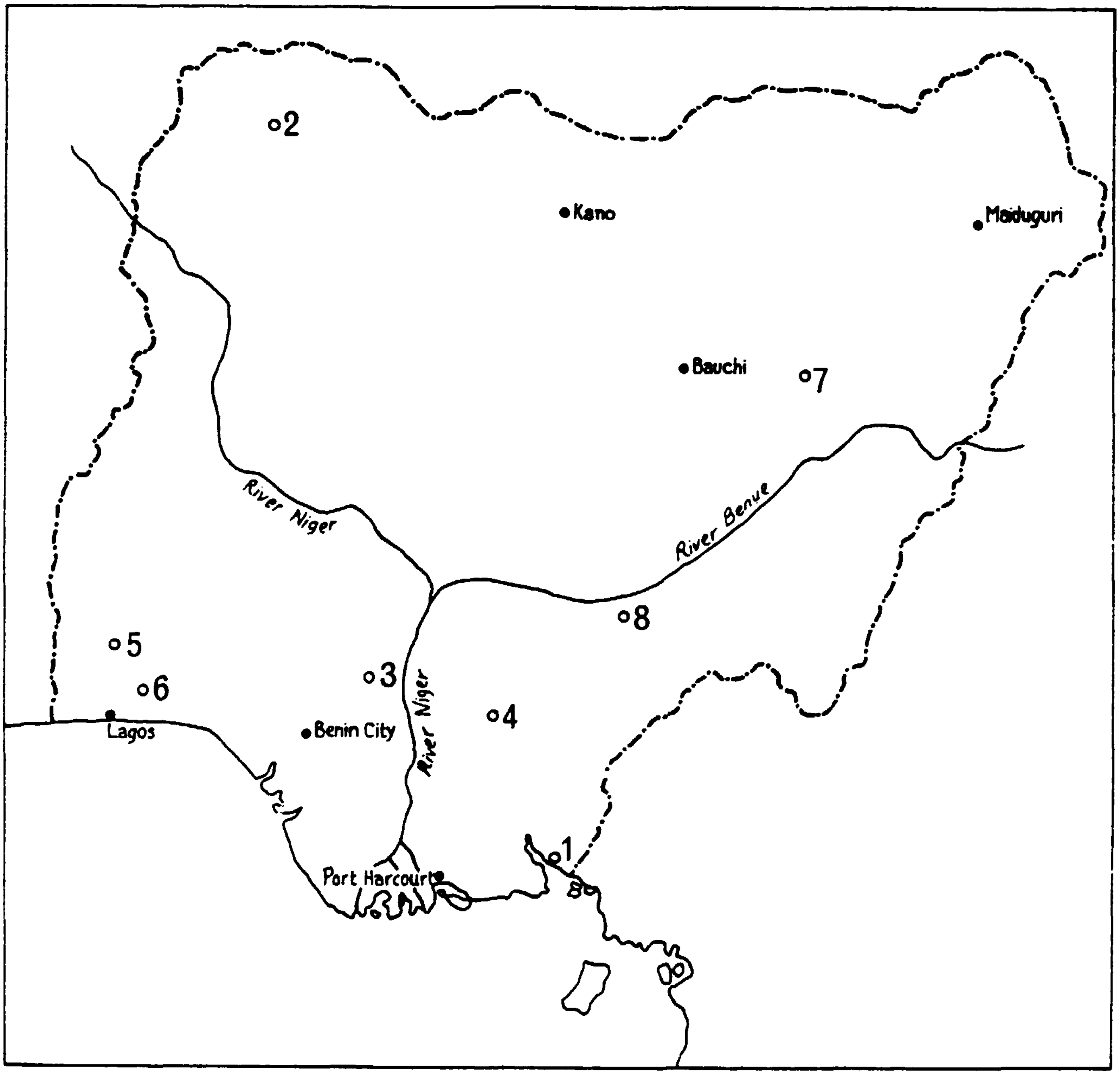
Company & Address of Head Office Plant(s)	Number of active kiln(s)			Fuel Used			Estimated yearly kiln capacity ('000t)				Production of finished cement, according to types and cement classes	Brand name(s)	Total number of persons employed
	Rotary dry	Rotary wet	Vertical	Fuel-oil	Gas	Coal	End of 1976	End of 1977	End of 1978	End of 1979			
CALABAR CEMENT CO. LTD. PO Box 219 Calabar C Calacemco 1 Calabar, Cross River St.	2			x			400	400	400	400		Calcemco	
CEMENT CO. OF NORTHERN NIGERIA PO Box 2166 Sokoto T 2280 C Sokocem 2 Kalambaina Sokoto St.	1			x			100	100	100	500 (a)		Sokoto	
UKPILLA CEMENT CO. LTD. PO Box 35 Auchi T Benin 6235 C Rhinocem 3 Auchi, Bendel St.	1			x			150	450 (a)	450	450	120 BS 12	Rhino	360
THE NIGERIAN CEMENT CO. LTD. PO Box 331 Enugu T 9001 C Nigercemco 4 Nkalagu, Enugu, Anambra St.		4				x	480	720 (b)	720	720	412 OPC	Nigercem	1,780
WEST AFRICAN PORTLAND CEMENT CO. LTD. PO Box 1001 Lagos T 31264, 31272 Tx Wapcem 21299 C Wapcemco Lagos 5 Ewekoro, Abeokuta Ogun St.	2	1		x			645	695	705	715	684 OPC	Elephant	1,528
6 Shagamu, Ogun St. (c)							-	100	720	740			
ASHAKA CEMENT CO. LTD. Ashaka Via Gombe PMB 3276 Kano T Lagos 26152 Tx Lagos 21299 7 Ashaka, Bauchi St.							-	-	300 (d)	300		Ashaka	
BENUE CEMENT CO. LTD. 8 Yadev, Benue St.	2						-	-	-	900	PC	Lion Brand	
TOTAL :	6	5		x		x	1775	2465	3395	5225	1,274		

Source : CEMBUREAU

(a) Expansion by one dry process kiln. (b) Expansion by two wet process kilns.
(c) New plant with two wet process kilns. The installation of a third kiln is under consideration.
(d) New plant with two dry process kilns. The installation of a third kiln is under consideration.

(Ref. 13)

FIGURE 5.4 : LOCATION OF CEMENT PLANTS



1. Calabar Cement Co. Ltd
2. Cement Company of Northern Nigeria
3. Ukpilla Cement Co. Ltd.
4. The Nigerian Cement Co. Ltd.
5. West African Portland Cement Co. Ltd.
6. West African Cement Co. Ltd.
7. Ashoka Cement Co. Ltd.
8. Benue Cement Co. Ltd.

Source: CEMBUREAU (Ref. 13)

The Cement Company of Northern Nigeria plans to add at least a further 100,000 t/y by 1983. Benue Cement Company, the latest entry, with Swiss technical partners and heavy reliance on Swiss engineering, has provisions for up to six new kilns, which would raise its output to 3m t/y. Ashaka Cement Company and West Africa Portland Cement Company are also contemplating expansion. Fortunately, Nigeria has most of the raw materials necessary for making cement. The building of the new Federal capital and theheavy civil works proposed in the Fourth Plan will continue to exert heavy pressure on the cement industry to expand throughout the 1980's.

5.5.7 Food and Beverages

Although at independence Nigeria was a net exporter of agricultural products, indeed agriculture accounted for some 80% of foreign exchange earnings, today the country is a net importer of food products and import requirements are rising annually and placing a strain on available foreign exchange resources. Agricultural production has fallen to some 60% of the 1960 level and government programmes over the past five years have been directed towards reversing this downward trend and developing the capability at a national level to feed the country without recourse to imports. In the Fourth Plan there are thus several projects for development of the agricultural sector and the downstream agro-processing industries. New production/processing facilities for sugar, cassava/starch, rubber, palm oil as well as for poultry and fish are all expected to go ahead in the Fourth Plan period. Some of these projects will be quite large and will be implemented by State Governments whilst others will be much smaller and entirely within the private sector.

Nigerians drink large amounts of beer and soft beverages. In 1980 there were 19 breweries producing 9.2m hectolitres a year, but the demand still outstripped the supply of 2m hectolitres. Six additional breweries are scheduled for 1981 and 1982, bringing the total to 25 with a combined output of 10.4m hectolitres a year and more or less taking care of the shortfall although annual per capita consumption of about 12 litres could rise further. Capacities of existing breweries lie mostly in the 350,000 to 750,000 hectolitres range and the industry is already committed to an investment of ₦600m in 1981 through 1983.

A similar situation exists in the soft drinks bottling industry which one can find in strategic locations throughout the country. This sector is growing by leaps and bounds. The climate favours the consumption of soft drinks, and so do religious beliefs on account of which many Nigerians abstain from alcohol. The average citizen takes at least a bottle a day. There are some 20 leading brands on the market, many produced under franchise.

The leading company in this sector is Nigerian Bottling Company Limited (Coca-Cola Leventis). Seven-Up Bottling Company Limited started up a ₦9m complex in Ibadan in 1980, believed to be the largest and most modern soft drinks plant in Africa. Pepsi Cola (John Holt) also has a significant share of the market.

Distilled alcoholic beverages, other than distilled palm wine obtained from traditional stills in the bush, are mostly imported in bulk, blended and bottled by two companies, West African Distillers Limited in Apapa and on a much smaller scale, Amalgamated Distilleries of Nigeria Limited in Port Harcourt. Developments in all these sub-sectors is expected to continue through the 1980's.

Within these process industries, the main requirement for copper and copper alloy containing products will be in process plant both new equipment and for maintenance. Requirements for power generation have been considered elsewhere. Other plant will require copper and copper alloys in heat exchangers and other sophisticated pieces of equipment and for electrical installations. Demand for copper in electrical installations has been included elsewhere and to include it here would result in double counting. Heat exchangers, vats, etc., will be supplied as part of the overall equipment package and will not be built in Nigeria during the coming decade and consumption in new plant has therefore been excluded from this survey.

There will be a small demand for copper and brass products for maintenance purposes which we estimate will, by 1986, total 1,000 tons per year of products which could be manufactured in Nigeria. Estimated demand for copper and alloy semis is given in Table 5.13 based on the number of plants in existence or planned for the future and related to actual experience in other countries at a similar level of development.

TABLE 5.13 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - MAINTENANCE OF PROCESS PLANT (1986)

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Tons
Copper wire						
Winding wire						
Copper rod						
Copper strip						
Copper tube						
Alloy wire						
Alloy rod	200	25	50	150	60	90
Alloy strip						
Alloy tube	600	25	150	450	60	270
Castings	200	30	60	140	60	84
Total						444

5.6 Brassware and Bronzes

There is a considerable demand for brassware for cooking and decorative purposes. The major factory has 80% of the market and is currently consuming 1,600 tons per annum of brass sheet purchased as blank discs. By 1986 consumption will have risen to 3,000 tons. Even allowing for expansion of other manufacturers in the business the total production is unlikely to exceed 3,500 tons by 1990 since more developed methods of cooking will come into use. The industry would purchase brass sheet in Nigeria if it were available.

The traditional bronze industry around Benin consumes large quantities of metal. There are a multitude of small craftsmen in Benin (we estimate at least 1,000) consuming an average 130kg per month of bronze giving an annual consumption of 1,600 tons per annum. The total may be at least double this. Their raw material is scrap, mainly purchased in Lagos at less than ₦500 per ton. The scrap comes from a whole variety of sources including vehicle components, piping, old air-conditioners etc. It is unlikely that any product from the proposed copper plant will be able to compete with existing sources of scrap and we have therefore not included it in our estimate of demand.

TABLE 5. 14 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - BRASSWARE 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Tons
Copper wire Winding wire Copper rod Copper strip Copper tube Alloy wire Alloy rod Alloy strip Alloy tube Castings	3,540	15	540	3,000	60	1,800
Total						1,800

5.7 Gas Bottles

High pressure gas bottles and LPG gas bottles each have brass valves. The consumption of valves in high pressure bottles is 17,000 per year and will rise to 80,000 by 1986. The current demand for LPG gas bottles is 320,000 and this will rise to 520,000 by 1986 even on a conservative basis. High pressure valves each weigh 900g and LPG valves 400g. Consumption of brass in these valves is given in Table 5.15.

TABLE 5.15 : CONSUMPTION OF BRASS IN VALVES FOR GAS BOTTLES (TONS)

Year	In LPG Valves	In HP Valves
1981	128	15
1982	140	21
1983	152	29
1984	168	40
1985	188	55
1986	200	76
1990	304	108

In view of the relatively low numbers of HP valves we think it unlikely that these will be made in Nigeria until after 1986. However it is likely that up to 50% of LPG valves will be manufactured alongside the manufacture of bottles. Table 5.16 shows the consumption of semis in valves in 1986.

5.8 Others

We considered a number of other potential users of copper and they were excluded from the survey either because consumption was negligible or because there is no possibility of manufacture of the product in Nigeria in the foreseeable future.

- Construction equipment

There is a wide range of construction equipment used in Nigeria and none of it is presently manufactured in the country. In view of the wide range of products it is unlikely that anything other than assembly of CKD kits will be undertaken before 1986 and the potential for use of locally made copper components is minimal.

TABLE 5.16 : RELATIONSHIP OF SEMIS, SCRAP AND METAL USED - LPG VALVES (1986)

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Tons
Copper wire						
Winding wire						
Copper rod						
Copper strip						
Copper tube						
Alloy wire						
Alloy rod	168	40	68	100	60	60
Alloy strip						
Alloy tube						
Castings						
Total						60

- Stationary Engines

Stationary internal combustion engines are used to drive pumps, generators, and a variety of other applications. As was stated in the section of this report dealing with the transport sector, it is considered unlikely that internal combustion engines will be manufactured in Nigeria prior to 1986. The demand for stationary engines is clearly below the level which would justify production purely for this purpose and thus, we have assumed that stationary engines will only be manufactured in Nigeria after production of engines for vehicles has been undertaken for several years. On this basis, we do not forecast any consumption of copper and copper alloy semi-finished products in this area.

- Machine Tools

Machine tools use some copper or brass components, but we do not consider that there will be any manufacture in Nigeria during the 1980's.

- Textiles

Copper rollers are used in roller printing of textiles but the process is being superseded by rotary printing which already has 80% of the production. We do not consider that this will be a significant user of copper by 1986.

- Bearings

Bearings are, on the whole, high precision products, many of which are imported as components of built-up machinery. Although there is demand for replacements most of these will be imports supplied by the original equipment suppliers. In view of this, and the variety of products needed, there seems little prospect of significant quantities of bearings being manufactured in Nigeria until there is major manufacture of other products such as pumps and motors and even then bearings will be imported ready-made until these industries have developed to a considerable size. We do not see any significant use in manufacture of bearings in Nigeria by 1986.

- Agricultural Machinery

The major item of equipment in this sub-sector consuming copper and copper alloy semi-finished products is the agricultural tractor. Agricultural equipment such as seed-planters, disc-harrows, etc., on the one hand are not imported into Nigeria in sufficient quantities and on the other hand are not significant users of copper and copper alloy products. The only other category of agricultural machinery where very large quantities of copper and copper alloy semi-finished products are used is dairy equipment. This latter type of equipment is not imported into Nigeria in significant quantities and is unlikely to be produced in the country within the foreseeable future. Within this sector, therefore, we have limited our review to the agricultural tractor.

Imports of agricultural tractors have risen progressively since the early 1970's. Prior to 1974 annual imports totalled less than 500 wheeled tractors per year. Following the oil price increase, imports rose quite rapidly, as can be seen from Table 5.17. The rapid growth in imports prompted the Government to consider establishing local assembly/manufacturing facilities for this product. Furthermore, the Government decided the product could most efficiently be produced in tandem with the heavy commercial vehicle manufacturing facilities that were planned and two companies, FIAT and Steyr, have commenced operation for assembly of agricultural tractors, whilst the other truck manufacturers (Leyland and Mercedes) are reportedly considering adding this product to the range of items they are manufacturing in their commercial vehicle facilities.

Whilst the Government would like to see a greater degree of manufacturing content in agricultural tractors produced in Nigeria, during the 1980's, as can be seen from Table 5.16, annual demands are relatively limited and as such manufacturing economies of scale are unlikely to be realised. Both Steyr and FIAT commenced assembly of agricultural tractors in 1979/80, but neither company anticipates any major component manufacture in Nigeria in the period prior to 1986. Indeed, it has been argued that even the radiator for these units will not be produced in Nigeria before the mid-1980's as the radiator manufacturing companies will concentrate their activities on passenger cars followed by light then heavy commercial vehicles, and only in the final phase will be agricultural tractor radiator be added. In

TABLE 5.17 : IMPORTS OF AGRICULTURAL TRACTORS - NIGERIA

Group/Item	1974	1975	1976	1977*	1978*
712.51 Tracked or Half Tracked Agricultural Tractors	241	1,209	1,982	1,350	1,046
712.52 Agricultural Tractors Wheeled Less 40BHP*	319	2,576	2,066	2,794	1,246
712.53 Agricultural Tractors Wheeled More 40BHP*	319	1,196	349	287	223
TOTAL WHEELED	638	3,772	2,415	3,081	1,469
TOTAL AGRICULTURAL TRACTORS	879	4,981	4,397	4,431	2,515

* The tendency of manufacturers and importers to quote power-take-off horsepower at low engine revs., makes the division between 712.52 and 712.53 relatively meaningless since units such as DB880, DB 990, MF245 and many others can be rated at less than 40BHP in this way.

Source: Nigerian Trade Summaries (Ref. 2).

view of this, we have assumed that there will be no local production of agricultural tractor radiators, nor indeed any other component, prior to 1986 and as such have not included any consumption of copper and copper alloy semi-finished products in our forecasts.

TABLE 5.18 : FORECASTS OF DEMAND FOR WHEELED AGRICULTURAL TRACTORS

Year	Number
1981	3,600
1982	4,100
1983	4,500
1984	5,000
1985	5,500
1986	6,000

- Refrigeration and air-conditioning

Domestic and room air-conditioning units have been considered elsewhere in this report. This section is confined to commercial/industrial equipment. These units are large and highly specialised and the volumes are too low to sustain local manufacture and all units will continue to be imported until after 1986. We do not see a significant local consumption of copper although very small amounts of tube may be used during installation. The quantities will however still be quite low even in 1986.

- Sewing machines

These are assembled from CKD kits and this will continue well into the future. They contain no significant amounts of copper - the copper component is wiring in very small quantities.

- Fire extinguishers

These are assembled in Nigeria, but all brass components have now been replaced by other materials.

5.9 Summary of General Engineering Products

Table 5.19 summarises the estimates for all the general engineering products. The assumption implicit in the data is that over 65% of products in this sector will be made in Nigeria by 1986 implying a very rapid development of the sector. The figures, however, are very heavily weighted by one product (indeed by one factory), that is brassware. Excluding this item, the proportion falls to 20% which is in line with the present level of development in the industry and the expandion that can be expected in the future.

TABLE 5.19 : SUMMARY OF DEMAND FOR COPPER AND ALLOY SEMIS BY NIGERIAN MANUFACTURERS OF GENERAL ENGINEERING PRODUCTS AND COPPER CONTENT OF ALL PRODUCT (TONS)

Item	Copper Semis 1986					Copper Alloy Semis 1986					1986 Copper Content of local Manu-facturer
	Wire	Winding Wire	Rod	Strip	Tube	Wire	Rod	Strip	Tube	Casting	
Pumps								48		46	48
Engineering Valves							71			123	100
Screws and Fasteners	7			5		56	79	45			89
Coinage								268			141
Process Plant Maintenance							200		600	200	444
Brassware								3540			1800
Gas Bottle Valves							168				60
Total	7			5		56	518	3901	600	369	2682

6. CONSTRUCTION INDUSTRY

In many countries the construction industry is one of the more important consuming sectors for copper and copper alloy semi-finished products. For example, within Europe, the construction sector accounts for some 15% by weight of total copper consumption. The percentage does vary from one country to another, with this sector accounting for over 18% of total copper consumption in the UK and less than 12% of total copper consumption in Italy. These quite significant variations result from the different building practices adopted in the various countries and the different material usage patterns and practices found. Indeed, it is the usage or absence of copper tubes within the domestic plumbing system which is the most important factor behind the above mentioned variances.

Statistics on construction activity in Nigeria are relatively sparse. Ideally, one would hope that in addition to overall data on the construction sector separate, detailed statistics would exist for the housing sector, the commercial sector and the industrial sector construction activity. Within the housing statistics, a breakdown of urban and rural housing activity would also be of value. Unfortunately, in Nigeria, there is no centralised data collection in this area and indeed available data is far from complete. In the following sub-sections, it has therefore been necessary to develop estimates based on the available data and Metra's experience in Nigeria and other developing countries.

The contribution of the construction and housing sectors to GDP progressively rose through the 1970's as can be seen from Table 6.1. Whilst in value terms a rise is projected for this sector, during the Fourth Plan period, as can be seen from Tables 6.2 and 6.3, the relative importance of the construction and housing sectors as a contributor to GDP is expected to slightly decline. Indeed, when GDP is considered in current prices the decline, as can be seen from Table 6.4, is quite significant. In part this decline is the result of a rapid rise in the manufacturing sector and to a lesser extent, the wholesale and retail trade contributions.

TABLE 6.1 : GROSS DOMESTIC PRODUCT AT CURRENT FACTOR COST - NIGERIA

(₦ Million)

Activity Sector	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
1. Agriculture	2,183.3	2,203.8	2,143.1	2,251.9	2,336.6	2,406.7	2,486.6
2. Livestock	488.8	491.2	393.9	399.6	409.9	422.2	440.6
3. Forestry	215.0	302.7	328.8	355.1	383.5	412.2	443.2
4. Fishing	465.0	567.6	573.8	607.1	658.7	698.2	743.6
5. Crude Petroleum	2,771.6	2,797.6	2,345.3	2,676.8	2,715.7	2,480.6	2,866.5
6. Other Mining and Quarrying	198.8	247.8	310.5	372.6	436.0	492.7	544.4
7. Manufacturing	611.0	601.4	729.7	854.4	943.0	1,040.6	1,151.0
8. Utilities	45.2	51.8	59.7	74.4	95.2	117.3	136.0
9. Construction	884.1	1,108.4	1,411.4	1,693.6	1,981.8	2,239.7	2,474.7
10. Transport	429.6	403.1	468.2	636.8	764.1	878.7	966.9
11. Communication	33.2	38.9	47.7	54.9	60.3	65.2	71.7
12. Wholesale and Retail Trade	2,268.1	2,295.1	2,491.5	2,788.5	2,043.9	3,245.2	3,492.2
13. Hotels and Restaurants	32.4	35.6	39.1	43.0	47.5	52.0	57.2
14. Finance and Insurance	140.5	155.0	170.4	187.6	206.4	226.7	249.4
15. Real Estate and Business Services	61.1	67.3	74.0	81.4	89.5	98.5	108.3
16. Housing	625.9	688.2	756.6	832.4	915.6	1,006.4	1,107.7
17. Producer of Government Services	664.4	743.4	1,049.1	1,082.4	1,208.5	1,299.3	1,399.8
TOTAL	12,118.0	12,798.9	13,392.8	14,992.5	16,285.2	17,182.2	18,740.4

Source: Outline of 4th Development Plan (Ref. 12)

TABLE 6.2 : GROSS DOMESTIC PRODUCT AT 1977 FACTOR COST : 1980-1985

(₦ Million)

Sector	1980	1981	1982	1983	1984	1985
1. Agriculture	4,372	4,547	4,729	4,918	5,115	5,319
2. Livestock, Forestry and Fishing	3,135	3,260	3,391	3,526	3,668	3,814
3. Mining and Quarrying	8,473	8,642	8,815	8,992	9,171	9,355
4. Manufacturing	2,657	3,056	3,514	4,041	4,647	5,344
5. Utilities	119	137	157	181	208	239
6. Constructions	3,785	3,974	4,173	4,382	4,601	4,831
7. Transport	1,277	1,430	1,602	1,794	2,009	2,251
8. Communications	97	112	128	148	170	195
9. Wholesale and Retail Trade	7,215	7,937	8,730	9,603	10,563	11,620
10. Housing	1,490	1,609	1,738	1,877	2,027	2,189
11. Producer of Government Services	2,268	2,540	2,845	3,186	3,569	3,997
12. Other Services	1,190	1,309	1,440	1,584	1,742	1,917
TOTAL	36,078	38,553	41,262	44,232	47,490	51,071

Source: Outline of 4th Development Plan (Ref. 12)

TABLE 6.3 : GROSS DOMESTIC PRODUCT AT 1977 FACTOR COST : 1980-1985 : PERCENTAGE DISTRIBUTION

Sector	1980	1981	1982	1983	1984	1985
1. Agriculture	12.1	11.8	11.5	11.1	10.8	10.4
2. Livestock, Forestry and Fishing	8.7	8.4	8.2	8.0	7.7	7.5
3. Mining and Quarrying	23.5	22.4	21.4	20.3	19.3	18.3
4. Manufacturing	7.4	7.9	8.5	9.1	9.8	10.5
5. Utilities	0.3	0.4	0.4	0.4	0.4	0.4
6. Constructions	10.5	10.3	10.1	9.9	9.7	9.4
7. Transport	3.5	3.7	3.9	4.1	4.2	4.4
8. Communication	0.3	0.3	0.3	0.4	0.4	0.4
9. Wholesale and Retail Trade	20.0	20.6	21.1	21.7	22.2	22.8
10. Housing	4.1	4.2	4.2	4.2	4.3	4.3
11. Producer of Government Services	6.3	6.6	6.9	7.2	7.5	7.8
12. Other Services	3.3	3.4	3.5	3.6	3.7	3.8
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Source: Outline of 4th Development Plan (Ref. 12)

TABLE 6.4 : GROSS DOMESTIC PRODUCT AT CURRENT PRICES : PERCENTAGE DISTRIBUTION

Sector	1980	1981	1982	1983	1984	1985
1. Agriculture	10.3	10.0	9.7	9.3	9.0	8.7
2. Livestock, Forestry and Fishing	7.4	7.2	6.9	6.7	6.5	6.2
3. Mining and Quarrying	32.9	31.6	30.3	29.0	27.7	26.4
4. Manufacturing	8.0	8.7	9.5	10.4	11.3	12.2
5. Utilities	0.4	0.4	0.4	0.4	0.4	0.4
6. Construction	6.9	6.8	6.7	6.6	6.5	6.4
7. Transport	4.3	4.6	4.8	5.1	5.3	5.6
8. Communication	0.2	0.2	0.2	0.2	0.2	0.2
9. Wholesale and Retail Trade	16.9	17.6	18.2	18.9	19.5	20.1
10. Housing	4.3	4.1	4.0	3.8	3.6	2.4
11. Producer of Government Services	5.7	6.0	6.3	6.6	6.9	7.2
12. Other Services	2.7	2.8	3.0	3.0	3.1	3.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Source: Outline of 4th Development Plan (Ref. 12)

As was mentioned above, data is extremely sparse in this sector. The Central Bank base their projections of activity in the construction sector on the consumption of a small range of selected construction materials. The items included in this area are cement, roofing sheets, and to a lesser extent, paints and allied products. As can be seen from Table 6.5 the consumption of these items has increased in the period 1975 through 1979. In terms of housing activity, however, whilst roofing sheet is used almost entirely in the residential and industrial building sectors, data on sheet used for refurbishment, as opposed to new construction, cannot be identified from the available data and as such its usefulness as an indicator is questionable.

The available data on the present housing stock and/or the level of new construction in the housing sector, has been pulled together from a variety of sources and whilst we have made reference to the recent study carried out by PRC, for the Ministry of National Planning "Strategy for Meeting Housing Needs in Nigeria's Urban Centres" we have been obliged to develop our own forecasts for the housing sector in Nigeria for forthcoming years.

TABLE 6.5 : CONSUMPTION OF SELECTED BUILDING MATERIALS

Item	Unit	1975	1976	1977	1978	1979
Cement	Tonne	3,324	3,408	1,292	1,540	1,897
Roofing Sheets	Tonne	115	113	172	153	154
Iron Rods	Tonne	429	445			
Paints and Allied Products	Million Litres	27.7	30.4	30.0	34.7	34.6

Source: Central Bank (Ref. 14)

The first problem which arises when considering the housing sector is a question of the total population and, more particularly, the urban population within Nigeria. For the purpose of this project, we have taken for the total population the data used by the Ministry of National Planning and for the urban:rural split, we have adopted the same ratios as were adopted by PRC in the above mentioned study. On this basis, the total population is expected to rise from 74.4 million in 1975 to 96.1 million by 1985 and 109.1 million by 1990. A more detailed projection is contained in Appendix A to this report. The urban population is expected to rise as shown in Table 6.6.

TABLE 6.6 : ESTIMATED URBAN POPULATION OF NIGERIA

Year	Total Estimated Urban Population (Millions)
1975	16.33
1980	23.09
1985	29.87
1990	38.29

Source: Min. of National Planning

As was mentioned above, no comprehensive official estimates of the size and distribution of the stock of urban housing in Nigeria was found. As part of the study of selected urban centres, Doxiadia Associates estimated a total of 755,000 dwelling units in 20 cities as shown in Table 6.7, in a study carried out in the early 1970's. It is estimated that these 20 cities accounted for some 37% of the total urban population of Nigeria at the time. Based on this data, a total urban housing stock of 2.04 million dwelling units is implied.

In a more recent study, PRC estimate the total urban housing stock to be 2.98 million dwelling units in 1975 divided as shown in Table 6.8.

TABLE 6.7 : 1972 ESTIMATED NUMBER OF DWELLINGS AND DENSITIES IN SELECTED URBAN AREAS

City	Estimated Number of Dwellings	Density of Development	
		1972 Persons Per Acre	Equivalent Persons Per Hectare
Lagos	224,500	62.5	154
Ibadan	110,833	39.5	97
Kano	55,100	40.0	99
Ilorin	44,100	49.5	122
Port Harcourt	28,667	30.5	75
Kaduna	25,067	23.0	57
Maiduguri	20,333	51.0	126
Enugu	35,277	38.5	95
Benin City	28,950	28.5	70
Jos	21,067	25.0	62
Calabar	16,071	30.5	75
Sokoto	15,167	26.5	65
Aba	21,227	50.0	124
Onitsha	13,467	57.5	142
Abeokuta	34,693	52.0	128
Ondo	15,167	77.5	191
Zaria	18,624	24.0	59
Warri	11,400	68.5	169
Sapele	9,333	33.0	82
Ikot Ekpene	6,667	47.5	117
Total, 20 Cities	755,708	42.5	104

Source: Doxiades (Ref. 15)

TABLE 6.8 : ESTIMATED 1975 URBAN HOUSING STOCK

State	Estimated 1975 Urban Housing Stock
Anambra	140,600 dwelling units
Bauchi	92,500
Bendel	74,200
Benue	40,600
Borno	56,500
Cross River	75,200
Gongola	17,600
Imo	73,100
Kaduna	109,800
Kano	58,500
Kwara	105,300
Lagos	270,900
Niger	33,900
Ogun	177,500
Ondo	305,500
Oyo	789,500
Plateau	24,800
Rivers	92,100
Sokoto	99,800
Total Urban Nigeria Dwelling Units	2,984,600

Source: PRC (Ref. 16)

Within Nigeria, housing is divided into three broad groups, according to the Federal Office of Statistics classification. These groups are :

1. Cement block of brick walls roofed with asbestos or corrugated iron sheets.

2. Mud walls, plastered with cement and roofed with corrugated iron sheets.

3. Thatch, plant, corrugated iron or mud rendered walls, roofed with thatch, mud or mud vaulted.

Whilst the distribution of the existing dwelling units by type of building material varies considerably from one region to another, ranging from over 90% in group one in some areas to less than 1% in this category in other areas, a weighted sample would suggest that even in urban areas only some 30-40% of existing dwelling units are of group one classification.

When consideration is given to the available facilities within a dwelling unit, particularly the availability of electricity and plumbing systems (both for water supply and toilet facilities), both of which are of direct relevance in the context of this project, an even more divergent pattern emerges from one region of the country to another, as can be seen from Table 6.9.

In estimating future urban housing needs and effective demand, PRC in their study, based projections on two key concepts namely:

- Housing need is a measure of the number and quality of dwelling units required to accommodate households at certain standards defined to be acceptable.

- Effective demand is a measure of the number and quality of dwelling units which can be afforded by the population, given patterns of household income and expenditure, operation of the housing finance and delivery system and policies on subsidies.

TABLE 6.9 : POPULATION AND HOUSING QUALITY INDICATORS FOR REPRESENTATIVE URBAN AREAS

Location		Percent of Dwellings with Infrastructure Services			
		In-House or in-Compound Water Supply	Sewerage Disposal		Power
State	City		Pit Latrine	Flush Toilet	
SOUTHWEST					
Lagos	Lagos Metro	66.0	30	30	94
Oyo	Ibadan	33.4	66.9	25.2	56.1
	Iwo	20.4	-	8.0	26.2
	Ife	17.4	72.3	1.6	30.4
Ondo	Akure	23.8	57.1	1.6	37.7
	Ikare	66.5	38.1	-	-
	Ikerre				
Ogun	Abeokuta	25.3	25.4	9.3	47.[illegible]
	Ijebu-Ode				
	Shagamu				
Bendel	Benin City	24.9	95.0	4.0	59.3
	Sapele	52.3	15.2	8.9	80.3
	Warri	65.4	5.4	19.5	86.3
SOUTHEAST					
Rivers	Port Harcourt	73.0	0.4	18.6	79.0
	Nembe	1.3	-	-	-
	Nchia		86.0		
Imo	Owerri				
	Aba	63.3	3.1	3.6	70.8
	Umuaka	-	65.9	-	-
Anambra	Enugu	49.9	5.6	26.4	68.7
	Onitsha	65.0	3.6	21.1	70.7
	Afikpo	9.0	100.0	-	-
Cross River	Calabar	11.3	51.6	3.5	26.2
	Ikot-Ekpene	4.3	57.5	3.2	19.3
	Ugep	-	6.8	-	-
Benue	Makurdi	21.9	18.2	-	23.1
	Igarra	-	70.8	-	-
	Ankpa	-	-	-	-
NORTH					
Kwara	Ilorin	30.7	33.4	10.3	28.4
	Offa	15.5	29.6	4.3	23.0
	Lokoja	27.7	73.3	2.4	43.0
Niger	Minna	44.8	89.0	1.2	30.5
	Bida	65.1	95.9	0.6	38.7
	Kagera				
Sokoto	Sokoto	25.4	95.1	0.6	14.2
	Gusau	16.8	98.7	-	14.9
	Jega	37.4	99.5	-	2.0
Kaduna	Kaduna	73.0	77.7	14.1	53.3
	Katsina				
	Zaria	91.2	96.3	-	31.0
Kano	Kano	26.1	76.9	1.3	69.3
	Gumel	2.2	97.6	-	1.6
	Hadejia				
Bauchi	Bauchi	5.0	-	5.0	25.0
	Azare	17.6	98.8	0.3	18.8
	Gombe				
Plateau	Jos	73.0	48.8	4.8	61.8
	Keffi				
	Lafia	44.8	39.5	-	-
Borno	Maiduguri	14.0			
	Nguru	22.4			
	Kardam				
Gongola	Yola (Jemetta)				
	Numan				
	Mubi	38.9			

Source: PRC (Ref. 16)

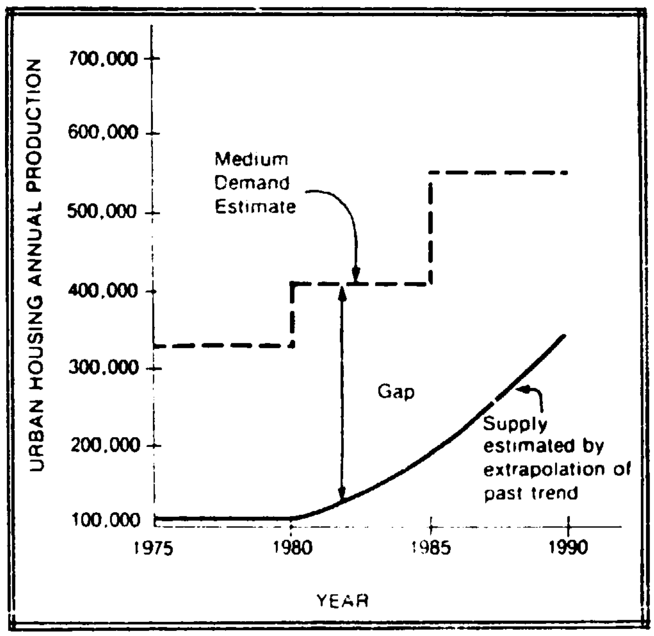
On the question of housing quality, it was assumed that an ultimate goal of urban housing strategy in Nigeria will be to provide one dwelling unit for each household. The question of what constituted an acceptable standard is certainly a difficult subject on which to generalise in Nigeria where climatic conditions, religious and historical factors play an important role in the housing pattern in various parts of the country. The recommended strategy however, was one which called for an improvement in housing conditions across the complete spectrum of income groups in Nigeria's growing urban population. The definition of what is truly low cost housing and medium cost housing was addressed with medium cost meaning ₦4,000-7,000 at 1980 price levels. On this basis it was estimated that in terms of the number of units required, some 55% would be in the medium cost category, 27% low cost and 19% would be high cost housing. The project called for a mixture of public and private initiatives in order to achieve the necessary level of new dwelling units and it called for a target national annual production of 440,000 dwelling units in 1985 of which 115,000 units annually should be low to medium priced units in the ₦4,000-7,000 category. On this basis, demand levels as shown in Figure 6.1 and Tables 6.10 were called for.

TABLE 6.10 : PRODUCTION TARGETS FOR 1985 (100,000 DWELLING UNITS)

Region	High Cost	Intermediate Cost	Low Cost	Total
North	20	45	30	95
Southwest	50	160	55	265
Southeast	15	35	30	80
TOTAL	85	240	115	440

Source: PRC (Ref. 16)

FIGURE 6.1 : FUTURE HOUSING DEMAND - NIGERIA



Source: PRC "Strategy for Meeting Housing Needs in Nigeria's Urban Centres" (Ref. 16)

The base data for the annual production of dwelling units in Nigeria was estimated from a variety of sources, based on the current housing stock, the inference from demographic factors, labour productivity in the construction sector and cross-country comparison with countries at varying stages of development. From all these it was concluded that the total housing production in Nigeria in 1975 was approximately 180,000 dwelling units with between 50% and 75% of these units being constructed in urban areas, even though such areas contain less than one-third of the population. It was acknowledged that there is no sound basis for assuming production levels have increased substantially in the 1975-80 period and it was further acknowledged that in the absence of positive Government action to encourage expansion of the housing sector, there was likely to be only a moderate increase in housing production in the Fourth Plan period.

The projections which were made in this study were based on the CPO's guidelines for the Fourth Plan which suggested that housing's share of GNP would increase from its present level of 4.3% to 4.7% by 1985 with GNP projected to grow in real terms by 8.5% annually. On this basis, a growth rate for the housing sector of 12% p.a. was calculated. This resulted in some 320,000 dwelling units being constructed in 1985. Through improved design and practices, making housing better meet the country's requirements, it was considered that the above total could be further increased with the possibility that if Nigeria could reproduce the success achieved in other countries, a 1985 potential production rate of some 690,000 dwelling units would be projected. This figure was reduced on the basis of unit housing costs in Nigeria still being significantly above the average population could afford (₦7,700 as opposed to ₦5,400) and for this reason the total demand figure was reduced to that shown in Table 6.10.

Whilst it is beyond the terms of reference of our own project to study this sector in detail, we have felt obliged to reduce the level of housing units completed from those shown in the above mentioned project. This has been done, firstly because overall growth rates have been somewhat modified subsequent to the guidelines for the Fourth National Development Plan (the basis on which the above mentioned forecasts were made) and because we cannot see the mobilisation of the necessary forces (neither in terms of financial resources nor manpower), to achieve such a rate of growth over such a short period of time. We have therefore assumed that the total level of urban housing completions in Nigeria in the period through to 1986 will be as shown in Table 6.11.

TABLE 6.11 : FORECAST OF CONSTRUCTION OF NEW HOUSING UNITS IN URBAN AREAS

Year	New Housing Units
1981	130,000
1981	140,000
1982	155,000
1983	170,000
1984	190,000
1985	210,000
1986	260,000

Based on the above mentioned breakdown by housing type, (in terms of high, medium and low income housing units), the numbers of the various housing types are shown in Table 6.12.

As far as copper consumption within this sector is concerned, electric and telephone wiring, along with electrical components, have been dealt with in other parts of this report. Within this sub-section we are concerned only with copper and brass hardware as used in the construction sector and in plumbing systems. In particular, within this sector, we are concerned with :

TABLE 6.12 : BREAKDOWN OF FURTHER URBAN HOUSING BY TYPE OF UNIT

Year	Number of Units		
	Low Cost	Medium Cost	High Cost
1980	39,000	71,500	19,500
1981	42,000	77,000	21,000
1982	46,500	85,300	23,200
1983	51,000	93,500	25,500
1984	57,000	104,500	28,500
1985	63,000	115,500	31,500
1986	70,000	143,000	47,000

- Brass, bronze, valves and taps
- Copper tubing
- Copper and brass fittings
- Brass hinges
- Brass locks, door and window fittings
- Brass screws, nuts and bolts
- Miscellaneous copper and brass fittings

In addition under this heading one would normally consider copper flashing and copper as used for architectural purposes. However, we have found no usage whatsoever in this area and do not expect any major usage to develop in the future.

Copper Tubing

Virtually all water supply piping used in Nigeria is of galvanised steel. Waste piping and some cold water piping is of PVC. The use of copper tubing in buildings in Nigeria at the present time is negligible. Some prestige buildings such as hotels have it, and hospitals use it for compressed air and other gases but beyond this and a very few very high cost houses, usage is insignificant.

The standard specifications for public works of the Ministry of Works and Surveys recommend copper piping but the Ministry does not insist on it and galvanised steel is specified as a less desirable but acceptable and less expensive alternative.

A number of reasons have been put forward for the non-use of copper in this sector. The more important are :

a) Copper tubing is much more expensive than galvanised steel. This applies even more so to brass fittings.

b) Nigerian plumbers know how to handle galvanised steel. Training them to use copper would be expensive.

c) Copper piping is easily damaged during construction, during fitting and when in use.

d) It is Nigerian construction practice to instal piping before internal finishes are applied, otherwise the plumbers would damage these finishes. If copper were installed instead of galvanised steel, this would be damaged during the application of finishes.

e) Copper tubing and fittings are not only expensive but also hard to obtain.

f) Galvanised fittings are manufactured to much wider tolerances than brass fittings so that even poor quality products and sloppy plumbers can produce a reasonably good job.

g) Galvanised pipe and fittings (threads) are more resistant to the malpractices and abuses which installers may inflict on them.

Nevertheless, some of those interviewed believe that copper piping will make headway in Nigeria in time, particularly if both the tubing and the fittings are produced locally.

In the latter respect, however, one must bear in mind that by the time any proposed copper mill would be in production, galvanised pipe may also have made its debut in Nigeria in terms of local production and as such, some of the cost differential that exists today could still remain.

Based on data collected during our survey prevailing prices of copper and galvanised steel tube of the type used in the plumbing sector are as shown in Table 6.13.

TABLE 6.13 : COMPARATIVE PRICES FOR PLUMBING TUBE

Material	BS	½" Pipe (per metre)
Copper	659/67	₦2.82
Galvanised Steel	1387	₦1.20

As can be seen from the data in Table 6.13, the price of copper tube is more than double the price of an equivalent galvanised steel tube. It is true that against this labour costs are somewhat less for copper with a ½" copper tube requiring around 0.4 hours per metre for installation, whilst a galvanised steel tube requires around 0.52 hours per metre of installation. Corresponding figures for a 2" tube are 0.72 hours and 0.98 hours respectively. Nevertheless this saving in installation cost is more than offset by the higher basic costs for both the tube and, even more importantly, the fittings.

As was mentioned above, the definition of low, medium and high cost dwelling units varies significantly within Nigeria. For the purpose of this exercise we have taken low cost housing as being within the bracket of ₦5,000 to ₦13,000, medium cost housing as being up to ₦40,000 and high cost housing as being above that level. Based on this data, the unit quantities of copper tube and brass fittings as shown in Table 6.14 has been developed. Based on a total construction of 260,000 housing units in 1986 and the breakdown between low, medium and high cost housing as discussed above, the total consumption of tube in plumbing and sanitation systems will be as shown in Table 6.15.

From Table 6.15 it can be clearly seen that whilst high cost housing accounts for less than 20% of the total number of units constructed it accounted for some 40% of total tube usage. As this sub-segment of the market is the one least sensitive to price, it should also be the sub-segment which can most readily be converted to copper tubing.

Without the introduction of strict control on the import of galvanised tube, we would doubt that the low and medium cost segment of the housing market could be converted to copper tube within the time horizon under consideration. Indeed, to convert all new high cost housing constructed in 1986 will, we believe, be extremely difficult, although through control on import duties, etc., it should be possible.

TABLE 6.14 : CONSUMPTION OF PLUMBING TUBE AND FITTINGS IN HOUSING SECTOR NIGERIA

Housing Type	Typical Price	M2	Tubing (M)	Taps (each)	Valves (each)	Fittings* (each)
1 bedroom low cost	7,500	30	8	1	2	3
1 bedroom low cost	10,000	40	10	2	3	5
2 bedroom low cost	13,000	50	10	2	3	5
3 bedroom medium cost	18,000	70	20	4	5	8
Medium cost	40,000	-	50	6	6	10
High cost	110,000	-	80	8	8	15

* Fittings include unions, reducers, elbows, ties

TABLE 6.15 : CONSUMPTION OF TUBE IN PLUMBING AND SANITARY SYSTEMS - NIGERIA 1986

House Type	Number of Units	Unit Tube Usage M	Total Tube Usage M
Low Cost	70,000	10	700,000
Medium Cost	143,000	25	3,575.000
High Cost	47,000	60	2,820,000
TOTAL	260,000		7,095,000

To the above tube quantities we believe a further two million metres of copper tube could be added to account for consumption in commercial and public sector building (offices, hospitals, etc.).

In both cases, in addition to the above mentioned consumption of copper tube the installation of this will necessitate the use of copper joints (elbows, tees, etc.), with ten such joints being used in each high cost house. Assuming a similar level of utilisation in commercial and public sector buildings a total of some 750,000 joints will be required in 1986.

On the basis of the above mentioned quantities (unit lengths) of tube required, a total potential exists for 2,086 tons of copper tube for the residential sector and 588 tons for the commercial and industrial sector. The amount of this potential which could realistically be achieved is we believe open to question.

In the absence of any positive action by the government and to promote usage of copper we believe the total amount of copper tube used in plumbing systems in Nigeria will be minimal; probably totalling 200 tons in 1986. For the purpose of this exercise, we have assumed 40% of the above potential is realised in 1986 equivalent to 1,070 tons of tube and some 7.5 tons of fitting.

Valves and Taps

This represents the largest sector of copper products in buildings. Virtually all valves and taps used for water distribution consist almost entirely of brasses and bronzes. Cast iron bodied valves are not generally available in sizes below 1½ inches.

A typical dwelling such as may be built in Nigeria in the latter 1980's will probably contain between one and eight taps and between two and eight valves depending on the type of unit. The valves will range from ½" to, say, 1½". If we assume an average weight of 0.5kg (typical for ¾" gate and globe valves), for valves and the same for the brass content of chromium plates taps, then each dwelling unit will contain the quantities of copper and copper alloys in these components as shown in Table 6.16.

TABLE 6.16 : USE OF COPPER AND COPPER ALLOYS, VALVES AND TAPS, NIGERIA 1986

Housing Unit Type	Number	Average Number		Total Weight (Tons)	
		Taps	Valves	Taps	Valves
Low Cost	70,000	2	3	70	105
Medium Cost	143,000	4	6	286	429
High Cost	47,000	8	8	188	188
TOTAL	260,000			544	722

Assumptions:
- 40% of weight valves are castings, balance rod
- 60% of weight taps are castings, balance rod
- Two-thirds of total requirements locally produced.

Prices in Nigeria for this type of product generally resemble those in the UK but those products purchased in Nigeria are generally of inferior quality frequently coming from Asia and other less developed countries. Clearly there is no reason why taps and valves should not be manufactured in Nigeria in the near future. Manufacture entails casting and machining operations based on relatively unsophisticated technology (Benin City has been casting bronze ornaments for centuries), and local production of some two-thirds of total requirements by 1986 is not unreasonable.

In addition, to the above mentioned products, the stems of larger cast iron valves in water mains are almost invariably made of brass, these, however, are unlikely to be manufactured in Nigeria in the foreseeable future.

A number of different materials are used for the various components, but for the purpose of this market study we can assume leaded 60/40 brasses and gunmetals averaging, say, 86% copper. On the average, valves and taps may thus contain 75% copper, in which case the copper content of valves and taps in the various types of residence will be as shown in Table 6.17.

Hinges

Nigerians use a lot of brass hinges on doors, furniture etc. These are easy to make but the development of domestic production will depend on the creation of a brass mill, otherwise the relatively high proportion of non-disposable scrap will make it uneconomical.

A typical high cost dwelling of the future may use, say, eight pairs of 4" hinges weighing altogether 3.5kg, together with screws. To this, one may add 1 kg for furniture hinges. In low and medium cost housing quantities are much lower and frequently no brass hinges are used at all.

If we assume that 50,000 better residences will be furnished with brass hinges per year, then this will amount to 225 tons of 60/40 brass or 135 tons per year of copper. Offices and public buildings, along with lower cost housing, may account for a further 20 tons per year copper content, giving a grand total of some 150 tons p.a. of copper in this sub-segment.

TABLE 6.17 : CONSUMPTION OF COPPER AND COPPER ALLOYS - TAPS AND VALVES 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod	717	40	287	430	75	323
Alloy Strip						
Alloy Tube						
Castings	406	-	-	406	75	305
Total						628

Assumption:

Commercial and industrial buildings will create a demand for 50% of demand in the residential sector.

TABLE 6.18 : IMPORTS OF LOCKSMITH WARES

	1974		1975		1976		1977		1978	
	Pieces Million	N Million	Pieces Million	N Million	Pieces Million	N Million	Pieces Million	N Million	Pieces Million	N Million
Door Locks	0.54	4.13	0.93	7.04	1.34	10.24	1.6	12.1	2.43	18.5
Pad Locks	0.17	0.40	0.3	.68	0.39	0.9	0.48	1.10	0.78	1.8
Hinges	1.02	0.66	1.7	1.10	2.62	1.7	2.9	1.9	4.8	3.1
Hasps and Staples (pair)	0.17	0.33	0.29	0.55	0.42	0.8	0.47	.9	2.07	1.5
Latches (door and window bolt types)	0.46	0.99	0.78	1.70	1.15	2.50	1.34	2.9	0.77	4.5
Door Handles	0.18	0.07	0.27	.10	.041	0.20	0.51	0.20	.012	0.30
Door Reclosers	0.002	0.06	0.03	0.08	.06	0.16	.006	0.16		0.30
Others		0.02		.05		.10		.10		.10
Total Metric tonnes	5,006		5,800		9,051		8,836		13,474	
Total Imports		6.66		11.3		16.60		19.46		30.1

Source: NISER (Ref. 17)

TABLE 6.17 : CONSUMPTION OF COPPER AND COPPER ALLOYS - TAPS AND VALVES 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod	717	40	287	430	75	323
Alloy Strip						
Alloy Tube						
Castings	40[illegible]	-	-	406	75	305
Total						628

Assumption:

Commercial and industrial buildings will create a demand for 50% of demand in the residential sector.

TABLE 6.19 : LOCAL PRODUCTION OF LOCKSMITH WARES

	1975		1976		1977		1978		1979		1980	
	Pieces Millions	N Millions	Pieces Millions	N Millions	Pieces Millions	N Millions	Pieces Millions	N Millions	Pieces Millions	N Millions	Pieces Millions	N Millions
Door Locks	0.23	1.73	0.36	2.73	0.03	3.79	0.40	3.03	0.53	4.09	0.34	2.62
Pad Locks	.07	0.17	0.11	0.26	0.12	0.27	0.13	0.29	0.17	0.39	0.11	0.25
Hinges	0.43	0.28	0.66	0.44		0.45	0.69	0.49	1.02	0.66	0.62	0.40
Hasps and Staples (pair)	0.23	0.14	0.36	0.22	0.36	0.22	0.39	0.24	0.54	0.33	0.33	0.20
Latches (door and window bolt type)	0.19	0.42	0.30	0.66	0.30	0.67	0.33	0.73	0.45	0.99	0.29	0.69
Door Handles	0.08	0.03	0.11	0.04	.11	0.04	0.14	0.05	0.16	0.06	0.11	0.04
Door Reclosers	0.05	0.02	0.001	0.04	0.001	0.04	.002	0.05	0.002	0.06	0.001	0.04
Others		0.01		0.01		0.02		0.02		0.02		0.02
Total		2.8		4.4		4.5		4.9		6.6		4.26

SOURCE: NISER (Ref. 17)

TABLE 6.20 : DEMAND PROJECTION FOR LOCKSMITH WARES

	1979		1980		1981		1982		1983		1984		1985	
	Pieces Millions	N Millions	Pieces Millions	N Millions	Pieces Millions	N Millions	Pieces Millions	N Millions	Pieces Millions	N Millions	Pieces Millions	N Millions	Pieces Million	N Millions
Door Locks	3.4	27.4	4.0	31.7	5.0	39.7	6.2	49.6	7.7	62.0	9.7	77.5	12.09	96.03
Pad Locks	0.54	2.7	0.62	3.1	0.76	3.8	0.96	4.8	1.2	6.0	1.5	7.5	1.9	9.2
Hinges	6.4	4.4	5.1	5.1	6.4	6.4	8.0	8.0	10.0	10.0	12.5	12.5	15.6	15.2
Hasps and Staples (pair)	3.7	2.2	4.2	2.5	5.3	3.2	6.7	4.0	8.3	5.0	10.3	6.2	13.0	7.6
Latches (door and windo bolt type)	2.6	6.6	3.1	7.7	3.8	9.6	4.8	12.0	6.0	15.0	7.5	18.75	9.4	23.7
Door handles	0.5	0.4	0.7	0.51	0.9	0.64	1.1	0.8	1.4	1.0	1.8	1.25	2.2	1.2
Door reclosers	0.01	0.4	0.02	0.5	0.02	0.64	.03	0.8	0.03	1.0	.04	1.25	.05	1.0
Total		44.2		51.2		64.0		80.0		100	125			156.0

Source: NISER (Ref. 17)

TABLE 6.21 : CONSUMPTION OF COPPER AND COPPER ALLOY PRODUCTS - LOCKSMITHS 1986

Item	Total Semis Required Tons	Scrap		Total Metal Content Tons	Copper Content	
		%	Tons		%	Total
Copper Wire						
Winding Wire						
Copper Rod						
Copper Strip						
Copper Tube						
Alloy Wire						
Alloy Rod	70.5	15	10.5	60	70	42
Alloy Strip	18.8	20	3.8	15	70	11
Alloy Tube						
Castings	5	-	-	5	70	4
Total						57

Locks and Builders' Hardware

The imports of locks and other builders' hardward is summarized in Table 6.18 . As can be seen from this Table imports have grown quite significantly through the 1970's along with a growth in local production as shown in Table 6.19.

The demand projection shown in Table 6.20 is taken from a project carried out by Niser in this sub-sector and is their projection of future demand in Nigeria for locksmiths' ware. Based on these totals, and assuming some 15% of the door locks and padlocks of a type using significant quantities of brass and other copper alloy products, we project the demand for copper and copper alloy semi finished products in this sector to be as shown in Table 6.21.

There is already a significant activity within this sector in Nigeria and we would see no reason why the whole of the abovementioned copper and copper alloy lock components should not be manufactured in Nigeria by 1985/86.

Within the builders hardware and related sectors there are a variety of other items in which small quantities of copper and copper alloy products are used. Many of these products most probably will not be manufactured in Nigeria in the forseeable future while other consume such small quantities of copper as to make detailed consideration of them irrelevant.

In Table 6.22 the expected consumption of copper and copper alloy products within this sub-sector in 1986 is shown.

TABLE 6.22 : SUMMARY OF REQUIREMENTS FOR SEMIS CONSTRUCTION SECTOR 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Plumbing Tube						1189*						
Plumbers Fitting						8						
Hinges										257		
Locks and builders hardware									71	19		
Taps and Valves									717			406
Total						1197			788	275		406

* Scrappage assumed at 10%.

APPENDIX A

APPENDIX A

Macro Economic Forecasts of Copper Semis

The consumption of copper semis can be correlated with both GDP and electric power consumption. These correlations will be considered in greater detail in Volume 3 of this study.

Figure A.1 shows log/log plots of per capita semis consumption against against per capita GDP for a number of countries over a period of 10 years for each country. The curve drawn is at least square fit of the data. The data for this figure and for Figure A.2 is contained in Table A.1

Table A.2 gives the Nigerian GDP (or contact 1977 prices). Data is calculated from the Fourth Plan guidelines. The population figures listed are taken from information supplied by the Nigerian Ministry of National Planning and have been used to calculate per capita GDP in Naira. This has been converted to US$ at the 1977 exchange rate of $ = N0.651. It is now possible to read of from the graph per capita consumption of copper semis and convert this to total consumption.

Figures A.2 shows log/log plots of per capita semis consumption against per capita power consumption for a number of countries over a period of 10 years for each country. The curve shown is a least squares fit of the data.

Table A.3 lists total power consumption in Nigeria from NEPA data. Per capita power consumption has been calculated from official population data. The per capita semis consumption has been taken from Figure A.2 and used to calculate total consumption.

Figure A.3 compares the two forecasts. During the early years the estimates do not compare well but over the period of interest to this project, 1985-1990, the two estimates compares well considering the uncertainty of estimates are based and the country to country variations shown in Figure A.1 and A.2.

TABLE A.1 : ELECTRICITY PRODUCTION AND CONSUMPTION OF COPPER AND COPPER ALLOY SEMI-FINISHED PRODUCTS

Country	Nos.	GNP 1978 US$ Mil.	Electricity Prd'n 1979* KwH Mil.	Semis Consumption 1979 Metric Tons	Population '000 mid-year Estimate 1978	GNP Per Capita 1978 (US $)	Electricity Production Per Capita KwH	Semis Consumption Per Capita
Nigeria	1	45,720	5,196	6,035	81,039	560	64	0.074
Austria	2	52,720	40,464	72,859	7,498	7,030	5,397	9.717
Belgium	3	89,520	52,260	105,368	9,870	9,070	5,295	10.676
Switzerland	4	76,050	42,708	151,039	6,286	12,100	6,794	24.027
Australia	5	113,830	93,696	100,000	14,366	7,920	6,522	6.961
Venezuela	6	40,710	23,051	14,097	13,965	2,910	1,651	1.009
Canada	7	216,090	352,308	271,935	23,568	9,170	14,949	11.538
France	8	439,970	241,128	648,327	53,182	8,270	4,534	12.191
Italy	9	218,320	180,528	549,083	56,800	3,840	3,178	9.667
Netherlands	10	117,190	64,452	149,618	13,971	8,390	4,613	10.709
Spain	11	128,920	105,408	177,970	36,655	3,520	2,876	4.855
West Germany	12	587,700	374,220	934,428	61,212	9,600	6,114	15.265
Japan	13	836,160	581,436	1,654,761	114,053	7,330	5,098	14.509
USA	14	2,117,890	2,247,372	2,914,456	218,373	9,700	10,291	13.346
United Kingdom	15	281,090	299,856	631,743	55,918	5,030	5,362	11.298
Yugoslavia	16	52,340	54,780	98,316	21,933	2,390	2,498	4.483
Hong Kong	17	14,050	10,128	31,688	4,622	3,040	2,191	6.856
Scandinavia	18	206,040	241,248	250,105	25,174	8,184	9,583	9.935
Peru	19	12,440	8,557*	14,780+	16,820	740	509	0.879
Philippines	20	23,250	13,764	4,200+	45,639	510	302	0.092
Zaire	21	5,510	4,100*	2,600+	26,410	210	155	0.098
Zambia	22	2,530	7,884*	2,161+	5,295	480	1,489	0.408

* Electricity: All 1979 figures, except : Peru, Zaire, Venezuela } 1977; Zambia – 1978

\+ Consumption of refined copper, average 1978/79

Source: UN Statistics (Ref. 6)

TABLE A.2 : ESTIMATION OF COPPER SEMIS CONSUMPTION IN NIGERIA FROM GDP

Year	GDP[1] 1977 Price billions N	Population[2] Millions	Per Capita GDP N	Per Capita GDP $	Per Capita Semis Consumption kg/yr	Total Semis Consumption t/yr ('000s)
1975	21.9	74.4	294	452	0.16	11.9
1976	24.6	76.6	321	493	0.18	13.9
1977	26.7	78.6	340	522	0.20	15.7
1978	28.2	80.6	350	538	0.21	16.9
1979	30.6	82.6	370	568	0.23	19.0
1980	33.1	84.7	391	601	0.26	22.0
1981	36.0	86.9	414	636	0.28	24.3
1982	38.8	89.1	435	668	0.31	27.6
1983	42.1	91.4	461	708	0.35	32.0
1984	45.7	93.7	488	750	0.39	36.5
1985	49.7	96.1	517	794	0.43	42.4
1986	53.5	98.6	542	833	0.47	46.3
1987	57.5	101.1	569	874	0.50	50.6
1988	62.0	103.6	598	919	0.55	57.0
1989	67.0	106.3	630	968	0.59	62.7
1990	72.0	109.1	660	1,014	0.64	69.8

SOURCES:

1. Nigerian 4th Plan guidelines (1975-1985)
   Metra estimate 1985-1995 (Ref. 11)
2. Nigerian Ministry of National Planning
3. Figure A.1

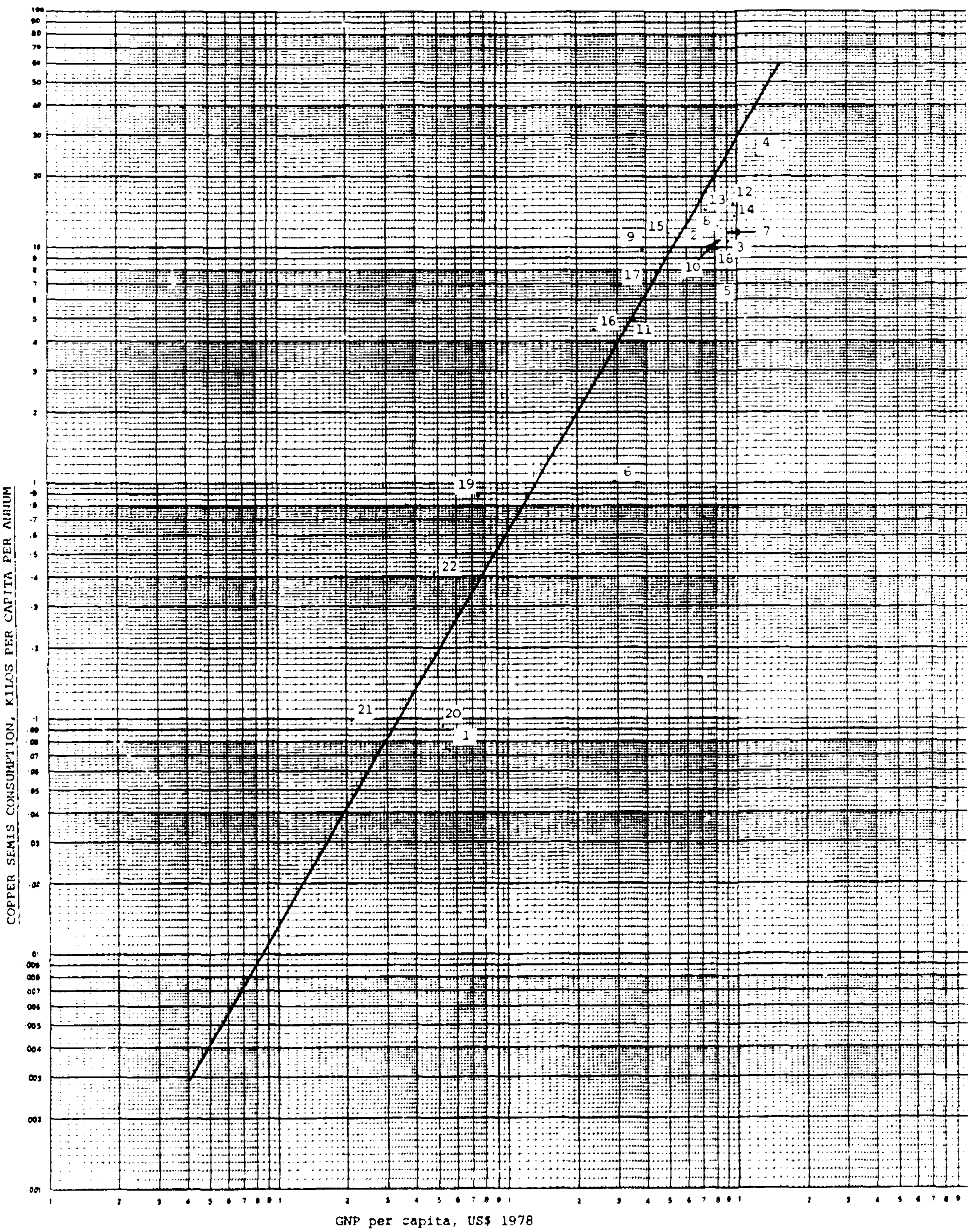
TABLE A.3 : ESTIMATION OF COPPER SEMIS CONSUMPTION IN NIGERIA FROM POWER CONSUMPTION

Year	Power Consumption[1] 10^9 KwH	Population[2] millions	KwH Per Capita	Per Capita[3] Semis Consumption kg/yr	Total Semis Consumption '000 t/yr
1975	2.65	74.4	35.6	0.053	3.9
1976	3.23	76.6	42.2	0.065	5.0
1977	3.79	78.6	48.2	0.076	6.0
1978	4.04	80.6	50.1	0.080	6.4
1979	4.41	82.6	53.4	0.086	7.1
1980	5.48	84.6	64.7	0.105	8.9
1981	7.11	86.9	81.8	0.135	12.0
1982	8.76	89.1	98.3	0.168	15.0
1983	10.56	91.4	115.5	0.200	18.3
1984	13.09	93.7	139.2	0.255	23.9
1985	14.99	96.1	156.0	0.285	27.4
1986	17.39	98.6	176.4	0.330	32.5
1987	20.21	101.1	200.0	0.380	38.4
1988	23.50	103.6	226.8	0.440	45.6
1989	27.55	106.3	259.2	0.510	54.2
1990	32.0	109.1	293.3	0.600	65.5

SOURCES:

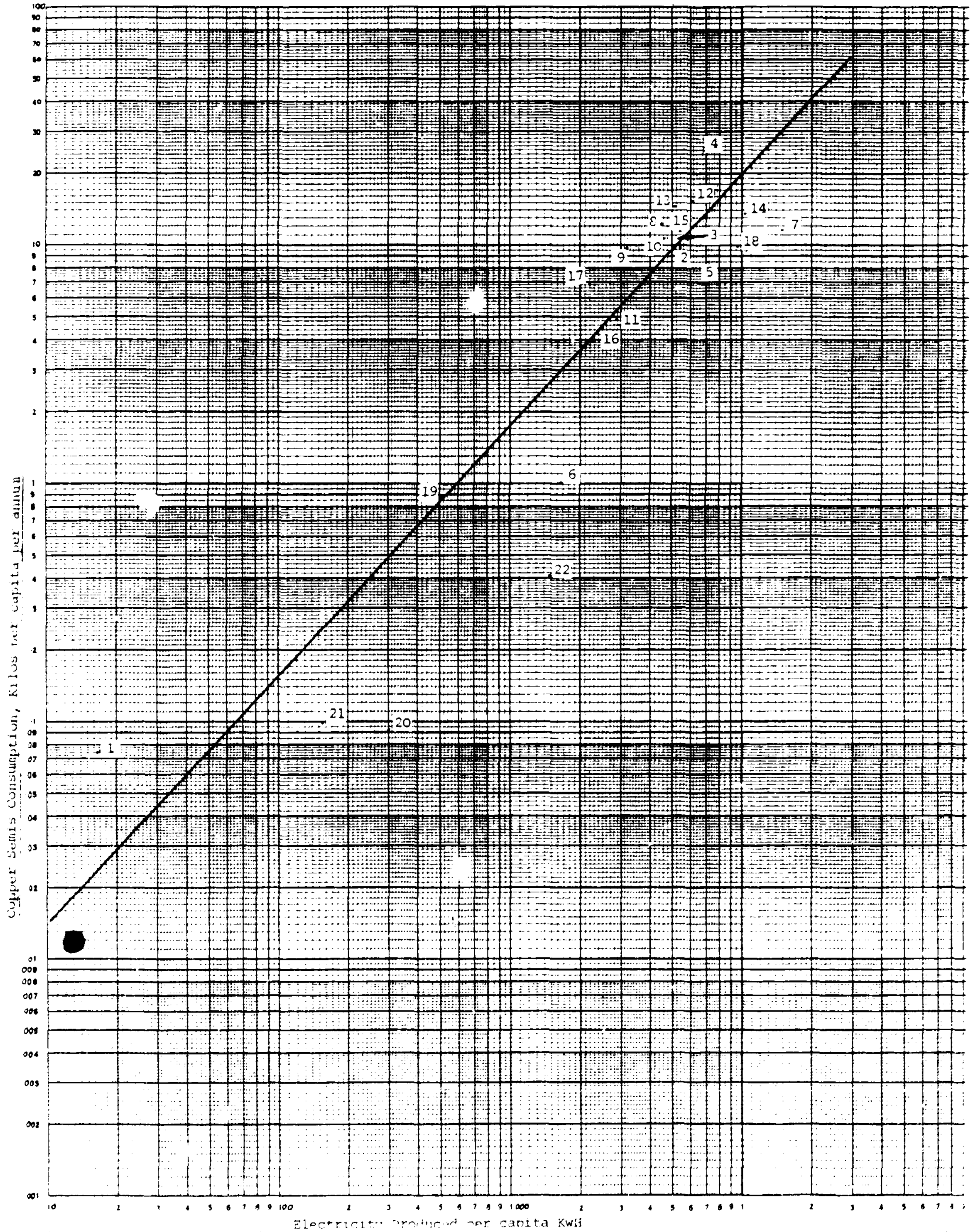
1. 1975-1978 NEPA Actual Production
   1978-1989 NEPA Forecasts
   1990 METRA estimate
2. Nigerian Ministry of National Planning
3. From Figure A.2

FIGURE A.1 : COPPER CONSUMPTION RELATED TO GDP, IN VARIOUS COUNTRIES



Sources: CIDEC (Ref. 10)
UN Statistics (Ref. 6)

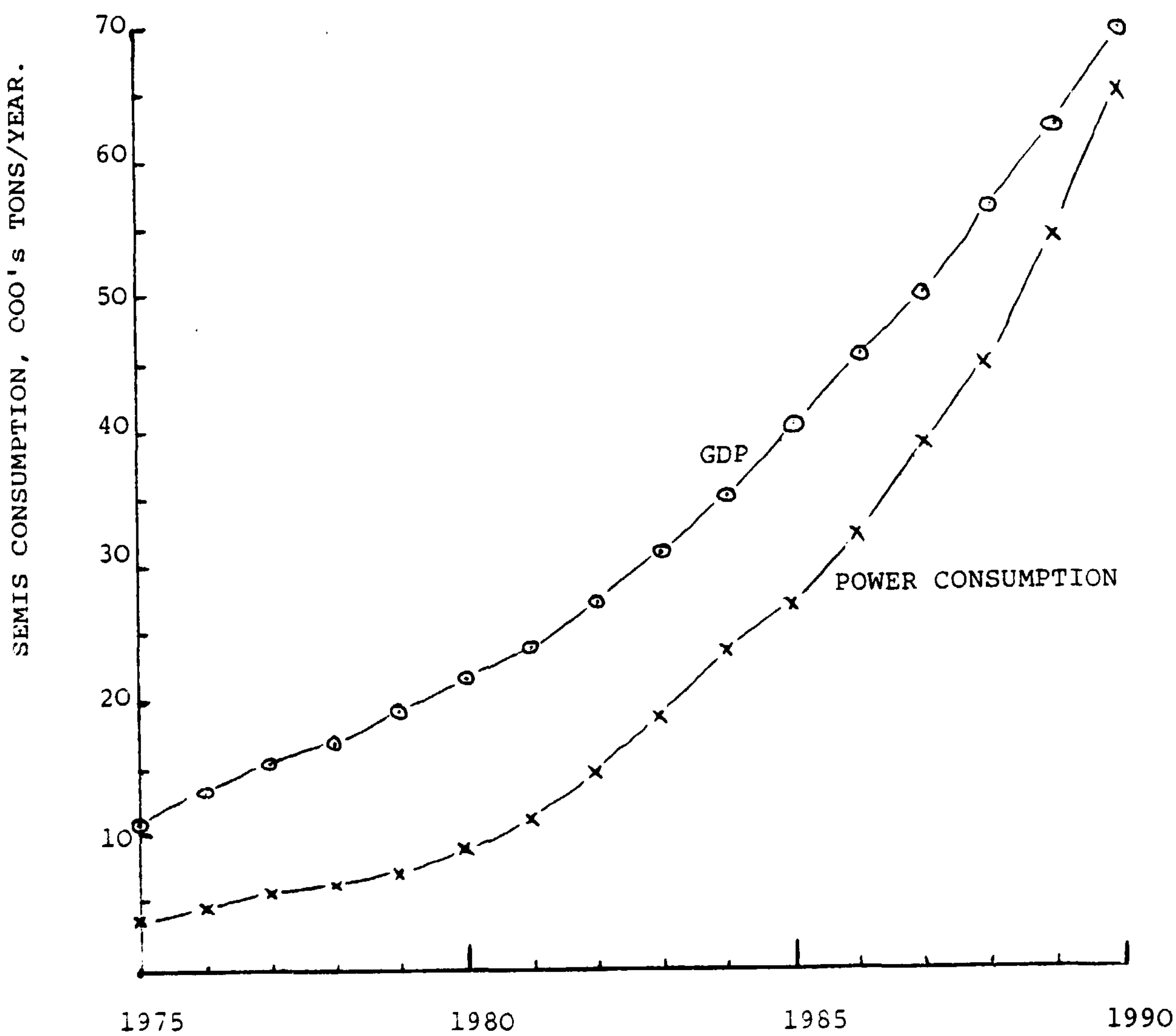
FIGURE A.2 : COPPER CONSUMPTION v ELECTRICITY, INTER-COUNTRY COMPARISONS

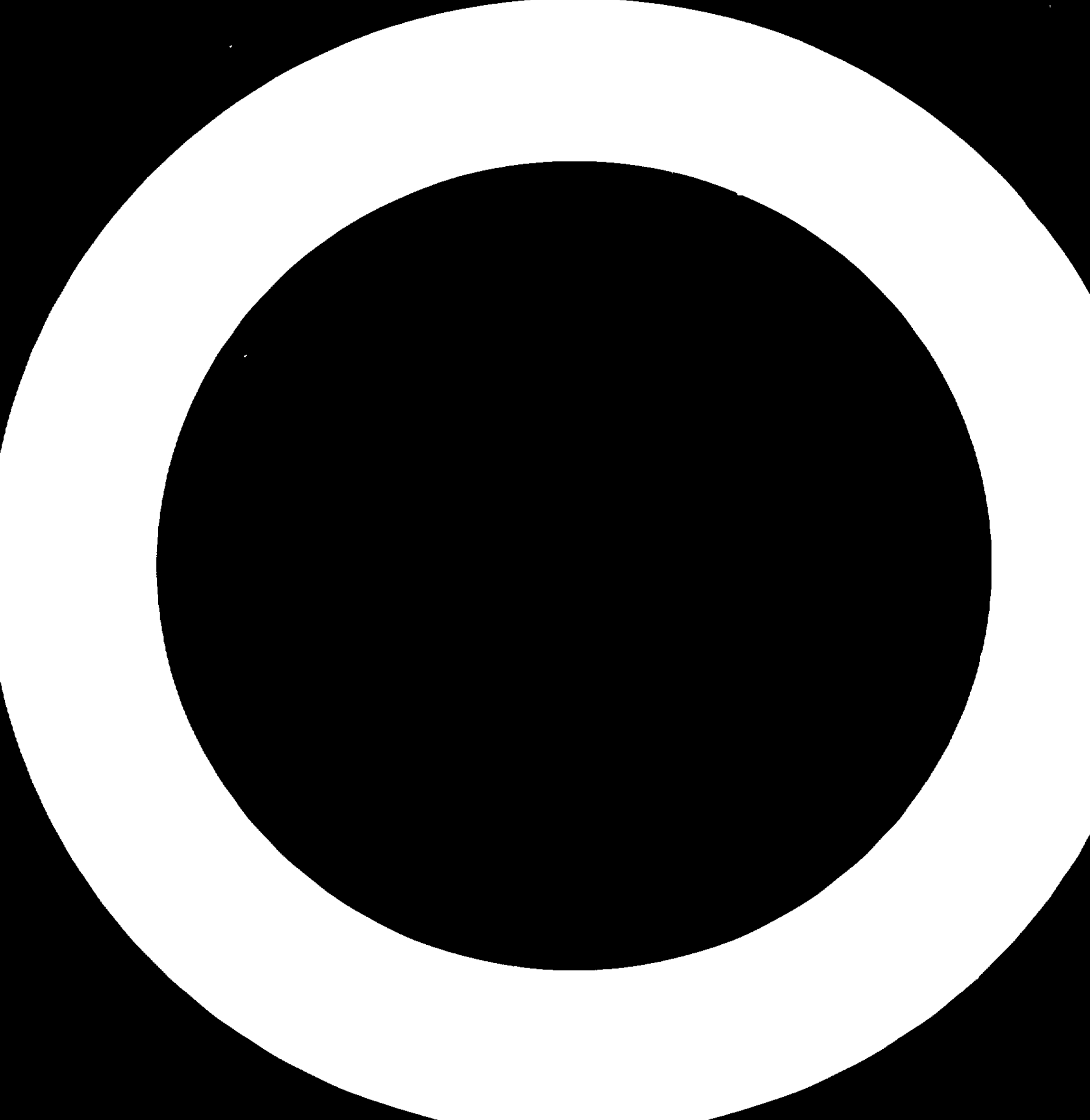


Sources: CIDEC (Ref. 10)
UN Statistics (Ref. 6)

FIGURE A.3

Forecasts of total semis consumption in Nigeria
Estimated from per capita GDP and per capita
power consumption.





APPENDIX B: BIBLIOGRAPHY

BIBLIOGRAPHY

Reference Number	
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2	Nigerian Trade Summaries - Federal Office of Statistics (Annually)
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14	Annual Report, Central Bank of Nigeria - 1979

Reference Number

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12495
(2 of 4)

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12495
(2 of 4)

United Nations Industrial Development Organisation

FEASIBILITY STUDY IN NIGERIA AND ZAMBIA ON THE ESTABLISHMENT OF A COPPER FABRICATION PLANT IN NIGERIA.

VOLUME 2 : EXPORT MARKET STUDIES

Draft Final Report

Prepared by Metra Consulting Group under Contract 80/154 (Project Number DP/RAF/79/006)

METRA CONSULTING GROUP LIMITED

St. Mary's House
42 Vicarage Crescent
London SW11 3LD

TELEPHONE: 01-223 7634
TELEX: 919173 MCGLDN G

CONTENTS

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MJE:RSH:JEB:AC:jaf
June 1981

ABBREVIATIONS

The following abbreviations have been used throughout this report.

LME	London Metal Exchange
Comex	Commodity Exchange (New York)
SKD	Semi-knocked down
CKD	Completely knocked down
NEPA	Nigerian Electric Power Authority
NNPC	Nigerian National Petroleum Company
RE	Rural Electrification
FMI	Federal Ministry of Industries
FMNP	Federal Ministry of National Planning
KV	Kilo Volts
GNP	Gross National Product
GDP	Gross Domestic Product
MW	Megawatt
KwH	Kilowatt Hour
GwH	Gigawatt Hour
V	Volts
MVA	Mega Volt Ampere
KVA	Kilo Volt Ampere
kg	Kilogramme
km	Kilometre
g	Gramme
HT	High Tension (Cables)
MT	Medium Tension (Cables)
LT	Low Tension (Cables)
sq.	Square
p.a.	per annum
p.m.	per month
p.w.	per week
hp	Horsepower
BSD	Standard Barrels per day
DDB	Dodecylbenzene
PVC	Polyvinylchloride
AC	Alternating Current
DC	Direct Current
k.cal	kilo-calories
KW	Kilowatt
ft.	Feet
ins.	Inches
m	metres
cm	centimetres
mps	metres per second
od	outside diameter
wt	wall thickness
amp	Ampere

rpm	revolutions per minute
fpm	feet per minute
BTU	British Thermal Units
SCF	Standard Cubic Feet
fob	free on board
cif	carriage, insurance and freight
₦	Naira
$	Dollars

1. INTRODUCTION

This project has been carried out under the terms of contract 80/154 between United Nations Industrial Development Organisation (UNIDO) and Metra Consulting Group. The project, DP/RAF/79/006 was initiated in response to a request from the Governments of Nigeria and Zambia to UNIDO to provide assistance in carrying out a project entitled "Feasibility Study on the Establishment of a Copper Fabrication Plant in Nigeria".

Under the terms of the above mentioned contract, four report documents are to be submitted. The first report, concerned with the demand for copper and copper alloy semi-finished products in Nigeria has already been submitted to the United Nations Industrial Development Organisation.

This report, which deals primarily with export opportunities for the new plant, but also includes a brief review of the world copper industry and trade in semi-finished products, as a means of placing in context the proposed Nigerian venture, comprises the second report in the series. Subsequent reports will be :

Feasibility Study

Executive Summary

As is clearly shown in the following sections of this report, at first sight, world trade in copper and copper alloy semi-finished products appears to be quite large. A closer examination, however, reveals that a significant part of this trade is trade within small trading blocs and as such the total "available" market in the strictest sense tends to be much more limited.

In overall terms, as a market for copper and copper alloy semi-finished products, Africa has tended to remain relatively stagnant in recent years. However, individual countries have exhibited significantly different consumptions with some countries exhibiting a relatively high rate of growth, whilst others have shown significant decline in their consumption patterns due, generally, to internal economic problems and changing conditions.

2. WORLD COPPER INDUSTRY

It is estimated that 0.007% of the earth's crust is comprised of copper occuring in a variety of mineral forms. The most important group of ores are the sulphides, these account for around 95% of world production and one of these ores, chalcopyrite, is believed to account for over half the world production. Other groups of ores which are important are the oxides and carbonates. Whilst it is true that the copper content of these different groups of ores varies quite significantly, this is a relatively unimportant criterion in determining whether or not a particular deposit is viable. Over the years the average copper content of ores mined has decreased quite significantly, even over the past fifteen years the average ore content has decreased from 1.5% copper content to 0.85%. This trend is linked with the development of new mining and processing equipment which has meant that many lower grade deposits are now commercially viable. Indeed, in British Colombia one ore body of 0.2% copper content is now being mined and this is said to be a commercially viable proposition. Sometimes, however, the true commercial picture of these low grade ore bodies is somewhat coloured and many are only commercially viable because of the quantities of other valuable metals such as gold and silver which are present.

The first part of this chapter sets out to examine the supply and demand situations for copper on a world basis, both historically and in the future. From this analysis, which examines not only primary production but also secondary production from scrap, it is found that the world will move from a theoretical surplus to a deficit situation as one goes through the 1980's. The surplus, it should be emphasised, is however only a theoretical surplus based on assumptions that the growth of demand does not exceed that experienced over the past decade, that exports from the West to the Communist Bloc countries do not radically increase and that new mining developments come on-stream at the planned date.

Subsequent chapters are devoted to world trade and possible export opportunities for the new Nigerian company in a selected range of neighbouring countries.

2.1 Supply and Demand

Copper is virtually indestructible, being "lost" only when used in chemical compounds and a few other chemical applications. This indestructibility results in metal being continually re-circulated from obsolete plant, process scrap, etc. This continuous recirculation means that there is a second source of supply in addition to mined raw material. The two sources of supply are commonly referred to as primary production, that is production of newly mined copper, and secondary production which is the metal derived from scrap. The relative importance of these two sources of supply can be clearly seen from Table 2.1 which gives details of mine production and secondary copper, both refined and used for alloying, etc., for the decade 1969-1979.

Whilst there are some 65 countries of the world mining copper on a significant scale (more than 500 tonnes copper content), in the majority of cases, annual outputs total less than 10,000 tonnes. Indeed, in only around half of the above total of countries, are annual outputs of copper in excess of 10,000 p.a. and it is only in these countries where there are facilities for treatment of the ore. In most of the other cases, the ore is sold either as ore, concentrate, cement or matte to a country with facilities for processing this through to blister copper and/or refined copper. As can be seen from Table 2.2, it is however from some 12 or 14 countries that the major portion of output comes. Indeed, the top six producers in the Western world account for some 75% of free-world mine production.

As can be seen from Tables 2.1 and 2.2, mine production has risen quite significantly between 1969 and 1979. This growth, however, has not been even. On the one hand the African countries have outputs which have remained relatively static. North American producers have likewise remained static cutting back from 1974 to off-set the small growth of the early 1970's. Indeed, it is in Central and South America and Oceana where the major growth in output has occurred along with a limited growth in Asia and perhaps, surprisingly, in Europe.

TABLE 2.1 : WORLD COPPER SUPPLY, 1969-1979 ('000 TONS)

Year	Mine Production	Secondary Refined	In Scrap	Total
1969	4,837	1,107	2,264	8,208
1970	5,164	1,138	2,118	8,420
1971	5,113	960	2,173	8,246
1972	5,644	973	2,271	8,888
1973	6,032	1,039	2,542	9,613
1974	6,148	1,147	2,298	9,593
1975	5,722	885	1,814	8,421
1976	6,162	954	2,205	9,321
1977	6,286	924	2,181	9,391
1978	6,091	1,001	2,293	9,385
1979	6,135	1,253	2,390	9,778

TABLE 2.2 : WORLD MINE PRODUCTION BY REGION/COUNTRY

Area	1969	1974	1975	1976	1977	1978	1979
Europe	205	282	296	298	299	298	264
Africa :	1,278	1,493	1,463	1,475	1,457	1,371	1,286
Zambia		698	677	709	656	643	588
Zaire		500	495	444	482	424	399
South Africa		179	179	197	205	209	203
Asia :	328	456	456	482	507	491	505
Philippines		225	225	238	273	263	297
Indonesia		65	64	69	57	58	56
North America :	1,921	2,270	2,016	2,188	2,123	1,999	2,088
USA		1,449	1,282	1,457	1,364	1,352	1,444
Canada		821	734	731	759	647	644
Central/South America	974	1,215	1,103	1,326	1,498	1,499	1,573
Chile		902	828	1,005	1,056	1,034	1,061
Peru		212	181	220	341	364	397
Mexico		83	78	89	90	87	110
Oceana :	131	435	392	395	404	418	406
Australia		251	219	219	222	219	235
Papua New Guinea		184	173	177	182	199	171
TOTAL	4,837	6,148	5,722	6,162	6,286	6,097	6,124

Note: Totals do not add exactly due to rounding

TABLE 2.3 : COPPER USAGE BY SOURCE

Year	Total Refined Production A	Refined Production From Scrap B	Refined Production Primary Metal C	Scrap Used Non-Refined D	Total Copper Used E	% of Total Originating From Scrap (B+D)/E	% of Total Refined From Scrap B/A	% of Total Which is Refined From Scrap B/E	% of Total Non-Refined Scrap D/E
1954	3,028	499	2,529	1,344	4,372	42.1	16.5	11.4	30.7
1955	3,323	573	2,750	1,530	4,853	43.3	17.2	11.8	31.5
1956	3,512	572	2,940	1,439	4,951	40.6	16.3	11.5	29.1
1957	3,516	514	3,002	1,357	4,873	38.4	14.6	10.6	27.8
1958	3,428	528	2,900	1,318	4,746	38.9	15.4	11.1	27.8
1959	3,603	593	3,010	1,509	5,112	39.4	16.5	9.9	29.5
1960	4,194	673	3,521	1,476	5,670	37.9	16.0	11.9	26.0
1961	4,276	660	3,616	1,513	5,789	37.5	15.4	11.4	26.1
1962	4,384	682	3,702	1,556	5,940	37.7	15.6	11.5	26.2
1963	4,440	668	3,772	1,679	6,119	37.1	15.0	9.7	27.4
1964	4,759	741	4,018	1,904	6,663	39.7	15.6	11.1	28.6
1965	5,056	861	4,195	1,969	7,025	40.3	17.0	12.3	28.0
1966	5,187	959	4,228	1,936	7,123	40.6	18.5	13.4	27.2
1967	4,781	866	3,915	1,866	6,647	41.1	18.1	13.1	28.0
1968	5,403	953	4,450	1,974	7,377	39.7	17.6	12.9	26.8
1969	5,860	1,101	4,759	2,123	7,983	40.4	18.8	13.8	26.6
1970	6,110	1,138	4,972	2,118	8,228	39.6	18.6	13.8	25.7
1971	5,773	954	4,819	2,165	8,728	35.7	16.5	10.9	24.8
1972	6,383	973	5,410	2,272	8,655	37.4	15.2	11.2	26.2
1973	6,684	1,040	5,644	2,544	9,228	38.8	15.5	11.2	27.5
1974	6,949	1,144	5,805	2,351	9,300	37.5	16.4	12.3	25.2
1975	6,263	885	5,378	2,699	8,962	39.9	14.1	9.8	30.1
1976	6,645	954	5,691	3,162	9,807	41.9	14.3	9.7	32.2
1977	6,873	928	5,945	3,087	9,960	40.3	13.5	9.3	30.9
1978	6,919	1,001	5,918	3,310	10,229	42.1	14.4	9.7	32.3
1979	7,041	1,158	5,883	3,605	10,646	44.7	16.4	10.8	33.8

It has already been mentioned above that copper is virtually indestructible and there is therefore a constantly recirculating volume of metal. This recirculating metal is of two types commonly referred to as new and old scrap. New scrap is obtained as a result of processing copper to semi-finished and finished products. Old scrap is metal obtained from obsolete plant, machinery, etc. Generally speaking, new scrap is of a much better quality than old scrap, is obviously much easier to sort, and therefore very often directly re-used. Copper scrap is much easier to re-use than the scrap of many other metals and there are many purposes where the purity of the copper and copper alloy scrap is not critical. The most important of these uses is in casting where products can be made by simply remelting the scrap, alloying and casting. In these applications there is no need for refining. The quantity of copper scrap recirculated is much more, in percentage terms, than for other metals. For copper, scrap accounts for some 35-40% of total consumption. By comparison aluminium scrap accounts for only 20% of total consumption. The high relative importance of copper scrap is due to a number of factors including its easier re-use relative to most metals, the increase quantity in use, compared with, for example, aluminium for which consumption is now almost equal, the fact that in many individual applications it is used in large quantities, examples are cables, tubes in buildings and heat exchangers and not least of all its relative price. The importance of copper scrap means that any review of the future situation with respect to copper supplies would be incomplete without giving due consideration to scrap.

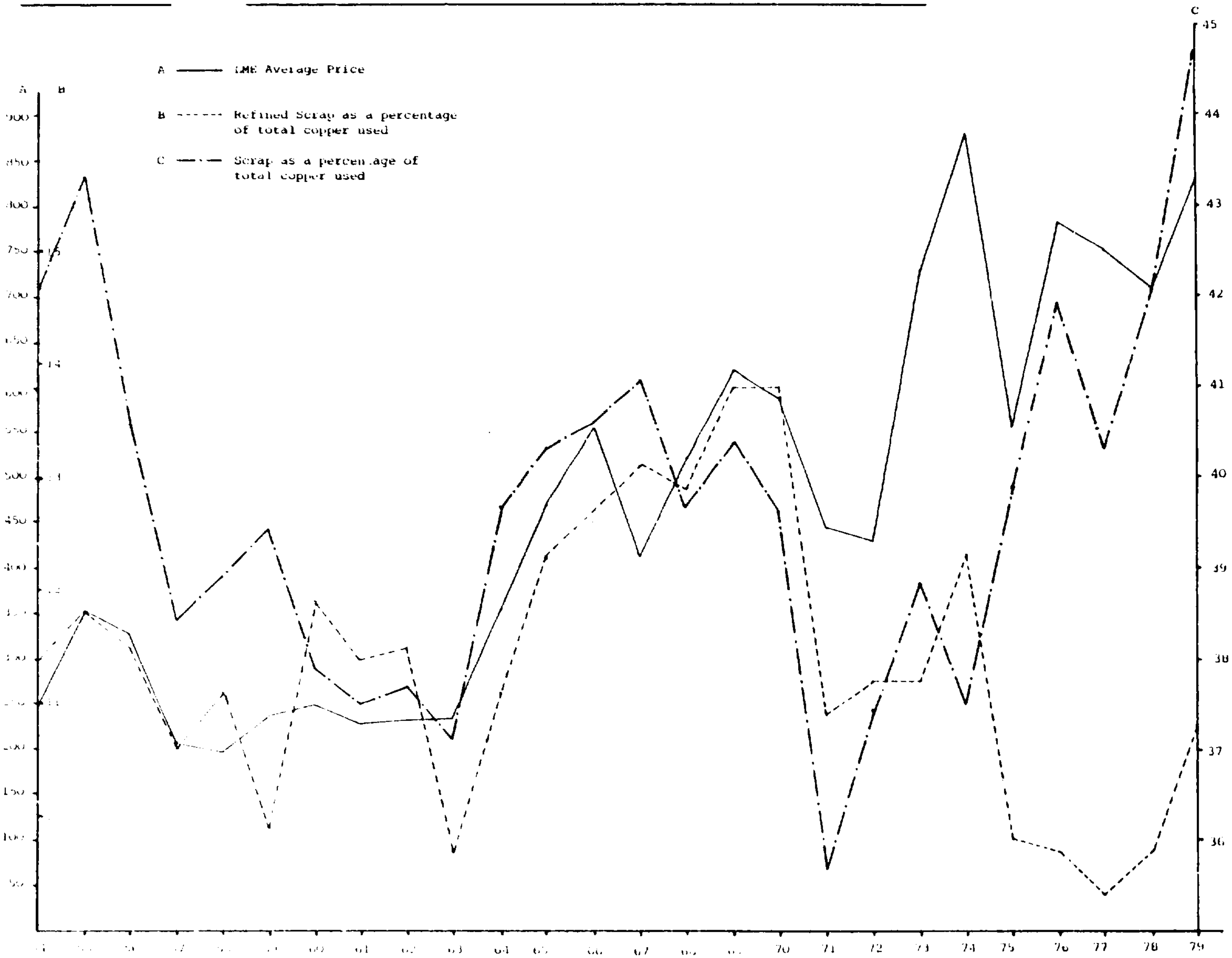
Before looking to the future, it is however, essential to examine the past in more detail. In Table 2.3 the total copper used per year for the period 1954-1979 inclusive is shown along with the source of this copper. From this table it can be seen that, over the period, the total copper used has increased from 4,372 thousand tonnes in 1954 to 10,646 thousand tonnes in 1979, a growth of some 3.6% p.a. Over this period the proportion of the total metal used in any one year originating from secondary sources has never been less than 35.7% or more than 44.7%, with the average being 39.7%. This secondary copper reaches the market partly as refined copper, that is the secondary copper goes through a second refining process, and partly as a less pure form which is only remelted. Again the percentages from year to year appear quite constant with an average 11.3% reappearing as refined copper and 25.5% as non-refined copper. These percentages have only varied between 9.3-13.8 and 24.8-33.8 respectively during this period. Furthermore, it is interesting to examine the relationship between the copper price and the quantity of secondary metal used in any one year and the proportion of this which is refined. In Figure 2.1 the average yearly price for cash electro wire bars over the period 1954-1979 is show, together with the proportions of total metal originating from secondary sources and the proportion of total refined production derived from secondary sources.

As can be seen from Figure 2.1, the portion of scrap rises in a strong market but falls in a weak market aptly demonstrating the important "balancing" or "make-up" function performed by the copper and copper alloy scrap market.

Mine production over the past decade has shown an uneven growth pattern. Whilst output increased at an average compound rate of 2.4% p.a. over the period, as can be seen from Tables 2.1 and 2.3, the actual rate of increase was 27% over the five years up to 1974 with mine production remaining flat in the latter part of the decade. During the period, the USA and African countries produced less whilst Peru and Chile increased output. This was not only a reversal of the trends in the 1960's when North America and African countries achieved the greatest increases, but also led to South America surpassing Africa in the "supply table" rankings.

Turning to the future, one must begin by emphasising the difficulty in forecasting "supply-demand-price" for copper. On the one hand today more than 40% of free world copper mine production is directly controlled by governments and as such non-industry considerations such as national employment, foreign exchange, balance of payments, etc., can be an overriding influence and thus a true "market response" is not always forthcoming. Secondly, and as happened in the 1970's, unforeseen factors outside the industry (such as the oil price increases of the 1970's) can

FIGURE 2.1 : COMPARISON OF LME PRICE AND SCRAP COPPER USED



result in sudden changes. Thus, for example in 1970 in an extremely well research paper, Sir Ronald Prain*, forecast available supplies of 7,159,000 tonnes in 1975. Actual production was some 20% less at 5,722,000 tonnes, but as was mentioned above, mine production rose by 27% in the period 1969 to 1974 but remained static thereafter.

During the forthcoming four to five year period, no significant new mining venture not already well developed can be brought on stream. Thus, on the basis of existing facilities (operating at previously established outputs - as opposed to theoretical capacities) with new capacity being brought on stream at latest revised dates; 25% of output of a new facility being lost in the first year in selling a "pipeline" through to the refinery and assuming that beyond 1980 annual losses due to strikes do not exceed 100,000 tonnes, the rate of growth of mine output will be as shown in Table 2.4.

On the basis that demand is expected to show an annual rate of growth of between 2.0% and 2.5% p.a. over the same period, the annual rate of growth of mine output at 3.6% p.a. would appear to indicate that supply will exceed demand in the period up to 1985 and even a few years beyond.

The second half of the decade, however, could see a more complex position. In the next few years positive new investment decisions must be made if new properties are to be brought on-stream by 1985. These decisions must be made not only by the mining companies of the world but also by Governments who control the reserves. At the present time, when copper prices are quite depressed, such decisions are not easy to make. Indeed as the cost of brining on new capacity rises, the problems resulting from depressed prices become ever greater.

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* Address to the Institute of Metals "The Future Availability of Copper Supplies".

TABLE 2.4 : PREDICTED COPPER MINE PRODUCTION 1980-1984 ('000 TONNES)

Country	1980	1981	1982	1983	1984
Canada and USA	2,275	2,380	2,479	2,547	2,574
Africa	1,347	1,359	1,363	1,374	1,389
Latin America	1,643	1,713	1,793	1,845	1,903
Asia	568	583	611	745	816
Europe	310	321	335	366	373
Oceania	392	393	390	397	395
Sub-Total	6,535	5,749	6,971	7,272	7,450
Allowance: for pipeline	25	104	56	76	44
for losses	350	100	100	100	100
TOTAL	6,160	6,545	6,815	7,098	7,306
Increase %	-	6.3	4.1	4.2	2.9

2.2 Prices and Pricing Policy

There is today no single price which can clearly be labelled "the" prevailing world price of copper. There are a number of producer prices, two important average prices, the merchant or outside price and the LME or Comex prices. Traditionally, the most important price in the USA has been the domestic producer price, whilst outside the USA it is the LME price which has been the most important. The Comex price has, however, in recent years become increasingly important in the USA, and indeed in the world, and as sich it is trading on the Comex exchange which tends to "lead" in relation to price changes.

The domestic producer price in the USA is the price at which Anaconda, Kennecott, Phelps Dodge and the smaller US producers sold copper to domestic consumers. Until 1978 this price was arbitrarily fixed by the three leading producers, officially not in a cartel manner, but since 1978 the price has been linked to the Comex price. Thus, where historically the producer price would frequently remain constant for periods of months rather than weeks (cases of an unchanged price for six months were not unknown) the price variations, whilst not daily, are considerably more frequent and are based on average Comex prices. Indeed, today it is an open question as to whether or not a producer price really does exist. The US producers have, since the late 1960's, been adjusting their published prices more frequently in response to changes in world market levels, with the 1978 decision to link the price to the Comex price making them merely more frequent. Indeed, in 1978 not all the US producers linked their price to the Comex price although their price changes again were much more frequent and implicitly were linked to Comex. Indeed, even today officially six of the major US producers have prices which are alledgedly not linked to the Comex market. It is, however, interesting that price changes by these six companies taken over a two year period indicate a 95% correlation with the Comex price.

Outside the USA the LME price is by far the most important single price. There are other exchange prices and a number of other producer prices. However, these all tend to follow the lead given on the LME and on Comex. Today, most of the copper sold within Europe is tied to the LME price, be it directly or indirectly.

As far as copper purchasers are concerned, one can sub-divide the sources of copper into four distinct areas, and taking the example of Western Europe, the four areas are :

- Europe's own copper smelters
- Copper producers of the Western World (primarily Chile, Zambia, Peru, Zaire, Canada and the USA)
- Free trading on the LME
- Scrap

The amount of copper obtained through each of these individual sources varies from country to country and from company to company. The largest companies in each country prefer to cover a significant part of their annual needs through countracts. In Europe some 40% of copper used for semis production comes from this source. Scrap and waste account for a further 35% of copper used in the EEC countries (this figure includes alloy materials such as zinc, tin and nickel). The balance is made up by purchasers primarily on the LME (or a similar market). Whilst at first sight, the prices charged for the copper from these different sources varies, a closer examination shows that there is a close relationship between the price from one source and another, with the LME price being the underlying basis. Obviously, it is important for the semis manufacturer that they are able to procure raw materials in a situation where there is not severe competition for material from one source or another. This general build up of price, with a not insignificant amount of copper physically being traded through an exchange such as the LME means that the prevailing price does reflect a supply-demand situation.

In Table 2.5, the long-term LME price is shown. Probably the most noticeable factor from this data is the way in which prices have increased since the mid-1960's. To a large extent many of these price changes have been a reflection of short-term factors, although more medium-term events (such as recessions, etc.), have also been a contributing factor.

In the longer term, the price of copper must obviously relate to the cost of production. It is, however, almost impossible to determine a single copper price based on cost. On the one hand, production costs vary considerably from one country to another, whilst production costs from a new development are often significantly different to those from a half-worked (and half-depreciated) facility. What, however, is very clear is that over the past few years, the price of copper has failed to keep pace with increased production costs. For example, the cost of creating an additional annual tonne of capacity increased from US$1,800 in 1960 to US$2,800 in 1969 and to between US$5,500-6,500 in 1979 with the latter figure rising to over US$10,000 if smelting and refining plant is included.

Over the past ten years, the price of copper in real terms has declined whilst costs have risen rapidly. Indeed, as can be seen from Table 2.6, which is taken from a study prepared by the International Lead and Zinc Study Group, the average LME price appears to have increased by just less than 60% but when viewed on a deflated index base (deflating by the wholesale price index of the major consuming countries) the real price is around half that prevailing in 1970 and little better than the depressed copper price level of 1975.

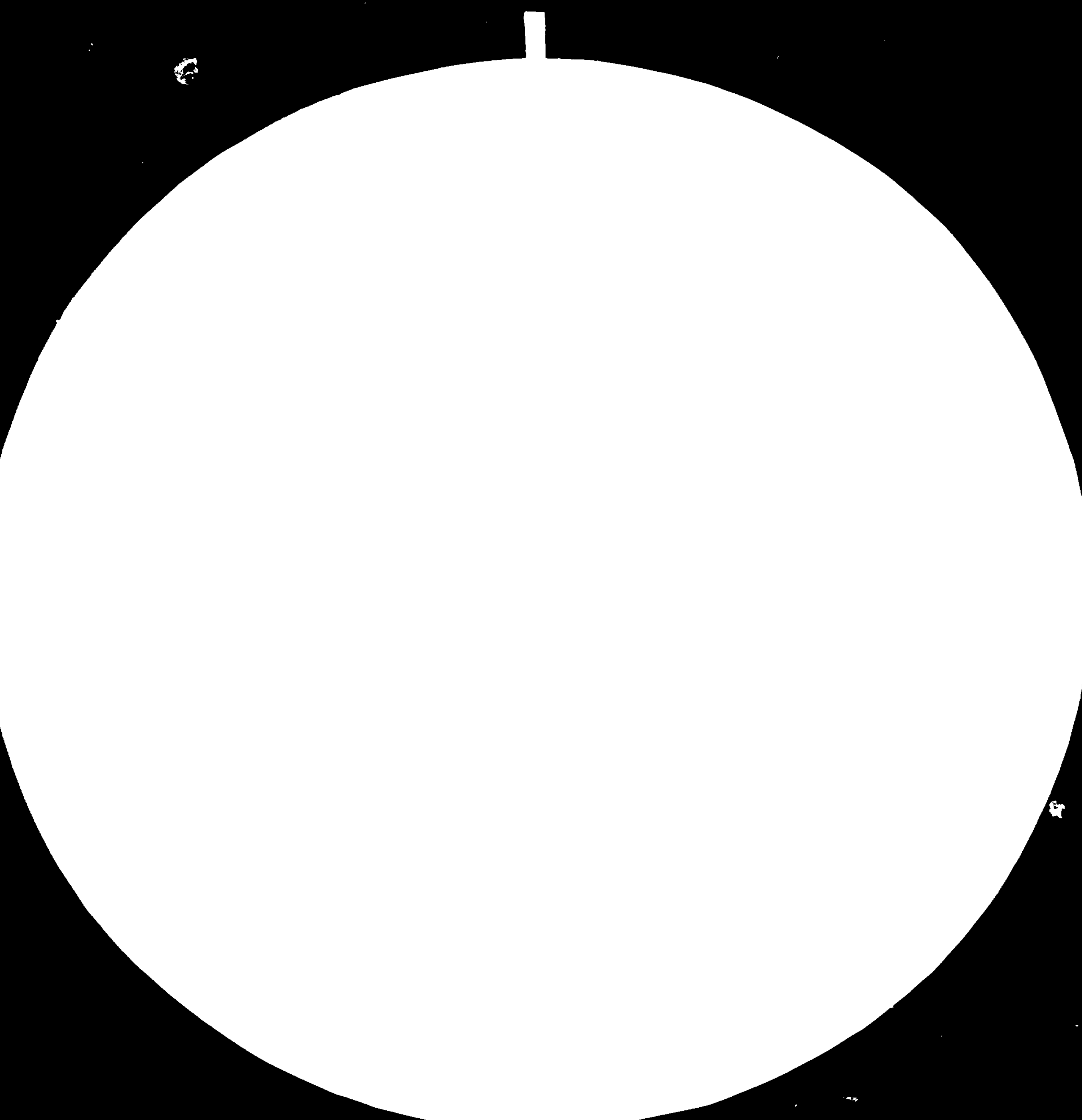
One of the problems which historically has resulted in the copper price becoming extremely depressed is that the four major copper producers outside the USA and USSR (Zambia, Chile, Peru, Zaire), all have economies which are very highly dependent upon copper as a source of foreign exchange. These countries all need the foreign exchange they obtain from copper for the import of other essential commodities. Thus, attempts by these producers to cut-back production in order to maintain the price, have frequently failed due to short-term national interests and due to the

TABLE 2.5 : LME COPPER CASH (MEAN) PER LONG TON CASH WIRE BAR

Year	£	Year	£
1923	65.18. 1	1947	130.11. 3
1924	63. 4. 2	1948	134. 0. 0
1925	61.19. 7	1949	133. 0. 9
1926	58. 0. 9	1950	178.19.11
1927	55.13.10	1951	220.13. 3
1928	63.14. 9	1952	259. 9. 6
1929	75. 9. 7	1953	256. 5. 6
1930	54.13. 7	1954	249. 7. 0
1931	38. 9. 7	1955	351.14.10
1932	31.14. 7	1956	328.14. 5
1933	32.11. 4	1957	219. 8.10
1934	30. 6. 4	1958	197.13. 3
1935	31.18. 1	1959	237.13. 1
1936	28. 9. 7	1960	245.15. 7
1937	54.10. 7	1961	229.13. 1
1938	40.15. 0	1962	233.19. 5
1939	43.14. 6	1963	234. 2. 9
1940	62. 0. 0	1964	352. 0. 5
1941	62. 0. 0	1965	468.16. 1
1942	62. 0. 0	1966	553.14. 4
1943	62. 0. 0	1967	416.18. 6
1944	62. 0. 0	1968	523.10. 0
1945	62. 0. 0	1969	620.16. 0
1946	77. 3. 5	1970	587.10. 0

LME COPPER CASH (MEAN) PER METRIC TON

Year	£	Year	£
1970	587.9	1975	556.8
1971	444.4	1976	782.5
1972	428.0	1977	752.7
1973	726.8	1978	710.1
1974	877.0	1979	936.2



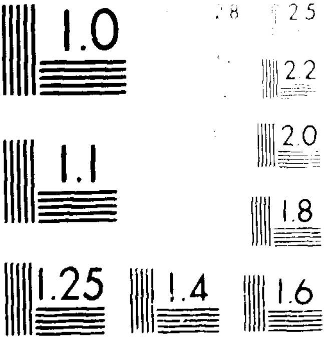

1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

TABLE 2.6 : AVERAGE LME SETTLEMENT PRICE COPPER - DEFLATED

Year	United Kingdom			Germany	Japan	USA
	Actual £/MT	Constant £ 1975	Index	Index	Index	Index
1970	587.9	1,086.7	100.0	100.0	100.0	100.0
1971	444.4	753.3	69.3	70.6	75.1	74.2
1972	428.0	689.2	63.4	62.2	62.4	70.3
1973	726.8	1,089.7	100.3	81.1	82.7	103.5
1974	877.0	1,070.8	98.5	79.8	78.0	100.3
1975	556.8	556.8	51.2	43.6	46.4	55.3
1976	782.5	667.1	61.4	49.3	50.2	60.4
1977	752.7	535.3	49.3	41.1	41.6	52.9
1978	710.1	463.5	42.7	36.3	34.6	51.0
1979	936.2	546.8	50.3	46.2	49.2	65.7

fact that in each of these countries the copper price on which their economic calculations are based (which in part is tied to their own production costs) varies considerably from the higher cost producer countries to the lowest cost producer. Furthermore, although in general this has played a relatively insignificant role at the raw copper stage, exports from Communist Bloc countries into Europe (and other places) are not always made on the basis of "normal" commercial decisions. Again, because of artificial exchange rates, these countries have on occasions found it convenient to sell significant quantities of copper into the Western World, even when the world copper price has been relatively depressed.

Whilst any attempt to forecast a world price for copper for the future is fraught with problems, strikes, political problems, etc., can soon cause radical changes in the price, based on a simple analysis of supply and demand, it would appear that during the early 1980's the price will remain relatively depressed, whilst in the mid to late 1980's a significant rise is likely to occur. Political problems in Iran however, where the Sar Cheshmeh Mine is scheduled to begin operating at capacity in 1984, could lead to the demand slightly exceeding supply before the mid 1980's with a resultant increase in the price of copper.

3. WORLD TRADE IN COPPER AND COPPER ALLOY PRODUCTS

World Trade in copper and copper alloy semi-finished products has risen quite rapidly between 1969 and 1979 as can be seen from Figure 3.1. During this period, total exports rose from some 600,000 tonnes to 1.55 million tonnes. The data on which Figure 3.1 is based is the exports of semi-finished copper and copper alloy products by the major copper processing countries of the world.

The most striking feature of this trade, as can be seen from Table 3.1 is the importance of Europe as a source of exports of this type of product. Indeed, as can be seen from Figure 3.1 and Table 3.1 Europe's share of the total has progressively increased through the period under study and today accounts for some 80% of total exports in this area.

When one considers where the above exports are bound for, it readily becomes evident that the major portion of trade in this area is trade between European countries. As can be seen from Table 3.2, West European countries account for the major portion of imports of these products with North America being the second most important region in terms of imports. In Table 3.1 the data on imports by Japan has been included merely to show the very limited imports into this country. Against this Japan has exported some 180,000 tonnes per year of copper and copper alloy semi-finished products over the past three years.

Returning to European imports of copper and copper alloy semi-finished products as can be seen from Figures 3.2 and 3.3 the relative share of imports from outside Europe has declined in the decade 1968 to 1978 while the actual volume of trade has increases significantly. Furthermore, if one considers the source of these imports into Europe coming from outside it quickly becomes evident that some two-thirds are from North America and are generally more specialised products and not the type of product likely to be manufactured by a developing country.

FIGURE 3.1 : ORIGIN OF COPPER AND COPPER ALLOY SEMIS TRADE

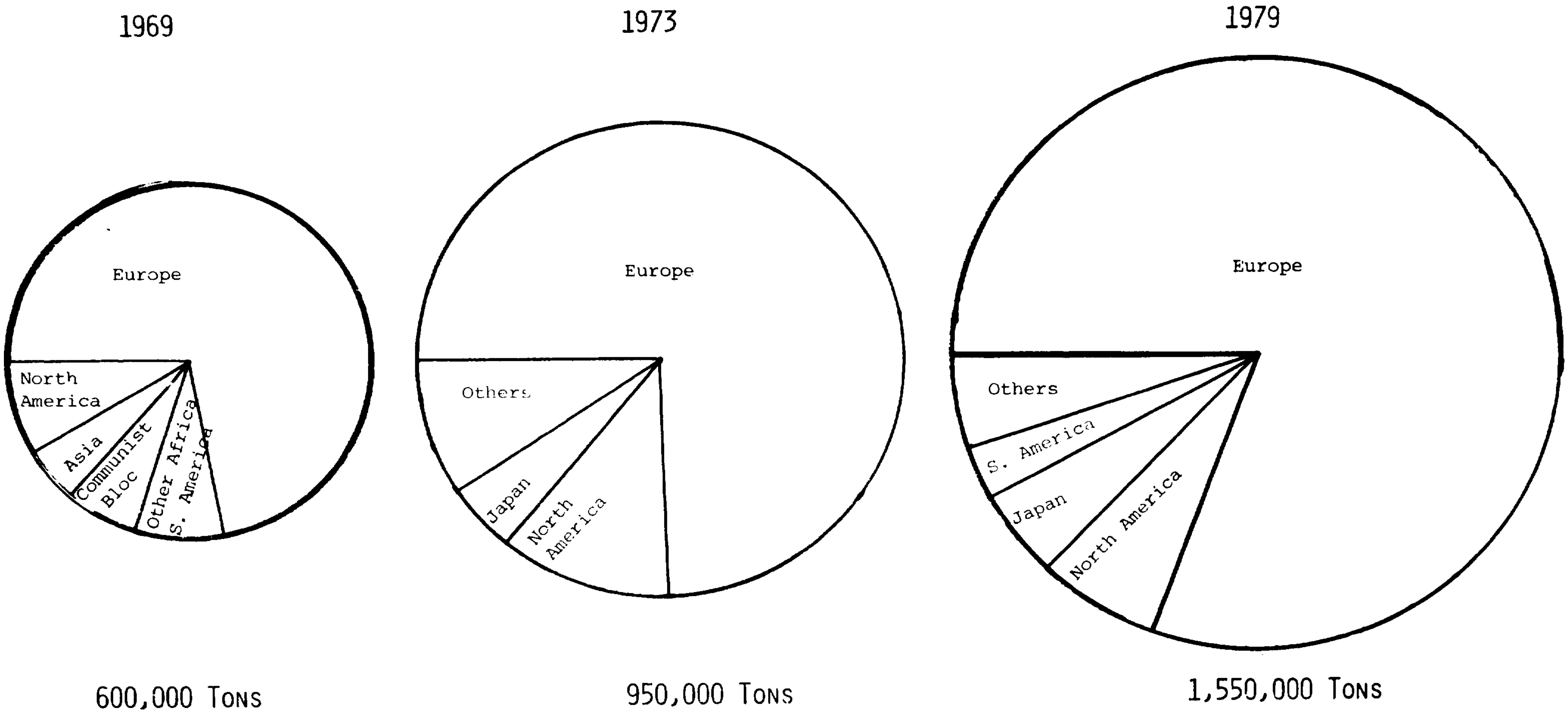


TABLE 3.1 : EXPORTS OF ALL COPPER AND COPPER ALLOY SEMI-MANUFACTURES

Country	1977	1978	1979
Austria	9,265	13,417	15,241
Belgium/Luxembourg	270,879	281,673	283,112
Denmark	5,748	9,055	10,663
Finland	23,209	29,100	31,088
France	107,445	114,881	157,715
Germany F.R.	235,271	296,591	334,346
Gibraltar	-	-	-
Great Britain	127,700	123,555	104,859
Greece	4,615	3,637	5,273
Iceland	-	-	-
Irish Republic	1,581	1,673	1,658
Italy	58,275	93,884	93,875
Malta and Goza	-	-	-
Netherlands	44,648	50,756	51,724
Norway	1,383	1,170	2,158
Portugal	1,080	484	782
Spain	8,384	17,168	19,197
Sweden	51,214	69,377	75,061
Switzerland	16,214	16,140	19,778
Turkey	-	-	-
Yugoslavia	28,240	26,399	15,641
Total Western Europe	995,151	1,148,960	1,222,171
Canada	42,259	50,474	46,632
USA	31,111	40,173	67,564
Japan	179,133	188,766	177,285
Australia	19,906	29,167	35,250
Others	2,725	3,411	4,309
TOTAL	1,270,285	1,460,951	1,553,211

FIGURE 3.2 : ORIGIN OF EUROPEAN IMPORTS OF COPPER AND COPPER ALLOY SEMIS - 1969

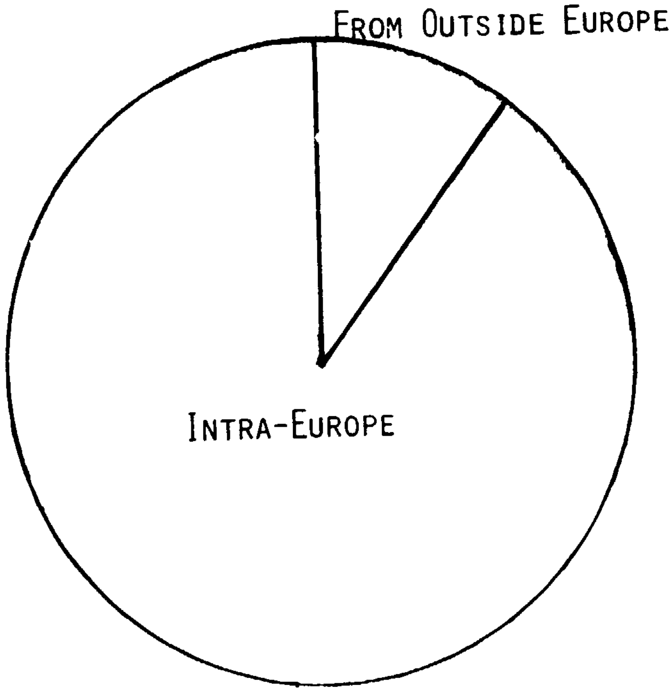
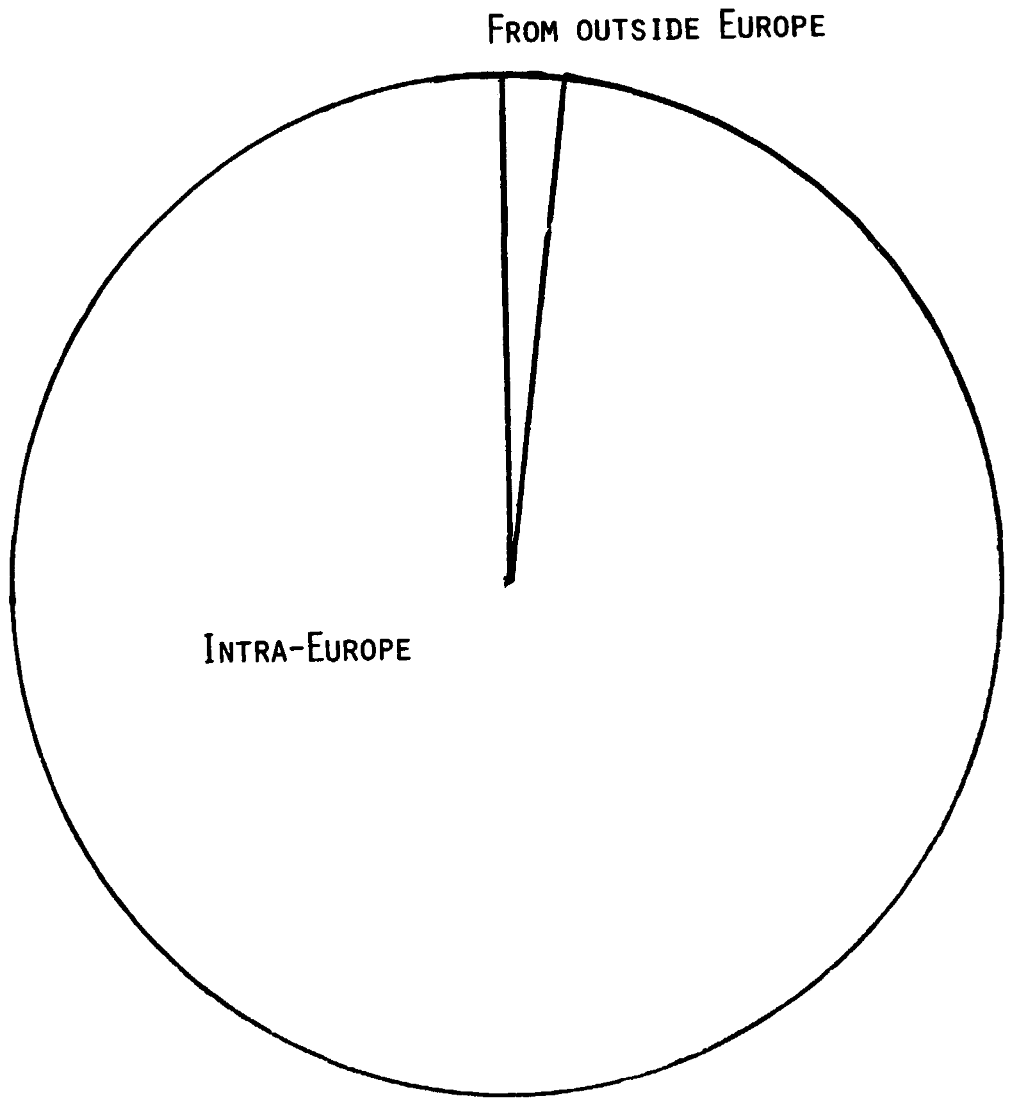


FIGURE 3.3 : ORIGIN OF EUROPEAN IMPORTS OF COPPER AND COPPER ALLOY SEMIS - 1978



Details of European imports from Non-European countries are presented in Table 3.2.

A similar picture emerges if one considers imports into the Far East. Here the dominant force is Japan, as can be seen from Figure 3.4. Again a new producer is likely to find difficulty in breaking into markets, although it must be said that some of them are far from impossible to penetrate.

Within Central and South America a number of the countries have developing copper semi-finsihed product manufacturing industries. A number of the countries indeed have already reached a level where small quantities of product are exported. However, the general theme is one of developing self sufficiency and as can be seen from Table 3.3 annual imports are relatively small, particularly if Venezuela is excluded. In the case of the latter country some 50% of imports originate in the USA.

In the case of North America both Canada and the USA have major copper and copper alloy semi-finished product manufacturing industries. Both also export and import important quantities of these products as can be seen from Table 3.4.

In the case of Canada "intra-North American trade" accounts for an important part of total imports (some 74% in 1979) however for the USA this intra regional trade represented less than 22% of total imports in 1979. Indeed the USA is one of the most "open" markets in the world importing not only the highly sophisticated products but also basic/standard products of the type likely to be produced in a developing country.

Whilst the same level of detailed data is not available for insulated wire and cable a similar picture emerges. Firstly as can be seen from Figure 3.5 the major exporting countries are the developed countries of the Western World. Again a similar picture emerges if trade flows are examined a large part of total trade being intra-European with non-regional imports only being significant in the less developed countries of the world.

TABLE 3.2 : EUROPEAN IMPORTS FROM NON-EUROPEAN COUNTRIES : 1979

Country	Tons
Canada	2,646
USA	23,818
Japan	6,736
South Africa	376
India	78
Australasia	448
New Zealand	59
TOTAL	34,161

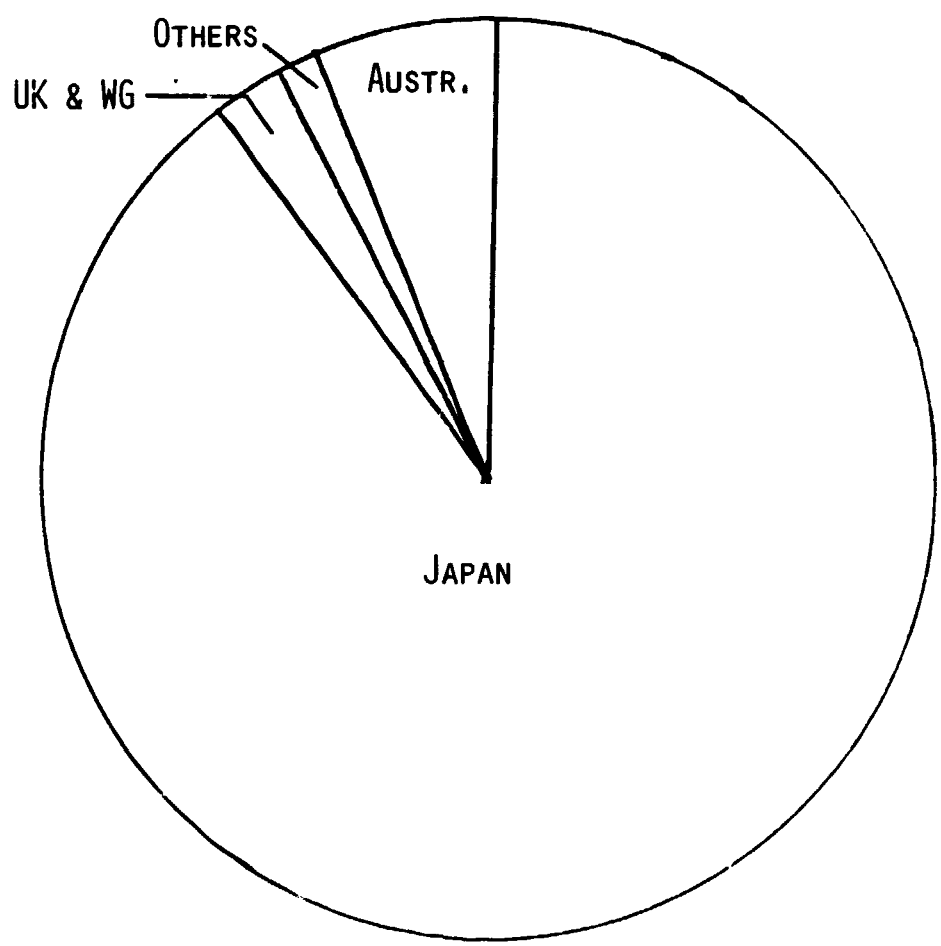
TABLE 3.3 : IMPORTS OF COPPER AND COPPER ALLOY SEMI-FINISHED PRODUCTS BY COUNTRIES OF CENTRAL AND SOUTH AMERICA

Country	Total Imports		
	1977	1978	1979
Mexico	4,186	4,127	6,805
Brazil	1,164	1,260	3,667
Colombia	1,116	1,427	1,374
Venezuela	12,722	15,333	14,097
Others	7,420	7,323	11,322
TOTAL	26,608	29,470	37,265

TABLE 3.4 : NORTH AMERICAN TRADE IN COPPER AND COPPER ALLOY SEMI-FINISHED PRODUCTS

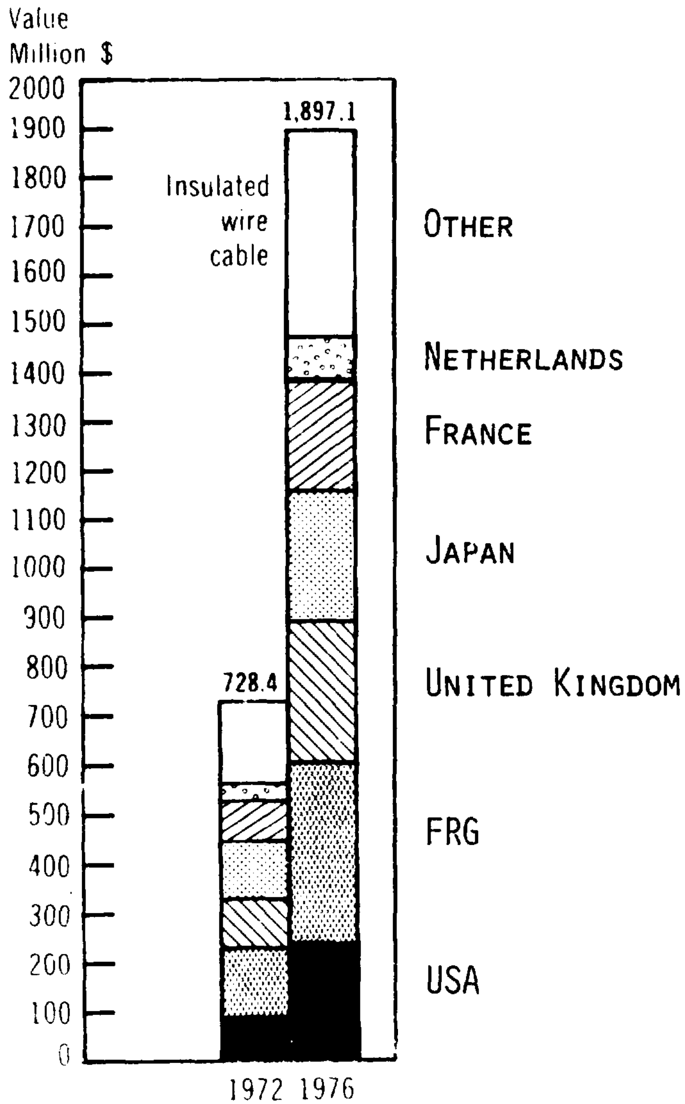
Country	1977	1978	1979
Imports:			
Canada	21,653	22,551	23,828
USA	141,732	176,896	157,497
Exports:			
Canada	42,259	50,474	46,632
USA	31,111	40,173	67,564

FIGURE 3.4 : ORIGIN OF COPPER AND COPPER ALLOY IMPORTS TO THE FAR EAST



Total 130,000 Tons

FIGURE 3.5 : PRINCIPAL EXPORTING COUNTRIES OF INSULATED WIRES AND CABLES



Finally, turning to Africa details of imports of copper and copper alloy semi-finished products by all African countries for the period 1977 through 1979 are contained in Table 3.5, as can be seen in some cases these have risen quite rapidly whilst in other cases they have declined. A selection of countries in West Africa offering potential as markets for Nigeria have been studied in more detail and the results of these surveys are presented in the following sections.

TABLE 3.5 : IMPORTS OF ALL COPPER AND COPPER ALLOY SEMI-MANUFACTURES BY AFRICAN COUNTRIES

Country	1977	1978	1979
Algeria	7,905	9,650	6,766
Angola	162	232	554
Benin Peoples Rep.	63	14	11
Burundi	19	8	-
Central African Rep.	13	2	5
Chad	5	11	2
Congo Rep. (B)	22	28	36
Djibouti	-	3	3
Egypt	5,734	6,008	4,725
Equatorial Guinea	-	11	5
Ethiopia & Eritrea	182	204	46
Fr. E. Africa	110	116	95
Gabon	142	62	60
Gambia	26	5	1
Ghana	1,318	1,218	607
Guinea Republic	14	20	15
Ivory Coast	1,092	1,649	1,536
Kenya	474	1,212	860
Liberia	61	101	72
Libyan Arab Rep.	4,724	6,692	3,714
Malagasy Rep.	47	56	63
Malawi	26	18	18
Mali	52	17	42
Mauritania	15	3	35
Mauritius & Seychelles	68	68	44
Mayotte	-	2	-
Morocco	7,514	7,227	6,528
Mozambique	91	293	85
Namibia	20	-	-
Niger	20	36	73
Nigeria	3,640	6,537	6,035
Portuguese W. Africa	5	-	-
Rhodesia	-	-	2
Ruanda	17	13	2
Rep. of Cape Verdi	-	7	3
Sao Tome Principality	-	27	7
Senegal	183	184	197
Sierra Leone	2	16	1
Somalia	6	20	35
South African Rep.	1,989	2,129	4,663
Spanish N & W Africa	91	194	150
St. Helena & Deps.	3	3	3
Sudan	366	177	145
Swaziland	-	-	93
Toga	20	52	41
Tunisia	3,589	3,221	3,012
Uganda	67	8	82
United Rep. Cameroons	148	269	444
United Rep. Tanzania	143	267	94
Upper Volta	11	10	10
Zaire	97	135	160
Zambia	174	27	86
TOTAL	40,470	48,352	41,258

4. EXPORT OPPORTUNITIES FOR NIGERIA

As has been shown in Section 3, significant export opportunities for a developing country fabricator, are unlikely to be found outside its immediate geographical zone. Within the framework of this study, the export market survey aspect has been restricted to the neighbouring countries of West Africa and, as a member country in the proposed venture, Zambia.

The seven countries chosen for the export survey are amongst the most important importers of copper and copper alloy semi-finished products within the whole of Africa as was shown in Section 3. These countries, with the exception of Zambia, have good or relatively good links with Nigeria and as such could be served by the new Nigerian company. In several cases, the countries have economies which are exhibiting a quite high rate of growth, particularly in a regional context. The countries chosen, however, do cover a very wide spectrum with countries such as the Ivory Coast having already undergone significant development, whilst countries such as Upper Volta are still at the beginning of the development spectrum.

Opportunities for the new Nigerian company can be divided into two distinct areas. In the first instance there are opportunities for the supply of copper wire rod to the wire and cable manufacturing industries which are, or will be, located in most of the countries included in this export survey. The second area of opportunity is to supply copper and copper alloy semi-finished products to the intermediate traders and/or direct to original equipment manufacturers and/or other end users. In the latter area the main products are copper alloy rods, bars and sections, copper tube and, to a more limited extent, flat copper and brass semi-finished products.

In Table 4.1, the opportunities for the new Nigerian company are summarised on the basis of forecasts of the total requirements of each of the countries for these products in 1985/86 with an assessment being made of the likely penetration which could be achieved by the Nigerian company. Obviously the latter will be a function of the effort directed towards commercialising the export opportunities. Furthermore, implicit in making these forecasts is the assumption that the product produced by the new Nigerian company will, in terms of specification and quality, be commensurate with that manufactured by European suppliers.

One area in which the Nigerian company is likely to face serious problems is in the area of specification. Whilst the export of insulated wire and cable was, strictly speaking, outside the scope of this project, we included an assessment of opportunities in this area in the course of our fieldwork in order to have a total picture. In many of the countries studied, it was found that specifications and standards employed were based on French standards, as opposed to the British standards which are normally used in Nigeria, and as such the Nigerian wire and cable industry could have difficulties meeting the requirements in many of these countries.

The question of standards/specifications, was less critical in the area of brass mill products, largely because prevailing world standards and specifications on these products are much more uniform than is the case for wire and cable products.

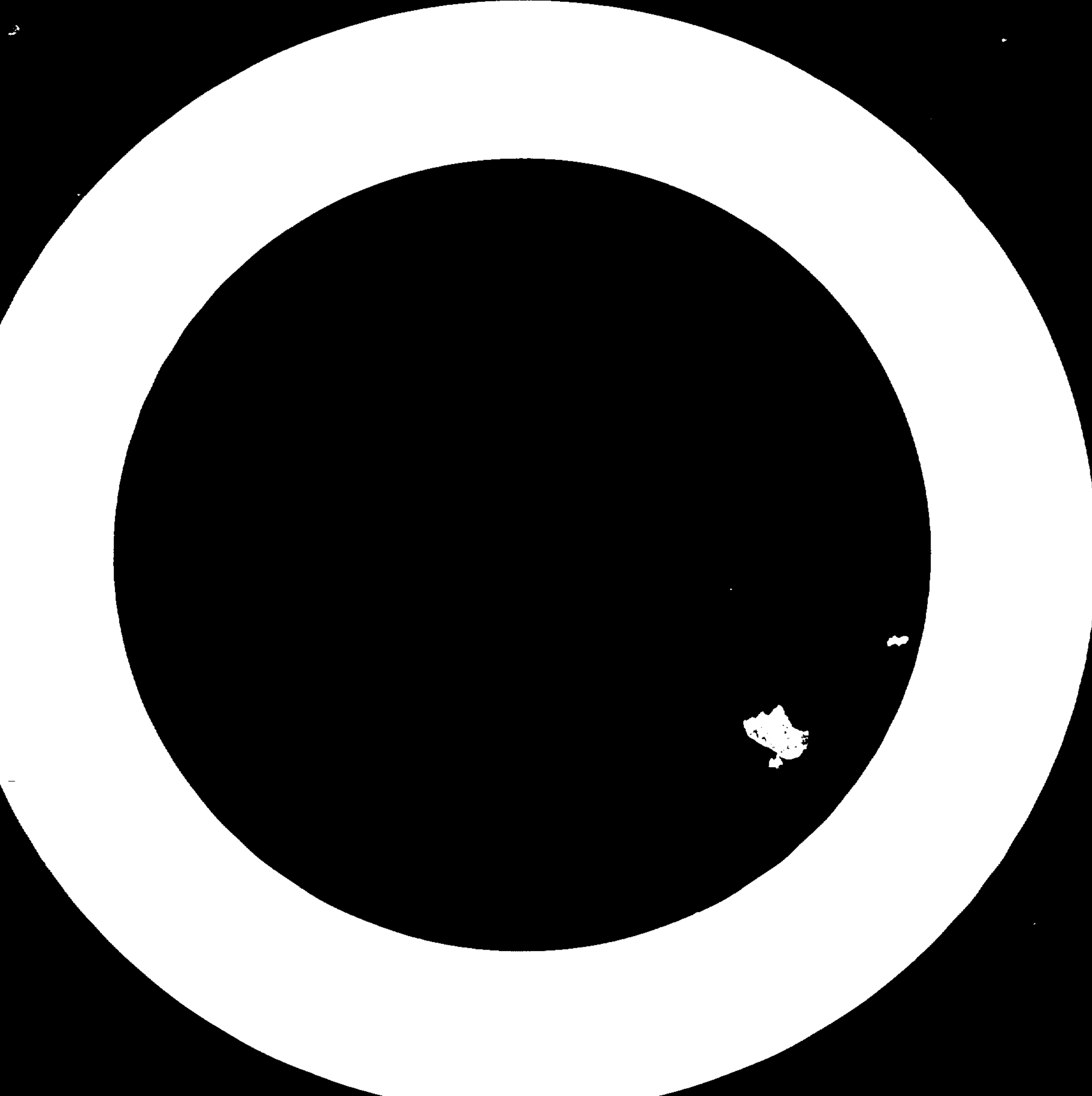
As can be seen from Table 4.1, opportunities appear to exist for the Nigerian company to export in total some 563 tonnes of copper and copper alloy semi-finished products in 1986 and some 1,000 tonnes of these products in 1990.

TABLE 4.1 : SUMMARY OF EXPORT OPPORTUNITIES FOR NIGERIAN PLANT

Country	Copper and Copper Alloy (Tons) 1985				Copper and Copper Alloy (Tons) 1990			
	Wire and Winding Wire	RBS	PSS	Tube	Wire and Winding Wire	RBS	PSS	Tube
Zambia	150*	38	40	5	**	120	57	8
Benin	30***	1	-	1	50***	2	-	2
Cameroon	6	86	5	6	10	153	8	10
Gabon	3	1	1	6	5	1	1	8
Ghana	2	30	1	3	5	150	5	20
Ivory Coast	7	100	7	24	22	260	20	80
Togo	1	1	-	2	1	1	-	2
Upper Volta	2	3	-	1	2	3	-	1
TOTAL	201	260	54	48	95	690	91	131

Based on securing 10% and 20% of available import requirements in 1985 and 1990 respectively.

* Probably this will be locally produced
** Assumed total requirements will be produced locally
*** Assuming a local cable industry is established



COUNTRY STUDIES - EXPORT OPPORTUNITIES

A. ZAMBIA

A.1 ECONOMIC AND DEMOGRAPHIC OVERVIEW

A1.1 Geography and Population

Zambia became an independent Republic in 1964. It is a large, land-locked country whose neighbours are Zaire, Angola, Zimbabwe, Malawi, Mozambique and Tanzania. It is this land-locked nature that poses problems for Zambia when transporting goods for import and export. The area of the country is approximately 753,000 square kilometres, more than three times the size of the United Kingdom. Most of the country is at an altitude of over 900 metres. This altitude makes the climate more temperate than is normal in a tropical country.

Much of the country is sparsely populated. The population of 5.65 million (mid-1979 estimate) is concentrated mainly along the railway line between Livingstone on the Southern border with Zimbabwe, and the copperbelt on the Northern border with Zaire. Lusaka, the largest city and capital, has an estimated population of 560,000. Other important population centres include Kitwe, Ndola, Mufulira, Chingola and Luanshya, all of which are on the copperbelt, as well as Kabwe, Kafue and Livingstone.

Two mighty rivers, the Zambezi and the Kafue, provide ample hydroelectric power for the copper industry and other requirements. Much flooding occurs in the rainy season, January through March, particularly in the Northern part of the country.

A large portion of the population (approximately 36%) are urban dwellers mainly as a result of the high population growth rate of 2.9% forcing people off the land and into the cities. About 52% of the population is engaged in agriculture, largely on a subsistence basis.

A1.2 Economic Structure

Zambia's economy is characterised by its high dependence on the copper industry, both as a foreign exchange earner and in terms of its contribution to the overall economy. Through reforms effected in the early 1970's the Government acquired a majority shareholding in the copper and other mines and in many leading commercial and industrial undertakings. New industries of national importance all emerged within the parastatal sector with the result that the State now directly controls large parts of the industry and other business sectors. The fortunes of private enterprises based on imported raw materials likewise depend on the Government insofar as the latter allocates import licences and foreign exchange. Zambian factories are usually granted import protection which virtually prohibits the importation of goods within their manufacturing capabilities.

Government activity in the industrial sector is primarily through the Zambia Industrial and Mining Corporation Limited (ZIMCO). This is the holding company for Zambian Government interests in manufacturing, distribution, trading, finance, energy, transport, insurance, mining, rural development, hotels, post and telecommunication, and a range of other areas. Most of the industrial manufacturing activity within the public sector is under the control of the Industrial Development Corporation (INDECO), a wholly-owned subsidiary of ZIMCO.

As far as the non-ferrous metals, mining and smelting sector is concerned, this is in the hands of two companies: Nchanga Consolidated Copper Mines Limited (NCCM) and Roan Consolidated Mines Limited (RCM). ZIMCO has today major equity holdings in both the above mentioned companies. The marketing of copper products is carried out by the Metal Marketing Corporation of Zambia Limited, again a wholly owned ZIMCO company.

A1.3 Zambia's Economy

Zambia's economy is based predominantly on copper, of which it is one of the world's largest producers. Copper accounts for some 95% of all Zambia's foreign exchange earnings. It is Government policy, however, to broaden the economic base by encouraging expansion of manufacturing industry and, particularly, agriculture.

Copper prices have not kept up with world inflation in recent years, and this downward trend, coupled with restriction of import/export routes due to political events in neighbouring countries, has greatly damaged the economy.

Following the precipitous fall in copper prices in 1975, and consequent fall in investment resources, Zambia's gross domestic product (GDP) in real terms has either been declining or stagnating at low levels since 1976. Preliminary data for 1980, presented in Table A1.1, shows a slight improvement in real terms in 1980 over the figure for 1979. Since, however, in 1979 the real GDP had declined by 8% compared to 1978, the 0.9% improvement in 1980 went little way to redressing the balance. The slight improvement in 1980, however, does suggest that the decline in the economy registered in earlier years, has probably been arrested and an upward movement has now begun.

In 1980 it was the agricultural sector which recorded the greatest increase which was largely a reflection of the very steep fall which occurred in 1979 and it is worthy of note that in 1980 value added in agriculture was below the levels of 1977 and 1978 in real terms.

Zambia's balance of payments position has been under considerable strain during the past decade resulting in large current account deficits and payment arrears especially after 1975. A number of adverse factors such as the low copper prices in the world market, the dramatic increases in oil prices, and poor weather conditions in some years necessitating heavy food import, have all contributed to these large deficits in the balance of payments during the decade 1971 to 1980.

The importance of the world copper price was aptly demonstrated in 1979 when a modest surplus was recorded as a result of better prices obtained during the year, whilst import restrictions on a wide range of goods had been continued from the previous year. In 1980 however, the balance of payments again went into deficit as a result of a fall in copper prices in the second half of the year and higher costs of oil imports and the large imports of maize which were required to

TABLE A1.2 : INVESTMENT IN THE THIRD NATIONAL DEVELOPMENT PLAN (K Million)

Sector	Government Budget	Parastatals		Private Sector	TOTAL
		Internal Resources	External Financing (Direct)		
AGRICULTURE:					
(i) Agriculture and Water Development	370.0	10.0	-	40.0	420.0
(ii) Lands and Natural Resources	70.0	-	-	15.0	85.0
Mining	13.0	450.0	180.0	30.0	673.0 (Copper 580)
Manufacturing	60.0	240.0	120.0	30.0	450.0
Power	50.0	140.0	-	-	190.0
Transport and Communications (excluding roads)	220.0	170.0	230.0	20.0	640.0
Public Works (including roads)	155.0	-	-	-	155.0
Commerce	10.0	28.0	-	20.0	58.0
Housing and real estate	95.0	23.0	-	125.0	243.0
Education	106.0	-	-	-	106.0
Health	43.0	-	-	-	43.0
Tourism, National Parks and Wildlife	10.0	24.0	-	20.0	54.0
Information and Broadcasting	30.0	-	-	-	30.0
Youth and Sports	4.2	-	-	-	4.2
Scientific Research	6.0	-	-	-	6.0
GENERAL ADMINISTRATION:	46.8	-	-	-	46.8
(i) Labour and Social Services	0.8	-	-	-	0.8
(ii) Home Affairs	7.0	-	-	-	7.0
(iii) Zambia Police	19.0	-	-	-	19.0
(iv) Foreign Affairs	5.0	-	-	-	5.0
(v) Provincial Administration	1.0	-	-	-	1.0
(vi) National Commission for Development Planning	1.0	-	-	-	1.0
(vii) Finance	7.0	-	-	-	7.0
(viii) Economic and Technical Co-Operation	1.0	-	-	-	1.0
(ix) Personnel Division	1.0	-	-	-	1.0
(x) State House	1.0	-	-	-	1.0
(xi) National Assembly	1.0	-	-	-	1.0
(xii) Legal Affairs	2.0	-	-	-	2.0
Provinces	150.0	-	-	-	150.0
TOTAL	1,439.0	1,085.0	530.0	300.0	3,354.0

make up the shortfall in domestic production as a result of unfavourable weather conditions in the 1979-80 season. The delicate nature of the Zambian economy is thus aptly demonstrated by these short-term trends, and the difficulty of long-term planning is readily evident.

A1.4 Development Plans

Since independence the Government has planned its economic and social development through a series of 5-year development plans. The latest of these, the Third National Development Plan, was released in October 1979 and covers the years 1979 through 1983. The principal objectives of the Plan are :

- To generate more employment and to adapt technology which is labour intensive, paying due regard to the social needs of the Zambian economy.

- To diversify the economic structure in order to reduce the economy's dependence on copper and to undertake a crash economic programme to promote agriculture and industry based on the use of local raw materials and to establish the necessary capital goods industries.

- To give the highest priority to rural development in order to create a strong rural economy.

- To promote prospection and exploitation of non-copper minerals.

- To reduce the disparities in the levels of income between rural and urban sectors.

- To obtain progressively and under conditions of reasonable price stability a target growth rate of 6% of GDP in real terms in the final year of the Plan as a result of programmes and projects planned for implementation during the Plan period.

The Plan also deals with and accords a high priority to attaining socialism, developing education and other social/welfare projects for improvement in the basic living standards of the population.

Allocations under the Third National Development Plan are summarised in Table A1.2.

A2. LOCAL COPPER PROCESSING INDUSTRY

Zambia is one of the world's leading copper producers and in 1980, copper production rose to 624,000 tons compared with the 578,000 tons produced in 1979. The total production exceeded the target for the year by some 14,000 tons although sales which are estimated at 607,000 tons, fell slightly below the planned target. The country's copper industry is controlled by two Government companies: NCCM and RCM. These companies, in addition to owning and operating a range of mines, also have smelters and refining operations and market their output in the form of blister copper and/or refined cathode. Within the context of this project, however, it is the downstream industry which is of more significance and the companies operating in this sector are reviewed in greater detail in the following paragraphs.

- ZAMEFA

  Apart from foundries, only one company manufactures semi-finished copper products, namely Metal Fabricators of Zambia Limited (ZAMEFA), part of the INDECO Group. ZAMEFA has two technical partners - Phelps Dodge Corporation of the USA and Svenska Metallverken of Sweden.

  ZAMEFA operates a 600 ton extrusion press as well as lines of machinery for making wire and cable up to 3.3 KV and telephone cable up to 1,200 pr. The extrusion press produces 8.0 mm and 9.5 mm wire rod from 150 mm billet cast specifically for this purpose by NCCM. It can also extrude other products such as bus bar and brass sections as well as aluminium profiles.

  Production and sales by ZAMEFA rose quite rapidly in the early 1970's following establishment of the company. The energy crisis and recession following the 1974 oil price rises, resulted in output from the plant falling, to recover again in the late 1970's (1978), before again falling away for more global economic reasons. Sales by ZAMEFA in 1980 are summarised in Table A2.1. Of this total, some 2,145 tons of copper was processed within the plant, whilst some 250 tons of copper was contained in products

TABLE A2.1 : SALES BY ZAMEFA IN 1980

Item	Tonnes	K'000
Copper Products (Weights Represent Copper Content)		
Rod	630	1,385
Bare Wire	365	815
Unarmoured Cable	285	2,465
Armoured Cable	715	6,830
Telephone Wire	300	2,000
Others	100	690
Aluminium Products		
ACSR Cable	85	520
Sections	100	750
TOTAL	2,580	15,455

Sales for 1980 divide in value terms as shown in Table A2.2.

TABLE A2.2 : SALES BY ZAMEFA BY END-USER

Item	K'000	Percent
Manufactured Products for Home Market	8,981	64.2
Manufactured Products for Export	2,259	16.1
Imported Products for Resale	2,750	19.7
TOTAL SALES	13,990	100.0

which were imported in finished form for resale. Output from the plant has totalled 3,500 tons per year, but prevailing economic conditions are such that this level is not expected to be achieved again until 1982 or beyond.

The management of the company are constantly considering diversification opportunities and are continuously examining ways of introducing profitable additional product lines. One major expansion under consideration is for a 6,000 ton per year continuous rod casting facility.* This facility would not only augment their existing manufacturing capacity, but would enable them to buy cathode from NCCM (as opposed to the specially cast billet which the company must today purchase) and would free the extrusion press for work other than wire rod. A second area in which the company are interested in possible diversification/development is the production of magnet wire. Preliminary consideration has been given to this aspect and a decision is expected during 1981 as to whether or not enamelled winding wire in a range of sizes can be produced on a viable basis in Zambia.

ZAMEFA enjoys import protection, which means that import licences are not being granted for any item that the company can manufacture. Subject to continued success, ZAMEFA could be in a position by 1985 to meet nearly all of Zambia's requirements for semi-finished copper and brass products other than those for plate, sheet, strip and tubing.

The Third National Development Plan provides for a plant to produce copper and brass sheet, tubing and rod, but this project appears to have been shelved.

Foundries

A number of small foundries, all in the private sector, cater to the replacement market for bronze and brass castings such as bushes for ore crushers. All the foundry companies are located on the copper belt with NCCM and RCM being their principal customers. Their raw materials consist almost entirely of scrap.

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* We have subsequently established the company plan to purchase a continuous casting facility from Outukumpu.

- Foundry and Engineering Limited, Luanshya

  This subsidiary of the Lutanda Group Limited claims 55-60% of the market. It serves mainly NCCM through United Machining Company in Chingole since the Group does not possess the necessary machining capabilities.

  The factory has sand casting and spin casting facilities for over 400 tons/annum of mainly bushes and rod. An extension is under construction and will accommodate new electric induction furnaces to permit steel castings. Further diversification projects under consideration include :

  . Castings for 65 mm bronze valves for fire hydrants, pump impellers.

  . Continuous casting of 1,200 tons per year of rod, primarily for export.

  The annual production currently amounts to approximately 220 tons, mostly phosphor bronze.

- Non-Ferrous Metal Works (Zambia) Limited, Ndola

  This firm is primarily an importer and distributor of semi-finished non-ferrous metals such as copper, brass and aluminium in the form of sheet, tubing and a great variety of extruded sections.

  Its foundry closely resembles that of Foundry and Engineering Limited, and offers much the same range of products, i.e. mainly large bronze bushes for crushers in RCM's operations.

  The company claims output of 180-240 tons per annum.

- Scaw Limited, Kitwe

  Scaw Limited in which INDECO has a 2% shareholding, operates a very much smaller non-ferrous foundry. It is mainly engaged in steel fabrication.

- United Machining Company Limited, Chingola

  United Machining Company set up a small bronze and brass foundry quite recently. This still represents only a minor sideline, as Scaw's foundry does, but could conceivably be developed further to achieve a high degree of vertical integration.

Other small companies include Ndole Metal Foundries Limited and Bolognini Foundries (Zambia) Limited. The maintenance division of Zambia Railways also has a small foundry.

All other companies concerned with copper and copper alloys either import and distribute semi-finished and finished products, or manufacture and assemble finished products. Their activities will be discussed in the relevant sections of the market analysis. The more important companies in this sector are clearly the companies who produce a range of copper craft articles. In each case, however, these companies purchase their sheet, strip or other semi-finished product from outside, although some thought has been given by companies in this sector to local fabrication.

Whilst a series of feasibility studies have been carried out in order to determine the possibility of establishing within Zambia industries for fabricating copper and copper alloy semi-finished products (particularly brass and castings) both to serve the home market and to export to the markets of neighbouring countries, as yet no decision has been made on implementation of any of the recommendations contained in these reports.

A3. IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS

Statistical data on imports of copper and copper alloy products are not particularly up-to-date in Zambia. The Central Office of Statistics made available to us some preliminary data for 1979 and this data is presented in Table 3.1.

TABLE A3.1 : IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS - ZAMBIA 1979

SITC Code	Item	Quantity (Tons)	Value (Kwacha)
6931200	Uninsulated stranded wire and cable	21.5	25,060
6822110	Wire	27.7	95,110
6822200	Plate, sheet & strip	1,435.0	254,840
6822160	Bar and Ingot	27.0	56,323
6822500	Tube, pipe and hollow bar	29.3	105,923
6822600	Tube and pipe fittings	7.4	47,797
6935219	Gauze, cloth, netting, etc.	10.0	46,581
6998120	Chain and parts	0.4	1,413
6822300	Foil, not exceeding 0.15mm	-	-
6998111) 6998132) 6998133) 6998119)	Tanks	-	-
6822190	Wrought, other	1,082.0	144,725
		2,640.3	

Source: Central Statistics Office, Zambia

In addition to the data contained in Table 3.1, we have examined the export statistics of the leading copper and copper alloy semi-finished products exporting countries and the export statistics of a range of countries supplying insulated wire and cables to Zambia. The results of these analyses are summarised in Tables A3.2 and A3.3.

Comparison of the data contained in these three tables shows considerable lack of consistency for most product groups. On the one hand, we know that for some product groups quantities of copper and copper alloy semi-finished products are imported by Zambia from countries not listed in our export survey. This factor, however, cannot account for the differences found in each case and we must question the reliability of the Zambian import statistics in certain areas.

In our fieldwork programme in Zambia, we carried out a programme of interviews with all the major copper and copper alloy semi-finished product consuming industries within the country and as such have built up our own picture of demand at the present time, along with projections of future requirements in this sector. In addition, ZAMEFA plays an important role, not only as a manufacturer, but also as a supplier of copper and copper alloy semi-finished products importing, as was mentioned in Section A2 above, significant quantities of these products for resale in the Zambian market. As such, we have gained a good insight into this area through our discussions with ZAMEFA.

The import of certain items, those which ZAMEFA can manufacture, is prohibited through controls on foreign exchange and this again serves a useful cross-check on import data recorded by the Statistics Office and the export data from other countries.

TABLE A3.2 : EXPORTS OF INSULATED WIRES AND CABLES FROM SELECTED COUNTRIES TO ZAMBIA

Exporting Country	1977		1978		1979		1980	
	Q Ton	V$000	Q Ton	V$000	Q Ton	V$000	Q Ton	V$000
USA	-	-	-	-	-	-	-	-
West Germany	175	432	-	-	-	-	-	-
Italy	6	24	7	30	-	-	-	-
France	134	423	-	-	-	-	10	80
United Kingdom	520	1325	-	-	-	-	-	-
Japan	-	-	-	-	-	10	9	170
Canada	-	-	-	-	-	-	-	-
Belgium/Luxembourg	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-
Sweden	130	632	24	120	20	155	29	101
Switzerland	-	-	-	-	-	-	n.a.	n.a.
Netherlands	-	-	-	-	-	-	-	-

TABLE A3.3 : EXPORTS OF COPPER AND COPPER ALLOY PRODUCTS TO ZAMBIA FROM LEADING* COPPER EXPORTING COUNTRIES

Year	Copper				Copper Alloy			
	Wire	RBS	PSS	Tube	Wire	RBS	PSS	Tube
1976	8	-	97	7	2	1	6	51
1977	63	-	81	8	12	2	8	-
1978	9	-	12	3	1	-	-	2
1979	10	-	43	3	2	23	3	2

* International Wrought Copper Council Members

A4. DEMAND FOR WIRE AND CABLE PRODUCTS

A4.1 Electricity Supply and Distribution

Zambia possesses 1,600 MW of generating capacity, almost all of it hydroelectric, and is a net exporter of electricity. The load amounts to only approximately 800 MW at present, leaving enough spare capacity to see the country through the 1980's. Hence, the power generation sector will not feature in the market for copper semis to any great extent during this decade.

The Central African Power Corporation (CAPCO), jointly operated by Zambia and Zimbabwe and financed by the World Bank, owns the principal transmission lines (330KV) which supply Copperbelt Power Company Limited (CPC), and Zambia Electricity Supply Corporation Limited (ZESCO). CPC distributes power on the Copper Belt to the mines and to ZESCO's sub-stations. ZESCO distributes electricity to all domestic consumers and to all industries except NCCM and RCM on the Copper Belt.

Hence, essentially four organisations procure materials for the distribution of electricity, namely:

- ZESCO for its own network as well as on behalf of CAPCO
- CPC
- NCCM for its own distribution systems
- RCM for its own distribution systems

Transmission lines do not contain any copper, even underground link-ups will in future consist largely of aluminium cable. The use of copper in this sector is limited mainly to local underground distribution, building wire, transformers and earthing systems.

By 1985, ZESCO will have 64 sub-stations in its distribution grid as well as 15 isolated diesel generating stations, varying greatly in size.

Rural, and even urban, electrification still have a long way to go. Domestic consumers number only 65,400, i.e. one per 90 head of population. The average household demands 10 KW and consumes 3,700 KwH per annum.

Energy sales are currently increasing at a rate of approximately 4.5% per annum, but this figure is not as much a measure of expansion as an indication of mining and other industrial productivity. The demand is rising at some lower rate.

CPC uses very little copper as it distributes only to bulk consumers. A single mine is said to purchase more copper wire and cable than CPC. The only major addition to CPC's system by 1985 will be a substation at Michelo, using entirely aluminium cable.

CPC accounts for 80% of Zambia's load. It now sells 4,500 GwH per annum, 87% of which goes to the copper industry. Sales increased at the rate of 2.8% but the demand went up by only 1.0% in the 1979/80 fiscal year. Conversion to electric smelting in the 1980's could lead to a 20% jump in demand over and above normal growth.

NCCM and RCM's underground distribution systems at up to 11 KV consist of predominantly copper cable and wire. Purchases during 1980 totalled approximately 463 tonnes in terms of copper.

Most copper wire and cable used in the transmission and distribution of electricity, including building wire, is made or imported by ZAMEFA, which reported the following sales for 1980 in terms of copper content :

	Tons
Armoured Cable	715
Unarmoured Wire and Cable	285
Bare Wire	365
TOTAL	1,365

Some of these outputs were exported, but imports by others may well exceed ZAMEFA's exports in respect of copper content and it would seem reasonable to assume that the total Zambian usage lies 10% and 20% above ZAMEFA's sales figures for bare and insulated wire respectively. These levels of consumption are likely to continue for the time being since one cannot foresee any exceptional demands on the electricity distribution system at present, at least not as far as copper wire and cable are concerned. In projecting usages to 1985 and from then on to 1990, we have therefore assumed annual increments of only 1% to 5% respectively in accordance with the possible rates of increase in power demand.

A4.2 Telecommunications

The Posts and Telecommunications Corporation now has 41,000 subscribers lines with altogether between 75,000 and 80,000 telephone stations. The number of telex subscribers stands at approximately 1,200.

A formidable nation-wide expansion programme now underway will result in a total of 52 automatic exchanges by 1982. Some eight manual exchanges will remain in service. Sizes range from, say, 15 lines for small rural improvements to 15,000 lines in Lusaka, a 500-line exchange being typical for rural areas.

With a few short exceptions, all new trunk routes will involve microwave transmission, so that cable will be required only from exchanges downstream to the telephone stations and for some inter-exchange connections. In addition to PTC's network, private telephone systems are making considerable headway.

ZAMEFA's capabilities range up to 1,200 pr., 500 in jelly-filled cable, and the company achieved a production level of 300 tonnes in 1980. According to informed sources, ZAMEFA cannot at present cope with the demand for telephone cable with the result that about 150 tonnes must be imported, bringing the total consumption to 450 tonnes per annum in terms of copper content.

In view of the current level of activities in this sector, it would seem reasonable to assume that the market for telephone cable will remain much the same on average for some time to come.

The number of telephone stations, including private stations, evidently rose by 15,000 during 1980. The estimated consumption of 450 tons p.a. thus corresponds to a copper usage of 30-45 kg per station.

A4.3 Other Uses of Insulated and Bare Wire

ZAMEFA supplies not only most of the wire and cable used in the connection of dwellings, industrial plants, commercial enterprises and urban services to ZESCO's network, but also almost all wiring used in the distribution of power throughout such facilities. All such applications are included in the foregoing assessment.

Zambia's current economic problems have reduced construction and industrial growth to low levels of activity. No major industrial project other than NCCM's cobalt plant appears to be underway. The construction of dwellings has almost come to a standstill and is unlikely to reach a level of even 50,000 low-cost units per annum for some time to come. New medium and high cost dwellings will not amount to more than a few hundred per year. An upswing in the economy would still seem a few years away. When it comes, it will bring about a substantially higher demand for cable and wire, and one may expect ZAMEFA to be ready to cope with it.

Earthing wire also comes from ZAMEFA and the estimate of 400 tonnes per annum should cover not only power distribution but also all other requirements.

With regard to electric appliances, Zambia has very little use of wiring. A population of less than 6 million, half of which are engaged in subsistence farming, cannot present much demand at the best of times. Moreover, the tight import restrictions limit the supply to only a fraction of the demand. In any case, technological advances steadily reduce the usage of wiring in appliances.

ITT Supersonic (Zambia) Limited manufactures radios, cassette recorders, TV sets and the like, under import protection. Its allocation of foreign exchange for raw materials permits only about 25% coverage of the demand, but even if the demand were met in full, the requirements for strapping wire, twin flex and mains cord would hardly exceed eight tons p.a.

With a few exceptions, such as electric water heaters, other appliances are imported. We consider it most unlikely that an appliance industry with any significant usage of wiring will emerge in Zambia is the foreseeable future.

Other minor uses of insulated wire occur in locally manufactured switchgear and in the reconditioning of electrical equipment, all of which is included in the foregoing assessment.

The assembly of wiring harnesses for automobiles entails specialised operations which ZAMEFA would hardly find economical. The wiring in all vehicles likely to be assembled in Zambia by 1985, i.e. a maximum of 6,000, would amount to only 10 tons p.a. of copper, assuming an average of 1.7 kg per vehicle. Assemblies will almost certainly wish to continue using established sources of supply. One can see good export opportunities here for suppliers to the Nigerian automobile industry.

A4.4 <u>Winding Wire</u>

Numerous firms rewind motors, particularly for the mines. Among the market leaders are Water Engineering Limited, Stator Electrical Limited, Electrical Maintenance Lusaka Limited, Winding Company of Zambia Limited, and Hawker Siddeley Electric Zambia Limited. Most of their supplies come from two distributors, namely Delta Enfield and GEC. These import approximately 80 tons p.a. between them. A further 20 tons p.a. to mostly special specifications is imported directly by equipment and appliance manufacturers and other distributors as well as by the copper industry itself.

The market has been fairly steady in recent years, perhaps even dropping slightly. Nevertheless, ZAMEFA plans to diversify into this area in the near future, in which case Zambia may become largely self-sufficient in respect of enamelled winding wire by 1985.

A5. DEMAND FOR BRASS MILL PRODUCTS

This group of products embraces all semi-finished materials other than wire and cable irrespective of whether they consist of copper or copper alloys. The demand is conveniently assessed on an industry-by-industry basis.

A5.1 Mining Sector

All non-ferrous mining in Zambia is in the hands of NCCM and RCM. A few non-metal mining and quarrying operations, under the umbrella of MINDECO, as well as Maamba Collieries Limited, both wholly-owned by ZIMCO, represent relatively insignificant elements of this sector as far as requirements for brass mill products are concerned.

The copper industry uses far more materials than any other, but brass mill products usually come as components of equipment and machinery, notably electrical equipment, their direct usage by the mines being quite modest.

NCCM and RCM reported total purchases in 1980 of the following order :

	Tons
Tubing, mostly copper	7.3
Copper sheet, strip & tape	0.6
Copper bar and other sections	0.1
Brass strip	0.4
Brass bar	0.7
Bronze bar, cored and solid	23.4
TOTAL	32.5

The companies may well have run down their stocks as a result of the extremely tight foreign exchange control in 1980. Normal requirements may thus amount to 50 tonnes per annum of brass mill products - still a relatively small volume.

A5.2 Electrical Engineering

Electrical engineering has been left to the private sector. It gives the impression of a growth industry to the extent that import restrictions on raw materials and capital equipment permit. The industry serves mainly the mines but also other sectors including, of course, ZESCO and CPC.

Four companies manufacture electric switchgear, namely:

- Reyrolle Africa Limited (high voltage)
- Allenwest (Zambia) Limited (low voltage)
- Cutler Hammer Zambia Limited (low voltage)
- Fairway Engineering Limited (low voltage)

They use altogether 50 tons per annum of bus bar, mostly from ZAMEFA although this source of supply still lacks in quality and is limited to a maximum section of 6 x 76 mm.

The great majority of switchgear is, however, imported by Delta Enfield Engineering (Zambia) Limited, GEC Zambia Limited and others. One authority puts the amount of copper in switchgear from all sources as high as 2,000 tonnes per annum.

South Wales Electric Zambia Limited is at present the only manufacturer of distribution transformers with a consumption of about 1,000 tons p.a. of copper strip for both new units and repairs. This strip comes in many different sizes, usually paper covered, all of it being imported. Round products are also used, but little enamelled winding wire. ZAMEFA is unlikely to meet these rather special needs in the foreseeable future.

Reyrolle Africa Limited intend to set up a transformer factory for 1,500 to 2,000 units per year in 1982. This could boost strip requirements for the transformer industry by, say, 500 tonnes per annum.

The extensive use of winding wire has already been discussed in the preceding section on wire and cable. Stator Electrical Limited uses approximately 25 tons p.a. of copper strip in addition to winding wire. With regard to consumer products, Electric Maintenance Lusaka Limited make extensive use of copper in the manufacture of light fittings. It is not the only company in its field. The display of Zambia's traditional product in homes and public buildings has considerable appeal. EML uses 4 tons p.a. of copper sheet including some bar, but could use ten times as much if adequate foreign exchange were available.

ITT Supersonic (Zambia) Limited is the only manufacturer of television and radio sets, radio cassette recorders, console radiograms and the like. It enjoys import protection, evidently 95% effective, and receives enough import allocations to meet one-quarter to one-third of the demand.

The use of copper in this industry does not amount to a great deal. Brass mill products comprise mainly copper bits for soldering irons, totalling only 21 kg per annum. 700 sq.m. of copper clad laminated sheet for printing circuits account for a negligible weight of copper. The preceding section deals with requirements in respect of wiring, which are likewise minimal.

A5.3 Automotive Industry

Copper-containing automobile components comprise essentially radiators, wiring harnesses, starter motors, alternators and ignition coils. Wiring harnesses have been discussed in the preceding section of this report.

Zambia's vehicle assembly industry is still in its infancy and suffering from the shortage of foreign exchange for importing components. One cannot, therefore, predict its future to any given degree of certainty.

Livingstone Motor Assemblers Limited did not operate at all at the time of the fieldwork for this study, but the company's problems are receiving serious attention with the more immediate objective of 2,000 passenger cars and 2,000 pickups per annum.

Rover (Zambia) Limited appears to be capable of assembling 1,500 vehicles per annum, Leyland Motors (Zambia) Limited assemble 150 trucks per annum and General Motors and BMC trucks are evidently also assembled in Zambia, albeit in very small numbers and from SKD units.

By 1985, the Zambian automobile industry may thus produce 2,000 passenger cars and 4,000 utility vehicles and trucks per annum with water-cooled engines.

Zambia already has a radiator industry, namely Automotive Radiators Limited and one or two very small manufacturers. Automotive Radiators cater for the replacement market, using at present 20 tons p.a. of copper strip and 20 tons p.a. of 70/30 brass strip. The company was recently granted import protection and soon hopes to provide all replacement radiators, from FIAT 127 to Caterpillar, using perhaps 60 tons p.a. each of copper and brass strip. These figures do not include the brass top and bottom tanks, which can usually be re-used after appropriate repairs.

None of the vehicles now assembled locally have Zambian made radiators, but one could assume that they will all do so by 1985. In this event, requirements for the original and replacement markets would be of the following orders of magnitude (Table A5.1).

TABLE A5.1 : DEMAND FOR COPPER AND COPPER ALLOY RADIATORS - 1985

Item	Brass Strip	Copper Strip	Total Strip	Total Strip
Passenger Cars	8.0	3.4	11.4	9.0
Utility Vehicles	7.6	3.2	10.8	8.5
Trucks	7.6	3.2	10.8	8.5
Replacements	60.0	60.0	120.0	102.0
TOTAL	83.0	70.0	153.0	128.0

The exceptionally high estimate of the replacement market may be attributed to the shortage of new vehicles and to the large number of heavy vehicles used in the mining industry. The above figures allow for up to 20% scrap.

As far as automobile electric equipment is concerned, the Zambian market will remain too small in the foreseeable future to warrant any significant local manufacture.

A5.4 Foundry Products

The non-ferrous foundry industry has already been discussed in Section A2. It currently produces approximately 450 tons p.a. of bronze and brass castings for the replacement market, altmost entirely from scrap. This volume could almost double by 1985 when the casting and machining of components for original equipment will probably have begun. If the continuous casting project of Foundry and Engineering Limited goes ahead, this industry could reach an output of 2,000 tons p.a. in the late 1980's.

A5.5 Construction

Other than wire and cable, which has been covered in Section A4, the Zambian construction industry uses hardly any semi-finished copper or copper alloy products.

Bronze and brass components in valves and fittings, mainly castings, could amount to 300 tons p.a., but such items are usually mass produced on a scale which the Zambian market would not warrant.

Very little copper tubing finds its way into plumbing, galvanised steel being the order of the day as in Nigeria. Non-Ferrous Metal Works Zambia Limited claim to be the only stockists of copper tubing, but turns over only 8 tons p.a. to plumbing contractors and to the mines altogether.

Some copper sheeting finds its way into offices and public buildings as decorative cladding, but the amounts involved are likewise minimal.

The assessment of the Zambian market includes nominal quantities of tubing, sheet and sections, and assumes that construction activities will eventually revive and that copper tubing will gain increasing acceptance.

A5.6 Copper Craft Industry

Several firms, notably Copper Crafts Limited and Zambia Art Metal Limited, produce a variety of decorative copper articles for the domestic and export markets. Their raw materials consist essentially of imported sheet.

We estimate that this industry consumes approximately 100 tons p.a. of copper sheet and that it could double production if import restrictions were lifted and one could take full advantage of the export potential.

A5.7 Other Industries

A number of other industries use copper as raw material :

- Monarch Zambia Limited, a member of the INDECO Group. This firm of metal fabricators manufactures electric water heaters among other product lines. Sales currently amount to approximately 50-70 tons p.a. of copper sheet ranging from 16-24 gauge.

- Manufacturers of brass hardware including locks (e.g. J. Legge and Company Zambia Limited). Their use of extruded sections and plate is probably minimal. Some import materials directly, others obtain it from stockists. Non-Ferrous Metal Works Zambia Limited, the main stockists of extruded brass sections, sells only approximately 15 tonnes per annum.

Other major industries include an oil refinery, steel fabrication, food and agro-industries, textiles and chemicals. Their use of copper semis for maintenance purposes amounts to small fragmented quantities procured largely from local distributors. It is difficult to put figures to these, safe to say that they must in total fall considerably short of maintenance requirements within NCCM and RCM.

Zambia has no industries making industrial equipment or consumer products with significant contents of copper semis other than cable, transformer and switchgear and a few less important manufacturers already taken into account. Nor are such industries likely to emerge until after 1985, beyond which one can hardly speculate on specific industrial developments.

A5.8 Emphasis on Quality

In general, quality ranks very highly among the criteria governing contracts for the supply of copper semis. ZAMEFA will be aware of the sustained effort needed to improve a new product line to the point where customers regard it as satisfactory. The introduction of enamelled winding wire, a product on ZAMEFA's more immediate diversification programme, will present a particular challenge in this respect.

By the same token, a Nigerian rolling mill can, for example, hardly expect to sell strip to Automotive Radiators Limited from the outset. This firm puts foremost emphasis on consistently high standards in respect of gauge tolerance, hardness and temper and believes that any new supplier will have a long struggle to break into the market.

A5.9 Purchasing Methods

As already mentioned, the two copper producers have a joint buying office for imports, located in London.

ZESCO (Zambia Electricity Supply Corporation Limited) and the Posts and Telecommunications Corporation both go out to international tender for any major requirements which ZAMEFA's factory cannot meet.

The Posts and Telecommunications Corporation currently relies on two multi-national contractors for its major development projects, namely Northern Electric/ ITT and L.M. Ericsson, who evidently use their established suppliers for any materials not available in Zambia.

Other than that, no hard-and-fast rules seem to apply. Materials may be imported through Zambian distributors or directly from abroad. Many firms deal with established regular suppliers, particularly those with foreign partners or parent companies.

A5.10 Major International Competitors

Major international suppliers of wire and cable generally have agents in Zambia. Thus, ZAMEFA represents the interests of BICC (British Insulated Callender's Cables Limited) in respect of products outside its own range of manufacture. BICC does considerable business with ZESCO. Stator Electrical Limited represents Pirelli.

ZAMEFA produces its own wire bar from ingots supplied by NCCM. Brass mill products find such a small market in Zambia at present that formal representation would hardly seem worthwhile, although some of the distributers may well have regular sources of supply.

A5.11 Opportunities for Nigerian Exports

Being a producer of refined copper and, indeed, economically dependent on the copper market, one must expect Zambia to continue to develop its own downstream copper industries.

ZAMEFA's extrusion press is used almost entirely for the production of wire rod which, in turn, serves the manufacture of a range of power and telephone cable which meets most of the requirements of Zambia's electricity and telecommunications systems. From time to time, the press is also used to extrude bar as well as aluminium sections.

ZAMEFA represents one of INDECO's success stories, having shown fairly steady growth since it began operations some ten years ago. The factory already exports 20% of its output, it seems therefore reasonable to assume that this company will continue to diversify and expand and to improve the quality of its products. It already has plans to make enamelled winding wire and to set up a continuous rod casting facility.

Opportunities for Nigerian exports of semi-finished products as from the mid-1980's will therefore be limited to brass mill items which ZAMEFA could not produce with the plant at its disposal and for which the domestic and Central and East African export markets are too limited to justify new plant. These items comprise essentially tubing, sheet and strip.

Zambia already has a number of non-ferrous foundries as well as machining capabilities catering to the replacement market for bronze and brass castings. These will likewise diversify and expand in accordance with the needs of the copper mines and other domestic consumers, leaving little scope for Nigerian exports except for mass-produced original equipment such as valves and fittings. In any case, the production of alloys other than for brass mill products usually represents the first step in the manufacture of finished castings which are beyond the scope of the proposed factory.

A6. SUMMARY OF THE ZAMBIAN MARKET

Table A6.1 summarises the present use of cable, wire and brass mill products with contingencies for miscellaneous uses. It also indicates anticipated requirements for 1985 and projects these to 1990 on the basis of macro-economic criteria and considered opinion.

These projections will be found more cautious than those developed by Keinbaum* in studies conducted in 1973 and 1980 but we believe more realistically reflect the growth opportunities open to Zambia in view of the present and forecast world copper market situation to the mid-1980's.

Table A6.2 condenses these results into the principal categories of cable, wire and brass mill products. Foundry work has been omitted because, although it constitutes an important use of copper alloys, neither the raw materials nor the products can be regarded as semis.

This analysis reflects the very limited extent of industries using any appreciable quantities of copper and copper alloy semis as raw materials. Other than wire and cable, low voltage transformers, some switch-gear, replacement automobile radiators and electric water heaters, almost all hardware is imported. Construction and maintenance work have been reduced to essentials by severe import restrictions.

With regard to export opportunities for the proposed Nigerian enterprise, one must consider the degree of self-sufficiency which Zambia may achieve by 1985, and this could be very high indeed.

ZAMEFA already produces most of the power and telephone wire and cable used in Zambia and can be expected to meet all but a few special requirements such as automobile harnesses by 1985. The company expressed a firm intention to diversify into enamelled winding wire in the very near future, in which case it should reach adequate quality standards to meet at least half the demand by 1985.

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*Keinbaum studies carried out for UNIDO.

TABLE A6.1 : ZAMBIAN MARKET FOR COPPER AND COPPER ALLOY PRODUCTS (TONNES/YEAR)

Item		1981	1985	1990
Cable and Wire				
Insulated for all uses except those listed below		1,200	1,250	1,600
Automobile Wiring Harnesses		3	7	10
Bare wire		400	420	540
Winding wire, enamelled		100	100	120
Telephone Cable		450	450	450
Brass Mill Products				
Mines:	- Tubing, mostly copper	7	11	13
	- Sheet and strip	1	2	3
	- Bar, mainly bronze	24	37	43
Electrical Engineering:	- Bus bar	50	200	1,000
	- Strip, insulated for transformers, etc.	1,025	1,500	2,000
	- Sheet for light fittings	8	40	50
Automotive Industry:	- Copper strip including scrap	20	70	70
	- Brass strip including scrap	20	83	83
Construction:	- Tubing	8	25	50
	- Bar, mainly brass	10	15	20
	- Sheet	10	15	20
Foundries:	- Bronze and brass castings	450	800	2,000
Copper Crafts:	- Sheet	100	150	200
Water Heaters and Other Heat Exchangers:	- Copper sheet	75	100	200
Other Uses for Production and Maintenance:	- Tubing	5	10	15
	- Sheet and strip	10	20	30
	- Bar and rod	35	50	75

TABLE A6.2 : ZAMBIAN MARKET SUMMARY (TONNES/YEAR)

Item	1981	1985	1990
Insulated Power Cable and Wire	1,200	1,250	1,600
Automobile Harnesses	3	7	10
Telephone Cable	450	450	450
Bare Wire	400	420	540
Enamelled Winding Wire	100	100	120
Total Cable and Wire	2,153	2,227	2,720
Copper and Brass Tubing	20	46	78
Copper Sheet and Strip	224	397	573
Insulated Copper Strip for Transformers and Motors	1,025	1,500	2,000
Brass Strip	20	83	83
Copper Bus Bar	50	200	1,000
Bronze and Brass Bar	69	102	138
Total Brass Mill Products	1,164	1,885	3,221
TOTAL MARKET	3,317	4,112	5,941

Both ZAMEFA and Foundry and Engineering Limited intend to diversify into continuous casting. If and when either of these projects materialises, Zambia will also be able to meet much of its demand for rod and bar. ZAMEFA already extrudes bus bar and a continuous rod casting facility would release its 600 tonne press for extruding adequate quantities of most of the commonly used copper and brass sectors. However, the domestic market, even for wire rod, is so small that a continuous casting plant would have to rely on an exceptionally high proportion of exports, which makes the viability of such a project somewhat doubtful at this point in time.

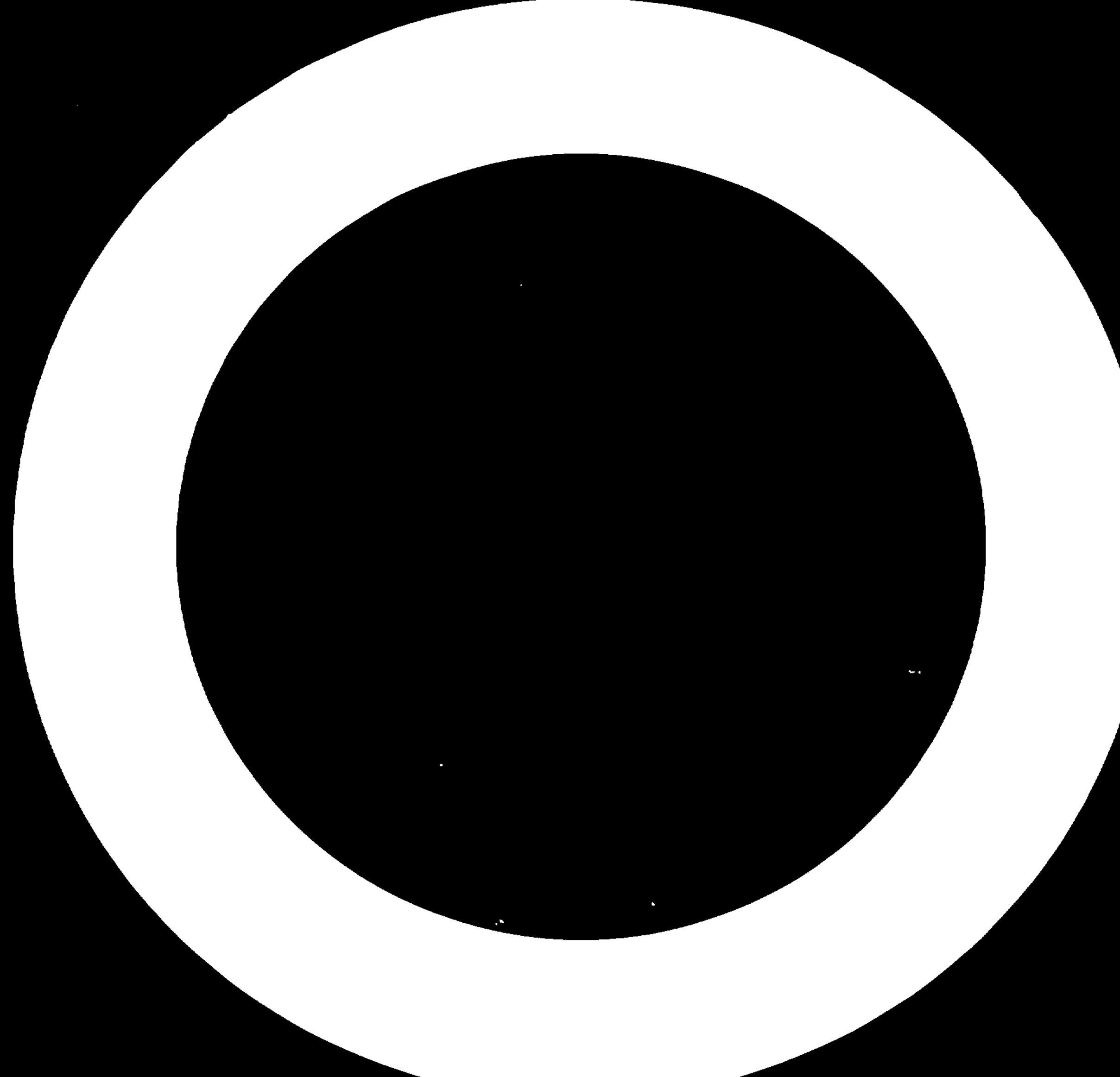
Tubing and flat rolled products will continue to be imported, the markets being far too small to warrant domestic manufacture.

Hence, even under the assumption that neither of the continuous casting projects will go ahead for the time being, export opportunities for Nigerian semis will be limited to the projects and volumes indicated in Table A6.3 or to portions thereof depending on the versatility and quality standards of the proposed Nigerian plant.

Automobile harnesses and winding wire will continue to be procurred on a competitive basis from experienced suppliers, and a new brass mill can hardly be expected to produce the great variety of insulated strip for transformers and motors. It is, therefore, quite likely that export opportunities for the proposed Nigerian plant may be limited to a share of some 500 tons p.a. and 700 tons p.a. of tubing, sheet and strip in 1985 and 1990 respectively. Obviously, if an agreement is made between the Governments of Zambia and Nigeria on this project, it is possible that a part of the Zambian market may be allocated as a special tariff category. Under normal commercial circumstances however, the Nigerian plant would find great difficulty in obtaining more than a very small share of the Zambian market.

TABLE A6.3 : MAXIMUM EXPORT OPPORTUNITIES FOR NIGERIA (TONNES/YEAR)

Item	1985	1990
Cable and Wire		
Automobile Harnesses	7	10
Winding Wire, enamelled	50	50
Total	57	60
Brass Mill Products		
Copper and Brass Tubing	46	78
Copper Sheet and Strip	397	573
Insulated Copper Strip for Transformers and Motors	1,500	1,500
Brass Strip	83	83
Bronze and Brass Bar	102	138
Total	2,128	2,372
TOTAL MAXIMUM EXPORT MARKET	2,185	2,432



B. PEOPLE'S REPUBLIC OF BENIN

B. PEOPLE'S REPUBLIC OF BENIN

B1. ECONOMIC AND DEMOGRAPHIC OVERVIEW

B1.1 Introduction

Benin has a surface area of 112,600 square kilometres and a population of 3,740,000 (1979 estimate). The population growth rate is a relatively high 2.8%.

From it's Southern border on the Gulf of Guinea, the country extends some 700 kilometres inland between Nigeria on the East and Togo on the West. In the North, Benin borders with Niger and Upper Volta. The country can be divided into two climatic regions with the equatorial type in the South characterised by high humidity, two dry seasons and two rainy seasons. Travelling North, the humidity level progressively decreases and there is only one dry season and one rainy season. There is also a variety of country with the sandy coastal region in the South, the plateau and hilly regions further inland and the Niger plains in the North.

The two largest towns are Cotonou, the capital, with a population of 208,000 (1979) and Porto Novo, with 119,000 inhabitants (1979).

The present Head of State, Lt. Colonel Kerekou, came to power in October 1972 and has since then pursued a socialist, centralised economic and political policy. In 1974 Marxist Leninist philosophy was formally adopted and this was followed by a number of major nationalisations. The first general election since 1972 was held in late 1979 when the ruling military National Revolutionary Council was superseded by the Revolutionary National Assembly.

The representatives of the assembly are all approved by the Marxist Leninist People's Revolutionary Party of Benin whose chairman is Lt. Colonel Kerekou. His authority was strengthened by his confirmation as President of the Assembly early last year.

B1.2 Agricultural Sector

The agricultural sector dominates the Beninese economy and employs over 60% of the male population. Some 85% of the population live in rural areas. The difficulties faced by this sector has been a major contributor to Benin's trade imbalance during the 1970's. The principal cash crops, traditionally accounting for 40-50% of export earnings, are palm products and cotton. Other cash crops are cocoa, groundnuts, karite and coffee. Droughts in 1976 and 1977 drastically reduced production, although this picked up noticeably in the following seasons. Production of Benin's principal cash crops are given in Table B1.1.

TABLE B1.1 : PRODUCTION OF CASH CROPS 1974-1980 : OOO TONNES

Crop	1975/6	1976/7	1977/8	1978/9	1979/80*
Cocoa	2	1	1	1	6
Cotton	31	20	14	19	25
Palm Kernels	46	50	12	23	29
Groundnuts	5	7	3	1	1
Karite	0.3	12	8	0.4	18

* Provisional

Source: BCEAO published in "West Africa" 8.12.81

Apart from droughts, output was also adversely affected by low producer prices imposed by the Government.

The main subsistence crop is maize which in 1976 accounted for about 65% of all cereal production increasing to about 80% in 1978. Available figures for production of cereals for the five years 1974-78 are given in Table B1.2.

TABLE B1.2 : CEREAL PRODUCTION 1974-1978 : OOO's TONNES

Year	Maize	Sorghum	Rice
1974	229	79	9
1975	217	52	13
1976	182	72	18
1977	235	76	18
1978	308	62	9

In view of its importance to the economy, the Government's 1977/78 - 1979/80 Development Plan was centrally concerned with the agricultural sector. State enterprises have been created to control inputs (SONAGRI) and exports (SONACEB) and an agricultural credit bank, the Caisse Nationale de Credit Agricole, established. A joint-venture with Beninese, European and Nigerian financing is setting up a major sugar plantation with a capacity of 40,000 tonnes, some 15,000 tonnes of which will be exported to Nigeria.

B1.3 Industrial Sector

The industrial sector is still relatively small in Benin, although it has expanded from contributing 15% to Gross Domestic Product in 1975 to about 20% currently. Most manufacturing enterprises are owned by, or controlled by, the Government. The most important industries are the refining of palm oil and cotton cloth manufacturing. Other industries in this sector include cement, flour, beverages, ceramics and cotton print.

A survey carried out by the Government towards the end of 1980 criticised under-utilisation of manufacturing plant and misuse of resources. An example is the cement industry which comprises two factories. The Societe des Ciments de Benin is 80% State-owned and has an annual capacity of 240,000 tonnes, but only produced 148,000 tonnes in 1979. The Societe Nationale de Ciment is 100% State-owned, has a capacity of 200,000 tonnes but in its first full year in 1979 produced only 107,000 tonnes. Special commissions of enquiry were also set up to investigate some State enterprises, particularly the Societe Beninoise de Palmier a Huile and the Caisse Nationale de Credit Agricole.

An oilfield, 10 miles offshore, was located in 1968 with an estimated capacity of 22 million barrels of oil. Initially development was not considered worthwhile but as a result of increased oil prices, the Government intends to exploit the field with Norwegian assistance Production is expected to begin in 1982 and it is hoped to achieve 15,000 barrels daily. 20% of this will be sufficient to meet domestic demand, leaving 80% for export. Other known natural resources are phosphates, uranium and limestone; only limestone is currently being exploited.

The commercial sector is generally regarded as the more successful part of the economy and contributes about 20% of Gross Domestic Product. Its geographical position favours the country's development as a maritime commercial base for neighbouring Nigeria and Niger. About 30% of the tonnage of merchandise handled by the Port of Cotonou was destined for these two countries. This will be facilitated by recent major investments in road and rail systems in Benin and expansion of the port. The commercial sector is largely in private hands and it is unlikely that steps will be taken to alter this in the near future.

B1.4 Economic Development

During the first half of the 1970's real per capita income fell as agricultural output declined and population increased. Gross Domestic Product data for the years 1974-1976 are given in Table B1.3.

It is difficult to obtain up-to-date reliable data on the economy but real GDP is thought to have increased since the mid-1970's but only marginally above the growth in population, which was some 3% per year. If the recent pick-up in agricultural output continues, there are prospects for modest real growth in GDP, particularly in view of the oil field development.

TABLE B1.3 : GROSS DOMESTIC PRODUCT 1974-77 : (CFA Billions)

Sector	1974	1975	1976*	1977*
Primary	37.7	39.0	50.0	56.5
Secondary	14.8	14.0	14.7	15.0
Tertiary	45.9	50.0	54.3	61.2
GDP	98.4	103.2	119.0	132.7

Source: "Statistics Yearbook 1980", Institut National de la Statistique et de l'Analyse Economique"

* Estimates

The above figures should be treated with some reserve. Statistics for the years 1975 and 1976 published by the UK Embassy in Cotonou suggest that Gross Domestic Product for these years was some 15% less.

Statistics prepared for a meeting of the Finance Ministers of the member countries of the BCEAO are the most up-to-date available and show an increasingly large current account deficit and consequent increases in external debt. (Table B1.4).

TABLE B1.4 : BALANCE OF TRADE 1976-1980 : US$ Millions

Item	1976	1977	1978*	1979*	1980**
Exports	102.5	146.5	164.0	189.5	227.3
Imports	-176.6	-233.6	-295.6	-350.7	-430.4
Services	- 22.2	- 39.1	- 33.7	- 22.6	- 14.0
Transfers	+ 47.7	+ 83.4	+ 83.3	+ 83.2	+105.4
Current Balance	- 48.6	- 42.8	- 82.0	-100.6	-111.7

Source: "West Africa" 8.2.81

* Estimated
**Projected

The 1977-80 Plan envisaged investment of US$1 billion primarily in projects designed to assist agricultural industries and import substitution. The development budget has traditionally relied heavily on foreign aid, e.g. an average of US$50 million was received from Western sources between 1974 and 1977. Early reports suggested that the Government was unable to reach its investment targets.

As yet no details are available on any further development plans, but would probably concentrate, as before, on agro-industry projects. Foreign investment has reduced in recent years, but this may be more forthcoming as a result of somewhat better relations with France over the past few months.

B2. LOCAL COPPER PRODUCING INDUSTRY

There is no significant local copper processing industry and it is unlikely that one will be developed during the time period being considered for this study.

B3. IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS

The latest available trade statistics on imports of copper products only run to 1978. Table B3.1 shows the imports for the years 1976-78.

TABLE B3.1 : IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS 1976-78 : TONNES

Item	1976	1977	1978
TOTAL	21	79	31
Of Which:			
- Bars, Sections, etc.	5	5	15
- Non-insulated electric cable	6	64	4
- Tubing	7	5	9

Source: INSAE

Benin, during this period, imported relatively little copper, the vast majority of which comprised the three categories, bars, cable and tubing.

The large volume of cable imported in 1977 may be accounted for to some extent by the cement plant which was completed in 1978. The demand for copper products of this type depends very much on large construction projects which tend to be on a single case basis. There seems to be no significant continuing demand as a result of any continuous construction programme.

Imports of insulated electric cable also peaked in 1977 although it is impossible to fully separate copper from aluminium cable. The tonnage of cable imported is given in Table B3.2.

TABLE B3.2 : IMPORTS OF INSULATED ELECTRIC CABLE 1976-1978 : TONNES

Item	1976	1977	1978
Copper insulated cable	31	84	125
"Other" insulated cable *	251	545	201

Source: INSAE
* This item includes both copper and aluminium insulated cable.

The increased imports in 1977 are due in part to an extension of the electricity supply network in Cotonou in this period.

Despite the country's present economic difficulties, local companies believe that the construction sector will expand, particularly as a result of the recently improved relations with France. There could therefore be a notable increase in demand for copper wire and cable although the total market will remain relatively small for a number of years to come.

The results of our fieldwork indicate that imports of copper wire and cable for the major copper using items will not have increased in the period 1979/80 and we have based our estimates for 1980 on the average for the period 1976-78. The nature of the market is such that demand fluctuates from year to year depending on the particular projects in progress. The view of local merchants is that the average level of activity has been low for the past few years.

Table B3.3 shows exports to Benin of copper and copper alloy products from the member countries of the International Wrought Copper Council for the years 1976-79. In addition, exports from the USA, Canada and Australia (all non-members) are included.

Not all countries exporting to Benin are members of this Council and there will be differences in times and systems of recording items. However, the export figures do confirm the higher than average importation of wire in 1977 and the generally low level of demand for copper and copper alloy products in recent years.

TABLE B3.3 : EXPORTS OF COPPER AND COPPER ALLOY PRODUCTS TO BENIN 1976-79 (Tonnes)

Year	Copper				Copper Alloy			
	Wire	RBS	PSS	Tube	Wire	RBS	PSS	Tube
1976	6	-	-	3	3	1	-	-
1977	48	5	-	8	2	-	-	-
1978	-	-	-	10	1	1	-	2
1979	1	1	-	4	2	1	-	2

Source: International Wrought Copper Council

B4. DEMAND FOR WIRE AND CABLE PRODUCTS

B4.1 Electricity Supply and Distribution

As with Togo, electricity is supplied to Benin from the hydro-electric dam in Ghana. Distribution of electricity within Benin is the responsibility of a separate State organisation, SBEE. Unfortunately SBEE were unwilling to provide up-to-date information for our study and the following data is from the statistical yearbook for 1980.

The number of subscribers to the electrical network 1975-77 are given in Table B4.1.

TABLE B4.1 : SUBSCRIBERS TO THE ELECTRICAL GRID 1975-77

Year	High Tension	Low Tension	Total
1975	95	14,042	14,137
1976	123	14,267	14,390
1977	169	15,892	16,061

As can be seen from Table B4.2 despite an increase in locally produced electricity during this period, Ghana supplies the vast majority of electric power.

TABLE B4.2 : ELECTRICITY SUPPLY 1975-77 : 1,000 KwH

Year	Local Production	Supply from Ghana	Total
1975	3,574	52,942	56,516
1976	4,409	57,618	62,027
1977	6,459	66,977	73,436

The extention to the electricity distribution network mentioned earlier and reflected in the higher consumption and increased number of suppliers can be readily seen in Table B4.3 showing the length of the network (1973-77).

During the period of expansion 1976 and 1977, the network expanded by 105 kilometres. SBEE estimate that their present annual requirements are about 100 kilometres of insulated cable and 50 kilometres of uninsulated.

Both high and low tension cables used in Benin are aluminium or aluminium alloy and SBEE cannot see this position altering as they believe there will always be a price difference in favour of aluminium.

The only occasions in which copper cable is used is for the final connection to the subscriber and occasionally in weak sections in rural areas as copper is a better conductor. A rough estimate of their consumption of copper cable is some 50 kilometres per year with the major sizes being 4 x 6 mm - 4 x 16 mm and rarely 5 x 25 km. The specifications for all electricity distribution cable is French UTE.

B4.2 Telecommunications

At the moment there are 15,000 telephone subscribers in Benin and the Office de Postes et Telecommunications plan a large increase in subscribers over the next few years. The capital, Cotonou, has 10,000 subscribers. Of the 16 automatic exchanges, four are in Cotonou. One of these exchanges has a capacity of 4,000 lines, whilst the other three have a capacity of 2,000 each which can be increased to 8,000 each.

In addition to the present 16 automatic exchanges, they hope to instal a further 34 by 1983/4 with a capacity of 300 subscribers each; the 300 lines can be expanded to 2,000 at a later stage.

The sizes of telephone cable used are from 7 - 896 pair. The most widely used cable sizes are 7 - 28 pair because these sizes are required for suburban connections but during their expansion programme the major sizes purchased will be 14 - 488 pair.

TABLE B4.3 : LENGTH OF ELECTRICITY DISTRIBUTION LINES - 1973-1977 : KILOMETRES

Item	1973	1974	1975	1976	1977
High Tension, Overhead					
- Cotonou, Porto-Novo, Ouidah	102	102	106	116	118
- Abomey, Bohicon	10	11	11	11	18
- Parakou	6	7	7	20	20
Total	118	120	124	147	156
High Tension, Underground					
- Cotonou, Porto-Novo, Ouidah	49	50	51	51	51
Low Tension, Overhead					
- Cotonou, Porto-Novo, Ouidah	197	200	200	225	250
- Abomey, Bohicon	13	18	18	18	28
- Parakou	9	10	10	10	20
Total	219	228	228	253	298
Low Tension, Underground					
- Cotonou, Porto-Novo, Ouidah	10	10	10	10	13
TOTAL NETWORK	396	408	413	461	518

In 1979 OPT ordered cable to the value of CFA 400 million (US$ 1.9 million) and it was said that such a volume had been the average over the past few years. In terms of cable sizes, this was approximately:

- 448 pair	15 kilometres
- 224 pair	15 kilometres
- 112 pair	15 kilometres
- 56 pair	15 kilometres
- 28 pair	15 kilometres
- 14 pair	15 kilometres
- Total	90 kilometres

This volume of purchase will be almost doubled for 1981 at CFA 750 million and trebled for 1982 and 1983 (CFA 1,500 million in both years). Thus, during the next three years, OPT will be installing more than 700 kilometres of telephone cable.

OPT expect their requirements for cable to continue expanding from 1983 to about 1986 as the numbers of subscribers increase, but demand will then fall off and stabilise. The size of cable required will be smaller, i.e. in the 14 - 122 pair range.

The final line to the subscriber is always single pair and OPT estimate that they purchase a minimum of 500 kilometres of single pair cable annually. With the extension of the network, the requirement for this type of cable is expected to increase by about 15% annually over the period 1981-1986.

Microwave systems are being used increasingly for transmission and by 1986 the requirement of copper cable for this purpose will be minimal.

As regards purchasing, OPT emphasised that prices must be competitive. They do call for international tenders but supplies have always come from France and the personal contact with suppliers is very important.

B4.3 Other Uses of Bare and Insulated Cable

There are a number of large projects in the course of construction at the moment, e.g. a large luxury hotel, sugar plant and stadium, which should be completed within two years. A particular problem in Benin is that building is often subject to delays. For various reasons, little work has been done on the hotel building for the past 18 months.

Construction has been at a low level for the past two years. Both the major installers of electricity cable in Benin believe that there will be a resurgence in construction as a result of the change in political climate with France; this expansion will depend on the availability of foreign aid and financing.

On the housing side the Government intend to build a total of 1,000 dwellings of various categories during the 1981-84 period. To date the Government has not been involved in housing construction and those that were built were all in the private sector.

Local installers and distributors have, at the moment, a requirement of some 30 tonnes maximum of electric cable. In addition to this there are unofficial imports from Nigeria and Ghana but it is impossible to quantify how much. One company felt that, assuming all goes well, the construction market could expand by about 20% annually over the next few years. The major sizes are 1.5 - 6 mm with two or four conductors. Specifications are European, not British Standards.

B4.4 Winding Wire

The two main installers of electric cable also rewind motors and in addition there are two distributors of winding wire. Their total requirement of winding wire at the moment is about 5 tonnes annually. Apart from these there are a number of small companies involved in motor rewinding.

The total requirement for this sector is difficult to estimate because of the volume of unofficial imports coming in from Nigeria which cannot be quantified. However, the total volume is unlikely to be more than 10 tonnes at the moment. This should expand as construction and electrification develop over the next few years.

B5. DEMAND FOR BRASS MILL PRODUCTS

During the three years 1976-1978, an average of 7 tonnes of copper tubing was imported annually. Copper tubing is used very little for plumbing purposes as galvanised steel is the primary material. Copper tubing is only used for making connections.

Copper tubing sized 10-35 mm diameter is used for repair and installation of air-conditioning and refrigeration units.

The demand will probably have declined in recent years from the level of 1978 but it is felt that demand for tubing will pick up as construction and electrification develop. The two main companies have a requirement for about 1½-2 tonnes annually at the moment, and even with expansion, the total demand will remain relatively small. There are no problems of specifications here, but the larger local companies would be unwilling to buy Nigerian tube because they believe quality is inferior and prices are too high.

B6. FUTURE DEVELOPMENTS AND OPPORTUNITIES FOR THE NIGERIAN COMPANY

Table B6.1 gives estimates for future demand of copper and copper alloy semi-finished products. The estimates for 1980 are based on average imported volumes 1976-78 and interviews held in Benin.

TABLE B6.1 : ESTIMATE OF MARKET FOR COPPER AND COPPER ALLOY SEMI-FABRICATED PRODUCTS - TONNES**

Item	1980	1985	1990
Bars, Sections	8*	13	20
Tubing	7*	11	18
Winding Wire	5	8	13
Non-Insulated Wire & Cable	24*	38	60
Insulated Wire & Cable	83*	130	265
Telephone Cable	66	180	250

* Estimates based on average imports 1976-78
** Copper Content

The general view was that the construction sector had been dormant over the past few years but would pick up again in the near future. Local importers and installers of cable suggested an increase of some 20% but we have reduced this to an average of 10% annually. The main reason is the reaction to the recently improved political climate may be over-optimistic especially as regards the availability of finance for social and industrial development. The second reason is that projects, once started, take a long time to complete.

As regards the opportunities for the Nigerian company, these will be limited by the fact that a lot of future development will necessarily be tied to sources of finance. Also, on a technical basis, the specifications of electricity and telephone cable, which are the largest consumers of copper, are European rather than British.

The more important areas are telephone and electricity cables with copper content of insulated wire and cable estimated at 215 tonnes in 1990 and telephone cable about 250 tonnes. It must be remembered that specifications of both these items are European rather than British.

Also, much of the development, certainly on large projects, that will take place in the future will be financed from "Tied Aid" and in the smaller but more open market French suppliers still have a dominant position.

C. THE UNITED REPUBLIC OF CAMEROON

C. THE UNITED REPUBLIC OF CAMEROON

C1. ECONOMIC AND DEMOGRAPHIC OVERVIEW

C1.1 Geography and Population

Cameroon has an area of nearly 475,000 square kilometres. It is bordered by Nigeria and the Gulf of Guinea to the West, by Chad and the Central African Republic to the East, and by the People's Republic of Congo, Gabon and Equatorial Guinea to the South.

Geographically, the country can be divided into three parts. The Northern region consists of savannah plains and steppes from Lake Chad in the North to the Adamaona mountain range running across the country from Mount Cameroon near the sea in a wide North-Easterly arc to a high plateau region. Starting at the coast, there are equatorial rain forests which reach from the coast to the Eastern border. In between these two regions there are vast scrub-covered uplands. There are many rivers and streams which flow from the mountains either North to Lake Chad, or the river Benoué South and East to the Atlantic or South-West to the Congo.

The Federal Republic of Cameroon was created in October 1961 when the former British Trust Territory of Southern Cameroon elected to join the Republic of Cameroon which had been a French Trust Territory. These two Federated States, known as East Cameroon (ex-French with Yaoundé as capital) and West Cameroon (ex-British with Buea as capital) became a unified State on 20th May 1972 under the title of the United Republic of Cameroon. Yaoundé is the capital, although Douala is chief port and commercial centre.

In 1980 the population was an estimated 8 million, growing at 2.3% per year, of which 54% are between the ages of 15 and 60 years, and 21% between 5 and 14 years old. The urban population has been growing at 7.5% per year to an estimated 40% of the population by 1980. This is expected to increase to 50% by 1990. The working population numbers about 3½ million, 80% of whom are employed in agriculture.

Yaoundé has a population of 350,000 and is the seat of Government and the centre of export of timber, cocoa, coffee and vegetable oils. Douala, with a population of 750,000 is the largest town and centre of commerce and industry.

Other major towns are Garoua (population 75,000) in the North, Buea (21,000), Victoria (58,000), Edea (80,000), Nkongsomba, Bamenda and Bafoussam.

The country is officially bi-lingual (English and French) although in practice, French is predominant. There are at least 20,000 Europeans, many of them French, living in Cameroon. There are well over 100 tribal groups within the country and no one group dominates.

C1.2 Economic Structure

President Ahmadou Ahidjo has run the country since independence, and has just been re-elected for a five year term. The President elects a cabinet which is appointed with regard to all the sensibilities of the regional groupings and as a result, the country enjoys political stability.

The economy is based on traditional agriculture, fishing and forestry, which still account for 33% of Gross Domestic Product and provide 75% of export earnings. The principal crops are cocoa, coffee (55%), cotton, rubber, bananas, palm oil and groundnuts. Only 4% of land area is under cultivation.

Industry accounts for 24% of GDP and is concentrated at Douala. The sector is based on the production of agricultural commodities and is comprised mainly on the subsidiaries of foreign companies.

There are substantial deposits of bauxite and iron ore (one billion tonnes of each), although they have been expensive to exploit. There is an aluminium processing plant at Edea (Alucam, a subsidiary of Pechiney-Ugine-Kuhlmann) which has been using bauxite imported from Guinea. This is one of the major aluminium processing plants in Africa with a capacity of 50,000 tonnes p.a. of ingots and bars. There are also rolling mills and aluminium fabrication.

Oil has been found, both offshore and on the Nigerian border, and production is now sufficient for home needs. By the mid-1980's, production of 5-8 million tonnes per year will provide a healthy surplus for export (local needs in 1981 will amount to about 750,000 tonnes per year), which should ensure continuous economic growth. There is also a strong possibility of natural gas being available in commercially exploitable quantities.

Cameroon operates a free economy with liberal investment laws which provide substantial advantages to foreign companies. Many of the Trading Houses are still in French hands although there is a process of "Cameroonianisation" particularly in the Government Ministries.

There are plans for creation of a steel works and, once again, the assembly of Landrover vehicles and there are several small sheet metal work factories, a trailer manufacturer and a cycle manufacturer. There are also industries manufacturing nails and wood screws, security fittings, aluminium household utensils, electric cables, cutlery, hand tools, paper, batteries and assembly of radios.

C1.3 The Economy

Cameroon has the basis of a well-run, expanding economy. Between 1966 and 1976 the Gross Domestic Product grew by 4.6% p.a. and 7.9% p.a. during 1977-78. In the period 1978-80, growth was stable at about 8% p.a. in real terms.

Agriculture still accounts for 32% of GDP after 35% in 1965. Manufacturing accounts for 9.6%, construction 5%, trade 16%.

Cameroon has a low debt service ratio at 11% and its standing in international financial circles is good. There is a small balance of payments deficit of 2.7% GDP which is expected to decrease as oil becomes available and overall GDP growth during this period to 1986 is expected to be 5-6% which will be accompanied by substantial growth in construction and services.

TABLE C1.1 : GROWTH OF GROSS DOMESTIC PRODUCT (CFA 000 MILLION) - IN CURRENT PRICES

Item	1959/60	1963/64	1966/67	1970/71	1974/75	1976/77	1977/78	1978/79	1979/80
Gross Domestic Production	101.7	139.3	170.2	268.5	499.0	679.2	801.5	958.1	1,137.9
- Primary Sector	48.8	57.6	62.4	93.2	193.7	259.7	305.4	362.4	430.1
- Secondary Sector	11.3	20.3	41.8	63.5	85.8	130.2	149.9	179.0	212.7
- Tertiary Sector	41.6	61.4	66.0	111.8	219.5	289.3	346.2	416.7	495.1
- Admin., Salaries and Taxes and Duties on imports	11.9	18.6	24.1	34.4	80.9	110.7	138.3	158.6	189.0
Gross Domestic Product	113.6	157.9	194.5	302.9	579.9	789.8	939.8	1,116.7	1,326.9

C1.4 Development Plans

Since independence, the development of the country's economy has been based on a succession of five year plans. The Fifth Plan (1982-86) is expected to be published shortly and it is likely that it will follow the pattern of its predecessors.

The previous plans were designed to develop the agricultural sector, whilst at the same time ensuring a steady development of the manufacturing capacity. Cameroon has a substantial range of food products for export, including fish, milt products, soft wheat, rice, brewers malt, refined sugar and cured tobacco.

The manufacturing sector has been based on the successful development of industry based on local raw materials. In the case of the aluminium factory, however, raw materials have been imported where local supplies were difficult to obtain. The Cellucam factory will produce paper pulp from the massive forest resources and the Victoria oil refinery will process local oil.

Agricultural production is projected to grow at 4% p.a. in the first half of the 1980's, the manufacturing sector is expected to grow by 7.5% per year and overall growth is expected to be 5-6%p.a.

Priorities in the new 1982-86 Plan are likely to be focussed on development of the agricultural sector, particularly forestry and rubber production, fishing and livestock. In the manufacturing sector, priority is likely to be given to investment in the production of construction materials, beverages, oil-refining and mining.

C2. LOCAL COPPER PROCESSING INDUSTRY

Apart from very small quantities of copper used for wood screw manufacture, the only company processing copper semis is the Cameroon Electric Cables (CAMELCAB) factory.

This factory, located at Douala-Bonaberi is owned by the International Investment Corporation Limited, of Bermuda and the Indian Group, Metha. The company was created in 1976 with capital of CFA 200 million (US$0.7 million) which was increased to CFA 300 million (US$1 million) in 1978. Capital investment was CFA 1.2 billion. (US$4.3 million).

Production started in March 1978 and capacity is an estimated 4,000 tonnes per year, with an original production target of :

- 2,500 tpa stripped aluminium conductors
- 950 tpa insulated aluminium wire and cable
- 350 tpa insulated copper wire and cable
- 200 tpa telephone cable
- 75 tpa household wire

The company has four wire drawing machines, three cable coating machines, winding machines, a quality control laboratory and a maintenance and repair shop. At the end of 1980, Camelcab was using 40 tonnes per month of copper rod, bought in two tonne coils (annealed) and in 1981 production is expected to be 500 tonnes of copper. Production is expected to grow by 12-15% per year over the next five years. Manufacture of telephone cables is planned to be an estimated 240 tonnes per year out of the total by 1985. Most of the telephone cable will be made from copper although there are plans to experiment with aluminium cables.

The imported copper rod is all ⅜" diameter in annealed coils which is imported from France with a specification of at least 99.5% pure copper.

Camelcab claim that their own production accounts for 70% of the total market for copper semis and that most of their output is sold into the domestic/ industrial low-tension cable/wire market. Most of the aluminium cable processed is sold to the State Electrical Company (SONEL) which use only aluminium cable for high and medium tension lines.

If production at Camelcab increases by 12% p.a. then copper rod consumption will be as follows :

	1985	1990
- Copper wire/cable	550	1,040
- Telephone cable	240	350
- Total	790	1,390

Camelcab is prepared to consider purchasing copper rod from the proposed Nigerian plant, but commercial considerations, particularly delivery time and price will be the prime factors.

It is claimed by local contractors that prices of wire and cable produced by Camelcab are 30-35% higher than imported products despite exoneration from import duties on raw materials used for products and the 30% fiscal and customs duties paid by importers.

C3. IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS

Imports of copper and copper alloy products into Cameroon are listed in Table C3.1. Total exports from the principal supplying countries are listed in Table C3.2. Whilst there are some differences from year to year between the two sets of statistics, the totals over the 1976-79 period confirm each other in global terms. Furthermore, the import figures tend to be confirmed by respondents within Cameroon.

The market for copper semis can be estimated from the import tables as shown in Table C3.3. The increase which has occurred from 65 tonnes in 1975 to over 600 tonnes (estimated) in 1980 is due almost entirely to the import of rod for the Camelcab cable and wire factory.

C3.1 Purchasing Criteria

In general, delivery time and price are regarded as highly important by Camelcab and others and, of course, the quality must equal the main specification criteria. Nigerian suppliers would be considered along with other European suppliers although the perceived reputation of Nigerian products is not good. These criteria are equally true of other sectors in Cameroon.

C3.2 Purchasing Methods

Camelcab purchases its copper rod from European suppliers by means of normal commercial methods including import licence. All local electrical contractors are required to purchase wire and cable from Camelcab. If Camelcab cannot produce to the required size or specification, then the contractor may apply for an import licence. In general, however, Camelcab is able to supply most of the low tension domestic/industrial cable and wire requirements.

The major State organisations like the Electricity Company (SONEL) and the Ministry of Telecommunications usually obtain their requirements through international tender, organised through the "Presidency" office, often to French or international standards although British standards are still used in the Western region.

TABLE C3.1 : IMPORTS OF COPPER PRODUCTS INTO CAMEROON : 1975-1980

Tariff Code	Product Category	1975		1976		1977		1978		1979		1980*	
		Tonnes	Value	Tonnes	Value	Tonnes	Value	Tonnes	Value	Tonnes	Value	Tonnes	Value
740111	Scrap & Copper Waste	13.9	788	-	-	7.0	500	-	-	-	-	-	-
740121	Raw Copper	-	-	-	54	-	53	0.6	600	-	-	0.5	506
740200	Copper Alloys	0.7	977	1.8	2,029	0.2	381	-	122	0.2	914	-	75
740300	Bars, Sections & Wire	28.8	18,772	35.4	24.125	20.8	17,730	117.0	60,823	355.9	181,855	282.1	209,647
740400	Copper Sheet	4.3	3,653	3.6	1,834	3.0	2,734	4.0	2,158	1.4	2,267	3.4	1,968
740500	Copper Strip	-	159	1.6	772	-	-	0.8	1,328	1.8	616	29.7	23,756
740600	Powder and Flake	0.2	808	0.4	597	0.4	849	1.3	2,692	0.4	1,533	2.4	4,082
740700	Tubes, Pipes	16.7	14,602	36.8	32,341	22.2	21,064	33.2	29,614	55.7	47,630	36.9	48,221
740800	Tube Accessories	3.6	7,758	16.7	13,579	8.2	15,554	5.9	14,259	6.9	16,351	14.3	13,803
741000	Cables, Cord & Wire	15.2	8,852	19.2	12,098	12.2	7,053	10.8	8,382	34.7	27,754	141.7	85,562
741101	Woven Wire	0.1	431	0.5	169	0.3	733	-	27	0.7	804	0.5	569
741111	Wire Netting, Lattice Work	-	-	0.2	81	-	-	0.1	201	-	129	-	-
741300	Chains	-	20	0.5	201	-	76	0.1	2,414	-	17	-	-
741400	Nails	16.5	4,526	6.7	1,987	30.4	4,257	11.3	1,813	1.1	185	-	-
741500	Nuts and Bolts	11.3	11,813	10.5	11,013	9.8	14,908	8.1	13,400	27.1	30,332	14.0	20,151
741600	Springs	-	14	-	339	-	116	-	420	0.4	733	0.8	909
741700	Non-Electric Equipment	17.1	6,979	1.2	977	2.0	2,015	0.9	760	10.7	12,494	0.8	909
741800	Household Utensils	1.0	3,139	0.5	1,763	1.5	5,543	1.2	4,145	1.9	4,411	0.5	1,643
741900	Other Articles	7.2	14,202	6.9	19,796	9.7	32,071	11.0	26,574	63.6	34,634	9.8	39,334
TOTAL		136.6	97,527	142.5	123,756	127.8	125,958	206.3	169,713	546.4	362,653	536.6+	467,840

Value: CFA 000's

* 9 months

+ 12 months estimate

Source: Cameroon Import Statistics

TABLE C3.2 : EXPORTS TO CAMEROON FROM THE PRINCIPAL SUPPLYING COUNTRIES 1976-79

Year	Copper					Copper Alloy					Grand Total
	Wire	RBS	PSS	Tube	Total	Wire	RBS	PSS	Tube	Total	
1976	22	4	1	14	41	1	18	4	13	36	77
1977	62	3	18	16	99	16	10	5	18	49	148
1978	203	5	2	9	219	8	28	2	12	50	269
1979	378	9	-	13	400	14	18	1	11	44	444

TABLE C3.3 : SUMMARY OF IMPORTS OF COPPER AND COPPER ALLOY SEMI-FINISHED PRODUCTS

Item	1975	1976	1977	1978	1979	1980
Rod, Bars, Sections :						
Weight (Tonnes)	44.0	54.6	33.0	127.8	390.6	423.8
Value (CFA 000)	27,624	36,223	24,783	69,205	209,609	295,209
Tube :						
Weight (Tonnes)	16.7	36.8	22.2	33.2	55.7	36.9
Value (CFA 000)	14,602	32,341	21,064	29,614	47,630	48,221
Sheet/Strip :						
Weight (Tonnes)	14.3	5.2	3.0	4.8	3.2	33.1
Value (CFA 000)	3,812	2,606	2,734	3,486	2,883	25,724
TOTAL: Weight (Tonnes)	65.0	96.6	58.2	165.8	449.5	493.8
TOTAL: Value (CFA 000)	46,038	71,170	48,581	102,305	260,122	269,154

Source: Extracted from Cameroon Import Statistics

Tube and copper sheet/strip is imported by the major trading houses, often French owned, such as Bernabé, SHO and others. Telephone cables are also imported directly by foreign owned companies such as Liftel Ericsson, Entrelec and Compagnie Générale d'Electricité although this situation will change as soon as Camelcab starts to supply large enough quantities of telephone cable.

Importers sell directly to the local electrical contractors, although several of the importers are themselves involved with contracting.

C3.3 Opportunities for Nigerian Exports

In the plumbing and engineering sectors, most of the importers of copper tube, strip and sheet, are likely to continue to import from France or from other European suppliers. Only if the supply is cheaper with quicker delivery is a Nigerian supplier likely to be considered.

However, in the larger market for rod supplied to Camelcab, a Nigerian supplier could expect to be considered along with European suppliers. Since Camelcab accounts for most of the Cameroonian market, this can be considered as a good likely customer. It has to be emphasised, however, that delivery times need to be shorter than European suppliers (i.e. less than one month).

Camelcab has increased its purchases from an estimated 100 tonnes p.a. to an estimated 500 tonnes p.a. in 1981. At present copper (⅜" diameter rod) is imported from France.

C4. DEMAND FOR WIRE AND CABLE PRODUCTS

C4.1 Electricity Supply and Distribution

Most of Cameroon's electricity is produced hydro-electrically although about 15% is still produced thermally. Production and distribution of electricity companies under the responsibility of the State Electricity Company (Societe Nationale d'Electricite - SONEL), although there is a small private sector consuming about 200 KwH annually. SONEL's total sales amount to about 1,300 KwH although over half this total is sold to the three major consumers - Alucam, Cellucam and Socatral.

The expected increase in new subscribers for the period 1980-85 is 17-18,000 new subscribers per year (i.e. about 15% p.a.). In 1982, a new dam will be commissioned which will double the hydro-electricity capacity.

Virtually all the medium and high tension cables used by SONEL have aluminium conductors, principally because of lightness, price, price movement and the availability of aluminium from France. In future, all medium and high tension cables will be aluminium insulated twisted, multi-strand cable for use at 15 KV, 30 KV, 90 KV and 220 KV, although ACSR cables are used and will continue to be used for very high tension cables.

By contrast, all low tension wires and cables (220 volt and 380 volt) are likely to continue to be made in copper. SONEL is only concerned with the installation and maintenance of the supply network (i.e. the high and medium tension cables). All low tension domestic wiring is carried out by private electrical contractors.

SONEL does, however, purchase very small quantities (5-10 tonnes p.a.) of 10mm^2 bare copper wire for transformers, together with bus bars (50 x 5 mm) made in copper (maximum 20 tornes p.a.).

TABLE C4.1 : ELECTRICITY STATISTICS

Item	1976/77	1977/78	1978/79	1979/80
Electricity Production (MW):				
- Total	373,643	379,079	376,794	377,400
- Hydro-electric	312,200	312,200	312,200	312,200
- Thermal	57,792	63,694	61,409	62,015
Electricity Sales (kWH) (Excluding sales to major consumers: Alucam, Cellucam, Socatral) :				
- Low Tension (Domestic)	166,483,912	189,685,691	220,814,692	255,510,541
- High Tension	188,624,433	212,651,920	261,998,794	279,893,467
- Total	355,108,343	402,337,611	482,813,486	535,404,008
Number of Subscribers:				
- Low Tension (Domestic)	78,427	91,544	103,680	118,628
- High Tension (> 15,000V)	410	471	503	563
- Total	78,837	92,015	104,183	119,194
- Annual Increase	-	13,178	12,168	15,011

TABLE C4.2 : TOTAL INSULATED CABLE AND WIRE IMPORTS INTO CAMEROON - 1969-79

Year	Weight (Tonnes)	Value (CFA Million)
1969	1,019	395.5
1970	1,436	611.7
1971	940	382.5
1972	695	277.4
1973	816	308.5
1974	912	513.9
1975	1,235	636.2
1976	1,738	1,127.0
1977	1,659	1,105.0
1978	1,499	1,276.2
1979	2,044	1,269.1

It is estimated that telephone cable imports amount to about 300 tpa, all in copper, and the remainder are mainly aluminium cables.

C4.2 Telecommunications

At present there are 23,000 telephones installed in the country, whereas five years ago there were 17,000. About 60% of the telephones are installed in either Yaoundé, Douala or Garona. There are 34 automatic exchanges lined by microwave relay stations. There is direct dialling to 80 countries worldwide and there are 3,500 km of telephone network in the towns.

It is estimated by the Ministry of Telecommunications that the number of subscribers will increase at the rate of about 8% per year.

Most of the telephone cables were originally installed to French standards, (i.e. use of even numbers of pairs) with a maximum size of 448 pairs, but in the Western region, cables tended to be to British standards (i.e. use of odd numbers of pairs) and there are some US installations in the North. Almost all the cables use wire diameters of between 0.4mm and 0.8mm. The 0.6mm diameter cable is the most widely used.

In future all cables will be metric diameters. Telephone cable purchases are estimated to be an annual 300 tonnes and the network extensions are normally installed by large foreign contractors. Consumer wiring is carried out by local contractors. All major tenders are international and handled through the office of the Presidency. Much of the telephone network is being installed by the French company LTT and in the private sector the foreign companies Liftel and Ericsson are dominant. Telephone cables used to be made from bronze but are now pure copper.

C4.3 Other Uses of Insulated and Bare Wire

The principal use of copper wire and cable is in domestic, administrative and other buildings wherever low tension supply is used. Almost all these wires and cables are made in copper and likely to remain so in the future. Most of this sector is now supplied by the local company Camelcab.

The most commonly used sizes are 1.5 mm^2 and 2.5 mm^2 although 4 mm^2 and 6 mm^2 sections are also used extensively. There is also a growing use of modular vertical columns in large apartments. Typical building wire is ordered to the French Afnor U500V standard. The price of Camelcab 1.5 mm^2 insulated cable is CFA 45 per metre and 6 mm^2 insulated cable CFA 219 per metre. The total market for copper wire and cable in this sector is an estimated 600 tonnes (cable weight) per year. The market is likely to grow by about 15% per year over the next five years until 1986. This is based on estimates of the likely increase in demand for cables due to an increase in the house-building programme, coupled with plans for electrification of existing housing units.

A further use of bare wire is for rewinding of electric motors. The specifications are usually French, typically Pirotherm Class H Grade 2, enamelled wire from 0.2 mm diameter to 1.6 mm diameter. The French-owned company Sorelec is the market leader in this sector with an estimated 70% of the market. The annual market is worth an estimated CFA 30-40 million (50 tpa) enamelled copper wire and it is increasing at about 5% p.a.

There are no other significant uses of copper wire and cable in Cameroon and there are unlikely to be so in the near future. If, and when, Landrover assembly restarts or if an automotive industry is started, the situation may change, but a substantial increase in usage in other sectors is unlikely before 1986.

C5. BRASS MILL PRODUCTS

This sector is much smaller than the wire and cable sector. Imports of tube have not expanded over the 1976-80 period, although imports of sheet/strip suddenly increased in 1980.

Tube imports in 1980 were an estimated 50 tonnes and imports of strip/sheet were an estimated 44 tonnes after 3.2 tonnes in 1979.

Approximately half tube imports were brass and half copper. An estimated 75% of these were used for domestic hot water systems in higher cost housing and the remainder were used for gas/gas-oil installations and air-conditioning systems. Some tubes are used for repair of refrigerator tubes. Tubes are bought either in the annealed condition (in coils) or straight. Straight tubes are normally purchased in 5 m lengths and typical sizes are:

- (I/D / O/D): 10/12 mm, 12/14 mm, 14/16 mm
  16/18 mm, 18/20 mm, 20/22 mm

Almost all are purchased through the main trading houses such as Bernabe, Structor, Saproc and Latalle and SHO which specialise in imports of hardware, building materials and other similar items. Most tube suppliers are French companies.

It is unlikely that this sector will increase dramatically in the near future although the housing programme which is likely to result from a growth economy, once the oil starts to effect revenues, is likely to result in some growth in the sector.

There is some usage of copper strip for repairing car and other vehicle radiators but the sector is small. There was an apparent increase in imports of strip during 1980 although it is likely that this was in reality imports of copper strip for the transformer/switchgear assembly factory run by Compagnie Generale d'Electricité (a French owned company). Annual consumption is likely to remain at the same level in the immediate future.

Some small amounts of brass sheet/plate are used in the local craft industry, although annual quantities are estimated to be less than 2 tpa.

C6. FUTURE DEVELOPMENTS AND OPPORTUNITIES FOR THE NIGERIAN COMPANY

The present market for copper and brass semis is summarised below, together with the estimates for 1985 and 1990 based on interviews within Cameroon.

TABLE C6.1 : ESTIMATE OF MARKET FOR COPPER/BRASS SEMI-FABRICATED PRODUCTS

Item	1981	1985	1990
Rods, Bars, Sections (Copper)	550	865	1,525
Tube : Copper	25)	60	100
Tube : Brass	25)		
Strip/Sheet : Copper	43)	50	80
Strip/Sheet : Brass	2)		
Motor Rewinding Wire (Enamelled)	50	60	100
Total	695	1,035	1,805
Imported Telephone Cable	300	80	120
Other Imported Copper Cable	50	50	50
Total	350	130	170

As far as opportunities for the Nigerian company are concerned, competition with existing, predominantly French, suppliers will be tough and the most likely outlet is the sale of $\frac{3}{8}$" diameter copper to the local cable company Camelcab. Assuming that the Nigerian company can achieve competitive delivery dates and price and quality equivalent to other suppliers, then potential sales could be as high as 1,000 tpa by 1990.

It is unlikely that other sectors will provide opportunities for anything but annual sales of single or double figure quantities of tube and other copper semis.

Sales of Nigerian copper semis to Camelcab can be best achieved by direct contact. Sales of tube and strip can be best achieved by contact with the major importing companies.

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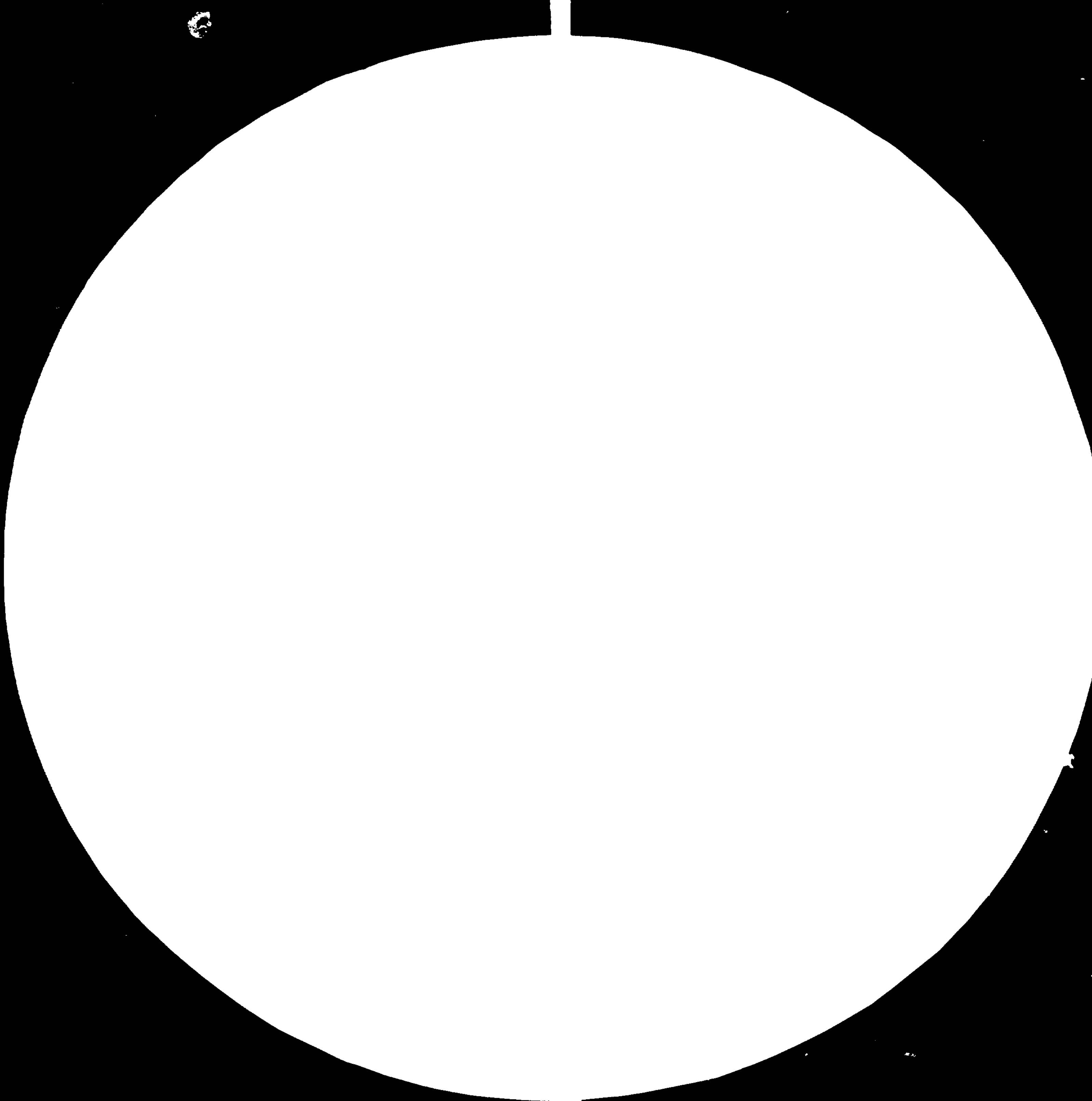

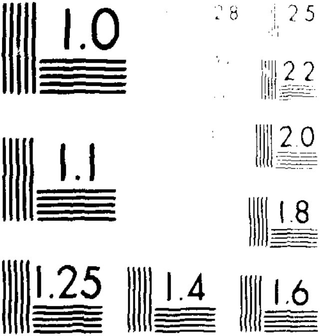
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D. GABON

D. GABON

D1. ECONOMIC AND DEMOGRAPHIC OVERVIEW

D1.1 Geography and Population

Gabon lies on the equator and covers an area of approximately 267,000 sq.km. It is bordered by Equatorial Guinea and Cameroon to the North and by the Congo in the South and to the East. In the West is the Gulf of Guinea and the Atlantic Ocean.

The country may be divided geographically into two parts, one a littoral about 100 km wide rising from the coast to over 660 metres, the other a plateau rising to over 1,000 metres at its highest point. Most of the country is covered by dense forest and the coastal plain is crossed by deep river valleys. The river Ogooué, which enters the sea at Port Gentil is navigable for 240 km inland as far as Lambarene.

The population in 1979 was estimated by the Government to be 1,050,000 and, at the end of 1980 a claimed 1.2 million, although the United Nations' estimate in 1979 suggests that the population was only 534,000. The majority, Bantou, of which there are about 40 ethnic groups. Pygmies living in the forests, account for about 1% of the population and there are 35,000 Europeans, mostly French. The commercial language is French.

Libreville, with a population of 200,000 is the capital and centre of commerce and Government. The other major towns are Port Gentil (population 75,000 and centre of the oil industry) and Franceville (centre of the uranium mining industry).

D1.2 Economic Structure

The Gabonese economy is dominated by oil and other mineral production. Gabon is a member of the Organisation of Petroleum Exporting Countries (OPEC). Oil accounts for about 40% of Gross Domestic Product, 70% of exports and 55% of Government revenue.

Oil production is dominated by foreign companies, principally Elf-Aquitaine (locally known as Elf-Gabon) and Shell (Shell-Gabon). The Government has a 25% participation in all oil producing companies.

Manganese and uranium together account for a further 6% of GDP and 15% of export revenue. Gabon is the world's largest exporter of manganese and has the world's largest proven reserves. Manganese is mined by the French Compagnie Minière de l'Ogoue (COMILOG) in which the Government has a 10% stake. Uranian ore is mined by the French Compagnie des Mines d'Uranium de Franceville (COMVF) in which the Government has a 25% share. Korea is also starting a $12 million uranium exploration project in Gabon with Cogema of France.

Traditionally Gabon's economy was based on the exploitation of its rich forest resources (e.g. Gabonese Okoumé wood) though in 1980 its relative importance had diminished so that timber accounted for only 2% of GDP, though 10% of exports.

The manufacturing sector is small but increasing following Government initiatives to encourage foreign private investment. As a result this sector now accounts for 9% of GDP and consists mainly of foreign-owned (often French) companies engaged in chemicals, oil refining, timber processing and agricultural production. The agricultural sector employs 80% of the population and accounts for 4% of GDP. Gabon also has vast reserves (600 million tonnes) of high grade iron ore in the North-East of the country which are as yet unexploited due to inaccessibility. This situation will change dramatically once the Transgabonese railway has been completed by the mid-1980's. This project is one of the most ambitious civil engineering projects in Africa and it will provide a backbone to the country which has virtually no asphalt roads and which is covered by dense rain forests.

Gabon has been practically stable since independence from France in 1960. President Bongo is a pragmatic leader who has encouraged foreign private investment and this approach has been matched by a non-alignment foreign policy. Despite this, Gabon still has considerable links with France, being a member of CFA Franc zone which is lined to the French Franc. France is still far the largest trading partner (over 50% of imports) and there are French advisors in all Ministries and many commercial establishments.

D1.3 The Economy

Following the quadrupling of oil prices in 1973-74, which led to a sharp increase in foreign exchange receipts, the Government embarked on an ambitious development programme. The increased Government spending resulted in an economic boom where the GDP, in real terms, averaged an estimated 28% per year over the period from 1973-76. The result was that by 1977 Gabon has one of the highest per capita GDP's in black Africa. In its wake came a higher cost of living, inflation which touched 20% in 1976, higher wages and a migration of workers to the towns.

This was accompanied by an increasing budget deficit which resulted in a crisis in 1977. The Government then embarked on a stabilisation programme, supported by the International Monetary Fund (IMF), which resulted in a slowdown of inflation to under 8% by 1980 and a fall in GDP which then stabilised, following oil price rises, to CFA 635,000 million ($2,800 million) in 1979. The Government then embarked on a 3-year (1980-82) Interim Plan which aims at consolidation and a much slower (1.6% p.a.) real growth of the GDP at constant prices.

The immediate outlook for the economy is, as a result, much healthier. In the longer term, oil production is likely to decrease gradually until reserves run out in 50 years time, although diversification of the economy and exploitation of the mineral reserves are likely to provide the basis for sustained economic growth in the longer term.

D1.4 Development Plans

The development strategy for the 1980-82 period is outlined in the Interim Plan known as the "Plan Intérimaire de Développement Economique et Social 1980-82".

The Plan, which is supported by the IMF, is one of consolidation and balanced growth and aims to diversify the economy and make more efficient use of natural resources, whilst at the same time reducing the external debt, rebuilding the reserves and maintaining price stability.

TABLE D1.1 : FORECAST RATE OF GDP GROWTH 1980-82

GDP	Rate of Growth %		
	Current Prices	Constant Prices	Constant Francs
GDP of non-financial enterprises	16.1	1.2	6.0
Petroleum activities	17.9	-5.5	8.0
Non-petroleum activities	14.7	5.2	5.0
GDP	15.8	1.6	6.0
Petroleum activities	17.9	-5.5	8.0
Non-petroleum activities	14.9	4.8	4.9

The investment programme over the 1980-82 period involves the spendong of CFA 360 million. Of this, 52.5% is allocated for infrastructure and transport, 10% for agriculture, 6% for electrical energy and water, 3.9% for urban housing and 12.4% for defense spending. The remainder is to be spent in miscellaneous sectors, including fishing, mines, industrial promotion, development research and social sectors. Private sector investment is expected to reach CFA 500 million over the three year period principally in sectors such as petroleum (25%), building and public works (12%), commerce and services (10%), transport and communications (8.8%), and mines (7.7%).

TABLE D1.2 : FORECAST RATE OF GDP GROWTH BY SECTOR 1980-82

Sector	Rate of Growth %	
	At Current Prices	At Constant Prices
Primary Sector	17.4	-2.2
- Agriculture and fishing	14.0	3.0
- Forestry	25.3	5.9
- Petroleum exploitation	18.0	-7.1
- Mines	13.6	10.0
Total Non-Petroleum	15.9	7.0
Secondary Sector	14.5	4.8
- Transformation industries	14.1	4.4
- Petroleum research & development	17.4	7.4
- Construction (building and public works	13.2	3.7
- Electrical energy and water	17.0	7.1
Tertiary Sector	14.5	4.8

D2. LOCAL COPPER PROCESSING INDUSTRY

There is no local copper processing industry in Gabon and there are no plans for any during the next five years.

D3. IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS

Imports of copper and copper alloy products are recorded by the "Direction Generale de la Statistique et des Etudes Economiques", which is part of the Ministere du Plan, du Developpement et des Participations. The import statistics for 1975-80 are listed in Table D3.1, and exports from the principal supplying countries are listed in Table D3.2. Imports of copper and alloy semis have been extracted from the copper import statistics and they are listed in Table D3.3.

Imports increased in the period 1975-77 from 167 tonnes to 285 tonnes before falling to 124 tonnes in 1978 and 120 tonnes in 1979. There was some recovery in 1980 when imports reached 147 tonnes. Grouping the above imports by type of semi-finished products gives a breakdown as shown in Table D3.2.

Again the peak year was 1977 when 229.6 tonnes of copper semi-finished products were imported. Imports fell to 54.3 tonnes in 1979 before the recovery in 1980 when imports reached 99.2 tonnes. About 50% of this total was accounted for by copper tubing, used principally for hot water systems in private houses and administrative buildings.

Interviews with the leading importers confirmed that the import statistics were held to be a fair reflection of the total market except the 1979 figure. The 1979 figure is probably too low as a result of a minor problem associated with customs officials who were under-declaring certain imported products.

D3.1 Purchasing Criteria

Quality, prices and delivery are all important factors in the purchasing decision. Quality and delivery time are both regarded as highly important criteria. Specifications used in Gabon are almost entirely based on French standards as far as cable and wire are concerned and copper tubes are bought in metric sizes.

Nigerian products are not well-known in Gabon, although the general image perceived by the mainly French general managers, who are responsible for purchasing copper semi-fabricated products is not good. Links with France are still strong and most of the import trading houses are either French-run or managed by Frenchmen. It is

TABLE D3.1 : IMPORTS OF COPPER PRODUCTS INTO GABON - 1975-80

Tariff Code	Product Category	1975		1976		1977		1978		1979		1980	
		Weight	Value	Weight	Value	Weight	Value	Weight	Value	Weight	Value	Weight	Value
740101	Copper Matte	-	-	147	204,552	142	376,800	1,306	571,050	42	470,300	2,173	1,741,100
740111	Scrap and Copper Waste	-	-	479	167,832	-	-	-	-	-	-	-	-
740121	Raw Copper	-	-	-	-	-	-	838	546,750	-	-	139	139,700
740200	Copper Alloys	-	-	-	-	237	452,400	-	-	812	638,800	-	-
740300	Bars, Sections and Wire	41,737	15,738,408	5,715	5,713,860	17,710	17,896,200	10,189	13,493,900	7,666	10,105,800	15,245	13,798,100
740400	Copper Sheet	991	596,160	1,055	801,517	206	418,050	2,879	1,987,850	683	737,500	3,302	3,459,600
740500	Copper Strip	-	-	30	61,776	-	-	1,104	530,000	20	40,700	150	317,900
740600	Powder and Flake	2	20,736	14	48,261	122	187,400	7	102,800	-	-	271	347,500
740700	Tubes, Pipes	33,797	21,709,944	53,499	43,326,501	60,855	50,213,500	42,055	31,168,500	20,367	23,679,800	49,115	69,518,400
740800	Tube Accessories	13,698	17,433,900	19,399	17,728,247	24,220	40,061,650	12,029	26,290,600	13,063	28,515,200	6,533	20,409,500
740900	Reservoirs	-	-	-	-	-	-	12	65,250	1	38,600	-	-
741000	Cables, Cord and Wire	46,272	23,517,996	75,103	45,475,030	150,867	86,527,350	24,750	16,078,800	25,479	18,660,700	31,482	29,787,300
741101	Woven Wire	6,258	10,801,944	418	371,660	655	343,800	1,488	2,975,648	1,265	952,600	315	247,000
741111	Wire Netting, Lattice Work	-	-	1,991	2,429,200	-	-	64	125,250	-	-	-	-
741300	Chains	-	-	275	1,902,795	140	1,097,250	15	285,900	-	-	-	-
741400	Nails	3,495	3,172,716	1,042	1,303,726	6,244	9,107,750	923	1,140,550	-	-	-	-
741500	Nuts and Bolts	5,304	6,397,488	6,458	6,276,829	10,166	11,325,550	7,591	14,502,500	25,070	12,353,400	10,810	10,606,500
741600	Springs	-	-	417	208,507	312	247,150	-	-	2,310	3,316,500	-	-
741700	Non-Electrical Equipment	1	27,648	897	796,396	169	561,300	9,270	7,179,300	2,016	1,261,000	3,902	2,145,000
741800	Household Utensils	4,857	6,597,396	5,621	7,059,013	4,108	7,149,850	1,503	4,859,250	9,938	15,461,300	4,165	16,392,200
741900	Other Articles	10,957	9,180,486	7,009	17,143,825	9,752	23,335,700	8,676	32,320,900	10,626	33,131,700	19,817	30,518,500
TOTAL		167,369	115,224,818	179,569	151,010,527	285,905	249,301,700	124,699	154,225,798	120,928	150,556,000	147,466	199,587,000

Source: Gaboneese Import Statistics

TABLE D3.2 : EXPORTS OF COPPER AND COPPER ALLOY TO GABON FROM THE PRINCIPAL SUPPLYING COUNTRIES (TONNES) 1976-79

Year	Copper					Copper Alloy				
	Wire	RBS	PSS	Tube	Total	Wire	RBS	PSS	Tube	Total
1976	97	9	-	67	173	9	8	-	30	47
1977	64	5	1	33	103	10	9	5	15	39
1978	22	1	1	13	37	7	6	1	11	25
1979	21	5	1	13	40	2	7	1	10	20

TABLE D3.3 : IMPORTS OF COPPER SEMI-FINISHED PRODUCTS

Item	1975	1976	1977	1978	1979	1980
Bar, Wire and Sections:						
Weight (kg)	88.0	80.7	168.5	34.9	33.2	46.6
Value (CFA C&F)	38,090,207	51,188,890	104,422,550	45,651,550	28,766,599	43,585,400
Tube :						
Weight (kg)	33.8	53.5	60.9	42.1	20.4	49.1
Value (CFA C&F)	21,709,944	43,326,501	50,213,500	31,168,500	23,679,800	69,518,400
Sheet/Strip:						
Weight (kg)	1.0	1.1	0.2	4.1	0.7	3.5
Value (CFA C&F)	596,160	863,293	418,050	2,516,850	778,200	3,777,500
TOTAL: Weight (kg)	122.8	135.3	229.6	81.1	54.3	99.2
Value (CFA C&F)	60,396,311	95,378,684	155,054,100	79,337,850	53,224,599	116,881,300

unlikely that Gabonese trading houses would consider purchasing Nigerian wire and bar, though it is more possible that they would consider purchasing tube so long as delivery times and prices are competitive with those imported from France.

D3.2 Purchasing Methods

Virtually all copper semi-finished products are imported through the various trading houses which are all privately owned foreign companies and many of them are French companies.

Copper tubing is imported through companies like Bernabé, Ceka, Soganéquipe, Sogarec, Sogatel, Davum Outremer, and Brossette which specialise in imports of sanitary ware, hardware and tools.

Electric wire and cable for the domestic and industrial markets are imported through private foreign companies, all French owned. The principal importers are Caric, Compagnie Générale d'Electricité Gabon and Equitec.

Large purchases of cables for both the mainly State-owned Electricity Company (Societe d'Energie et d'Eau du Gabon) and State Telecommunications Company (Office de Poste et de Telecommunications) are purchased directly from foreign suppliers, often French, usually by means of international tender though sometimes directly from approved foreign suppliers such as Cables de Lyons in France.

D3.3 Opportunities for Nigerian Exports

Because of the small market for semi-finished products in Gabon, the potential for exports in Nigeria is very low, and is likely to remain so for the foreseeable future.

In addition, there are substantial links with suppliers in France which further limit the potential for Nigerian products.

We can conclude that the real potential market is probably less than 10 tonnes per year.

D4. DEMAND FOR WIRE AND CABLE PRODUCTS

D4.1 Electricity Supply and Distribution

Electricity is produced and distributed by the Société d'Energie et d'Eau du Gabon (SEEG) which is 64% owned by the State. The remainder is owned by private companies including Elf Gabon.

The number of subscribers has been increasing at about 10% per annum and is likely to continue to do so over the period until 1985. About 74% of power is hydro-electric and 26% thermal. Low tension consumption represented about 38% of total in 1979. Libreville accounts for 60% of total consumption and Port Gentil accounts for a further 22%. 67% of subscribers are in Libreville and 14.7% in Port Gentil. The total length of the electricity supply network is 1,250 km.

The hydro-electric potential is estimated to be 40 billion KwH which effectively means that there is no limit to expansion of supply well into the next century.

High tension transmission lines in Gabon are all aluminium cables made to French standards and therefore there are no new purchases of copper HT cable. For maintenance purposes small quantities of copper cable are purchased for replacing old network cables. Purchases are likely to become less and less in the future as all the old copper network is replaced. Purchases for maintenance in 1980 were as follows :

- 60km 2 x 16 mm^2 twisted aluminium cable
- 50km 4 x 16 mm^2 twisted aluminium cable
- 10km 4 x 25 mm^2 twisted aluminium cable
- 1km 2 x 16 mm^2 twisted copper cable
- 1km 4 x 16 mm^2 twisted copper cable
- 1km 4 x 25 mm^2 twisted copper cable

Purchases of copper are limited to earthing rods, which are purchased from Copperweld in the USA. In fact, even these are copper coated steel rods of 29 mm^2 section. Some copper rod is also used for lightning breaker rods. Very small numbers of 5mm x 50mm copper bars are occasionally used for repairing transformers but most are returned to the original supplier for repairs.

TABLE D4.1 : ELECTRICITY PRODUCTION AND CONSUMPTION IN GABON - 1975-80

Year	Installed Power (MW)	Production (Million KwH)	Sales (Million KwH)	No. of Subscribers
1975	119.9	253.1	216.4	19,390
1976	137.6	327.8	276.5	22,188
1977	205.1	430.7	360.3	27,149
1978	208.0	488.2	380.5	28,421
1979	209.5	526.5	455.1	30,083
1980	209.5	569.5	498.0	33,109

The SEEG does not purchase cables and wire for installation in domestic or industrial/commercial premises. This is left to the private contractors. Whereas the distribution system is almost all aluminium cable, the low tension cables for use in domestic/commercial are almost all copper cables and wire. There has been some attempt to use aluminium cables but tradition and the fact that copper wires and cables are easier to instal has meant that low tension cables are likely to continue to be used.

Total imports of insulated cables were as follows over the 1975-80 period.

TABLE D4.2 : IMPORTS OF INSULATED CABLE

Year	Weight kg	Value CFA C&F
1975	5,948,816	844,733,843
1976	1,534,226	11,169,452
1977	3,413,006	2,356,807,210
1978	1,611,547	1,092,203,582
1979	1,169,002	821,339,637
1980	1,012,642	944,508,973

D4.2 Telecommunications

There were 9,500 subscribers at the end of 1980 and it is planned to increase this to 20,000 by 1985. Libreville accounts for 70% of the total and Port Gentil about 17%.

Theoretically, telephone lines are installed for a period of 20 years, but in practice often last no longer than 10 years because of high humidity. Planning estimates show that, on average, 100 metres of wire are required for each new subscriber. Annual purchases for maintenance requirements are about 10% of the total network. These purchases amounted to CFA 50 million (US$0.18 million).

New cables will be purchased in 1981 to enable the 10,500 new subscribers to be connected by 1985. No new cable purchases for the network will then be made until after 1985. The cables are all made of copper wire and the approximate new purchase requirements in 1981 will be as follows :

- 53,000 km 0.4 mm diameter wire
- 54,100 km 0.6 mm diameter wire
- 5,400 km 0.8 mm diameter wire
- 800 km 0.9 mm diameter wire

This represents about 300 tonnes copper content. The cables will be purchased in about 40 different sizes from 8 pairs to 896 pairs. It is likely that the telephone cables will be purchased from France.

There are 13 microwave centres, and Gabon is linked to the Nkoltang Satellite which is linked to Intelsat which provides a link to France and from there to the rest of Europe. It is unlikely that fibre optics will be used in Gabon for the next 20 years.

D4.3 Other Uses of Insulated and Bare Wire

The main use of copper cable is for low tension supply within domestic dwellings and factory/commercial premises. The market is thus very much dependent on the building and construction sector. It is estimated that there will be a 10-15% annual increase ir ... sing rural electrification and other construction ... ill probably be reflected in the likely annual ... ption of copper cable.

The total market for copper cable (LT and MT) is an estimated CFA 300-400 million (US$1.1-1.4 million), 70% of which is imported by three French-owned private import/contracting companies. These are Caric, Compagnie Generale d'Electricite and Equitec. This represents about 30-40 tonnes copper within the cables.

Specifications are always based on French standards and almost all cables of above 50 mm^2 sectional area are made in aluminium. Copper cables used are typically 1.5mm^2, 2.5mm^2, 4mm^2, 6mm^2 and 10mm^2. The most common sizes are 1.5mm^2 and 2.5mm^2.

Probably 70% of all LT cables are used in domestic/administrative buildings and the remainder are used in factories.

Other than these two sectors, there are no radio manufacturers or manufacturers of white goods although small quantities of enamelled wire are imported for electric motor rewinding. Motor rewinding is carried out by French owned private companies such as Sorelec and SEB. Imports are estimated to be less than 15 tonnes per year.

D5. DEMAND FOR BRASS MILL PRODUCTS

This group of products embraces all semi-finished materials other than wire and cable. Most of this is copper tubing.

Very small quantities of copper strip are imported for use by car radiator repairers. Imports were less than 3.5 tonnes p.a. in 1980. The sector is stable.

Small quantities (probably no more than 5 tonnes p.a.) of copper tubing are imported for use in the marine repair yards for gas oil lines in ships. Copper tube in this sector is purchased from the import trading houses in 15 metre coils (annealed). Tube diameters are 6 mm bore to 30 mm bore. The most common sizes are 8 mm I/D (10 mm O/D) and 10 mm I/D (12 mm O/D). The price of 8 mm I/D (10 mm O/D) tube is CFA 400/kg, and the price of 10 mm I/D (12 mm O/D) tube is CFA 1,167/kg. The sector is stable and likely to remain so.

The biggest usage of copper tube is the plumbing sector for use with hot water systems. About two-thirds of the tubing purchased is in annealed coil form (typically 15 metre lengths) and the remainder is purchased as straight tubing (typically 5 metre lengths). The most common sizes are 8 mm I/D / 10 O/D and 10 mm I/D / 12 mm O/D which account for 70% of the market. An estimated 80% of tubing is used for hot water systems. The remaining 20% is used for installing air-conditioner systems though small quantities are used for gas oil systems. Small amounts of tubing are used for repair of refrigerators and freezers.

There are no other industries established in Gabon which require brass mill products. Even the breweries do not now use copper tubing.

There are a number of other uses in Gabon for copper products such as screws which are used in the woodworking sector. There is no significant copper craft industry in Gabon. There is also some small usage of extruded sectors, finger plates and other architectural accessories for decorative purposes.

The estimates of the likely growth of the market for brass mill products are listed in Table D5.1 based on interviews within Gabon.

TABLE D5.1 : MARKET FOR BRASS MILL PRODUCTS BY SECTOR

Item	1981	1985	1990
Copper Tubing			
- Hot water systems	35	40	50
- Air-conditioning systems	10	15	20
- Marine/gas oil	5	5	5
Total	50	60	75
Bar			
- Transformer switchgear } - Electricity network }	5	5	10
Strip/Sheet			
- Vehicle radiators } - Other }	4	5	10
Wire/Rod			
- Motor rewinding	10	15	20
- Lightning/earthing	20	20	25
- Other	5	5	5
Total	35	40	50

D6. FUTURE DEVELOPMENTS AND OPPORTUNITIES FOR THE NIGERIAN COMPANY

The market in Gabon for copper semi-finished products is summarised in Table D6.1, together with the market for insulated wire and cable. The table also includes projections for 1985 and 1990 on the basis of local informed opinion.

The general conclusion is that the market for all copper semis is small and likely to remain so until major user industries are established. Present Government planning does not foresee, at present, the establishment of such industries, bearing in mind the small population. Furthermore, links with French suppliers are still strong and likely to remain so for the foreseeable future.

We can therefore conclude that the real potential market for Nigerian semis is at present no more than some 10 tonnes per year and is unlikely to increase to more than 20 tonnes per year by 1990. Within this sector, the market for tubing will represent the biggest potential.

The market for copper wire and cable products is larger (an estimated 525 tonnes p.a. in 1981, increasing to 600 tonnes p.a. in 1985) and specifications are normally to French AFNOR standards. To sell into this sector, the Nigerian company will have to manufacture cable to this specification and sell it through the major importing companies in Gabon.

TABLE D6.1 : ESTIMATE OF THE MARKET FOR SEMI-FINISHED COPPER PRODUCTS AND CABLES

Item	1981	1985	1990
Insulated Cable and Wire			
- Copper insulated cable and wire	300	300	500
- Telephone cable	100	50	100
Total	400	350	600
Brass Mill Products			
- Copper tubing	50	60	75
- Copper and brass sheet and strip	4	5	10
- Copper bar	5	5	10
Total	59	70	95
Bare Wire			
- Motor rewinding wire - enamelled	10	15	20
- Other wire/rod	25	25	30
Total	35	40	50

E. GHANA

E. GHANA

E1. ECONOMIC AND DEMOGRAPHIC OVERVIEW

E1.1 Geography and Population

Ghana, which was formally known as the Gold Coast, has an area of about 238,000 square kilometres, and lies entirely within the tropics. It is bounded on the South by the Gulf of Guinea, to the East by Togo, to the North and North-West by Upper Volta and to the Southern part of the Western border by the Ivory Coast.

The coastline consists mainly of scrubland and plains and there are lagoons to the mouth of the Volta River. Further inland, there are extensive rain forests and, in the North, open savannah.

Ghana, formally a British territory, became an independent State within the Commonwealth in 1957 and was proclaimed a republic in 1960 by the late Kwame Nkrumah who was the first President. Dr. Nkrumah's Government was replaced by a military regime which was followed by a civilian Government in 1969. In 1972 there was a further coup d'etat and the country was governed by the Supreme Military Council under General Adreampory until 1978 and then by General Akuffo. This Government was overthrown in 1979 by a number of junior officers led by Flt. Lt. Jerry Rawlings. Civilian Government returned in late 1979 and since then, President Limann has been the Head of State.

The population of Ghana is an estimated 12 million, increasing at 3% per annum, and Accra, the capital and seat of Government has a population of about one million. Accra is also the main commercial centre and contains the head offices of the majority of leading companies and importers.

The principal ports are Takoradi (population 58,000) and Tema (74,000). Takoradi is also the centre for a number of engineering concerns, particularly those involved with the railways and mines. Tema, 30 kilometres East of Accra, is the centre of Ghana's fishing industry and a growing industrial development area. Kumasi is Ghana's second city with a population of 260,000. Ashanti is the centre of the cocoa producing area and the centre of saw milling and logging. Other important towns are Tamale (84,000) and Cape Coast (52,000).

E1.2 Economic Structure

The economy is based on agriculture which accounts for 40% of local revenue and 80% of export earnings. An estimated 25% of the population work in agriculture.

The cocoa industry is by far the dominant sector of the economy but the industry has fallen into disarray in recent years. There is a shortage of insecticides and spraying equipment and the standard of husbandry has deteriorated to the extent that a high proportion of trees are reaching the end of their productive life and have not been replaced. As a result, Ghana's share of the world cocoa market has declined.

To compound Ghana's difficulties, the price of cocoa dropped from £1,500 per ton in 1980 to £850 per ton in January 1981, thereby dramatically reducing revenues.

Ghana has considerable mineral resources which should make it one of the most prosperous in tropical Africa, but poor management and lack of spare parts for machinery have resulted in a decline in production of gold, manganese, bauxite and diamonds. There are some prospects of finding oil but as yet there is no evidence that this will be available in commercially exploitable quantities.

Like most of Ghana's industries, the textile industry is running at 25% capacity due to lack of spare parts and raw materials and the timber industry has been affected by the ban on export of certain types of logs, the lack of machinery spares and breakdowns.

There is an aluminium smelter company, VALCO, which is part US-owned and there are other areas of foreign investment which is now favoured by the Limann Government in several areas of mining and agriculture. In general, however, Ghana is run by the Ghanians themselves and there is a very small expatriate European or US presence in the country.

The public sectors of industry are made up of corporations established by the Government such as the Ghana Industrial Holding Corporation (GIHOC), the Ghana National Trading Corporation, State Hotels Corporation and Ghana Publishing Corporation.

E1.3 The Economy

The Ghanaian economy has not registered any real growth in Gross Domestic Product since 1978 although firm statistics are lacking. Inflation in 1977 reached 117% but fell in 1979 to about 50% and by 1981 to about 40%.

The local currency is the Cedi and it is not easy to calculate the real GDP in terms of Dollars because of local black market rate is considerably higher than the official rate. Local goods are priced according to black market rate because the Cedi cannot be used to buy foreign goods abroad. Foreign exchange of any denomination is therefore in huge demand.

The economy has deteriorated over the last few years to such an extent that Ghana has been placed in the invidious position of having to ask for international aid. However, the Limann Government has expressed its determination to correct the situation and very recently there has been some confidence that economic management is tighter. This had led to an increased confidence in banking circles and talks with the IMF are expected to result in standby borrowing facilities. The foreign exchange situation is likely to remain precarious for some time and the economy is unlikely to show any substantial real growth until 1985 and beyond.

The United Kingdom is still the major trading partner, followed by the USA, West Germany, Netherlands, Switzerland and Nigeria.

E1.4 Development Plans

There are no official 5-year or similar plans, the main aim of Government being to correct the situation caused by the economic mismanagement of its predecessors. The present policy is the consistent repayment of debts and honouring of current obligations. It is likely that there will be a stabilisation programme aimed at internal economic reforms and substantial foreign assistance, primarily from the International Monetary Fund. As a precursor to the IMF assistance programme

TABLE E1.1 : THE ECONOMY - MAIN INDICATORS

Item	1977	1978	1979
GDP at Current Prices (Million Cedis*)	11,571	19,879	27,930
GDP at Constant Prices (1975 Million Cedis)	5,277	5,454	5,450
Per Capita GDP at Current Prices	1,084	1,807	2,465
External Debt ($US Million)	960.7	1322.1	1329.1
Exports (fob $US Million)	970.1	894.6	1065.6
Imports (fob $US Million)	839.7	781.9	803.1

* Official Rate : 1 Cedi = $2.75 (January 1981)

TABLE E1.2 : LOCAL PRODUCTION

Item	1977	1978	1979
Cocoa (000 Tonnes)	323	277	264
Gold (000 Troy Ounces)	502	415.9	362.4
Diamonds (000 Carates)	2085.5	1817.8	1253.4
Manganese (000 Long Tonnes)	478.5	342.1	266.5
Bauxite (000 Tonnes)	275.4	329.9	213.7
Aluminium (000 Tonnes)	153.8	111.6	165.8

the Bank of Ghana has introduced a programme of austere import licence restrictions and the short-term outlook is not very favourable. Indeed, until a significant devaluation (probably more than one) has been enacted, the economic recovery programme cannot really begin. Today the black market exchange rate for the Cedi stands at five times the official rate. Inflation is higher than anywhere else in West Africa.

In the medium term, given good and continuous economic management, there are grounds for some optimism, but there is unlikely to be substantial growth until after 1985.

E2. LOCAL COPPER PROCESSING INDUSTRY

There are two local Ghanaian companies processing copper rod for the manufacture of electric wire and cable. These two companies are called Kabel Metal and the Ghana Cable Company. Of the two companies, Kabel Metal is the largest and is by far the largest user of copper semis in Ghana.

Kabel Metal is the subsidiary of the West German Company Kabel Metal of Hannover. The same company has a subsidiary in Nigeria. The company has a 40% Ghanaian participation.

All copper rod is purchased in West Germany and any change in the purchasing procedure would have to be decided by the parent company. Almost all purchases are copper rod of 7 mm diameter of 99.8-99.9% purity. Occasionally there is a need for 9.5 mm diameter wire rod but this is mainly used for the manufacture of aluminium wire and cable.

Kabel Metal claim that the present market in Ghana is appalling and in 1981 they only anticipate buying 180 tonnes of copper rod whereas, in the peak year of 1976 purchases were 900 tonnes.

Production at Kabel Metal is based on 1½ shift working and capacity is about 900 tonnes per year although if necessary they could work on a three shift basis and produce 1,800 tonnes p.a.

Production at the factory started in 1979 and 99% of output is for low tension or medium tension applications in the domestic/industrial market. Between 5 and 15% of production is exported to the neighbouring francophone countries of West Africa.

Kabel Metal estimate that the total demand for copper wire and cable in Ghana is about 1,500 tonnes per year but that the present market is considerably less having falled by 70-80% since 1976. It is likely that in 1982 and 1983 the markets will be as low as in 1981 and unlikely that the market will rise substantially before 1986.

Copper rod is bought in wooden drums of 1.4 tonne weight from West Germany. Kabel Metal purchased the following amounts of copper rod over the last three years :

- 1979 317 tonnes (including 90 tonnes of copper-weld*)
- 1980 205 tonnes
- 1981 180 tonnes (estimated)

*Copper-weld is steel rod coated with copper for earthing circuits.

The Ghana Cable Company is a small private Ghanaian company which was founded in 1980. Modern machinery has been purchased from West Germany and Switzerland.

The company, which is run by the retired Managing Director of the State Electricity Corporation, has had difficulties in obtaining import licences because of the economic crisis in the country. Production is likely to be on a small scale building up from an estimated 63 tonnes in 1980 to perhaps 100 tonnes of copper rod by 1982. The capacity of the plant is 300 tonnes per year, but this is unlikely to be achieved before 1986. Import licences have so far only been obtained for 21 tonnes of copper rod.

Copper rod is imported as coil (annealed) from West Germany, of 8mm diameter. This is sufficient for wires of 1.5mm^2 to 6mm^2 sectional area, although by the end of 1981 they expect to produce cables of between 10 and 16mm^2.

All sales from the company are to private electrical contractors and they hope to achieve 25% export to Togo and Upper Volta. They also plan to manufacture stranded conductors, PVC covered, enamelled wire for electric motors and telephone cables. They plan to work on a one shift basis.

Apart from these two companies, there are no other significant copper processing industries. There are a number of very small radiator repair workshops which purchase very small annual quantities of copper strip and there are two companies assembling and repairing air-conditioners and refrigerators. These two companies import copper tubing.

E3. IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS

Imports of copper and copper alloy products into Ghana are listed in Table E3.1. Total exports from the principal supplying countries are listed in Table E3.2 and the imports of copper semi-finished products are listed in Table E3.3. Unfortunately the latest Ghanaian imports are those of the first half of 1978. However, where it is possible to compare the export figures to Ghana and the import figures, there is a reasonable degree of correlation, although the import figures appear to be slightly higher.

Discussions within Ghana point to the fact that since 1978, imports of copper semis have dropped even further to an estimated 200-250 tonnes for 1981. The market is therefore small and, in the next five years, is likely to remain at a low level.

E3.1 Purchasing Criteria

Because of the difficulties in obtaining foreign exchange in Ghana, the normal purchasing criteria do not apply. However, in more normal times delivery and price are regarded as highly important and of course, quality must equal the main specification criteria. Nigerian suppliers are unlikely to be considered as suppliers to Kabel Metal, but no doubt some agreement could be arranged with the Kabel Metal factory in Nigeria so that both factories purchase Nigerian produced copper semis.

Nigerian products are often imported into Ghana and the reputation of Nigerian products is better than in the Francophone territories. It should therefore be possible, bearing in mind the proximity of Ghana to Nigeria, to sell Nigerian copper tube, sheet/strip and rod to Ghana.

E3.2 Purchasing Methods

It is first necessary for the potential Ghanaian importer of copper semis to obtain an import licence from the Government. At the present time, licences are difficult to obtain because of the economic crisis.

TABLE E3.1 : IMPORTS OF COPPER PRODUCTS

Item	Tariff Code	1975	1976	1977	1978 (6 mnths)
Copper & Alloys, whether or not refined unwrought	682100				
- Weight		90.0	21.0	74.2	15.8
- Value		87,586	12,393	185,137	8,901
Bars, Rods, Sections & Wire	682200				
- Weight		1,247.3	917.9	1,654.0	385.9
- Value		1,829,540	2,135,322	2,333,648	1,232,234
Copper Powders & Flakes	682240				
- Weight		-	-	1.0	-
- Value		18	-	2,849	-
Tubes, Pipes & Blanks & Hollow Bars	682250				
- Weight		133.0	31.2	95.3	19.4
- Value		305,087	137,862	443,820	114,925
Tube and Pipe Fittings	682260				
- Weight		101.6	14.4	16.2	22.5
- Value		223,947	79,343	77,267	133,225
Copper Plates, Sheets & Strip Copper Foil	682270				
- Weight		22.8	110.2	134.1	0.3
- Value		65,396	21,284	13,105	1,099
Domestic Utensils in Copper	697229				
- Weight		0.8	1.9	-	4.8
- Value		4,693	11,412	54,545	28,580
Copper Springs	698620				
- Weight		12.7	12.1	13.6	19.8
- Value		2,409	4,398	15,156	43,155
Chains of Copper	698810				
- Weight		7.4	1.5	1.5	0.6
- Value		1,262	10,793	4,760	3,662
Articles of Base Metal	698920				
- Weight		8.3	29.1	14.5	9.3
- Value		37,767	66,182	48,655	43,754
Nuts & Bolts	694220				
- Weight		71.4	10.4	14.6	3.9
- Value		33,873	53,754	62,117	26,224
TOTAL : Weight		1,695.3	1,149.7	2,019.0	482.3
Value		2,591,578	2,532,744	3,241,059	1,635,759

TABLE E3.2 : EXPORTS OF COPPER SEMIS TO GHANA FROM THE PRINCIPAL PRODUCING COUNTRIES

Year	Copper					Copper Alloy					Grand Total
	Wire	RBS	PSS	Tube	Total	Wire	RBS	PSS	Tube	Total	
1976	619	10	-	20	639	41	511	16	13	576	1,215
1977	1,044	2	8	76	1,130	41	129	12	6	188	1,318
1978	833	36	9	256	1,134	10	56	-	11	77	1,211
1979	394	-	7	45	446	16	145	-	-	161	607

TABLE E3.3 : IMPORTS OF COPPER SEMI-FINISHED PRODUCTS

Item	1975	1976	1977	1978 (6 months)
Rods, Bars, Sections :				
Weight (Tonnes) :	1,247.3	917.9	1,654.0	385.9
Value (Cedis) :	1,829,540	2,135,322	2,333,648	1,232,234
Tube :				
Weight (Tonnes)	133.0	31.2	95.3	19.4
Value (Cedis)	305,087	137,862	443,820	114,925
Sheet/Strip :				
Weight (Tonnes)	22.8	110.2	134.1	0.3
Value (Cedis)	65,396	21,284	13,105	1,009
TOTAL : Weight (Tonnes)	1,403.1	1,059.3	1,883.4	405.6
Value (Cedis)	2,200,023	2,294,468	2,790,573	1,348,258

Kabel Metal import all their copper rod from West Germany and their copper coated steel rod (copperweld) from the USA. Some small quantities of copper rod are imported from the UK, Switzerland and Italy. Quotations for supply to the Ghana Cable Company are obtained directly with European companies and Kabel Metal order through their West German office.

Copper tube is imported at present under special licence by those Ghanaians with available foreign currency. Tube is then sold on the local market to plumbers and general contractors.

The major State Organisations import by means of international tender for the large cable network contracts and for other smaller purchases they import after obtaining the quotation, the licence and the foreign exchange.

Telephone cable are based on British Standards (odd numbers of pairs) but copper semis are imported in metric sizes.

E3.3 Opportunities for Nigerian Exports

Bearing in mind that both Ghana and Nigeria speak the English language, that there is considerable trade between the two countries and that they are neighbouring countries, linked by road, it should be possible to export Nigerian copper semis to Ghana.

The present market in Ghana is small, however, at about 200-250 tonnes per year. It is likely to remain so for the next five years, but if the economy can fulfill its potential, then by 1990 the market may return to its latent demand levels of 1,500-2,000 tonnes of copper semis per year.

E4. DEMAND FOR CABLE AND WIRE PRODUCTS

E4.1 Electricity Supply and Distribution

Electricity production in Ghana is the responsibility of the Volta River Authority. Distribution of electricity is the responsibility of the Ghana Electricity Corporation.

The Volta River Authority (VRA), is so called because of the hydro-electric power which is produced by large dams on the Volta River at Akosombo and a new one at Kpong. The VRA has 912 MW of installed generating capacity and they are planning to install a further 164 MW in 1981. In 1983, a further 450 MW plant will be started and it will be in operation by 1988. Therefore, in the next 7 years, they plan to increase the theoretical capacity by 67%. This will alleviate one of the present problems which is due to lack of capacity.

TABLE E4.1 : GENERATION OF ELECTRICITY - MILLION KwH

Authority	1976	1977	1978	1979
Volta River Authority	4,172	4,394	3,721	4,631
Electricity Corporation of Ghana	47	36	34	32
Mines	5	2	2	2
Total	4,226	4,432	3,757	4,665
Of which: Consumption of Valco Aluminium	2,645	2,784	2,086	2,908

Sales of electricity to subscribers other than Valco Aluminium are expected to increase by 90% during the period 1980-1990 (i.e. about 7% per annum).

TABLE E4.2 : FORECAST OF UNIT SALES 1980-1990 (GwH)

Year	Domestic	Commercial	Industrial	Miscellaneous	Total
1980	365.4	207.1	404.7	10.5	987.7
1981	410.2	221.7	465.6	11.2	1,108.7
1982	427.4	237.4	510.4	11.2	1,186.2
1983	442.9	250.3	577.7	11.9	1,282.8
1984	464.0	259.3	627.8	12.8	1,363.9
1985	506.9	260.7	666.3	13.8	1,447.7
1986	537.0	276.2	705.8	14.5	2,253.8
1987	568.7	292.5	747.5	16.2	1,624.9
1988	599.7	308.4	788.2	17.2	1,713.5
1989	630.7	324.4	828.9	18.0	1,802.0
1990	661.6	340.3	869.6	18.9	1,890.4

There are approximately 17[illegible],000 subscribers and this is expected to increase at about 5-7% per annum over the next 10 years.

The VRA does not purchase any copper cables. All cable purchases for the high and medium tension lines (11KV, 33KV, 66KV and 161KV) are purchased by the Electricity Corporation of Ghana, usually by international tender. Very small quantities are occasionally imported through the Ghana Supply Commission.

As in the Francophone West African States, all high tension cables are now in aluminium. Copper cables are still used for the overhead lighting network and there are some medium tension underground feeder cables made in copper.

The cable imports shown in Table E4.3 were recorded during the period 1975-1978.

Since 1978 annual cable imports have remained at a low level (200-300 tonnes per year). It is estimated that less than 20% of power cables are copper. By contrast almost all wires for use in domestic/industrial low tension applications are all made in copper and are likely to remain so. The low level of imports is due to continuing economic crisis in Ghana.

E4.2 Telecommunications

At present there are 68,000 telephones installed in Ghana and the demand in 1981 was an estimated 96,000 telephones. Out of the total number of telephones, 59,945 were automatic and 8,224 manual.

The Post and Telecommunications Ministry estimates that it is unlikely that any new telephones will be added to existing network until after 1983/84. The present exchanges are almost full and negotiations are in progress with the World Bank to finance the extension of the existing network. It is also possible that there may be some finance available from either Ecowas or the EEC countries.

TABLE E4.3 : IMPORTS OF CABLES FOR ELECTRICITY

Item	1975	1976	1977	1978 (6 months)
Power Cables				
Weight (Tonnes)	800.0	176.6	161.2	190.8
Value (Cedis)	1,100,074	458,995	794,380	687,089
Telephone Cables				
Weight (Tonnes)	488.6	290.0	106.7	1.1
Value (Cedis)	604,535	451,811	309,111	10,611
Flexes, Cables used for Wiring Houses				
Weight (Tonnes)	85.9	43.2	63.2	41.1
Value (Cedis)	274,843	126,607	235,505	279,060
Other Cables				
Weight (Tonnes)	48.2	171.7	1,025.9	143.4
Value (Cedis)	107,487	588,084	2,135,340	442,700
TOTAL : Weight (Tonnes)	1,422.7	681.5	1,357.0	376.7
Value (Cedis)	2,086,939	1,625,497	5,557,827	2,396,220

As a result, imports of copper telephone cables have fallen from 488 tonnes in 1975 to less than 60 tonnes in 1980/81. The telephone cable network is based on the British system (odd numbers of pairs) and annual requirements range from 15,000 metres of 15 pair 0.5mm cable to 1,500 metres of 800 pair 0.5mm cable. All cables have metric diameters.

E4.3 Other Uses of Insulated and Bare Wire

The principal use of copper wire and cable is in domestic, administrative and other buildings wherever low tension supply is used. Almost all these wires are made in copper and are likely to remain so in the future. Most of this sector is supplied by the local cable company Kabel Metal.

The most commonly used sizes are $1.5mm^2$ and $2.5mm^2$ although $4mm^2$ and $6mm^2$ sections are also used extensively. Domestic lines are 230 Volt and industrial lines 415 Volt. In 1981 the estimated market for domestic/industrial low tension cables will be an estimated 200-250 tonnes per year which is only 15% of the latent demand. The market is unlikely to increase over the next 2-3 years.

A further use of bare copper wire is rewinding electric motors, but like most other sectors in Ghana, this is now a very small market of no more than an estimated 20 tonnes p.a. Specifications for motors were traditionally to British specifications but nowadays motors are imported from many different countries (e.g. West Germany, Italy, USA).

The cable import statistics show that quantities of copper wire for non-electric uses are imported. Imports were 81 tonnes in 1975, 55 tonnes in 1976, 53 tonnes in 1977 and 59 tonnes in the first six months of 1978. It is likely that these wires were destined for various lightning conductor applications. Some is used for earthing wires on domestic refrigerators and some is used for decorative purposes.

E5. BRASS MILL PRODUCTS

This sector is much smaller than the wire and cable sector and imports of both tube and sheet/strip are falling.

Imports of copper tubing have fallen from 133 tonnes in 1975 to an estimated 30 tonnes in 1980/81. Tubing is used in domestic plumbing systems for hot water lines although its use is declining. Two local Ghanaian factories now produce PVC pipes with the result that these pipes are extensively used in housing plumbing systems.

Typical sizes of copper tubing used in plumbing systems are ½", ¾" and 1¼" nominal bore and there is some use of 2" nominal bore tube. Some small amounts of tubing are used by the two assemblers of air-conditioners, typically ⅜" and ¼" diameters. The ¼" bore tubing costs about 10 cedis per foot on the local open market.

Ghana Sanyo (manufacturers of refrigerators, freezers, radios and TV sets) use copper tubing (quarter and three-tenths inches nominal bore) for the assembly of refrigerators and freezers (about 50,000 metres per year). Tubing for the assembly of air-conditioners is normally of ⅜" diameter nominal bore.

Tubing used for these purposes is an estimated 50,000 metres per year. Both Ghana Sanyo and the State ELectronics Company assembly air-conditioners. Tubes in the plumbing and domestic sector are purchased either as coil (annealed) or straight tubing (20 feet lengths).

It is unlikely that this sector will increase substantially in the near future.

There is some very small usage of copper strip for the repair of car radiators but imports of strip in 1980/81 are estimated to be less than 10 tonnes p.a.

E6. FUTURE DEVELOPMENTS AND OPPORTUNITIES FOR THE NIGERIAN COMPANY

The present market for copper and brass semis is summarised below, together with the estimates for 1985 and 1990, based on interviews within Ghana.

TABLE E6.1 : ESTIMATE OF MARKET FOR COPPER/BRASS SEMI-FABRICATED PRODUCTS

Item	1981	1985	1990
Rods, Bars, Sections (Copper)	250	300	1,500
Tube : Copper	25	25	) 200
Brass	5	5	)
Strip/Sheet: Copper) Brass)	10	10	50
Motor Rewinding Wire (Enamelled)	20	20	50
Total	310	360	1,800
Imported Telephone Cable	60	60	80
Other Imported Copper Cable	150	150	900
Total	210	210	980

As far as opportunities for the Nigerian company are concerned, competition with West German and other suppliers to the market will be tough. The major outlet, however, is for the sales of rods to the two cable companies (Kabel Metal and Ghana Cable Company).

Assuming that the Nigerian company can achieve competitive delivery dates and prices, and quality equivalent to other suppliers, then potential sales could be as high as 1,000-1,500 tonnes by 1990, although they are unlikely to be more than 250-300 tonnes until after 1985.

F. THE REPUBLIC OF THE IVORY COAST

F. THE REPUBLIC OF THE IVORY COAST

F1. ECONOMIC AND DEMOGRAPHIC OVERVIEW

F1.1 Geography and Population

The Ivory Coast has an area of 322,500 square kilometres and lies on the Gulf of Guinea. In the West it is bordered by Liberia and the Republic of Guinea, in the North it is bordered by Mali and Upper Volta and in the East by Ghana. The country is divided into two geographical areas consisting of equatorial rain forests in the South and a drier savannah belt in the North.

The population was estimated in 1977 to be 7.3 million and growing at 5.9% per year, so that at the end of 1980 the population must be approaching 8.5 million. The natural population is growing at 4% per year. There are more than 60 different tribes comprising six principal ethnic groups, the most influential being the Baoules in the centre of the country around Bouake. There are also many foreign born Africans living in the country, particularly from Upper Volta, Senegal and Ghana. These groups form a large part of the country's labour force. Of the non-African population there are over 50,000 Frenchmen and also many Lebanese and Syrians (over 100,000), and Italians.

Abidjan is the capital and seat of Government. It is a modern European-style city with a population of around 1.2 million and one of the best natural harbours on the West Coast of Africa. Bouake in the centre of the country is the next largest town with a population of 175,000 and it is the home of the textile industry. Other large towns are Daloa (population 60,000), Man (49,000), Korhogo (45,000), San Pedro (45,000) and Gagnoa (42,000).

The adult literacy rate is about 20% and around 46% of children receive schooling. The religion of the population is predominantly animist, although there are some Moslems and Christians. The language used in commerce and business is French.

The Ivory Coast gained its independence from France in 1960 and since that time it has enjoyed a stable Government under the continuous rule of one party, founded and still led by President Felix Houphouet-Boigny. There are still very close links with France and France is by far the largest trading partner. The currency used is the CFA Franc which is linked to the French Franc at a fixed rate and it is a convertible currency.

F1.2 Economic Structure

The Ivory Coast is the most industrialised of the former French West African territories, with industry accounting for 17% of Gross Domestic Product. Industry is based on the processing of local agricultural produce, particularly cocoa, coffee, palm oil, latex, forestry and fishing products.

Cocoa and coffee still account for over 64% of export earnings and agriculture, foresting and fishing still acount for 25% of GDP. Ivory Coast is Africa's leading producer and exporter of timber, particularly Okoumé wood and is the world's third largest palm oil producer.

Sugar production has been rapidly expanded although the present world glut of sugar and EEC import regulations have resulted in a considerable production downturn.

The Ivory Coast has followed a policy of import substitution for industrial goods but recently the emphasis has been towards export-orientated business with the aim of increasing the share of manufactured exports from 30% in 1975 to 50% by the early 1980's.

Whilst most of the industry sector is based on forestry and agro-processing, there is also substantial activity in textiles including cotton and polyester production, printing and tyre manufacture.

The mining sector is of little importance although there are significant deposits of iron ore. Manganese production was discontinued in 1970 and diamond production is falling. There is some mining of nickel and gold.

Oil was found in 1977 and there is reason to be optimistic that the Ivory Coast may be self-sufficient by 1983/84. It is unlikely, however, that there will be an oil bonanza although some experts believe there will be some available for export.

The Ivory Coast runs a liberal investment code which does not insist on majority local control, although foreign investment has been disappointing. There are, however, many French-owned import/trading houses.

F1.3 The Economy

The Ivory Coast enjoyed an economic boom in the late 1960's when the real growth rate averaged 8.3% p.a. In the early 1970's growth slowed to 5.6% per year and then a combination of high inflation (27% in 1977) and the increasing foreign debt resulted in an increasing balance of payments deficit. As a result, after consultations with the World Bank, Ivory Coast decided to defer some of its more ambitious development projects. This created a recession, particularly in the construction sector.

This has meant that there has been a considerable slow down in the growth rate. The Gross Domestic Product did, however, rise by 8% in 1980 to CFA 2 billion (CFA 244,500 per capita, or $1,100 per capita) which is high by developing country standards. Real growth was probably less than 6% but this is still an impressive record.

There is unlikely to be any major surge in growth until 1983/4 when oil will undoubtedly begin to play a significant part in the economy. Oil is likely to be sufficient for domestic needs and there may be a surplus for export. The construction sector, and hence the market for copper semis, is likewise unlikely to expand before 1983/84.

TABLE F1.1 : GROWTH OF GROSS DOMESTIC PRODUCT (CFA 000 Million)

Item	1976	1977	1978	1979	1980
Gross Domestic Production	n.a.	1,406.8	1,630.0	1,750.0	1,900.0
Primary Sector	272.7	373.5	422.6	500.0	600.0
Secondary Sector	330.4	523.3	509.0	n.a.	n.a.
Tertiary Sector	422.2	525.3	666.9	724.3	1,003.9
Taxes and Duties	88.6	117.2	142.5	n.a.	n.a.
Gross Domestic Product	1,113.9	1,539.3	1,741.0	1,850.0	2,000.0

F1.4 Development Plans

The development of the Ivoirian economy has, since independence, been governed by a series of Five Year Plans. The last one, the Fourth Development Plan 1976-80, has already seen most of its targets met or surpassed except for the failure to mobilise private investment despite the liberal investment laws. The gap was filled by the public sector largely through the state enterprises which have a poor record of growth.

Capital investment increased from CFA 397.6 billion in 1977 to CFA 600 billion in 1980 and was focussed mainly on infrastructure projects like the construction of dams, the reform of agriculture, the establishment of export orientated industries, the acceleration of Ivoirianisation and the development of the less prosperous regions of the economy.

The Development Plan 1976-80 allotted CFA 1,010 billion for total public sector budgetary expenditure over the 5 year period, including 21% for agriculture, 11% for industry, 22% for transport and telecommunications and 15% for energy.

In general, the Ivory Coast has been one of the most successful African economies since Independence in 1960 and despite the temporary downturn, renewed growth is likely after 1984.

F2. LOCAL COPPER PROCESSING INDUSTRY

There is only one major user of copper semis in the Ivory Coast. This is a French-owned cable and wire manufacturing company called SICABLE.

SICABLE started production in 1976 and reached maximum production in 1978 before falling in 1978. Since that time production has remained relatively stable. The consumption of copper rod over the period 1976-80 is given below :

Year	Copper Consumption (Tonnes)
1976	88
1977	557
1978	1,304
1979	1,066
1980	1,000

The copper used by SICABLE is known as electrolytically pure copper purchased to the French specification A53 100 annealed rod. Of the 1,000 tonnes imported, 950 tonnes are 8 mm diameter rod and the remaining 50 tonnes are a variety of sizes including 0.15, 0.20, 0.25, 0.30, 0.40 and 0.5 mm diameters. The tolerance specification has to be ± 1.5% and resistivity has to be a maximum of 1.7241 cm^2 per cm at 20°C.

There are three suppliers to SICABLE. Two of these are French: Trefimetaux, Lens and the third is a Belgian company called Olen. Copper is normally purchased in 3.5 tonnes annealed coils.

SICABLE estimate that the domestic sector accounts for about 75% of the market for copper cables.

As regards the market for potential Nigerian suppliers, SICABLE are prepared to consider any source of supply as long as delivery time, price and quality are competitive with traditional French/Belgian sources.

The only other user of copper semis in the Ivory Coast is the French owned radiator manufacturer Chausson. Chausson Afrique is the only major repairer and manufacturer of car radiators in the Ivory Coast.

Copper and brass strip is imported, mainly from France. It is interesting that in France there has been a trend away from the use of copper in radiators towards the use of aluminium. However, in Ivory Coast copper is still used because, in the hot climate, the higher conductivity produces better cooling.

Chausson Afrique buy copper and brass in strip form in the following sections: 40 x 0.08 mm, 63 x 0.08mm, 82 x 0.08mm, 101 x 0.1 mm and 120 x 0.1mm. They also import tubes in brass of diameters 34 x 0.14mm wall thickness; 34 x 0.12mm and 35 x 0.16 mm.

Total imports in 1980 were 21.95 tonnes of copper sheet and a similar amount of brass. The copper consumption represents 10,000 radiators per year and the radiator body represents 70% of consumption for radiator repairs.

Chausson are free to purchase copper from any source they wish although the links with France are strong. The market has fallen since 1977 because of the increase of imports of Japanese cars which do not have the same design as the French car radiators. Chausson are able to repair Japanese car radiators but not manufacture them. This sector for copper semis is likely to remain small for the next few years.

F3. IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS

Imports of copper and copper alloy products into the Ivory Coast are listed in Table F3.1. Total exports from the principal supplying countries are listed in Table F3.2. The market for copper semis can be estimated from the import table as shown in Table F3.3.

There is a good degree of correlation between the export figures to the Ivory Coast and the official import figures, and local interviews within the Ivory Coast confirm the overall market sizes as indicated by the import figures.

The figures show that the imports of bar and rod semis increased from 79 tonnes in 1975 to 1,244 tonnes in 1979 and then decreased by about 10% in 1980.

Imports of copper tube increased from 14 tonnes in 1975 to an estimated 240 tonnes in 1980. The market showed no sign of decline in 1980. Similarly, the imports of sheet/strip increased from 24 tonnes in 1975 to 69 tonnes by 1980 and the market showed no sign of decline in 1980.

F3.1 Purchasing Criteria

In general, delivery times and price are regarded as highly important by SICABLE and by Chausson. The quality, of course, must equal the main specification criteria. Nigerian suppliers would be considered along with other European suppliers although the perceived reputation of Nigerian products is not good. These criteria are equally true of other sectors in the Ivory Coast.

F3.2 Purchasing Methods

SICABLE and Chausson purchase their copper rod and strip/tube from France and Belgium by means of normal commercial methods including import licence. All local electrical contractors are required to purchase wire and cable from SICABLE. If SICABLE cannot produce the required size or specification, then the contractor may apply for an import licence. In general SICABLE estimates to supply about half the cables required and they concentrate on the main sizes. They supply a large percentage of the domestic/industrial low tension market.

TABLE F3.1 : IMPORTS OF COPPER PRODUCTS AND CABLES -

Tariff Code	Product Category	1975		1976	
		Weight	Value	Weight	Value
740110	Copper Matte	.307	321,074	8.063	4,281,666
740120	Copper Scrap & Waste	20.004	614,040	15.015	795,675
740131	Copper for Miscellaneous Refining	2.427	1,367,975	2.906	1,659,618
740200	Copper Alloys	1.075	611,252	5.811	2,144,587
740300	Bars, Sections & Wire	79.821	42,834,017	301.495	135,279,102
740400	Copper Sheet, Plate	12.098	6,039,294	16.677	12,199,757
740500	Copper Strip	12.496	7,346,412	28.487	19,507,311
740600	Powder and Flake	2.182	1,871,155	1.182	20,165,585
740701	Copper Tube	10.358	7,710,737	80.113	50,369,160
740709	Brass Tube	3.973	6,718,213	6.949	5,784,654
740790	Other Pipe Fittings (Brass)	60.289	45,459,200	116.819	78,893,910
740800	Tube Fittings (Copper)	34.000	37,400,390	19.293	32,304,368
740900	Tanks	-	-	-	-
741000	Cables & Twisted Wire	33.280	21,890,582	84.991	35,956,412
741100	Woven Wire	1.757	1,471,420	2.544	1,733,453
741300	Miscellaneous Chains	.106	163,695	10.357	1,128,973
741400	Nails	2.650	1,965,456	1.566	1,609,139
741500	Nuts and Bolts	28.393	29,478,927	18.281	17,047,385
741600	Springs	.519	489,917	.007	12,054
741700	Non-Electric Equipment	2.063	1,925,339	3.334	2,962,907
741800	Household Utensils	7.405	18,649,125	16.656	39,081,872
741901	Copper Vessels > 300L	.244	598,182	.221	416,016
741902	Copper Vessels > 300L	-	-	-	-
741910	Copper Chains	-	-	-	-
741920	Other Accessories	4.834	2,980,069	1.297	3,577,067
741990	Other Items	29.444	24,244,235	47.222	35,311,617
TOTAL		350.311	264,011,705	808.906	185,770,947

- IVORY COAST (Value: C&F in CFA)

1977		1978		1979		1980 (9 Mths)	
Weight	Value	Weight	Value	Weight	Value	Weight	Value
-	-	-	-	2.018	2,067,541	7.726	8,199,170
40.960	2,570,759	14.834	967,085	.006	8,971	2.561	1,845,127
.125	93,736	.002	5,068	.003	15,625	-	-
1.098	1,124,968	.088	157,674	-	-	.423	522,635
819.025	407,079,734	1024.768	467,101,193	1244.389	702,334,941	766.983	461,744,800
21.249	16,570,243	32.213	26,701,319	15.435	13,879,312	21.364	20,026,542
16.881	12,470,390	24.679	18,073,265	38.081	30,905,401	31.095	29,864,973
1.351	1,499,067	.802	996,437	1.263	2,258,269	1.484	2,384,340
90.195	59,217,472	125.803	83,546,935	168.351	121,131,996	77.313	70,991,219
7.932	9,649,428	7.866	7,086,300	31.763	30,032,577	23.648	25,008,991
195.990	140,930,184	127.840	102,576,300	114.642	95,171,304	76.833	81,004,149
34.770	64,247,062	51.325	121,690,951	45.252	94,872,514	35.146	68,026,842
.006	3,197	10.184	25,221,025	-	-	-	-
80.377	55,238,979	160.458	95,066,091	59.020	89,164,778	22.846	19,872,932
1.858	1,968,288	2.026	3,265,818	2.863	4,017,990	2.185	1,950,355
1.038	5,879,701	.072	275,284	-	-	-	-
111.266	10,447,332	2.000	2,517,161	-	-	-	-
23.203	29,308,964	17.418	39,743,423	19.471	38,307,815	44.411	36,012,625
1.127	412,577	.011	40,728	.015	49,144	.152	274,028
.104	275,723	.156	737,859	22.240	16,831,800	.018	87,296
27.561	50,121,066	23.124	54,398,999	15.301	37,482,541	13.677	25,144,369
.026	257,088	.508	423,314	.017	96,279	-	-
-		-	-	.090	196,150	.075	148,253
-			-	.166	181,440	.013	21,302
1.524	1,651,228	1.490	356,288	2.587	11,404,964	-	-
40.525	46,620,490	28.810	37,065,033	22.775	71,659,724	22.504	31,525,275
1519.165	919,660,629	1656.471	1,051,458,480	1805.836	1,362,552,574	1150.537	886,655,193

TABLE F3.2 : EXPORTS FROM THE PRINCIPAL SUPPLYING COUNTRIES OF COPPER SEMIS TO THE IVORY COAST

Year	Copper					Copper Alloy					Grand Total
	Wire	RBS	PSS	Tube	Total	Wire	RBS	PSS	Tube	Total	
1976	432	13	32	136	613	21	36	12	46	115	728
1977	700	17	36	120	873	60	33	40	86	219	1,092
1978	1,224	14	27	193	1,458	56	22	24	89	191	1,649
1979	1,142	51	36	165	1,394	18	44	23	57	142	1,536

TABLE F3.3 : IMPORTS OF COPPER SEMI-FINISHED PRODUCTS

Item	1975	1976	1977	1978	1979	1980*
Rods, Bars, Sections :						
Weight (Tonnes)	79.821	301.495	849.025	1,024.768	1,244.389	766.983
Value (CFA 000)	42,834	135,279	407,079	467,101	702,334	463,744
Tube :						
Weight (Tonnes)	14.331	87.062	98.127	133.669	200.114	178.274
Value (CFA 000)	14,429	56,154	68,867	90,633	421,458	96,000
Sheet/Strip :						
Weight (Tonnes)	24.594	45.164	38.130	56.892	53.516	52.459
Value (CFA 000)	13,385	31,707	29,041	44,775	44,785	49,892
TOTAL: Weight (Tonnes)	118.746	433.721	985.282	1,215.329	1,498.019	997.716+
Value (CFA 000)	70,648	223,140	504,987	602,509	1,168,577	609,636

* Nine months
\+ Est. 12 months 1,330 tonnes.

The major State Organisations like the Electricity Company (EECI) and the Ministry of Telecommunications usually obtain their requirements through international tender, usually to French or international standards.

Tube is imported by the major trading houses, almost all French-owned, such as Bernabé, Equitec and Brossette. Telephone cables are imported from trading houses, also French-owned.

Importers sell directly to the local electrical contractors, although several of the importers are themselves involved with contracting.

F3.3 Opportunities for Nigerian Exports

In the plumbing and engineering sectors, most of the importers of copper tube would not consider buying their needs from Nigeria. Only if the supply is cheaper, with quicker delivery, is a Nigerian supplier likely to be considered.

However, in the larger market for rod supplied to SICABLE, a Nigerian supplier could expect to be considered. The decision as to whether to buy from Nigeria will depend on good delivery times and competitive prices. Delivery times need to be less than one month.

F4. DEMAND FOR WIRE AND CABLE PRODUCTS

F4.1 Electricity Supply and Distribution

A large proportion of electricity is now generated by hydro-power whereas in 1971 most was generated by thermal power. All new power will be generated hydro-electrically. Production and distribution of electricity is the responsibility of the State Electricity Corporation L'Energie Electrique de la Cote d'Ivoire (EECI).

Total electricity production in 1980 reached 1,717 GwH and delivered electricity reached 1,601 GwH. Installed capacity in 1980 was 720 MW. Consumption has increased from 60 GwH in 1960 to 1,526 GwH in 1980. The number of domestic subscribers has increased from 137,126 in 1975/6 to 269,180 in October 1980, which represents an annual increase of about 15%.

The EECI is planning eventually to distribute electricity to the whole country. Hydro-electric potential is estimated to be five times as much as has already been realised. The programme of dam building will mean that the number of subscribers and the consumption of electricity will increase by 10-15% p.a. until the year 2000.

Virtually all the cables used by the EECI are made from aluminium, principally because of lightness, price, price movement and the fact that France processes aluminium. In future all cables will be made from aluminium for all high and medium tension applications. (5.5KV, 15KV, 33KV, 90KV and 225KV). All low tension (220/380V) domestic/industrial wires are likely to continue to be made in copper, but the ECCI is only concerned with high/medium tension cable installation and maintenance.

TABLE F4.1 : INSULATED CABLE AND WIRE IMPORTS INTO THE IVORY COAST 1975-80 (WEIGHT)

Year	Insulated Cable	Motor Re-Winding Wire	Other Wire (Electric)	TOTAL
1975	1,471.0	40.2	12.4	1,523.6
1976	1,221.8	51.0	26.8	1,249.6
1977	2,751.9	38.8	26.8	2,817.5
1978	2,339.2	61.6	27.2	2,428.0
1979	2,101.9	69.7	29.0	2,200.6
1980*	642.8	31.3	17.6	691.7

* Nine months

F4.2 Telecommunications

At the end of 1980 there were 71,000 connected subscribers, although officials estimated that the number in use is approximately 45,000. About 75% of all subscribers are in Abidjan.

There are plans to connect a further 90,000 subscribers by 1985 although it is likely that pressure from the International Monetary Fund will reduce this to about 35,000 new subscribers over the same period. This will result in an annual increase of about 10% over the period 1981-85. It should also be remembered that annual maintenance requirements amount to about 10-15% of the existing network.

All the telephone network has been installed to French standards (i.e. the use of even numbers of pairs). The most common size of cable have 0.6mm diameter copper wires and 896 pair cables are the largest. Imports of telephone cables are an estimated 400 tonnes per year and the network extensions are normally carried out by large international contractors. Domestic wiring is carried out by local contractors. All major contracts are handled by means of international tender.

TABLE F4.2 : ELECTRICITY STATISTICS

Item	1976	1977	1978	1979	1980 Oct.
Installed Capacity (MW)	1,535	1,506	1,533	2,114	n.a.
Electricity Production (MWh)					
Hydro-electric	389,450	205,514	204,275	454,803	1,269,344
Thermal Network	630,446	941,957	1,089,645	996,011	384,511
Private Thermal	56,955	63,956	74,999	93,349	63,084
TOTAL	1,076,851	1,211,427	1,368,919	1,544,163	1,716,939
Electricity Sales (MWh)					
Domestic	218,824	251,112	301,835	354,140	
Commercial	116,309	128,331	141,873	173,455	
Public Lighting	24,348	27,269	32,163	51,412	
Preferential Tariffs	11,184	11,260	6,317	8,301	n.a.
Total Low Tension	370,665	417,972	482,188	587,308	
High Tension	493,870	577,347	654,659	735,548	n.a.
Number of Subscribers	161,038	182,027	205,024	236,365	270,522
Low Tension	160,174	181,831	203,945	235,130	269,180
Medium Tension	861	955	1,076	1,232	1,339
High Tension	3	3	3	3	3

F4.3 Other Uses of Insulated and Bare Wire

The principal use of copper wire and cable is in domestic, administrative and other buildings wherever low tension supply is used. Almost all these wires and cables are made in copper and are likely to remain so in the future. Much of this sector is now supplied by the local cable company, SICABLE.

The most commonly used cable sizes are $1.5mm^2$ and $2.5mm^2$ although 4mm2 and $6mm^2$ sections are also used. The total market for copper wire and cable in this sector was an estimated 2,000 tonnes in 1980, a similar amount to 1979. About 50% of the market is supplied by SICABLE.

There were a further 88.4kg of 100% pure copper imported for earthing requirements.

The total market is unlikely to increase before 1983 but thereafter we can expect an up turn in the market of perhaps 5-10% per annum.

A further use for bare wire is for rewinding of electric motors. The specifications areusually French and two of the main companies engaged in this field are the French-owned companies, Sorepel and Sorem. The sector is small and is static at about 40-60 tonnes per annum.

There are no other significant uses of copper wire and cable in the Ivory Coast and there are unlikely to be in the near future.

F5. THE DEMAND FOR BRASS MILL PRODUCTS

This sector is much smaller than the wire and cable sector. Imports of copper and brass tubing have increased from 14 tonnes in 1975 to an estimated 237 tonnes in 1980. About 75% of annual needs are copper tube and 25% brass tube. Imports of strip/sheet have also increased from 25 tonnes in 1975 to about 70 tonnes in 1980.

Approximately 75% of tube imports are used as hot water pipes in domestic plumbing systems. The remaining 25% are used for installing domestic air-conditioning systems and refrigeration systems.

The company, SEEE, is one of the principal companies importing tubing in this sector. They import about 15,000 metres of copper tubing annually, of various sizes (¼", ⅜", ⅝", ½", ⅞", 1⅛", 1⅜", and 2") for the air-conditioning and refrigeration sector, and a further 80-100,000 metres of copper tubing for plumbing and water systems. SEEE also assembles about 500 air-conditioners per year and use about 10 metres of tube for each unit.

Some tubes are also used for gas/gas-oil installations. Tubes are either purchased straight, often in 5 metre lengths in coiled form (annealed). Almost all tubes are purchased through the main trading houses such as Bernabé, Equitec and Brossette. The most common sizes of tube used for plumbing systems are 12/14mm and 14/16mm.

There is some usage of copper strip for reparing car radiators. Chausson (Afrique) for example, purchased about 22 tonnes of strip for radiator assembly/repair. Some copper bar is purchased by the company CAFTEL who assemble instrument panels and medium tension control cabinets. Bar of 20 x 3mm, 50 x 5mm and 80 x 5mm is purchased through the importing company CFCD, but annual quantities are small, being measured in kilos rather than tonnes.

In general, the market for brass mill products is likely to be strongly influenced by the housing and construction market which is expected to remain stable until 1983 when it is likely to increase. An estimated 10,000 houses per year will be constructed in 1985 which is slightly higher than the level in 1979.

F6. FUTURE DEVELOPMENTS AND OPPORTUNITIES FOR THE NIGERIAN COMPANY

The present market for copper and brass semis is summarised below, together with the estimates for 1985 and 1990 based on interviews within the Ivory Coast.

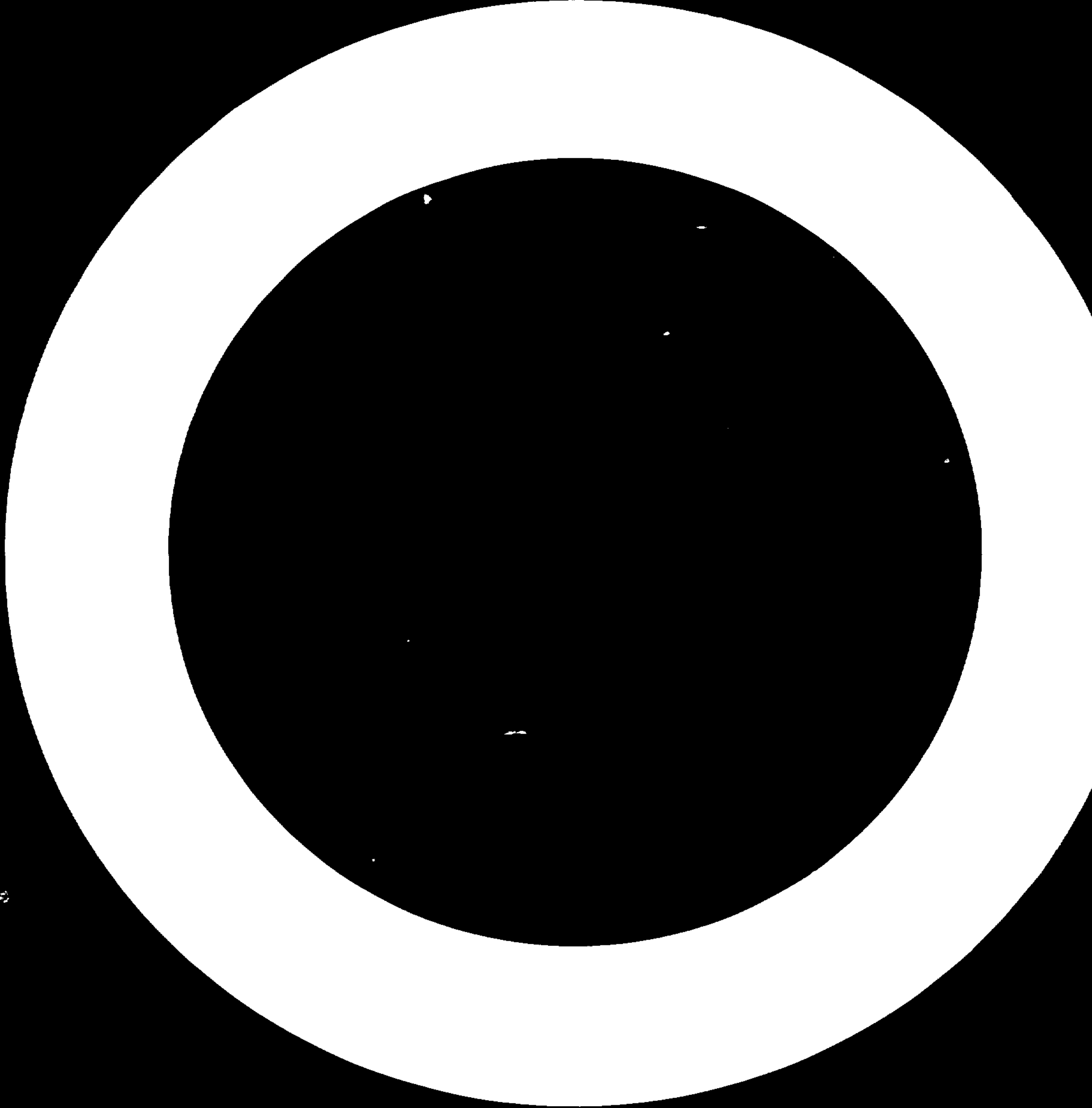
TABLE F6.1 : ESTIMATE OF MARKET FOR COPPER/BRASS SEMI-FABRICATED PRODUCTS

Item	1981	1985	1990
Rods, Bars, Sections :			
Copper	1,000	1,000	1,250
Brass	15	15	20
Tube:			
Copper	180	180	290
Brass	60	60	100
Strip/Sheet:			
Copper	45	45	70
Brass	20	20	30
Motor Rewinding Wire (Enamelled)	45	70	110
TOTAL	1,365	1,365	1,870

As far as opportunities for the Nigerian company are concerned, competition with existing, predominantly French, suppliers will be tough and the most likely outlet is the sale of 8 mm rod to the cable company SICABLE. Assuming that the Nigerian company can achieve competitive delivery dates and prices, together with quality equivalent to other suppliers, then potential sales could be as high as 1,250 tpa by 1990.

In order to sell to Sicable, it will be necessary to have direct contact with them and offer competitive delivery dates (less than one month) and prices. Quality, of course, must be reasonably equivalent to that of existing European suppliers.

G. TOGO



G. TOGO

G1. ECONOMIC AND DEMOGRAPHIC OVERVIEW

G1.1 Introduction

Togo is a thin strip of land approximately 80 kilometres across and extending some 400 kilometres inland from the sea to its Northern border with Upper Volta. The total land surface area is 56,600 square kilometres. To the East it is bordered by Benin and to the West by Ghana. The variety of country such as the coastal areas, plateau and hilly regions and virgin forests afforded by its position make Togo an attractive location for visitors and one of the Government's aims in recent years has been to develop tourism as a major industry and foreign exchange earner. The sea port facility at Lome, the capital city, also plays an increasingly important part in the country's economy.

The size of the population was estimated to be 2.5 million in 1980 and is increasing by 2.7% annually. Lome is the largest town, with a population of 200,000; other principal towns are Atakpame (17,500), Mango (9,000), Bassari, Dapango and Lama-Kara. The total urban population is slightly less than 400,000 (16%) and density of population is 45 inhabitants per square kilometre.

G1.2 Agricultural Sector

More than 80% of the population are involved in agriculture which is predominantly subsistance farming and contributes about 25% of Gross Domestic Product. The principal food crops are manioc, yams, sorghum, maize, millet, rice and beans. In 1977 President Eyadema stated that self-sufficiency in basic foods should be achieved within five years, but variable weather conditions make this unlikely. Only 11% of Togo's surface area is presently being cultivated and the problem is exacerbated by low mechanisation and the drift of young people to urban areas. The objective of self-sufficiency will continue to be a major part of Togo's 5 year plan beginning this year through projects aimed at improving irrigation and reducing wastage; it is estimated that some 30% of peasant production rots before it is commercialised. Following several years of drought and near-drought, weather conditions were good in 1978 and 1979 so that production of food crops totalled over one million tonnes in the 1978/79 season. However, whilst there has been a surplus of root crops in the past two years, the country cannot meet domestic demand for the cereals maize and rice.

Cash crops account for 25% of agricultural output and the two principal ones, coffee and cocoa, now account for about 30% of Togo's export earnings. Other cash crops are cotton, groundnuts, and palm oil products. After reaching a peak of more than 16,000 tons in the late 1960's, coffee production fell to 4,700 tonnes in 1977/78. As a result of a five year replanting programme started in 1975 and increased producer prices in 1978, coffee production recovered to 6,300 tonnes in 1979. The Government's projections indicate that coffee production should increase to 12,700 tonnes by 1985. There has been less success with attempts to increase cocoa production. From a high of more than 29,000 tonnes in 1972, production has declined to 12,500 tonnes in 1979. The replanting programme for cocoa was less successful than anticipated because of problems of land tenure, lack of incentive for farmers and the 1976/77 drought. The Government's aim of 17,000 tonnes production now looks optimistic.

The major cash crop in Togo, apart from coffee and cocoa, is cotton. Assisted by a combination of good weather conditions and a foreign financed cotton project, production of cotton has increased rapidly in recent years to a level of 22,000 tonnes in 1979 and the aim is to increase production to 30,000 tonnes by 1981. However, there is currently a shortage of storage and milling capacities. The Government has started projects and expects to develop a cotton processing capacity of 60,000 tonnes by 1985, which will be above the expected production level of 55,000 tonnes.

G1.3 Industrial and Mining Sector

The secondary sector accounted for about 28% of GDP in 1980. Phosphate mining is a vital feature of Togo's economy and accounts for about 40% of the country's export earnings. Because phosphates are such a central feature, development of the economy can be radically affected by world prices for phosphates. The extensive industrial investment undertaken by the government in the late 1970's were a direct result of rapid increases in phosphate prices which it was thought would continue.

Production of phosphate was about 2.8 million tonnes in 1978 and 1979. Although no definite figures were available, production is thought to have increased to 3.3 million tonnes in 1980 and estimates are that 3.6 million tonnes should be reached in 1981.

The industry has been helped by the merging of the production and marketing operations last year under the overall responsibility of the Office Togolaise des Phosphates (OTP).

The cement manufacturing plant (CIMTOGO) produced 299,000 tonnes of cement in 1979 which was slightly less than the previous year although domestic and export demand in neighbouring countries is greater than supply. CIMTOGO is in the process of increasing capacity and hopes to produce 700,000 tonnes in 1981 and 850,000 tonnes by 1985. They estimate that this will be sufficient to satisfy both local demand and that from neighbouring countries.

A cement clinker plant (CIMAO) owned jointly by Togo, Ghana and the Ivory Coast began production early last year. Production volume in 1980 was 700,000 and is expected to increase to 1 million tonnes in 1981 and 1.2 million tonnes by 1982 which is maximum capacity. It is hoped to double the capacity to 2.4 million tonnes during the 1980's.

Other industries have had less success in recent years. A publicly owned steel mill with a capacity of 20,000 tonnes of steel rod was opened in January 1979 to support the local construction industry. The construction industry has expanded in recent years owing to a number of large new projects including a luxury hotel, a trade fair centre, a conference centre and a road improvement scheme from Lome to the Northern border with Upper Volta. However, with the road completed and supply of hotel accommodation exceeding demand, the requirement for local steel has declined. In addition the mill depends on expensive electricity and imported scrap iron. The mill has closed periodically and is operating very much below capacity.

The existing textile mill, ITT, has had major operating problems and a project for a new textile factory TOGOTEX, using some 3,000 tonnes of cotton has been unable to go ahead for financial reasons. As mentioned earlier, the development of cotton production in Togo relies on local industry being available to process the cotton.

The state-owned oil refinery, the Societe Togolaise des Hydrocarbures, with a capacity of 1 million tonnes opened in January 1978 and closed the following August. During this time it only achieved one-third of its capacity. The refinery reopened in April 1979 and its operations have been notably more successful. Production totalled 389,200 tonnes in 1980. About 80% of production is exported and the refinery is no longer obliged to sell to other unprofitable state enterprises. However, whilst production has continued normally, profitability has tended to be reduced by sharp fluctuations in prices. Other manufactures in this sector are glass, palm oil, sugar and milk.

G1.4 Commercial and Service Sectors

The tertiary sector makes the largest contribution to GDP and accounted for some 44% in 1980. The port at Lome handled 1 million tonnes of cargo in 1979 and this was estimated to have increased by about 50% for 1980. It is a modern port, which can handle container traffic and a $40 million expansion project is due for completion in 1981. With the completion of the major North-South roadway transit trade has increased, particularly with Niger, Mali and Upper Volta. A second international airport at Niamtougou is due for completion in 1981.

As mentioned earlier, one of the Government's aims is to develop tourism in Togo and two major luxury hotels have recently been completed at a cost of more than $150 million. Hotel bedrooms available tripled from 1,000 to 3,000 between 1976 and 1980 but occupancy is currently less than 50% and must increase considerably if the investments in this sector are to pay off.

Despite the economic problems in the public sector, the private sector has continued to expand in recent years. There are five major West African trading houses in Togo, viz SGGG, CFAO, SCOA, CICA, and UAC, and a wide variety of consumer and industrial goods are sold in this market.

G1.5 Economic Development

Togo achieved a real growth rate of 5% annually between 1972-78. This declined to 2% in 1979 and although it was expected to increase by about 6% in 1980, due to continued deterioration in terms of trade, real GDP fell by 2% last year. Table G1.1 shows Gross Domestic Product Figures for the years 1977-80.

TABLE G1.1 : GROSS DOMESTIC PRODUCT 1977-1980 : US$ MILLIONS

Item	1977	1978	1979	1980
GDP market prices	668	765	-	1,220
GDP (constant 1975 prices)	497	595	643	-
Per capita GDP (market prices)	285	319	-	476

Sources: "Foreign Economic Trends" - US Embassy
Government 5-Year Plan 1981-85

Togo's present economic problems arise from an intensive industrial investment programme undertaken in the late 1970's after the high, but relatively shortlived, increase in phosphate prices. Phosphate prices quadrupled in 1973/74 and in this period Togo embarked on most of its public sector investment. Although phosphate prices fell drastically in 1975 and remained at half their peak level until mid-1979, when they increased over a period by about 50%, the Government continued its expansionary policy. The US$ 1 billion of foreign debt contracted to provide an industrial base led to a debt service to export earnings ratio of 30%.

Faced with mounting foreign debt, budget and balance of payments deficits, the Government, with the IMF, embarked on a programme to correct the balances and control the economy. The IMF were first called in in 1971 and the most recent rescheduling of debts was early in 1981. The Government has continued its austerity programme and despite the adverse effects of deterioration in terms of trade, there is optimism that the recent policies agreed with the IMF will put the economy on a sounder footing in the medium term.

Table G1.2 gives foreign trade figures for 1977-79 and during this period phosphates accounted for between 40-50% of Togo's exports in value terms.

TABLE G1.2 : FOREIGN TRADE 1977-80 : US$ MILLION

Item	1977	1978	1979
Imports	258	437	447
Exports	195	258	285
Balance	-63	-179	-162

Source: "Foreign Economic Trends" US Embassy

The Five Year Plan, 1981-1985, aims at a growth rate of 6.5% annually, which was the average rate of growth for the fifteen years 1966-1980. Bearing in mind the present economic situation, this would appear optimistic. The overall emphasis in the Plan is on achieving self-sufficiency in food production.

On industrial development the Government plan to spend CFA 73-90 billion (US$360-480 million). The largest and most important project, which has World Bank support, is for a phosphoric acid plant at a cost of CFA 50 billion (US$246 million). It will be some three years before construction will start on this project. There are also plans to build a hydro-electric dam at Nangbeto on the Mono river, comprising 2 x 30 MW stations, further electrification of the six major towns and a high tension line connecting Lome, Otakpame and Notse Kpalime. Housing construction is normally carried out by the private sector, but the Government also intend to build some 1,000 houses during the 1981-85 period.

G2. LOCAL COPPER PROCESSING INDUSTRY

There is presently no significant copper processing industry in Togo. The only activity in this sector are the small workshops manufacturing items for the tourist trade, e.g. brass figures, etc. It is impossible to quantify consumption by this segment, but as the raw material is locally produced scrap, it plays little role in the copper processing industry in the strictest sense.

The economic problems facing Togo in the medium term would make the establishment of any copper processing industries very unlikely and even though the economy may be ready for further industrial development in 4-5 years time, it is still unlikely that any significant copper processing would be undertaken as a priority.

There are tentative proposals to establish a factory in Lome for production of insulated wire and flex of the type used for internal wiring and domestic purposes. These proposals are still only tentative and it is impossible therefore to establish the capacity or the likelihood of the project going ahead.

G3. IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS

Table G3.1 shows imports of copper products, 1977-1980, and Table G3.2 shows exports for the same period.

TABLE G3.1 : IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS 1977-80 : TONNES

Item	1977	1978	1979	1980*
Bars, Sections	6	7	7	4
Tubing	16	8	16	16
Electricity Cable	4	54	18	7
Other Copper Cable	2	2	11	10
TOTAL	43	86	60	42

Source: Foreign Trade Statistics
* Estimates based on first three months.

TABLE G3.2 : EXPORTS OF COPPER AND COPPER ALLOY PRODUCTS 1977-80 : TONNES

Item	1977	1978	1979	1980*
Raw and Scrap Copper	68	-	-	
Other Vessels in Copper	-	18	15	-
Other Work in Copper	-	40	53	58
TOTAL	68	58	68	58

Source: Foreign Trade Statistics
* Estimates based on first three months

Whilst a comparison of Tables G3.1 and G3.2 would, at first sight, suggest that Togo is a net importer of copper, it is important to remember that the major portion of scrap in the country originates from old wire and cable products. Furthermore, we believe that data in Table G3.2 should be treated with caution.

Table G3.3 shows imports of insulated copper cable for the years 1977-1980. As can be seen from this table, the tonnage imported tripled between 1978 and 1979. As has been noted earlier, however, this was a period during which some major construction projects were nearing completion such as the two major international hotels, the trade centre and the CIMAO cement factory. The estimated import volume of 430 tonnes of copper cable for 1980 should be treated with reserve as it is based on only three months' deliveries.

TABLE G3.3 : IMPORTS OF INSULATED COPPER CABLE 1977-1980 : TONNES

Item	1977	1978	1979	1980+
Insulated Copper Cable Etc.	366	172	569	430
Other Insulated Cable*	334	536	1,710	56

Source: Foreign Trade Statistics

* This includes both copper and some, but not all, aluminium cable.

+ Estimates based on first three months.

G4. DEMAND FOR WIRE AND CABLE PRODUCTS

G4.1 Electricity Supply and Distribution

There are presently about 28,000 subscribers to the electrical grid in Togo and the distribution company, CEET, expects this to expand by 2,500-3,000 new subscribers annually over the next 10 years. Production of electricity during 1976-80 is given in Table G4.1 and sales, split by high and low tension for the same period, are given in Table G4.2.

TABLE G4.1 : ELECTRICITY PRODUCTION - 1976-1980 : MILLIONS KwH

Year	Electricity Produced
1976	93
1977	117
1978	142
1979	161
1980*	185

Source: BCAO

* Estimated based on nine months' production

NOTE: The majority of electricity is supplied from Ghana.

TABLE G4.2 : ELECTRICITY SALES 1976-1980 : KwH MILLIONS

Sales	1976	1977	1978	1979	1980*
Low Tension	n/a	46	56	69	79
High Tension	n/a	46	54	61	80
TOTAL	79	92	110	129	159

Electricity sales have doubled since 1976 and reasonably priced electric power is urgently needed to allow further industrial development.

About 60% of Togo's electricity is supplied from the Akosombo Dam in Ghana. A separate company, CEB, is responsible for electricity supply from Ghana to both Togo and Benin. Before this system was established, CEET ran their own power stations and are still responsible for some in the interior. The 50 MW supplied from Ghana is only for Togo's maritime region; maximum capacity in the interior is 4 MW. The requirement for Lome is 32 MW and is expected to increase to 65 MW by 1985. There are 16 electrified towns in Togo, four of which are inter-connected and they have plans to electrify a further two. All electricity produced locally in Togo is from (fuel oil or diesel) operated thermal plant.

The high cost of refined oil has caused problems for the country's major thermal plant. The first phase of this was completed in 1979 with 2 x 27.5 MW gas turbines, but the plant has been unable to obtain and pay for a steady supply of fuel. The second phase comprising 4 x 10 MW diesel generators is being built at the port. The final third phase will be a vapour turbine producing 15-20 MW annually. Reports earlier this year said that no further progress had been made on this project and the position of CEET is that the first phase and second phase, when completed, are being held in reserve until the time when Ghana stops supplying electricity. With the high cost of fuel the first phase plant of 55 MW already completed would only be able to supply power at six times the cost of the electricity coming from Ghana.

The Government has secured financing for a joint hydro-electric scheme with the Republic of Benin. The Dam will be located at Nangbeto on the Mono River near the border with Benin. In the Five Year Plan, 1981-85, estimated expenditure on this project is CFA 18-22,000 million (US$ 85-103 million) and will comprise 2 x 30 MW stations with a total generating capacity of 130 million KwH. There will also be the possibility of adding a third station of 30 MW. Once construction begins it will take some four years to complete.

Other electrification projects listed in the Five Year Plan are CFA 1,000 million (US$4.7 million) electrifying six chief towns; CFA 100 million (US$ 0.5 million) on reinforcement and extension of the electricity network in Lome; CFA 1,500-2,000 million (US$ 7-12 million) to be spent on a high tension line connecting Lome, Atakpame and Notse Kpalime.

Demand for copper products is very limited in this sector because the cable used by both CEB for transport and CEET for distribution is aluminium or an aluminium alloy.

There is a limited usage of copper wire for low voltage meter connections and copper for trolley wires, but CEET were unable to give us estimates of quantities of wire used.

G4.2 Telecommunications

There are now about 8,000 telephone subscribers in Togo and the Direction du Poste et Telecommunications expects this number to increase by at least 15% annually over the next 4-5 years. Nine towns have automatic exchanges and transmission between them is by microwave.

In the current Five Year Plan the Government intends spending CFA 1,500 million (US$7 million) on establishing mini microwave systems between the chief towns to improve reception quality.

About 65% of subscribers are in Lome and installation of a new central telephone system has recently been completed there with 7,000 lines and capable of extension to 20,000 lines.

In towns both underground and aerial cable is used but the majority is underground. Cable suzes are from 3 to 1,200 pair. In rural areas 3 mm bare copper wire is used between villages.

Over the next 4-5 years it is estimated that P&T will be purchasing 10 tonnes of bare copper wire annually.

P&T will also be spending a minimum of CFA 150-200 million (US$0.7-0.9 million) annually on underground cable for urban areas over the same period.

During 1981 P&T will be purchasing 40 kilometres of cable sized 124-1,200 pair for Lome alone. The majority will be to improve existing lines but some will be for increasing traffic.

Interviews with a local telephone installation company indicated that the work on the telephone network now being carried out in Lome by P&T will be completed within two years, after which activity in this sector will drop considerably and will consist of repair work only. Assuming that the number of subscribers in Lome is presently just over 5,000, an increase of 15% over two years will almost reach the maximum capacity of 7,000 lines on the recently installed central telephone system.

If the 15% rate of increase were to be maintained for the next 5 years, this would double the present number of subscribers to 16,000. Based on an average of five pair kilometres of cable from the central exchange to individual subscribers, the requirement of cable over this 5-year period would be 40,000 kilometres.

G4.3 Other Uses of Bare and Insulated Wire

Construction

The construction boom of the late 1970's has now finished. Activity in the construction sector was particularly high in 1979 when imports of insulated copper wire and cable were triple those of the previous year. The general view of local construction companies and electrical installers is that construction activity has reduced to the levels of 1977/78. They do not foresee any major projects and believe that the market will remain fairly stable over the next few years. The Government does not have the resources to finance any significant number of large projects. Two important projects in the Five Year Plan are a US$ 400 million phosphoric acid plant which will have World Bank financing and the US$ 114 million hydroelectric dam at Nanbeto which has international financing. Neither of these projects have yet started and initial studies for the phosphate plant will probably take some 18 months to complete. Also in the Plan the Government have stated their intention of building two further hotels, one of which will be 2-star with 60 bedrooms costing CFA 400 million (US$ 1.9 million). However, as mentioned earlier, there is surplus capacity at the moment and the progress of these projects will depend on the development of the tourist industry. In the education field it is probable that two or three schools and two or three teacher training colleges will be built during the next 4-5 years.

Housing construction in Togo has traditionally been undertaken by the private sector. At the moment there are three projects underway in Lome involving construction of some 350-400 houses in total. These, however, are exceptional and a general average is 200 houses built annually by the private sector. In the Five Year Plan the Government intend to invest CFA 4,000 million (US$19 million) in building a total of 1,000 houses at an average of 200 per year. They also intend to spend CFA 2,500 million (US$12 million) equipping 2,000 lots in Lome and principal towns with the basic services, i.e. water, electricity and sanitation, with the intention that they will eventually be suitable for habitation. Again, the progress of these projects will depend on the Government's ability to obtain finance and the resolution of the country's present economic problems. It is unlikely that apart from the phosphoric acid plant and the hydroelectric dam, there will be any significant industrial/commercial or domestic building over the next five years.

Winding Wire

Unfortunately, it was not possible to get detailed information on the market for winding wire in Togo but the volumes are likely to be small. The major distributor for winding wire is UAC and there are a number of small companies involved in rewinding motors. The biggest users are the phosphate mining company OPT and the railway company, CFT, both of whom do their own rewinding. UAC estimate that they sell one tonne of this wire annually and from import figures given in Table G4.3, the share taken by rewinding wire is likely to be three tonnes annually.

Other Industries

At the moment there is no manufacture or assembly of the type of products, e.g. cars, domestic appliances, etc., which would provide a market for copper wire and cable. Such products are all imported complete and there are no plans to set up any assembly operations.

G5. DEMAND FOR BRASS MILL PRODUCTS

Apart from electric wire and cable, the single largest copper item imported into Togo is copper tubing, but this is still a relatively small market with imports for the three years 1977-79 totalling only 40 tonnes. The main materials for both industrial and domestic plumbing are galvanised steel and PVC, whilst copper tubing is used mostly for making connections. The other market for copper tubing is for repair of air-conditioning and refrigeration equipment. The most important sizes of tubing are 8/10 mm - 16/18 mm (internal/external diameters). Copper tubing is imported primarily via local distributors the most important of which are SGGG, CFAO, UAC and Brossette and 90-100% of tubing is supplied from France.

At the moment there is no manufacture or assembly of products which would use copper tubing, e.g. air-conditioning units, refrigerators, freezers and there are no plans to establish them. In the medium term the market would appear to remain one of installation and repair of this type of equipment and will not pick up noticeably until the volume of new construction increases.

G6. FUTURE DEVELOPMENTS AND OPPORTUNITIES FOR THE NIGERIAN COMPANY

Table G6.1 gives estimates of copper requirements for 1985 and 1990 based on 1980 imports and total some 360 tonnes and 415 tonnes respectively. The important sectors are telephone and electricity cables. We have taken 1977 as the basis for estimating demand for insulated wire and cable as this will be stronly influenced by the volume of activity in the construction sector which has now reduced to 1977 levels. The requirement for telephone cable reflects the intended investment in underground cables in urban areas.

TABLE G6.1 : ESTIMATES OF MARKET FOR COPPER AND COPPER ALLOY SEMI-FABRICATED PRODUCTS - TONNES*

Item	1980	1985	1990
Bars, Sections	4	4	5
Tubing	16	16	18
Winding Wire	3	3	5
Other Copper Cable	7	11	13
Non-Insulated Wire & Cable	7	11	13
Insulated Wire & Cable	150	165	165
Telephone Cable	40	50	70

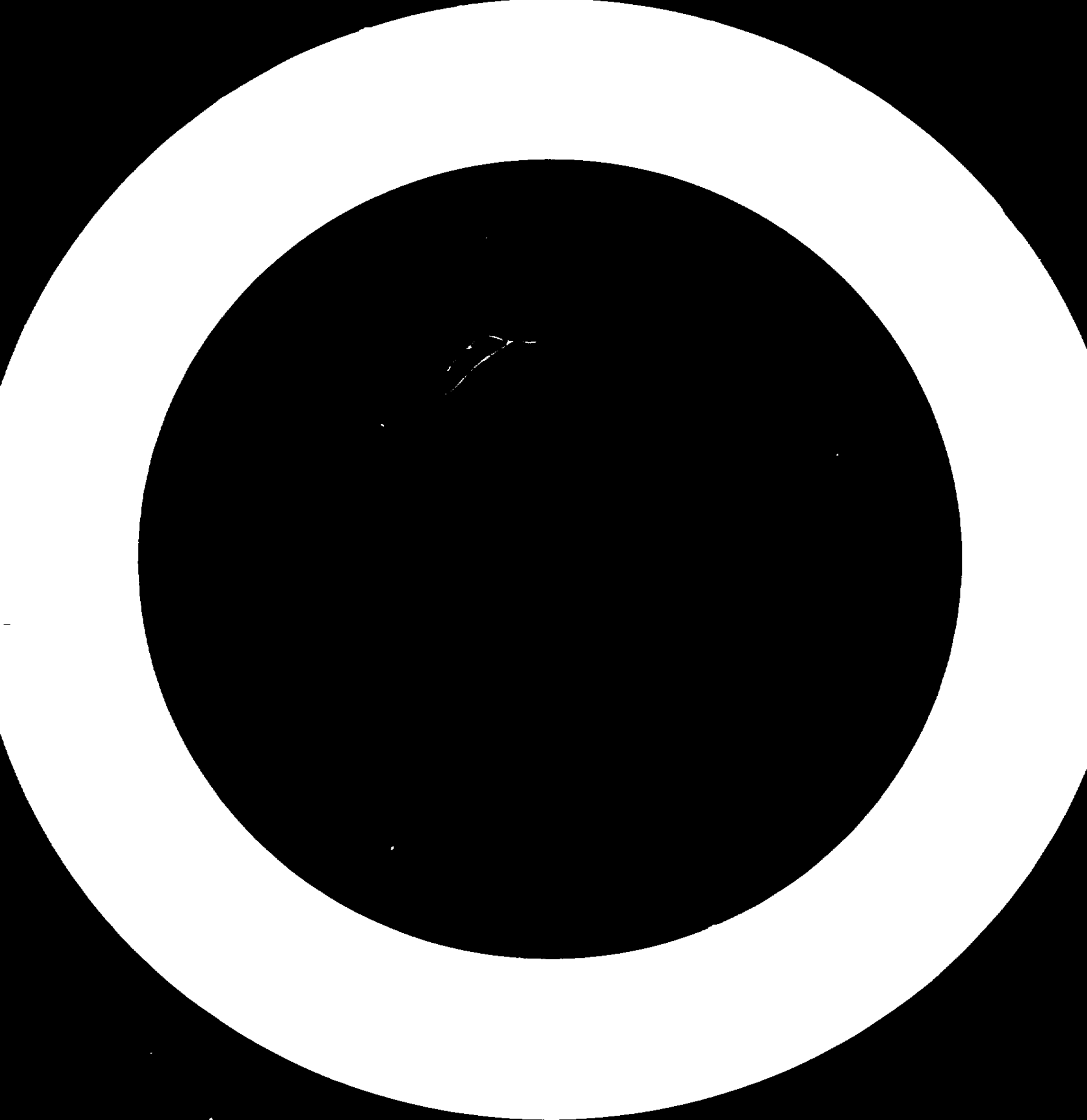
* Copper Content

In view of Togo's present economic problems, it is not envisaged that there will be any significant increase in construction to 1985 but some expansion to 1990 has been allowed for on the assumption that the country will have resolved its problems.

The Nigerian company will have to overcome the dominance of French suppliers to this market. The larger companies installing electric cable buy the majority of their cable direct and the work to extend the telephone network in Lome during the next few years will be undertaken as a joint-venture with a French company. The source of supply of materials for large construction projects will depend on the type of financing. In addition, the specifications for both electricity and telephone cable are European rather than British.

Problems of converting currency or instability of the Naira may pose an obstacle as local importers prefer to trade within the Franc zone.

H. UPPER VOLTA



H. UPPER VOLTA

H1. ECONOMIC AND DEMOGRAPHIC OVERVIEW

H1.1 Introduction

Upper Volta has a surface area of 274,200 square kilometres and is a landlocked country, bordered by Mali to the North-West, Niger to the North-East and the Republics of Benin, Togc and Ghana to the South.

The population is estimated (1979) to be 6.5 million and is increasing at a rate of 2.06% annually. It is predominantly rural (95%) in character, with the two major towns being the capital, Ouagadagou, and Bobo-Dioulasso, an important commercial centre. Ouagadagou has 200,000 inhabitants and Bobo-Dioulasso has 60,000. The other main towns in Upper Volta are Koudougou, Ouahigouya and Banfora. The overall density of population in the country is 23 inhabitants per kilometre.

H1.2 Agricultural Sector

With a per capita income of $149 in 1979, Upper Volta ranks as one of the poorest countries in the World and some 80% of the people are engaged in traditional subsistence farming.

The Northern part of the country forms part of the Sahelian zone and, as such, has suffered drastically from a series of droughts in recent years. Agriculture contributes approximately 34% (1977) of the country's gross domestic product and livestock production, which is also it's most important export item, contributes 6%.

Upper Volta suffered a particularly severe 7-year drought between 1967-74, since when agricultural production has been irregular, but above drought-year levels. Table H1.1 shows sales of major cash crops between 1975 and 1980.

TABLE H1.1 : SALES OF MAJOR CASH CROPS : TONNES, 1975-1980

Item	1975/76	1976/77	1977/78	1978/79	1979/80
Ground Nuts	13,100	4,733	1,781	998	1,165
Cotton Seed	50,695	55,253	38,043	59,957	77,520
Cotton Fibre	18,168	20,242	13,902	20,099	28,715
Karite	48,500	32,400	56,653	6,989	40,061
Sesame	1,764	3,192	1,699	4,043	4,236

Source: Banque Centrale des Etats de l'Afrique de l'Ouest.

A report published by the Ministry of Commerce, Industrial Development and Mines in 1979, noted that livestock production had not yet recovered from the effects of the drought. This sector has diminished in importance as a result of the droughts and now contributes some 6% to gross domestic product. Upper Volta is traditionally a major supplier of livestock to the Ivory Coast and Ghana.

Recent reports for the Sahal Region overall indicate that further droughts have even set-back the recovery of livestock production as they were just beginning to regain 1972 levels which is when they were decimated by the previous severe drought.

H1.3 Industrial Sector

Local difficulties have limited the rate of expansion of the manufacturing sector in Upper Volta although this now accounts for some 13% of gross domestic product. In particular, the problems are the distance from a sea port (minimum distance is 435 miles from Ougadougou), and consequent high costs of transport, the absence of hydro-electric power, weak domestic demand because of low per capita income, communications difficulties, lack of trained personnel and lack of local capital. The few factories are in Bobo-Dioulasso, Ougadougou, Banfora and Koudougou, all of which are sited on the country's single railway line running from Ougadougou to Abidjan in the Ivory Coast. Of the total 1,145 kilometres of railway line, 517 kilometres are in Upper Volta and in addition there are approximately 850 kilometres of paved roads.

The major emphasis of local manufacturing industry is in processing agricultural commodities. The larger local companies include the SOSUHV sugar complex near Banfora with a capacity of 300,000 tonnes, the VOLTEX textile mill at Koudougou, the SOVOPLAS plastics factory in Ougadougou, and the CITEC sheanut/cotton seed processing plant in Bobo-Dioulasso. Other local manufactures are leather goods, bicycles, car batteries, tyres, shoes, soft drinks, oil and soap, simple kitchen utensils and breweries.

Upper Volta also has a number of natural mineral resources although the commercial viability of extracting some of them has still to be determined. The Poura gold mine, which was worked until 1966, contained an estimated 27.6 tons of gold, and the Tambao manganese deposits contain some 14 million tonnes of high grade manganese ore. Recent surveys also show that Upper Volta has a further two deposits of gold, diamonds, uranium and vanadium. Additionally, there are deposits of 30 million tonnes of phosphate in the region of Tansarga Kodjari and 60 million tonnes of limestone at Tin Hrassan.

H1.4 Economic Development

Table H1.2 shows Gross Domestic Product for the years 1975-1980 and it is estimated that GDP increased in real terms in 1978 and 1979 by 3.1% and 3.5% respectively.

TABLE H1.2 : GROSS DOMESTIC PRODUCT 1975-80 : US$ MILLIONS

Year	GDP		
	Current Prices	1970 Prices	Per Capita Current Prices
1975	555	551	94
1976	578	377	92
1977	686	357	108
1978	827	399	130
1979	980*	n.a.	151*
1980	1,170	n.a.	176*

* Estimates
Source: "Foreign Economic Trends", US Embassy, Metra Interviews

On November 25th 1980, there was a military coup in Upper Volta and President Lamizana was replaced by Colonel Zerbo as Head of State. The consitution was suspended and the National Assembly dissolved with the Government of the country being taken over by a Military Committee for National Recovery and Progress. As yet there are no precise details of the new Government's economic plans, although in an Independence Day speech in December 1980, Colonel Zerbo said that, in terms of economic development, priority would be given to self-sufficiency in food production rather than cash crops and research into mining would be intensified. The Five Year Plan, 1977-81, of the previous administration also had as its priority self-sufficiency in food production and use of local agricultural produce.

The immediate cause of the coup was a long-standing dispute with school teachers which finally led to general strikes in November. However, it was also felt that the Government was unable to resolve the problems faced by the country. Inflation had been particularly severe in Upper Volta during the previous 18 months as a result of the general trend in the world economy and the country was seen as being further than ever from achieving a reasonable degree of economic self-sufficiency. The foreign trade gap has widened progressively, as can be seen from the trade statistics shown in Table H1.3.

TABLE H1.3 : FOREIGN TRADE 1975-1979 : US$ MILLIONS

Year	Imports	Exports	Balance
1975	135	39	96
1976	144	53	91
1977	209	55	154
1978	226	43	183
1979	300	76	224

The International Monetary Fund estimated that the rate of inflation increased from 10% in 1975/76 to 25% in 1977, declining to 8% in 1978. According to the consumer price index, the cost of living rose 13% for low income families in 1979 and probably averaged 20-25% for middle income families. Government figures put inflation at 12% for 1980. Part of the reason for this is increases in import prices and as can be seen from Table H1.4, one of the major import items, accounting for some 15% of imports in value terms in 1979, is petroleum.

TABLE H1.4 : MAJOR IMPORTS 1975-1978 : US$ MILLION

Item	1975		1976		1977		1978	
	$M	%	$M	%	$M	%	$M	%
Milk Products	3.0	2.2	8.2	5.7	10.2	4.9	15.5	6.9
Cereals	6.6	4.9	7.1	4.9	13.3	6.4	18.0	8.0
Petroleum Products	12.0	8.9	11.3	7.8	17.7	8.5	19.3	8.4
Mechanical Machinery	13.0	9.6	15.5	10.8	28.1	13.4	24.5	10.8
Road Transport Eqmt.	17.3	12.8	16.4	11.4	28.0	13.4	29.0	12.8
TOTAL	51.9	38.4	58.5	40.6	97.3	46.6	106.3	46.9

Source: BCEAO

H2. LOCAL COPPER PRODUCING INDUSTRY

There is no significant local industry for processing of copper at the moment in Upper Volta and bearing in mind its present stage of industrial development, it is unlikely that such an industry would be developed to any degree during the period covered by this study.

There is a market for figurines for the tourist trade but, as we found in Nigeria, the basic raw material used here is from locally available or imported scrap copper and brass.

H3. IMPORTS OF COPPER AND COPPER ALLOY PRODUCTS

Upper Volta is presently importing only a small volume of copper and copper alloy products. In view of the types of industry established in the country and the likely future development, the major potential markets to be considered for Nigeria are electric cable, telephone cable, internal wiring and copper tubing for domestic and industrial plumbing. These sectors are dealt with in detail in Section 4 of this report.

Table H3.1 shows imports of copper and copper products 1977-80, which average under 40 tonnes annually apart from 1979.

TABLE H3.1 : IMPORTS OF COPPER AND COPPER PRODUCTS 1977-1980 : TONNES

Item	1977	1978	1979	1980*
Bars, Sections, Wire	4	23	49	8
Tubes & Tubing	4	4	3	3
Electric cable, non-insulated	15	4	6	13
Other	16	7	12	12
TOTAL	39	38	70	36

* Estimated based on import figures, January-June 1980

Source: Foreign Trade Statistics

France was virtually the only supplier of these products for the period 1977-80. With the exception of copper bars and profiles imported in 1978 and 1979, France accounted for 95-100% of these imports. Bearing in mind the historical and economic ties between the two countries, it is unlikely that this dominance will change to any great extent, certainly over the next few years.

Exports of copper during this period were negligible; 6 tonnes of scrap copper were exported in 1978 and 7 tonnes in 1979.

The demand for copper tubing for plumbing purposes and for uninsulated electric cable, some of which will be used for earthing circuits, will depend to an important degree on the progress of the construction sector. This is discussed in more detail later, but in general we would expect to see only a modest increase in construction over the next few years.

Table H3.2 shows imports of winding wire and insulated electric wire and cable for the period 1977-1980. Again, the total volume imported annually is relatively modest and the major supplier is France. In 1980, 55% of insulated cable less than 19mm2 was supplied from France but from 1977-79 this varied between 75% and 100%. The final item listed in Table H3.2 "other insulated electric cable" includes both copper and aluminium cables, and whilst it was impossible to determine the precise volume of each, we would estimate from out discussions in other countries in this region that some 50% is copper cable. Again, between 75% and 90% of this cable was imported from France during the period.

TABLE H3.2 : IMPORTS OF WINDING WIRE AND INSULATED ELECTRIC WIRE AND CABLE 1977-1980 : TONNES

Item	1977	1978	1979	1980*
Winding wire	4	2	2	2
Electric wire and cable -cars and motorcycles	6	4	6	6
Insulated electric cable in copper - minimum 19mm2	34	11	51	25
Other insulated electric cable **	122	156	148	654

* This includes both copper and aluminium cables not specified as such in trade statistics

** Estimates based on import figures, January-June 1980

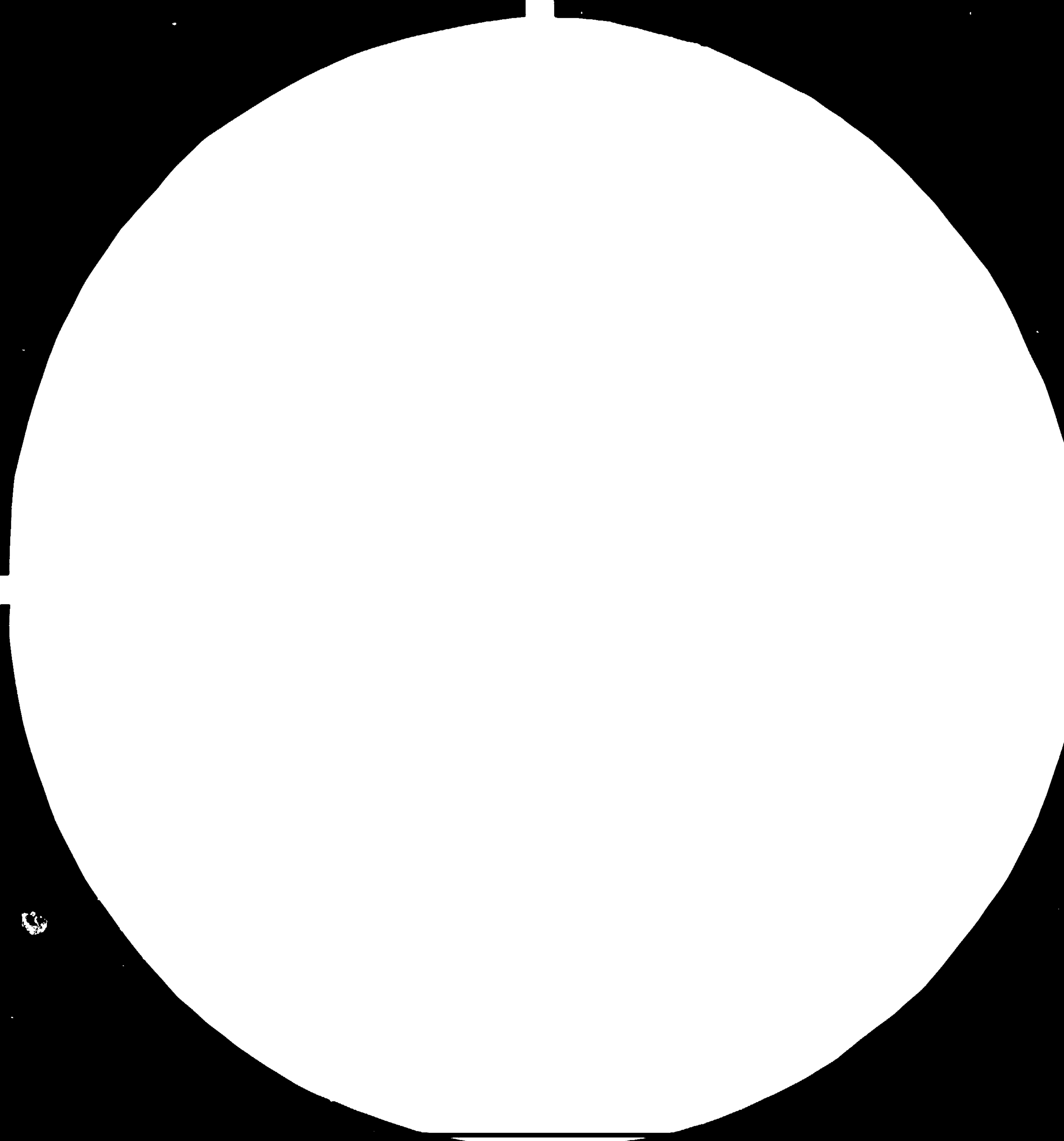
Source: Foreign Trade Statistics

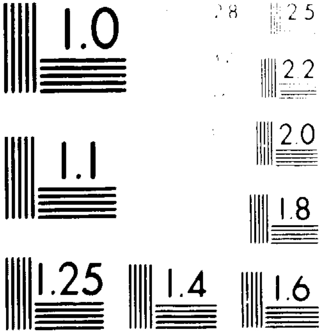
The figure of 654 tonnes of "other" cable imported during 1980 should be treated with caution as it is based on six months' delivery and the timing of deliveries tends to change from year to year depending on particular projects, but, even assuming no further deliveries in the second half of the year, the volume is double that of previous years.

A particular problem for Nigerian companies planning to supply this market, is that specifications of electric power cabled used in Upper Volta is generally French and so differs from that used in Nigeria.

Purchase of electric cable tends to be made direct by the company carrying out the installation and the major French cable companies supplying this market are Trefimetaux/Pirelli, Cables du Lyon and CEAT. VOLTELEC, the electricity supply company, now use aluminium cable for distribution and usually ask for tenders and base purchasing decision on price. Although local installers have clearly established trading relationships with French suppliers, the only major obstacle to buying from Nigeria is the question of specifications. One of the two major distributors also felt that problems of converting Naira and CFA may also pose a major obstacle.

Because of the fact that VOLTELEC mainly use aluminium cable for distribution, the future demand for copper electricity wire and cable will depend to a large extent on the progress of the construction sector and particularly industrial projects planned over the next few years.





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H4. DEMAND FOR WIRE AND CABLE PRODUCTS

H4.1 Electricity Supply and Distribution

Installed electricity generation capacity in 1980 was 38 MW compared to 21.5 MW in 1977. The number of subscribers increased during this period by just over 50% to the present 18,229.

The five principal towns in Upper Volta have all been electrified. By far the most important in terms of numbers of subscribers and production capacity are Ougadougou and Bobo Dioulasso. In 1979 54% of subscribers were in Lome and 33% in Bobo Dioulasso and in 1980 83% of total production capacity was located in these two towns.

Table H4.1 shows the increase in subscribers in each of the five main downs during 1976-1979 and Table H4.2 gives the installed capacity (1980) in each town.

TABLE H4.1 : TOTAL SUBSCRIBERS TO NATIONAL GRID 1976-1979

Town	1976	1977	1978	1979
Ougadougou	6,593	7,310	8,743	9,910
Bobo Dioulasso	3,647	4,300	5,126	6,012
Ouahigonya	376	452	569	706
Koudougou	-	-	676	855
Banfora	-	-	578	746
TOTAL	10,616	12,062	15,692	18,229

Over 98% of subscribers during this period have been connected to low tension lines.

TABLE H4.2 : INSTALLED CAPACITY : 1980

Town	MW	Percent
Ougadougou	21.7	57
Bobo Dioulasso	9.9	26
Banfora	0.8	2
Koudougou	5.2	14
Ouahigouya	0.4	1
TOTAL	38.0	100

Sales of electricity in 1979 were 99 million KwH compared with 94 million KwH in 1978 and the total network length was 646 kilometres in 1979, an increase of 44 kilometres on the previous year.

All production of electricity at the present time is from thermal stations. Work has already started on two further units in Ougadougou each having 7.5 MW capacity and completion is expected in 1982.

A hydro-electric dam is planned with two turbines both of 7 MW capacity to supply Ougadougou and Koudougou. The financing for this project still has to be found and once work starts it should take some six years to complete. Power will be supplied by overhead cable over a total distance of about 500 kilometres from the dam to the two towns. The five towns are not linked,although there will be a line from Bobo Dioulasso to Banfora by 1985.

The market in this sector is very limited because all cable used in Upper Volta is now aluminium or aluminium alloy. High tension cable is 15 KV overhead. Voltelec are starting to install underground cable in Ougadougou but this will only total some 15 kilometres. The old copper low tension lines are now being replaced by "corded" aluminium cable. The requirement of this type of cable for the whole country is some 20-30 kilometres annually.

Voltelec purchase electricity cable direct from France from companies such as CEAT or Cable du Lyon, but also buy occasionally from a local general importer, Brossette. The company asks suppliers for prices and takes the best offer.

H4.2 Telecommunications

There are now about 6,000 telephone subscribers in Upper Volta and the Ministry of Information, Post and Telecommunications plan to expand the service to 10,000 by 1985 and 15,000 by 1990.

Six towns have automatic exchanges and there are fairly firm plans to install them in a further six towns during the next few years, followed by a further eight towns as and when financing becomes available.

About 89% of subscribers are in Ougadougou (3,850 - 64%) and Bobo Dioulasso (1,500 - 25%); capacity in the other exchanges is 200.

The previous Government's five year plan, 1977-81, envisaged an extension of the central echanges at Ougadougou and Bobo Dioulasso, the former increasing from 5,000 to 10,000 lines and the latter from 2,000 to 2,500. It was also intended to increase capacity at Banfora and Ouahigouya from 200 to 600 lines and at Koudougou from 200 to 800. As yet none of these projects have been carried out.

The Ministry is in fact currently preparing a request for international tenders to expand the telephone network and because of this it proved very difficult to obtain information on their future plans and requirements.

Between the main towns transmission is by micro-wave system. Underground cable is used only in the two larger towns from the central exchange to areas in the city. They are planning to install three sub-exchanges in Ougadougou and one in Bobo Dioulasso using numerical transmission (PCM) which will reduce the requirement for transmission cable.

1,088 kilometres of new overhead cable was required for rural areas in 1980 and the estimate for 1981 is 910 kilometres. This includes transmission cable between towns. Cable requirements beyond 1981 have still to be estimated. The average length of cable from exchange to subscriber is two kilometres which indicates a network of some 12 kilometres now increasing to 20,000 kilometres by 1985.

The sizes of telephone cable used in Upper Volta are 14-224 pair. For large quantities of cable the Ministry goes to international tender. Their policy is that they are open as to country of supply providing quality is good and price competitive. They purchase from France, e.g. Cable du Lyon, but have also bought cable from Germany and recently received tenders from Poland.

In April this year the IDA were considering a $15 million credit to the Government for a "Telecom III" project with the objective of upgrading the country's telephone and telex facilities and increasing penetration into rural areas.

It should be noted that the specification of telephone cable used in Upper Volta is that of France and the majority of European countries, and is based on a unit of 7 viz 14, 28, 56, 112, 224. This will limit the ability of Nigerian manufacturers supplying this market unless they can meet these specifications.

H4.3 Other Uses of Bare and Insulated Wire

The major determinant of demand for internal wire and cable is the level of construction activity in the country. In Upper Volta it proved very difficult to make reliable estimates of future activity partly because this will depend on the new Government's plans and partly because of inadequate data.

Building permits issued in Ougadougou suggest some 300 units a year being built, the vast majority of which are housing units. However, there is often a gap of several years between obtaining a permit and completing the building.

An indicator of construction activity is the volume of cement being imported as 75% of consumption of cement is in the buildings sector. Recent studies have estimated that cement imports will increase at a rate of just over 10% on average for the next five years.

Two hotels are presently being built in Ougadougou both with over 100 rooms and a third is due to start construction. Apart from these, a few smaller room hotels are built each year. Housing is in the private sector and one local company had estimated that only about 150 were being built annually of which only 50 would have plumbing and electricity. It is impossible to make realistic assessments of industrial and commercial construction over the next few years. Our interviews suggest that the construction sector in the short/medium period will remain fairly stable or at best increase by some 5% annually. It must be borne in mind that construction in developing countries fluctuates dramatically, being significantly affected by two or three large projects.

Major installers of electric cable are Sogetel and SAEL and main distributors are Brossette and Peyrissac. Both Sogetel and SAEL buy directly from suppliers in France. Among both groups potential problems were raised as regards trading with Nigeria. Firstly there is the problem of non-compatibility between European EDF, UTE specifications and British Standard specifications. Secondly they foresee problems in currency conversion between the Naira and the CFA Franc.

H4.4 Winding Wire

Official import figures (Table H4.3) show that only a very small amount of winding wire is imported, viz 8 tonnes in the three years 1977-79. Demand will depend on the increase in electrification and industrialisation but is not likely to reach any significant volume over the next few years. Demand for winding wire would be particularly affected, for example, by development of the mining industry.

H4.5 Other Industries

As yet there are no other manufacture or assembly operations of products which would be major users of copper wire and cable and the the emphasis on the agricultural sector, such operations are unlikely to be set up in the near future.

H5. BRASS MILL PRODUCTS

Imports of copper tubing for the period 1977-80 average less than 4 tonnes annually. Copper tubing is not used to any large extent for plumbing purposes as the main materials are galvanised steel or PVC. Copper is used for connections.

Copper tubing is also used for installing and repairing air-conditioning units which is a fairly limited market at the moment, only being installed in offices and the more expensive houses. It is also used to some extent in hospitals and breweries on soft drink production plant involving gases and liquids.

The largest local installation company in this sector is Tunzini and the most important distributors are Brossette and Peyrissac. All are located in Ougadougou. Demand for copper tubing will depend on increased production, extension of electricity and demand for air-conditioning units.

Sizes of tubing for plumbing purposes are 8/10mm, 10/12mm, 12/14mm and 14/16mm (ID/OD). Sizes of tube for air-conditioning use are ⅜", ⅝' ⅞" and 1" although up tp 2" is also used.

Imports of bars and sections averaged 21 tonnes annually 1977-80 with high deliveries in 1979 (49 tonnes). A large proportion of this will be used in electricity sub-stations and industrial plant using large generators and switch gear.

H6. FUTURE DEVELOPMENTS AND OPPORTUNITIES FOR THE NIGERIAN COMPANY

Table H6.1 shows estimates of present and future demand for the main categories of copper and copper alloy semis to 1990, based on 1980 imports.

TABLE H6.1 : ESTIMATE OF MARKET FOR COPPER AND COPPER ALLOY SEMI-FABRICATED PRODUCTS : TONNES**

Item	1980	1985	1990
Bars, Sections, etc.	8	25	33
Tubing	3	6	9
Winding Wire	2	4	6
Non-Insulated Wire & Cable	13	17	21
Insulated Wire and Cable	120	150	190
Telephone Cable	350	705	705

** Copper Content

The estimate of future demand for bar and sections etc., is based on average imports over the past four years. Clearly the two largest items are insulated wire and cable and telephone cable. The estimates of wire and cable allow for the fact that up to 50% of "other" cable imported may be using copper rather than aluminium conductor (see note to Table H3.2). The estimates for telephone cable assume that the planned expansion to 15,000 subscribers by 1990 takes place.

The main problems faced by the Nigerian company in Upper Volta are firstly the dominance of French suppliers and the fact that European specifications are used both for wire and cable and for telephone cable. Possible problems of convertibility of currency between the Naira and the CFA Franc were also noted by local distributors and may be an obstacle to them considering Nigerian suppliers.

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EXPORT COUNTRIES

✓ A. Zambia

✓ B. Benin

✓ C. Cameroon

✓ D. Gabon

/ E. Ghana

/ F. Ivory Coast

✓ G. Togo

✓ H. Upper Volta

12495
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United Nations Industrial Development Organisation

FEASIBILITY STUDY IN NIGERIA AND ZAMBIA ON THE ESTABLISHMENT OF A COPPER FABRICATION PLANT IN NIGERIA

VOLUME 3 : FEASIBILITY STUDY

Final Report

Prepared by Metra Consulting Group under Contract 80/154 (Project Number: DP/RAF/79/006)

METRA CONSULTING GROUP LIMITED

St. Mary's House
42 Vicarage Crescent
London SW11 3LB

TELEPHONE: 01-223-7634
TELEX: 919173 MCGLDN G

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MJE:AC:PRG:id
August 1981

ABBREVIATIONS

The following abbreviations have been used throughout this report.

LME	London Metal Exchange
Comex	Commodity Exchange (New York)
SKD	Semi-knocked down
CKD	Completely knocked down
NEPA	Nigerian Electric Power Authority
NNPC	Nigerian National Petroleum Company
RE	Rural Electrification
FMI	Federal Ministry of Industries
FMNP	Federal Ministry of National Planning
KV	Kilo Volts
GNP	Gross National Product
GDP	Gross Domestic Product
MW	Megawatt
KwH	Kilowatt Hour
GwH	Gigawatt Hour
V	Volts
MVA	Mega Volt Ampere
KVA	Kilo Volt Ampere
kg	Kilogramme
km	Kilometre
g	Gramme
HT	High Tension (Cables)
MT	Medium Tension (Cables)
LT	Low Tension (Cables)
sq.	Square
p.a.	per annum
p.m.	per month
p.w.	per week
hp	Horsepower
BSD	Standard Barrels per day
DDB	Dodecylbenzene
PVC	Polyvinylchloride
AC	Alternating Current
DC	Direct Current
k.cal	kilo-calories
KW	Kilowatt
ft.	Feet
ins.	Inches
m	metres
cm	centimetres
mps	metres per second
od	outside diameter
wt	wall thickness
amp	Ampere

rpm	revolutions per minute
fpm	feet per minute
BTU	British Thermal Units
SCF	Standard Cubic Feet
fob	free on board
cif	carriage, insurance and freight
₦	Naira
$	Dollars

The views expressed in this Report are those of the Consultants and do not necessarily reflect the view of the Secretariat of the United Nations Industrial Development Organisation.

SUMMARY

This report examines the technical and economic feasibility of a factory to meet the market demands identified in Nigeria, other West African countries and Zambia.

The proposed scheme consists of a versatile brass mill and a wire rod and winding wire plant to make 19 different groups of semi-finished copper and copper alloy products. It uses up-to-date proven technology.

Implementation will take five years, after which production will begin with single-shift working at a rate of altogether 15,550 tonnes per annum. Within a further five years, the output will build up to the 1990 target of 58,350 tonnes produced by working two shifts a day, 240 days a year.

Five generally suitable locations in western, eastern and northern Nigeria were evaluated according to a range of criteria. The results led to a short-list of three, namely the greater Port Harcourt area as far north as Aba, the greater Lagos area including the extreme south of Ogun State, and Enugu in this order of preference. Rail access and availability of natural gas are highly desirable although liquefied petroleum gas could be used as an alternative fuel.

The shipment of refined copper and zinc from Zambia has marginal cost advantages to the Metal Marketing Corporation of Zambia. The principal attractions of this project to Zambia lie, however, in an assured market for about 10 per cent of its copper production and in part ownership of the proposed enterprise.

The report presents outline specifications with layout drawings and a capital cost estimate which adds up to the following investments:

	₦ million
Site work	3.8
Factory building	21.7
Process plant	45.2
Diesel generating station	16.0
Other services	1.8
Offices and staff amenities	0.7
Vehicles	0.4
Pre-production expenses	2.4
	92.0

When in full production, the operation will have 800 people on its payroll, most of them highly skilled. It will spend ₦ 3 million per year on salaries, wages and fringe benefits and thus render a major socio-economic contribution to wherever it will be located.

A technical partner, preferably committed to the success of the project through participation in the equity, is regarded as absolutely essential to the viability of this project. This partner should be a prominent group in the copper industry with in-house expertise in the manufacture of semi-finished products and will introduce adequate training, production programming, maintenance and, last but not least, product quality.

The financial analysis includes profit and loss, cash flow and balance sheet projections based on an equity to fixed capital loan ratio of 1 to 2 and on a 5-year tax holiday under the Pioneer Status Scheme.

Working capital requirements will rise to a maximum of ₦ 17.8 million in the 5th year of operation, when the turnover should have reached ₦ 105 million.

P & L projections are based on the premise that products must be competitive with imports, hence selling prices correspond to current market prices cif Nigerian port plus the modest Import Duties currently applicable to semi-finished copper products.

A project thus defined calls for the following maximum funding :

	₦ Million
- Share Capital	30.0
- Fixed Capital Loans at 9% interest	62.6
- Working Capital Loan 11% interest	11.0
	103.6

All loans can be repaid by the 11th year of operation.

Selling prices of semi-finished copper and brass products are tied to prevailing metal prices, which are quoted daily on the London Metal Exchange and can fluctuate considerably. Hence profits do not depend on raw material costs except insofar as the manufacturer speculates on futures. It is the conversion margin which concerns the manufacturer primarily.

The manufacturing costs of the various products depend not only on each other but also on the production schedule and on the availability and choice of equipment capacity. A rough analysis indicates that none of the 19 product groups are clearly unprofitable.

The overall profitability was examined by four criteria, namely pay-back period, simple rate of return, net present value and internal rate of return. With regard to the pay-back period, investments can be recovered after six years of operation. The simple rate of return works out at 9%. The net present value shows a positive out-flow at a cut-off discount rate of 11%, which means that lending institutions should be prepared to extend the required fixed and working capital loans.

The internal rate of return amounts to 11.7% which, at current interest rates, should prove quite satisfactory to the shareholders who will realise a return of 21.6% on their investments. One must conclude that the project as it stands is just feasible from a financial standpoint at the current level of interest rates.

The financial analysis is based on a location in the Port Harcourt or Lagos regions. Enugu involves somewhat higher capital and raw material costs, but not enough to make any significant difference to the profitability.

The sensitivity analysis shows a break-even point of 40% of full production. Adverse events with regard to fuel, labour and operating material costs make little difference to the profit margin, and fluctuations in metal costs none at all.

A 30% drop in production, however, which could occur on account of shortfalls in demand or operational problems, would cut the profit margin in half. A strong technical partner represents the best insurance against such an event.

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1. PRODUCTION PROGRAMME

Reports 1 and 2 have researched, reviewed, analysed and considered the demand for semi-fabricated forms of copper and brass in Nigeria, Zambia and in several countries adjacent to Nigeria. These demand totals have been measured (by fieldwork) and forecast on that base, for 1985-6 and for 1990-91 that is 5 years and 10 years from now. In this, it has been assumed that a suitable new factory to supply such demand would not be in production until 1985.

The demand totals indicate the maximum tonnage it is desirable to produce. We have not taken account of possible markets beyond West Africa (except Zambia) because they are (and will continue to be) served by sources that are nearer to them than is Nigeria, already producing satisfactory copper and copper alloy semis. Due mainly to transport costs, similar products eventually to be made in Nigeria could be uncompetitive beyond the area we have examined.

This means that if major plant items in Nigeria are used at unprofitably low levels of production, there is no scope for making them profitable by selling more of the products in other markets.

The analysis of Reports 1 & 2 discusses and takes account of marketing measures which should be applied to maximise sales in the "home" and export markets. The 1986 and 1991 total demand levels indicated (Tables 1.1, 1.2) do include the effects of these measures and represent probable maximum net sales levels for the products shown.

The production programme is expected to develop in accordance with the market demand growth between 1986 - 1991. Probably the growth will not be uniform but routine marketing intelligence work will give early warning of new steps in demand so that production increases can be planned and set up in good time. Factories assembling domestic appliances, motor vehicles and other consumer-durable goods are constantly increasing the "local content" in terms of value-added and in materials.

TABLE 1.1 : REQUIREMENTS FOR COPPER AND COPPER ALLOY SEMIS - ALL NIGERIAN INDUSTRY - 1986

Sector	Copper (Tons)					Copper Alloy (Tons)				Castings (Tons)
	Wire	Winding	Rod	Strip	Tube	Wire	Rod	Strip	Tube	
Electrical Engineering	16,425	1,405**	88	346	27		209	1,171	3	
Domestic Appliance	232*	401*		34	513		53	117	20	8
Transport	273*	85*	3	396			4	878	605	
General Engineering	7			5		56	518	3,901	600	369
Construction					1,197		788	275		406
TOTAL	16,432	1,405	91	781	1,737	56	1,572	6,342	1,228	783

* Excluded from final total as also included in Electrical Engineering Sector.

** Of this total, some 300 tons is heavy wire for transformer windings.

The change from importing of components to local manufacture commonly takes place in a stepwise manner and following direct enquiries among a local material sources. Thus the Nigerian suppliers of say, copper tube would be among the first to know of local manufacture of evaporators for AC units, for example.

The timing of specific increases (steps) in demand cannot be forecast in detail. For study purposes we propose the production output increase in five equal annual steps between 1986-1991 and to consider the 1991 forecast demand levels (Table 1.2) as maxima for output. Maximum inputs and direct costs are derivable from the base, so too is revenue. Hence feasibility and profitability can be calculated. They are tabulated later in this report.

Today local manufacture of brass mill products in Nigeria is extremely limited. Only one company is involved in this area and this company is privately melting scrap and casting it into ingot, the scale of operation is very limited. Indeed the bulk of demand is met by import from Europe, North America and Japan. As output from the existing manufacturing unit in Nigeria is so small we have assumed that the Nigerian demand detailed in Tables 1.1 and 1.2 is all available to be met by the new facility. In export markets and in the wire mill products sector in Nigeria and other countries we have taken due account of existing capacities and future plans to establish a net demand which the Nigerian plant could be called upon to serve. In our initial analysis for 1986 we have assumed the plant relies upon the home market for its viability and in the first exercise it has been assumed that no exports are made.

Within Nigeria the four wire and cable manufacturers between them will be able to meet demand in the late 1980's for virtually all insulated wire and cable products. None of these companies has detailed plans for manufacture of magnet wire and none has plans to install facilities for production of wire rod. As such both have been included within the framework of this study. A wire rod plant of the type envisaged in this study would feed all the wire and cable manufacturers in Nigeria as well as the proposed magnet wire plant.

TABLE 1.2 : AVAILABLE NIGERIAN DEMAND FOR PRODUCTION BY PRODUCT TYPE

Product Type	Product*	Detail	Demand (Tons)	
			1986	1990
Copper - Wire Mill	Wire Rod	9 mm (sale)	16,432	27,600
	Winding Wire**	0.25-2.0 mm	1,075	3,800
	Wire Rod	TOTAL Prod	17,507	31,400
Brass Mill	Extruded Sections			
58Cu-2½Pb-Zn	Brass Rod	TOTAL	1,572	5,000
	of which:	Drawn	572	1,400
		As Extruded	1,000	3,600
	Copper ETP	Drawn Busbar and Sections	391*	1,500
	Strip Rolled			
67Cu-Zn	Brass	TOTAL	4,792	7,050
	of which:			
50-250Ø	For circles	0.3mm	2,000	3,166
250-500Ø	For circles	0.9mm	400	634
	For radiators	0.1mm min	863	1,500
	Other		1,529	1,750
	Copper PDO for radiators	0.06mm min	361	1,000
	ETP for transformers		420	1,500
	Sheet	500-900mm		
67Cu-Zn	Brass	TOTAL	2,100	2,400
	of which:			
500-900Ø	For circles	0.9mm	1,835	1,900
	Tubes			
	Copper	TOTAL	1,737	3,400
	of which:			
	AC	⅛" ¼" Ø	513	1,150
	Refrig.		277	750
	DWS	12-25mmØ	597	1,000
	GEng.		350	500
63Cu-Zn	Brass	TOTAL	1,228	1,500

Copper Alloy Wire excluded from production programmes as demand at 56 tons 1986 is too small to justify production.

** 300 tons excluded as outside the size range.

* 300 tons included as transformer section, lacquered as for winding wire.

Although the latter plant has been considered as part of the new project it is important to realise that this facilitity could well be beneficially linked to the expansion plans of one of the existing wire and cable manufacturers. In either event a viable unit should be possible.

While tariff protection against continued imports would certainly be given to a Nigerian copper semi-fabrication industry in its home market, the same is less likely to be given elsewhere in favour of Nigerian product. Thus as was mentioned in Volume 2 of this report it is realistic to assume only a portion of total requirements are secured by the Nigerian company. Obviously as time progresses Nigeria may develop bilateral or multi-lateral regional agreements which give tariff concessions etc. to Nigerian manufactured semi-finished products. For the present however we believe it is prudent to adopt the conservative estimates made in Volume 2 for exports from Nigeria.

1.1 Products

The Terms of Reference for this study mention "various forms and sizes of (copper based) semi-finished products ....". Market research has revealed that total demand for certain forms is indeed sufficient to justify serious consideration of them for manufacture. Examination of the costs of, and the return upon suitable plant to produce them, forms the main part of this feasibility study.

The products are in two main categories, named by the type of factory:

- Copper Wire Mill Products
- Brass Mill Products

Copper Wire Mills are commonly associated with production of insulated wires and cables for electrical and telecommunication purposes, which incidentally require good quality, high conductivity copper. They have specialised, high production rate machines which make only one product: wire of pure copper for insulating.

The Nigerian wire and cable industry was discussed in Volume 1 of this report. The present industry supplies a substantial part of Nigerian demand and future plans of the companies suggest that, except for certain very specialised and unusual types of cable, it will be capable of meeting almost 100% of Nigerian demand. The several Nigerian wire and cable makers have wire-drawing facilities, but none produces wire-rod (the raw material for drawing).

Growth in demand for insulated wire and cable is clearly related to overall industrial growth (and industrialisation) electrification and construction activity. As was mentioned in Volume 1 a high rate of growth is expected over the forthcoming decade in all the above areas. The existing companies which make-up the Nigerian wire and cable industry have plans for expansion and development and collectively these will enable the existing industry to keep pace with growth in demand for all but a very small quantity of sophisticated cables. As the existing wire and cable industry has the potential, capability and plans to meet demand and since it is the policy of the Nigerian Government not to set-up public sector industries which will compete with existing private sector activities we have excluded the manufacture of insulated wire and cable from this project. However as was mentioned above, production of wire rod and winding wire has been included.

Today all the Nigerian manufacturers of wires and cables import copper rod of 5mm diameter and upwards. The total demand for this product, in 1985-6 and especially in 1990 is such that a modern production unit for it is almost certainly feasible. Imported copper rod is bulky, hence expensive in shipping and transit. No single private sector wire or cable maker can justify investment in plant to manufacture it in Nigeria (although they import from their associated companies abroad). Industrially, wire rod is a strategic raw material.

The conclusion is that the Nigerian Government could and (subject to feasibility) should produce copper wire rod for use by Nigerian industry, with local export possibilities also.

Zambia already produces wire rod, by a method (extrusion) which although somewhat expensive is probably more economical overall than shipping-in rod made overseas. Plans there allow for continued supply of most Zambian needs in future, by expansion of this small facility to include a continuous rod casting installation. This plant would be primarily to serve the Zambian market and the plant chosen, an Outokumpu, is the smallest continuous casting unit made. Clearly this plant has the potential to serve the requirements of neighbouring countries and the investment is being made with this objective in mind.

There is one copper wire product that is not made in Nigeria, but which is in demand there and that is winding wire or magnet wire, pure copper wire insulated with (clear) lacquer. It is used for armature windings in electric motors and generators of all sizes, also in small transformers and chokes. Its manufacture requires specialised plant and materials, with relatively high investment cost. To make it in Nigeria would constitute significant import substitution because it is a high value product, essential to industry for manufacturing and maintenance. For the same reasons winding wires could be exported also.

Thus we propose to limit feasibility studies in the copper wire mill sector to:

- wire rod production
- winding wire production.

Brass Mill. An integrated brass mill produces all wrought forms, not only of brass, but of copper and other copper alloys too. However it is rare in the world today to find one company making all semi-fabricated forms. It is even rarer to find units which produce them all on a single site. Thus, while significant market demand exists in Nigeria for each of the three main wrought forms:

- foil, strip and sheet
- rods bars and section
- tubes

It may be that one, two or all three forms are not feasible and not competitive with presently imported supplies. The existing factories in Europe, Japan and America commonly make one semi-fabricated form each. They serve high-volume home markets, so that they can supply a complete range of sizes, specifications and compositions. Their orders even for unusual sizes/specifications amount to feasible production quantities.

The Nigerian market, the Zambian market and the West African markets together constitute a substantial tonnage demand, although most of it is relatively conventional in sizes and materials, being based upon imports. The advent of an integrated plant capable of all sizes and materials (within reason) will allow the markets, especially the Nigerian home market to become more selective and possibly more economical in its material usage. For example, an exporter to West Africa may require an extra die charge to supply 28.5mm diameter brass rod, so the consumer orders 30mm, saves the extra die charge but has to machine off and lose 30-28.5 = 1.5mm. With his source in Nigeria the rod buyer can have more choice of size - there may be several other buyers who prefer 28.5mm and if so, none will pay the die charge. Alternatively, if he does buy 30mm and machine it, he can sell back to the Nigerian mill the swarf and it is not lost to him. The plant would be designed to produce the range of sizes for which demand has been identified, using standard, modern machinery. This means that some small demands for extreme (small) sizes would not be met, but conversely where a specific substantial demand for small sizes is known we propose to test the marginal feasibility of installing a special machine for it. For example, modern automobile radiators are made in Nigeria and the car industry there is planned for growth. Radiators need very thin brass strip of closely controlled gauge (for welding to water tubes) and even thinner strip of copper for the fins. Special finishing mills are required to produce "radiator strip" and we would expect to test the profitability of installing such a mill to meet the forecast Nigerian demand, although for all other purposes the strip gauge produced is too thin or "too good". For example, copper transformer strip does not need to be of very close gauge tolerance but there is some demand for it at 0.30mm and below. Thus a product such as this transformer strip could help fill the capacity of the "radiator strip mill" and thus help its profitability as a unit. Taking all such marginal factors into account the products of the projected brass mill factory would be as folows:

<u>Strip</u>

- High conductivity rolled copper strip for transformer windings. Width up to 160mm, gauges 2.5 - 0.15mm.
- Brass and copper strip rolled to close tolerance and uniformity of gauge for fabrication to motor vehicle radiators 0.30-0.05mm gauge.
- Brass and copper strip of commercial gauge tolerance up to 500mm wide, gauges 2.5-0.25mm.

Sheet

- Brass (optionally copper, too) up to 1000mm wide, also circles cut from sheets, gauges to 0.5mm.

Rods, Bars and Profiles

- Brass (optionally copper busbar and transformer band, too) round, square, hexagonal and other sections, for forging and/or machining. Maximum dimension of section 180mm.

Tubes

- Copper refrigerator tubing, cleaned and purged internally and plugged, soft annealed in pancake coils: minimum size 6.35mm OD x 0.7mm wall.

- Copper AC tubing purged, soft annealed in layered coils. Typical size 9.5mm OD x 0.4mm wall.

- Soft copper tubing for general engineering purposes. Sizes 50-5mm OD.

- Hard drawn copper tube for domestic water services, straight lengths. Sizes 12-25mm diameter.

- Brass tubes for general engineering purposes 50-5mm OD.

1.2 By-Products

There are no saleable by-products from the manufacture of copper rod, copper winding wire or brass mill products. All metal off-cuts and rejected materials are returned within the factory for re-melting. All non-metallic residues, solid liquid or gaseous are wastes.

1.3 Wastes

There are two main waste materials:

- used refractory mixes, slags and melting shop waste;

- used lubricants.

Waste heat and products of combustion (none of which are toxic) are dissipated in colling water, which is recirculated and made up, or into the atmosphere.

Used refractories have to be carefully sorted for metal content and the metal bearing portions are milled along with the slags. Air blast (to a precipitator or cyclone) then removes the powdered non-metallics, leaving the metal values behind for re-melting. Hence the refractory waste is a mixture of dust and lumps, suitable only for dumping.

Used lubricants are floated in separating tanks and the oily wastes again can only be dumped.

Minor quantities of waste acids are produced from pickle tanks, minor because the acids are stripped electrolytically of copper and recycled until polluted. Waste acid is neutralized with lime and the resulting wet slurry dumped.

All factories produce some scrap iron and steel from containers, drums and tooling. While this could in theory be collected and sold to Nigerian steelworks as a by-product, the costs of collection and transport are likely to be higher than the revenue, hence it must be classed as waste. However it is non-polluting.

2. PLANT CAPACITY

It is necessary in the first place when planning or making projections in relation to a manufacturing unit, to decide at a strategic level its capacity. A factory with too large capacity will have overhead charges for depreciation of plant too high upon each unit produced, and will be so under-untilized that it will not produce a proper return on the capital it employs.

A factory with too small capacity, although it should be highly profitable, cannot satisfy its market, hence will tend to lose it to competitors or to substitute products. As such a unit tends to regulate and control supply, having created a seller's market (unless competitors do have extra capacity), its clients will search more keenly for alternatives and substitutes, as they in turn try to create a buyer's market situation.

In the present case, the market for copper and copper alloy semi-manufactures to be made in Nigeria is large and expected to grow rapidly. However the start of production is in our estimation about five years in the future, which means the market will have had five years to develop the use of substitute materials and to design with reduced or eliminated use of copper alloy. Although in our market forecasts we have tried to take account of probable substitution over the next five years it is important that the Government of Nigeria do not impose too high a level of tariff on imports of copper and copper alloy semi-finished products, thus promoting a high degree of substitution in the market place, in the five years upto commencement of manufacturing operations.

2.1 Criteria for Capacity

At the present time no plans have been identified in the public sector or in the private sector for copper wire mills or brass mills in Nigeria. The nearest relevant developments are:

- expansion of electric and communications wires and cable production in Nigeria in the private sector. But this expansion will represent for the projected copper rod mill additional demand for its product, namely copper rod;

- the expansion of the copper mill capacity in Zambia, although it must be said that consideration of such a capacity falls outside the terms of reference of this project, at least in the context of Nigeria home demand;

- the small existing ingot producing facility at Igbobi.

It not the intent of the Nigerian Government to compete with private sector industries already in place and in this product category that would not arise unless the Government is asked to permit some new as yet unknown project. In that unlikely event, the Government would presumably not permit the development unless and until this proposed public sector project is abandoned.

The demand for copper and copper alloy semi-manufactures from a Nigerian factory in many respects can be forecast with a high degree of probability. The growth demand is primarily a function of the development of industrialisation, electrification and internal economic development. Obviously demand could be reduced by adverse political or economic conditions and would only be affected by world economic conditions insofar as they influence the country's total revenue.

Other factors which could influence the planned capacity of this project are raw material supply and labour availability. Neither is likely to prove a problem and neither would have a major influence in the matter.

Raw Material Supply

A part of the original conception of this copper semifacation project is as an outlet for Zambian copper, located in a major market area, that is West Africa. The Zambian Government is to participate in the equity.

Zambia is exporting annually more than 600,000 tons of refined copper, has done so for many years now and it is certain it will continue to do so for reasons vital to the national economy there. There is no possibility of such a shortage of copper occuring as to leave the Nigerian works (in which Zambia is to be a partner) in any way short of the copper it needs. Limited supply of copper cannot be a criterion for the works' capacity at all.

Zambia is also a substantial exporter of zinc, the other main raw material of brass mills. Alth ugh there are other sources of zinc, we can assume that Zambia would assure the supply to Nigeria, along with its contract for copper supply, on mutually beneficial terms. But certainly supply of raw zinc is no criterion in fixing the capacity of the brass mill.

Labour Availability.

Nigeria is the most populous country in Africa. Although large in area its density of population is also relatively high. In few places in Nigeria and in no places where urban industrial infrastructure is in existence, is there any real shortage of labour. This factor is taken into account when the plant location is discussed in this report (Section 6). But here we note that labour availability does not and will not influence or decide the capacity of the proposed works.

If the location were to be fixed (which is not the case) in an area of low population or of very full employment, that could increase the cost of production but it would also allow the consideration of more costly plant requiring less labour, as a viable alternative. Whilst assuming and specifying new, modern equipment for the works we have not made efforts to limit the labour needs of any process steps. On the contrary, it is an incidental aim of the project to provide productive employment - a socio-economic benefit. In no way therefore is labour availability a criterion of capacity for the project.

2.2 Major Alternatives in Capacity

In the first instance capacity of the projected works is based upon the 1991 assessed demand. Major alternatives in plant to produce those tonnages in Copper Wire Mill and Brass Mill shops are related to the productivity of each alternative and also the question of whether demand is to be met on a single or multi-shift basis.

In the second instance we have assumed a margin on capacity for export. For convenience we have adopted an overall figure for export of 20% of Nigerian demand in 1990/91 rather than trying to add individual export opportunities. Indeed a good marketing organisation should be able to secure such a level of export in the countries studied. Projected growth rates for production and sales are those as shown in Table 2.1.

TABLE 2.1 : FORECAST DEMAND GROWTH : FIRST FIVE YEARS' SALES

Product Group	1986 tons	1991 tons	Total Growth %	Annual Average Growth % p.a.
a) Including 20% allowance				
Copper Wire Mill	17507	31400	79	12.4
Brass Mill	12051	22150	84	13.0
b) Excluding 20% allowance				
Copper Wire Mill	17507	26167	49	8.2
Brass Mill	12051	18458	53	8.8

Although the growth rates shown in Table 2.1 are high, under both assumptions and for both product areas, they are quite obtainable. Indeed in a rapidly developing economy such as Nigeria's high growth rates in areas such as GDP, industrial output, electricity consumption are all planned. As was shown in Volume 1 these factors are known to be related to copper consumption in semi-fabricated forms and we have adopted the more conservative of the various demand forecasts made.

Alternative plant capacities which can be reconciled with the assessed and forecast demand volumes are:

a) single shift working to meet the 1985-6 demand level within say, one year of start-up;

b) two shift working to meet 1985-6 demand;

c) single shift working to meet 1990-91 demand;

d) capacity 1990-91 demand with two shift working;

e) capacity 1990-91 demand with three shift working;

other alternatives can be rejected immediately and indeed some of the above can be ruled out such as:

- three shift working means working to capacity. By 1990-91 the works should be at maximum efficiency and productivity. Whilst it would therefore be at maximum profitability, that capacity allows for no possibility of expanding production without a re-investment programme at that time, only five years after start up;

- conversely, if capacity is fixed at the 1990-1 level with single shift work only, then the works will be producing only a small fraction of capacity, with consequently enormous overhead cost per unit produced.

(a), (b) and (d) deserve examination, all three allow scope for further expansion of production after 1991 without re-investment.

A capacity (b) equal to 1985-6 demand with two shift working allows expansion of production by up to 50% if a third shift is worked, but no more. Table 2.1 shows that 50% growth is sufficient only to meet demand at the lower level in 1990-91 (no exports). The possible extra 20% could not be met and there would be no further expansion of production after 1991 without re-investment.

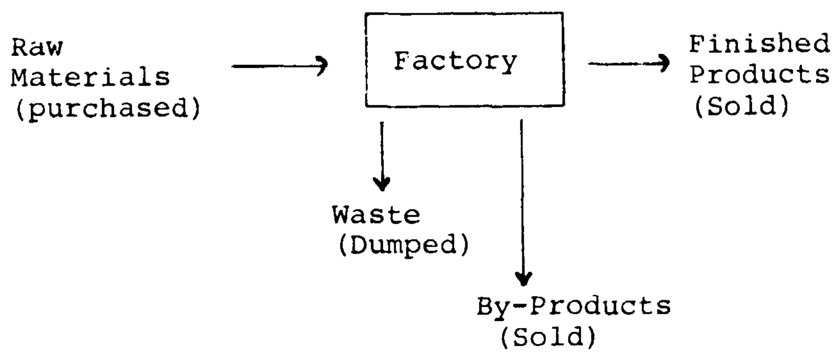
Option (a) has in it a 200% potential expansion of production, if second and third shifts are added in a plant of capacity equal to 1985-86 demand in only one shift. But Table 2.1 shows that 1990-91 demand would be met with maximum 80-85% increase on 1985-6 demand. Hence this option in 1991 has excess capacity equal to at least 115% of the 1985 demand and this is unlikely to be viable economically. Without the 20% contingency and export margin on the 1991 demand estimate, the excess capacity would be an intolerable 150% of 1986 demand.

This leaves (d) as the best option for overall works capacity planning, namely the 1991 demand level, met with two shift working. It is true that such capacity allows the possibility of expanding production by a further 50% if a third shift is worked but demand could well grow after 1991 so as to cut into that "reserve" very substantially, indeed as was mentioned above we have deliberately been conservative in our forecasting.

With this capacity the factory will work more than one shift to meet the 1986 demand, which will offer the new management early choices and flexibility in working practices. Even a partial second shift requires duplicated work-teams, a greater number of trained men and initially, there will be few trained men. Thus it would be more convenient (and perhaps more profitable too) to extend the first shift in some departments by 25% or more. Where physical working conditions permit, it is better to work one 12-hour shift than 1½ shifts of eight hours because the labour numbers and cost are less for the former.

2.3 Material Input-Output Relationships

A manufacturing unit takes in materials, converts, transforms and assembles them (hence adding value) and despatches finished products. Part of the material taken in leaves as waste or by-product.



We have seen in Section 1 of this report that in copper semi-fabrication there are no significant by-products and no metallic waste because all reject and off-cut metal, other than prime goods, are returned as fresh input within the factory.

Raw materials for copper and brass mill factories are copper and zinc metals but for brass mills they can be in any of several forms including copper and brass scrap. Indeed, it is vital to the economics of brass rod manufacture in industrially developed countries that the main raw material be brass scrap. This subject is discussed more fully in Section 4 - Raw Materials.

Within the brass mill there is effectively a continuously recirculating tonnage of scrap but as none is sold or dumped it does not enter into the input-output balance, <u>except</u> when the rate of production is changing.

The volume of sales of finished goods (in steady production) from copper wire mill and brass mill is equal to the volume of metallic raw materials purchased, less the very small losses in forms such as:

- saw swarf
- dust
- fume (esp. of zinc oxide)
- etc.

With good security (from theft) and efficient handling of scrap (especially swarf) the overall losses are kept at 0.5% or below.

We have already defined capacity of the works in terms of sales, namely as being nominally equal to the 1990-1 market volume, with two shift working. Whether the works is eventually operating at capacity, below capacity or above capacity (by adding third shift), the volume of material inputs will always be sensibly equal to the volume of sales.

Fluctuations in the rate of production usually cause changes in the amount of work-in-process (WIP), also in the amount of scrap generated and in circulation within the works. If a rolling mill handles say, 50 coils in a shift it will produce a few kg. of end off-cut from each of 50 coils, but from 60 coils will produce 60 off-cuts. In other words the amount of scrap produced is proportional to the volume of finished goods produced. Whether the same volume of finished goods is produced in a longer or a shorter time, the amount of scrap incidentally produced will still remain the same.

The volume of WIP will also depend upon the volume of goods produced. Although that would not be the case with a single continuous process, nor with a sequence of processes exactly matched in rate-of-working, those conditions do not apply in the case of a brass mill. There is a theoretical minimum volume of WIP between any two (mis-matched) machines in sequence and in practice there will invariably be a greater volume than the minimum. Good management aims to keep WIP volume down because it represents capital tied up, as also do stocks of raw materials and of finished goods.

Even so, the tendency is for WIP volume to increase as throughput (rate of production) increases, at any given process stage. The output-related WIP volumes as shown in Table 2.2 are typical operating levels in most brass mills.

TABLE 2.2 : WORK IN PROGRESS NORMS - BRASS MILL

(Before) Process	Material	Stock or WIP level
Melting & Casting	New Metals Cu Zn Pb Returned & bought-in scrap In-House scrap	According to frequency of batch delivery. One weeks' consumption (max) Two shift returns
Milling	Cast slab	One day (max)
Breakdown RM	Milled Slab	One day (max)
Batch annealing	Strip, Tube	One cycle load (min)
Continuous Annealing	Strip, Tube	Half shift (max)
Other rolling Mills	Strip	Half shift (max)
Draw benches, blocks, spinners	Tube, brass rod	Half shift (max) 1 - 2 batches (min)
Extrusion	Cast & sawn billets	One day
Despatch	*Finished goods "stocks"	Two days (max)

* Unless decisions are taken to finance and organise ex. stock delivery services, copper semi-fabricated products are invariably made-to-order. Goods awaiting despatch are WIP and not true stocks.

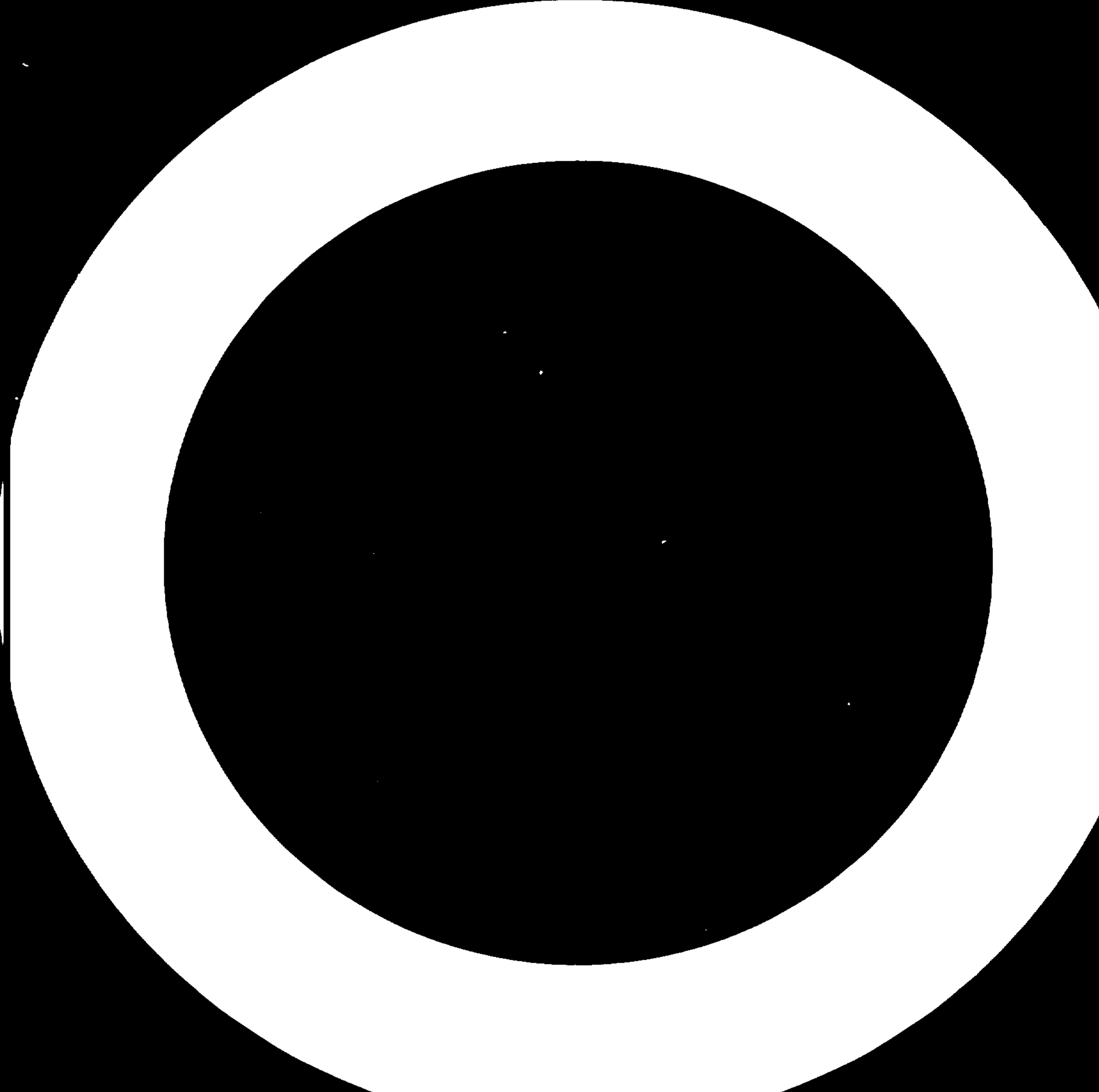
Thus it is clear that as production increases year by year to accommodate increasing market demand, the raw material input required will be greater as a result of increases in:

- re-circulated, in-house scrap;

- work-in-process;

both are directly related to the level and rate of production and sales.

Apart from these relatively small changes, the raw material inputs will be equal to the sales volume (output) plus say 0.5% (max) non-recoverable waste.



3. TECHNOLOGY

Demand for copper and copper alloy semis is effectively confined to a few conventional forms. While any given end use could with exhaustive analysis be "assigned" to a particular mix of alloy composition, size and form of copper (alloy) semi, to produce at the lowest cost the article that will serve the user best and longest, such analytical approach is uncommercial and uncommon. In realistic terms. users of wrought brass and copper habitually design products to be made from common, standard alloys in commonly semi-fabricated sizes, and forms.

Past practice in user industries has caused certain sizes to be preferred and in some forms this means those sizes are cheaper, being produced in greater volume than "less preferred" sizes. But this development grew in traditional, industrialised user areas of the developed countries. While it is likely that similar preferences could eventually become manifest in Nigerian industrial demand patterns, we must assume for costing, planning and study purposes now, that the common sizes of say, UK and USA will also be commonly required in Nigeria but in the latter case there will be no "discount" for common sizes and no "premium" on less common ones. In the event of enquiries for unusual sizes, a decision would be made then as to whether or not to make them. Such decisions would depend in each case upon the assessed term demand for the size, but if it is positive, no premium would be charged.

Decisions upon the choice of technology at the present, study stage depend upon the range of size to be produced, the quantity throughput scheduled and the material being processed. All plant items process limited ranges. Some produce several discrete sizes or size ranges dependent upon some tooling change. Where the alternative tools are low-cost such as drawing dies, then several sizes and a wide range overall can be provided for, but where they are expensive, such as sets of alternative mill rolls then we plan on working only one size or one range.

TABLE 3.1 : FIVE YEAR DEMAND SCHEDULE BY PRODUCT CATEGORY

tons

	Product	Detail	1986	1987	1988	1989	1990-1	
Copper - Wire Mill	Wire Rod	9 mm (sale)	19400	22675	25950	29750	32400	
	Winding Wire	0.25-2.0 mm	1075	1755	2440	3120	3800	
	Wire Rod	TOTAL Prod	20475	24430	28390	32870	36200	
Brass Mill	Extruded Sections							
58Cu-2½Pb-Zn	Brass Rod	TOTAL	1572	2430	3290	4145	5000	
	of which:							
		Drawn	572	780	990	1195	1400	
		As Extruded	1000	1650	2300	2950	3600	
	Copper ETP	Drawn Busbar & Sections	391	670	945	1225	1500	
	Strip Rolled							
67Cu-Zn	Brass	TOTAL	4792	5360	5925	6490	7050	
	of which.							
50-250Ø	For circles	0.3mm	2000	2290	2580	2870	3166	Strip weight
250-500Ø	For circles	0.9mm	400	460	520	580	634	Strip weight
	For radiators	0.1mm min	863	1020	1180	1340	1500	
	Other		1529	1590	1645	1700	1750	
	Copper. PDO For radiators	0.06mm min	361	520	680	840	1000	
	ETP For transformers		420	690	960	1230	1500	
	Sheet	500-900mm						
67Cu-Zn	Brass	TOTAL	2100	2175	2250	2325	2400	
	of which:							
500-900Ø	For circles	0.9mm	1835	1850	1865	1880	1900	Sheet weight
	Tubes							
	Copper	TOTAL	1737	2180	2620	3060	3400	
	of which							
	AC	¼" ½" Ø	513	670	830	990	1150	
	Refrig.		277	390	510	630	750	
	DWS	12-25mmØ	597	700	300	900	1000	
	GEng.		350	390	420	460	500	
63Cu-Zn	Brass	TOTAL	1228	1280	1350	1420	1500	

We have now to select the most suitable technology in the light of the volume and nature of the products to be made and of Nigerian-Zambian conditions. In so doing we take account of capital cost, operating cost and reliability in broad terms and of necessity, much of that is opinion and estimation on the part of present users of the various alternative technologies.

Plant items to employ the technologies recommended here are specified and costed in Section 9 to 11 of this report.

3.1 Scope of Project

Market studies in the present project have established the range of sizes and materials demanded by the market now and in prospect. Apart from some minor quantities required in extreme sizes or unusual alloys, our objective in specifying the plant is to meet satisfactorily all that tonnage to be demanded in 1991 in the sizes likely to be demanded and the materials required.

The tonnage forms and sizes are shown in Table 3.1, the 1991 volumes being taken as capacity, with two-shift working. Accordingly we propose to examine here the technology by which each of these product categories is made and thus to recommend the most appropriate for the levels of production required, in the light of our knowledge of the Nigerian situation.

3.2 Continuous Casting

The past ten years have seen a major trend in copper and copper alloy processing. The same trend occurred sooner in aluminium semi-fabrication and much slower in the steel industry, that is the common adoption of continuous casting processes.

This trend has transformed the initial, melting and casting aspect of both the copper wire mill industry and the brass mill industry and has incidentally affected the copper producers too. Continuous casting, like any other continuous process brings benefits of uniformity and consistency in the product. Ingots and billets cast in fixed moulds (including wirebars) exhibit such heterogeneity that a significant part of each has to be discarded. Although this top discard can be recirculated, it is obviously preferable not to discard it and to retain a high yield of cast material good for further processing.

Continuous cast material has no top, hence no top discard and is homogeneous along its cast length. Semi-continuous casting gives far less end scrap than batch casting, also good homogeneity.

A further advantage in continuous casting is the freedom it brings from batch size limitation in later processes. In the case of copper rod a much larger batch size can be worked than before.

With brass slab or billet one can work large or small piece batches at will.

3.3 Copper Rod Production

The widespread adoption of continuous casting in the two areas - copper wire mill and brass mill - has had two effects which have made it virtually inevitable that it be selected in the present project. Ten years ago there was a real choice between the batch cast, hot rolling route and the continuous casting and rolling processes. (See Appendix A). A factor in making such choice was then the uncertainty factor, the novelty of the technology, as the latter processes, expressed as "it might be too complex to keep running". At the same time the rod rolling and other hot mills were becomming "more sophisticated" and faster, hence better. In fact and with the benefit of hindsight, the CCR processes are generally not complex and use modern, very reliable control equipment that is not expensive to buy and is easy to replace. By contrast, a new rod rolling mill to be competitive in labour requirements would need much expensive auto-control gear and much mechanical and electrical maintenance. As such, continuous casting is clearly to be preferred.

The second factor is strictly practical in this study. Rod-rolling mills are no longer made and to obtain price cost estimates for engineering, hardware and installation of a rod mill is now impossible. Opinion is that for the same (high) production level a semi-automatic rod mill would cost about twice as much as say a Southwire machine.

The CCR processes for copper rod dispose of the need for wirebar casting on the part of copper producers, hence the incidental result of the worldwide swing to continuous rod casting has been a huge increase in the volume of refined copper delivered as cathodes.

The LME had run for many years separate markets in cathodes and wirebars but the volume traded in wirebars was by far the larger. Furthermore, there was an unofficial but competitive market in toll rolling of wirebar to rod of 6.5, 8 or 9.5 mm, commonly 5/16". The price for this "conversion" was quoted as an addition to the LME wirebar price. Nowadays most owners of CCR machines make rod (from cathode) for their own use and for sale to wiredrawers, there is an unofficially quoted market price for CCR rod 8 mm. While one can derive a CCR conversion price by subtracting from the CCR rod price the LME cathode price* there is little, if any, such conversion done on toll because the CCR line owners prefer to select the brand of cathode. Processing of a different brand can upset the running of a CCR line in which the set-up may have been fixed with some difficulty to run satisfactorily with a particular brand.

CCR rod, pickled in-line and layer-wound in coils up to 5 tons of one length are now popular with wire drawers. Provided they are willing and able to handle large coils they have the benefits not only of freedom from welding successive small coils but also of fewer breaks in wire-drawing operations (they mostly occur at welds) and of the elimination of rod pickling and shaving.

Hot-rolled rod is (was) produced and sold in unit coils of 100-120 kg. (corresponding with wirebar weight) black. Before being introduced to the first breakdown drawing machine these unit coils had to be pickled free of scale and welded end to end. For certain end users (notably magnet wire or winding wire and thin telephone wire) the rod was drawn one pass to round the section and shaved, only then leading into the drawing sequence.

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* The apparent conversion cost thus is about £120 per ton in UK, including delivery of rod.

CCR rod is finished bright and with a light protective wax coating if it is for outside delivery. It is in very long continuous length with no welds, does not require shaving and seldom breaks in wire drawing. Thus CCR rod is now not only the most common form of copper rod made and traded but also the best in techno-economic terms.

Arguably a superior rod is produced by hot extrusion of copper from cast cylindrical billet. Such rod is perfectly circular in section and perfectly uniform in grain structure but it has three drawbacks. First, the coil weight is limited by billet weight, in practice to 100-150 kg., or rather less if several strands are extruded from a single billet. Second, these rather small coils are black and thus need the same pickle-coat-weld pre-treatment that hot rolled rod coils need. Third, extrusion is a relatively slow and (per unit processed) expensive operation, especially for small extruded sections.

In a wire and cable factory serving the electricity transmission and distribution industry, an extrusion press is a useful and flexible tool. It allows the production of copper busbar sections as well as of aluminium conductor sections for ACSR and insulated cables. In ZAMEFA's factory the extrusion press can produce all these and also copper rod for drawing to wire, sufficient for Zambian demand today. Evidently this is feasible in Zambia, where the use of lower cost raw copper offsets the higher cost of extruding wire rod. In fact, as was mentioned earlier in this report and in Volume 2, ZAMEFA plan to introduce an Outukumpu continuous copper rod plant.

In Nigeria local demand alone is sufficient to justify installing a CCR machine and with exports it is well worthwhile. The technology is proven and with single sourcing of copper cathode (from Zambia) such a plant, once set up would produce excellent quality saleable rod at what should be a low added cost and high profitability.

3.4 Hot Working: Extrusion

The brass mill is to produce all the common semi-fabricated forms in copper and brass:

- sheet and strip, including foil
- rod bars and profiles, including busbar
- tubes, including thin wall DWS and ACR copper, but excluding condenser tubing

All these forms can be made starting from a cylindrical cast shape upon which the first preforming operation is hot extrusion in a hydraulic press and this can be a solution to the choice of technology. For strip, the hot preform can be extruded slab, for tube, extruded hollows and bars and profiles are extruded at or near finished size.

But this all - extrusion decision is one which commends itself only where total output required is small and mixed. An extrusion press can be run at about 30 billets per hour and a large billet size is 300 mm diameter x 600 mm long which in brass weighs about 360 kg. Gross extrusion rate maximum would be about 10.8 tons per hour, yielding at finished sizes say, 6-7 tons per hour. With two shift working maximum hours worked are 4,000 hrs. p.a. With 80% press availability, finished work output could thus possibly reach 20,000 tons, whereas the market-based scheme proposed calls for over 22,000 tons in one option.

The press to extrude all these forms would be a very powerful one, very large (for the billet size) and very expensive. Indeed a second press would be needed to meet the projected production capacity. Extrusion presses are expensive to buy, to install and to operate. Whereas hot extrusion could be the only hot-working operation for all forms, hot working can be achieved by other technology or dispensed with in some cases. A more positive way to choose suitable technology is thus to pose the question "Is an extrusion press necessary?"

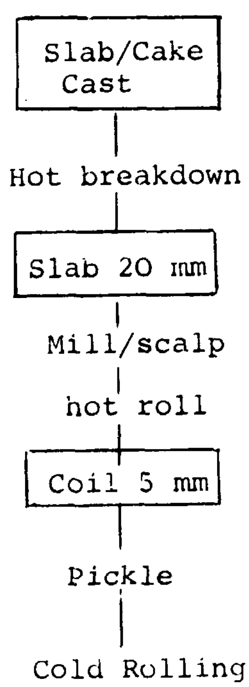
In Appendix A there is a description of the hot piercing process for making tube hollows and this may be preferable where there is to be very large volume production of tubes, but in the present project the required capacity is less than 5,000 tons p.a. finished and that in several different types. Yet 5,000 tons p.a. of mixed tubes requires extrusion of about 9,000 tons of billet, too little for even a moderate-sized press.

By contrast, the extrusion process is ideal for brass rod and sections. Duplex brass, containing less than 63% copper is very ductile and malleable when hot, requires at least 50% reduction from the cast state to homogenise its structure. It is hard and tough when cold and cannot be cold worked to any great extent. Furthermore, end user industries have become used to (hot worked) section shapes in free-machining brass which would be difficult or impossible to make by say, hot rolling in grooved rolls. Apart from the need for several specific sets of rolls to make a range of sections, hot rolling of bars and rods is slow and labour-intensive, furthermore, the finishing temperature cannot be well controlled nor uniform in the finished bar.

Extrusion on the contrary, works the whole billet in one operation at the same temperature. We conclude that a hot extrusion press is a necessity to produce the brass rod required, is the preferred plant for making tube hollows in the tonnage required. An extrusion press will also conveniently provide the required tonnage of busbar and other sections in high conductivity copper.

3.5 Hot Working: Sheet & Strip

The conventional and still the common route for working flat rolled brass and copper is thus:



Rectangular section say, 100 mm thick, say, 1500 mm long.

Although this was improved by casting longer and bigger slabs (to eliminate end effects) and finally semi-continuous slab casting, hot rolling continued because the slabs were cast too thick for cold rolling - all conventional metals are softer when hot.

The next and decisive step in development has been to cast a slab which is thin enough to be cold rolled. However hot rolling from large thick slabs continues in existing works in Europe, USA, N.America and Japan for several reasons still:

- the works for sheet and strip are large enough (and specialised) to have a wide and complete range of widths in their order intake. This means they can justify rolling most of their output at a width which is too large for continuous casting thin slab. Narrow widths are slit from the wide material.

- they also produce a significant proportion of copper sheet and strip. Pure copper is much more difficult to cast in thin slab, hence continues to be (hot) rolled from thick slab.

- wide hot mills and associated plant represent a heavy vested interest in working wide materials. Even where the plants are written off (amortised) they bear substantial overhead cost in shop floor space. Therefore they continue to be used.

None of these reasons apply in the Nigerian project under study here.

Copper strip is a minor part of the total demand. No demand for wide copper sheet has been identified at all. The very great investment needed for a wide hot mill (over 950mm) is simply not justified by the volume of wide material in the market mix. (Nor can cold mills of this width be justified for later processing of coils).

Two cheaper alternative solutions have already been mentioned:

- extruded thin slab
- continuous cast thin slab.

Concerning extrusion, even a large press will produce slab only 275 mm wide from a 300 mm dia. billet. As less than 35% of brass strip and sheet demand is below 260 mm and since billet casting plus extrusion will be almost as costly as slab casting plus hot rolling even if pickling is eliminated alternatives must be studied.

Continuous casting processes for brass slab are now claimed capable of producing 600 x 16-20 mm slab and are certainly producing 500 mm wide, using water-cooled graphite moulds integral with channel-cored electric induction holding/casting furnace. Over 75% of brass (and copper) strip demand is 500 mm wide or less, according to the market forecast. Plant to produce sufficient volume of brass slab to capacity need not in fact be purchased at the outset. It would consist of several casting machine lines in parallel, actually supplying one slab milling line.

The technology of these machines, be they for horizontal strand casting or vertical, depends upon accurate and precisely matched control of casting (pullout) speed with mould and molten metal temperatures. It can accommodate some variations in supplies (electricity, cooling water volume and temperature) and is now reliable.

The use of continuous cast, milled slab eliminates hot rolling and pickling. With the present width limitation it requires cross rolling of 500 mm material to produce 900-950 mm wide sheets for which there is some demand in brass. Concerning copper, we anticipate a market for about 1,000 tons p.a. of foil for automotive radiators and a further 1,500 tons p.a. of high conductivity copper strip for transformer winding. While the radiator foil copper could be cast as continuous slab the graphite mould has a reduced life with copper generally, and a very short life with tough pitch (oxygen bearing) copper. However, both these known copper strip requirements are for narrow width and can therefore be extruded to slab in the extrusion press. In the scheme proposed, a single suitable press can process in two shift operation this copper slab, the tube shells and the rod bar and section.

3.6 Billet Casting

Semi-continuous processes must now be considered as standard practice for this, provided the volume of a given alloy and size is sufficient. If an alloy (or a size) is made only occasionally then it should be cast in fixed moulds and treated as a "special" rather than interrupt the usual high volume flow in the continuous casting plant.

We are in fact specifying that very few alloys be made in this plant and those to be cast to billet are shown in Table 3.2

TABLE 3.2 : BILLET ALLOYS DEMAND

Composition			End Use	Tonnage Capacity Approx.
Cu	Zn	Pb		
60	38	2	Brass rod for forging	4300
57	39	4	Drawn rod for machining	2000
100	-	-	ETP Copper for:	
			- busbar extrusions	2100
			- slab for rolling	2100

The ETP, high conductivity copper cannot be continuous cast to slab for rolling to strip because of the disastrous effect hot tough-pitch copper has upon the graphite mould, hence we plan that it be extruded. This need to cast ETP copper as billet is instrumental in choosing the billet-casting technology.

For cylindrical billets (and thick slabs) there are two basic systems of continuous casting:

- horizontal, in graphite ring mould, similar to the process specified here for thin slab.
- vertical or drop casting in moulds of water-cooled copper, alloyed copper or plated copper.

We know it is not practicable to cast tough pitch copper in graphite so we have to choose drop casting. This process is very well proven and widely used for brass and copper (and indeed for many other alloys).

3.7 Strip Rolling

Strip of brass and copper (ETP and PDO) will be produced initially as slab at about 16 mm thickness. It will require scalping or milling on both sides to ensure a low level of surface defects at finished size. Millers may be of the horizontal axis type with a large, helical cutter,alternatively the vertical type with several cutting tools around the periphery of a circular cutting head. The vertical type has to be of diameter slightly greater than the strip width and cuts twice: at the front edge of the cutter and at the back edge. The drawback of this type is that swarf is not readily removed and can get caught in the second cut, causing slight damage to the cutting bits and goug... the strip slab. The large helical horizontal tools are more expensive than the vertical end-cutter disc assemblies, but they have replaceable cutting edges in lengths of 50-100 mm which are less susceptible to damage and less likely to cause it, compared with the replaceable "teeth" of the face miller tool.

Our assessment is that the horizontal helical cutter type is preferable and more problem free. While such milling should preferably take place in-line with the casting, such interdependence between milling and casting would endanger productivity in that unless both were working there would be no production of slab. Happily, milling is a much faster process than slab casting so we can specify one or two millers to work the output of the several slab casting lines.

Both the millers and the casting lines have upcoilers to produce unit large diameter coils to pass to the first cold breakdown rolling mill. This mill may be 2-high or 4-high, but best yield and at lowest cost are given by a 2-high, non-reversing mill equipped with an upcoiler and not a tension coiler. Reductions in this mill should go as far as the material will allow, from 15 mm as milled, that is to 3 mm in copper, 4.5-5 mm in brass. The purpose is to break up the course, cast structure (of the brass) and to allow coiling to a more manageable diameter for the subsequent annealing treatment.

The reduction is limited mainly by the tendency of the as-cast edge to cracking and also but less, by the increase in hardness as the brass is rolled.

The second breakdown mill receives coils from the first mill, after annealing in a roller hearth furnace. The second breakdown mill should be a 4-high mill and again it may with economy be non-reversing. Non-reversing mills have the advantage that all parts of the coil may be rolled to the same thickness, whereas reversing mills have an unrolled portion at each end of the coil, which is wasted and diminishes the yield, markedly so when the strip is thick.

Non-reversing mills do not usually adjust the roll gap during passes. This gives great simplicity in operation. Reversing mills with tension coilers back and front can both reduce gauge more rapidly and adjust gauge variations, by controlling these tensions and by automatic adjustment of roll gap. These sophistications are justified only with thinner strip, where the tension applied is significant in terms of strip tensile strength, or where big reductions are to be made in high tensile metals. The ultimate mills in this respect are the cluster mills, particularly the Sendzimir designs. They are commonly used for heavy reductions on stainless steel for example, at high rates of output. A Sendzimir mill is not justified by the quantity or the nature of the work in the present project. It would be too expensive and far too sophisticated.

The second breakdown mill is to carry out the "rundown" reduction to the pre-finished size, at which the last anneal takes place (except where foil is to be the end-product).

For this last anneal we specify a bell furnace, which is economical in factory floor space, in original cost and in fuel consumption and which allows accurate control of temperature and soak time.

The final reductions or temper rolling serve to adjust the strip shape, the strip gauge to within tolerance and the hardness, which will have been specified by the buyer. For this purpose a four-high reversing mill, with tension coilers, automatic gauge control and hydraulic roll gap adjustment is the best alternative.

A second similar mill but with smaller work rolls and more sensitive control systems is necessary and justified for the production of copper and brass foil for automobile radiators. This is close tolerance material in the range 0.05-0.25 mm gauge. Some specialised and sophisticated mills have been developed for quantity production of radiator foils, e.g. Frohling pre-stressed, but we feel that for the quantity involved a second conventional finishing mill at moderate cost should be preferred, dedicated to finishing foil. The maximum finished gauge rolled on it should be 0.3 mm and it must be remarked that this mill is only justified at all by the forecast market demand for radiator foil.

3.8 Sheet Rolling

We have examined the question of maximum width in the choice between hot rolling and continuous strip casting. To meet the demand for sheet brass 500-900 mm wide by rolling coil would require hot rolling and that would not be justified in capital cost for the tonnage involved. Furthermore, we have rejected the possibility of hot rolling overall.

Given that the maximum original strip width (cast) is 500 mm the only way to produce wider material will be to cross-roll. This is done in a simple four-high non-reversing cold mill but in single sheets.

The feeding of single sheets to such a mill and especially the stacking after each rolling pass are easily mechanised with wide belts or driven roller tables.

It is therefore proposed that the required material be cut to length (maximum 1000 mm) at 3-5 mm gauge, in-line as it emerges from the first breakdown mill. It should then be bundled and annealed in the roller hearth furnace at that gauge, also similarly at thinner gauges as necessary during the rolling sequence, in the same furnace.

It should be noted here that without this requirement to anneal sheet, the 500 mm wide coils would in fact be more economically annealed in a bell furnace, alternatively the presence of the sheet requirement justifies the choice of the roller hearth furnace.

3.9 Rod and Bar Finishing

It is customary for bars and sections (extruded) of free-machining brass to be drawn one pass and straightened, as a finishing sequence. This ensures good dimensional uniformity in the sector, which is necessary for automatic machining equipment and enhances machinability still further in the material. For this, a simple pointer and drawbench are required, also provision for coil feed in the case of lighter sections which are coiled upon extrusion. The sections need pickling before drawing and the points cut off after drawing.

All extruded sections, whether drawn afterwards or not, require straightening. A cross-roll or Medart straightener is suitable only for round bars and gives excellent results. However, a 2 x 9 roll straightener is necessary for other sections and will work satisfactorily on round bar too, so it must be preferred. The capacity volume demand does not justify both.

3.10 Tube Finishing

Tube shells extruded from billet need pickling free of scale, which is conveniently done adjacent to the quench cooling trough in which the shells run-out from the press.

We have then to examine the alternative ways of working these hollows to the much smaller diameter tubes, with thinner walls, which the market requires. So far as initial reduction or breaking down is concerned there are two possibilities of which one, the tube reducing or Pilger mill was originally developed for hot reduction of steel tubes but is now specified (and in use) where high volume production of copper tubes is being set up.

The two alternative processing routes, i.e. tube reducing and draw bench drawing, were considered in relation to the range of product types, sizes and alloys demanded. Tube reducing has established an excellent reputation in recent years for high output rates and large unit weights but requires high volumes of one size of input and output to be economical. Furthermore, it requires a higher capital outlay than equivalent capacity draw benches, is more complex and costly to maintain in view of its high reciprocating masses and requires a substantially longer training period for both operation and maintenance. For the range of products and alloys demanded here, it is considered that greater operational flexibility, reliability and economy would be provided by the choice of a 120,000 lb x 150 foot triple draw bench for use predominantly in breaking-down operations for both copper and brass.

Copper Finishing

In choosing finishing routes and technology we have to consider the manufacture of copper tubing for air conditioning, refrigeration and domestic water services. The quantities specified lend themselves to mass production techniques and hence are classed as mass production copper, whereas a small amount of general engineering copper (classed as miscellaneous copper) can be accommodated either on the brass bench route (outlined below) or will be close to the standard size during the manufacture of the mass production products. The prior choice of extrusion press size and consequent limitation on billet weight gives some constraint on the following process techniques from the 120,000 lb draw bench. Assuming the normal requirement for AC tubing in 100 kg. long length coils, then the process really demands the use of spinner blocks to retain the total shell weight to the finished size. If very little AC tube in coil form were required then conventional 5 foot drop off blocks and smaller piece weights would be a satisfactory and lower cost-alternative. However, the long term growth potential of AC tube would indicate the desirability of starting with the most modern blocks, i.e. spinners. Furthermore, for handling small diameter thin-walled tubing spinner blocks are much superior. The piece weight for spinner blocks should ideally be greater than the 150 kg. available in these present proposals, but a significant increase could only be achieved by increasing the size of extrusion press.

Hence the process route chosen consists of an 84" diameter intermediate breaking-down drop off block which will feed tubing in baskets to one of two 84" diameter spinner blocks. *These latter two machines are completely* interchangeable and can make a wide range of finished tubing down to ¼"OD x 0.012" thick if necessary. Normally the smallest air conditioning tubing is ⅜" OD x 0.016" thick and the smallest refrigeration tubing is ¼" OD x 0.028" thick.

Air Conditioning tubing, when supplied in coil form, is finished in what is known as layer or level wound coil, the approximate dimensions being 32" OD x 22" bore x 9" in depth and the tubing being in the range 500-2,000 feet long. No special cleaning techniques other than purging prior to bright annealing are required and the coils are sold in the soft, open-ended condition.

Refrigeration tubing is normally supplied in pancake coils of varying diameter and containing 60-90 feet of tubing. This quality is sold to a cleanliness specification and the coils require steam cleaning prior to annealing and are plugged at both ends after annealing.

DWS plumbing tubing is available in two alternative specifications, i.e. BS 2871, Table X and Table Z. Both are sold in 6 metres/20 feet lengths. Table X is in the half-hard condition and can be bent by a plumber given the right tools and skills. Table Z is in the hard condition and has a thinner wall, i.e. at 15 mm OD x 0.5 mm for Table Z and x 0.7 mm for Table X. Both require fittings to join the lengths together and, whilst Table Z requires a few more fittings per installation, the total cost of the installation is cheaper because of the time saved in not bending and the lower cost per unit length of tubing (tubing costs more to make but this is more than out-weighed by the less expensive copper it contains). Furthermore, the half-hard copper requires special cleaning techniques if it is going to be used in areas where the water supply is hard and this can sometimes result in corrosion problems from residual carbon inside the tubes. It is very rare to have this problem with hard copper.

Table Z is, therefore, recommended and the required sizes can be drawn to penultimate size on the spinner blocks and finished on a combined drawing, straightening and cutting to length machine. This machine would also be equipped with a coiling machine which would be used for the manufacture of refrigeration coils.

Intermediate and finishing operations - brasses

The following recommendations assume the manufacture of a range of tube sizes from ¼" to 2" OD as specified under "preferred sizes for general purposes" BS 885 Table 1 and BS 2871 (1972) Table 4 metric equivalent. For all sizes up to and including 1⅛"Ø it is proposed to adopt a standard intermediate feed stock of 1.53"b x .125" thick x 23.5 ft. length supplied by breaking down drawbench.

Polymer type lubrication is recommended for all intermediate and finishing processes.

For intermediate reductions and finishing, tubes will be pointed and drawn on a 60" horizontal axis drawing block. Brass tubes generally require annealing after every 2-3 passes and this would be done in coil in a roller hearth furnace, repeatedly until finished size is reached. For brass tubes and less common copper tube sizes we specify a cutting and straightening line and a separate inspection bench. Final anneal can take place in the same No.1 Roller Hearth Furnace.

4. RAW MATERIALS

The raw material inputs for the proposed plant can be divided into a number of distinct areas. The first and by far most important area is that of metals. The first requirement is for copper cathodes and we have considered the supply of these from two sources, Zambia and the international market.

The total requirement for copper can be divided into two areas:

- copper required for electrical purposes;
- copper required for alloying and other non-electrical purposes.

In the first case the copper implicitly must be electrolytically refined cathode or a processed form of this material. In the latter case fire-refined and in certain instances even blister copper would be adequate. Under the general Government protocol relating to this project, copper would be supplied to the plant by Zambia although a detailed cost has not been agreed. For the purpose of this exercise we have assumed that the basis will be that copper is priced LME price cif Nigerian port. Likewise we have assumed that Zambia would provide zinc and other alloying materials on a similar price basis with an option existing in practice for the supply of alloyed ingot and blister copper. For the preparation of this feasibility study we have assumed that all copper used is supplied as cathode and all alloying is carried out in Nigeria.

The cost of raw material to the plant obviously must include all landing charges, harbour dues, import duties and the cost of inland transportation as well as the cif price of the material and these items and costs are all detailed in Section 11 of this report.

As the copper plant and other similar units are established in Nigeria over a period of time, a local scrap collection and sorting industry will develop and progressively an input of scrap, in addition to that generated within the copper plant and within the wire and cable factories, will become an increasingly important raw material input.

In the earlier stages of industrial development in a country it is not just the absence of a scrap collection and sorting industry which limits the use of scrap as a raw material in industrial plants such as the one envisaged in this project, but also the general absence of significant quantities of scrap metal per se. Whereas in countries such as the UK, where significant quantities of copper have been used for more than 50 years, a good "reservoir" of copper in use exists in developing countries there is no such "reservoir" and no large quantities of old scrap coming to the market on a regular basis.

In a developed country certain sub-segments of the copper processing industry rely almost entirely on scrap metal as their raw material input. In Nigeria without importing the scrap metal such an alternative is not possible.

We have considered the possibility of the shipment of copper and copper alloy scrap from for example Europe and other developed countries to Nigeria. Firstly there are in a number of countries several complications resulting from legislation and regulation prohibiting or limiting the export of copper and copper alloy scrap materials. Secondly, the transport costs tend to cancel any cost savings there may be from using scrap as opposed to virgin material. Therefore we have limited the usage of scrap to new scrap generated within the industry and assumed all other copper and copper alloy raw materials would be based on imported ingot and cathode.

Nigeria has only a very limited metallic mineral wealth. Prior to the civil war lead and zinc was mined in Anambra State and at some stage in the future we understand these workings could possibly be re-opened. Whether or not there are sufficient reserves to justify the investment in smelting and refining facilities for lead and zinc, it would appear to be an open question at the present time. In the absence of any firm plans however, we must assume that none of the metallic raw materials will be available locally.

The other raw material imports comprise a range of consumable materials, these are:

- enamel (for winding wire);
- pickling acid;
- lubricants;
- packaging materials;

- refractories;
- rolling emulsions;

as well as a whole host of consumable tooling in the form of dies, pressure pads, burners, saw blades, moulds etc.

The consumable tooling items will all be imported and an amount of these will come as part of the initial plant in the form of consumable spares.

Enamel likewise must be imported. This is a product where quality and technical/chemical characteristics are extremely important and local manufacture in Nigeria on the scale required is unlikely to be viable.

Lubricants and rolling emulsions will also in all probability be imported over the next ten years. Some of the more common lubricants could become available locally in the second half of the 1980's when the planned new refinery and blending capacities are brought on-stream. Indications are that prices for such items will be comparable with the price of imported products and as such local availability would make little difference to the feasibility calculation.

Pickling acid should be available locally in Nigeria. A number of plans are already operational and developments in the chemical, petrochemical and related sectors are such as to ensure that several new acid producing plants will be operating by 1985/86.

Packaging materials again should be available locally, although some of these items could be met by imports, particularly in the earlier years.

We would recommend that in all areas, once raw materials of a suitable quality etc. become available in the local market these are used by the Nigerian company. Such locally manufactured items must however be of a satisfactory quality as many of the copper and copper alloy semi-finished products to be manufactured must be produced to close tolerances and must be produced under tightly controlled conditions. Contaminants from rolling emulsions etc. can cause serious and costly problems.

The major problem to be faced in the area of raw materials is the shipment of metal from Zambia and the options in this area have been considered in detail in the following sub-section.

Shipments from Zambia

The establishment of facilities in Nigeria for the semi-fabrication of copper products not only maximises the domestic value added but also avoids double shipment, i.e. shipment of Zambian cathode to plants outside Africa and subsequent return of the semis.

All Zambian copper is now exported to world markets through East African ports, which it reaches by rail or road. The state has part ownership of the Tazara Railway to Dar es Salaam as well as of Zambia Tanzania Road Services Ltd. and thus profits from overland transportation. Nevertheless, Zambia's land-locked position puts the copper producers at a distinct disadvantage since world market prices are on a c & f basis.

Shipments to Nigeria would probably bring a marginal relief from this burden, although this cannot be determined quantitatively at this stage of the project. Copper cathode already enjoys favourable ocean freight rates, for example approximately US $50 from Dar es Salaam to Europe. We have established that similarly favourable treatment can be accorded to shipments to Nigeria. Rates could in fact be slightly lower on account of the shorter distances involved. It probably matters little from which East African port the consignments originate. Metal Marketing Corporation of Zambia Ltd., which is responsible for exporting all copper, now chooses whichever port happens to be the most expedient.

The Benguela Railway from the Copper Belt west through Zaire to the Angolan port of Lobito remains closed to Zambian traffic on account of civil disturbances within Angola. However, this line to the west may well be safe and rehabilitated by the time the proposed project becomes operational, in which case it will offer the obvious route to Nigeria. Rail transportation may prove slightly more costly than to eastern ports on account of somewhat greater distance, but the short coastal run from Lobito to Nigeria should result in an overall saving of transportation costs. It is not possible at present to obtain any quotations so that this comparison must remain qualitative for the time being.

In their Zambian Coastal Links Transport Study finalised in June, 1980 Cooper & Lybrand Associates Ltd. came up with the following findings which support the foregoing views:

"The cheapest route for Zambian trade is via Tazara to Dar es Salaam port. Furthermore, since GRZ have a half share in the ownership of the Tazara Railway, there are additional financial advantages in it utilising this route to the maximum practical extent.

The Lobito route also appears to be relatively cheap according to our estimates (based on the rates prevailing at the time the route was closed in 1975 which have been adjusted for inflation). However, much depends on whether the Benguela Railway and Lobito port retain their relatively low tariff structures once this route re-opens. It is possible that tariffs may be raised substantially in order to finance urgently needed investment".

Table 4.1 shows inland and through tariffs (from and to Europe) they computed for the principal routes.

Through tariffs for copper exports are less than a half those for general goods imports. This mainly reflects the ease with which copper can be handled, its favourable loading characteristics, and the fact that it is normally shipped in quite large consignments which reduces documentation, administration and other costs. It also partly reflects the preferential tariffs which have historically been charged on this vital commodity (particularly at Dar es Salaam port).

The only semi-fabricated copper product available in Zambia for export at the present time is wire rod. The manufacturer, ZAMEFA, estimates that up to 5,000 t/y could be shipped now (based on 3-shift operation) and that 7,000 t/y may be available when a small wire rod casting line, currently under consideration, has been added to the extrusion plant. These quantities are low compared with the demand in West Africa.

Nchanga Consolidated Copper Mines Ltd. produces approximately 2,400 t/y of billets for ZAMEFA's extrusion press on a casting wheel, but given a choice the company would rather phase this operation out.

TABLE 4.1 : COMPARISON OF REPRESENTATIVE TARIFFS FOR ZAMBIAN TRADE BY MAIN ROUTE (Kwacha Per Tonne)

Route	Through Tariff		Inland Sector	
	Break Bulk Imports	Copper Exports	Break Bulk Imports	Copper Exports
Tanzam Highway to DSM	288	106	132	64
Tazara to Dar-es-Salaam	256	97	100	55
Lobito	250	131	110	91
Southern Route	332	154	182	114
Road/Rail via Malawi	304	124	149	84
Road/Rail via Moatize	302	123	146	84

Source: Cooper and Lybrand Associates Limited (1980)

5. MARKETING STRATEGY

Before considering the marketing strategy for the new company it is perhaps worthwhile to briefly review the way in which copper and the products of copper are traded in various parts of the world.

5.1 Trade in Copper and Copper Alloy Products

Raw materials cover ores, concentrates, blister and refined copper as well as wire-bar and more recently continuously cast wire rod. Semi-finished products include hot rolled wire rod, wire, flat products, tubes and rods, bars and sections. Traditionally wire rod has been regarded as a semi-finished product, however the growth of continuously cast wire rod is eliminating wire bar, and Southwire rod is now increasingly being traded as a raw material as opposed to a semi-finished product.

Throughout the world the above mentioned raw materials are handled by the major international commodity traders such as Philipp Bros., Tennants, Harlow and Jones, Ametalco and the Japanese trading houses of the major companies. The precise way in which these companies operate does tend to vary somewhat in that some act only for a limited number of clients while others are purely commodity trading houses matching sales and purchases on a commission basis. Some companies such as Ametalco are sales agents for mining companies although not all are owned by the mining company. In addition to providing a sales service these companies also provide other services such as the arrangement of shipping, invoicing, market research and technical services. In general, with the exception of the Japanese companies, those organisations involved in raw material trading are not involved in trading in semi-finished products or at least not in the developed countries of the world.

Copper and copper alloy semi-finished products are traded in a number of ways. Within the home market a company will have a number of sales agency and stock-holding companies and in general the manufacturer will have a majority equity holding in these companies even if they are not wholly-owned subsidiaries of the semis manufacturer. These sales agencies handle complaints and other service functions. Many exclusive agents never physically handle the semis, but arrange for direct shipment from the manufacturer to the end-user. This results primarily from the fact that holding stocks entails a high risk where stock levels are likely to change significantly. The price of the average semi is made up of 70% copper and 30% to cover conversion, profit, labour and overheads.

The end-user sector to be supplied plays a very important part in determining whether or not a stockist is required. Most industrial users are serviced either direct by the semis manufacturer or through an agent with supplies being despatched direct from the semis manufacturer to the end-user. The construction industry however tends to be served via stockists and the relatively low value added content of the main products supplied to this sector means that stockists must handle sales and purchases very carefully.

It is to a large extent for the above mentioned reasons that large volumes of semis generally are not moved across inter-regional boundaries, as was shown in Volume 2 of this report. The high proportion of the total value of a semi-finished product accounted for in the value of the copper means that freight costs, duties and the high risk associated with a volatile commodity price makes this a relatively unattractive commercial proposition.

Before considering the way in which the new Nigerian company should establish its export activity, in order to best commercialise its products, it is worthwhile to examine the experience of other countries in this area. As was shown in Volume 2 of the report neither of the two North American countries are major exporters of copper and copper alloy semi-finished products, and as such the way in which these countries have organised their export activity is of little significance in the context of the present project. Indeed a high percentage of exports from these countries are tied to American end-user companies having located overseas. For example, a manufacturer of air-conditioning units who establishes a facility in Saudia Arabia is likely to continue to source his copper tube for condensor manufacture from the USA. In many cases this sourcing may be through his own US parent company rather than direct from the manufacturer of the copper and copper alloy semi-finished product. In Europe a similar situation prevails with exports accounting for only some 15% of total production from many countries. There are some exceptions, such as Belgium, but here a closer examination reveals that the major portion of exports are made to neighbouring countries and as such are of little significance.

The only European country where exports account for a large part of total production is Yugoslavia. That country in the early 1970's developed its copper industry, based on indigenous raw material, as a major export earner. The country has progressively developed markets in Europe, North America and indeed in other parts of the world for its products. Much of this success has been achieved by offering products acceptable in quality at highly competitive prices. For example, in the USA semis from Yugoslavia are significantly cheaper than those from other countries. A comparison of the value of US imports from for example, Germany and Yugoslavia show the latter to be at least 10% less than the former. As is the case in Europe, US imports from Yugoslavia are generally the lowest value per ton of all imports in any category.

Being a copper producing country Yugoslavia does not have to price copper on an LME basis or any other recognised copper price. By selling copper in the form of semi-finished products Yugoslavia has been able to obtain more "hard" foreign exchange than if the country had chosen to sell its copper in the form of blister or refined. On the other hand the price of Yugoslavian semis do not represent a true commercial price if raw material is priced at a world market price and actual conversion costs are added to the raw metal price. This approach can however be justified. On the one hand it could be argued that a dual foreign exchange rate is being operated, whereby the higher value added content, the difference between the price which could be obtained for the raw material and that for the semi is converted at a different exchange rate to that normally operating for raw material sales.
By increasing the value added content of its natural resources Yugoslavia is creating employment, developing its own industry and enabling economical levels of production to be achieved. Alternatively it can be argued that Yugoslavia is using dual pricing systems whereby semis are sold to the local market at prices which would have to be charged if only the local market was being served. These savings are then passed on to products manufactured for export.

Unquestionably Yugoslavia has this flexibility because it is a copper producing country and the copper industry is vertically integrated from mine through to semi-finished products. The transfer price of copper from one stage to another need not therefore be the prevailing world price.

On the debit side several countries have endeavoured to develop exports of copper and copper alloy semi-finished products. A notable case is Chile again a copper producer. In the 1960's Chile increased exports of copper and copper alloy semi-finished products until in 1965 over 60,000 tons of products were exported. Some 55% of these exports were wire rod with the major portion of other exports being flat products. By 1967 total Chilean exports had fallen to 8,000 tons with only some 600 tons being brass mill products. This fall was due to a number of reasons. In part it was a result of tied sales to the USA being cancelled and in part was due to a failure to meet adequate standards and specifications. Within Europe markets were lost because of poor quality and bad deliveries although it is true to say that Chile never had very substantial permanent markets in Europe. Gained sales by South Africa and Mexico in general fall into this category. In the 1970's Chile managed to restore its level of exports in part, but on no occasion did exports again reach the levels of the mid-1960's. Indeed throughout much of the 1970's exports totalled around 38,000 tons per annum.

Turning to the actual mechanism of commercialisation most European countries (and indeed other non-East European countries) approach this in one of two ways, or by a mixture of both. These two approaches resolve simply into direct representation and exclusive agencies. Most copper wire-rod sales are made as a result of direct representation while sales of brass mill products to the building sector are made largely through exclusive agency agreements. Products such as wires and cables and brass rods, bars and sections tend to fall between these two extremes with a part of total sales going through the two channels. East European (including Yugoslavia) and to some extent Japanese companies make sales through direct representation by State Trading Organisations and Federations with agents possibly being appointed to deal with regions and sub-sectors of the market.

Turning to the specific case of Nigeria the precise form of marketing organisation will be dependent upon the type of agreement which is reached regarding production of semis in Nigeria. Three possibilities exist regarding production. On the one hand a joint-venture may be established with a European or North American company and in part at least sales to certain markets should be possible through the sales organisation of this company. The second possibility regarding production is that Nigeria and Zambia choose to develop the semis industry alone (or at least without the aid of a foreign company) using foreign personnel on a contract basis to provide the necessary technical expertise. In this case an entire marketing organisation will have to be created. A third possibility is that the marketing arm of the Zambian company MEMACO is developed to serve as the marketing arm of the new company in markets outside Nigeria. This company already has some experience of marketing semis although obviously its prime expertise is in marketing raw copper.

Because stocks of semis represent tied capital end-users try to keep these to a minimum and seldom carry a stock level equal to the unit size of an order. Thus the end-user needs to be confident that the quality of the product will be as specified and he will not be faced with the possibility of having to return a complete shipment (particularly where this has come from overseas) thus having insufficient stock to continue production. The confidence of an end-user in deliveries and quality can only be developed with time although the appointment of an agent/stockholder already trading in semis will assist in this respect.

In general, price is an important factor only insofar as that if delivery, quality etc., from two alternative sources are equal, then a decision will probably be made on the basis of price. Obviously where dumping prices are in operation then the situation changes and an end-user may buy purely for the value of the metal. It is true that in a few cases where for example, the semi is to be used in a developing country to make holloware, then price is very important. In such a case however, transportation costs alone make sourcing this sector from an outside market impossible and as such the sector is served from locally fabricated sheet, using scrap metal as the input.

Within neighbouring countries of West Africa one of the most significant problems that the new company will face will be that of standards and specifications. In the field of wire and cable this will be a major problem and within the foreseeable future the best course of action is for the company to ignore those sub-segments of the market requiring specifications outside the common ranges to be made by the Nigerian industry. In the area of brass mill products the problems of specification will arise in only a very few areas as most brass mill products are manufactured to satisfy most specifications.

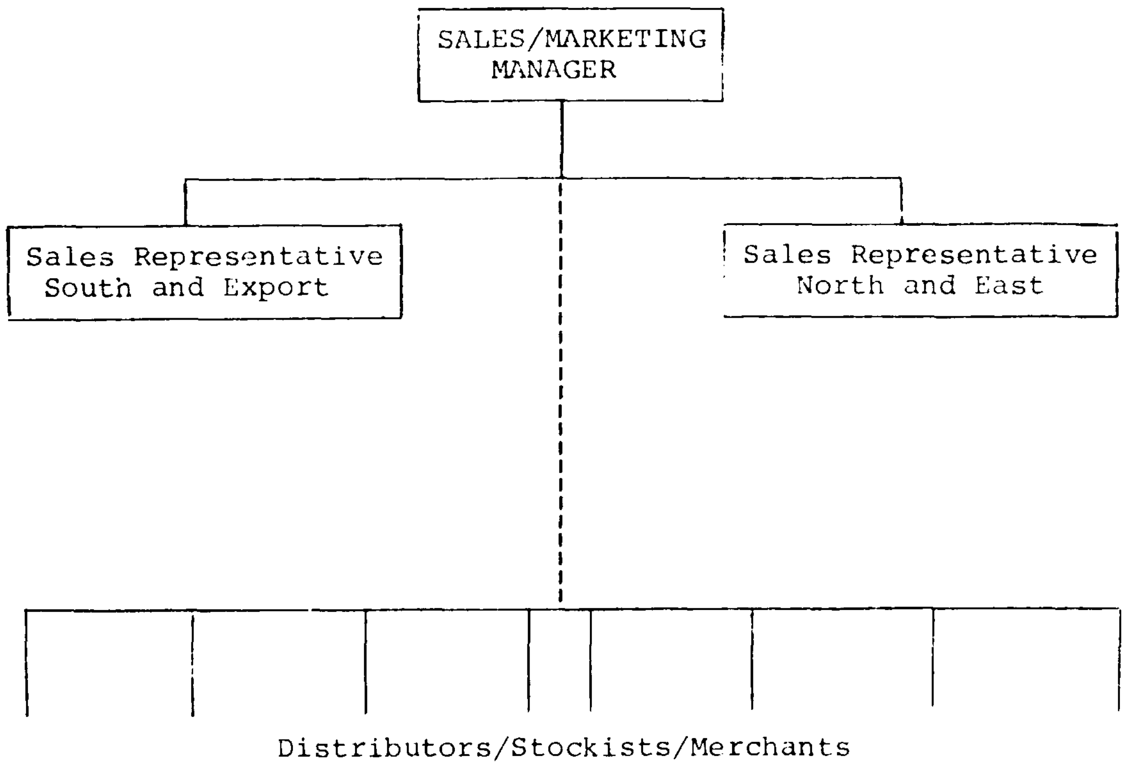
The main part of the marketing organisation of the new company will be concerned with activities in Nigeria. In this respect the company will need a number of marketing and sales people as well as agent/builders merchants in different regions of the country. The actual organisation will be a function of the agreement made between the two Governments and between the new company and its technical partner. Nevertheless we have assumed a marketing and sales organisation as shown in Figure 5.1.

Indeed even for the type or organisation outlined above several people with the experience of marketing semis will be required to co-ordinate the sales effort in the different regions/markets. It is therefore essential that the necessary steps be taken immediately to place such people in companies where they can acquire the necessary experience. Training could take place while the factory is under construction so that once on stream a chain of distributors and named sales people are in place.

It cannot be over emphasised that in the initial years of marketing it will be imperative to gain confidence in all market sectors and as such any mistakes or failings could be very costly and it could take several years to restore confidence.

In those neighbouring countries where the potential market for Nigeria is relatively small the most suitable approach will be to appoint agents. Obviously, at this stage agents will be unwilling to make any firm commitment but once products are available agents can be appointed. Most agents operate entirely on a commission basis although some private arrangements are sometimes made regarding financing and pricing of copper. Commission rates vary according to order size and type of semi ranging from 2% to 10%, higher commissions being given for more sophisticated products. Very often agents will never physically handle the semis, but will arrange for direct shipment to the customer.

FIGURE 5.1 : MARKETING AND SALES ORGANISATION



Finally at a Government level it may be possible in negotiations and contact with other Governments around the world to accord priority to purchase copper and copper alloy semi-finished products by those countries with which Nigeria has an unfavourable balance of trade. This approach is equally applicable with countries in both the Western and Eastern Blocs.

5.2 Prices and Pricing Policies

Contrary to quite widely held beliefs prices of copper and copper alloy products are not widely different from one developed country to another. Differences which are found in less developed countries are usually a reflection of higher cost associated with small volume production. Even in countries where disproportionately large supplies of scrap are available, prices tend to be only marginally different to those in countries where large quantities of scrap are not available. This situation arises primarily from the fact that copper is a commodity which is widely traded. Because copper is a very marketable commodity a company or country wishing to sell this is able to command an international price and assuming that there is no legislation regarding exports of raw materials or scrap metal, the company is generally prepared to sell this to either a local or an overseas purchaser. This is no incentive for the seller to differentially price local and overseas sales of these materials beyond difference in freight and/or port handling charges etc. These factors all serve to establish an "international price".

It is not to say that scrap or processed copper will not be sold at a price below the prevailing international price at the time. Export incentives, foreign exchange bonus system and a country's desire for an increased value added content in its raw materials in certain cases does result in prices which differ from those which can be termed international prices.

In Volume 2 of this report a review of world prices of copper was given along with an outline of different pricing policies on copper and copper alloy semi-finished products.

The London Metal Exchange (LME) price of copper is subject to change as a result of a variety of factors. Obviously the supply - demand situation is the most important and the LME price reacts to short-term as well as long-term changes in supply and demand. Furthermore, the LME is also used by speculators and will react to buying or selling by such people. Often this speculation is purely and simply speculating on a change in price of copper, however, at other times it is used as a hedge against currencies or other forms of investment. In recent months the world's currency position has been volatile and as a result there has been a move away from currency into commodities, with a consequent increase in price. What has been more important in recent months however, has been the change in value of different currencies relative to one another. The US dollar has increased in value while sterling and other currencies have decreased in value. The LME price of copper is always quoted in sterling and as such has changed as the value of sterling has changed relative to other currencies.

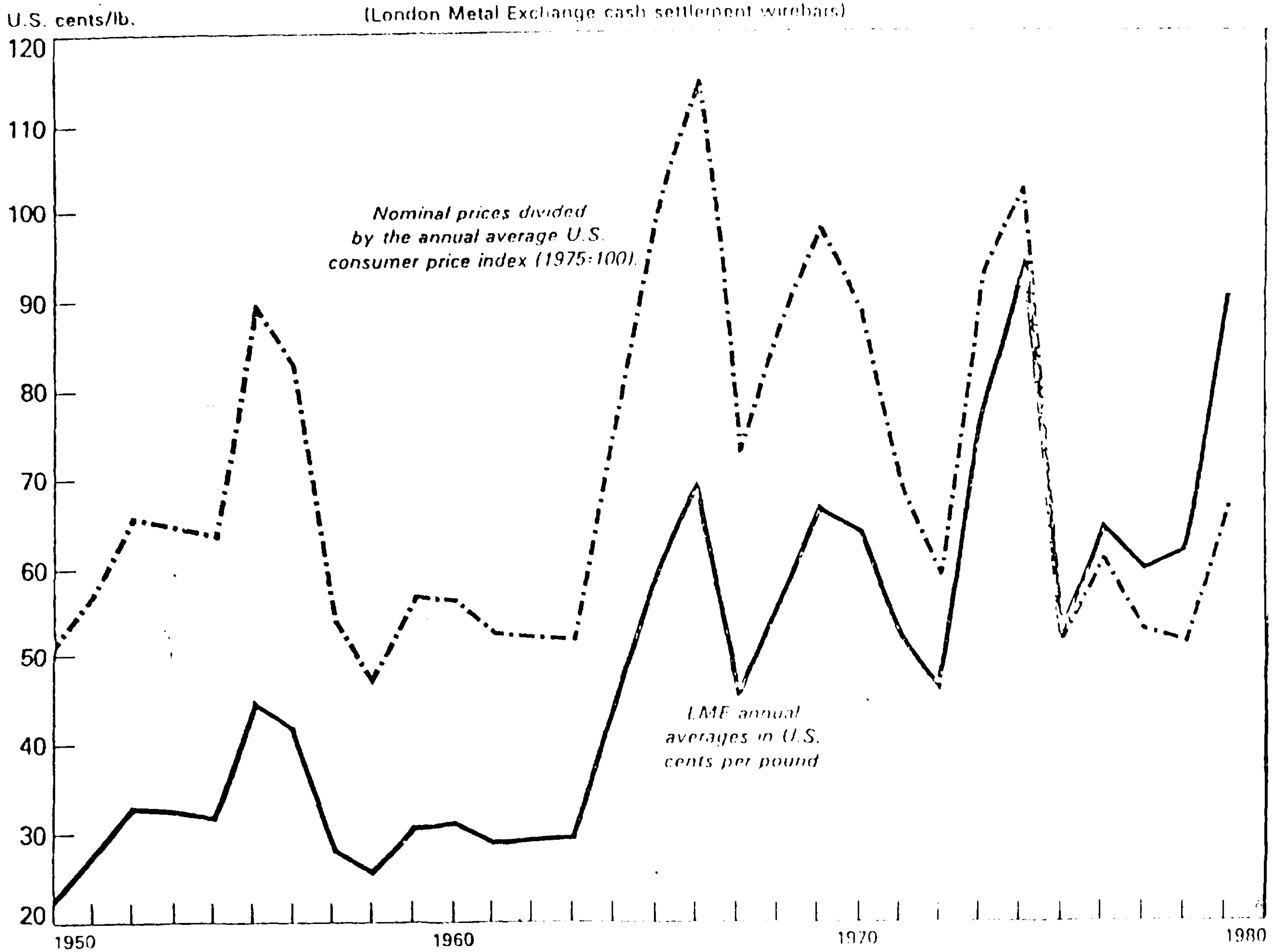
It is virtually impossible to find an absolute level to "neutral" currency for comparative purposes. In Figure 5.2 the nominal and real copper price for the period 1950 to 1979 is shown. As can be seen this shows a wide variation from the LME price and as such copper producers have difficulty in planning their economies as revenues in real terms vary considerably.

As far as copper semis are concerned, as was mentioned above these are in the first place "tied" to the copper price. Again in general there are "international" prices although some regional differences do exist. The differences however, in general merely reflect different basic copper prices, tariffs and/or freight costs from one region to another. Europe probably provides the best example of how semi-finished products are priced in national and international markets. Within most European countries, the raw metal is priced entirely on the LME price and the low level of tariffs between European countries means that manufacturing costs must be kept to a minimum or acceptable/competitive level. In the following paragraph the derivation of prices in two European countries France and Belgium, is considered in detail. These two countries serve as very good examples to show how semi-finished product prices are determined in developed countries of the world and the ways in which raw metal purchases and sales of finished products are matched.

In France some 70% of all primary copper requirements are purchased by GIRM (Groupement d' Importation et de Repartition des Metaux). This is a non-profit making central buying organisation whose main objective is to provide reliable sources of refined copper for the fabricating industry. To achieve this goal, GIRM buys copper from the producers and stocks and finances this on consignment with the fabricators, to whom it sells

FIGURE 5.2 : NOMINAL AND REAL COPPER PRICE 1950-79

(London Metal Exchange cash settlement wirebars)



Source: Metallgesellschaft, World Metal Statistics, IFS the copper under special conditions. These conditions are sufficiently flexible to allow for considerable variation in the quantity of copper purchased daily. The GIRM quotations, which closely follow the LME quotations, are the official French copper price.

Other sources of copper in France are the one electrolytic refinery and foreign producers who supply long term contracts direct and again the price from those sources are closely tied to LME.

There is of course one other source of copper in France as indeed there is in every other country, namely scrap. In general the price of scrap, particularly clean scrap is related to three references:

- the LME or GIRM price for wirebar and cathode;
- the overall supply and demand situation in all markets;
- the equivalent cost of transformation of scrap into cathode, or wirebar as required;

thus the price is effectively GIRM or LME price less some discount, which will relate to the quality of the scrap and to the market conditions. For pure scrap the upper limit is about GIRM less £20 per ton, this being the cost of using scrap instead of wirebar or cathode. If the price rises above this level the fabricators will not buy because primary copper will be more economical. Of course, the market conditions do not just relate to fabricators scrap purchases; the refineries, foundries and export markets also influence price.

Some 95% of GIRM's copper is purchased on long term contracts from the producers, while the remaining 5% is obtained from various other sources including merchants and dealers in London. These additional supplies, which are purchased on a one-off basis, give GIRM an additional flexibility of supply to enable it to meet the variations indemand with respect to location and form of raw material as well as quantities.

GIRM sets its domestic price for copper on a weighted average of the prices it has paid for its purchases. Thus the GIRM quotation for the day reflects a weighted average of its purchase price in proportion to the tonnages provided by each supplier on an fob or cif basis as the case may be. In effect the base for GIRM price is close to the LME cash settlement price currently ruling for the day. It will fluctuate with LME and to a lesser extent with foreign exchange rates. However, in an attempt to partially stabilise the price against small daily fluctuations on the London Metal Exchange, or at least to reduce the frequency of fluctuations, GIRM only alters its quotation if LME prices vary by more than about £3 per ton, (about FF4 per 100kgs). This margin has recently been increased to about £4 per ton (about FF5 per 100kgs).

The exact alteration is made from historical data on the effective discount or premium of the GIRM price over or under LME price on the same days, so that in the long term GIRM does not make a profit or loss charging a price that differs from LME prices, which is, of course, the basis of their purchase price. The effect of this £3 per ton "ceiling" is to reduce the number of price fluctuations in a 12 month period from about 250 to 150-200.

On top of the basic price, GIRM charges a small premium which is intended to defray administration expenses, freight and maritime insurances, forwarding, customs clearance, inland transportation, handling costs, warehousing, financial charges etc. This premium works out to be about 1-2% of the basic price; in actual terms it is about £5-7 per ton, but effectively the cost to the fabricator is about £2-4 per ton over direct purchases from LME or producers, as some of GIRM's services would otherwise have to be operated by the purchaser.

In addition to GIRM's normal sales of domestic copper, they also operate a service for fabricators who are exporting some of their output. In these cases the fabricators can buy 10-20% of their purchases from GIRM as "GIRM-export copper". The quantity sold as export copper is about 2,700 to 3,000 tons per month.

The copper is not stocked on consignment, but is delivered directly from the producers to the fabricators whilst the GIRM acts as a type of broker. Obviously, there will be some delay in delivery of this copper which is effectively bought long term. The GIRM export price is arbitrarily fixed:

- when a "backwardation" exists on LME the export price will be close to LME three months price;

- when a "contango" exists on LME the export price is still below GIRM normal price and is probably close to, but below, LME cash settlement price;

in effect without buying on different terms GIRM is giving an export subsidy to the fabricators, and is offsetting the cost against domestic consumers. The "export copper" system enables exporters to maintain their price competitiveness and partially hedge their risk in export trading.

Excluding export sales which only account for about 10-11% of copper used in semi-manufacturing there are three ways in which semis are sold and distributed in France. For the majority of electric wire and cable, and a proportion of wrought semis both in large or small orders, direct sales from the fabricators to the consumers are made. Here the goods are shipped from fabricators' works to consumers' works, even though it is possible for an agent to perform some intermediate function, perhaps as a means of credit, without actually handling or owning the products.

These agents are usually very reluctant to hold copper in stock, and even if they physically handle the material they will probably only buy for immediate resale. Although these agents do provide a necessary function by extending credit facilities and servicing small buyers they are not favourably regarded by the fabricators.

In the second system dealers or merchants physically stock semi- products for resale. These stocks will be held either on consignment from the fabricator, or by the stockists in their own right. In the latter case the dealers are taking the risk of holding copper; in the former case the fabricators could be holding copper at 'risk'. For certain products, for example domestic water tube, it is necessary to continue the chain of distribution to lower levels; large merchants/stockists will be selling to smaller merchants who in turn sell to the consumer; but the practice of consignment stocking will not extend past the first level of stockists.

The actual quantities sold direct or through merchants/ stockists vary considerably from one company to the next. As a general rule; 'special' products and semis destined for the electrical or automotive industries are sold direct; standard products are sold about 50% direct and 50% by merchants.

The third system by which semis are sold is the toll system. Under this system the end-user provides the fabricator with copper and in return receives the required semis, only paying the transformation charge. In Trefimetaux, the production of semis on toll accounts for about 100,000 tons per year; over all France the total tonnage of copper transformed on toll contracts of this type probably amounts to about 140,000-150,000 tons per year.

This type of transaction is very popular both with the end-users and the fabricators; but under French tax laws, an upper limit of 40% of sales from each fabricator to each customer can be on toll. For quantities above the 40% the end-users' copper must be directly or indirectly sold back to the fabricator and 'full' semis prices must be paid.

The electricity and telephone companies both use this type of toll contract for the purchase of some non-insulated wire and cable. They provide the transformers with refined copper that has been obtained on toll contracts with the refiners from old scrap.

For domestic sales of semis in France the price is usually fixed on the day of shipment. All export sales and some special domestic sales are priced on the day of order.

In general, similar conditions of contract exist for domestic sales of semis both for electrical wire and cable and for wrought products, and for sales on order or from stock.

In all cases using the normal agreements, the price of the semi is fixed on the day of shipment, whether delivery is due in six months or immediately.

This system was initiated after the Korean war when copper prices were falling rapidly due to the sudden surplus of supply. Although the fixing of a price on the day of shipment seems to favour the semi-manufacturers, the system was initiated at the request of the users. Due to pressures and legislation from the Government's Price Department, the users of semi-products have to base the price of the copper content of their end products on their day of delivery. These users of semi-products prefer their raw material to be priced near to their delivery date to avoid suffering from rapid changes in the value of their copper. The system was even favoured during times of rising prices.

Although it is possible for the date of shipment to be artificially controlled by the semi-fabricator, this is not done, due to the difficulties in controlling production and despatch in such a way. Of course, the system does require a certain amount of mutual trust between the fabricator and the consumer, but over the years this has arisen. Both sides, while accepting that it is not a perfect system, are unable to find an alternative which is mutually satisfactory.

The actual price tariffs of semi-products in France are fixed by the Chambre Syndicale des Metaux, but these prices are in fact maximum prices. In effect, the price paid is arrived at in negotiations, between fabricators and users, to determine the rebate that will apply for each individual sale.

The prices are calculated on a simple system, which uses set formulae for standard products, with fixed 'extras' to cover the whole range of semis. The basic formulae and 'extras' have been reached in negotiations between the Government's Price Department and the fabricators, represented chiefly by the Chambre Syndicale des Metaux.

For each of the basic semi-products there is a formula from which the daily price (le prix "usine") can be calculated and then modified by the extras (la plus-value de fabrication). The basic semis from which prices are calculated are:

- Copper wire : diameter 3mm
- Brass wire : diameter 3mm
- Copper strip : 670 by 2000mm or) thickness 1mm
- Copper sheet : 1000 by 2000mm)

- Brass strip	:	670 by 1340mm thickness 1mm
- Copper tube	:	outside diameter 50mm wall thickness 2mm
- Brass tube	:	outside diameter 50mm wall thickness 2mm

The formulae are usually made up in the following way:

$$P = aM + E$$

'P' is the price of the semi product in French Francs per 100 kilos.

'M' is the GIRM official ruling price for copper for the day.

'a' is the coefficient which allows for: financial charges on stock and work in progress, estimated scrap loss (about 1-2%), agents commission for buying copper, customers' 2% discount if payment is made within 30 days after the end of the month of delivery.

'a' usually varies between 1.05-1.10, that is 5-10% over metal price.

'E' is the basis for the fabrication charge and it includes fabricators' costs and margins.

Originally the values used for 'a' and 'E' were calculated on operations at Trefimetaux's works. In most cases the value for 'a' has remained virtually unchanged for 25 years, but the value of 'E' is reviewed at regular intervals, annually or bi-annually. Although some increases have been made in the values of 'E' despite the continuous Government pressures to prevent these, the values currently in use bear little relationship to the actual fabricators' costs. The fabricators are currently very distressed because the Government Price Department, which regulates the price of most articles sold in France, will not allow the value of 'E' to rise by more than about 1.5% every 18 months, this is despite recent inflation in wages and energy costs of 10% pa and 3½% pa respectively.

For products ordered for long term delivery the labour component of the formulated price can vary independently, in accordance with the BOSP (The Official Price Bulletin) index. However it is not allowed to move for the first 12 months after order and even then it must lag six months behind the time index.

Actual selling prices are open to individual negotiations where discounts may be offered for order quantity, historical quantities bought etc. Some hidden discounts and incentives may be offered, for example, by favourable returned scrap terms.

All discounts or rebates are of course applicable only to the standard transformation cost E and the 'extras'.

Different price lists are issued for the different levels of distribution. Orders sold by the fabricators or the large stockists and merchants are priced on the Red tariff; sales from small merchants and stockists are priced on the Green tariff, which adds about 3% to the basic price to allow for the operation of the lower distribution levels.

Like the published semis prices there are published prices for scrap, but these do not necessarily indicate the actual prices paid. The merchants publish a scrap price through 'La Nouvelle Usine': this is not the ruling price, but is a few days old, and only refers to small quantities. The CIM2F (Centre Interprofessional des Metaux non-Ferreaux de Deuxieme Fusion) which represents the secondary refiners, publishes an average price of scrap, paid by its members for each period of 15 days, and the price of copper and alloy ingots. These CIM2F stated prices are monitored closely by the Ministry of Finance and are used as a reference by fabricators, when they are negotiating the purchase or sale of scrap with merchants etc. Scrap merchants do not however use it for their own dealings.

Typically all transactions involving scrap are made on spot terms on a 'one-off' basis. The price, which is based on GIRM less discount, may be fixed on the day of order or sometimes in a fixation period of up to 30 days around the day of order. In these cases delivery will usually be within about 15 days or less. Payment is net cash upon receipt of documents or at delivery.

Some of the bigger scrap merchants offer long term contracts for the sale of scrap. These will be on 3, 6, or 12 month terms with regular supplies at (say) monthly intervals. In these cases prices will be fixed during a fixation period by the purchaser. The prices are based on a contracted formula which can be modified for form and quality of scrap. The terms of payment for long term contracts and even some ad hoc contracts can be cash, 30 days or 90 days; most people prefer to pay by three month draft if credit facilities are available. To service these long term regular contracts the merchants have special long term purchasing contracts with scrap generators. These deals may include the operation of scrap handling facilities at the vendor's works so that the merchant acts as a 'contract scrap clearer'.

Some merchants and others, dealing mainly in scrap, especially the larger international organisations, carry out hedging operations on the LME and other terminal markets, to cover their unmatched sales and purchases of copper.

The price of semis is stabilised to a certain extent by GIRM's policy with respect to small fluctuations on LME. To simplify the buyer's and seller's problems, inherent in selling semis through complex distributive systems at frequency changing prices, the fabricators operate their own stabilizing operation. For all semis, except electric wire and cable, the fabricators do not change their prices until the GIRM price of copper has moved by more than about £15-20 per ton depending on the type of semi-product. La Chambre Syndicale des Metaux, carefully calculates the differences between GIRM price and fabricators' price and sets new levels so that in the long term the losses and profits, made by the fabricators, due to the effective premium or discount against the ruling copper prices, are eliminated. On average this results in prices changing only twice a month.

For wire and cable the prices are not controlled in the same way because the French fabricators must stay in line with the highly competitive European market in these products.

Terms of payment for semi products sold in France are usually cash, 30, 60 or 90 days after the end of the month of shipment. Full price is charged for 90 days and 1, 2 and 3% discounts are given for 60, 30 days and cash. For example for goods received between January 26th and February 26th, payment is due in the specified period after the 10th March. Thus a draft or bill of exchange (une traite accepte) would be issued for net payment on 10th June, or for 1% discounted payment on 10th May, or 2% discounted payment on 10th April. Cash conditions vary and may depend on the period taken before the invoice is sent. Typically 'cash' means payment within 10 days of invoicing or by the end of the month of delivery.

Although all French fabricators prefer to sell their semis under the conditions mentioned above, with certain customers they are virtually forced to sell under different terms. Two main differences may occur:

- price may be fixed on the day or order not the day of shipment;

- long term contracts for a regular 'quota' supply may be signed;

pricing on the day of order is unusual for domestic sales of wrought semis and probably only accounts for about 1-2% of the total consumption. For wire and cable, where there are several very large buyers and competition from abroad is strong, 'fixed price' contracts are more widely used. In these cases the official ceiling prices (list prices) may still be calculated in the same way, but with the buyer knowing the price at the time of order. Although different conditions do prevail according to the customer.

In the case of the Electricity Company, EdeF, annual negotiations between the Syndicat des Fils et Cables, representing the cable makers, determine a fixed price for the period March to March for each type of cable. After the price is fixed it can only be changed if the Ministry of Finance decrees that the fabricators should lower their prices to follow a falling copper price.

The Railway Company and Post, Telephone and Telegraph, PTT, obtain only a relatively small proportion of their cable purchases on direct contracts. These are usually on long term and favourable conditions. For these and other semis they may obtain fixed price quotations in times of relative stability, provided the delivery date is not too far in the future.

Long term contracts are used for supplies of semis to industries, where a regular usage of sub-contractors components exists. Typical examples are for the automotive and electrical appliance industries. In these contracts special terms may be negotiated and these may include fixed prices, but they may be very similar to the standard contracts excepting the terms of delivery.

For many special products which occur mainly in the alloy or the wire and cable fields, there are no published list prices. In these cases, individual contracts are signed often after tenders have been made on fixed prices or at least special terms.

Some 30-35% of all semis are manufactured in France on toll contracts. These toll contracts are usually one-off transactions, although in practice the fabricators receive a fairly regular flow of orders of this type from end users.

Toll contracts are of two types, in both of which the fabricators at no time actually finance the copper involved, but only act as custom transformers:

- clean, process scrap from the end users works or other sources is supplied to the fabricator for reprocessing to the required semis;

- primary refined copper obtained by the end user is supplied to the fabricator for processing;

the latter type of toll contract is used in two ways:

- by wiredrawers and cablemakers who obtain wirebars and cathode from GIRM or the producers, or in exchange for scrap, and have it transformed on toll to wire-rod for drawing.

- by Government controlled organisations like the Railways and PTT, who obtain their raw copper in exchange for scrap, and have it transformed on toll to their required semis.

The first type of toll contract originated between the fabricators and users of brass semis. The users of brass rod, especially those using extensive machining operations, produce a high percentage of clean scrap. This can easily be reused by the fabricators, to reprocess to more brass rod. Nowadays, this type of transaction is common for most types of semi-products.

In the toll contracts the prices are also fixed by means of formulae. For standard semis these give ceiling prices, to which must be added'extras' to give a catalogue of list prices for all usual products. The formulae used are similar to those previously mentioned. (P=aM+E), but the value of 'a' here only covers the scrap loss, as the other costs are borne by the customer. Thus the formula for copper tube could be P=0.022M + 29.5. The 'E' value has increased from 23.16 as shown previously, to cover the extra cost of fabricating tube from scrap instead of billet.

For export sales of semis, contract terms are dominated by the usual conditions prevailing in the importing country. Export contracts are individually negotiated but in most cases the products are made to order, not sold from stock. The prices are fixed on the day of order based either on LME cash settlement price or in some cases on a forward price. This may be the LME cash settlement price six weeks before delivery or even the LME three month quotation on day of order.

In Belgium copper is priced entirely on the basis of the LME, although it is referred to as the "SGM (Societe Generale des Minerais) Price". The SGM price is the LME price converted to Belgian Francs at the days' exchange rate. The major portion of copper purchased by Belgian semi-finished products manufacturers are on the basis of the SGM price. Some spot purchases are made in the open market or in the LME terminal markets. The volume of these latter purchases vary, being dictated by short-term fluctuations in orders of semis.

The major users of wire and cable, the Electricity and Telephone Companies, advise the cable makers annually of their anticipated requirements for the forthcoming year. This enables the cable makers to forecast with confidence their own tonnage copper requirements for the bulk of their production and thus to make contracts for the purchase of copper accordingly. Periodically throughout the year the cable purchaser will 'fix' his copper requirements giving detailed orders for delivery at a specified time. In 'fixing', the cable user will choose a day of days within two weeks either side of the chosen day of fixing and will notify the cable maker that he wishes to fix on the particular day. The Belgian quoted price on that day will be applied to copper contained in finished cables supplied. There are limits as to the amount of copper that a cable maker will allow to be fixed on any one day, this total is usually around 200 tons.

Basic cable prices are negotiated between the cable maker and the end user with the copper price being the only really variable quantity in the equation. In certain cases there are clauses within these contracts which stipulate that other component parts of the total price will be changed if, for example, the cost of living index, increase at a rate above that which has previously been the case.*

Prices of wires and cables to smaller users are again quoted on the basis of a price excluding copper with the copper price being fixed at the time of delivery.

On brass mill products the Belgian brass mills are not inclined to book long term orders for semi-finished products with orders covering some three to four months being the usual maximum commitment a mill will make. The semis price to a large end user will be agreed on a copper plus basic conversion plus extras (size, etc) arrangement, with the copper price being fixed on a day chosen by the purchaser at between three and ten days before the despatch of each portion, parcel or part order. In practice, the conversion price is usually negotiable in spite of the price control regulations which mean that this should not be so. Most export business is also priced in this way.

Sales of brass mill products in small quantities (up to five tons per item) are priced on a system of a basic price with extras for size, quality and finish options. The basic price contains a copper figure, the SGM/LME price of the day, at the moment the order is received, but in general this is not specifically shown

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* Within Belgium all prices of goods and services are fixed and any change must be agreed by a prices office. Copper has been excluded from this legislation and, as such, manufacturers are able to increase the price of a product as the result of a change in the price of copper, but this increase must not exceed the increase resulting from a change in the copper price. Increases sought for any other reason must be approved by the prices office.

in the price. This procedure is of course normal for any form of manufactured goods, the distinction in the case of Belgium lies in the fact that the prices of copper semis are allowed to vary according to copper price variations, whereas other goods are not free to vary in the same way in Belgium. Irrespective of the delivery time the price of a particular semi-finished product will be fixed on the day of ordering and this also applies to all sales made by stockists.

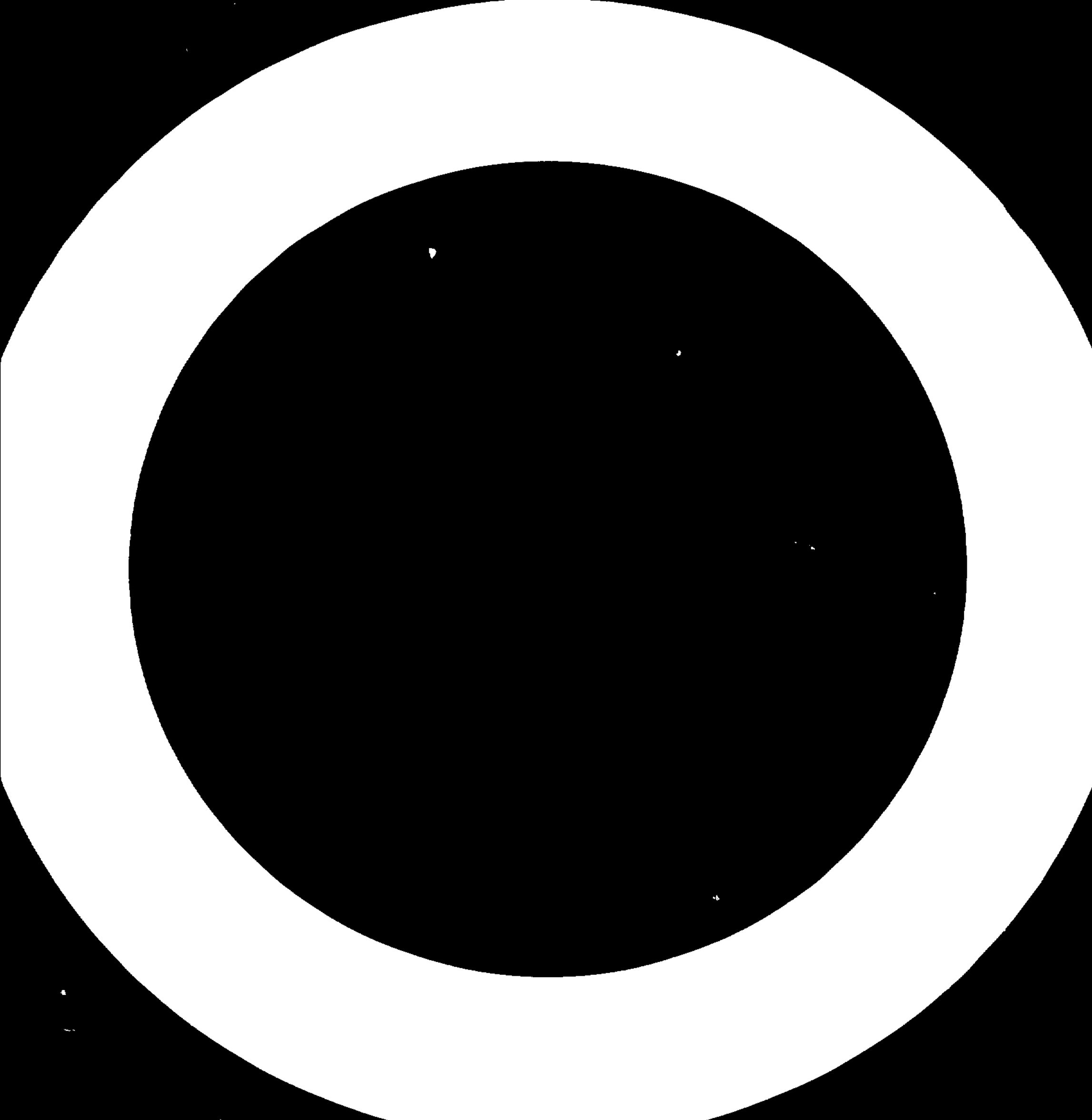
Stockists and non-industrial users have to pay special attention to the bought-in price of copper semis, as neither is in a position to add value to the goods before selling them. The plumber or roofing contractor will pass on to his customers the price he pays, which must obviously be as near as possible to the price on the day of invoicing his customer. The stockist too will wish to minimise the time between buying and selling stock in case of price moves. Sales ex-stock are made at the copper price on the day of sale. Both these types of customer buy semi-finished products with an open copper price, fixing the price as late as possible. These are the only cases where copper semis are priced on the day of delivery, which can be compared with the situation in France where this is the norm.

Private arrangements do exist between semi-fabricators and their selling agents and stockholders as to commissions and consignment terms. Consignment stocks represent an extension of risk copper held as work in progress, but the cost of this in terms of time and capital forms part of the general expenses (overheads) of the factory cost, included in the conversion cost, provided that the total amount of copper so tied does not change significantly.

A major portion of the Belgian domestic market is held by a few selling agents and stockists such as Geisler-Lignian SA, who are exclusive stockists and agents for Cuivre et Zinc de Liege.

Pricing in other developed countries is generally on similar lines.

Within Nigeria we have based prices on the prevailing semis price at the present time. This price is tied to LME for the copper component and is basically a cif Lagos price increased for the small duties and post handling charges prevailing at the present time. The idea was that if this level proved unprofitable, alternatives resulting from increased customs duties could be considered in a second stage.



6. PLANT LOCATION

Apart from the dispersal of new industries, which is a matter of Government policy and not to be considered here, the principal criteria which may govern the selection of a suitable location of a copper processing plant in Nigeria comprise:

- raw material transportation costs
- proximity to markets in terms of transportation time and cost;
- construction costs;
- the cost of transporting machinery and other equipment to site;
- availability and cost of suitable labour;
- availability and cost of utilities;
- industrial infrastructure;
- climate and environmental considerations;

other criteria such as suitability of the nearest port facilities, the availability and cost of land, water supply, housing, social emenities and commercial services, to name only a few are either less important in this instance or cannot be foreseen clearly at this early stage.

6.1 Transportation Costs

The transportation of raw materials to site poses a challenge in logistics. One shipment per month would seem a reasonable frequency of supplies from Zambia, in which case 3,500 t of refined metal may have to be moved at a time depending on plant throughput and stocks in hand. This is in addition to 1,250 tonnes of scrap per month at full production. One could establish a warehouse at the Nigerian port of entry and thence transport the cathodes daily by road, or alternatively load directly onto railway wagons and transport the whole shipment by rail to site in the shortest possible time. We recommend the latter approach because it would be less costly and avoid road damage which the necessarily heavy trucks would undoubtedly cause. One would thus have to choose a site on a railway line and invest in a siding.

With this requisite in mind and in view of other important criteria, we considered a short list of five alternative locations across the country, namely:

- the greater Lagos area including points on the railway in Ogun State;
- the greater Port Harcourt area as far north as Aba;
- Enugu;
- Ilorin;
- Kaduna;

railway freight rates from the nearest of the two main ports are approximately as shown in Table 6.1

TABLE 6.1 : SELECTED NIGERIAN FREIGHT RATES

Journey	Cost (₦/tonne)
Apapa to greater Lagos area	8
Apapa to Ilorin	16
Apapa or Port Harcourt to Kaduna	29
Port Harcourt to greater Port Harcourt area	8
Port Harcourt to Enugu	13

These figures also apply to the cost of transporting machinery and other equipment to site, assuming that they go by rail.

The market for copper and brass semis calls generally for prompt but irregular supplies to scattered locations, few of them with rail access. Hence products must be shipped by road, which is relatively fast so that transport time becomes an unimportant factor and proximity to markets may be measured in terms of haulage costs alone.

While the manufacturer bears the burden of inland metal transportation costs, the cost of delivery semis will be to the customer's account. These two cost elements however are complementary in so far as the economy of location is concerned.

For a first approach to delivery costs one may assume that the products destined for one of four centres in the proportions as indicated by market research and as shown in Table 6.2.

TABLE 6.2 : MARKET FOR COPPER SEMIS BY REGION - NIGERIA 1990

Region	Centre	% of Production
West	Lagos	45
East	Port Harcourt	25
North	Kaduna	25
Export	PH or Lagos	5

Road haulage rates from the five plant locations to the focal points shown in Table 6.2 are approximately as detailed in Table 6.3.

TABLE 6.3 : FREIGHT RATES FROM PLANT TO MARKET LOCATIONS

(₦/t)

Location	Market Area		
	Lagos	Port Harcourt	Kaduna
Lagos	10	44	52
Port Harcourt	44	10	52
Enugu	41	25	44
Ilorin	29	45	41
Kaduna	52	52	10

On this basis, the inland transportation costs for raw materials and products to and from the five locations will be as shown in Table 6.4.

TABLE 6.4 : TRANSPORTATION COSTS

(₦/t)

Location	Raw Materials	Products	Total
Greater Lagos area	8	29	37
Greater Port Harcourt area	8	36	44
Enugu	13	37	50
Ilorin	16	36	52
Kaduna	29	42	71

6.2 Construction Costs

Construction costs vary according to the availability and cost of labour, the availability and transportation cost of materials, whether or not a construction camp is needed, the size of the project, to what extent the site calls for piling, familiarity of the contractor with the area and competition among contractors. The climate in this industry tends to change and opinions on likely costs differ, but the present consensus of opinions among five leading firms interviewed shows the following comparative costs for a project of this magnitude, taking the greater Lagos area as a norm:-

Greater Lagos area	100
Port Harcourt	100
Ilorin	105
Enugu	110
Kaduna	112

6.3 Labour

The production of copper semis is not heavily labour intensive but calls for relatively high skills. Wage rates for skilled labour do not depend significantly on the location, but suitable skills are more readily available in areas which already have established engineering industries. Of the five locations under consideration, the greater Lagos area offers advantages in this respect while Ilorin falls somewhat short of the others.

6.4 Utilities

Metallurgical operations are energy intensive, and this project forms no exception.

The Nigerian Electric Power Authority (NEPA) charges uniform rates across the country, but its supplies have been eratic and will probably continue so for some years to come. As a result, it is common practice in industry to install at least stand-by generating capacity. Much of the power needed for this plant will supply electric melting and holding furnaces and other machines which do not lend themselves to unexpected interruptions of service. Hence this project includes diesel generators capable of meeting the entire load. The price of diesel oil is likewise equalised throughout the country.

At least the foundries also depend on natural gas or liquified petroleum gas (LPG) in modest but nevertheless essential supplies. Of the locations under consideration, only the Port Harcourt region offers natural gas at present. Lagos should receive gas by pipeline in the mid-1980s, but this will primarily serve a new power station and one cannot at present count on its eventual availability to industry in any particular area. LPG will soon become readily available from the new oil refinery at Kaduna, while Lagos already receives substantial shipments from Warri.

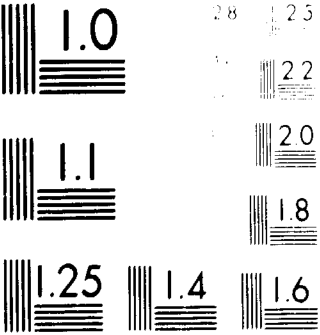
The price of natural gas remains a matter for negotiation with the Nigerian National Petroleum Corporation (NNPC). It depends on the load and on the cost of new pipeline construction. ₦6.00/10^6Cal. has been suggested as an order-of-magnitude for a small demand. The Products Marketing Department of NNPC recently quoted N 4.60/10^6Cal. for LPG in bulk ex. refinery. To this one must add freight and any other applicable charges. Since the cost of natural gas and LPG cannot be determined precisely at this stage, we shall assume the same figure for each, namely ₦ 6.00/10^6Cal. This compares with ₦ 12.00/10^6Cal. for diesel oil. Only the ready availability of either one or the other will then affect the choice of plant location.

6.5 Infrastructure

The industrial infrastructure in other respects is going to be adequate for the proposed project in all five locations. One should, however, bear in mind that modernisation of the railway system will begin in the east.

TABLE 6.5 : RATING OF SELECTED LOCATIONS

Criteria	Criteria rating	Greater Lagos area	Greater Port Harcourt area	Enugu	Ilorin	Kaduna
Raw material transportation cost and proximity to markets	4	20	16	10	10	4
Construction costs	2	9	9	4	6	2
Machinery transportation costs	1	4½	4½	3	2	1
Availability & cost of utilities	3	9	15	6	3	12
		42½	44½	23	21	19


1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

6.6 Climatic and Environmental Constraints

Differences in climatic conditions need not influence the choice of location as long as one stays clear of the coast where a corrosion hazard could arise. The low sulphur content of Nigerian oil and gas should obviate any cause for concern about surface attack on finished products in the vicinity of the Port Harcourt and Kaduna refineries. Fume emissions from the alloy and copper furnaces meet clean air regulations in Europe and the USA and should not therefore present any pollution problems. There are no other objectionable effluents. Pickling acid will be neutralised before discharge.

6.7 Recommendations

Four of these criteria thus remain significant, and these have been rated in Table 6.5, in order of importance. The five locations under consideration have then been rated in order of preference against each criterion, and these ratings have been weighted by multiplying them with the criteria ratings. In cases where two locations rank equally, they have been accorded average values.

The greater Port Harcourt and Lagos areas emerge with equally high total ratings according to this somewhat arbitrary exercise, followed by Enugu and Ilorin, again with about equal ratings.

Our qualitative judgement based on intimate knowledge of Nigeria tends to support these findings, and we thus recommend that the following locations be short-listed in this order of preference:

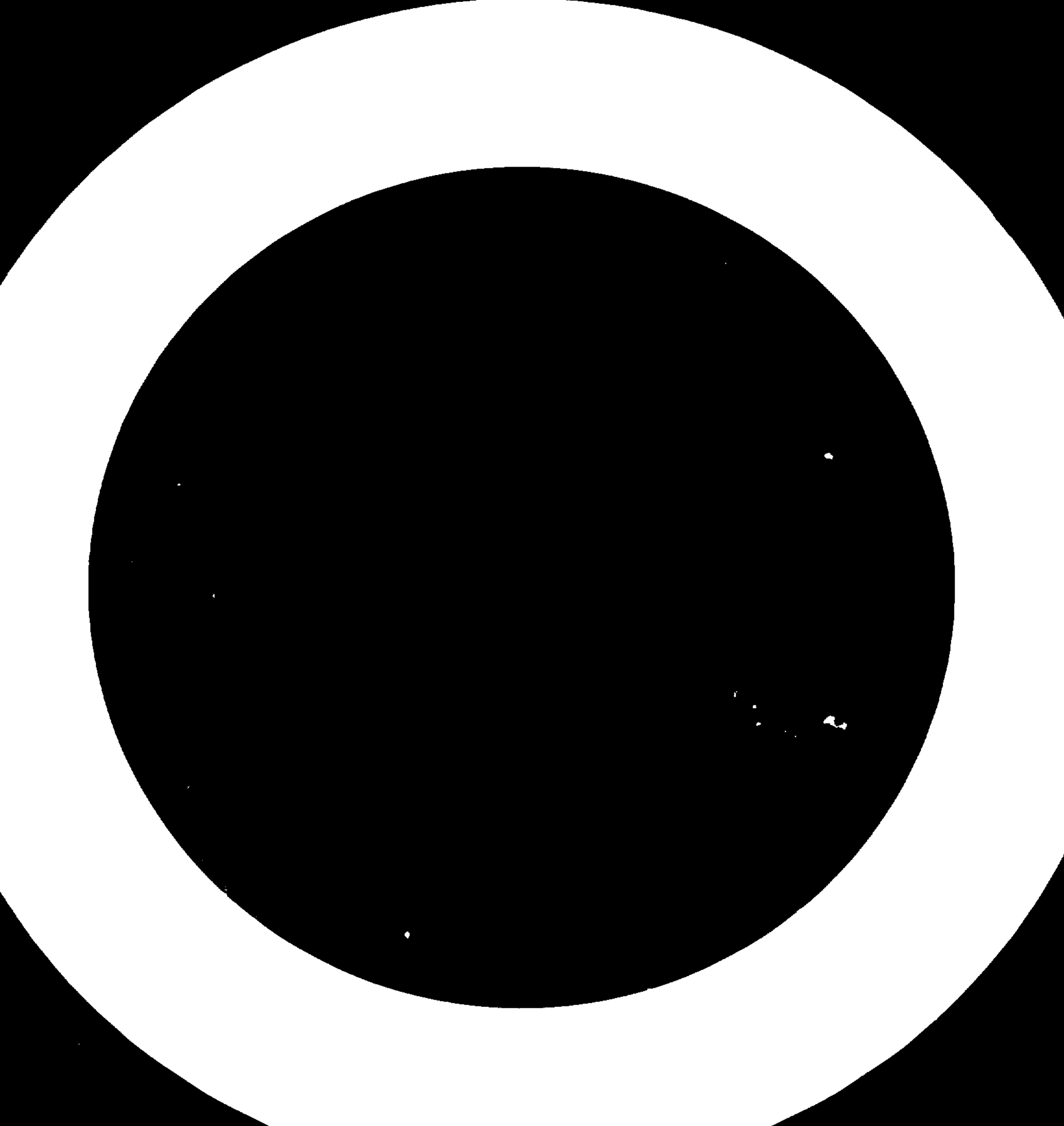
1. The greater Port Harcourt area as far north as Aba

2. The greater Lagos area including the extreme south of Ogun State

3. The vicinity of Enugu

The site should be on a railway line. If this is not possible, then the Warri/Sapele area should also be considered.

The eventual selection of a site should not be entered into lightly. It is one of the most critical decisions that management has to make in the light of constraints with regard to government policy on the disposal of industries.

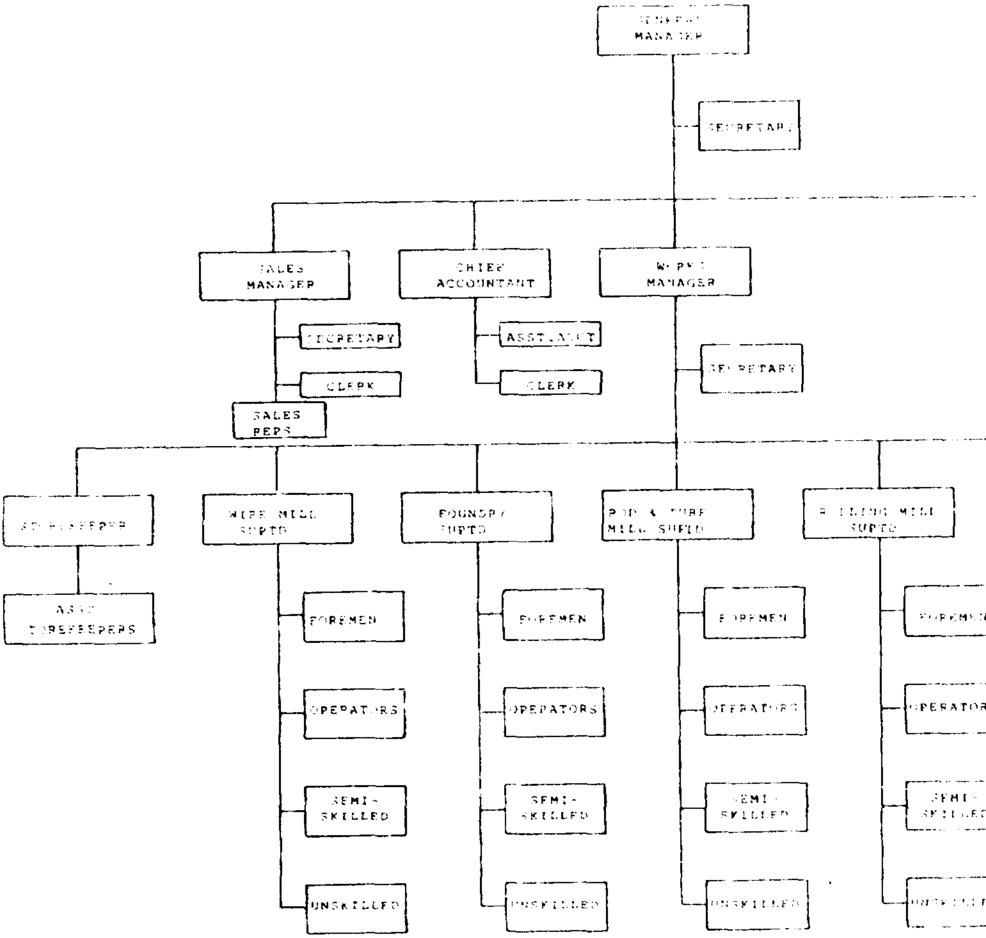


7. ORGANISATION AND STAFFING

Figure 7.1 represents an appropriate organisation chart for the proposed project. At the beginning this will be heavily manned and interspersed with specialists seconded from or through the technical partner. Such specialists may include one or two people on the shop floor such as for roll dressing. The cost of these services over and above the regular payroll appears separately in the financial projections.

Staff requirements for the first three years of operation, together with the proposed scale of basic salaries and wages are set out in Table 7.1. They allow for single shift operation in the first year with the exception of the extrusion plant and maintenance personnel which will have to work a second shift from the outset. From the third year onwards, the project requires a total staff of about 800, mostly quite highly skilled. At such a level of staffing, and with the mix of skills required, the project will obviously have a significant impact on the region in which it is located.

FIGURE 7.1 : ORGANISATIONAL STRUCTURE



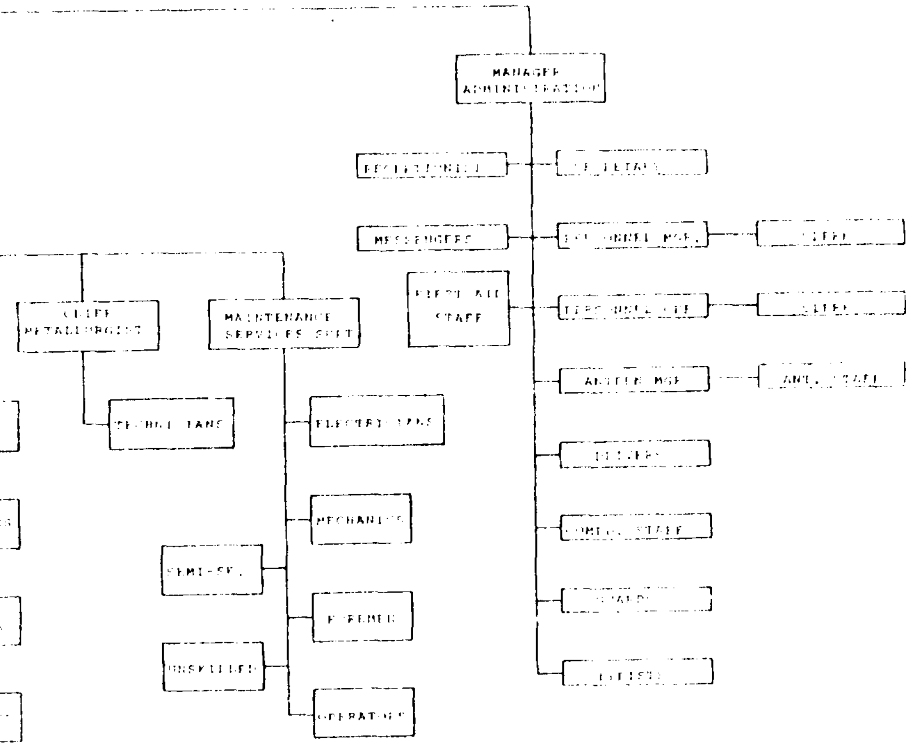
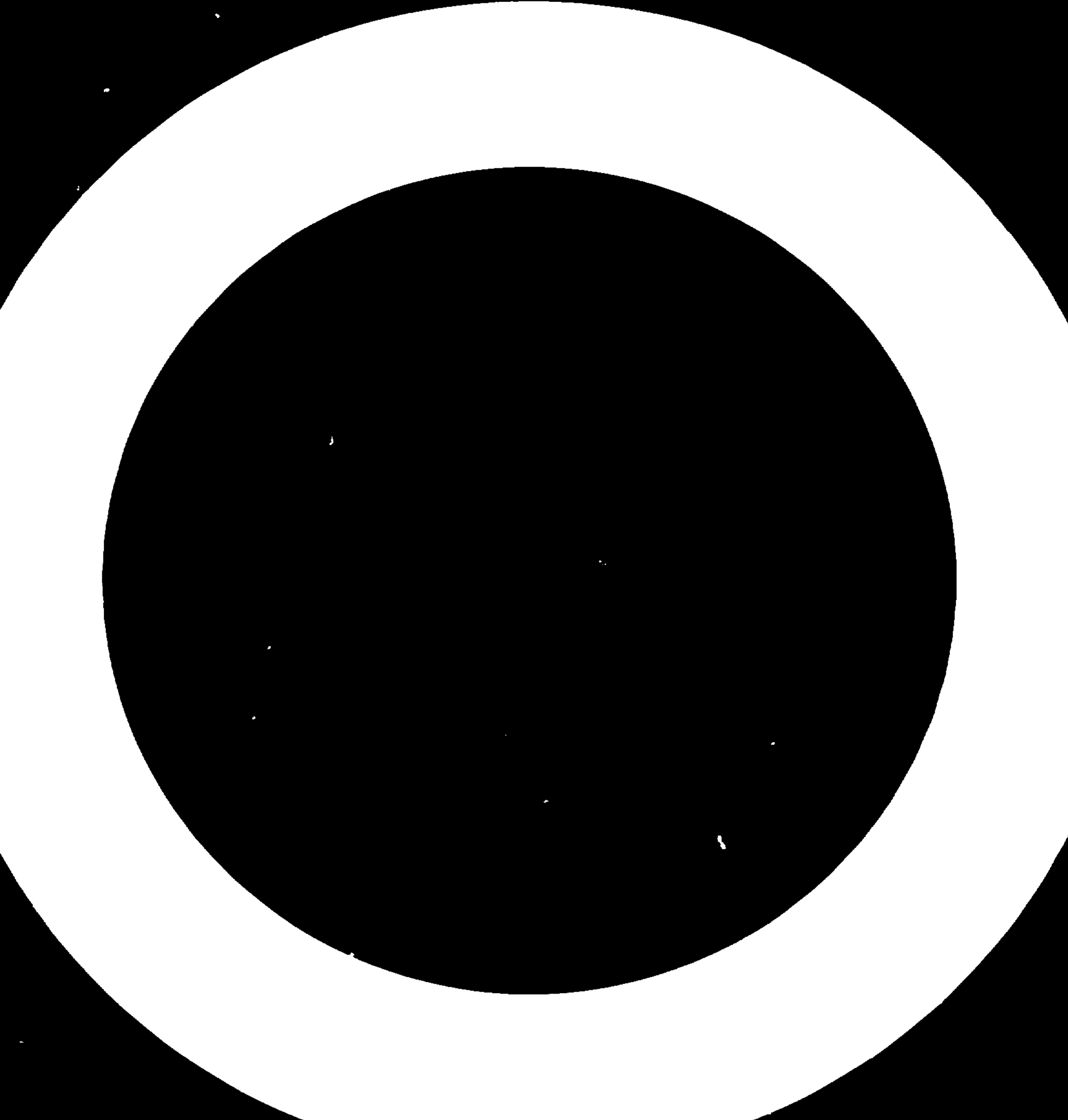

MANAGER
MESSENGERS
FIRST AID
STAFF
CHIEF
MAINTENANCE
MECHANICS
SEMI-SK.
UNSKILLED

TABLE 7.1 : STAFFING

Staff	Basic Annual Salaries/Wages (₦)	Year		
		6	7	8
Management and Administration				
Senior and middle management:				
General Manager	35,000	1	1	1
Works Manager	30,000	1	1	1
Administration Manager	20,000	1	1	1
Chief Accountant	20,000	1	1	1
Sales Manager	20,000	1	1	1
Chief Metallurgist	20,000	1	1	1
Works Superintendents	15,000	5	5	5
Personnel Manager	12,000	1	1	1
Procurement Officer	12,000	1	1	1
Assistant Accountant	9,000	1	1	1
Sales Representatives	10,000	2	2	2
Junior:				
Secretaries	3,500	4	4	4
Receptionist	3,000	1	1	1
Clerks	2,500	4	4	4
Typists	2,000	5	5	5
Messengers	1,500	6	6	6
Total		36	36	36
Works Staff				
Indirect:				
Canteen Manageress	2,500	1	1	1
Canteen staff	1,700	7	11	11
First Aid Nurse	2,500	1	2	2
Assistant Nurse	2,000	2	3	3
Drivers (including forklift)	2,500	23	38	38
Guards	2,000	12	12	12
Compound staff	1,500	15	25	25
Storekeeper	3,000	1	2	2
Assistant Storekeepers	2,000	2	4	4
Mechanics	3,000	14	19	19
Electricians	3,000	6	8	8
Foremen	3,500	8	12	12
Operators/skilled workers	2,500	11	16	16
Technicians	2,500	8	16	16
Semi-skilled workers	2,000	25	35	35
Unskilled workers	1,500	17	30	30
Direct:				
Foremen	3,500	11	19	21
Operators/skilled workers	2,500	91	165	193
Semi-skilled workers	2,000	63	120	130
Unskilled workers	1,500	94	171	193
Total		412	709	771
GRAND TOTAL		448	745	807



8. IMPLEMENTATION AND PRODUCTION SCHEDULE

According to the schedule detailed in Figure 8.1, production can begin 4½ years following the decision to proceed. This takes into account all the activities and time factors associated with launching a project of this magnitude and complexity in Nigeria.

We have tried to be realistic about the duration of pre-construction activities. For example, the acquisition of land will take a year if farmers are to be relocated. Three months lead time has been allowed for unforeseen delays prior to start-up. Nevertheless, the need for a strong project management team with all necessary freedom of action cannot be overstressed.

Throughout this report, years 1 to 5 are pre-production years and production begins with year 6.

The financial projections are based on building up production in accordance with the schedules shown in Table 8.1. This allows for adequate learning periods and, at the same time, does not exceed market projections.

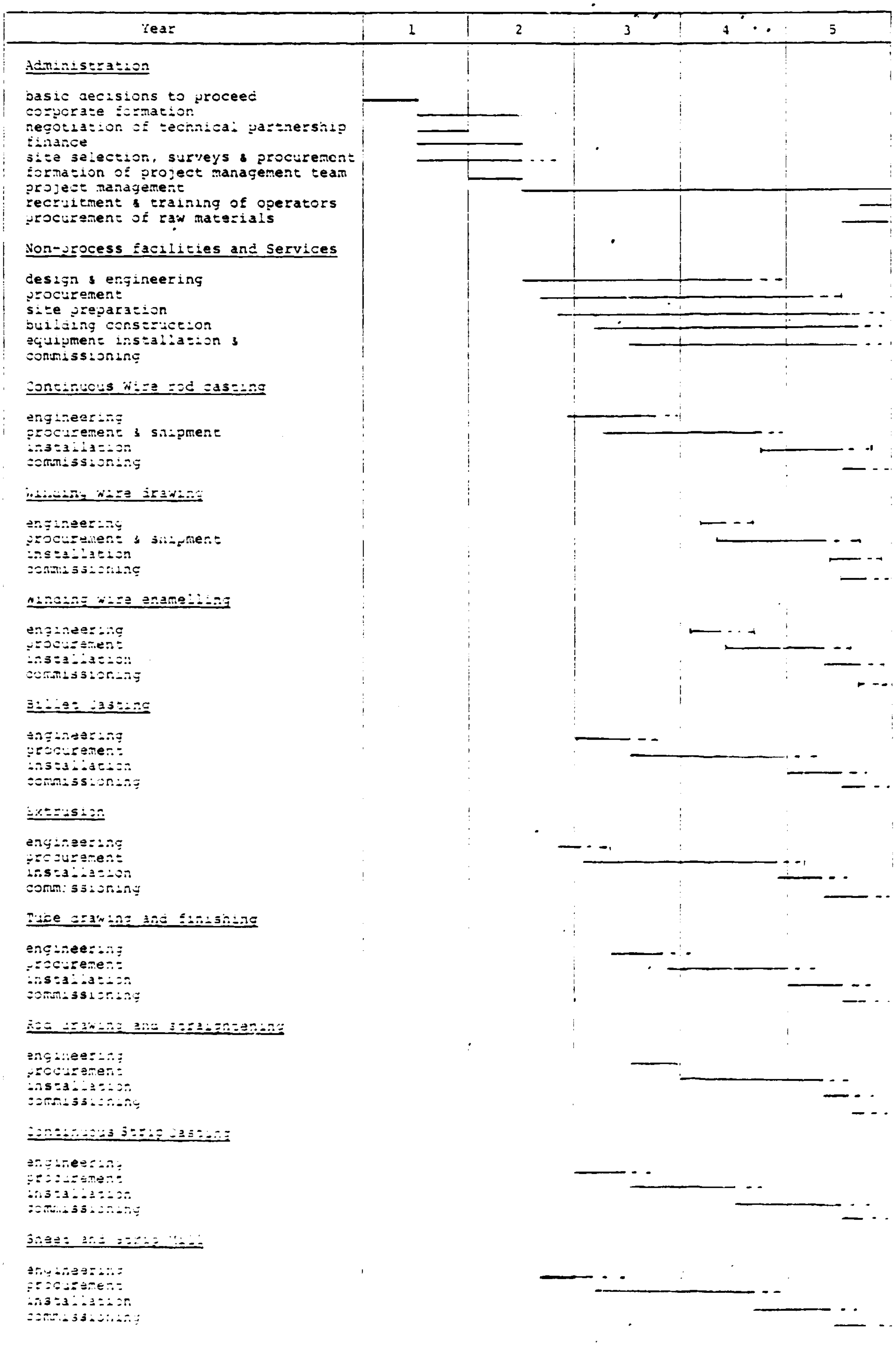
All process units with the exception of the extrusion plant will operate only a single daily shift in the first year, and all units will run two shifts thereafter. The continuous strip casting plant will have only three of its six lines in operation during the first and second years of production.

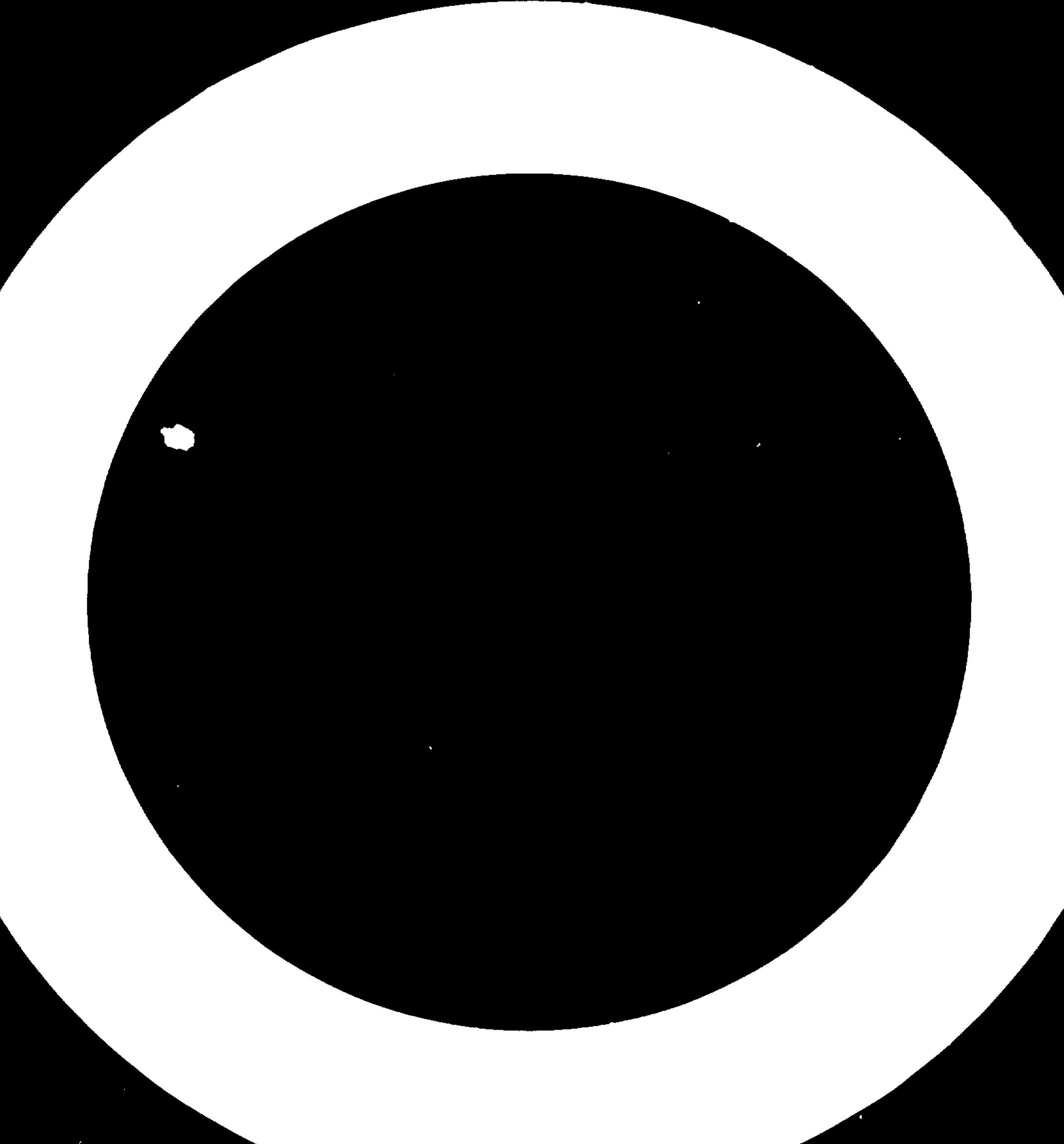
While these production targets should be attainable with well-trained operators, it will take much longer to reach competitive product qualities. This applies particularly to radiator strip and winding wire. We have not, however, provided for any discounts because the Government will probably consider some form of import protection in the first few years to help this new industry on its feet, and indeed, as has been discussed elsewhere in this report, a small additional custom duty may be desirable to provide the necessary protection if import licensing is not the chosen control mechanism.

TABLE 8.1 : BUILD-UP OF PRODUCTION (t/y)

Product Group		Year				
		6	7	8	9	10
1.	Wire rod	8,250	12,950	25,050	29,750	32,400
2.	Winding wire	950	1,650	2,350	3,100	3,800
3.	ETP copper strip	350	700	950	1,250	1,500
4.	PDO copper radiator strip	250	500	700	850	1,000
5.	67/33 brass radiator strip	350	800	1,050	1,250	1,500
6.	67/33 brass strip - coil	100	600	1,200	1,200	1,250
7.	67/33 brass strip - cut	50	250	450	500	500
8.	63/37 brass sheet	100	150	200	250	250
9.	Copper sheet	100	150	200	250	250
10.	67/33 brass circles - small	1,050	2,150	2,250	2,650	3,000
11.	63/37 brass circles - large	400	700	1,100	1,400	1,500
12.	60/38/2 leaded extruded brass rod	1,100	1,650	2,200	2,900	3,600
13.	57/39/4 leaded drawn brass rod	500	800	1,100	1,100	1,400
14.	Drawn ETP copper rod	400	650	950	1,150	1,500
15.	AC copper tube	350	750	800	1,000	1,150
16.	Refrigeration copper tube	200	500	550	650	750
17.	DWS copper tube	350	600	750	800	1,000
18.	General engineering copper tube	200	350	400	400	500
19.	63/37 brass tube	500	1,150	1,150	1,200	1,500
		15,550	27,050	43,400	51,650	58,350

FIGURE 8.1 : IMPLEMENTATION SCHEDULE





9. PROCESS PLANT SPECIFICATION

Appendix C outlines the specifications of the most appropriate process units in the light of the foregoing technical review and market analysis. Emphasis has been put on versatility so that the plant can manufacture a wide range of products and thereby make Nigeria practically independent of copper and brass semis.

Figures 9.1 and 9.2 depict the basic schemes for the wire and brass mills. The sequence of operations within each of these units will be apparent by reference to the respective layout drawings in Appendix D.

FIGURE 9.1 WIRE MILL SCHEME

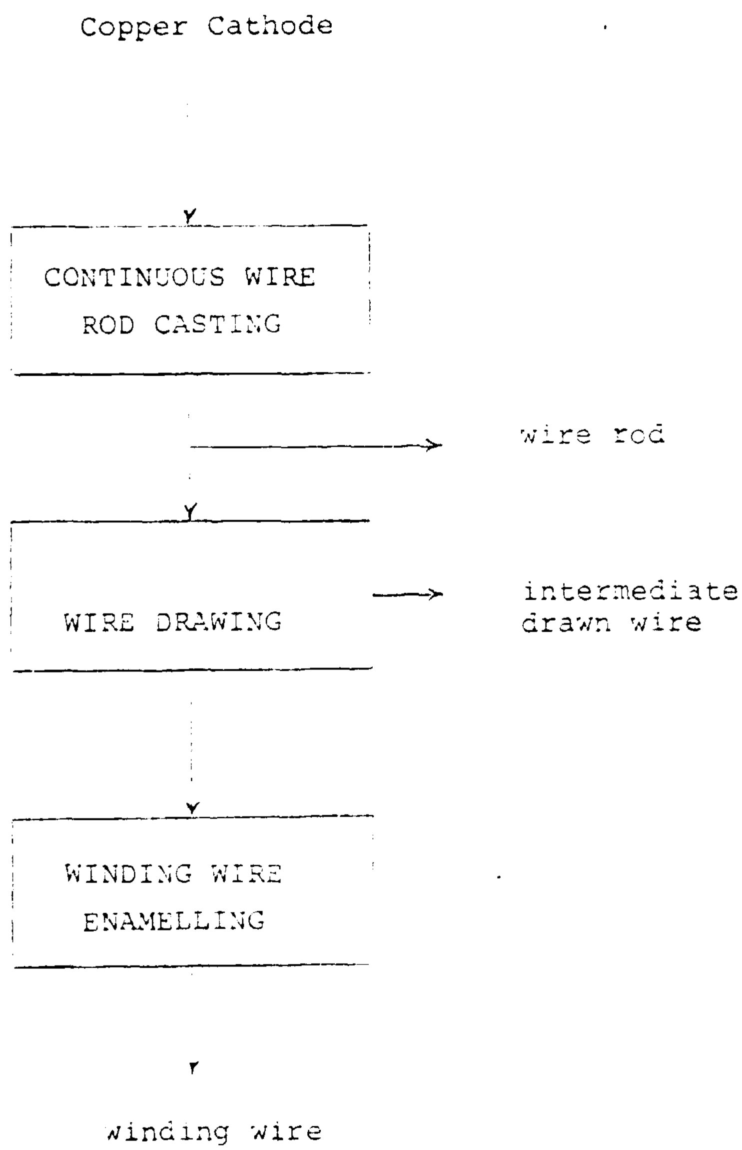
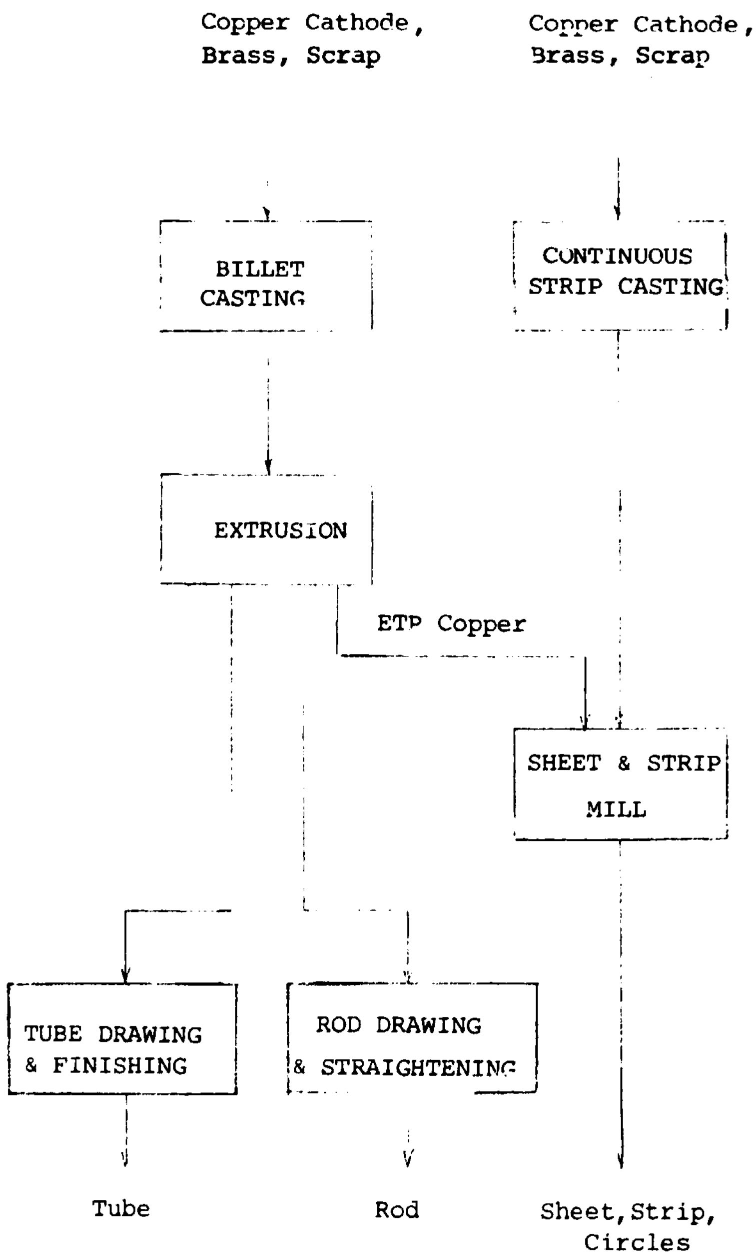
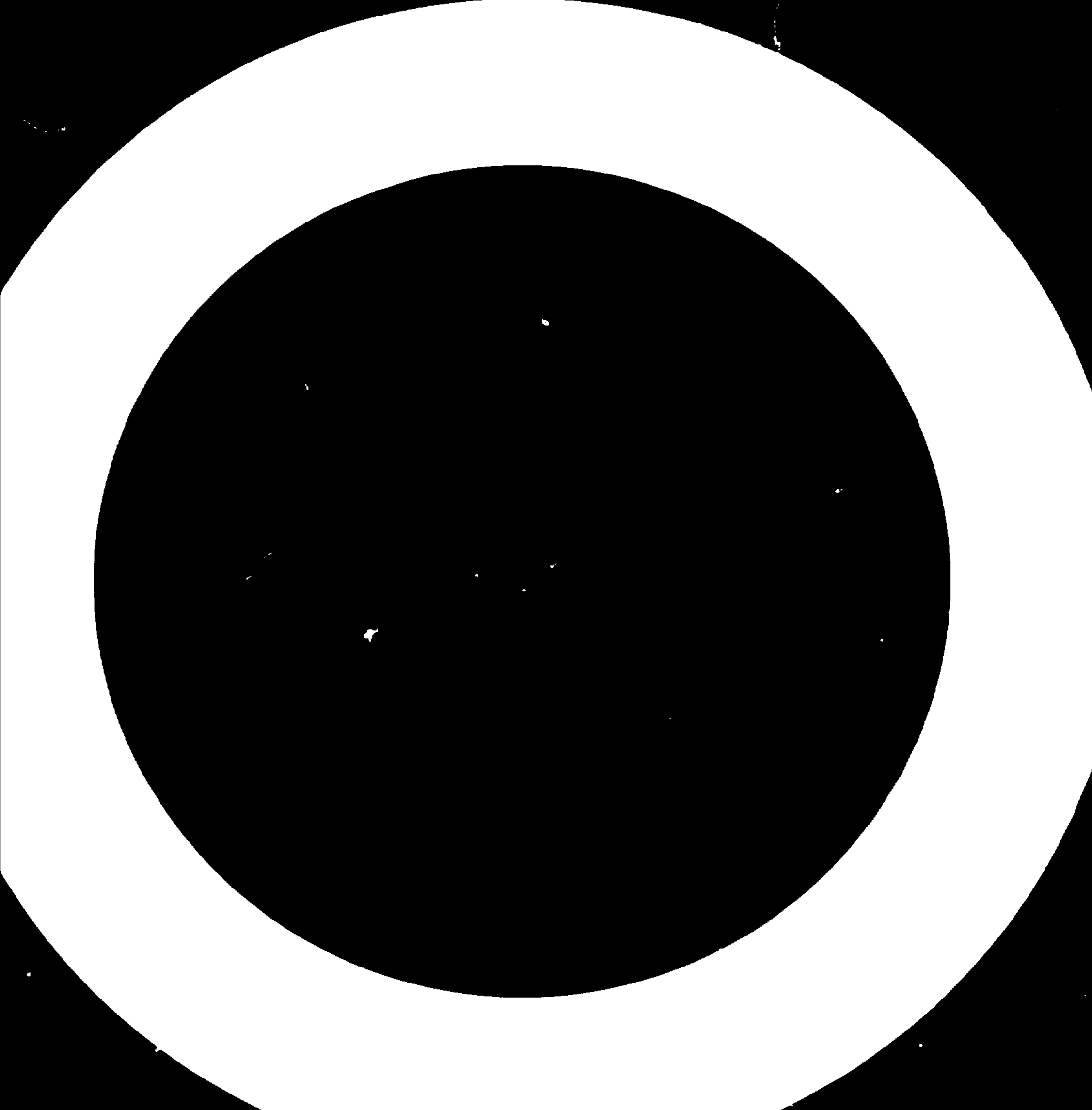


FIGURE 9.2 : BRASS MILL SCHEME





10. CAPITAL COST

We estimate that the project would entail capital investments as shown in Table 10.1. Supporting data will be found in Appendix E.

These estimates have been built-up in two ways. Local costs were determined in the course of fieldwork. Virtually all manufacturing plant estimates are based on budget proposals and include spare parts for one to two years' operation as well as reasonable contingencies where deemed desirable. One may assume that the cost of any unforeseen items will be offset by competitive bidding. Indeed, in preparing these costs, we have obtained a number of different budget proposals for each item of equipment and/or for each processing section within the proposed scheme. In general we have adopted an average cost although in a few cases where a single scheme was clearly superior, we have adopted the specific cost of that scheme. Factored items are based on sample unit costs. These estimates all reflect current costs in accordance with other aspects of the financial projections. Appropriate inflation factors should be applied to the project as a whole. Under the circumstances, it is unnecessary to add any overall contingency.

The timing of these investments could follow a schedule on the lines of that outlined in Table 10.2, and pre-production finance charges have been calculated accordingly. The investment in diesel generators continues up to year 8 :

Pre-production years	₦	7.2 million
Year 6		4.0
Year 7		3.2
Year 8		1.6
TOTAL	₦	16.0 million

Figure 10.1 shows an outline site plan identifying the principal elements.

FIGURE 10.1 : SITE PLAN

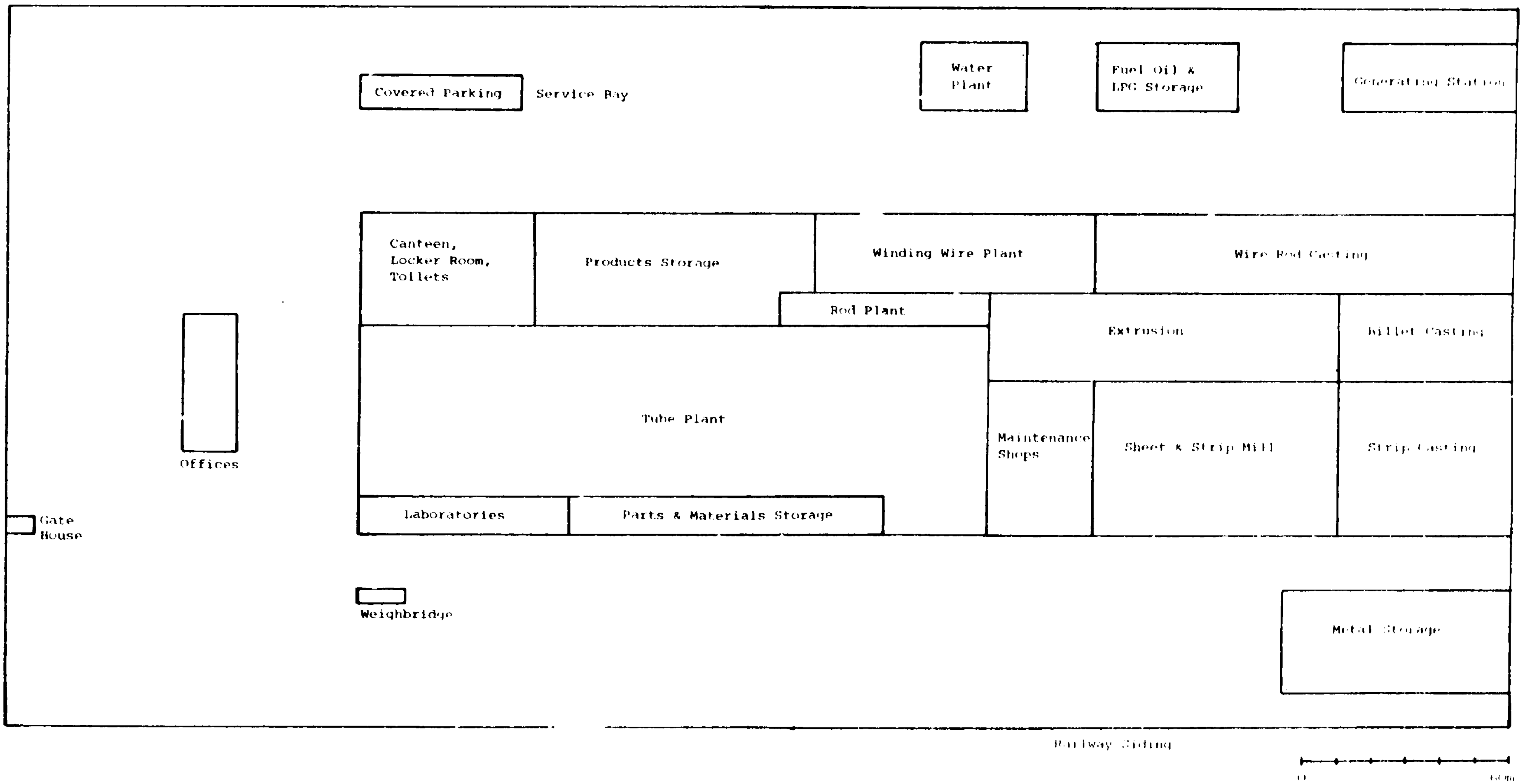


TABLE 10.1 : CAPITAL COSTS - ₦'000

Item	Lagos or Port Harcourt area		Additional for Enugu area
Site work		3,842	375
Factory building		21,714	2,171
Manufacturing plant: -			
wire rod casting	5,177		
wire drawing	900		
winding wire enamelling	1,492		
billet casting	3,410		
extrusion	7,227		
tube drawing and finishing	9,584		
rod straightening and drawing	1,668		
continuous strip casting	3,404		
sheet and strip mill	12,314		
Sub-total	45,176	45,176	338
Generating station		16,000	240
Water supply, treatment & cooling system		600	20
LPG and fuel oil depot		50	2
Maintenance shop equipment		800	-
Laboratory equipment		300	-
Vehicles		439	-
Vehicle service facilities		3	-
Offices and Staff amenities		705	51
Pre-production expenses		2,410	-
TOTAL		92,039	3,197

TABLE 10.2 : PHASING OF CAPITAL COSTS (₦'000)

	Year 1				Year 2				Year 3				Year 4				Year 5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Site work								300	300	300	300	300	300	300	300	300	300	300	300	242
Factory building									2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	214	
Manufacturing plant -																				
wire rod casting									1057						2460	460	[illegible]	256	256	255
wire drawing														180			427	111	96	86
winding wire enamelling														313			251	188	188	52
billet casting										653					1632	363	[illegible]	218	218	
extrusion										1455						6500	730	676	433	433
tube drawing & finishing												1858				1644	1008	897	589	588
rod drawing & straightening													320				801	283	264	
continuous strip casting										670				1645	141	318	210	210	210	
sheet and strip mill									2387						5967	1144	[illegible]	[illegible]	606	603
Generating station											400	400	400	400	800	800	800	800	1200	1200
Water plant						200						50	50	50	50	50	50	50	50	
LPG and fuel oil depot															10	10	10	10	10	
Maintenance shop equipment														240				520		40
Laboratory equipment														90				195		15
Vehicles																				439
Vehicle service facilities																				1
Offices and staff amenities									40	70	70	70	70	70	70	70	70	70	35	
Pre-production expenses			130	130	130	130	130	130	130	130	130	130	130	140	140	140	140	140	140	140
Total			130	130	130	330	130	430	5914	5278	2000	4808	3270	5428	13570	[illegible]	[illegible]	[illegible]	[illegible]	4096

11. REVENUES AND PRODUCTION COSTS

Profit and loss statements for the first ten years of production are presented in Table 11.1. These have been computed on the basis described in the following sub-sections.

11.1 Sales Revenue

The cost price of a copper or brass product is the sum of the metal price and the price of conversion into the product. Metal prices are quoted on the London Metal Exchange (LME) and fluctuate from day-to-day. The producer must therefore tie his selling prices to the prevailing LME prices and the cost of metal does not affect his P & L accounts except insofar as he buys and sells on speculation. One can regard the metal as an inventory of variable value - part of the working capital.

Table 11.2 shows cif prices for each of the product groups to be manufactured as of June 22, 1981, when LME prices stood at the levels shown in Table 11.4. They have been computed on the basis of actual quotations from leading suppliers. On the premise that the project would not attract investors unless its products could compete with imports, we have based the P & L projections on these cif prices, plus landing and harbour charges (approximately ₦ 10/t) and prevailing import duties.

Import duties are currently charged at the rates listed in Table 11.3, subject to rulings at the time of importation.

No Excise Tax is levied on semi-finished copper and brass products.

11.2 Metals

We expect that MEMACO will sell refined copper, zinc and lead at LME prices cif Nigerian port. Adding landing charges, harbour dues, import duty and inland transportation, one arrives at the delivered costs listed in Table 11.4.

TABLE 11.1 : PROFIT AND LOSS STATEMENT

Year	6	7	8	9	10	11	12	13	14	15
Sales Revenue	28,481	50,937	77,245	91,941	104,968	104,968	104,968	104,968	104,968	104,968
Direct Cost of Production										
Refined Metals	17,354	29,669	46,879	55,899	62,969	62,969	62,969	62,969	62,969	62,969
Brass Scrap	-	-	1,699	1,977	2,303	2,303	2,303	2,303	2,303	2,303
Consumable Plant Components and Operating Materials	1,076	1,783	2,700	3,435	4,123	4,123	4,123	4,123	4,123	4,123
Labour Including Payroll Overheads	744	1,385	1,709	1,778	1,848	1,888	1,900	1,900	1,900	1,900
Protective Clothing and Catering	88	162	183	183	183	183	183	183	183	183
Fuel Oil for Power Generators	510	991	1,472	1,746	2,064	2,064	2,064	2,064	2,064	2,064
Gas	60	110	174	206	233	233	233	233	233	233
Total Direct Cost	19,782	34,100	54,816	65,224	73,763	73,763	73,775	73,775	73,775	73,775
Indirect Cost of Production										
Staff Including Payroll Overheads	781	991	1,030	1,071	1,115	1,123	1,123	1,123	1,123	1,123
Protective Clothing and Catering	64	92	92	92	92	92	92	92	92	92
Maintenance	784	1,367	2,486	2,654	2,734	2,766	2,766	2,766	2,766	2,766
Vehicle Operation	31	31	31	31	31	31	31	31	31	31
Special Technical Services	700	600	500	400	300	300	300	300	300	300
Insurance	323	394	453	485	507	507	507	507	507	507
Administrative, General & Sales Expenses	156	198	206	214	223	224	224	224	224	224
Depreciation and Amortisation	4,772	-	-	-	-	24,115	7,406	7,404	7,407	7,406
Finance Charges	5,004	5,805	6,495	6,845	6,482	5,904	4,032	3,171	2.424	1,641
Total Indirect Cost	12,615	9,478	11,293	11,792	11,484	35,062	16,481	15,618	14,874	14,090
TOTAL COST OF PRODUCTION	32,397	43,578	66,109	77,016	85,207	108,825	90,256	89,393	88,649	87,865
NET PROFIT	(3,916)	7,359	11,136	14,925	19,7 1	(3,857)	14,712	15,575	16,319	17,103
TECHNICAL ASSISTANCE FEE	-	147	222	299	395	-	294	312	326	342
PROFIT BEFORE TAXATION	(3,916)	7,212	10,914	14,626	19,366	(3,857)	14,418	15,263	15,993	16,761
INCOME TAX	-	-	-	-	-	-	4,752	6,868	7,197	7,542
PROFIT AFTER TAX	-	-	-	-	-	-	9,666	8,395	8,796	9,219

TABLE 11.2 : SELLING PRICES AND CONVERSION MARGINS (₦/t)

Product Group	cif Apapa	Landing Charges, Harbour Dues & Import Duty	Proposed Ex-Factory Price	Metal Cost Delivered to Factory	Available Conversion Margin
1 Wire Rod	1,357	81	1,438	1,177	261
2 Winding Wire	2,297	492	2,789	1,177	1,612
3 ETP Copper Strip	1,724	191	1,915	1,177	738
4 PDO Copper Radiator Strip	2,023	222	2,245	1,177	1,068
5 67/33 Brass Radiator Strip	1,849	204	2,053	997	1,056
6 67/33 Brass Strip - Coil	1,498	167	1,665	997	668
7 67/33 Brass Strip - Cut	1,722	191	1,913	997	916
8 63/37 Brass Sheet	1,836	203	2,039	974	1,065
9 Copper Sheet	1,756	194	1,950	1,177	773
10 67/33 Brass Circles - Small	1,914	211	2,125	997	1,128
11 63/37 Brass Circles - Large	1,915	211	2,126	974	1,152
12 60/38/2 Leaded Extruded Brass Rod	1,536	91	1,627	956	671
13 57/39/4 Leaded Drawn Brass Rod	1,536	91	1,627	938	689
14 Drawn ETP Copper Rod	1,768	103	1,871	1,177	694
15 AC Copper Tube	2,864	311	3,175	1,177	1,998
16 Refrigeration Copper Tube	2,547	277	2,824	1,177	1,647
17 DWS Copper Tube	2,979	166	3,145	1,177	1,968
18 General Engineering Copper Tube	2,800	304	3,104	1,177	1,927
19 63/37 Brass Tube	2,750	299	3,049	974	2,075

NOTE: All brass costs allow for 1% loss as zinc. The use of bought-back scrap in brass rod has not been taken into account.

TABLE 11.3 : CURRENT IMPORT DUTIES - NIGERIA

Tariff Item	Tariff Description	Rate (% of c & f)
	Refined metals:	
74.01	Copper	5.25
79.01	Zinc	5.25
	Semis imported by approved users:	
74.03	Rod and bar	5.25
74.04	Sheet and strip, circles	10.50
74.07	Tube for water supply	5.25
	Tube for other uses	10.50
74.10	Winding wire	21.00

TABLE 11.4 : METAL COSTS (₦/t)

Metal	LME	Landing Charges, Harbour Dues & Import Duty	Inland Freight to Lagos or Port Harcourt Area	Total Cost	Extra Freight to Enugu Area
Copper	1,101	68	8	1,177	5
67/33 Brass	925	59	8	992	5
63/37 Brass	904	57	8	969	5
60/38/2 Leaded Brass	886	57	8	951	5
57/39/4 Leaded Brass	869	56	8	933	5
Brass Scrap	-	-	-	794	-
Zinc	570	40	8	618	5

TABLE 11.5 : CONSUMABLE COMPONENTS AND OPERATING MATERIALS

Process Section	₦/t input
Continuous wire rod casting: casting rings, belts, spouts, refractories, mould coating, edge trimmer cutters, rolls, acetylene, pickling solution, wax, rolling emulsion, lubricants, packaging materials, etc.	15
Winding wire drawing and enamelling: dies, enamel, lubricants, packaging materials, etc.	517
Billet casting: mould liners, saw blades, refractories, lubricants, etc.	15
Extrusion: billet liners, pressure pads, mandrels, die inserts and holders, saw blades, hydraulic fluid, lubricants, etc.	40
Tube drawing and finishing: dies, refractories, saw blades, burners, pickling acid, lubricants, packaging materials, etc.	8
Rod drawing and straightening: dies, saw blades, pickling acid, lubricants, packaging materials, etc.	4
Continuous strip casting: moulds, tools, refractories, hydraulic fluid, lubricants, etc.	20
Sheet and strip mill: rolls, tools, burners, refractories, rolling emulsion, lubricants, packaging materials, etc.	17

All in-house scrap will, of course, be recycled, so that total metal requirements amount to the production lumes shown in Table 8.1 plus metal losses. The latter consist essentially of zinc and have been assessed at 1% of the weight of all brass products.

Brass scrap will come available from customers shortly after commencement of the local semis industry. In computing metal costs, it has been assumed that, from the third year of operation onwards, 20% of all brass sales are brought back in the form of scrap at 80% of LME prices, delivered to the factory. This scrap will then be used in the production of brass rod.

11.3 Consumable Components and Operating Materials

Most of the process units have wearing components which need regular replacements, over and above normal maintenance. The frequency of replacement is a function of throughput. Table 11.5 summarises the unit costs of these and other operating materials. The figures do not include the machining of tools and rolls in the maintenance shops, which are charged to indirect expenditures.

11.4 Wages, Salaries and Other Staff Costs

Staffing requirements and the proposed basic salary and wage scales have already been set out in Section 7.

Fringe benefits vary, but the following percentages of basic pay are typical of a Nigerian metal-working business and have thus been applied :

	Senior Staff & Middle Management	Junior & Works Staff
Leave Allowance	4½	2
Housing Allowance	10	7
Transport Allowance	7	7
Annual Bonus	10	8½
Pension Funding	15	10
Medical Services	3	3
Industrial Training Fund	1½	1½
Total	51%	39%
Shift premium for second shift		15%
Shift premium for night shift		30%

Annual increments of 4% are applied for the first four years of a job, after which a balance between advancements and replacements is deemed to have been achieved.

11.5 Protective Clothing and Catering

A provision of ₦ 100 per person per year has been made to cover the cost of suitable protective clothing.

₦ 1.00 per person per day has been allowed for catering expenses including replacement of canteen utensils.

11.6 Fuel Oil for Power Generators

Power requirements depend primarily on the rate of production. The P & L forecasts therefore show a direct fuel cost of ₦ 0.03/KWH for electricity as determined in Appendix E. All other costs connected with the operation of the generator station are reflected in the respective indirect cost items.

11.7 Gas

LPG or preferably natural gas, must be made available, and pending a decision on the location and negotiations with NNPC, a cost of ₦ 6.00 per million Cals. has been chosen for present purposes as discussed in Section 6.

11.8 Maintenance and Repairs

Site Work	0.5% of capital cost
Buildings	1.0% of capital cost
Equipment	4.0% of capital cost

These allowances cover materials and labour other than in-house maintenance labour.

In view of the capitalisation of about two years' supply of spare parts, and in consideration of guarantees, equipment maintenance costs of only 1% and 2% have been assumed for the years 6 and 7 respectively.

11.9 Vehicle Operation

An average of ₦ 3,000 per vehicle has been allowed for running and maintenance costs excluding insurance. Much will depend on the wear and tear on the fork-lift trucks.

11.10 Technical Services

We have assumed that the technical partners will receive the maximum permitted technical assistance fee, namely 2% of pre-tax profits. Alternatively, the Government is prepared to consider a lump sum fee for the first three years of a new company.

In addition, we have made provisions for special services beyond the responsibilities covered by a technical assistance contract.

The technical partner will thus derive income in the form of :

- Technical assistance fees
- Special technical services
- Dividends from equity participation

11.11 Insurance

The extent of insurance coverage is a matter of good judgement, and premiums for a large package are negotiable up to a point. Bearing in mind the nature of this particular enterprise, the following cover and rates have been applied :

Fire and Additional Perils:	0.25% per annum on buildings, plant, stocks of raw materials and products, and work in progress.
Consequential Loss:	0.3% of gross profit, wages and salaries.
Burglary:	0.4% per annum of stock, loose equipment and furnishings. This includes pilferage by employees.
Fidelity Guarantee:	₦ 10,000 per annum for ₦ 500,000 indemnity
Cash:	0.1% of cash in transit, 0.5% per annum of maximum cash in safe.
Vehicles:	8% per annum.
Public Liability:	₦ 3,000 per annum for ₦ 1 million indemnity
Workmen's Compensation:	2% of wages.

Insurance against machinery breakdown and consequential losses is quite expensive and has been omitted, but the P & L statements include generous allowances for maintenance.

Goods in transit need not be covered as long as sales revenues pertain to an ex-factory basis.

11.12 Administrative, General and Sales Expenses

These include telecommunications, office supplies, dues and subscriptions, legal and audit fees, miscellaneous taxes and licences, travel and sales promotion. A collective provision of 20% of the indirect payroll would seem sufficiently generous at this stage of the project for these items.

11.13 Depreciation and Capital Allowances

There are no rulings concerning depreciation rates for accounts purposes. Instead of such rates, the financial projections in this study use the capital allowances for tax purposes as amended in the 1980 Finance Bill, namely (the rulings are not entirely clear) :

	Initial Allowance %	Annual Allowance on Straight Line %
Industrial Buildings	15	10
Plant	20	10
Furniture and Fixtures	20	10
Vehicles	20	20

In the year of disposal of any asset, a balancing charge on allowance should be raised to equate the tax value and the sale proceeds, but for the sake of clarity we have not done so.

Pre-production expenses and interest are amortised entirely during the first year of operation because they may not qualify as a capital allowance on expiration of the Pioneer Status period.

These allowances are taken as from the sixth year of operation, i.e. on completion of the tax exempt period granted under the Pioneer Status (See Section 11.15).

11.14 Finance Charges

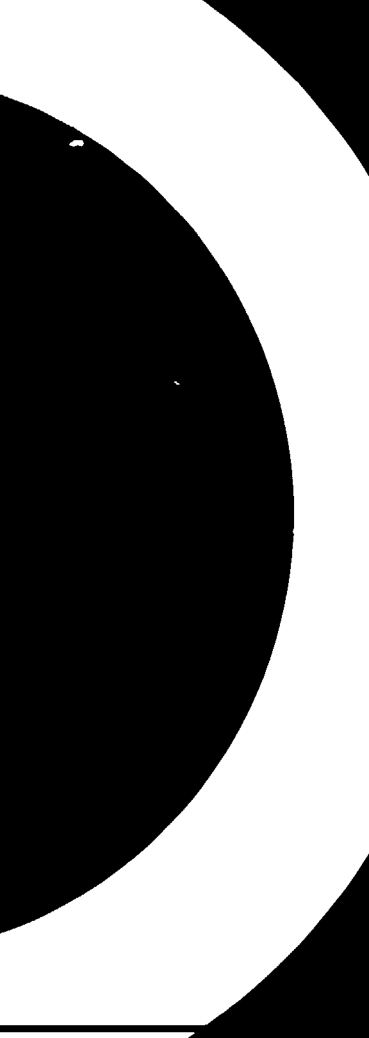
See Section 12.2.

11.15 Taxation

According to the Federal Ministry of Industries, the project would receive Pioneer Status under the Industrial Development (Income Tax Relief) Decree 1971. This gives a company exemption from taxation for a period of three years, extendable to five years under certain circumstances such as continuing losses or major expansions. Capital allowances are not claimed during the tax exempt period, but all qualifying capital expenditure up to the end of the tax exempt period is deemed to have been incurred on the first day following the end of that period. This in practice will give a further period of reduced liability to taxation.

The financial projections in this study take advantage of Pioneer Status for a period of five years on the grounds that the market will not permit full utilisation of plant capacity until the fifth year of operation.

Tax at 45% is paid in the year in which it accrues.



12. CASH FLOW, SOURCES OF FUNDS AND BALANCE SHEET PROJECTIONS

Table 12.1 shows the sources of funds assumed for this project and the anticipated cash flow up to the tenth year of operation. Table 12.2 projects corresponding balance sheets. The following sub-sections explain the assumptions made for the purpose of these calculations as far as they have not already been dealt with.

12.1 Equity

It is expected that equity will be subscribed by the Governments of Nigeria and Zambia, by the technical partner and possibly also by the Government of the State in which the plant will be located. An equity/fixed capital debt ratio of 1:2 has been assumed, which is the minimum required by the Nigerian Bank for Commerce and Industry (NCBI). The Nigerian Industrial Development Bank (NIDB) normally requires a ratio of 1:1.5.

The maximum allowed dividends have been taken, namely 60% of after-tax profit or 25% of paid-up share capital, whichever is the greater. Dividends are paid in the year to which they pertain.

12.2 Loans

Much of the fixed capital loan will probably come from the NBCI or NIDB. Both grant a moratorium of two years and repayments must be completed over periods of up to 15 and 10 years respectively. Irrespective of these provisions, however, the cash flow has been computed on the basis of making repayments as quickly as possible as and when funds become available. Dividends and repayment of the working capital loan have been accorded precedence, and sufficient cash has been retained to meet the working capital requirements set out in Table 12.3.

Interest rates ranged from 8½% to 11% in recent months. Bearing in mind that foreign machinery suppliers can usually offer subsidised credit terms at around 8%, the cash flow allows for 9% interest on all fixed capital loans.

TABLE 12.1 : SOURCES AND APPLICATION OF FUNDS (₦'000)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sources of Funds															
Generated Profit Before Taxation	-	-	-	-	-	(3,916)	7,212	10,914	14,626	19,366	(3,857)	14,418	15,263	15,993	16,761
Depreciation and Amortisation	-	-	-	-	-	4,772	-	-	-	-	24,115	7,406	7,104	7,407	7,406
Share Capital	260	1,020	18,900	9,820	-	-	-	-	-	-	-	-	-	-	-
Fixed Capital Loan	-	-	-	26,247	29,354	3,344	3,638	-	-	-	(17,779)	(9,572)	(8,299)	(8,703)	(8,676)
Working Capital Loan	-	-	-	-	-	4,550	3,300	3,186	(3,300)	(5,257)	(2,479)	-	-	-	-
	260	1,020	18,900	36,067	29,354	8,750	14,150	14,100	11,326	14,109	0	12,252	14,368	14,697	15,481
Application of Funds															
Purchase of Assets (See Section 10)	-	500	18,380	35,517	26,432	4,000	3,200	1,600	-	439	-	-	-	-	439
Working Capital (See Section 12.3)	-	-	-	-	-	4,550	3,300	4,800	2,440	1,960	-	-	-	-	-
	-	500	18,380	35,517	26,432	8,550	6,500	6,400	2,440	2,399	-	-	-	-	439
Outflow															
Dividends	-	-	-	-	-	-	7,500	7,500	8,776	11,620	-	7,500	7,500	7,500	7,500
Income Tax	-	-	-	-	-	-	-	-	-	-	-	4,752	6,868	7,197	7,542
Pre-Production Expenses	260	520	520	550	560	-	-	-	-	-	-	-	-	-	-
Pre-Production Finance Charges	-	-	-	-	2,362	-	-	-	-	-	-	-	-	-	-
	260	520	520	550	2,922	-	7,500	7,500	8,776	11,620	-	12,252	14,368	14,697	15,042
Net Bank Movement	0	0	0	0	0	200	150	200	110	90	0	0	0	0	0
Closing Bank Balance	0	0	0	0	0	200	350	550	660	750	750	750	750	750	750

TABLE 12.2 : BALANCE SHEET PROJECTS (₦'000)

Year	6	7	8	9	10	11	12	13	14	15
Fixed Assets										
Site Work	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842
Factory Building	21,714	21,714	21,714	21,714	21,714	21,714	21,714	21,714	21,714	21,714
Plant and Machinery	46,276	46,276	46,276	46,276	46,276	46,276	46,276	46,276	46,276	46,276
Services	11,853	15,053	16,653	16,653	16,653	16,653	16,653	16,653	16,653	16,653
Offices and Staff Amenities	705	705	705	705	705	705	705	705	705	705
Vehicles	439	439	439	439	878	878	878	878	878	1,317
	84,829	88,029	89,629	89,629	90,068	90,068	90,068	90,068	90,068	90,507
Less Cumulative Depreciation						24,115	31,521	38,925	46,332	53,738
Pre-Production Expenses & Interest	4,772									
Less Amortisation	4,772									
	0									
Current Assets										
Metals in Hand	3,620	6,180	10,120	12,060	13,600	13,600	13,600	13,600	13,600	13,600
Fuel and Other Consumables	40	80	120	150	170	170	170	170	170	170
Work in Progress	300	530	800	960	1,090	1,090	1,090	1,090	1,090	1,090
Finished Products	590	1,060	1,610	1,920	2,190	2,190	2,190	2,190	2,190	2,190
Bank Balance	200	350	550	660	750	750	750	750	750	750
	4,750	8,200	13,200	15,750	17,800	17,800	17,800	17,800	17,800	17,800
Total Assets	89,579	96,229	102,829	105,379	107,868	83,753	76,347	68,943	61,536	54,569
Represented By:										
Share Capital	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Profits	(3,916)	3,296	14,210	28,836	48,202	44,345	54,011	62,406	71,202	80,421
	26,084	33,296	44,210	58,836	78,202	74,345	89,011	92,406	101,202	110,421
Less Dividends	-	7,500	15,000	23,776	35,396	35,396	42,896	50,396	57,896	65,396
	26,084	25,796	29,210	35,060	42,806	38,949	41,115	42,010	43,306	45,025
Loans	63,495	70,433	73,619	70,319	65,062	44,804	35,232	26,933	18,230	9,544
	89,579	96,229	102,829	105,379	107,868	83,753	76,347	68,943	61,536	54,569

TABLE 12.3 : CUMULATIVE WORKING CAPITAL (₦ '000)

Year	6	7	8	9	10
Metal in hand - 10 weeks' supply	3,620	6,180	10,120	12,060	13,600
Finished Products - 1 weeks' Production	590	1,060	1,610	1,920	2,190
Fuel Oil and Other Consumables - 4 weeks' supply	40	80	120	150	170
Work in Progress - 50% of Sales for 1 week	300	530	800	960	1,090
Cash in Hand	200	350	550	660	750
TOTAL	4,750	8,200	13,200	15,750	17,800

For the working capital, the cash flow assumes a bank loan at 11% interest.

12.3 Working Capital

Cumulative provisions will be found in Table 12.3.

The inventory of spare parts will be shipped with the equipment and thus becomes part of the fixed capital investment.

Accounts payable and receivable have been omitted from the cash flow because we do not foresee a need for any significant long-term credit. Monthly payables and receivables should largely cancel each other out.

13. PROFITABILITY OF INDIVIDUAL PRODUCTS

The manufacturing costs of the various products depend not only on each other but also on the production schedule (which is, in turn, a function of the demands) and on the availability and choice of equipment capacities. An optimisation programme is not included in the terms of reference for this study. For a brass mill as versatile as that under consideration, such an exercise would be very complex and only of academic interest in view of the long-term nature of the market projections and other uncertainties. Nevertheless, one should at least determine at this stage of the financial analysis whether any of the proposed products are going to be so unprofitable that they should be eliminated.

For this purpose we have divided the process plant into a number of cost centres as itemised in Table 13.1. To each of these cost centres we have allocated its share of the direct costs (excluding metals) as well as a proportion of the indirect costs. The direct costs include total power costs as determined in Appendix E.

In order to cost the various product groups fairly, one should apply such finance charges as may be incurred under normal circumstances, i.e. without any special scheme for liquidating loans. We have accordingly applied 9% interest on ₦63.8 m, which is the fixed investment and working capital less ₦30.0 m equity and less the ₦16.0 m power plant on which interest has already been included in the electricity rate of 7.5 K/KWH.

As in the case of the simple rate of return (see Section 15.2), we have chosen year 17 for this exercise for convenience although any year from year 12 onwards would give much the same result.

The indirect costs account for 60% of the total conversion costs. Their allocation therefore becomes very important when assessing the viability of different product groups. Yet such allocation must remain arbitrary until the proposed enterprise is operational and one has the benefit of practical experience.

It so happens - and this is purely coincidence - that the indirect or fixed costs break down into three almost equal components which we allocated as follows :

TABLE 13.1 : COST CENTRES

1	Continuous wire rod casting
2.1	Winding wire unit - drawing - enamelling
3	Semi-continuous billet casting
4	Extrusion
5.1	Tube drawing and finishing - specification items (1), (2), (4), to (8) and (18)
5.2	- specification items (9) to (17)
5.3	- specification item (3)
6.1	Rod drawing and straightening - specification items (6) to (8)
6.2	- specification items (1) to (5)
7	Continuous strip casting
8.1	Sheet and strip mill - specification items (1), (3), (4)
8.2	- specification items (5), (6), (7)
8.3	- specification items (8), (9), (10)
8.4	- specification item (15)
8.5	- specification items (2), (13), (14)
8.6	- specification items (11), (12)

1.	Finance charges	)	Allocated to cost centres in proportion to their process plant costs
2.	Maintenance and depreciation of process plant.	)	
3.	Other fixed costs		Allocated to product groups in proportion to revenues

This method of allocating indirect costs, while still rather arbitrary, seems as equitable as possible under the circumstances.

Table 13.3 sums up the processing costs pertaining to the cost centres through which each of the 19 product groups passes. Adding item 3 above, we arrive at an approximation of the conversion cost per tonne for each product group.

In most cases, the conversion cost falls reasonably below the available conversion margin calculated in Table 11.2. Extruded rod (products 12, 13, and 14) shows a break-even situation, while general purpose copper and brass tubing (products 18 and 19) show relatively high profit margins. ETP copper strip (product 3) and brass strip coil (product 6) show slightly negative profit margins while copper sheet (product 9) also breaks even.

On the basis of these results and bearing in mind the flexibility of allocating overheads we would not, on the whole, rule out any of the product groups as definitely unprofitable.

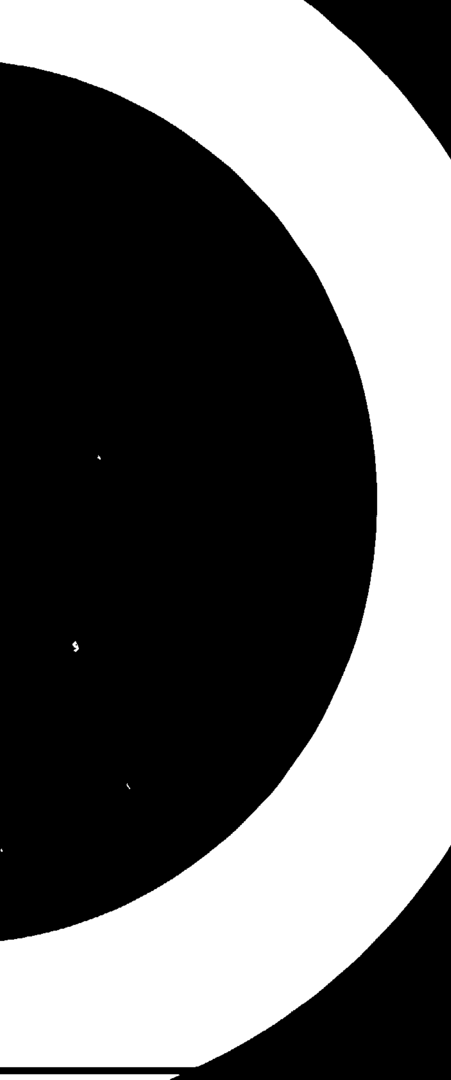
TABLE 13.2 : ALLOCATION OF COSTS BY COST CENTRE

Costs \ Cost Centres	1	2.1	2.2	3	4	5.1	5.2	5.3	6.1	6.2	7	8.1	8.2	8.3	8.4	8.5	8.6
Direct Costs																	
Operating Materials and Components	582	8	1,957	324	820	15	18	15	6	14	264	32	26	12	11	5	14
Labour Including Payroll Overheads	193	39	54	147	136	182	275	22	42	81	243	100	72	86	60	83	85
Protective Clothing and Catering	17	3	5	14	13	18	28	2	4	8	24	9	7	9	6	8	8
Electricity	383	135	135	811	1,020	239	255	9	30	14	1,230	164	146	121	28	78	116
Gas	146						7	11				29	40				
Total Direct Costs	1,321	185	2,151	1,296	1,989	454	583	59	82	117	1,761	334	291	228	105	174	223
Indirect Costs Allocated to Cost Centres	1,344	196	1,702	1,204	1,980	568	810	104	128	138	1,540	510	294	302	150	254	254
CONVERSION COSTS ALLOCATED TO COST CENTRES	2,665	381	3,853	2,500	3,969	1,022	1,393	163	210	255	3,301	844	685	530	255	428	477

NOTE: The direct costs include ₦ 1.44m finance charge and ₦ 0.80m depreciation on the diesel generation station.

TABLE 13.3 : PRODUCT CONVERSION COSTS FOR YEAR 17 (₦'000)

Cost Centre \ Product Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	2,398	267	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.1	-	381	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.2	-	3,853	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	275	-	-	-	-	-	-	-	-	700	275	275	225	150	200	100	300
4	-	-	437	-	-	-	-	-	-	-	-	1,111	437	437	357	238	317	159	476
5.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	245	153	204	102	318
5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	557	362	474	-	-
5.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	163
6.1	-	-	-	-	-	-	-	-	-	-	-	-	101	10[illegible]	-	-	-	-	-
6.2	-	-	-	-	-	-	-	-	-	-	-	140	57	58	-	-	-	-	-
7	-	-	-	363	528	462	165	99	99	1,057	528	-	-	-	-	-	-	-	-
8.1	-	-	118	76	118	101	42	17	17	237	118	-	-	-	-	-	-	-	-
8.2	-	-	116	82	116	96	41	-	-	234	-	-	-	-	-	-	-	-	-
8.3	-	-	-	-	-	138	58	-	-	334	-	-	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-	-	-	170	85	-	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-	53	54	-	321	-	-	-	-	-	-	-	-
8.6	-	-	181	119	177	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2,398	4,501	1,127	640	939	797	306	169	170	2,032	1,052	1,951	870	879	1,384	903	1,195	361	1,257
Production (t/y)	32,400	3,800	1,500	1,000	1,500	1,250	500	250	250	3,000	1,500	3,600	1,400	1,500	1,150	750	1,000	500	1,500
Unit Cost (₦/t)	74	1,184	751	640	626	638	612	676	680	677	701	542	621	586	1,203	1,204	1,195	722	838
Other Indirect Costs (₦/t)	79	154	104	122	112	93	104	116	116	118	116	90	91	104	171	155	174	174	170
Total Conversion Cost (₦/t)	153	1,338	855	762	738	731	716	792	796	795	817	632	712	690	1,374	1,359	1,369	896	1,008
Available Conversion Margin (₦/t)	261	1,612	738	1,068	1,056	668	916	1,065	773	1,128	1,152	671	689	694	1,998	1,647	1,968	1,927	2,075
Pre-tax Profit (₦/t)	108	274	-117	306	318	- 63	200	273	- 23	333	335	39	- 23	4	624	288	599	1,031	1,067
Pre-tax Profit as Percentage of Selling Price	7.5	9.8	(6.1)	13.6	15.5	(3.8)	10.5	13.4	(1.2)	15.8	15.8	2.4	(1.4)	0.2	19.7	10.2	19.0	33.2	35.0



14. EFFECTS OF LOCATION ON FINANCIAL ANALYSIS

Whilst one specific site may offer cost advantages over another, a broad comparison between locations in the greater Lagos and Port Harcourt regions shows up no significant differences. Construction costs, transportation costs for plant and raw materials, labour and fuel costs are all much the same.

The third preferred location, namely Enugu, does involve somewhat higher costs although the differences are so small that they hardly affect profitability calculations. Indeed, as was shown in Table 10.1, the fixed capital cost would be 3% higher and, based on the data shown in Table 11.4, raw material costs would rise by only 0.5%.

Other considerations such as the supply of natural gas, rail access and proximity to markets far outweigh these cost factors.

15. OVERALL PROFITABILITY

The terms of reference for this study require that the overall profitability of this project be examined by four criteria, namely

- payback period,
- simple rate of return,
- net present value,
- internal rate of return.

15.1 Pay-Back Period

This is defined as the period required to recoup the original investments through after-tax profit after adding back financial charges and depreciation. According to Table 15.1, the investments are recovered after 11 years, i.e. six years of operation.

15.2 Simple Rate of Return

The simple rate of return is defined by the formula

$$R = \frac{NP + I}{K} \times 100$$

where R = rate of return
NP = net profit after depreciation, interest charges and taxes
I = interest charges
K = total investment costs (fixed assets, pre-production capital costs and working capital)

In year 17, this rate works out at :

$$\frac{₦10,141,000}{₦112,201,000} \times 100 = 9.0\%$$

We chose year 17 for this exercise because it is the first year for which the profit and loss projection is not distorted by the accelerated liquidation of loans. Any other year from year 12 onwards (the second year of production at full capacity) would however show much the same simple rate of return.

15.3 Net Present Value and Internal Rate of Return

These involve identical techniques of measuring profitability, taking the timing of receipts and expenditures into account.

TABLE 15.1 : PAY-BACK PERIOD (₦ '000)

Year	Cumulative Investments	Cumulative Profit Plus Interest & Depreciation
1	260	-
2	1,280	-
3	20,180	-
4	56,247	-
5	85,601	-
6	94,351	5,860
7	101,001	18,877
8	107,601	36,286
9	110,151	57,757
10	112,640	83,605
11	112,640	109,767

TABLE 15.2 : ANNUAL INVESTMENTS AND DISCOUNTED CASH REVENUES

Year	Item	Actual Investments & Revenues	11%		11.5%	
			Discount Factor	Present Worth	Discount Factor	Present Worth
	Investments					
Start 1	See Cash Flow Table	260	1.000	260	1.000	260
2		1,020	0.901	919	0.897	915
3		18,900	0.812	15,347	0.804	15,196
4		36,067	0.731	26,365	0.721	26,004
5		26,992	0.659	17,788	0.647	17,464
6		8,750	0.593	5,189	0.580	5,075
7		6,650	0.535	3,558	0.520	3,458
8		6,600	0.482	3,181	0.467	3,082
9		2,550	0.434	1,107	0.419	1,068
10		2,445	0.391	956	0.337	824
15		397	0.212	92	0.218	87
End 20	Recovery of Working Capital	(17,800)	0.124	(2,207)	0.113	(2,011)
20	Disposal Value of Fixed Assets	(8,959)	0.124	(1,111)	0.113	(1,012)
				71,444		70,410
	Cash Revenues					
End 6		5,860	0.535	3,135	0.520	3,047
7		13,017	0.482	6,274	0.467	6,079
8		17,409	0.434	7,556	0.419	7,294
9		21,471	0.391	8,395	0.375	8,052
10		25,848	0.352	9,098	0.337	8,711
11		26,162	0.317	8,293	0.302	7,901
12		21,104	0.286	6,036	0.271	5,719
13		18,970	0.258	4,894	0.243	4,610
14		18,627	0.232	4,321	0.218	4,061
15		18,266	0.209	3,818	0.195	3,562
16		17,913	0.188	2,268	0.175	3,135
17		17,476	0.170	2,971	0.157	2,744
18		17,477	0.153	2,674	0.141	2,464
19		17,477	0.138	2,412	0.126	2,202
20		17,477	0.124	2,167	0.113	1,975
				75,412		71,556

The net present value is defined as the value obtained by discounting, separately for each year, the difference of all cash outflows and inflows accruing throughout the life of the project at a pre-determined interest rate. The discount rate chosen may be that paid for loan capital, in which case the inflows must at least equal the outflows for the project to be viable.

The internal rate of return is that discount rate at which outflows equal inflows, i.e. at which the net present value is zero. The internal rate of return thus represents the exact profitability of the project and can serve to compare this project with other forms of investment.

For the purpose of these calculations we have chosen a project life of 20 years corresponding to 15 years of production. At the end of this period the investments will have been fully depreciated for taxation purposes. Nevertheless, we have assumed a disposal value of 10% of the original fixed capital investments.

Table 15.2 shows the annual investments and cash revenues discounted at 11%, which we have chosen for the net present value, and at 11½%. Cash revenues comprise the after-tax profits plus depreciation and interest paid on loan capital. For simplicity, all investments are deemed to have been incurred at the start of the year and all revenues taken at the end of the year concerned.

At a discount rate at 11%, revenues less investments amount to ₦ 3.97 million. This means that, if investors choose a cut-off point of 11% interest, the profitability of the project will be above this level.

At a discount rate of 11½% revenues less investments amount to ₦ 1.15 million. Revenues actually equal investments at 11.7% which thus represents the internal rate of return.

15.4 Discussion

Pay-back periods and simple rates of return are rough-and-ready indicators of profitability. Quick pay-back does not necessarily signify a good investment, and the simple rate of return takes no account of the fact that a Naira in the future has less value than a Naira now.

The net present value indicates that lending institutions should be prepared to furnish the fixed and working capital loans. They will want to see a profitability beyond their top lending rate of 11%, which we took as the cut-off point.

Equity holders will certainly require a profitability well beyond the interest rate applied to loan capital. At an internal rate of return of 11.7%, against fixed and working capital loan rates of 9% and 11% respectively, they should be satisfied since they will have contributed only 33% towards the present worth of the investments. The shareholders should thus realise a return of 21.6% on their investment as can be seen from Table 15.3. This Table lists equity investments and revenues (after-tax profit plus depreciation) discounted at 21½%.

TABLE 15.3 : DISCOUNTED EQUITY INVESTMENTS AND REVENUES (₦'000)

Year	Item	Actual Investments and Revenues	21½%	
			Discount Factor	Present Worth
Start 1	Investments	260	1.000	260
2	See Cash Flow Table	1,020	.823	839
3		18,900	.677	12,795
4		9,820	.557	5,470
End 20	Recovery of working capital	(17,800)	.020	(356)
20	Disposal value of fixed assets	(8,959)	.020	(179)
				18,829
End 6	Cash Revenues	(1,506)	0.311	(468)
7	See Profit and Loss Projections	7,212	.256	1,846
8		10,914	.211	2,303
9		14,626	.173	2,530
10		19,366	.143	2,769
11		20,258	.117	2,370
12		17,072	.097	1,656
13		15,799	.080	1,264
14		16,203	.065	1,053
15		16,625	.054	898
16		17,054	.044	750
17		17,476	.036	629
18		17,477	.030	524
19		17,477	.025	437
20		17,477	.020	350
				18,911

16. SENSITIVITY ANALYSIS

Again taking year 17 as a normal production year, the profit margin (before technical assistance fee and income tax) at different outputs can be obtained from Figure 16.1. The graph shows a break-even point at 40% of full production. If production falls to 70% on account of low demand or operational problems, the profit margin will be halved from ₦18 m to ₦9 m.

A diagramatic analysis of the turnover in year 17 will be found on Figure 16.2.

Shortfalls in quality, which could occur in early years on such products as radiator strip and winding wire, would reduce demand rather than selling prices, but both would have the same effect on sales revenue.

The cost of the metal is passed on directly to the customer since selling prices are tied to LME prices. Hence any change in metal cost need not affect the profit margin.

Fuel and labour costs have been quite generously assessed, so that there should be no risk in respect of the accuracy of the figures. They account for one-half of the direct costs other than metals. In the unlikely event that the aggregate should increase say 50% without permitting a higher conversion margin, the profit would drop by only 9%. The same applies to consumable plant components and operating materials which account for an equal proportion of the direct costs.

Hence the only serious financial risk is a shortfall in production, which makes it vitally important to have a strong technical partner who will :

- Keep the plant running well by proper training, scheduling and maintenance;

- Ensure acceptable product quality to meet all market requirements.

Demands in excess of those forecast for 1990 could be met by running a third shift, which could increase the annual profit by up to 50% even though the third shift would hardly produce as much as the other two.

FIGURE 16.1 : SENSITIVITY CHART FOR YEAR 17

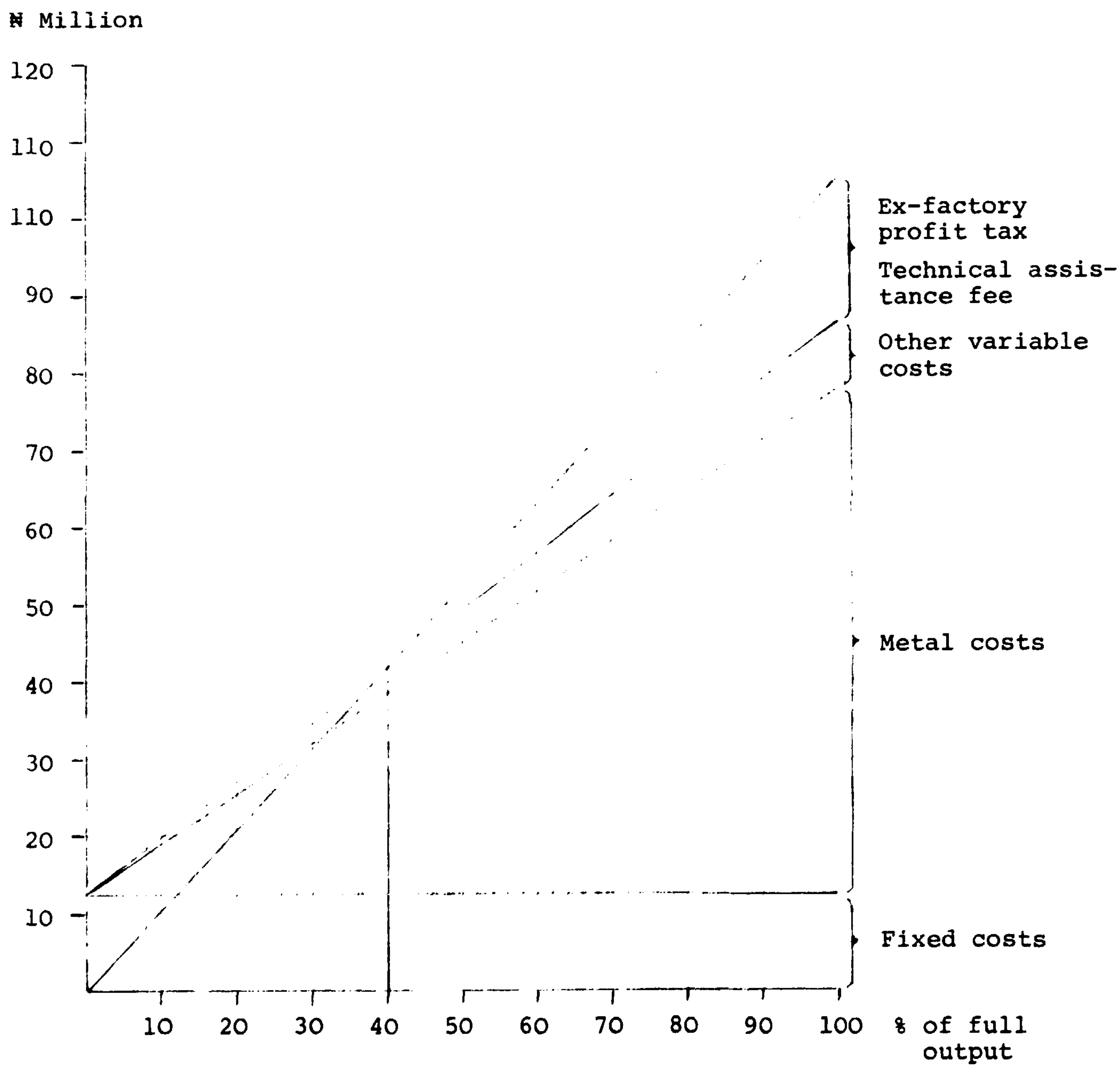
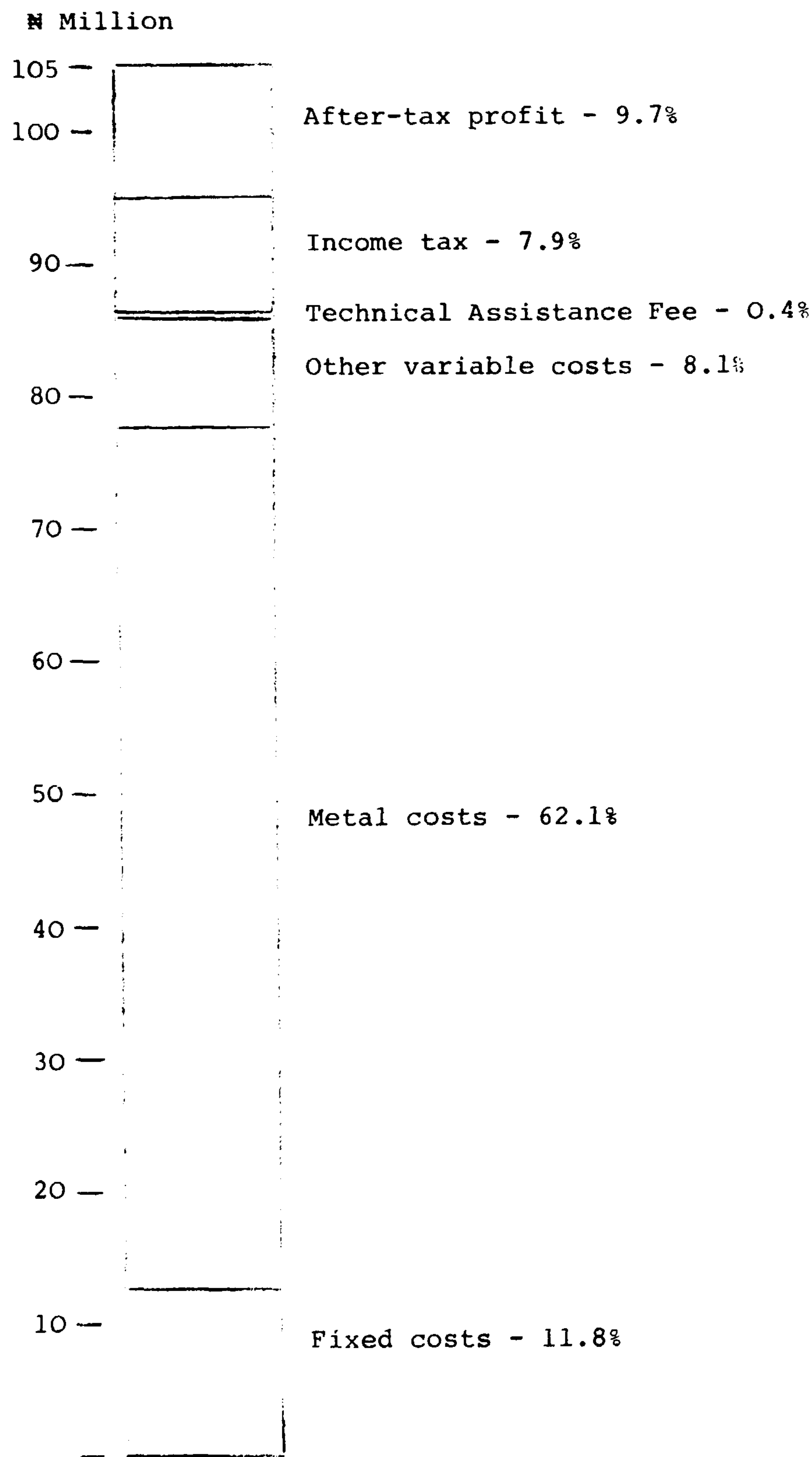
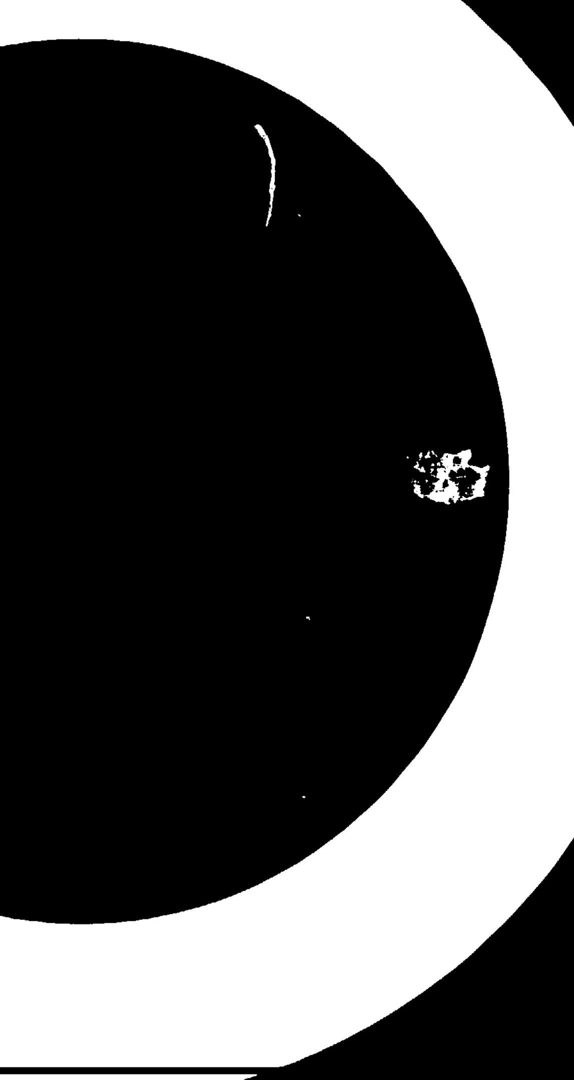


FIGURE 16.2 : ANALYSIS OF TURNOVER - YEAR 17





APPENDIX A : COPPER SEMI-FABRICATION PROCESSES

A1. MANUFACTURE OF COPPER WIRE ROD

Copper wire rod, the feed-stock for production of wire by drawing, is supplied in nominal diameters ranging from 6-12 mm. Common diameters are ¼" (6.35mm), 5/16" (8mm) and 9mm.

Some ten years ago several developments occurred in the performance of wire drawing machinery. Equipment became available which would draw faster and incorporated continuous, in-line annealers and spoolers. These developments and improvements are now in common use in the copper wire mills and the engineering of wire drawing plant for copper has become a separate speciality within wire drawing generally.

Accompanying this process of advance and development in wire drawing has been the switch first in demand, now in supply, from the traditional route of hot rolling wire bars to produce one coil of black rod for each wire bar, to the continuous casting and rolling (CCR) processes which give unlimited coil weights of a single length.

Wire rod used to be produced by hot rolling cast wire bars which had been cast in lengths of around 1.4 m with each weighing 90-115 kg each. The wire bars were pre-heated and rolled in up to 20 passes in 10 or more mill stands successively, to produce separate coils each the same weight as the wire bar. The design and installation of such mills called for great expense and skill, and their operation requires much control, maintenance and adjustment by skilled personnel to ensure the physical quality of the rod is maintained. Copper rod of indifferent or variable quality is costly to use in wire drawing, because the number of breakages during the wire drawing process, already relatively high where the plant is fed with unit coils welded end-on-end to give continuous feed, is greatly increased by imperfections in the rod engendered by faults in hot rolling.

Copper rod hot rolled from wire bar is still made, but is seldom offered as a market commodity. Where it is sold and delivered outside the factory where it is rolled, it is now customary for the rod to be pickled free from scale, welded end-on-end to make large multiple coils, and drawn one or two passes so as to ensure good concentricity.

A majority of copper rod produced today is by the continuous casting and rolling processes. Conversion in these is direct from cathode to rod, the cost of this conversion is less than the hot rolling and auxiliary finishing processes, and the quality of the final rod is held by users to be reliably superior.

A third method of producing rod is used where relatively small quantities are required. Unless the extrusion press is mainly used for producing larger sections or other alloys then the cost of producing copper rod by this route is too expensive for large scale production.

The most popular and the most successful branded processes for producing continuous cast and rolled (CCR) copper rod utilize one or two continuous bands of steel strip to form the first solid cast section. Also processes rely on in-line hot rolling in small diameter rolls where the speeds of the individual mill stands are carefully matched to avoid stretching, breakage or looping of the rod between.

A1.1 Southwire (SCR) Continuous Casting and Rolling

The Southwire Company with Western Electric began in 1962 a programme aimed at developing a continuous copper rod production process based upon the Properzi system which had proved very successful for the continuous casting and rolling of aluminium and zinc rod and strip. The casting principle, which is retained today on the latest models, is to pour the molten copper into the groove of a large copper wheel, where the groove is closed on the fourth and longest side by an endless steel band. Casting takes place around three-quarters of the periphery of the casting wheel, aided by carefully controlled cooling water sprays.

Careful control of the metal flow from the pouring pot to the casting cavity is an extremely critical factor in the production of a cast bar of uniform quality and shape, as variations in flow rate will change the conditions further along the sequence. This is obviously undesirable in a process where continuity and uniformity are vital to high efficiency, high volume production. Although metal levels and temperature are controlled at earlier stages by automatic sensing and feedback devices, the final control of pouring is manual, a single operator working with full concentration for about one hour before taking turn and turn about, two such operators per shift.

The cast bar emerges from the casting cavity vertically and at a temperature of about 900 C. It is led by a roller conveyor to the horizontal plane and into a mechanical scarfing and brushing stage, which removes a small amount of "flash" and bevels both the acute corners of the section.

At this point a flying cropping shear is provided for use in discarding as convenient lengths bar cast at the beginning of a shift before it reaches steady conditions, fit for subsequent rolling. This cropping shear and one or two others at later stages are also used on the infrequent occasions when the rolling mills produce a "cobble" (i.e. where the product is the wrong size or shape).

In the normal course of events, the cast and conditioned hot bar passes into the 4-stand roughing mill train, which rolls the bar alternately in the horizontal and vertical planes and passes to the 8 or 10 stand finishing train a bar at about 600 degrees C, which is approximately round at about 30 mm diameter. The second emergency cropper is provided between the roughing and finishing mill trains. Both lubrication and cooling of the bar whilst rolling are provided by high pressure sprays of soluble oil emulsion in a separate system for the roughing train and a second one for the finishing train. The emulsion is filtered to remove metal particles and recirculated and maintained at constant temperature, being preheated before the line is started and subsequently cooled or heated as necessary to keep the constant temperature approximately 130 degrees F, depending upon the installation and the ambient temperature conditions.

All Southwire plants now use the extremely efficient ASARCO cathode melting shaft furnace. Originally these were designed specially to melt copper cathode using gas fuel. There is now an oil-fired version available as an option, but the gas fuel is the more manageable, equally so for natural gas or LPG. The advantages of the ASARCO furnace are its high thermal efficiency, due to the fact that the burnt exhaust gases heat the cold metal feed in the upper part of the shaft, its high melting rate, its homogenizing effect and its very short start-up and shut down times. Starting from cold cathode, molten copper is produced in about 40 minutes. If the fuel/air supply is turned off, molten copper ceases to flow in less than 5 minutes.

Southwire (SCR) copper rod is produced bright. Oxidation during rolling is kept to a minimum by the soluble oil emulsion cover which effectively provides a steam atmosphere at the bar surface. Upon emerging from the last stand of the finishing train, the rod passes into a cooling and pickling tube in which is provided a pumped counter current flow of a 3% alcohol-water mixture. At the temperature conditions which obtain, the alcohol reduces the oxide scale that is present on the rod back to copper. In so doing, the alcohol itself is consumed and is continuously replenished in the recirculating system. There follows in the same tube at a second stage a water rinse, so that upon emerging from the pickle and rinse tube the rod is bright, warm and dry. A spray application of a dilute wax emulsion is then applied to prevent tarnishing of the rod in transit and it is fed directly to the coiler which may be one of several types according to the form of coil required.

By suitable layer-winding techniques, coils of a very high density are made, up to eight tons unit bulk weight are possible if required.

The plant supply specifications for Southwire machines include sensors which are fitted to the lowest of the three rings of burners fitted to the ASARCO furnace. These burners are supplied with gas/air mixture, and the sensors monitor the oxygen level in the products of combustion adjacent to some of these burners. Experience has shown that certain indicated oxygen levels at this point correspond with certain oxygen levels in the finished copper rod. Being generally associated with the "pitch" of the copper, its oxygen content is a matter of some importance in its physical properties during further working to fine wire or wire for special applications. It does not greatly affect the electrical conductivity within limits, but practice in this regard differs between, for example, European wire drawers and United Kingdom. Whereas, copper wire of high conductivity and CCR copper rod in Britain are normally at about 250 PPM oxygen near to tough pitch quality, the Europeans now prefer an oxygen level around 50-100 PPM. Whilst this property is quite readily controlled in the ASARCO/Southwire combination, it is worth repeating that with an installation of this kind, uniformity and consistency in all operating conditions is paramount in achieving and maintaining mimimum running costs and maximum profitability.

A2. MELTING AND CASTING IN BRASS MILLS

The melting furnaces used by most fabricators of copper and copper alloy products are low frequency electric induction furnaces. Although it is possible to melt copper and brasses in gas-fired or oil-fired crucible furnaces, only electric induction gives the flexibility and control necessary with such relatively high value materials being melted. Only if it is required to melt large quantities of one single metal or alloy is it useful to contemplate other methods and in that case the ASARCO shaft furnace, gas or oil fired, would almost certainly be the preferred choice.

A2.1 Induction Furnaces

Low frequency induction melting furnaces came into use about sixty years ago and are now used in most billet and slab casting foundries. Ratings range from 80 - 1,000 kW with one or two inductors and with charge capacities of some 7/8 tons. In principle the LF induction furnace is a crucible melting furnace in which a ring of molten metal surrounds one leg of an iron transformer core. A current of up to 20,000 Amp is developed in the ring of metal which forms the secondary coil, by passing a much smaller current in the primary coil, thus the ring of metal is heated due to its electrical resistance. The ring or loop is so designed that the effect of magnetomotive force generated by the high current creates circulation between the secondary loop and the crucible itself. Thus the overheated metal in the secondary loop is continuously replaced by cooler metal from the crucible and the solid charge in the crucible is quickly melted by the circulating molten metal. The choice of refractory lining materials for these furnaces is a little critical due to the requirements for low electrical conductivity and resistance to wear.

A new furnace (or a relined one) is first half-filled with molten metal so as to fill the secondary loop and thus allow circulation and melting to proceed. Next is charged clean scrap and virgin metals to be melted. As melting proceeds, further copper and scrap are charged and just before pouring the alloy will be corrected to the composition required, which means adding more zinc in the case of a brass melt. The charge is ready for pouring or casting after it has been skimmed of dross and given a protective floating charcoal covering. At this stage it will be at about 200 degrees C above the melting point. The drawback to this type of furnace, which is known in Britain as a "channel furnace" is that a maximum of 60% of the molten metal can be poured out, the remainder being necessary to maintain the secondary circuit in the induction loop, but an advantage of this is that composition variations are smoothed effectively by the use of up to half molten metal of the correct composition in each total charge.

A2.2 Continuous Casting of Billet and Slab

Continuous casting methods have been widely adopted for the casting of copper and copper alloy slab and billet. These all involve passage of the metal through a cooled sleeve of metal or graphite, it being molten at one side of the sleeve and emerging at the other side as a solid shape in a continuous length.

Whatever the metal cast and whether the withdrawal be horizontal, vertically upward or vertically downward, all these methods have mechanical means for withdrawing and controlling the speed of casting, that is the speed of withdrawal from the mould of the solid shape.

Round billets and thick slab for sheet rolling in copper and copper alloys are commonly cast by a semi-continuous method called drop-casting. The moulds in this case are of alloyed copper (e.g. CuCr). Several moulds are usually fed from a single pouring trough or tundish which is in turn fed from a holding furnace. All the billets are withdrawn downwards starting at the same moment, and withdrawal speed is constant until the charge is all cast or until the bottom of the rig or pit is reached. There are copious water sprays immediately below the moulds on all of the billets being cast. This process is suitable for ETP copper, PDO copper and the brasses. Logs of up to 5 - 6 metres in length are produced, and for reasons of uniformity of structure and composition they are reckoned much preferable to discontinuous, single cast billets.

Monitoring of the start of withdrawal and of the speed of withdrawal during the casting process is by means of temperature sensors placed in the molten metal close to the point where solidification takes place.

For smaller sections such as the thin slab required to eliminate hot rolling, a horizontal process is more suitable, using a graphite mould. Graphite is a particularly suitable material for this application because of its good thermal conductivity, combined with its dry lubrication property. It is also relatively easy to fabricate, thus to cut and finish to close tolerance replacement moulds.

In processes of this kind the graphite is a lining material in a water-jacket but the necessary taper in the mould is of course machined into the graphite. Withdrawal of the slab is intermittent by means of pinch rolls 1 to 2 metres from the mould. 1 to 3 cm are withdrawn at each pull and the drive then disconnected so that the slab can in fact pull back a few millimetres. The water-jacket assembly with graphite mould liner are made integral with the side of an electric induction holding furnace of the channel type. To start the casting process, a dummy slab end is placed in the mould aperture, the furnace tilted back and filled or refilled with molten metal of the correct composition and the heat input adjusted to maintain it just above the melting point. Note that the stiring action characteristic of the channel induction furnace is particularly beneficial in a holding furnace role.

The length, frequency and speed of withdrawal are integrated with sensors for temperature and water flow in the cooling jacket, ultimately controlled by the surface temperature of the emerging slab to achieve a uniform result of satisfactory quality. Clearly too long or too rapid or too frequent withdrawals can all cause breakout of the liquid metal.

Graphite mould continuous casting processes are unsuitable for casting copper which contains oxygen because of the effect of that oxygen upon hot graphite and vice versa. The life of a graphite mould when working with ETP copper would be a matter of hours rather than the several days which is customary when casting brass or other alloys.

The metallurgical advantages of these processes are: reduced segregation of composition variation, high density, absence of shrinkage porosity. Operational advantages include elimination of end scrap, uniformity of composition in further processing, choice of batch lengths to be delivered to subsequent processing and others. The main disadvantage is the extra capital cost of the fairly sophisticated multi-variant control apparatus.

A3. MANUFACTURE OF SHEET AND STRIP

In general the classification of flat rolled products describes as "strip" metal which is flat and less than 500 mm wide, and as "sheet" all metal wider than 500 mm. Concerning gauge, material less than 0.15 mm thick is termed "foil." All these products are manufactured by rolling, usually finishing with cold rolling, and having various process stages of heat treatment, surface conditioning, edge trimming.

The raw material for rolling processes is a flat, thick cast shape, usually termed slab and the first and necessary operation involves breaking up the coarse crystalline internal structure as-cast. This is necessary not only for the sake of uniformity and homogeneity but also to increase the basic ductility and working and cutting properties of the metal.

Hot rolling by definition takes place at a temperature above the minimum recrystallisation temperature of the metal, that is above say 650°C for brass and say 350°C for copper. Thus in hot rolling, the breakup of the coarse cast structure, and its recrystallisation to a finer, more homogeneous structure take place simultaneously. Furthermore, all metals are softer and more plastic when hot than when cold. Were this not so, the choice between hot rolling and cold rolling as a first operation would be difficult to make but in absolute terms, the selection between the two is governed by the thickness of the cast slab and by the comparative power of the available rolling mill. It follows that the ideal combination is the rolling of the thickest slab which the given rolling mill can handle, preferably to be cold rolled.

Cold rolling eliminates the need for pickling or other scale removal methods, with consequent loss of material, but the drawback to initial cold rolling is the rather limited reduction which can be made because of the danger of inter-granular cracking in the original cast structure. Nevertheless, all coppers and the common brasses can accept a two-thirds reduction cold in continuous cast slab, especially if the brass has its cast surface removed by milling as the first process after casting.

This first reduction, which may take several passes in a 2-high or 4-high cold mill should be followed by edge trimming to remove any tendency to tooth-edged cracking and then by annealing, preferably in a controlled atmosphere furnace to give a bright, clean result which does not require pickling before further rolling. Annealed, hence recrystallized material from such furnace should then be "rundown" by several passes in a single stand mill, or in a tandem arrangement of two or three mills or,for heavy reductions, few of them and high volume production with good precision cluster mills are now used to advantage. The rundown will conclude at the stage at which the last anneal of the material is to take place, assuming that it is ductile enough to reach that following the previous anneal at the breakdown stage. For example, if brass broken-down to 6 mm gauge were required to have its last anneal at 0.5 mm, the reduction would be too much for the ductility of the brass to achieve without a further intermediate anneal.

Finishing rolling, rolling to final size may take place involving reductions from 5% or less to 75% in gauge, depending upon the hardness or "temper" required by the consumer. The heavier the reduction, the harder the temper in the final result. Finish rolling invariably takes place on 4-high mills, with close control of gauge being achieved by flying micrometers or radiation indicators. The work rolls on such mills are as small a diameter as is practicable, they may have bright or controlled roughness finish so as to give the desired results in the finally rolled strip and for the maintenance of visual and physical quality they will be changed periodically and often.

The sequence in sheet rolling is similar in principle and in detail, but unless the quantities justify it the increased width of machinery necessary to roll large, heavy and expensive coils of sheet widths will not be justified. In this situation, a relatively small volume of sheets can be made by cross-rolling to increase the width of cut lengths of thick strip after breakdown rolling.

Thin slab for direct cold rolling may with advantage be produced in an extrusion press, provided that the limitation on slab width (which is reflected exactly in the final strip width) as imposed by the billet size, can be tolerated. Extruded slab does not have the coarse, cast structure, because extrusion is in fact a hot working process, that is involving simultaneous forming and recrystallization from the cast structure of the billet.

A4. THE MANUFACTURE OF SEAMLESS TUBE

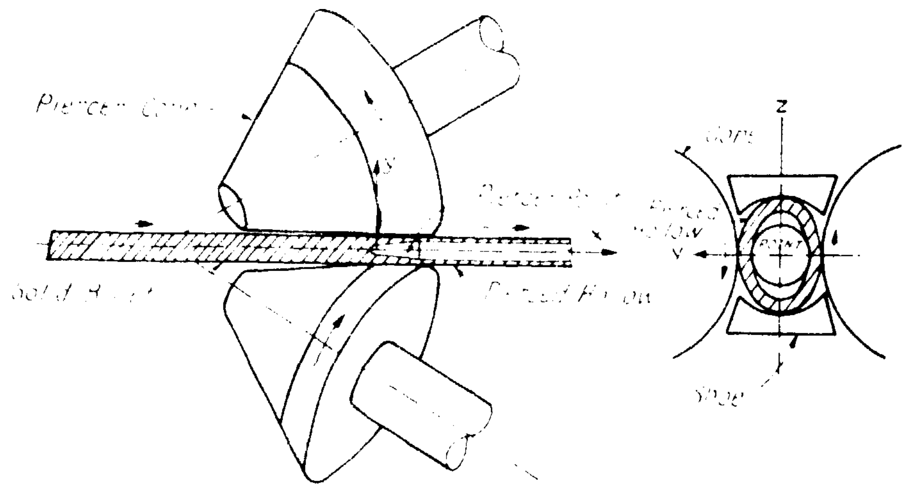
Tube hollows are almost all produced by two methods: hot piercing and hot extrusion, the starting point for both methods being a solid cast cylindrical billet. Cast diameter relatively thin walled tubes can be produced by deep drawing in several stages from a flat sheet blank but this is very expensive and rare. For very large tubes, diameter greater than 200 mm, cast hollows are prepared.

Hollows are eventually reduced to final tube sizes and all thicknesses by a sequence of cold drawing, annealing, pickling etc. These operations are described below.

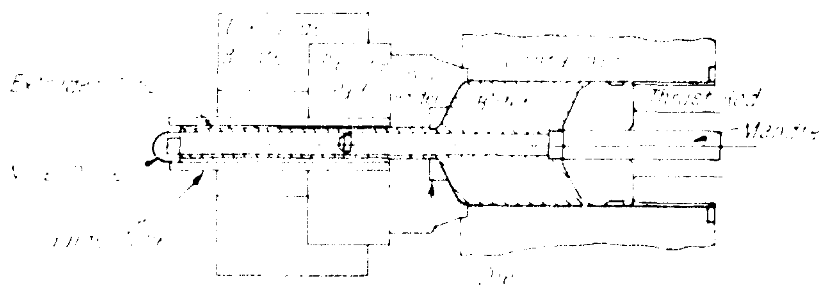
A4.1 Piercing

In forming hollows by piercing, the hot billet is forced over a mandrel by cross-rolling to form a shell. The pre-heating temperature for the billet depends upon the metal composition, and in the case of non-ferrous metals may be between 550 and 1100 °C. All grades of commercial copper and most copper alloys too, can be readily pierced but the optimum temperature range for piercing a given alloy is a small one and close control is required upon it. If the billet is too hot, cracks may form on the inside of the tube, if too cold the billet will pierce more slowly or may jam in the machine. For pure copper a suitable piercing temperature is about 870°C.

The essential mechanical parts of a piercing mill, sometimes known as a Mannesmann machine, are two main driving rolls, a small guide-roll and a piercing mandrel or arbor (Figure A.1). Each of the driving rolls is two truncated cones upon the same axis, so as to form a ridge at the joint of the two cones. The two rolls are set at such an oblique angle that the ridge of each roll takes the path of a screw-thread. When the billet is inserted into the rolls and the rolls rotated they grip it in such a way as to force it forward into the machine. The guide roll is placed between the two drawing rolls and well below the centre line. The centre line of the billet as it is being pierced, must be below the centre line of the main driving rolls to keep it from jumping out upwards. The guide roll may be either straight or ground to a shape similar to the driven .olls.



SCHEMATIC PIERCING OPERATION



SCHEMATIC ARRANGEMENT OF TOOLING AT END OF LUBRICATED EXTRUSION

The mandrel or arbor is a long bar of steel with a point of hot die steel, over which the metal is rolled to form a shell. The other end of the mandrel is held firmly in a swivel device so that it can rotate freely about its longitudinal axis. In addition to these essential components, certain guides are necessary for the billet entering and for the shell leaving the rolls.

The diameter and length of the rolls are determined by the size of the billets to be pierced. The tube size produced will depend upon the mandrel diameter and the roll setting, but in any case several sets of rolls and mandrels are held at the mill to give a full range of sizes.

A4.2 Extrusion

In the extrusion press the hot billet is forced under compression to pass through a die aperture, or to manufacture tubes, between a die and a mandrel. Certain copper alloys, notably the brasses with less than 62% copper are soft and extremely malleable when hot, yet difficult to cold work and strong and hard when cold. It is these alloys which are mainly extruded to the brass rod sections so commonly chosen in industry for ease of machining along with corrosion resistance and the other good properties associated with copper alloys.

The great advantage of extrusion is that the temperature is maintained during the whole reduction process close to the initial, pre-heating temperature. This means that the resulting sections have uniform grain size, with fine grain structure if the temperature has been suitably chosen and not too hot.

Note that different alloys have much different physical properties when hot and are thus somewhat variable in their ease of extrusion one from another. The differences are expressed in practical terms as limiting extrusion ratio, that is

$$\frac{\text{billet cross section area}}{\text{extruded section area}}$$

For example, PDO copper has an extrusion ratio of 29:1 whilst 60/40 brass has an extrusion ratio of 24:1.

Extrusion machines can be either vertical or horizontal, but horizontal are now much the more common. The principle of tube extrusion is also shown in Figure A.1. The basic process of extruding tubes, rods or sections is the same, but certain parts of the machine are differently arranged. The die mechanism, including the die itself is basically the same for all extrusions, so are the container and the container liner. Differences occur in the other parts. For tube extrusion a second piston and minor ram within the main piston and ram are employed. This minor ram acts as a mandrel and acts independently of the main ram, through a hole in the block. The main ram is backed by a large hydraulic cylinder about 80 cm diameter acts through the thrust rod upon the block which is the same size as the container and the billet and which transmits pressure to the billet. Billet sizes vary according to the press and container size from about 15 cm diameter to 30 cm plus. The thrust rod of the ram is of course slightly smaller than the block so that its withdrawal at the end of an extrusion stroke is not prevented by the thin shell of metal which is back extruded past the block. The first step in tube extrusion is for the minor ram to be forced through the billet and through the die aperture. This causes a small plug to be forced forwards, and the billet itself to back extrude somewhat, so that the main ram must be without pressure to allow this. The second stage is for the main ram to act and extrude the metal past the nose of the mandrel through the annular die aperture which remains.

The advantages of extrusion over other methods of producing tubes is that it lends itself to production of tubes in alloys that cannot easily be pierced and also yields a dense shell that is substantially free from physical defects. However, extruded shells are not particularly concentric and require careful handling in subsequent drawing to correct this.

Copper and brass tubes are usually extruded directly into a quench cooling tank.

At the end of the extrusion stroke, both rams are withdrawn and the block together with the remaining billet end stub and the back extruded metal sleeve are removed, separated and the metal values sent for scrap. The total weight of that scrap can be as high as 20% of a small billet, rather less with larger billets.

A4.3 Tube Drawing

Tube shells are pointed by hand hammering or more usually, by a pointing machine and then drawn on draw benches or on drawing blocks similar in principle to wire drawing machines. Cold drawing reduces the outside and inside diameters and at the same time reduces the wall thickness and circular area of the tube. Inside the diameter is reduced slightly less than the outside diameter and the operation results in a smooth finished surface inside and outside. During drawing operations, the metal is work-hardened and particularly for brasses, softening by annealing has to be carried out as the reductions proceed. Tube drawing on draw benches can be by one of the following four methods:-

- drawing over a fixed mandrel or plug
- drawing by sinking, that is drawing with no mandrel inside the tube
- drawing onto a mandrel inside, causing the mandrel all to travel through the die with the tube
- drawing with a floating plug, that is a plug free within the tube

Such a plug is composed of two cylindrical sections, differing in diameter and joined with a tapered shoulder between. During drawing, the forward motion of the tube forces the plug up to the die, its smaller diameter portion resting within the die and defining the drawn inside diameter. The tapered shoulder to the larger diameter of the plug prevents the plug from being pulled right through the die with the tube. The floating plug was originally developed for drawing tubes in coils on blocks, where it is not possible to use a plug rod.

The drawing cycle on the draw bench is as follows:-

- the tube is threaded, tail first, over the plug and plug rod which is fixed to the back edge of the bench.
- the pointed end of the tube is then passed through the die where it is grasped by the jaws of a carriage.

- the carriage is hooked to the chain, and pulls the tube through the die over the plug. The size and shape of the plug determines the inside diameter of the tube, and the size and shape of the die aperture determine the outside diameter of the tube.

The draw bench consists of a horizontal frame that has a mechanical drive at one end, a die plate through which the tube is drawn and a tail stock at the other end. An endless, square linked chain passes horizontally forwards from the die plate, returning beneath the frame. The carriage, equipped with jaws to grip the pointed end of the tube, runs on tracks along the top of the draw bench and is engaged by hooks to the continuous chain when the point is attached. Modern draw benches may draw up to three tubes simultaneously. Benches are rated in pounds of pull (nowadays in kN) corresponding to the maximum capacity of the main chain. The chain may alternatively be hydraulically driven. Common draw bench ratings range from 1,000 - 300,000 lbs.

Tube finishing to size can alternatively be carried out on Pilger type tube reducing mills, in which conical dies are effectively rolled in a rocking motion over the tube surface, reducing it against a mandrel inside. The tube is rotated meantime to give similar working over the whole circumference. Pilger mills are specific as to the size produced, and are accordingly favoured for preliminary cold reduction from the pierced or extruded tube shell size to a suitable pre-finished size for the volume sizes in copper tubing, that is 15 mm diameter for domestic water tube service. Where demand is for a rather greater range of sizes and materials, the more flexible arrangement of draw benches and drawing blocks is to be prefered.

For high volume production, particularly finishing of small diameter, thin walled tube in coil as for refrigeration and air conditioning end use, the spinner block is the preferred modern machine.

A4.4 Tube Straightening

Straightening is required after drawing, or after the final anneal, to eliminate any general or local curvature resulting from mill processing. Straightening may be done by one of three methods depending on the size and temper of the finished tube.

a) Roll Straightening

A roll straightening machine may have 8, 12, 16, 20 or more rolls each grooved to fit approximately the size of tube to be straightened. The rolls arranged in tandem, are staggered and adjusted so that as the tube is passed between them it is sprung back and forth slightly by them. The rolls are divided into two sets, one acting in the horizontal plane, the other in the vertical plane, and within each group only one side of the set is driven. The principle is to bend the tube back and forth starting at a radius much smaller than any bend already present and then in successive sections to reduce this to zero bend or infinitely large radius. The adjustment of the rolls is however a matter for some skill. If adjustment is not correctly made then the tubes will emerge uniformally curved but in any case not straight.

b) Medart Straightening or Reeling

In a reeler, two power-driven rolls are used, one with straight surface and the other concave or barrel shaped. The two rolls are contraposed relative to the centre line and to one another in their aixis angles. Between and below the centre of the rolls is a soft metal guide. Once the tube is started in the rolls it is propelled through the machine by the driven rolls, rotating at high speed awhile, and emerges as a straight tube. Medart straightening is commonly applied to annealed tubes and it imparts a degree of stiffness to the tube.

c) Hand Straightening

There are several methods, all rely on skill to achieve a straight tube, but such methods are necessary where tube sizes unusually large or the wall thickness too small for machine straightening.

APPENDIX B : PROCESS SCRAP

B1. PROCESS SCRAP

Taking the transformation process of copper and its alloys from the refined or ingot stage through billets, slabs, cakes, etc., to semi-finished and finished products, some 30% of the total throughput can be expected to be recycled as process scrap. This new scrap, as opposed to old scrap derived from obsolete finished goods which contain copper, can largely be re-processed without any special treatment. Indeed, a large proportion of process scrap is consumed within the plant of generation.

B1.1 Sources of Scrap

The individual amounts of scrap generated at each point in the transformation network will, of course, depend on the type of product being manufactured, the method employed, the equipment being used and, last but not least, the skill of the operatives. The major sources and forms of scrap can be summarised as :

- Melting furnaces: skimmings, spills and drosses.

- Casting: gates, physical defects, rejects due to off mixture.

- Processing tube: butts and slugs from extrusion operations, pieces cut from the ends of extruded and pierced tubes, points, saw cuttings and rejects due to off gauge surface defects, etc.

- Processing rod, bars and sections: butts from the extruded, rod ends and points, saw cuttings, rejects due to wrong size or dimensions.

- Processing sheet, strip and plates: milling or scalping scrap from overhauling slabs or cakes after breakdown, points and tails cut from the end of the coils or sheets before rolling; trimming scrap from slitters, shears or edge trimmers; rejects due to offgauge, wrong temper, grain structure or other defects.

- Processing wire rod: scrap intermediate rod due to accidental stoppages in production, scrap finished rod due to defects in mechanical properties, surface or dimension.

TABLE B1 : AVERAGE PERCENTAGE OF SCRAP GENERATED WHEN CASTING COPPER AND COPPER BASE ALLOYS INTO BILLETS, SLABS AND CAKES TO BE FABRICATED INTO COPPER AND COPPER ALLOY PRODUCTS

Forms	Source of Scrap	Percentage
Billets:		
Extrusion, rod and shapes	Gates (first cut)	3- 5
All alloys	Physical defects (second cut)	2- 4
Electric furnaces	Off mixtures	½- 2
Water-cooled moulds	General average, all scrap	5
Air-cooled moulds	General average, all scrap	8
Rolled Rods	Gates (first cut)	6- 8
All alloys	Physical defects (second cut)	3- 4
Electric furnaces	Off mixtures	½- 2
Air-cooled moulds	General average, all scrap	10
Rolled Rods	Gates (first cut)	8-12
All alloys	Physical defects (second cut)	4- 6
Reverberatory Furnaces	Off mixtures	½- 2
Air-cooled moulds	General average, all scrap	12
Extrusion, Tube	Gates (first cut)	3- 5
All alloys	Physical defects (second cut)	1- 2
Electric furnaces	Off mixtures	½- 2
Water-cooled moulds	General average, all scrap	6
Air-cooled moulds	General average, all scrap	9
Piercing, Tubes	Gates (first cut)	4- 6
Copper	Physical defects (second cut)	2- 4
Electric furnaces	Off mixtures	½- 2
Water-cooled moulds	General average, all scrap	8
Air-cooled moulds	General average, all scrap	10
Piercing, Tubes	Gates (first cut)	4- 6
All alloys	Physical defects (second cut)	2- 3
Electric furnaces	Off mixtures	½- 2
Water-cooled moulds	General average, all scrap	10
Air-cooled moulds	General average, all scrap	12
Slabs:		
Flat for Strip	Gates (first cut)	3- 5
All alloys (other than rich mixtures)	Physical defects (second cut)	1- 2
Electric furnaces	Off mixtures	½- 1
Water-cooled moulds	General average, all scrap	7
Air-cooled moulds	General average, all scrap	9
Flat for Strip	Gates (first cut)	3- 5
All alloys, rich mixtures included	Physical defects (second cut)	2- 4
Nickel silver, electric furnaces	Off mixtures	½- 2
Water-cooled moulds	General average, all scrap	9
Air-cooled moulds	General average, all scrap	12
Cakes:		
Flat for Sheets and Plates	Gates (first cut)	12-18
All alloys	Physical defects (second cut)	2- 4
Air-cooled moulds	Off mixtures	3- 6
Electric and reverbatory furnaces	General average	16

TABLE B2: AVERAGE PERCENTAGE OF SCRAP GENERATED IN FABRICATING COPPER AND ALLOY PRODUCTS FROM THE CAST BILLET TO FINISHED SIZE

Form	Percentage
Strip, 20 inches wide and narrower, all gauges, all alloys	30-45
Strip, wider than 20 inches, all gauges all alloys	30-50
Copper sheets wider than 20 inches	30-45
Copper strip, 20 inches wide and narrower all gauges	25-40
Alloy tubes, all sizes and gauges	30-55
Plates, all mixtures, all sizes and shapes	40-60
Copper tubes, all sizes and gauges	25-40
Rods, all alloys, all sizes	25-35
Shapes, all alloys, all sizes	30-50

TABLE B3 : PRACTICAL MAXIMUM LIMITS OF SCRAP UTILISATION IN COPPER AND BRASS FABRICATION

Forms	Types of Scrap	Percentage
Billets:		
Rod and shapes, containing 2.25% lead or more	Borings Reclaims Copper or Brass	50-90 10-15 5-10
Rod and shapes, containing 1-2% lead	Borings Reclaims Copper or Brass	20-40 5-10 80-90
Rod, containing less than 1% lead	Borings Reclaims Copper or Brass	10-20 5 70-80
Rod, non-leaded	Brass Copper	30-50 30-50
Tube-piercing, all alloys	Brass Copper	30-50 30-60
Tube-piercing	Brass Copper	90 90
Tube-extrusion, all alloys	Brass Copper	30-50 30-70
Slabs, Cakes:		
Rolling brass strip and sheets, 75% copper and under	Brass Copper	25-75 20-30
Rolling brass strip and sheets, 76% and over	Brass Copper	20-50 25-60
Hot rolled, strip and sheets, all mixtures	Brass Copper	25-50 25-50
Rolling lead brass strip and sheets	Brass Copper	25-75 20-40
Rolling nickel-silver strip and sheets	Brass Copper Nickel	20-30 50-80 10-15
Muntz metal strip, sheets and plates	Brass Copper	40-50 50-60

All the scrap in the preceding tables is considered production or plant scrap and is utilised by the plant when melting new charges. In addition, approximately 2-4% dross and skimming is generated in melting. About one-third of the weight of this is zinc oxide and ash from charcoal, and almost all the remainder is small particles of metal. About 20% of the skimming is recovered by passing it through a ballmill and shakers and over screens. The remainder of the material is returned (generally) to the refinery.

In addition to the above production scrap, the fabricators generate between 10-60% scrap as clippings, trimmings, stampings, borings and turnings when processing copper and copper alloys semi-finished to finished products. Scrap also originates from surplus obsolete, damaged or idle inventory. All this type of scrap is classified as process scrap and with the exception of borings and turnings, it can be recycled to the foundry for casting to billets or slabs without any treatment. This scrap is detailed in Volume 1.

B1.2 Limits of Use

Fabricators prefer to utilise as much clean selected scrap as possible to conserve new metal, which is more expensive than scrap. It is customarily assumed that at least $15 per ton can be saved in metal cost when scrap is used in place of virgin metal. Certain technical limitations apply to the maximum copper and alloy scrap ratios to new metal that can be utilised, but generally it is possible to use 90% or 100% scrap if it is available in a suitable form.

However, casting shops are reluctant to use the maximum amount of scrap theoretically permissible because it requires more manual effort to charge furnaces and unless rigid control is exercised melting times are longer for fine or loose scrap and production rates and quality can suffer. The practical limits of scrap utilisation for the fabricators of various copper and brass products is given in Table B3.

B1.3 Specification of Scrap

The following specifications are used by some fabricators to cover scrap purchases.

All brass and copper scrap must be free from excess grease, oil and other impurities. Plates, enamelled or soldered materials cannot be accepted. All scrap must be of uniform mixture with various alloys strictly segregated. Heavy scrap, rod ends, turnings, etc., must be packed separately. Under normal conditions tube scrap is not acceptable.

In addition, the following requirements must also be met:

1. Copper scrap shall be 99.9% pure and consist of skeleton scrap from new sheets or strip stock.

2. Brass scrap shall consist of skeleton, trimmings, clippings, and punchings from new sheet or strip. Punchings may not be smaller than ¼ inch in diameter and may not comprise more than 10% of the total shipment.

3. Turnings and borings from free-cutting brass rod shall consist solely of free-cutting turnings - free from iron, steel, aluminium, manganese, and all other alloys. They shall be free of grindings and babbits and shall contain not more than 0.30% tin, nor more than 0.15% combined iron, and not more than 3% oil and moisture.

4. Brass forging-rod flashings shall contain not more than 10% punchings. The punchings may not be smaller than ¼ inch in diameter.

5. Brass forging-rod turnings shall consist solely of rod turnings free from aluminium, manganese, and all other alloys. They shall be free of grindings and babbits and shall contain not more than 0.3% tin, not more than 0.15% combined iron, and not more than 3% oil and moisture.

6. Commercial bronze and low brass shall meet the same requirements as for sheet brass and must contain no tin.

   Scrap should be shipped loose, not in compressed form. Receiving weights are to govern.

APPENDIX C : OUTLINE SPECIFICATION OF PROCESS PLANT AND LAYOUT - WIRE MILL

C1. CONTINUOUS WIRE ROD CASTING

Seven proprietary systems have been developed for continuous casting of non-ferrous wire rod. Table C1 shows the number of each installed and reflects experience more than popularity. Three of these have been considered, namely Southwire, Contirod and Secor. The General Electric dip-forming process uses less recent technology, but should be re-examined when theproject goes ahead. Outokumpu's process lends itself only to much lower capacities than that required for Nigeria.

Table C2 compares budget fob prices of the three processes under consideration. Performances and production costs hardly differ, depending more on operating practice than on design.

Manufacturers' performance claims tend to be based on ideal conditions. Regardless of such data, a system availability of 80% and a saleable product yield of 95% seem realistic targets for all four plants. For an output of 37,000 t/y of rod, corresponding to 9.6 t/h at 3,840 h/y, one would then require an input of:

$$\frac{9.6}{0.8 \times 0.95} = 12.6 \text{ t/h}$$

The Contirod 10C11 and 10 t/h SECOR lines are somewhat too small. SECIM cannot offer a plant of more suitable capacity, its next larger SECOR line being rated at 20 t/h. This leaves the Contirod 14C11 and Southwire SCR 2000, both of which come sufficiently close to capacity requirements. The Delta Group in the UK has in fact achieved a consistent 90% system availability with its Southwire plant, which would lower the required input to 11.2 t/h. The capacity of the Contirod 14C11 can be increased to 20-25 t/h by merely adding a stand of rolls.

TABLE C1 : CONTINUOUS COPPER WIRE ROD CASTING PLANTS INSTALLED (EARLY 1980)

Manufacturer	No. of Plants	Hourly Capacity (tons)
Southwire	26	592
General Electric	17	109
Properzi	5	71
Contirod	12	430
Outokumpu	7	16.2
Essex International	5	36.5
Secor	1	25

Note: A second Secor plant, capacity 10 t/h, was being built in 1981.

Source: SNC Group, 1980

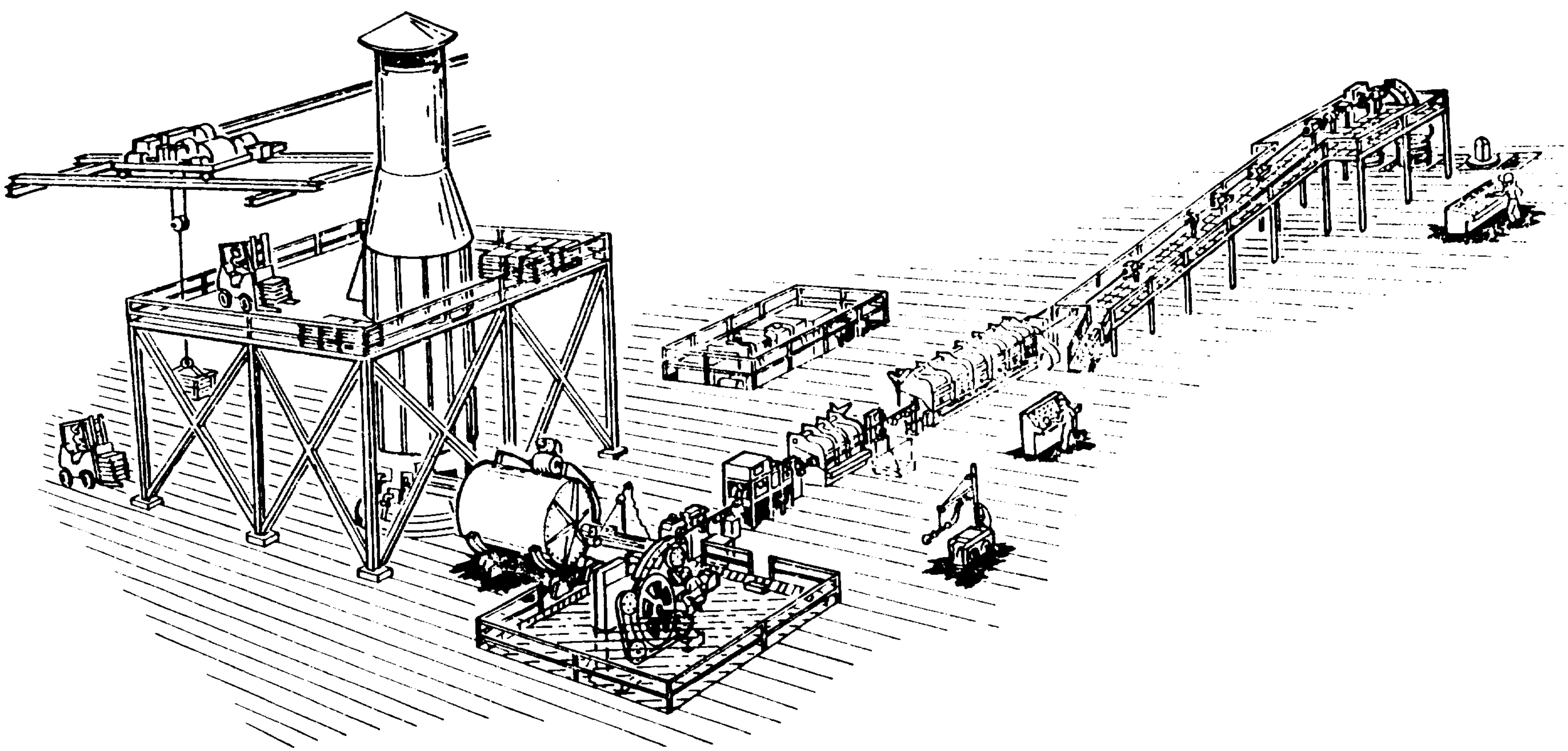
TABLE C2 : CAPACITIES AND COSTS OF CONTINUOUS WIRE ROD CASTING PLANTS

	Nominal Capacity (t/h input)	Budget Price (₦ million fob)
Southwire SCR 2000	11.5	3.3
Contirod 10C11	9	4.3
Contirod 14C11	13	4.6
10 t/h SECOR	10	3.1

Source: Metra 1981

The price differentials in Table C2 should not be judged too critically because they are only indicative and usually subject to negotiation and they do not cover exactly the same extent of supply and services. Nevertheless, the difference between the SCR 2000 and Contirod 14C11 is such that the former must be preferred at this stage and the specification and estimate of the continuous wire rod casting system are formulated accordingly.

FIGURE C1



Typical SCR Copper System

The Southwire SCR 2000 system is shown diagrammatically in Figure C1 and consists of the following principal components:

SOUTHWIRE BASIC SCOPE OF SUPPLY

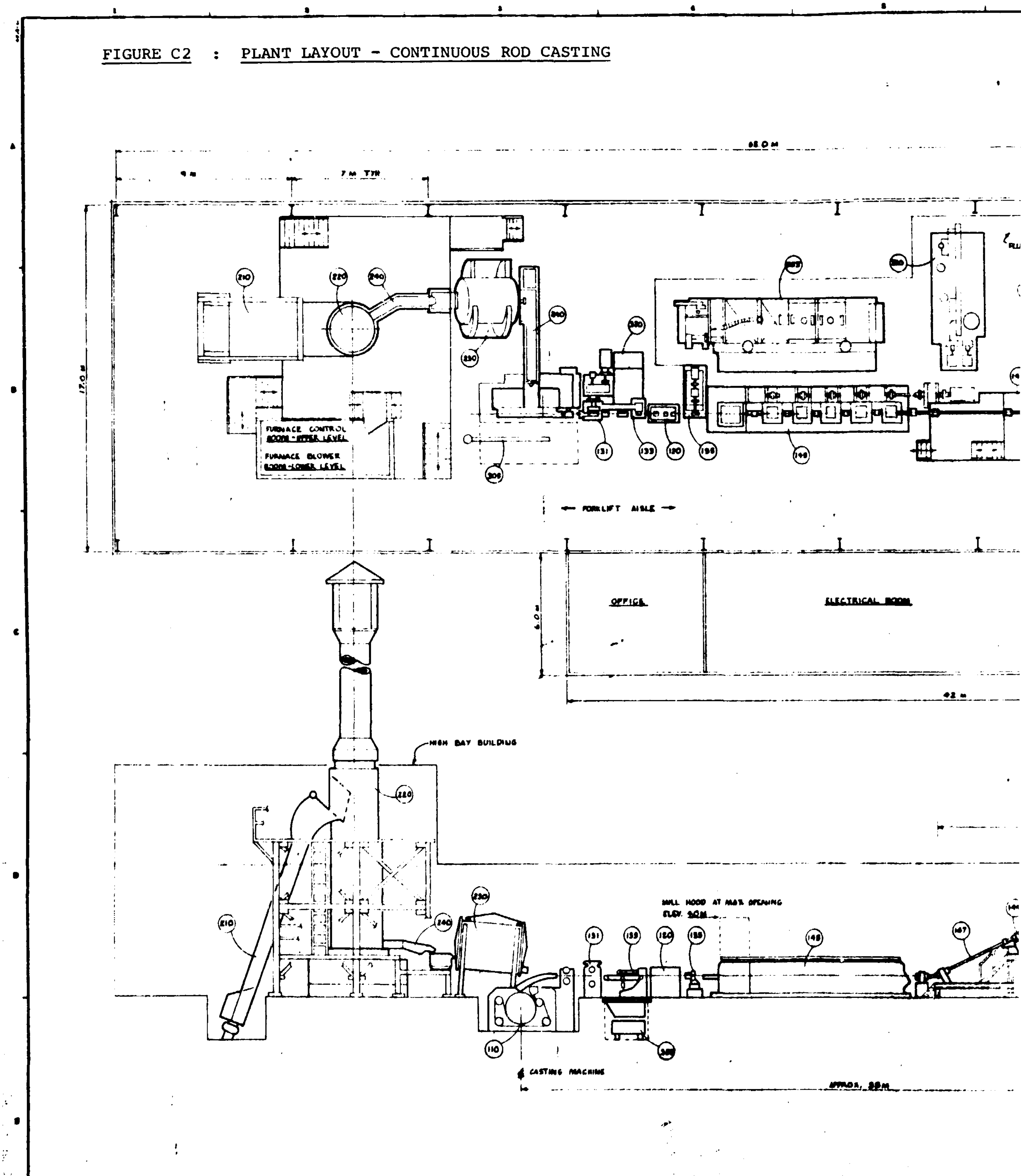
1. Southwire (15 MTPH) Melting Furnace
2. Holding Furnace (9 MT)
3. Launders and Launder Combustion Equipment
4. Pour Pot and Pot Prehead Combustion System
5. Two (2) Pot Stands
6. Casting Machine (1520mm - 60in)
7. Casting Machine Accessories
8. Electrically Powered Rotary Crop & Cobble Shear
9. Crop Discharge Table
10. Bar Preparation Unit
11. Mill Entry Pinch Roll
12. 10 Stand No-Twist Rolling Mill
13. Non-Acid Rod Cleaning Pip and Injector
14. Laying Head Coiler with 3 Station Conveyor
15. Lubrication Oil System
16. Electrics and Instrumentation

AUXILLIARY SUPPORT EQUIPMENT

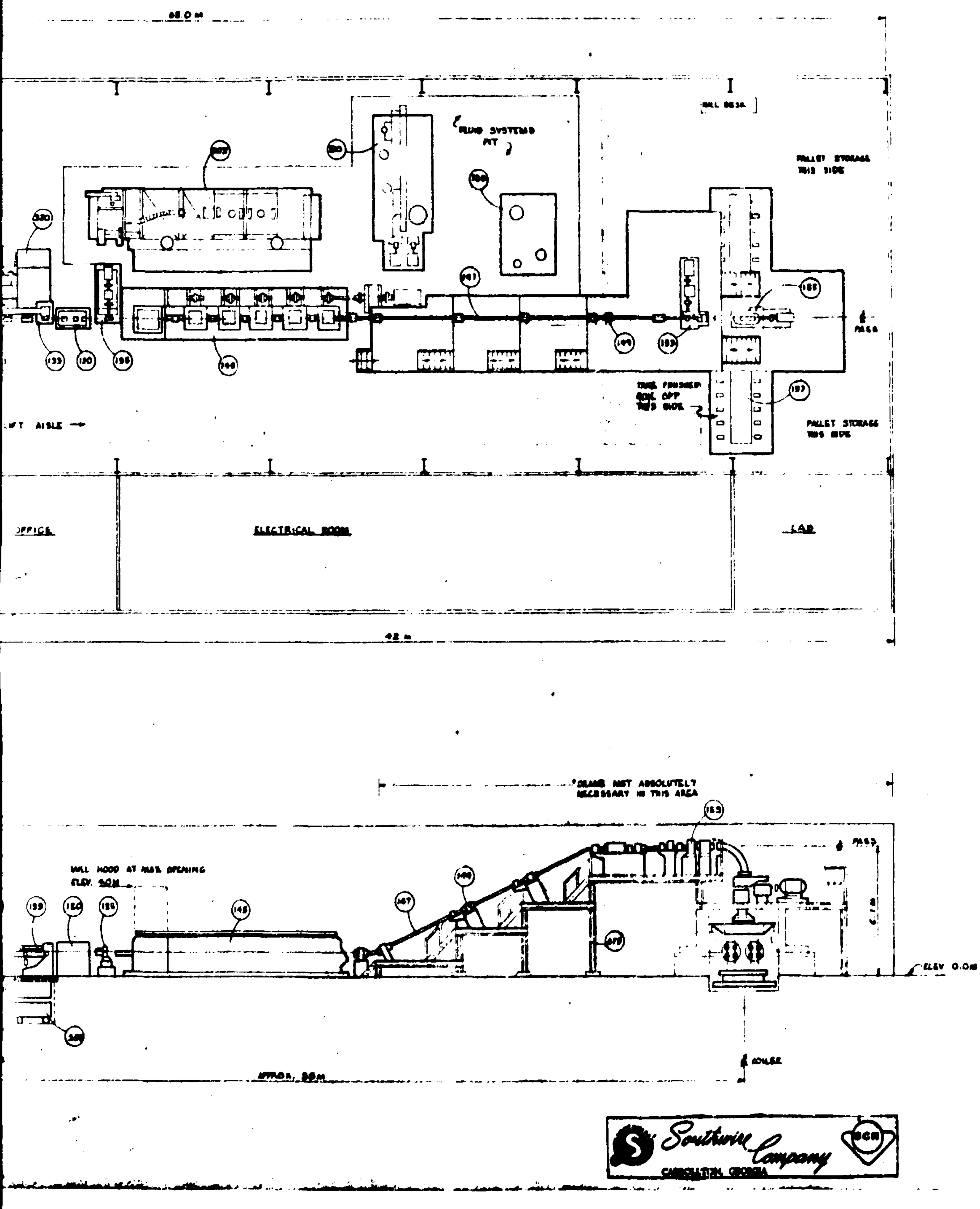
1. Furnace Loading System (Skip Cart)
2. Standby Shears
3. Soluble Oil System
4. Non Acid Pickling System
5. Process Water System
6. Casting Machine Water System
7. Oxygen & Acetylene System
8. Compressed Air System
9. 10 Ton Overhead Crane

The layout of this area of the plant is shown in Figure C2.

FIGURE C2 : PLANT LAYOUT - CONTINUOUS ROD CASTING



SECTION 1


68.0 M
FLUID SYSTEMS PIT
PALLET STORAGE THIS SIDE
THIS FINISHED COIL OFF THIS SIDE
PASS
LIFT AISLE
OFFICE
ELECTRICAL ROOM
LAB
42 M
*BEAMS NOT ABSOLUTELY NECESSARY IN THIS AREA
WALL HOOD AT MAX. OPENING ELEV. 9.0M
ELEV. 0.0M
COILER
APPROX. 39M
Southwire Company
CARROLLTON, GEORGIA
SCR

SECTION 2

C2. WINDING WIRE

C2.1 Drawing

The proposed plant will produce 3,800 t/y of winding wire between 1.63 and 0.38 mm (16 and 28 SWG) from 8 mm rod. On the basis of working 48 weeks per year, 5 days per week and two 8-hour shifts per day, it will have to handle 1,000 kg/h. The drawing speed of a machine depends on the size reduction. The following train of equipment should suffice for a reasonably flexible product mix:-

(1) Breakdown machine. Outputs at 80% efficiency:

1.13 mm	1,170 kg/h
1.80 mm	1,600 "
2.75 mm	3,000 "
3.30 mm	3,400 "
3.50 mm	3,800 "

(2) Continuous resistance annealer with steam generator

(3) Coiler

(4) Pointing machine

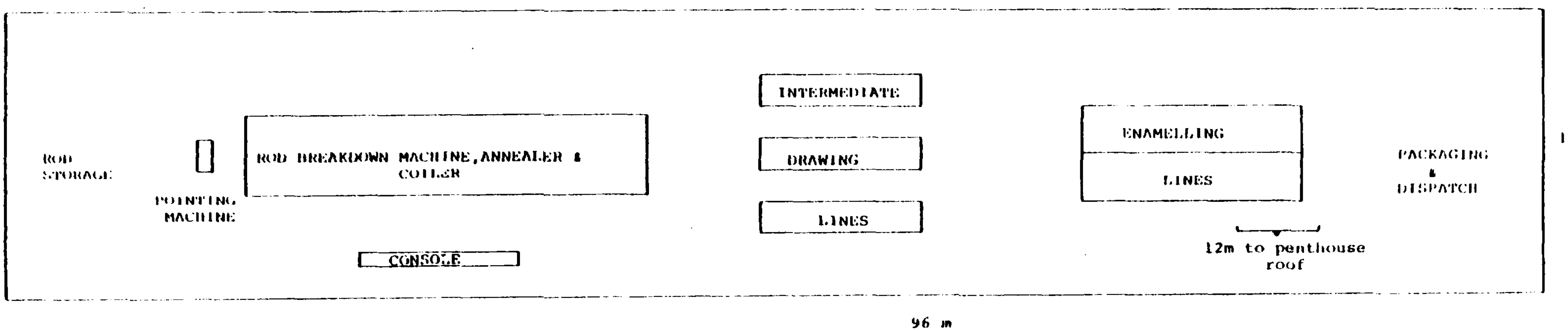
(5) Three intermediate drawing machines. Outputs at 80% efficiency based on 3.5 mm inlet size:

0.375 mm	129 kg/h
0.670 mm	282 "
0.850 mm	322 "
1.040 mm	307 "
1.110 mm	324 "
1.320 mm	353 "
1.350 mm	369 "

(6) Three spoolers

Items (1) to (4) will have spare capacity for drawing other copper wire down to about 2 mm.

FIGURE C3 : WINDING WIRE DRAWING AND ENAMELLING LAYOUT



C2.2 Enamelling

To enamel 3,800 t/y of wire produced by the drawing equipment on the same time schedule, two 20-head tower oven units, each comprising the following elements, are required:-

(1) 20 wire pay-off units

(2) electrically heated annealing plant

(3) enamel applicator unit

(4) tower oven with supporting gantry and wire guide wheels

(5) wire cooling equipment

(6) 20 rewind machines

(7) ducting and exhaust system

(8) control and monitoring console

A plant layout for the winding wire, wire drawing and enamelling area is shown in Figure C3.

APPENDIX D : OUTLINE SPECIFICATION OF PROCESS PLANT AND LAYOUT - BRASS MILL

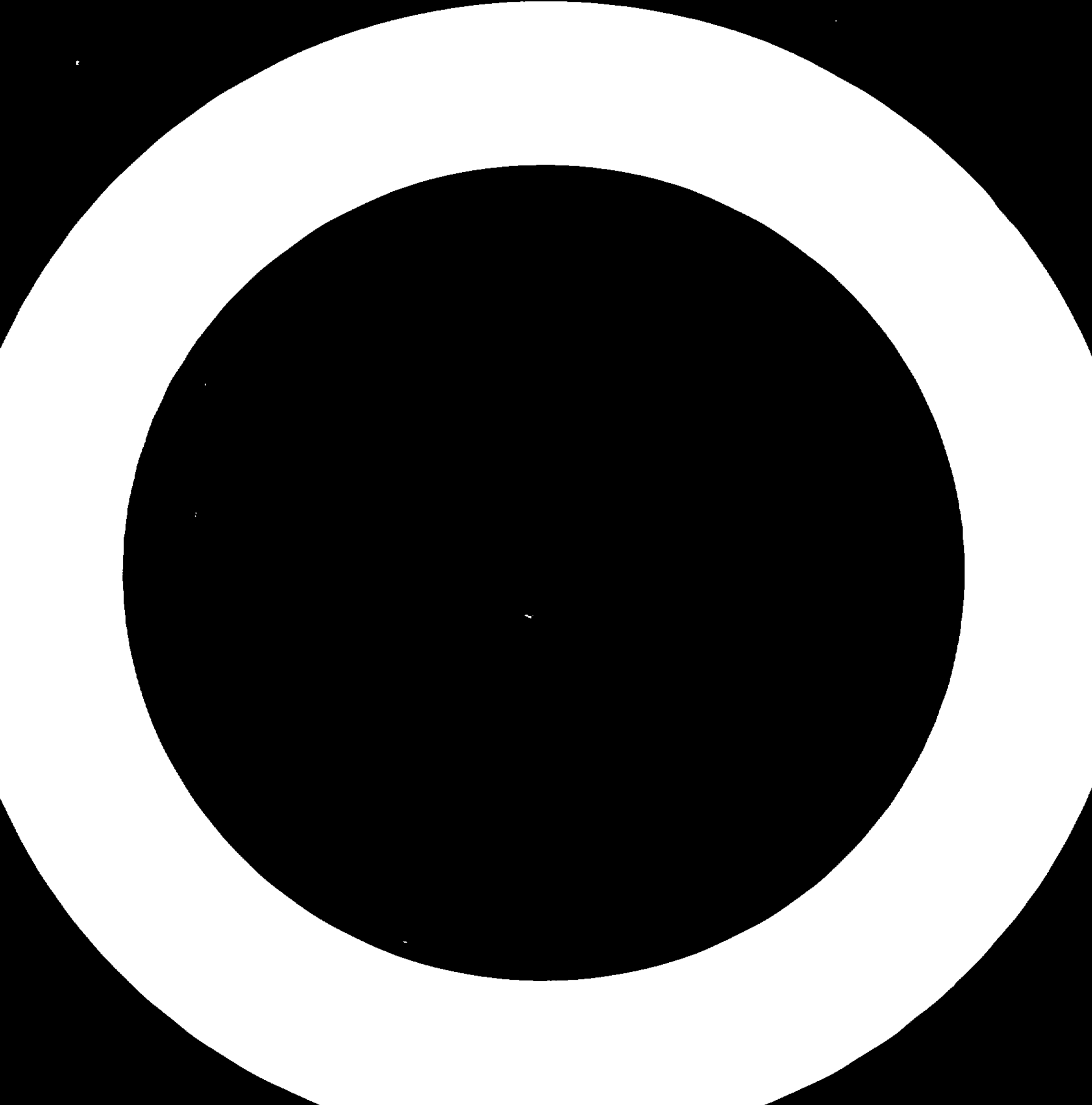
D1. BILLET CASTING

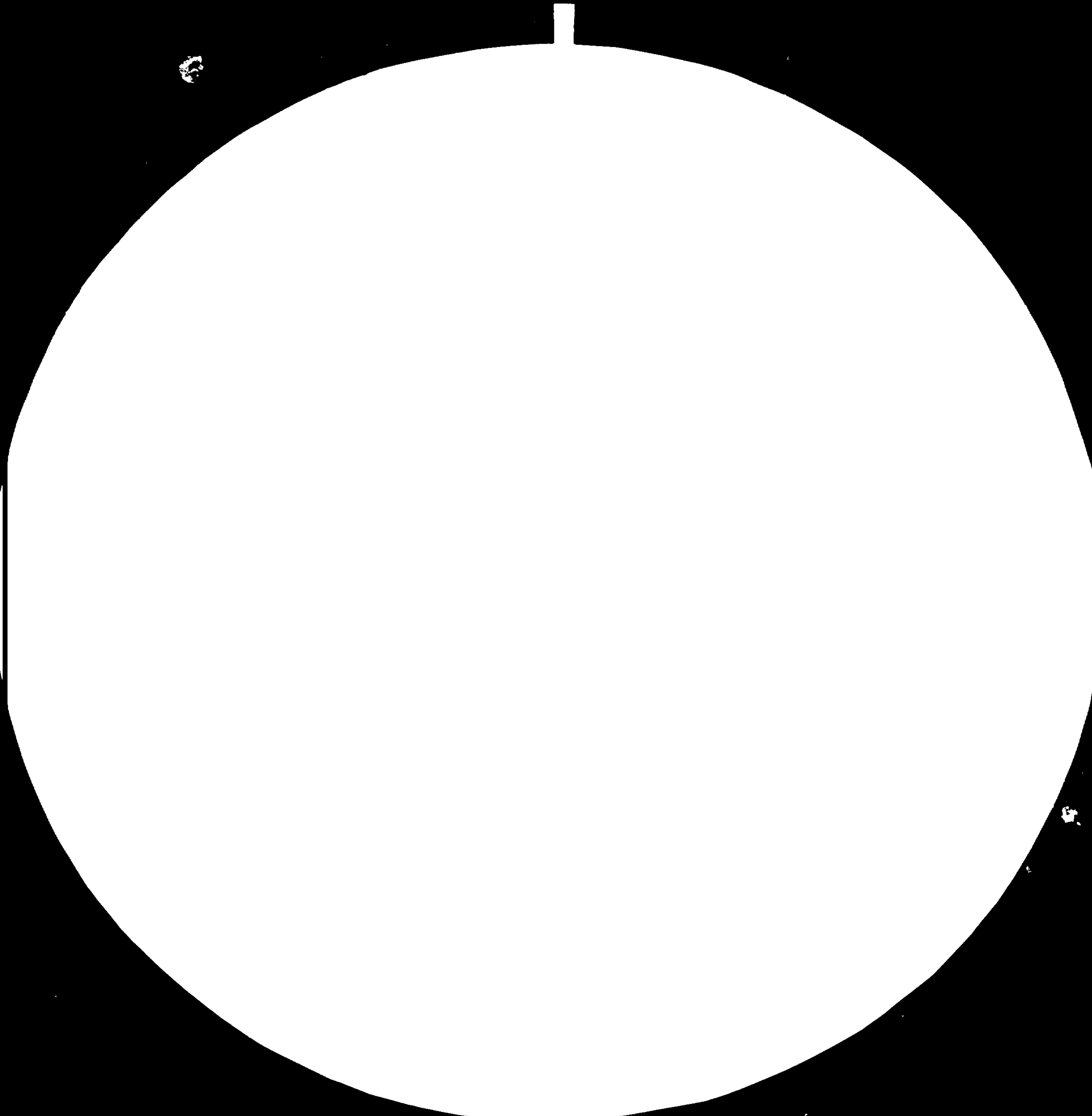
A semi-continuous vertical billet casting system comprises these principal components:

- scrap baling press;
- channel type electric induction melting furnace (two units give greater flexibility) operated from the highest level, approximately 3.30m;
- channel type electric induction holding furnace operated from an intermediate level of approximately 1.40m. Launders convey the melt to and from this furnace;
- a water-cooled mould assembly at ground level. The mould frame is moveable so that the finished castings can be lifted from the pit when the cast is complete;
- a hydraulically controlled casting table which lowers the castings at a present speed to match the metal poured into the moulds. This table is located in a pit approximately 7.70m deep. The table supporting column moves in a borehole below the casting pit;
- a billet saw with roller tables for the castings and sawn billets.

Figure D1 shows a typical arrangement of two 2-strand casters, each with two melting furnaces.

For casting a total of 20,500 t/y of brass and copper billets in about equal proportions on a 2-shift basis, two 3-strand casters are required, one for brass and the other for copper. Each casting would measure up to 4.50m in length and weigh up to 2.5 tonnes. Any desired billet diameter can be chosen.





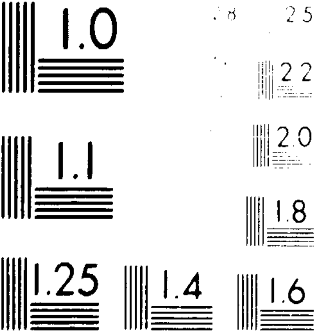
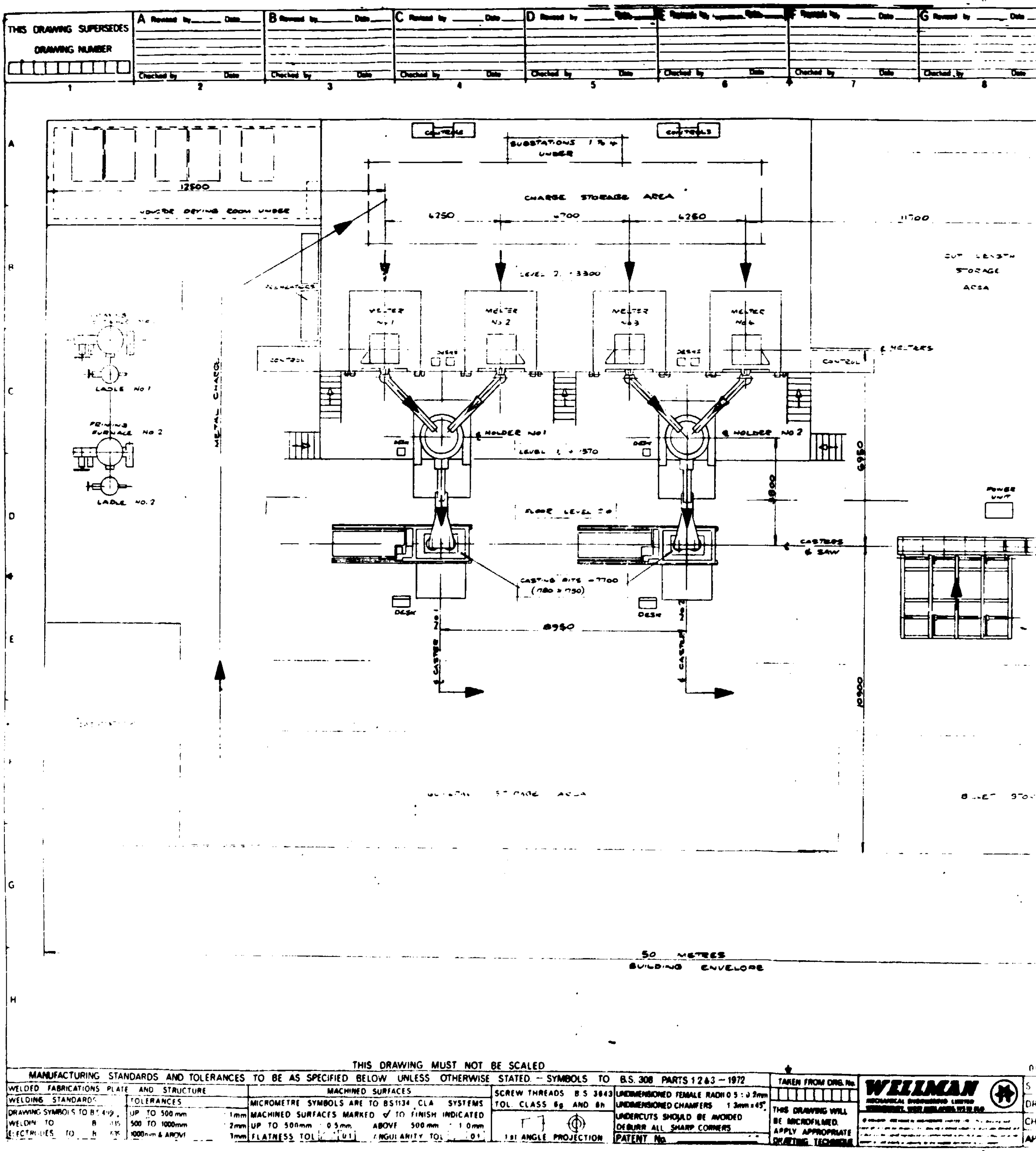
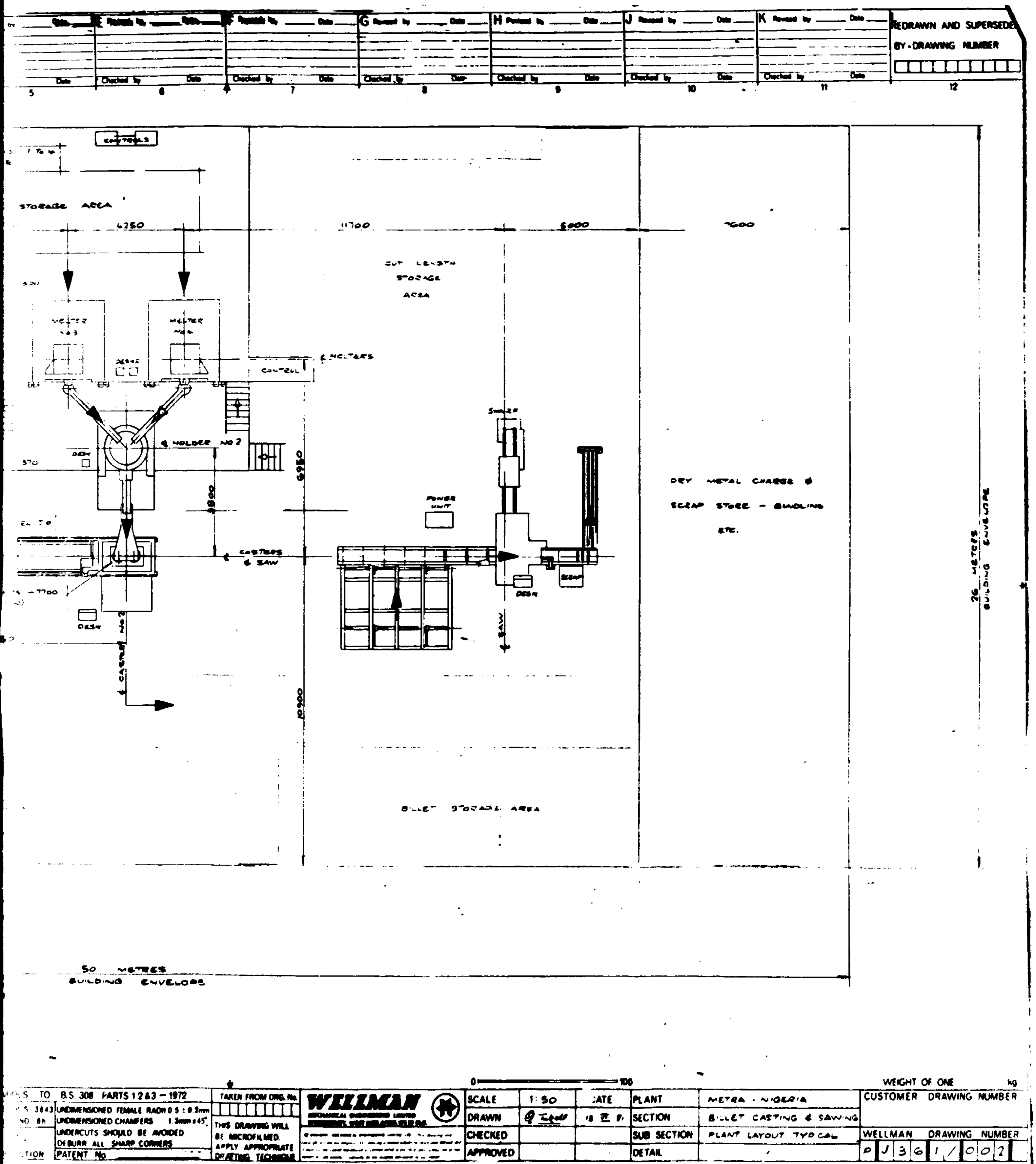

1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

FIGURE D1 : PLANT LAYOUT BILLET CASTING




REDRAWN AND SUPERSEDED BY-DRAWING NUMBER
CONTROLS
STORAGE AREA
4250
11700
5000
7600
CUT LENGTH STORAGE AREA
MELTER No 3
MELTER No 4
DESKS
CONTROL
℄ MELTERS
℄ HOLDER No 2
SHEARS
6950
3800
POWER UNIT
DRY METAL CHARGE & SCRAP STORE - BUNDLING ETC.
CASTERS & SAW
DESK
SCRAP
SAW
10900
℄ CASTER No 2
26 METRES BUILDING ENVELOPE
BILLET STORAGE AREA
50 METRES BUILDING ENVELOPE
B.S. 308 PARTS 1 2 & 3 — 1972
UNDIMENSIONED FEMALE RADII 0.5 ± 0.2mm
UNDIMENSIONED CHAMFERS 1.3mm x 45°
UNDERCUTS SHOULD BE AVOIDED
DEBURR ALL SHARP CORNERS
PATENT No
TAKEN FROM DRG. No.
THIS DRAWING WILL BE MICROFILMED. APPLY APPROPRIATE DRAFTING TECHNIQUE
WELLMAN MECHANICAL ENGINEERING LIMITED
SCALE 1:50
DRAWN
CHECKED
APPROVED
PLANT METRA - NIGERIA
SECTION BILLET CASTING & SAWING
SUB SECTION PLANT LAYOUT TYPICAL
DETAIL
WEIGHT OF ONE kg
CUSTOMER DRAWING NUMBER
WELLMAN DRAWING NUMBER
PJ361/002

SECTION 2

D2. EXTRUSION PLANT

A 2,500-ton direct extrusion press with 300 t internal piercing cylinder should be capable of extruding the required product mix comfortably on a 2-shift basis.

The slab and rod require an input of 11,100 t/y of billets at an average press yield of 80%. This corresponds to 51,900 billets of 210 mm diameter and 710 mm length. At an extrusion rate of 50 billets per hour, this production would require 1,040 extrusion hours.

The tubes require an input of 9,430 t/y of billets, again at a yield of 80%. This corresponds to 69,800 billets of 210 mm diameter and 450 mm length for extruding tube hollows. At an extrusion rate of 40 billets per hour in this case, 1,740 extrusion hours would be needed.

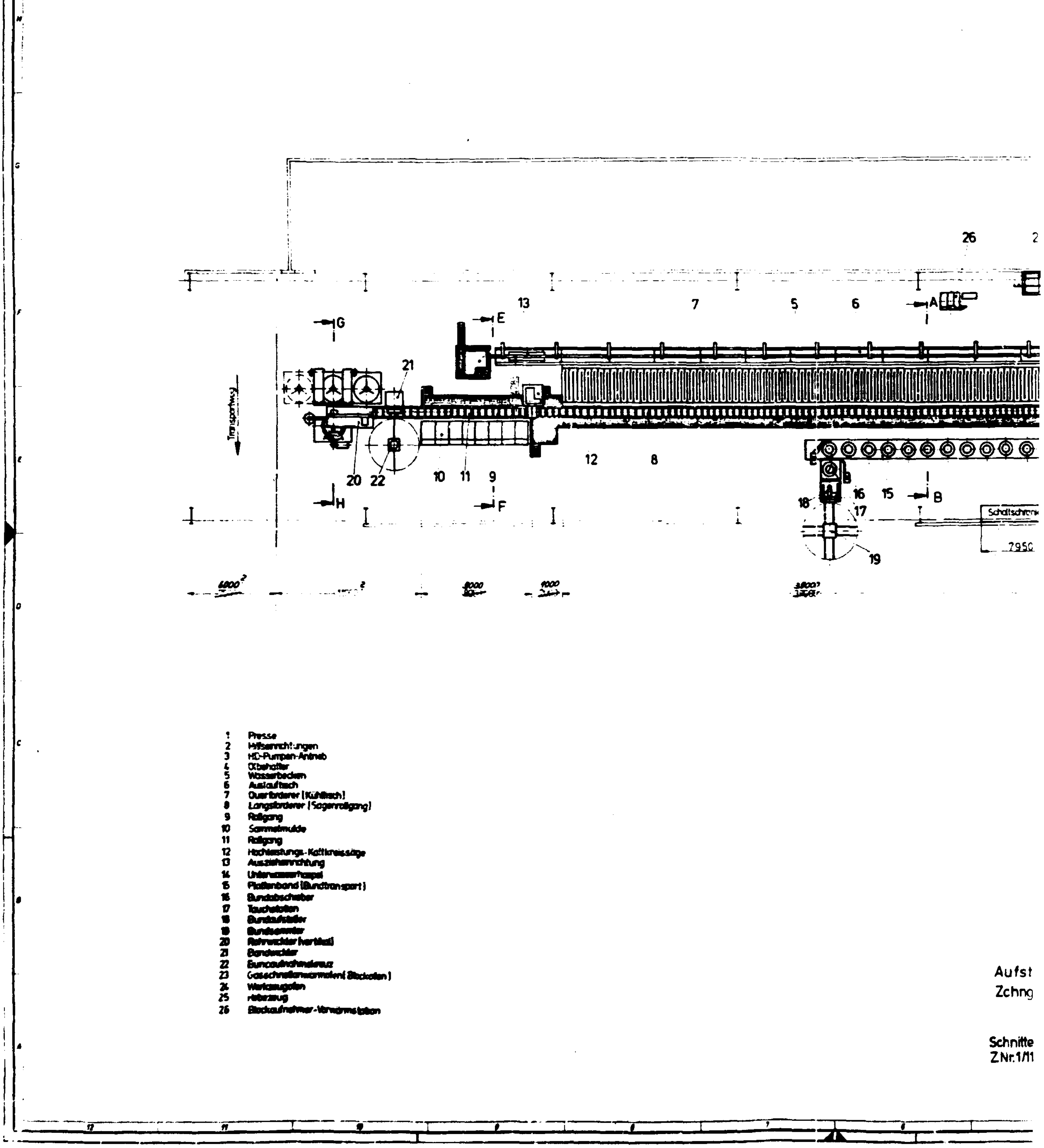
The press may run 13 hours in a 16-hour day, in which case the above total can be achieved in 214 working days. This leaves a margin of 26 working days for extruding smaller billets or at lower rates.

The press itself will be of the horizontal 4-column piercing type with hydraulic drive and will have tool sets for a number of alternative diameter billets. It will have built-in container heating and extrusion cutting equipment and preferably also an external container pre-heat station. The press will be complete with billet and pad loading gear, discard and pad separation and handling gear, and hydraulic pumping system.

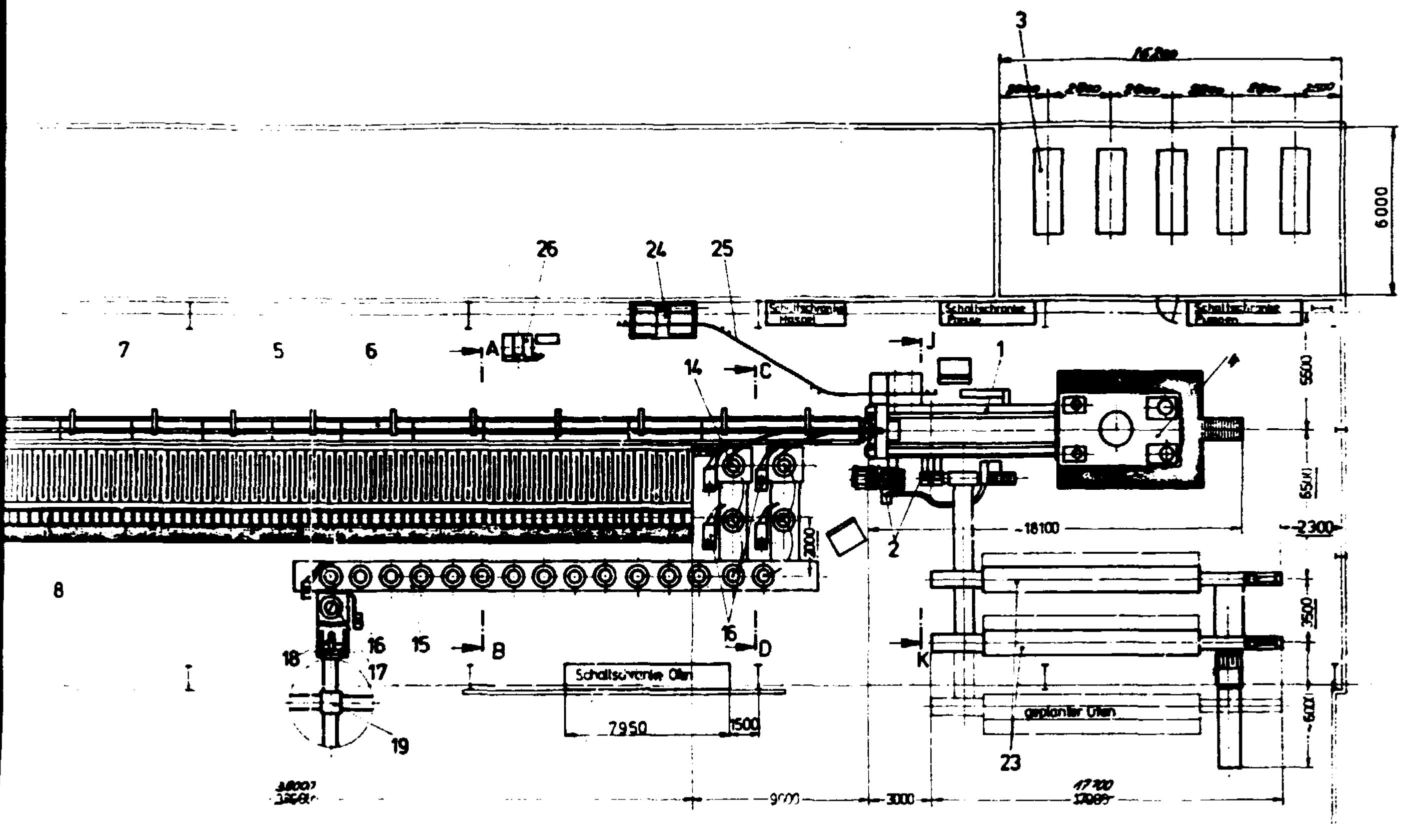
An induction type billet heating installation must be provided ahead of the press.

The extrusion runout system should comprise all underwater runout, cooling, coiling and cut-off equipment necessary to cope with a complex product mix. Figure D2 shows a versatile extrusion and runout installation in plan.

FIGURE D2 : EXTRUSION PLANT LAYOUT



SECTION 1



Aufstellungsplan Presse siehe
Zchngs.-Nr.: 0/ 2493860

Schnitte durch die Anlage siehe
Z.Nr.1/1161969

1 : 150

Ölhydr. Strang-und Rohrpresse
31,5 MN 250 bar 2200 Hub

Aufstellungsplan

SCHLOEMANN SIEMAG

1 1161963

SECTION 2

D3. TUBE DRAWING AND FINISHING

The equipment set-up shown diagrammatically in Figure D3 and outlined below should suffice for the manufacture of the required range and quantities of copper and brass tubing:-

(1) rotary cold push pointing machine with 100mm die and hydraulic feed, togethr with saw and table;

(2) triple draw bench, capacity 55t, for 45m length, speed range 9 to 36m/min;

(3) roller hearth annealing furnace, gas heated, output up to 2.3 t/h, with 20 furnace baskets;

(4) 1.5m horizontal axis tube reducer block with handling structure and pointer;

(5) rack for drawn lengths;

(6) 2.1m vertical axis tube reducer block with conveyors and table;

(7) straightener with cut-to-length saw;

(8) inspection conveyor for thick tube;

(9) two 2134mm spinner blocks with 8-pan carousels;

(10) basket conveyor system including upender;

(11) basket pay-off station and layer winding machine for air conditioner tubing;

(12) basket pay-off station, cutting and straightening unit;

(13) straightener with cut-to-length saw;

(14) inspection table;

(15) coil purge unit;

(16) coil steam cleaning unit;

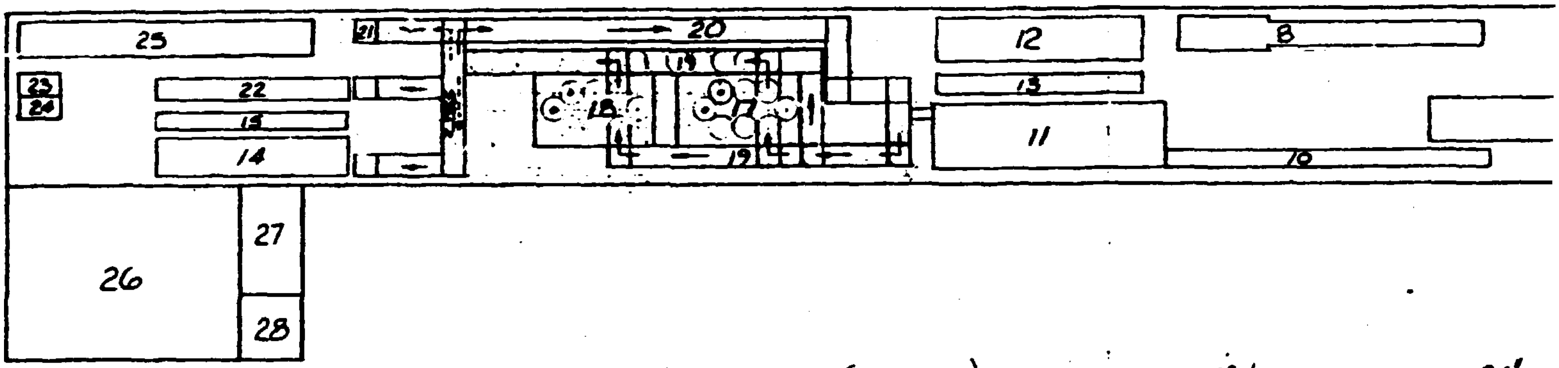
(17) roller hearth annealing furnace, gas fired, for level wound coils, pancake coils and cut lengths;

(18) 5-t gantry crane.

FIGURE D3 : TUBE MILL PLANT LAYOUT

IF IN DOUBT-ASK!

THIRD ANGLE PROJECTION



1. PUMP HOUSE (NOT SHOWN)
2. BILLET INDUCTION HEATER
3. EXTRUSION PRESS & ACID PICKLING/RINSE
4. Nº1 SAW TABLE & POINTER
5. Nº1 BENCH 120 000 lb x 150 FT
7. Nº1 ANNEALING FURNACE
8. 60' HORIZONTAL TUBE REDUCER
10. BLOCK FEEDING RACK
11. 84' DROP OFF BLOCK
12. Nº1 STRAIGHTENER & SAW
13. INSPECTION CONVEYOR Nº1
14. Nº2 STRAIGHTENER & SAW
15. INSPECTION CONVEYOR Nº2
17. Nº1 SPINNER BLOCK 84'
18. Nº2 SPINNER BLOCK 84'
19. FULL BASKET CONVEYORS
20. EMPTY BASKET CONVEYORS
21. BASKET PAY-OFF STATION
22. BASKET PAY-OFF STATION
23. COIL PURGE UNIT
24. COIL STEAM CLEAN UNIT
25. Nº2 ANNEALING FURNACE
26. DESPATCH WAREHOUSE
27. OFFICES
28. PHYSICAL TESTING LABORA

ALL DIMENSIONS IN MILLIMETRES (mm)

TOL. UNLESS OTHERWISE STATED	OVER	UP TO	TOL.
SIZE IN MULTIPLES OF 0·5mm (e.g. 12·5)	0	600	± 0·5
	600	—	± 1·0
SIZE TO 2 DEC. PLACES (e.g. 12·50)	ALL SIZES		± 0·10
ANGULAR TOL. ±			

SURFACE TEXTURE VALUES	
FINISH	SYMBOL
ROUGH	
MEDIUM	
FINE	

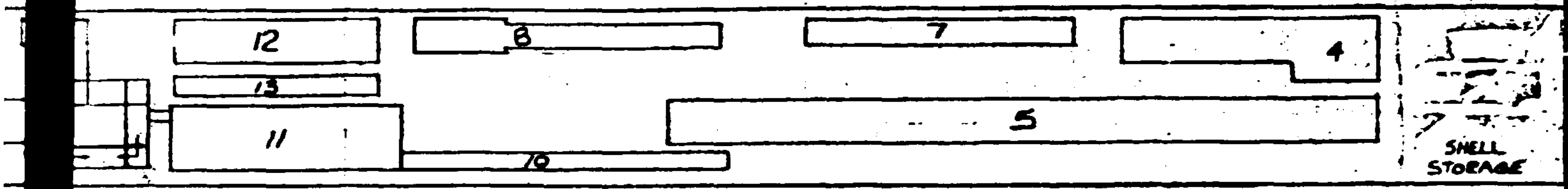
Torvale Engineering Ltd
INCORPORATING ASSOCIATED CONVEYORS

Proposed Conformed Mill Layout

SECTION 1

THIRD ANGLE PROJECTION

ALTERATIONS				
No.	DESCRIPTION			



. NOT SHOWN)
CTION HEATER
ESS & ACID PICKLING /RINSE
BLE & POINTER
0 000 lb x 150 FT
..G FURNACE
IL TUBE REDUCER
..NG RACK
F BLOCK
ENEL & SAW
ONVEYOR Nº1
TENER & SAW
ONVEYOR Nº2

17 Nº1 SPINNER BLOCK 84' & CAROUSEL
18 Nº2 SPINNER BLOCK 84' & CAROUSEL
19 FULL BASKET CONVEYORS
20 EMPTY BASKET CONVEYORS
21 BASKET PAY-OFF STATION & LEVEL WIND COIL MACHINE
22 BASKET PAY-OFF STATION CUT & STR[illegible]EN
23 COIL PURGE UNIT
24 COIL STEAM CLEAN UNIT
25 Nº2 ANNEALING FURNACE
26 DESPATCH WAREHOUSE
27 OFFICES
28 PHYSICAL TESTING LABORATORY

Torvale Engineering Ltd
INCORPORATING ASSOCIATED CONVEYORS

PART	DESCRIPTION	QTY	MATERIAL			
DRAWN	TRACED	CHECKED	APPROVED	DATE	SCALE	ISSUE
JAB				JULY 81	10mm=20ft	

DRAWING No. SK 2006

SECTION 2

D4. ROD DRAWING AND STRAIGHTENING

Figure D4 shows diagrammatically the flow of materials through this section of the plant, which comprises basically the following equipment:-

(1) acid pickling trough, rinse trough and copper recovery system for pickling only extruded rod and tube to be drawn;

(2) coil pay-off swift;

(3) bar racks;

(4) single chain triple draw

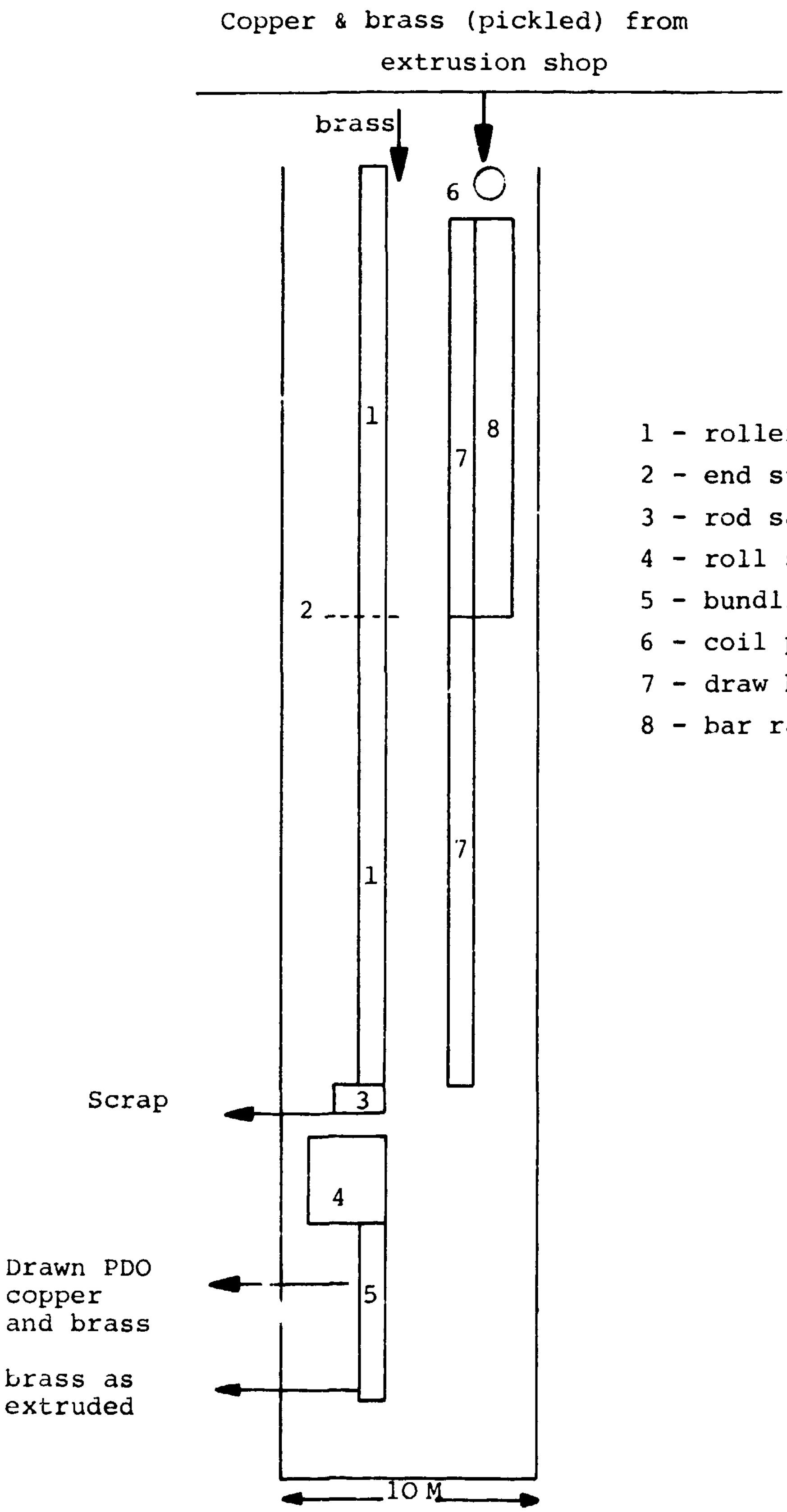
(5) roller table with end stop for by-passing the draw-bench when drawing is not required;

(6) rod cut-off wheel or saw for cutting to length;

(7) straightener for round, square and hexagonal sections;

(8) run-out and bundling table.

FIGURE D4 : ROD DRAWING AND STRAIGHTENING LAYOUT



1 - roller table
2 - end stop
3 - rod saw
4 - roll straightener
5 - bundling table
6 - coil payoff swift
7 - draw bench
8 - bar rack

D5. CONTINUOUS STRIP CASTING

A horizontal continuous strip casting line consists of the following principal elements:-

- a channel type electric induction melting furnace (one furnace may serve two lines of plant);
- a channel type electric inductuion holding furnace, charged by lauder from the melting furnace;
- a removable water-cooled graphite die assembly attached to the holding furnace;
- a rhythmic withdrawal machine with roller tables ahead and behind;
- a hydraulic cut-off shear;
- a strip upcoiler.

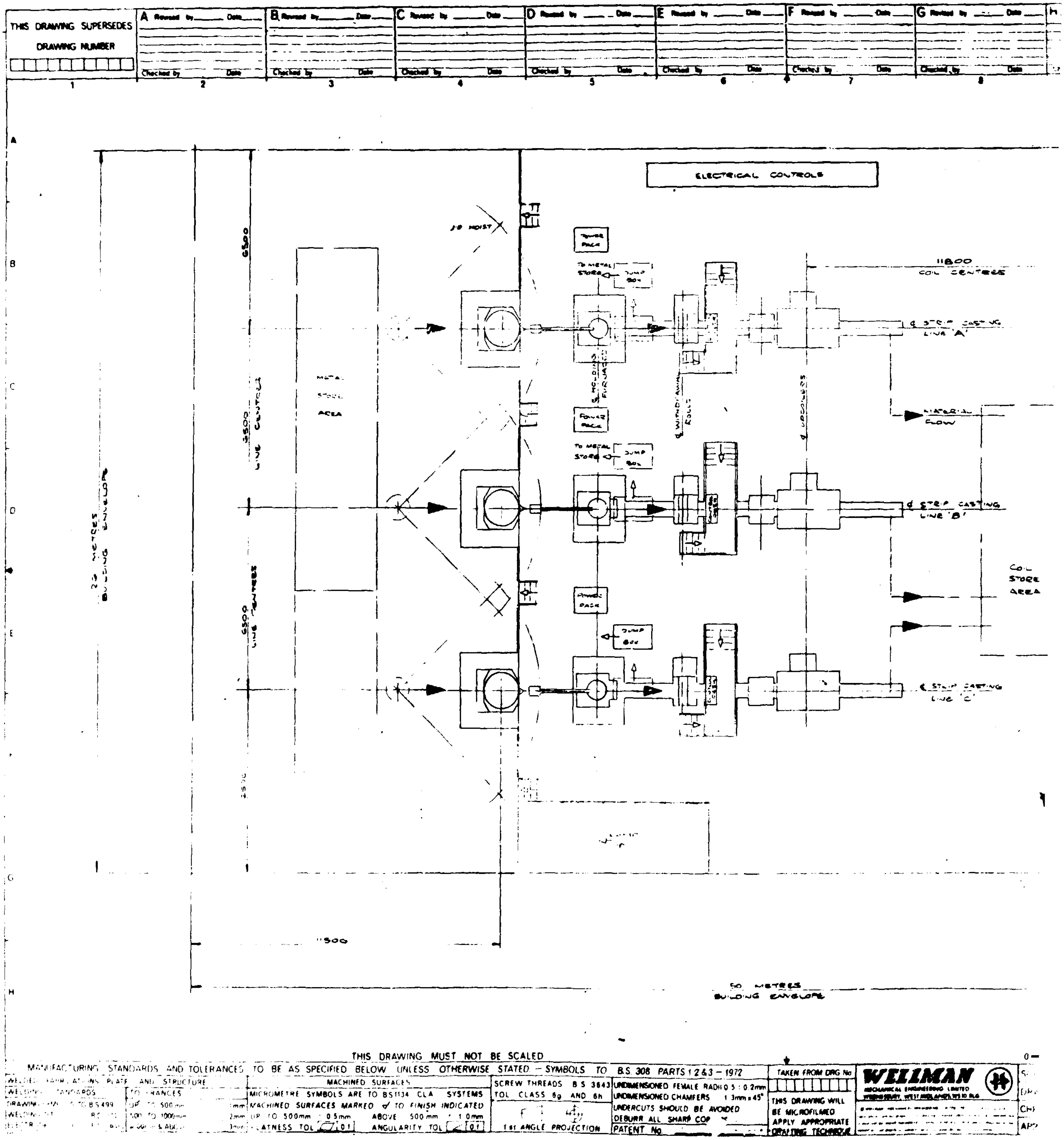
An out-of-line milling machine serves to mill the strip from all casting lines. (A single casting line could include an in-line milling machine).

Whereas this process is relatively simple, obviates hot rolling and entails only modest investment costs in machinery and building, it operates at rather low casting speeds. One line can produce 500mm wide and 15mm thick strip at a rate between 500 and 600 kg per hour. For an output of 12,600 t/y at a yield of 95% and a utilisation factor of 85%, the project thus requires six casting lines in parallel, operating two shifts per day.

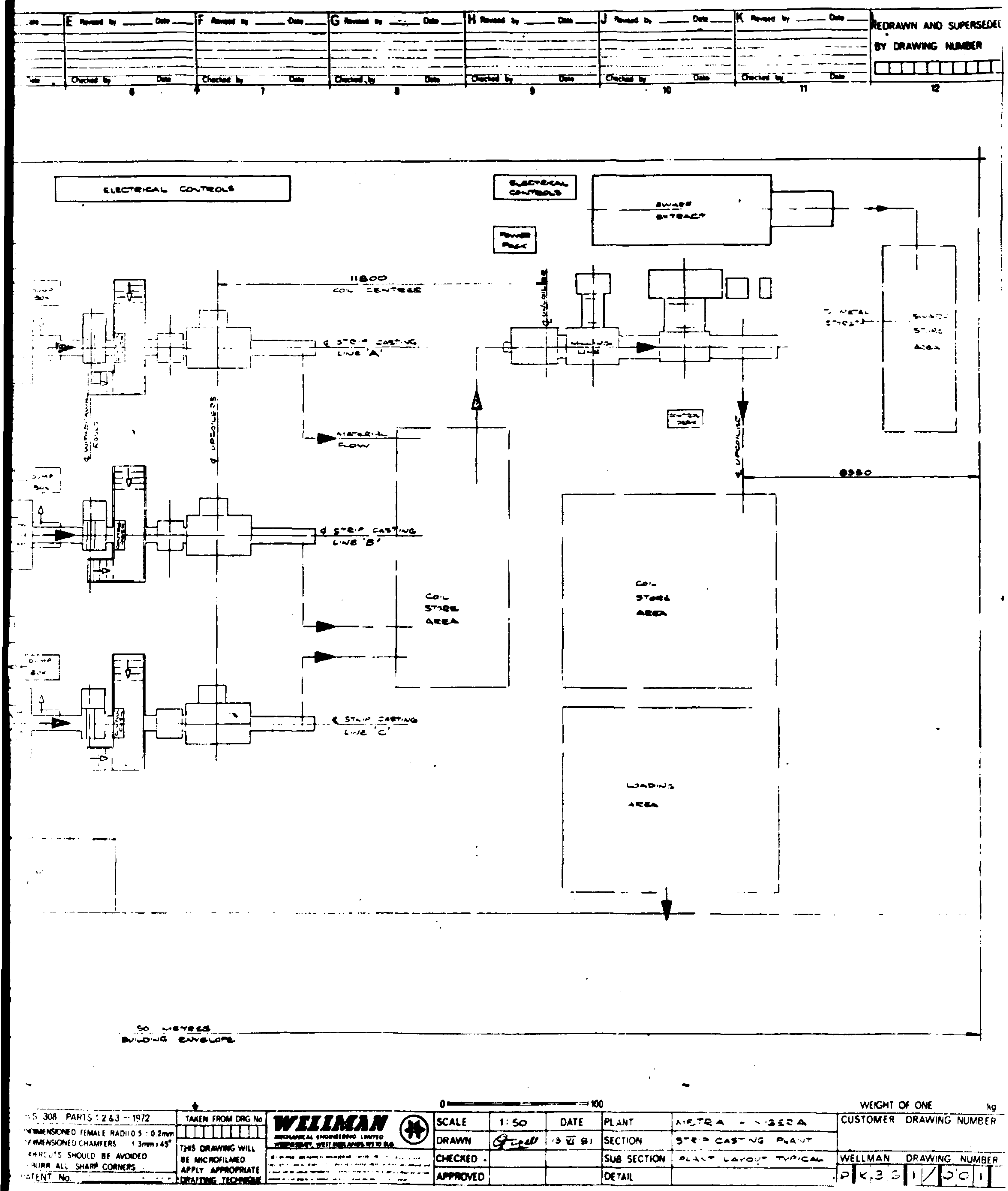
The six lines of plant may be phased in as the demand for sheet and strip develops, but in this instance little would be saved by not building them all at once.

Figure D5 shows a typical 3-line system in plan.

FIGURE D5 : STRIP CASTING PLANT LAYOUT



SECTION 1


REDRAWN AND SUPERSEDED BY DRAWING NUMBER
ELECTRICAL CONTROLS
ELECTRICAL CONTROLS
POWER PACK
SWARF EXTRACT
11800 COIL CENTRES
℄ STRIP CASTING LINE 'A'
℄ STRIP CASTING LINE 'B'
℄ STRIP CASTING LINE 'C'
MATERIAL FLOW
COIL STORE AREA
COIL STORE AREA
LOADING AREA
SWARF STORE AREA
8950
50 METRES BUILDING ENVELOPE
WEIGHT OF ONE kg
TAKEN FROM DRG No
THIS DRAWING WILL BE MICROFILMED. APPLY APPROPRIATE DRAFTING TECHNIQUE
WELLMAN
SCALE 1:50
DATE
DRAWN
CHECKED
APPROVED
PLANT
SECTION STRIP CASTING PLANT
SUB SECTION PLANT LAYOUT TYPICAL
DETAIL
CUSTOMER DRAWING NUMBER
WELLMAN DRAWING NUMBER

SECTION 2

D6. SHEET AND STRIP MILL

As the only plant of its kind in West Africa, it must be capable of a great variety of products. Hence it requires a versatile assembly of machinery such as shown diagrammatically in Figure D6. This comprises:-

(1) 2-high reversing heavy breakdown mill with decoiler and upcoiler, to reduce up to 500mm wide cast and milled strip from 15mm to 3-5mm gauge. It will also break down extruded 180mm wide ETP copper. Alternatively, a 4-high mill and non-reversing rolling should be considered.

(2) Cutting to length line, flying shear type, for strip up to 500mm wide and 5mm thick.

(3) Heavy edge slitter with uncoiler and recoiler for 500mm strip.

(4) Roller hearth annealing furnace, gas heated. One could opt for a series of gas heated bell annealers at considerably lower investment and running costs, but perhaps less flexibility.

(5) 4-high reversing breakdown and finishing mill with coilers to reduce up to 500mm wide strip from 5mm to 1mm.

(6) Slitter with coilers to slit 480mm wide strip into three 160mm widths.

(7) Bell type batch annealing furnace, gas heated, for coils up to 480mm wide.

(8) 4-high reversing finishing mill for rolling up to 480mm wide strip from 2.5mm to 0.25mm thickness, with coilers and accurate gauge control.

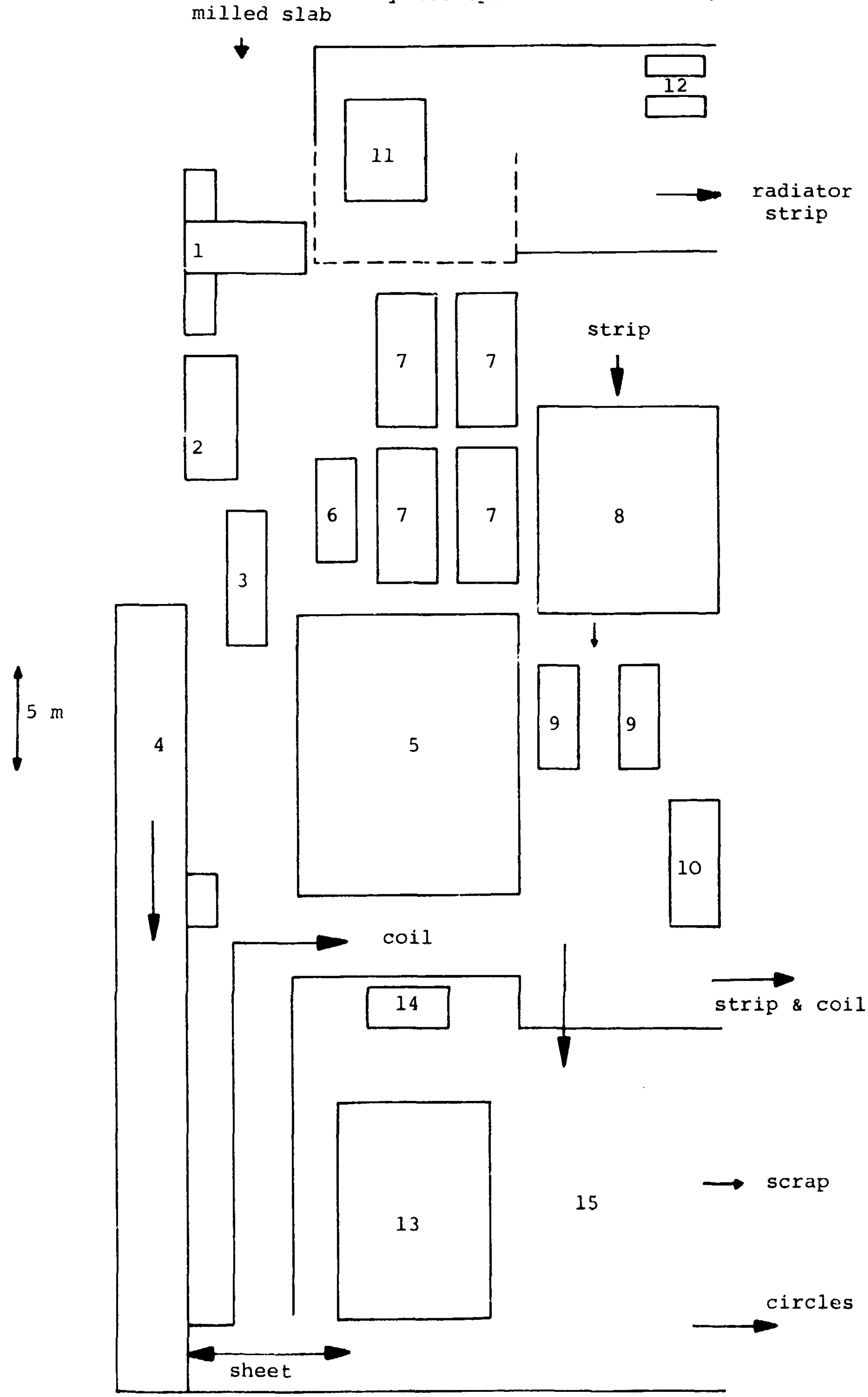
(9) Two finished strip slitters similar to Item (6).

(10) Cutting to length line similar to item (2).

(11) 4-high reversing foil finishing mill similar to item (8) for producing radiator strip.

(12) Two thin strip slitters for different working widths.

FIGURE D6 : SHEET AND STRIP COLD ROLLING SHOP LAYOUT
(for key see specification items)



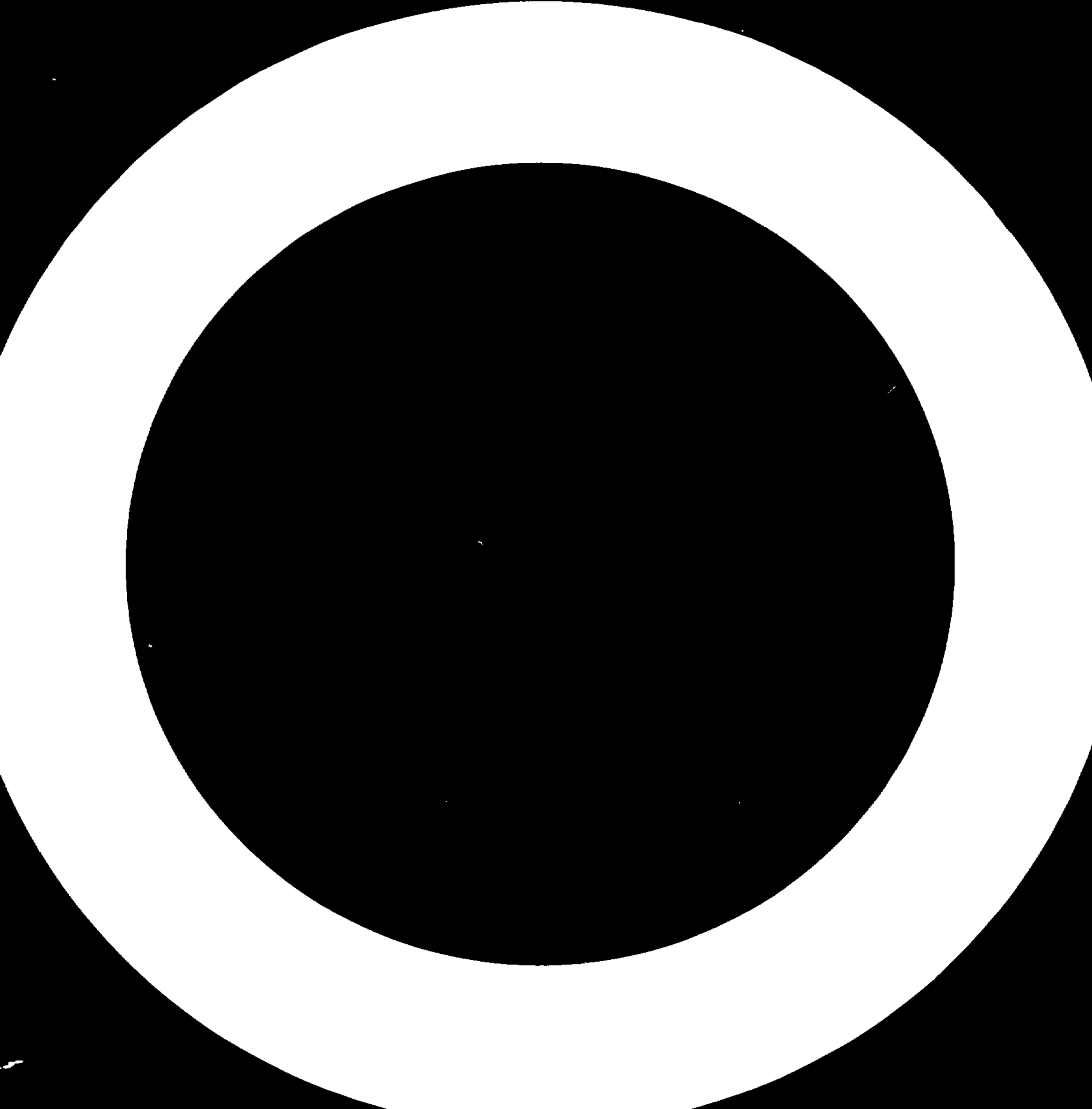
(13) 4-high non-reversing sheet mill for cross-rolling 500mm wide sheet. Hand controlled.

(14) Sheet guillotine for up to 2,000mm cuts.

(15) Circle cutting line comprising:

- 500t hydraulic blanking press;
- hydraulic shuttle system to carry tooling equipment to produce zig-zag pattern of punching for full utilisation of base material;
- feed table for carrying material into the machine;
- strip feed system with de-coiler and coil straightening attachment;
- scrap shearing press;
- tool sets to produce the range of discs required.

(16) Two 10-t gantry cranes.



APPENDIX E : CAPITAL COST ESTIMATES

E1. LAND

No capital cost has been accorded to the land as this will probably be leased from a State Government, which will already have paid compensation for crops and buildings.

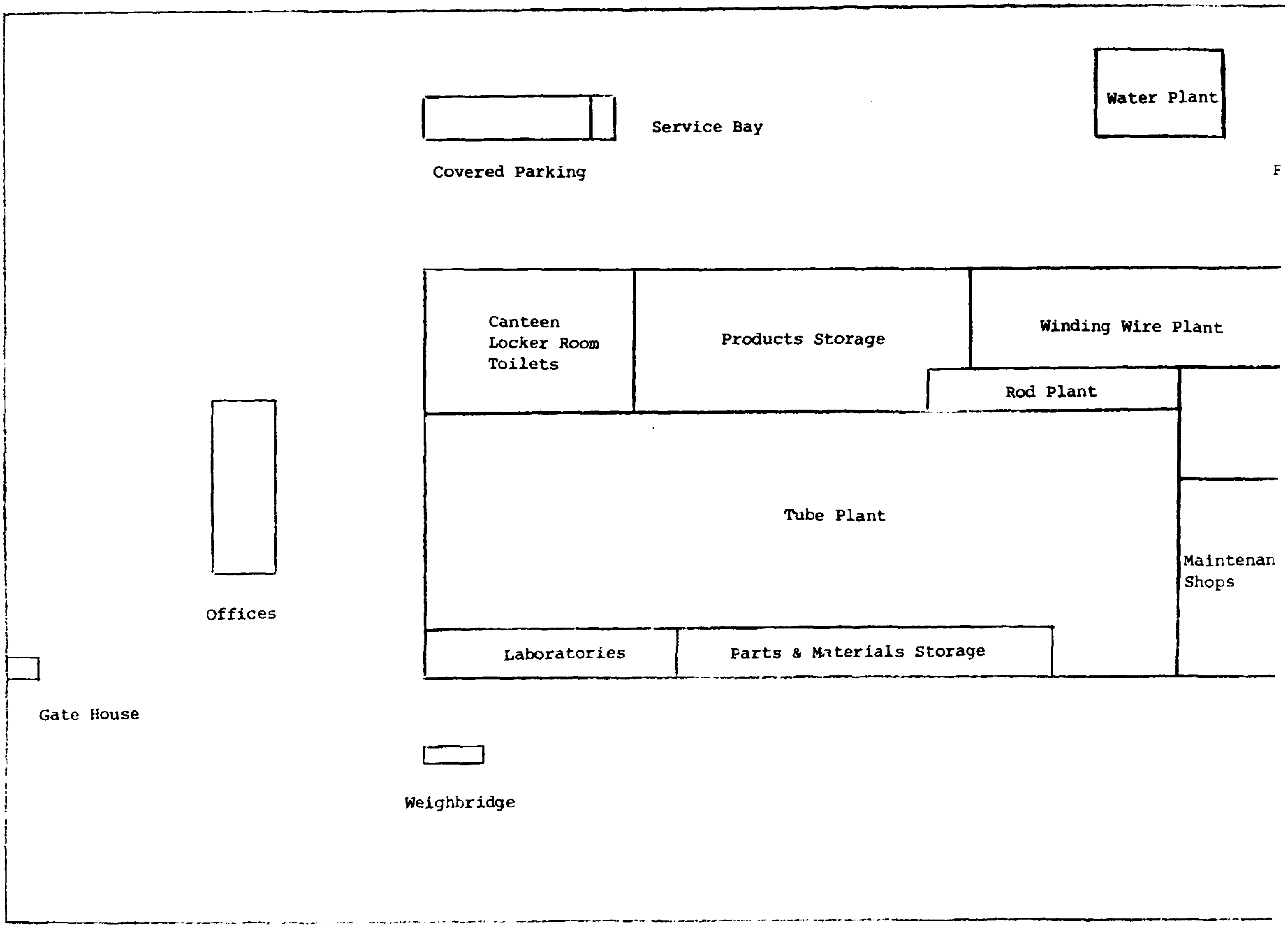
E2. SITE WORK

This cannot be assessed until a site has been chosen and at least conceptional plans have been drawn up. Meanwhile, the provisions as shown in Table E1 would seem adequate. It has been assumed that power, natural gas and an access road will all be available at the "factory gate".

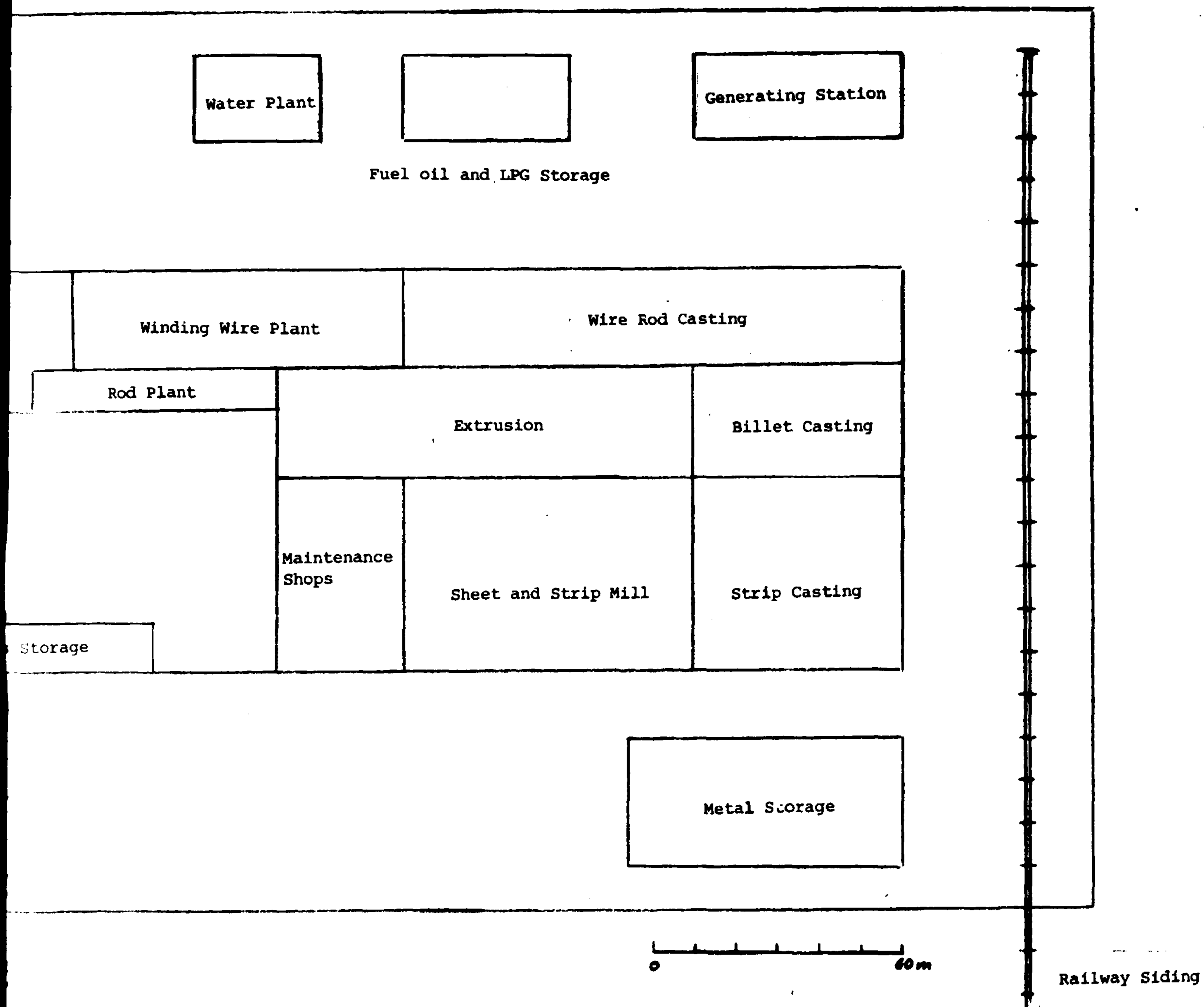
TABLE E1 : SITE WORK COSTS

Item	Assumption	Cost ₦ '000
Bush clearing and any demolition	10ha @ ₦30,000	300
Grading, fill and rolling Storm and sanitary sewers and soakaways Exterior electrical work incl. compound lighting Water distribution Gas distribution Roadways and parking areas) landscaping	10ha @ ₦300,000	3,000
Gate house		15
Perimeter fence & gate	1,400m @ ₦70	98
Weighbridge		35
Septic tanks		70
Railway siding	1 km of track	150
		3,668
Engineers' land surveyors' and quantity surveyors' fees	4¾%	174
TOTAL		3,842

FIGURE E.1 : SITE PLAN



SECTION 1


Water Plant
Generating Station
Fuel oil and LPG Storage
Winding Wire Plant
Wire Rod Casting
Rod Plant
Extrusion
Billet Casting
Maintenance Shops
Sheet and Strip Mill
Strip Casting
Storage
Metal Storage
0
60m
Railway Siding

SECTION 2

E3 FACTORY BUILDING

Most the the process plant must be housed in a heavy industrial building, generally 9m to the eaves with penthouses above the billet casting and wire annealing units. The structural steelwork must support gantry cranes over much of the area. The billet casting, extrusion press, wire rod casting plant and other sections require extensive cellars and pits. There will be numerous reinforced concrete machinery bases, and at least the extrusion press needs extra heavy foundations.

Pending the development of design data, one can only assess the cost of the building on a floor space basis. A unit cost of ₦700/m^2 would seem appropriate for the total work comprising:

- excavation and backfill;
- piling or rafts as far as necessary;
- foundations and equipment bases;
- structural steelwork;
- building shell;
- exhaust systems as far as not provided with process plant;
- internal partitions;
- plant control rooms and offices;
- water, gas and compressed air distribution;
- sanitary drains and vents and storm drains;
- electrical distribution and fixtures;
- storage racks and other fixtures;
- all contractors' charges;
- all architects' , engineers' and quantity surveyors' fees.

It includes adequate contingencies for roof structures in the compound such as 2,000 m^2 metal storage area and a 400m^2 vehicle shelter.

Figure E1 shows how all manufacturing and associated facilities may be arranged in a single 31,020m^2 building with four spans of approximately 23m or five spans of 19m. The dividing lines indicate the spaces needed for the various sections and do not necessarily represent internal partitions.

TABLE E2 : CONTINUOUS WIRE ROD CASTING - TOTAL INSTALLED COST

Item	Cost
Southwire basic scope of supply) Systems engineering) Licence fee) Overseas training (excl. expenses))	$ 4,203,000
Auxiliary support equipment) Maintenance equipment) Laboratory equipment)	$ 803,000
Spare parts incl. furnace linings, pour pots, band coils, spouts, rolls, etc - 10%	$ 500,000
sub-total, fob US port	$ 5,506,000
@ ₦ 0.64/US $ 1.00	₦ 3,524,000
Freight - 1,000 cu. m @ ₦ 100	100,000
Insurance - 2%	70,000
	3,694,000
Import Duty - 5.25%	194,000
Inland freight to site near Lagos or Port Harcourt - 1,000 cu. m @ ₦ 9	9,000
sub-total, delivered to site	3,897,000
Installation and commissioning -	1,280,000
Total, installed and Commissioned	₦ 5,177,000
Additional costs for Enugu location:	
inland freight - 1,000 cu m @ ₦ 5	₦ 5,000
contractor, say	25,000
Total	₦ 30,000

E4. EQUIPMENT - INSTALLED COST

Plant installation costs are difficult to assess at the feasibility study stage of a project of this kind. They consist chiefly of labour, supervision and overheads, all of which depend as much on the time which elapses as they do on the amount of work done. Skilled labour for this type of work is scarce in Nigeria and contractors shy away from it, so that plant suppliers will probably have to furnish at least some labour as well as supervision. Under the circumstances, the capital cost estimates used allow 40% of the total fob cost of equipment for installation in the Nigerian plant.

In Tables E2 to E11, each section of the plant is dealt with individually and the total capital cost and installation cost elaborated for each. Where relevant assumptions and bases for calculations have been shown.

As can be seen from these tables, equipment quotations have been obtained from many sources. The selected quotation has been based on suitability and price. In each case equipment has been shown in original currency, converted to Naira with additional installation etc., costs being added as appropriate.

TABLE E3 : WINDING WIRE DRAWING - TOTAL INSTALLED COST

Item		Cost
Breakdown machine with annealer, coiler and pointing machine	DM	1,356,000
3 intermediate drawing machines with spoolers		841,000
Spare parts - 5%		110,000
sub-total fob European port	DM	2,307,000
@ ₦ 0.26/DM	₦	600,000
Freight and port charges - 250 cu. m @ ₦ 100		25,000
Insurance - 2%		12,000
		637,000
Import Duty - 5.25%		33,000
Inland freight to site near Lagos or Port Harcourt - 250 cu. m @ ₦ 9		2,000
sub-total, delivered to site		672,000
Installation and commissioning		228,000
Total, installed and commissioned	₦	900,000
Additional costs for Enugu location:		
inland freight - 250 cu. m @ ₦ 5	₦	1,250
Contractor, say		4,750
Total	₦	6,000

TABLE E4 : WINDING WIRE ENAMELLING - TOTAL INSTALLED COST

Item	Cost
2 complete 20-head enamelling lines with annealers and structural steelwork ex. U.K. works.	£ 714,000
Packaging equipment	20,000
Spare parts	70,000
Freight to Nigerian port - two 12 m and one 6 m containers	11,000
Sub-total, c & f	£ 815,000
@ ₦ 1.28/£	₦1,043,000
Insurance - 2% of ex works value	16,000
Import Duty - 5.25% of c & f value	55,000
Inland freight to site near Lagos or Port Harcourt - 166 cu. m @ ₦ 9	2,000
Sub-total, delivered to site	1,116,000
Installation and Commissioning	376,000
Total, installed and commissioned	₦1,492,000
Additional costs for Enugu location:	
inland freight - 166 cu. m @ ₦ 5	₦ 1,000
Contractor, say	8,000
Total	₦ 9,000

TABLE E5 : BILLET CASTING - TOTAL INSTALLED COSTS

Item	Cost
Complete system comprising - 4 melting furnaces - 2 holding furnaces - 2 3-strand casters - 1 billet saw - ancillary equipment - 2 spare melting furnace bodies - 8 spare induction boxes - 12 spare coils - spare refractory linings, mould liners, etc. - 15-t gantry crane - fume extraction system fob European port - £1,700,000 @ ₦1.28	₦ 2,176,000
Ocean freight, port charges & insurance	218,000
Sub-total, cif Nigerian port	2,394,000
Import Duty - 5.25%	126,000
Inland freight to site near Lagos or Port Harcourt	20,000
Sub-total, delivered to site	2,540,000
Installation and commissioning	870,000
Total, installed and commissioned	₦ 3,410,000
Additional estimated costs for Enugu location:	
inland freight	₦ 11,000
contractor	17,000
Total	₦ 28,000

TABLE E6 : EXTRUSION PLANT - TOTAL INSTALLED COSTS

Item	Cost
Extrusion press with all ancillaries	£ 1,900,000
Billet heating equipment and die oven	310,000
Extrusion runout system	780,000
Initial tooling	500,000
Spare parts - 10%	300,000
Sub-total, fob U.K. port	£ 3,790,000
@ ₦ 1.28/£	₦ 4,851,000
Freight and port charges, say	250,000
Insurance - 2%	97,000
	5,198,000
Import Duty - 5.25%	273,000
Inland freight to site near Lagos or Port Harcourt, say	25,000
Sub-total, delivered to site	5,496,000
Installation and commissioning	1,731,000
Total, installed and commissioned	₦ 7,227,000
Additional costs for Enugu location:	
inland freight, say	₦ 15,000
contractor, say	35,000
Total	₦ 50,000

TABLE E7 : TUBE DRAWING AND FINISHING - TOTAL INSTALLED COST

Item	Cost
All equipment specified including spare parts, fob European port - £4,837,000 @ ₦ 1.28	₦ 6,192,000
Ocean freight, port charges and insurance - 10%	619,000
Sub-total, cif Nigerian port	6,811,000
Import Duty - 5.25%	358,000
Inland freight to site near Lagos or Port Harcourt	62,000
Sub-total, delivered to site	7,231,000
Installation and commissioning	2,353,000
Total, installed and commissioned	₦ 9,584,000
Additional estimated cost for Enugu location:	
inland freight	₦ 35,000
contractor	₦ 45,000
Total	₦ 80,000

TABLE E8 : ROD DRAWING - TOTAL INSTALLED COST

Item	Cost
Pickling system, coil payoff swift, bar rack, draw bench and spare parts, fob European port - £475,000 @ ₦ 1.28	₦ 608,000
Ocean freight, port charges & insurance - 10%	61,000
Sub-total, cif Nigerian port	669,000
Import Duty - 5.25%	35,000
Inland freight to site near Lagos or Port Harcourt	6,000
Sub-total, delivered to site	710,000
Installation and commissioning	240,000
Total, installed and commissioned	₦ 950,000
Additional estimated cost for Enugu location:	
inland freight	₦ 3,000
contractor	5,000
Total	₦ 8,000

TABLE E9 : ROD STRAIGHTENING - TOTAL INSTALLED COST

Item	Cost
Roller table, cut-off wheel, straightener and run-out table and 5 t gantry crane, complete with spare parts, fob European port - £360,000 @ ₦ 1.28	₦ 460,000
Ocean freight, port charges and insurance - 10%	46,000
Sub-total, cif Nigerian port	506,000
Import Duty - 5.25%	27,000
Inland freight to site near Lagos or Port Harcourt	5,000
Sub-total, delivered to site	538,000
Installation and commissioning	180,000
Total, installed and commissioned	₦ 718,000
Additional estimated cost for Enugu location:	
inland freight	₦ 3,000
contractor	4,000
Total	7,000

TABLE E10 : CONTINUOUS STRIP CASTING - TOTAL INSTALLED COST

Item	Cost
3 melting furnaces with electrical equipment, 2 spare inductors and 2 spare refractory linings	*AS 7,774,000
6 casting lines with electrical equipment, 2 spare furnace bodies, 2 spare inductors and 2 spare refractory linings	32,581,000
Fume extractor system with bag filter	3,000,000
	AS 43,355,000
@ AS 26/₦1.00	₦ 1,668,000
Strip milling line with spare parts - £400,000 @ ₦ 1.28/£	512,000
3 5-t gantry cranes - £40,000 @ ₦ 1.28/£1.00	51,000
Sub-total, fob European port	2,231,000
Freight and port charges - 1500 cu m @ ₦ 100	150,000
Insurance - 2%	45,000
Sub-total, cif Nigerian port	2,426,000
Import Duty - 5.25%	127,000
Inland freight to site near Lagos or Port Harcourt - 1500 cu. m @ ₦ 9	14,000
Sub-total, delivered to site	2,567,000
Installation and commissioning	837,000
Total, installed and commissioned	₦ 3,404,000
Additional costs for Enugu location:	
inland freight - 1500 cu. m @ ₦ 5	₦ 8,000
contractor, say	17,000
Total	₦ 25,000

* Austrian Shilling

TABLE E11 : SHEET AND STRIP MILL - TOTAL INSTALLED COST

Item		Cost
All equipment specified including spare parts, fob European port - £6,216,000 @ ₦ 1.28	₦	7,956,000
Ocean freight, port charges and insurance - 10%		796,000
Sub-total, cif Nigerian port		8,752,000
Import Duty - 5.25%		459,000
Inland freight to site near Lagos or Port Harcourt		80,000
Sub-total, delivered to site		9,291,000
Installation and commissioning		3,023,000
Total, installed and commissioned	₦	12,314,000
Additional estimated cost for Enugu location:		
inland freight	₦	45,000
contractor		60,000
Total	₦	95,000

E5. GENERATING STATION

In view of the problems encountered by the Nigerian Electric Power Authority (NEPA) in providing electricity to industry, it will remain absolutely essential for some years to come to provide a power-intensive operation of this kind with its own generating capacity for the total demand.

Short of specific engineering study, informed electrical engineering contractors estimate that the total cost of a 20,000 KVA diesel generator station including switchgear, automatic transfer switch to NEPA supply, oil tanks and pumps, building and foundations, all contractors' charges and engineering fees, will be of the order of ₦16 million. This figure should also include the cost of rectifiers for running the numerous large DC motors.

At a consumption of 70 million KWH/y, the cost of electricity produced may then be approximated as shown in Table E12.

TABLE E12 : ELECTRICITY COSTS

Item	Cost ₦
Diesel oil - 0.27 l/KWH @ ₦0.11/l	0.030/KWH
Capital charges - ₦16m @ 10% per annum	0.023
Maintenance and operating supplies - 3%	0.007
Direct labour	0.001
Depreciation (accounting rate) - 5%	0.012
Allocation of other indirect costs	0.002
Total	0.075/KWH

The data contained in Table E12 can be compared with the following NEPA charges for 400V supply:

- Demand charge - 20,000 KVA @ ₦60/KVA/y	₦	0.017/KWH
- Energy charge		0.040
	₦	0.057

The present study is therefore based on in-house generation of all electricity by diesel generators and the figure of ₦0.075/KWH is used for allocating electricity costs to the various cost centres. This figure applies to maximum production rates. At lower production rates, power will be correspondingly dearer.

Some saving could be effected by using natural gas available at half the cost of diesel oil on a calorific basis, but this would call for a dual fuel system (to ensure against interruptions in gas supply) and we have no data at this time to estimate the additional capital cost this would entail.

E6. WATER SUPPLY, TREATMENT AND COOLING SYSTEM

Water requirements at full production will total approximately 1,500 cu. m per hour depending on temperature. Most of this substantial quantity will be needed for quenching in the annealing furnaces and extruder run-out system and for cooling moulds, launders and lubricants. Water coming into contact with processed metals must meet high purity standards. Assuming 10% make-up depending on atmospheric conditions, the following system will have to be provided:

- borehole for $150m^3/h$;
- treatment plant for $150m^3/h$;
- cooling tower for $1,500m^3/h$, 20^oC temperature reduction;
- water reservoirs;
- pumping station.

The capital cost estimate includes a provision of ₦600,000 for these facilities, but it must be understood that the actual cost depends very much on the availability of water at the site eventually chosen.

E7. STORAGE FACILITIES

Sufficient floor space has been provided in the factory building for storing the following materials:

- Copper cathode;
- Products;
- Spare parts;
- Operating supplies;
- Packaging materials.

The cost of storage racks may be assumed to be included in the unit cost of the building, which is sufficiently generous to cover also a separate light structure for accommodating scrap and more cathode.

A provision of ₦50,000 has been made for an LPG storage depot. Even if natural gas is available, such a facility will still be needed as insurance against interruptions in gas supply.

E8. MAINTENANCE SHOP EQUIPMENT

Continuity in operation and assurance of product quality call for many regular and occasional maintenance tasks for which well-equipped and versaile in-house mechanical and electrical workshops staffed with highly skilled personnel are indispensable. These must include a tool and die shop, not to mention a roll dressing shop for which the grinding machinery alone could cost as much as ₦520,000 installed. The factory building estimate includes enough space for these facilities, and a total of ₦0.8m should be set aside for the necessary machine tools and other equipment including gantry crane.

E9. LABORATORY EQUIPMENT

Equal importance should be accorded to laboratory facilities which must be staffed and equipped for rapid chemical and physical analyses on a considerable variety of materials. Quality control and minimisation of rejects depends on it. Indeed, the metallurgist performs a key function in the entire operation. Space has been allowed for a central laboratory, in addition to which instant test rooms will have to be located adjacent to some of the process units such as the casting furnaces. A provision of ₦300,000 has been made for procurement and installation of the mostly quite sophisticated equipment.

E10. VEHICLES

All incoming supplies are being estimated on a delivered basis and revenues apply to sales ex-factory. On this basis, the following fleet of vehicles should suffice provided they are properly maintained:-

Type	Number	Unit Cost (₦)
10-t truck	1	25,000
5-t truck	2	18,000
pickup	3	8,000
fork lift truck	15	18,000
front loader	2	10,000
passenger car	8	8,000

For simiplicity it is assumed that all vehicles will be replaced every five years at their original cost.

E11. VEHICLE SERVICE FACILITIES

The capital cost estimate includes a provision of ₦3,000 for a 50m^2 service bay. Covered parking space is included in the estimate of the factory building.

E12. OFFICES AND STAFF AMENITIES

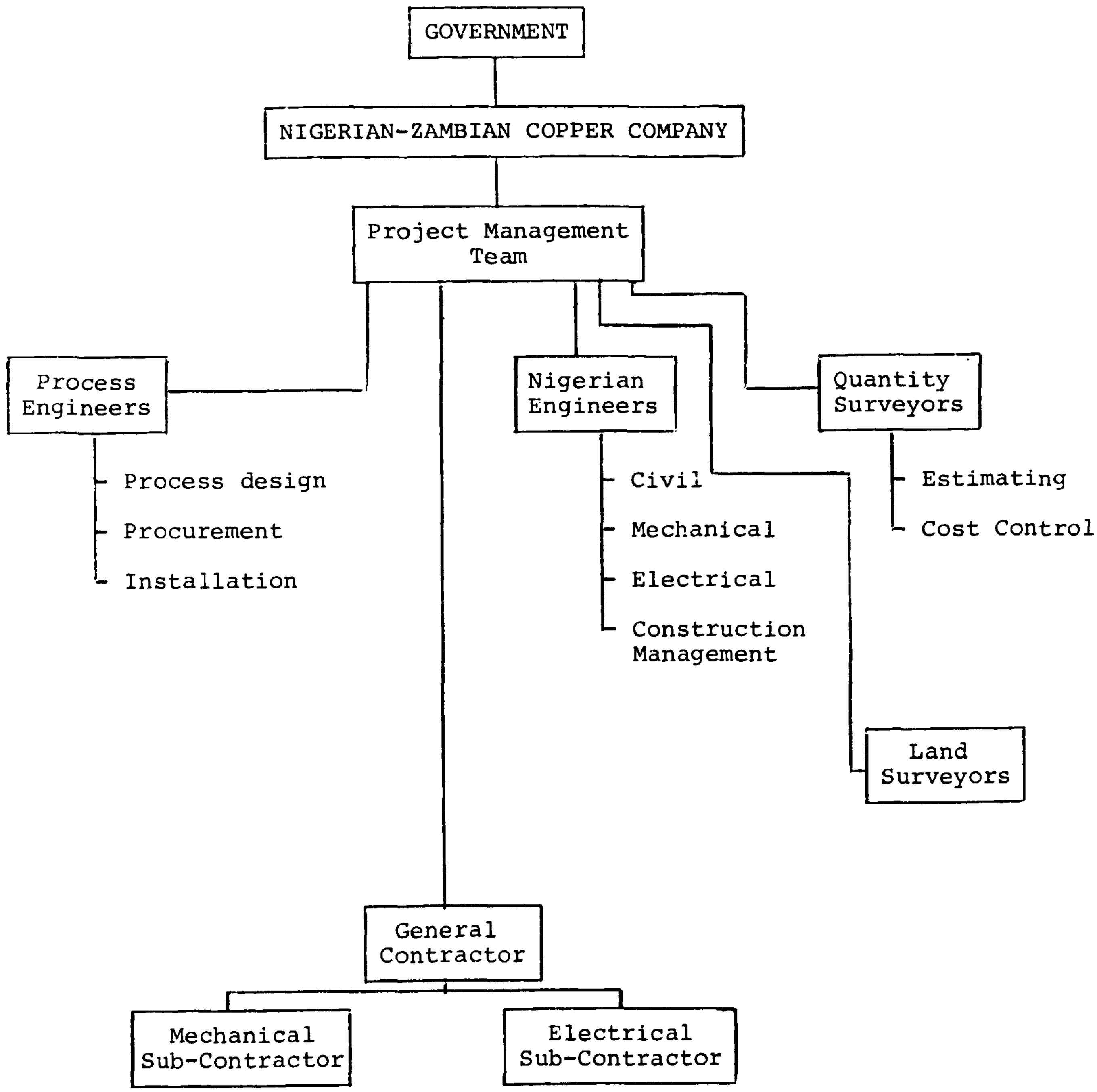
Short of a layout, 600sq. m should be adequate to accommodate all regular staff and visitors and all necessary facilities.

- Office space - 600sq. m @ ₦800 inclusive air conditioning and all contractor's charges.	₦480,000
- Architects' and Quantity Surveyors' fees - 6%.	30,000
- Office furniture and equipment - ₦100/sq.m	60,000
- Telephone exchange and distribution system	100,000
	₦670,000

The factory building includes space for a canteen, change and rest rooms and a first-aid room. ₦35,000 has been provided for all equipment and furnishings. Sanitary fixtures are part of the building cost.

The estimates make no provision for any staff housing on the grounds that the factory will probably be located in an area with a good infrastructure and that the payroll overheads include housing and transport allowances.

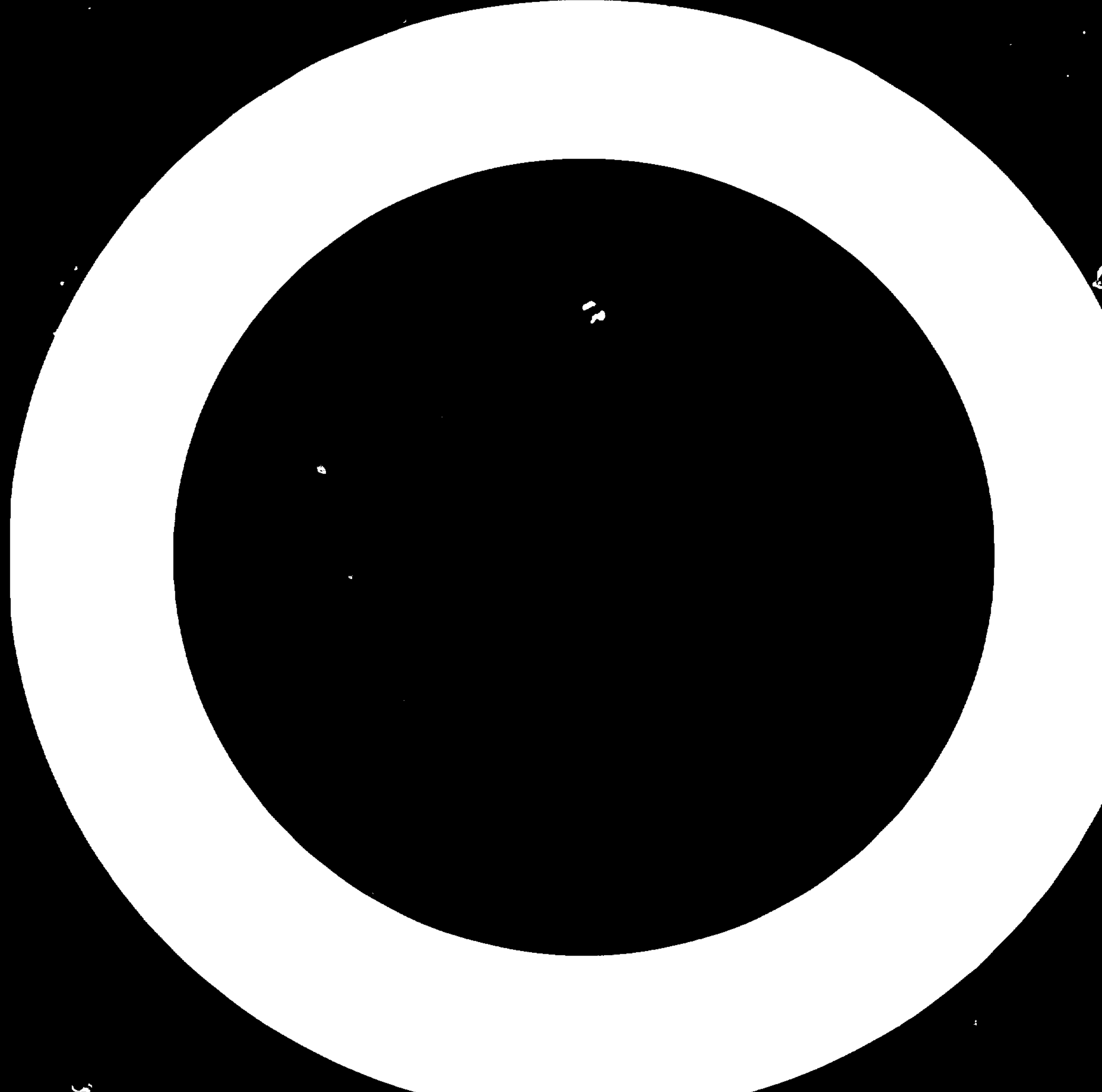
FIGURE E2 : IMPLEMENTATION ORGANOGRAM



E13. PRE-PRODUCTION EXPENSES

The organisation required for implementing this project would probably resemble Figure E2. It calls for a strong project management team with engineering, procurement and cost control capabilities to handle all aspects and to direct, co-ordinate and control the work of engineers, surveyors and contractors. The responsibility of this team to the investors is crucial. How it is set up and how it will function will depend very much on arrangements with technical partners. A high content of expatriate staff will be inevitable. Pending such decisions, a provision of ₦2.25 million would seem appropriate, ie, an average of ₦500,000 per year prior to the commencement of production.

Pre-production training of operators can usually be arranged by plant suppliers free of charge, which leaves only wages and expenses. For 31 foremen and operators, which we consider a reasonable number for a basic start-up complement, a provision of ₦160,000 will permit three months' training. While thorough training of the operators is of utmost importance to the success of this project, we recommend that overseas training be minimised to the bare essentials needed to get production started. Much money can easily be spent with little to show. The real experience can only be acquired on the job from a strong team provided by or through the auspices of the technical partners. The financial projections allow for a correspondingly low output during the first year of production.



APPENDIX F : EQUIPMENT MANUFACTURERS

F1. EQUIPMENT MANUFACTURERS

The companies, detailed in Table F1, among others, specialise in the design and supply of process plant and equipment for the manufacture of semi-finished copper and copper alloy products. Those marked with an asterisk submitted proposals used in the specifications and estimates for this study.

TABLE F1 : EQUIPMENT MANUFACTURERS

Company	*	Specialities
The Bronx Eng. Co. Ltd., Stourbridge, England		tube mill machinery
Bültmann KG, Küntrop, W. Germany	*	tube mill machinery
Danieli & C. spa. Udine, Italy		
Ebner-Industrieofenbau, Linz, Austria	*	annealing furnaces
Engineering Promotions Ltd., Farnborough, England	*	winding wire enamelling plant
Sir James Farmer Norton & Co. (International) Ltd., Manchester, England	*	rolling mills
The Fenn Mfg. Co., Newington, Conn., USA		rolling mills, wire and tube drawing equipment
Fielding & Platt Ltd., Gloucester, England	*	extrusion presses
Fröhling GmbH, Olpe, W. Germany	*	rolling mills
The Head Wrightson Machine Co. Ltd., Middlesbrough, England	*	tube and bar mill machinery
Maschinenfabrik Hercules Hans Thoma GmbH, Marienborn, W. Germany	*	roll grinding machines
Otto Junker GmbH, Simmerath, W. Germany	*	annealing furnaces
Fried. Krupp GmbH, Essen, W. Germany	*	wire rod casting, billet casting, roliing mills

/Continued..

TABLE F1 : EQUIPMENT MANUFACTURERS (Continued)

Company	*	Specialities
Loewy Robertson Eng. Co., Ltd., Poole, England	*	rolling mills
MAG-Maschinen und Apparatebau GmbH, Graz, Austria	*	winding wire enamelling plant
Maschinenfabrik Niehoff KG, Leuterschach, W. Germany	*	wire drawing plant
Marshall Richards Barcro Ltd., Crook, England	*	tube drawing plant
Mesta Machine Co., Pittsburgh, PA., USA		rolling mills
Metatherm GmbH, Vienna, Austria	*	continuous strip casting
Ruesch Machine Co., Springfield, N.J., USA		strip mill equipment
Reika-Werk GmbH, Hagen-Kabel, W. Germany	*	tube mill machinery
Secim, Courbevoie, Cedex, France	*	wire rod casting, rolling mills, extrusion presses
Schloemann-Siemag AG, Düsseldorf, W. Germany	*	extrusion presses
Walzmaschinenfabrik August Schmitz GmbH, Düsseldorf, W. Germany		rolling mills
Southwire Co., Carollton, Ga., USA	*	continuous wire rod casting plant
The Torrington Co., Waterbury, Conn., USA		tube and wire mill equipment
Torvale Engineering Ltd., Leominster, England	*	tube mills
Waterbury Farrell Division of Textron Inc., Cheshire, Conn., USA		rolling mills

/Continued..

TABLE F1 : EQUIPMENT MANUFACTURERS (Continued)

Company	*	Specialities
Wellman Furnaces Ltd., Warley, England	*	annealing furnaces
Wellman Mechanical Eng. Ltd., Wednesbury, England	*	continuous strip casting, billet casting
Carl Wezel KG, Mühlacker, W. Germany	*	rolling mills
Wild Barfield Ltd., Watford, England	*	annealing furnaces

United Nations Industrial Development Organisation

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Final Report

12495
(4 of 4)

United Nations Industrial Development Organisation

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VOLUME 4 : EXECUTIVE SUMMARY REPORT

Final Report

Prepared by Metra Consulting Group under Contract 80/154 (Project Number: DP/RAF/79/006)

METRA CONSULTING GROUP LIMITED

St. Mary's House
42 Vicarage Crescent
London SW11 3LB

TELEPHONE: 01-223-7634
TELEX: 919173 MCGLDN G

The views expressed in this Report are those of the Consultants and do not necessarily reflect the views of the Secretariat of the United Nations Industrial Development Organisation.

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CONTENTS

CONTENTS - TABLES

Continued ...

Contents - Tables - Continued ...

CONTENTS - FIGURES

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ABBREVIATIONS

The following abbreviations have been used throughout this report.

LME	London Metal Exchange
Comex	Commodity Exchange (New York)
SKD	Semi-knocked down
CKD	Completely knocked down
NEPA	Nigerian Electric Power Authority
NNPC	Nigerian National Petroleum Company
RE	Rural Electrification
FMI	Federal Ministry of Industries
FMNP	Federal Ministry of National Planning
KV	Kilo Volts
GNP	Gross National Product
GDP	Gross Domestic Product
MW	Megawatt
KwH	Kilowatt Hour
GwH	Gigawatt Hour
V	Volts
MVA	Mega Volt Ampere
KVA	Kilo Volt Ampere
kg	Kilogramme
km	Kilometre
g	Gramme
HT	High Tension (Cables)
MT	Medium Tension (Cables)
LT	Low Tension (Cables)
sq.	Square
p.a.	per annum
p.m.	per month
p.w.	per week
hp	Horsepower
BSD	Standard Barrels per day
DDB	Dodecylbenzene
PVC	Polyvinylchloride
AC	Alternating Current
DC	Direct Current
k.cal	kilo-calories
KW	Kilowatt
ft.	Feet
ins.	Inches
m	metres
cm	centimetres
mps	metres per second
od	outside diameter
wt	wall thickness
amp	Ampere

rpm	revolutions per minute
fpm	feet per minute
BTU	British Thermal Units
SCF	Standard Cubic Feet
fob	free on board
cif	carriage, insurance and freight
₦	Naira
$	Dollars

1. INTRODUCTION

This project has been carried out under the terms of contract 80/154 between United Nations Industrial Development Organisation (UNIDO) and Metra Consulting Group. The project DP/RAF/79/006 was initiated in response to a request from the Governments of Nigeria and Zambia to UNIDO to provide assistance in carrying out a project entitled "Feasibility Study on the Establishment of a Copper Fabrication Plant in Nigeria".

Under the Terms of Reference of the above mentioned contract, the Consultants are to submit four separate report documents. These are entitled :

Volume 1 : Nigerian Market Study

Volume 2 : Export Market Studies

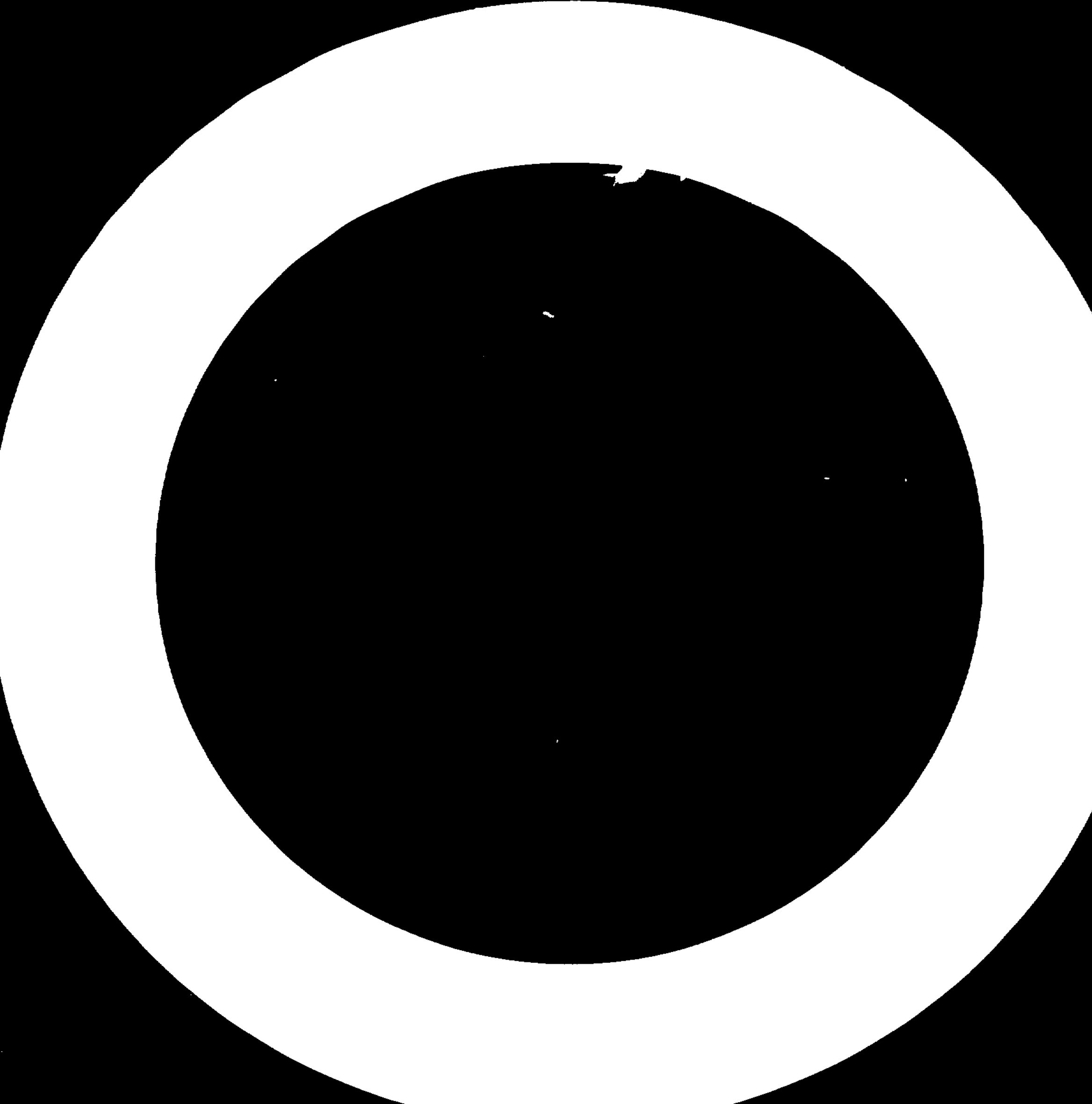
Volume 3 : Feasibility Study

Volume 4 : Executive Summary

Volumes 1, 2 and 3 have been submitted to UNIDO on phased time programmes and this final Executive Summary Report brings together in a succint manner, the conclusions of the Consultants in relation to this project.

Volume 1 is summarised in Section 3.1 of this Volume, Volume 2 in Section 3.2 and Volume 3 in Section 3.3.

The data in this Volume has been taken from the previous volumes. In order to facilitate cross-referencing, the Volume and page from which data has been taken is indicated on each Table.



2. CONCLUSIONS

2.1 Experience in other countries has shown that in order to ensure a viable copper and copper alloy semi-finished products manufacturing industry a sufficiently large home-based demand is essential. Countries which have had to rely heavily on exports in order to reach minimum economic plant volumes have, in general, been unsuccessful.

2.2 The total demand for copper and copper alloy semi-finished products in Nigeria in 1986 will total some 30,000 tons. Of this total, some two-thirds will be in the form of copper semi-finished products with the balance being in the form of copper alloy products.

2.3 The total demand in 1986 in Nigeria divides such that close to 60% of demand is for wire mill products (wire and wire rod) with the balance of just over 40% being brass mill products.

2.4 Looking further ahead, total demand for copper and copper alloy semi-finished products is expected to rise to some 60,000 tons in 1990/91. The division between wire mill and brass mill products is not expected to change significantly from the ratios which will prevail in 1986.

2.5 Of the total requirement for semi-finished copper and copper alloy products in 1986, some 15% will be returned directly to the system as processed scrap generated by the end-user industries. This total excludes scrap which will be recirculating within the wire mill and brass mill complexes, the latter varies considerably from product to product but is expected to average between 6% and 7%.

2.6 Taking due account of the total demand for copper and copper alloy semi-finished products, and account of the above mentioned process scrap, together with the copper content of the alloys used, a net consumption of copper metal of some 23,000 tons is to be expected in 1986, rising to some 45,000 tons in 1990. The major portion of this metal would be supplied by Zambia in the form of copper cathode, although small quantities of copper in other forms could be contemplated.

2.7 The electrical engineering sector will account for some 65% of the total demand for copper and copper alloy semi-finished products in 1986. This demand will be largely in the form of copper wire rod and wire. The remaining 35% of demand is divided between the domestic appliance sector, 2.5%, the transport sector, 6.2%, the construction sector, 8.8%, with the balance going to the general engineering sector.

2.8 Comparison of the above figures with those for other countries show a disproportionarly small part of total demand going to the transport and domestic appliance sectors. This is probably a reflection of the development of these sectors and, in the period beyond 1986, these industry sectors are expected to exhibit a disproportionately high rate of growth in terms of their consumption of copper and copper alloy products. During this period, for example, the transport sector is likely to see the establishment of companies manufacturing electrical components and similar products. Within the domestic appliance sector manufacture of compressors (for refrigerators, air-conditioning units, etc.), electric motors, is likewise expected to develop on a significant scale.

2.9 The population of Nigeria, at over 100 million by the mid-1980's, is such that given political stability and continuing oil revenues, industrialisation can continue at a high rate for many years. Furthermore, the provision of infrastructures such as electricity, etc., will require enormous sums of money and can only be contemplated over a very long time horizon. As such, the demand for copper and copper alloy semi-finished products will not peak or level out but will continue to expand, given the above mentioned conditions, for the foreseeable future.

2.10 Although the total quantity of copper and copper alloy semi-finished products crossing international boundaries in 1979 was in excess of 1.55 million tons, more than 60% of this total was accounted for by intra-European and intra-North American trade. As such the available export markets in which the new Nigerian company must operate is considerably less and in the initial phase, the best opportunities are likely to arise in neighbouring African countries where a new Nigerian company will have advantages on transportation costs and possibly preferential trade agreements under the umbrella of ECOWAS.

2.11 In establishing the viability of the various sub-projects detailed below, we have based our assumptions on the fact that the Nigerian project must be viable based on Nigerian demand. Exports, particularly in the earlier years of the project, will be limited.

2.12 The best products in terms of export opportunities are likely to be wire rod to neighbouring West African countries and a selection of the more common brass mill products, particularly flat products and tube. The export of wire and cable products will, in many cases not be feasible, due to the fact that a number of the neighbouring West African countries have based their standards for power cable and similar products on French standards as opposed to the British standards on which Nigerian specifications have been based. In the area of brass mill products, the problem of different standards does not really occur and as such the new Nigerian company can compete in all the brass mill markets as well as the above mentioned wire rod market in these countries.

2.13 We have set as a target a maximum of 10% of total imports by these countries in 1986 as the share for which the Nigerian company should aim. We have then increased to 20% the volume which the new Nigerian company should aim to achieve in 1990/1991. In the earlier years, the new Nigerian company will not be able to satisfy any export demand in several product areas as a gradual build-up of output has been assumed and total output will fall below the Nigerian home market demand. In 1990/1991, the company will have an available capacity to meet the export demand and for simplicity we have assumed a large part of total exports at this time will be in the form of wire rod, although in reality the product mix of exports will vary from one year to the next.

2.14 Today, there is a quite well developed wire and cable manufacturing industry in Nigeria. The sector comprises four important companies, each of which has a foreign participation at an equity and/or technical level. All four existing wire and cable manufacturers have plans to expand their existing production facilities to enable them to make a more comprehensive range of products than is manufactured today. The plans of these companies are such that by the mid to late 1980's, the local industry should be able to satisfy the major portion of the country's demand for wire and cable products for both the telecommunications and power sectors. A small part of the demand, the portion relating to special and/or highly sophisticated products, probably totalling no more than 5% or 6% of total demand, will continue to be met by imports since manufacture of such products cannot be justified at the volumes required in Nigeria.

2.15 Today none of the existing wire and cable manufacturers have plans for manufacture of wire rod and/or magnet wire. One company has considered the manufacture of magnet wire but has postponed a decision on this product for the foreseeable future. We have therefore included both wire rod and magnet wire as products which could form a part of the new project.

2.16 Within the area of brass mill products, there is no significant manufacturing activity in Nigeria. One company is involved in the collection, melting and casting of copper and copper alloy scrap (most of this product is cast into ingot and exported, although annual volumes are very small). As such, for the purpose of this project, we have been able to assume that any project undertaken by the Government would not in any way compete with or infringe upon existing manufacturing activities within the public and/or private sector in Nigeria.

2.17 A single complex comprising production facilities for copper wire rod, magnet wire, and a complete range of brass mill products (rods, bars, sections, flat products, tubes, in both copper and copper alloys) has been shown to be a viable proposition for establishing in Nigeria. Such a complex will entail a total investment of ₦ 92 million, and will have an ultimate capacity to process some 58,000 tons of products working on a two-shift basis. The above level of capacity will be realised in 1990.

2.18 The profitability of the above mentioned project is such that the investment can be recovered after six years of operation. The simple rate of return works out at 9% whilst net present value shows a positive outflow at a cut-off discount rate of 11%. This means that lending institutions should be prepared to extend the required fixed and working capital loans. The internal rate of return on the project amounts to 11.7% which at current interest rates should prove quite satisfactory to shareholders who will realise a return of 21.6% on their investments. Thus, on a normal accounting basis, and bearing in mind that no artificial price increases have been assumed, one must conclude that the project as it stands is just feasible at the current level of interest rates.

2.19 The sensitivity analyses carried out show that the break-even point is 40% of full production. Adverse events with regard to fuel, labour, operating materials, make little difference to the profit margins and fluctuations in metal costs make no difference at all (since it has been assumed that the company does not speculate on the metal market). The one aspect to which profitability is extremely sensitive is the question of throughput (production volume). A 30% drop in production, for example, would cut profit margins by half, whilst production shortfalls beyond this would quite quickly lead to loss of all profit.

2.20 In developing the equipment requirements, every effort has been made to ensure a high degree of flexibility is maintained within the brass mill products area. This will enable the company to respond to changes in demand from one brass mill product type to another. Likewise the company will be better equipped to deal with export orders which, in many cases will be merely to meet shortfalls in existing supplies, be they local or imported.

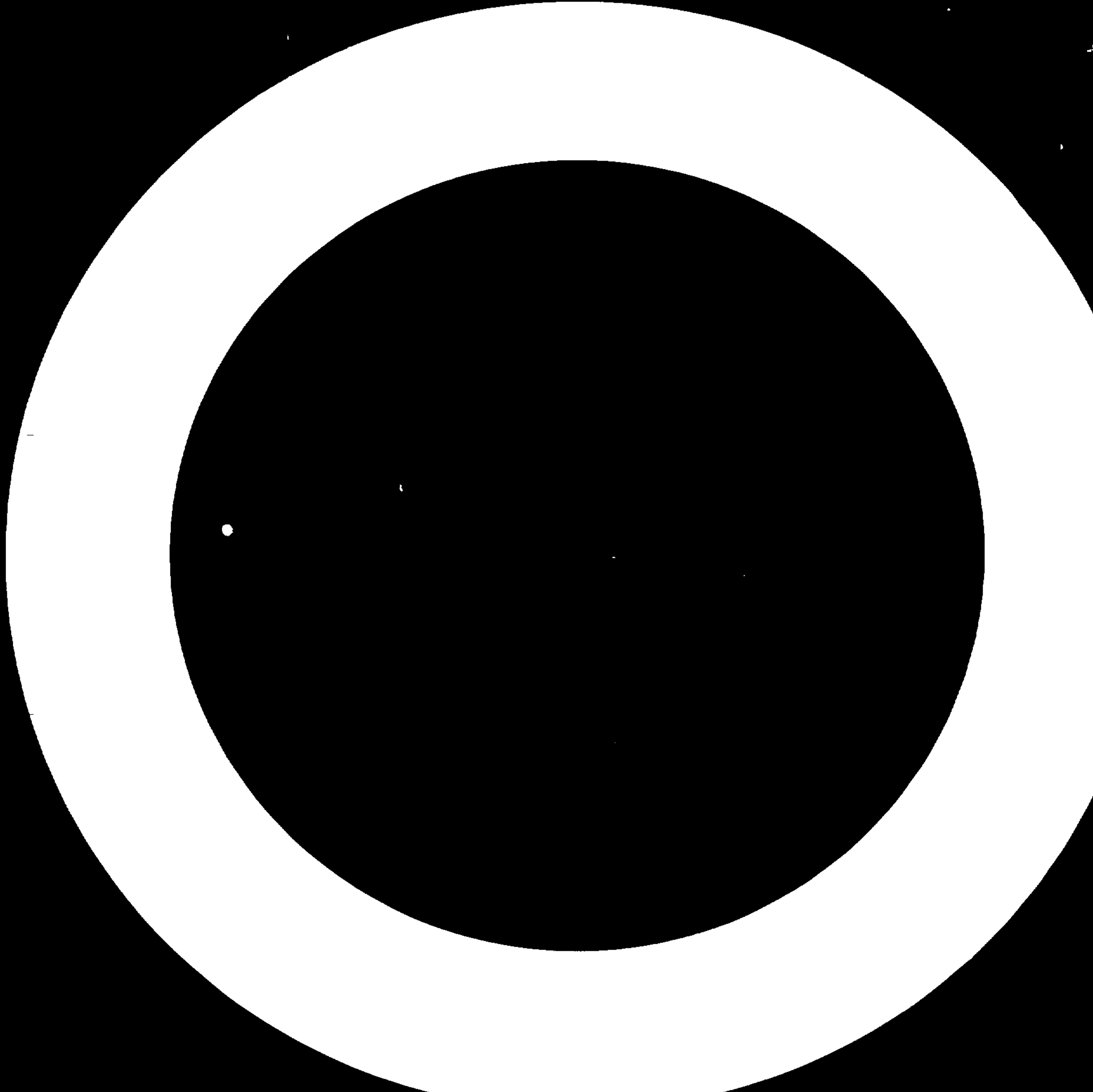
2.21 A complex of the type envisaged would in many respects, be unique. To have wire rod, magnet wire and brass mill manufacturing facilities on the same site, is most unusual. The wire rod facility need not be linked to the brass mill, indeed, more frequently this type of facility is linked to the wire and cable manufacturing plant, whilst the magnet or winding wire production unit is also frequently a sub-section of a wire and cable manufacturing facility. To include the wire rod production facility under the umbrella of a public sector organisation, to serve all private sector wire and cable manufacturers in Nigeria, has many advantages. The possibility of having four separate wire rod facilities, one each attached to the existing wire and cable manufacturing facilities, cannot be justified since adequate demand does not exist even based on the smallest continuous casting wire rod production facility available. Individually, the wire and cable manufacturers would be unhappy to rely on one of their competitors as their only source of wire rod, each feeling that the competitor would give preferential treatment to his own wire and cable facility in cases where demand shortages arose. The possibility of establishing a jointly owned wire rod facility, with each of the existing wire and cable companies holding equity, is a feasible alternative, but would appear to offer no real advantage over the option of having the wire rod facility within the planned public sector copper processing complex.

2.22 The inclusion of the magnet wire or winding wire manufacturing facility within the new public sector complex is again a decision which has been made since the existing wire and cable manufacturers do not appear to plan manufacture of this product and a substantial demand exists and will exist in the future for this product. The integration of a magnet wire plant with a wire and cable manufacturing facility does offer several advantages although it must be said that several autonomous and highly profitable magnet wire plants do exist in different parts of the world. Economically the magnet wire plant can clearly be attached to a complex of the type proposed, or to a wire and cable manufacturing facility with equal viability. In some respects, integration with a wire and cable plant could lead to a much higher utilisation of wire drawing machinery within the wire and cable plant and if one or more of the existing wire and cable manufacturers in Nigeria wish to undertake this project, the Government should at least give consideration to this option as well as to the inclusion of this within the public sector project.

2.23 The brass mill section of this project has been planned on the basis of providing capacity to meet the major portion of demand for brass mill products in Nigeria in the early 1990's. Obviously, a number of products, both in terms of alloys and/or specific shapes, will not be manufactured since the volumes required are so small as to make local manufacture unviable. In total, however, over 90% of all brass mill products required in Nigeria in 1990 could be produced within the proposed facility with the percentage in all probability being in excess of 95%.

2.24 The products to be manufactured and the equipment and processes to be used are such that a technical partner is an important prerequisite. As was mentioned above, the project is more sensitive to production volume than to almost any other single parameter. As such achievement of outputs is important and this will be achieved much more readily if the proposed company has the support of a technical partner who is able to call upon significant resources of experience and expertise Within the framework of this project, a number of companies have been contacted and several have expressed a general interest in further discussions in this area. Obviously, without having completed a feasibility study, companies are not prepared to commit themselves to collaboration in such a project and it has not been possible in our discussions with these prospective partners to give them precise details on the viability of the project since the feasibility study was merely in the process of being carried out. In Section 4 of this report a number of prospective technical partners have been identified and once the new company is established, discussions should be opened with these, and indeed, other companies.

2.25 A technical collaborator may, in certain instances, wish to have an equity participation in the company and may be interested in, or be prepared to, assist the company in export of product from the proposed facility by making use of its marketing organisation particularly within the context of exporting product to neighbouring countries in Africa.



3. SUMMARY

In this section of the report the Nigerian Market Study, Export Opportunities and Manufacturing Plant possibilities, are all considered and summarised. The approach which has been adopted is to examine the Nigerian market in terms of the broad industrial sectors, electrical engineering, transport, domestic appliances, construction, and general engineering, then to consider the broader aspects of international trade in copper and copper alloy semi-finished products before considering export opportunities for Nigeria in the seven neighbouring countries which were selected for inclusion in this project. In the final sub-section of this chapter, the plant possibilities and feasibility study aspects are summarised.

3.1 Nigerian Home Market Demand

a) Electrical Engineering Sector

The electrical engineering sector is the most important copper consuming sector in virtually all countries irrespective of their level of development. Nigeria is no exception to this rule with the sector accounting for close to 60% of total demand for copper and copper alloy semi-finished products in 1986. The demand for these products is very closely tied to the development of the electricity industry, with the telephone sector being the second most important sub-segment and hence being the second most important factor influencing demand.

In developing our projections for demand for copper and copper alloy semi-finished products within this sector, we have held numerous meetings with representatives of the Nigerian Electric Power Authority (NEPA) and the Nigerian Telephone Authorities (both companies responsible for internal and external communications), and based on the projected plans of these organisations (and others) prepared our forecasts for this sector. As can be seen from Table 3.1, the installed capacity of the Nigerian Electric Power Autnority would rise rapidly during the 1980's. Much of this planned expansion is already committed and construction work is already in progress on many of the new and expanded power stations necessary to give this increase in capacity.

TABLE 3.1 : EXISTING AND PLANNED INSTALLED CAPACITY - NIGERIAN ELECTRIC POWER AUTHORITY

Year	Installed Capacity MW	Year	Installed Capacity MW
1973	600	1981	2,413
1974	606	1982	2,778
1975	606	1983	3 158
1976	876	1984	3,777
1977	1,026	1985	4,507
1978	1,026	1986	5,057
1979	1,767	1987	5,557
1980	1,922	1988	5,557

Vol. 1, p.9

TABLE 3.2 : TOTAL NEPA CUSTOMERS

Year	Number (000)	Year	Number (000)
1973	350	1982	1,190
1974	390	1983	1,360
1975	440	1984	1,550
1976	500	1985	1,767
1977	600	1986	2,015
1978	710	1987	2,296
1979	800	1988	2,617
1980	910	1989	2,984
1981	1,040	1990	3,403

Vol. 1, p.9

The projected rate of growth in sales of electricity is such than annual increments of 20% are anticipated during the early years of the 1980's, falling to an annual rate of growth of 17% p.a. as one moves through the 1980's. This high rate of growth is such that the installed capacity outlined in Table 3.1 will still fall somewhat short of the capacity necessary to satisfy the total demand. An amount of standby generating capacity will thus be necessary.

The total number of electricity consumers presently stands at around 1 million. Some 80% of this total are domestic consumers, less than 1% are industrial consumers, whilst the balance is classified as commercial and related (municipalities etc.). The total number of electricity consumers is expected to rise to over 3.4 million, as can be seen from Table 3.2. The annual rate of growth in the number of industrial consumers, an average of 15% per annum, is somewhat higher than for other categories with residential consumers rising by 12.2% per annum and commercial consumers by 10% per annum.

When measured in terms of their relative importance with respect to total consumption, the picture is significantly different. Industrial consumers, for example, although accounting for less than 1% of all consumers by number, account for some 36% of total electricity consumed. This percentage is expected to rise still further with this category representing some 40% of total electricity sales by 1990. Residential consumers today account for just over 40% of total electricity sales and their relative importance is expected to decline slightly (to just less than 40%) by 1990.

In addition to the electricity consumers served by the Nigerian Electric Power Authority, the Government has a programme for rural electrification. This programme is being sponsored by the Government through the State Governments and plans are such that the number of new consumers which it is expected to add to the data contained in Table 3.2 will be of the order of 60,000 in 1981, rising to 134,000 by 1990. Although these consumers, being almost entirely residential or small commercial, will consume only a small quantity of electricity, their "connection" will still be significant in terms of wire and cable consumption. As can be seen

TABLE 3.3 : NEW CONSUMERS IN THOUSANDS OF RESIDENTIAL EQUIVALENTS

Year	NEPA			Rural Residential	Total "Residential Equivalents"
	Industrial	Commercial	Residential		
1977	69	46	83	39	237
1978	80	50	92	43	2[illegible]5
1979	92	55	70	47	264
1980	106	61	88	52	307
1981	122	67	105	57	351
1982	140	74	130	63	407
1983	161	81	140	69	451
1984	185	89	157	76	507
1985	213	98	181	83	575
1986	244	108	208	92	652
1987	281	118	237	101	737
1988	323	130	272	111	846
1989	371	143	314	122	950
1990	427	157	370	134	1088
Average Growth Rate	15%	10%	12.2%	10%	12.4%

Vol. 1, p.21

from Table 3.3, the rate of growth of consumers to rural electrification schemes is on average some 10% per annum. The summation of individual State programmes yields a much higher rate of growth, but we have adopted this lower and more conservative figure since we believe the necessary organisation to implement such a programme does not exist in many of the States, and is unlikely to be installed in the foreseeable future.

Within the telecommunications sector, Nigeria still finds itself with a relatively low level of telephones per capita on a world scale. In 1975, at the beginning of the Third Plan, it was estimated that there were some 52,000 telephone lines in operation within Nigeria. The Plan envisaged installation of a total of 750,000 lines between 1975 and 1980. The first three years of the Plan saw only 12,000 lines being added to the system and in 1978 the targets were adjusted with the new programme calling for the total lines in operation to be raised to 87,000 by mid-1979 with a further 100,000 lines being added in the period up to January 1980. The latter target was again re-scheduled to January 1981 and, in the course of our fieldwork, during January and February of 1981, current estimates by the P&T were that the total number of lines in operation was 100,000 with the target of 188,000 being realised by the end of the year.

Although the P&T requested a budget of ₦ 6 billion for investment during the Fourth Plan, this was reduced to ₦ 2.4 billion during the Plans passage through the National Assembly. It is possible that the P&T may be able to raise additional funds through overseas loans, but for the purpose of our exercise, we have assumed that expansion of the telephone network is limited to additions which can be provided within the framework of internal funding, with only those projects already well advanced being considered in the period up to 1986. In the period 1986-1990, we have assumed a rate of growth similar to the rate prevailing in the first half of the 1980's and it is important to realise that even in 1990, on the bases we have assumed, the number of subscribers will still be only 1% of the total Nigerian population or in excess of 100 persons per telephone. The projected growth in telephone connections is summarised in Table 3.4.

TABLE 3.4 : ESTIMATED NUMBERS OF TELEPHONE CONNECTIONS AND TELEPHONE POPULATION 1980-1990

Year	Total Telephones installed ('000's)	New Installation in year ('000's)	Population Millions	People Per Telephone
1980	100	-	84.8	848
1981	155	55	86.9	560
1982	215	60	89.1	414
1983	281	66	91.4	325
1984	354	73	93.7	265
1985	435	81	96.1	221
1986	524	89	98.6	188
1987	621	97	101.1	163
1988	728	107	103.6	142
1989	846	118	106.3	126
1990	976	130	109.1	111

Vol. 1, p.38

In projecting the requirements for telephone cable we have assumed that up to the mid-1980's, the consumption of cable continues at the same level as it has in recent years when viewed on a per connection basis. Obviously, as the density of the network increases, the amount of cable per new connection declines (basic trunk network and main exchange cables having already been installed with adequate spare capacity) and we have therefore assumed that in the decade between 1985 and 1995 the consumption of cable per subscriber will decline reaching, in 1995, a level more in line with that found in countries of intermediate development. As such the total quantity of copper in telephone cable installed will rise, as shown in Table 3.5. To this total must be added scrap generated in the manufacture of these cables in order to arrive at a total throughput for wire rod for this sub-segment of industry.

The third area of importance in the wire and cable sub-segment of the electrical engineering industry is the area of building wire and other low voltage wire products. To a large extent consumption in this sub-segment is a function of the number of new connections to be made by the Electricity Authority and by the State Rural Electrification schemes. Based on projections for new housing, projections for electricity connections and estimates of growth in GDP and the commercial and industrial sectors, we have calculated the number of new consumers based on "residential equivalents" and from this made estimates of the total requirement for building wire and similar products in Nigeria. Based on the above forecasts, the total consumption of building wire is expected to rise from some 3,320 tons copper weight in 1980 to 11,750 tons copper weight in 1990. The progressive growth of consumption is detailed in Table 3.6.

TABLE 3.5 : CONSUMPTION OF COPPER IN TELEPHONE CABLES (tons)

Year	Total new Subscriber ('000's)	Pr.Km/ Subscriber	Copper in ELP 5kg/pr.km	Copper in Dropwire 1.14kg/subs	Copper in Inside wire 0.18kg/subs	Total Copper
1981	55	11.3	3,108	63	10	3,181
1982	60	11.3	3,390	68	11	3,469
1983	66	11.3	3,729	75	12	3,816
1984	73	11.3	4,124	83	13	4,220
1985	81	11.3	4,577	92	15	4,684
1986	89	10.8	4,806	101	16	4,923
1987	97	10.3	4,996	111	17	5,124
1988	107	9.8	5,243	122	19	5,384
1989	118	9.3	5,487	134	21	5,642
1990	130	8.8	5,720	148	23	5,891

Vol. 1, p.41

TABLE 3.6 : CONSUMPTION OF COPPER IN BUILDING WIRE (Tons)

Year	Consumption	Year	Consumption
1977	2,560	1984	5,480
1978	2,860	1985	6,210
1979	2,850	1986	7,040
1980	3,320	1987	7,950
1981	3,790	1988	9,030
1982	4,400	1989	10,260
1983	4,870	1990	11,750

Vol. 1,p.23

To the total shown in Table 3.6 must be added estimates for scrap in processing to manufacture cable, in order to determine the total wire rod requirement to meet this demand.

The fourth and only other area within the wire and cable sub-segment of the electrical engineering sector is winding wire or magnet wire. This product is used in a variety of applications including :

- Transformers
- Electric motors (manufacture and repair)
- Generators (manufacture and repair)
- Vehicle components (starter motors, alternators, coils, etc.)
- Electronic equipment (transformers, coils, chokes)
- Fluorescent light fittings (chokes, starters)

In some applications the quantities used are relatively small, but the total demand is significant. Although in all the other categories of wire and cable products mentioned above some manufacturing activity takes place in Nigeira, there is no production facility for magnet wire. Furthermore, to our knowledge, there are no plans to commence manufacture of this product in the country.

TABLE 3.7 : SUMMARY OF DEMAND FOR COPPER AND ALLOY SEMIS BY NIGERIAN MANUFACTURERS OF ELECTRICAL ENGINEERING PRODUCTS AND COPPER CONTENT OF ALL PRODUCTS (TONS)

	Copper Semis 1986					Copper Alloy Semis 1986					1986 Copper Content of local Manu-facturer
	Wire	Winding Wire	Rod	Strip	Tube	Wire	Rod	Strip	Tube	Casting	
Building wire	7822										7040
Power cable	4178										3760
Telephone cable	3920										3530
Transport/Appli-ances	505	486									
Generators		471									403
Transformers		333		333	7		8				609
Switchgear		9	84	13	20		14	6	3		
Electric meters								333			150
Electric motors		37	4				3	2			38
Generation accessories								198			97
Wiring accessories							184	357			326
Lamps	19	69						95			
Batteries								180			90
Total	16444	1405	88	346	27		209	1171	3		

Vol. 1, p.77

Based on our estimates of demand, from the end-use analysis and projections carried out as part of this project, the following demand requirements for magnet wire is indicated.

- Transport sector	85	tons
- Domestic Appliance sector	401	tons
- Generator Manufacture and Repair	471	tons
- Transformer Manufacture	333	tons
- Switchgear	9	tons
- Electric Motors	37	tons
- Lamps and Fluorescent Fittings	69	tons
- TOTAL	1,405	tons

The wire and cable sub-segment of the electrical engineering sector is, however, only one component part. In many of the products mentioned above, generators, transformers, switchgear, etc., there are significant quantities of other copper and copper alloy semi-finished products used. As can be seen from Table 3.7, in the manufacture of transformers, switchgear, electric meters, electric motors, generation accessories and wiring accessories, important quantities of copper and copper alloy semi-finished products will be used in Nigeria in 1986. Furthermore, when account is taken of the fact that in 1986, and indeed, in 1990, the local industry will be manufacturing only a portion of the total demand for products in many of these areas, the long-term potential for expansion can clearly be seen as being enormous. Indeed, between 1986 and 1990, we expect the total copper consumption in this sector to increase by more than 50%, due in part to creation of new industries, in part to increased demand within the country, and in part as a result of local industry manufacturing a higher portion of the total requirements for these products.

b) Domestic Appliance Sector

The domestic appliance sector in Nigeria is moderately well developed although in some countries the relative level of development of this sector has been ahead of the level of development so far achieved by the industry in Nigeria. Nevertheless, the next decade is likely to see several major developments in this area, with the establishment of assembly facilities progressively giving way to component manufacturing units as one moves through the 1980's. In the following sub-sections, each of the major domestic appliances has been considered individually and, where relevant assumptions on demand, local manufacture, etc., stated.

o Domestic Refrigerators

Of all the sub-segments of the domestic appliance industry, in Nigeria the domestic refrigerator assembly sector is probably the most well-developed sub-segment of this industry. Presently some 10 companies assemble refrigerators, although with local assembly totalling less than 100,000 units in 1979, the scale of operation is in general relatively small.

During the course of our analysis on demand for domestic refrigerators, it became evident that demand is possibly being restricted by the relatively low level of residential households which have electricity. The future demand for domestic refrigerators will therefore in part be influenced by the programme of NEPA and the State Rural Electrification schemes for adding residential consumers to the network. We estimate that the total demand for domestic refrigerators in Nigeria is really the higher forecasts shown in Table 3.8 but, because of concern as to the rate of implementation of the NEPA and rural electrification programmes, we have adopted the lower forecasts in our end-use analysis and in our calculations of demand for copper alloy products.

TABLE 3.8 : FORECAST OF DEMAND FOR REFRIGERATORS

Year	Forecast Demand	
	Medium	High
1981	200,000	200,000
1982	230,000	230,000
1983	250,000	260,000
1984	275,000	300,000
1985	300,000	350,000
1986	330,000	400,000

Vol. 1, p.87

It has been assumed that by 1986 there will not be any local manufacture of refrigerator compressors although by 1990 it would be reasonable to assume that such an activity was at least meeting a part of total demand within the country.

In 1986 the domestic refrigerator industry will consume just over 80 tons of copper and copper alloy semi-finished product. Around half this total will be in the form of copper wire (flex for connection to power supply) with the major portion of the balance being in the form of copper tube and a small quantity of alloy strip.

o Refrigerated Display Cases and Freezers

The demand for both refrigerated display cases and freezers is somewhat limited in Nigeria, with demand for the domestic type freezer totalling no more than 10,000 units per year and for refrigerated display cases less than 5,000 units per year. With only a moderate rate of growth expected the demand for copper and copper alloy semi-finished products in this sub-sector will total just less than 30 tons in 1986, with close to 80% of total demand being in the form of copper tube and the balance in the form of copper wire (flex and cable) and alloy strip.

o Air-Conditioning Units

The development of the local assembly industry for air-conditioning units has followed a pattern very similar to that for domestic refrigerators. Indeed, the development of demand has shown a not too dissimilar pattern, with total demand being of the order of 90,000 units in 1979.

At the present time some 85% of all domestic air-conditioning units are of the room or window type with split units accounting for no more than 10% of demand and packaged units for less than 5%. Although this ratio is expected to change in the future, it is estimated that even in the mid-1980's room or window type units will comprise more than 80% of total demand.

In Table 3.9 the demand for room air-conditioning units is shown, with estimates being made of the share of this total demand which will be met by local production.

TABLE 3.9 : FORECAST DEMAND FOR ROOM AIR-CONDITIONING UNITS 1981-1986*

Year	Imports	Local Production	Total
1981	50,000	60,000	110,000
1982	50,000	80,000	130,000
1983	50,000	110,000	160,000
1984	50,000	150,000	200,000
1985	40,000	170,000	210,000
1986	40,000	200,000	240,000

* Share of total which are window-type units are expected to decrease from 85% in 1981 to 80% in 1986.

Vol. 1, p.97

In common with the situation prevailing in the domestic refrigerator sector, it is assumed that in 1986 all compressor units will be imported, with the local manufacture of these not commencing until 1990 or beyond. Thus, the largest copper consuming component within such units will not be locally manufactured and as such will not create a demand for copper and copper alloy semi-finished products.

Based on the assumption that in 1986 some 200,000 air-conditioning units are produced in Nigeria, with around 160,000 of these units being window type, and based on the assumption that all fan motors are locally produced, along with the evaporator coils and mains cable, the demand for copper and copper alloy semi-finished products will total just over 600 tons. Of this, some 70% will be in the form of copper tube, 18% in the form of winding wire, 10% in the form of copper wire for mains cable, and the balance in the form of alloy strip for use in connections, contacts, etc.

o Washing Machines

At the present time there is no local manufacture or assembly of washing machines in Nigeria. Demand for these products is still relatively limited and we estimate that ownership totals no more than 40,000 units, equivalent to less than 1% of households within the country.

Based on this very low level of demand, we do not expect any local assembly to commence prior to 1985. Beyond this date, local assembly could commence, but we doubt that it will entail any major component manufacture, at least within the time horizons being considered in relation to this project. If assembly operations were to commence in 1985, by 1986 the local industry would still be operating on CKD or SKD units and as such local content would be extremely limited. Indeed, we believe that except for extremely small quantities of copper wire, in the form of mains cable (probably totalling little more than one ton), no local demand for semi-finished copper and copper alloy products would be generated by this sub-segment of industry in the short-term.

o Television Sets

There is today a quite extensive network of television transmission stations within the country. Plans are in hand to further extend this network so that it covers not only the more populated centres of the country, but also the major portion of rural villages and more outlying communities. In 1975 transmissions in colour began and the network served by colour transmission is being progressively increased. By the mid-1980's it is assumed the major portion of the country will be covered by the colour tranmission network.

The assembly of television sets in Nigeria is a relatively recent event. Following a rapid expansion in the volume of imports, the Government decided in 1976 to introduce controls, through import licences, and by 1978 companies were being increasingly obliged to bring in sets in kit form. The Government philosophy with regard to this sector is to progressively increase the level of local content, although no formal programme has been laid down.

The data on imports, local production and demand for television sets is somewhat inconsistent. We have therefore in our analysis relied not only on data generated in Nigeria, but also on data from the countries supplying the kits and finished units, as well as our own in-house files as a result of work in this industrial sector in the past. Based on this data, we have built-up what we believe is a realistic picture of the growth of demand and from this we have made projections of future demand and these are summarised in Table 3.10.

From our discussions with the local assembly industry, and making assumptions on probable Government policy regarding this sector, we have developed forecasts for the use of copper and copper alloy semi-finished products based on the components that we anticipate will be manufactured locally in 1986. On this basis, some 150 tons of copper and copper alloy semi-finished products will be required by this sector with around one-third of this total being in the form of copper wire in mains cables, just over 20% in the form of copper strip and a further 20% in the form of copper alloy strip, used primarily in connections, switches, etc., with the balance being in the form of winding wire. It is perhaps worthy of note that some of this winding wire is so fine, that we have assumed that it will not be manufactured locally since volumes will be relatively small (being required only for the electronics sector) and manufacturing problems are quite significant and certainly beyond the realistic achievement of a young and new company in this area.

TABLE 3.10 : FORECAST DEMAND FOR TELEVISION SETS IN NIGERIA

Year	Units
1981	215,000
1982	230,000
1983	250,000
1984	270,000
1985	300,000
1986	320,000
Colour sets are expected to account for the following volumes :	
1981	25,000
1982	30,000
1983	45,000

Vol. 1, p.110

o Radio and Other Audio Equipment

The radio and other audio equipment segments of the consumer electronics market in Nigeria is a sector which is complicated by a number of different factors. On the one hand, particularly since 1978 when most of this type of product was placed on the prohibited list of imports, there has been an increase in smuggling and illegal imports. As such official import statistics under-record the actual level of imports. Added to this there are several complications regarding the classification of products in this sector with a general aggregation in Nigerian import statistics. Again, therefore, we have had to rely heavily upon data from other sources to build-up a picture of historical developments in this sector in terms of imports by Nigeria etc. Based on the available data on historical imports, coupled with estimates of local production and forecasts of GDP etc., we have prepared forecasts for audio equipment in 1976 and these forecasts are summarised in Table 3.11.

TABLE 3.11 : FORECASTS OF DEMAND FOR AUDIO EQUIPMENT - 1986

Product	Units
Turntables	180,000
Amplifiers	300,000
Cassette Decks	250,000
Tuners	100,000
Speakers	180,000
Radio/Radio Cassette) Car Radio)	400,000

Vol. 1, p.117

By 1986, except for the more sophisticated and high quality hi-fi equipment, the major portion of the demand shown in Table 3.11 will be manufactured locally. In total, this sub-segment will create a demand for some 150 tons of copper and copper alloy semi-finished products with just over 43% of this being in the form of winding wire, 26% being in the form of copper alloy strip, 19% in the form of copper wire (primarily mains cable), and the balance in the form of copper alloy rod for use in connections etc.

o Domestic Cooking Appliances

For the purpose of this study we have divided domestic cooking appliances into four categories namely:

- Electric cookers
- Gas ranges
- Gas cookers
- Other cooking equipment

The above division is essential because both the overall quantities of copper and copper alloy used and the specific forms and types of semi-finished products required varies from one product group to another. Indeed, variations can and do occur, not only between the various groups of products, but also within the individual product groups with, for example, products having the same component made in steel in one model and in brass in another.

Within all the above four groups of products, the existing manufacturing activity in Nigeria is extremely limited. Furthermore, major developments in this area are not foreseen prior to 1986 with growth rates in general being relatively modest. In total we see the sector as consuming only some 70 tons of copper and copper alloy semi-finished products in 1986 with brass rod, accounting for 30% of total demand, brass tube, some 29% of demand, with the balance being divided between copper wire (for mains cable), copper tube, alloy strip and castings.

o Electric Fans

Until very recently, all electric fans used in Nigeria have been imported. Two local companies have begun assembly of electric fans based on SKD units imported from the Far East. The extent to which this industry sector will develop in the short-term future remains an open question as indeed does the extent to which they vertically integrate. For the purpose of this exercise, we have assumed that overall demand grows at only some 7% p.a. through to 1986, and 5% p.a. beyond, with local manufacture accounting for some 80% of local production by the end of the decade.

The main copper consuming component in these units is the electric motor and clearly the total demand is such that without an electric motor manufacturing facility being established to meet demand in other product areas, a dedicated motor manufacturing plant for electric fans would not be a feasible operation.

We have assumed in other sections of this report, that an electric motor manufacturing unit is established prior to 1985 and as such have assumed that motors from this plant could be used in the electric fans. As such total demand for copper and copper alloy semi-finished products will be some 240 tons in 1986 with close to 80% of this total being in the form of winding wire.

o Other Appliances

In addition to the above mentioned appliances, consideration was given in the course of carrying out fieldwork in the domestic appliance sector to a range of other products. Products such as water heaters, flat irons, vacuum cleaners, small appliances (mixers, blenders, juicers, etc.), have all been considered in the course of this project. In general, however, demand for these products is such that local assembly is extremely unlikely (except for water heaters) and/or local component manufacture incorporating copper and copper alloy semi-finished products is not feasible at the volumes being considered. As such demand for copper and copper alloy semi-finished products outside the above mentioned sectors will be extremely limited, perhaps some 27 tons being required for water heaters, mainly in the form of copper tube and alloy rod, and small quantities for other products primarily in the form of mains cable.

In the longer term, the demand for copper and copper alloy semi-finished products within the domestic appliance sector will clearly rise at a rate far in excess of the rate of growth in demand for these products. In our end-use analysis there are many copper containing components which, we have assumed, will not be manufactured during the forthcoming five or six year period, but clearly such items will, in the longer term, be produced in Nigeria and will therefore augment still further the demand fc·̄ copper and copper alloy products eminating frcⁿ this sector of industry.

c) Transport Industry

The transport industry in many countries is the second or third most important industry in terms of copper consumption. Within this sector of industry the road transport equipment segment is clearly the most important. In developing countries this segment is frequently the only segment of significance with rail, marine and air transport equipment accounting for extremely small portions of total demand. Within these latter sectors products tend to be imported until industrialisation has become relatively well advanced.

In the course of this study, we have reviewed the road transport equipment, railways and marine equipment segments although it must be said that the latter is such a small consumer that it will have very little significance in the context of this project. The railway sector, again whilst consuming relatively small quantities, is worthy of consideration as is the road transport sector.

The automobile industry in Nigeria has undergone a significant development over the past five years. Today there are two companies assembling passenger cars, four companies assembling commercial vehicles along with a number of smaller and more traditional activities, primarily in the area of commercial vehicles.

In the area of passenger cars, two companies Peugeot and Volkswagon, both commenced assembly operations in the mid-1970's and over the past five years have not only increased their total volume of output but also the local content of the vehicles produced.

Demand for passenger cars in Nigeria rose quite dramatically in the early 1970's although, in part as a result of Government control on foreign exchange, annual registration of new cars over the past three years has been significantly below the level reached in 1977, as can be seen from Table 3.12.

TABLE 3.12 : NEW CAR REGISTRATIONS - NIGERIA

Year	Number	Year	Number
1971	8,548	1976	73,224
1972	24,374	1977	90,950
1973	27,794	1978	67,392
1974	40,830	1979	61,679
1975	71,049	1980	75,413

Vol. 1, p.135

Although there has been a quite rapid growth in demand for motor vehicles in recent years, Nigeria still remains relatively under-developed in terms of the total number of vehicles in use. Indeed, our estimates are that the total passenger car park at the end of 1979 stood at less than 500,000 units, a figure far below that prevailing in many countries at a similar stage of development.

Turning to commercial vehicles, the picture is slightly different in that ownership levels tend to be more in line with the level of development of the country. The total commercial vehicle park in Nigeria is very similar in size to the passenger car park as can be seen from Table 3.13.

TABLE 3.13 : NIGERIAN VEHICLE PARK

Year	Total Passenger Car Park	Total Commercial Vehicle Park
1970	35,000	80,000
1971	35,000	96,350
1972	43,212	112,889
1973	67,091	135,203
1974	133,899	177,635
1975	203,353	218,370
1976	274,241	293,328
1977	361,882	374,691
1978	424,683	440,072
1979	480,208	482,757
1980	547,508	558,890

Vol. 1, p. 138/146

The planned production of passenger cars by the two local companies although satisfying the major portion of demand in the early 1980's, will by 1986 fall far short of demand and we believe could prompt further expansion by the existing companies or indeed the entry of a third company into this industry. As can be seen from Table 3.14 the local industry is able to satisfy some 90% of demand in 1981 but only just over 50% of total demand in 1986, based on existing plans for expansion and production. Although we have been obliged to accept this data in preparing our forecasts of demand for copper and copper alloy products, it is important to recognise that, probably not by 1986, but by 1990, the local industry will be satisfying a much greater proportion of total demand for the component products with the local passenger car assembly industry probably satisfying more than 90% of total demand.

TABLE 3.14 : PLANNED PASSENGER CAR PRODUCTION BY PEUGEOT NIGERIA AND VOLKSWAGON NIGERIA

Company	Annual Production (Units)					
	1981	1982	1983	1984	1985	1986
Peugeot Nigeria	55,000	56,000	55,000	55,000	55,000	56,000
Volkswagon Nigeria	26,500	26,500	32,000	33,000	35,000	35,000
Total Local Production	81,500	81,500	87,000	88,000	90,000	91,000
Total Demand	86,500	99,700	114,700	130,900	151,700	174,500
Deficit	5,000	18,200	27,700	42,900	61,700	83,500

Vol. 1, p.149

In developing forecasts for consumption of copper and copper alloy semi-finished products in this sector, one is concerned only with locally manufactured items and since gestation periods are relatively long, we much limit ourselves to those activities already planned or in existance in establishing demands for 1986. As such, we have considered each of the copper consuming components individually, examined the local industry, its plans, etc., and based on these projected the requirements for copper and copper alloy products.

Although the commercial vehicle sector has requirements for similar products to the passenger car segment of the market, it is important to realise that only in the smaller commercial vehicles are the components comparable to those used in passenger cars and for larger (heavier) commercial vehicles, many of the units are made in different plants or require different machinery, techniques, etc.

The total demand for commercial vehicles in Nigeria is detailed in Table 3.15 by size and type. As can be seen, the growth rate is somewhat more modest than that for passenger cars and a major part of this demand will be met by locally assembled/manufactured products.

Turning to copper consumption, in the following paragraphs, each of the main copper and/or copper containing items has been considered individually. As was mentioned above, in the period up to 1986, local production will meet no greater portion of demand than is possible from existing projects or committed expansion or new investments.

o Radiators

The total number of radiators required is largely a function of the number of vehicles produced, although account must be taken, on the one hand, of replacement demand, and on the other hand of vehicles which have air-cooled engines. Indeed, the latter is particularly significant in Nigeria where the Volkswagon "Beetle" is produced.

TABLE 3.15 : COMMERCIAL VEHICLE MARKET FORECASTS

Type	Annual Growth Rate %	1981	1982	1983	1984	1985	1986
0-2 Ton 4 x 4	4	5,870	6,100	6,350	6,600	6,860	6,950
0-2 Ton 4 x 4	8	40,608	43,857	47,365	51,154	55,247	60,000
2-5 Ton	7	5,992	6,411	6,860	7,340	7,854	8,100
5-10 Ton	10	8,800	9,680	10,648	11,713	12,884	14,000
10 Ton +	8	1,188	1,283	1,386	1,497	1,616	1,800
Artic	10	3,212	3,533	3,887	4,275	4,702	5,000
0-20 Seats	8	42,900	46,300	50,000	54,000	58,000	62,000
Over 20 Seats	9.5	2,847	3,117	3,414	3,738	4,093	4,300
TOTAL		111,417	120,281	129,910	140,317	151,256	162,150

Vol. 1, p.148

At the present time there is one company manufacturing radiators in Nigeria and this company has been established to serve the requirements of Peugeot. The company has an installed capacity to manufacture Peugeot's requirements through to 1986 (and indeed beyond) and at the present time does not have any plans for manufacture radiators for other vehicles although the company believes it could quickly increase its capacity if, for example, a significant volume of light commercial vehicle radiators were required. We have therefore assumed that by 1986 this company, or another company coming into this sector, would be able to meet the total requirements for light commercial vehicle radiators along with passenger car radiators for both original equipment and replacement demand. Furthermore, we have assumed that by 1986 some 50% of the total production from the Volkswagon plant would be units with water cooled engines. Likewise we have assumed that the share of light commercial vehicles (up to 2 tons) with air-cooled engines will be no greater than 10% of the total new units products.

Based on the above assumptions, and taking due account of the different sizes and hence weights of radiators we estimate that in 1986 some 1,830 tons of copper and copper alloy semi-finished products will be required by this sector. This total divides between copper strip, copper alloy strip, and copper alloy tube in the ratio of 20:47:33 respectively.

o <u>Electrical Equipment</u>

Apart from the wiring harness, manufacture of electrical equipment and components for motor vehicles has not, as yet, commenced in Nigeria. There is, however, a project planned for implementaticn in 1983 which is a joint venture project and plans to produce :

- Starter motors
- Alternators
- Ignition coils
- Wiper motors
- Voltage regulators

The company have targetted the full range of Nigerian assembled cars and commercial vehicles (including agricultural tractors) as their market, with an additional 10-12% per annum going to the replacement market. The company, which has links with Fiat, plans to commence its operations by manufacturing the above mentioned components for Fiat trucks and tractors assembled at the National Truck Manufacturing Company in Kano. The company then progressively plan to add other models to their range.

As far as wiring harnesses are concerned, one company is supplying a small number of wiring harnesses to Peugeot and by 1986 it would seem reasonable to assume that the company (or similar companies) will have developed their activities to such a level that they are able to meet the major portion of demand for wiring harnesses within Nigeria.

Based on the assumption that all wiring harnesses for vehicles assembled in Nigeria in 1986 are produced locally and alternators, starter motors, ignition coils for passenger cars and light commercial vehicles are also locally fabricated along with 30% of the requirements for other commercial vehicles, the total requirements for copper and copper alloy semi-finished products vehicle electrical products will be of the order of 350 tons with some 64% being in the form of copper wire (for wiring harnesses), 25% in the form of winding wire and the balance primarily in the form cf copper strip with small quantities of copper rod and alloy rod also being required.

The other vehicle components which consume significant quantities of copper are :

- Motor vehicle carburettors
- Gearboxes
- Thermostats
- Fuel pumps
- Tyre valves
- Sintered bronze bearings
- Gaskets and seals
- Instruments
- Brakes and clutch rivets
- Drain plugs

Of the above components, only thermostats are likely to be locally produced on any significant scale by 1986. Demand for copper and copper alloy products in these latter components is quite limited, in total we estimate some 15 tons of copper alloy rod will be required, with manufacture of other components not commencing until the late 1980's or 1990's.

o Other Road Transport Equipment

Under this sub-heading the main items are motor-cycles and bicycles. The market for motor-cycles has grown rapidly in recent years and since 1978 the Government has insisted on sime local assembly in this area. Without the manufacture of major components, copper consumption in this sector is unlikely to be significant and the general concensus within the industry was that by 1986 development would still mean the industry was primarily assembling imported components and/ or sub-assemblies. As such, we have assumed that any copper consumption into this area would be so small as to have no significant bearing on the proposed copper manufacturing facility.

TABLE 3.16 : SUMMARY OF DEMAND FOR COPPER AND COPPER ALLOY SEMIS IN NIGERIAN MANUFACTURES - TRANSPORT SECTOR 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Radiators					362					863	605	
Electrical Equipment		223	85	3	34				4			
Thermostat										15		
Railways		50										
TOTAL		273	85	3	396				4	878	605	

Vol. 1, p.164

o Railways

Although under the Fourth Development Plan there are significant developments envisaged for the Nigerian railway system, there are no programmes for electrification of lines and as such copper consumption in this sector will be limited to signalling equipment, telecommunications cable, etc. Indeed, in the absence of electrification and manufacture of rolling stock (particularly locomotives) the railway sector is relatively unimportant as a copper consumer and we estimate that little more than 50 tons of copper in signalling and communications cable will be required in this sub-sector in 1986.

o Marine Engineering

Whilst the marine engineering sector is an important user of copper and copper alloys in developed countries, in Nigeria it would appear that, within the foreseeable future, this industry will account for only minimal quantities of copper and copper alloy products. The construction of new vessels is limited at the present time and is likely to remain so until the 1990's. The present activity is limited to the assembly of small craft, in this case all engines and other marine hardware are imported in finished or completely built up form, and this situation is expected to continue for the foreseeable future.

In summary, therefore, the transport sector will become increasingly important as a consumer of copper and copper alloy products as one moves through the 1980's. It is, however, primarily the road transport sector, as can be seen from Table 3.16 which will be the major copper consuming sector with only the railway being of interest of the other "transport" areas.

d) <u>General Engineering Industry</u>

The general engineering industry in any country is very fragmented and Nigeria is no exception. Throughout Europe this industry accounts for some 16% by weight of the total consumption of copper and copper alloy semi-finished products. The relative importance of the sector in Nigeria however, is somewhat lower and were it not for the manufacture of brass holloware, the sector would account for a considerably smaller portion of total copper consumption than the corresponding sector in Europe.

During the course of the present study, we have considered the following areas in which copper and copper alloy semi-finished products could be used :

- Pumps
- Engineering Valves
- Screws and Fasteners
- Coinage
- Process Plant
- Brassware and Holloware
- Gas Bottles
- Miscellaneous items

We were unable to obtain any data on defence industry requirements and it must be recognised that this could be a significant user of brass sheet and strip.

o <u>Pumps</u>

A considerable number of pumps are used in Nigeria, mainly for water supply and to a lesser extent in industry. There is no manufacture of pumps at the present time and we did not identify any planned projects in this area. For the purpose of this exercise we have assumed that only some 10% of the total demand for copper and copper alloy products in pumps required in 1986 would be met by a local industry (the assumption being that local industry would just be commencing operation around 1986) and a total of 48 tons of alloy strip, along with 46 tons of brass and bronze castings is all that is required.

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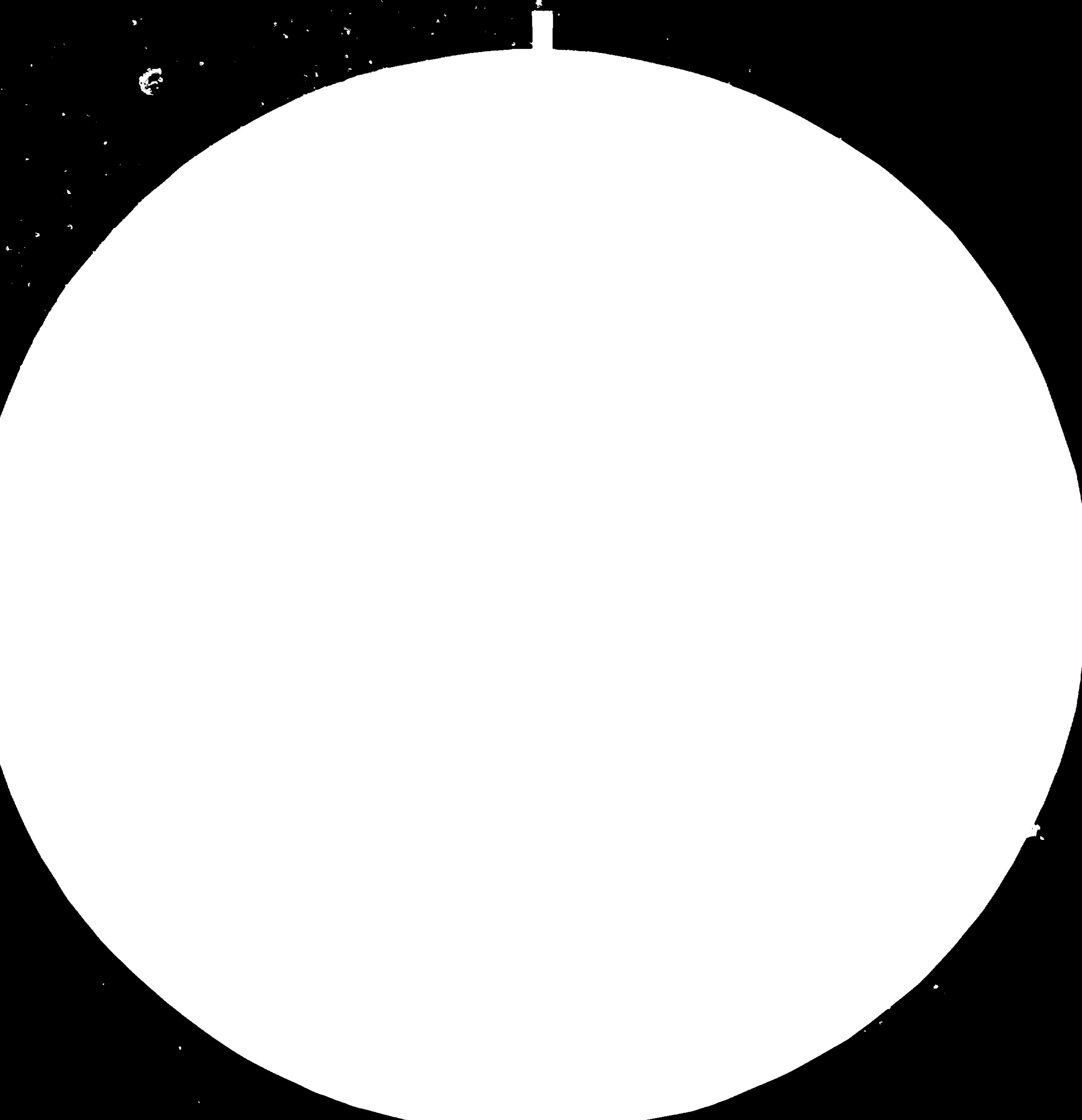

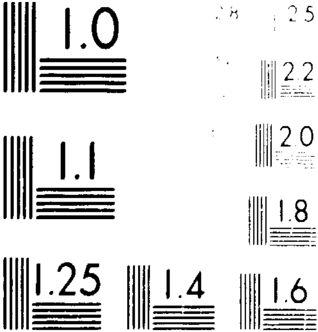
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1.6

o <u>Engineering Valves</u>

Again, in this sub-segment there is today no local manufacture in Nigeria. Furthermore, there would appear to be no plans to commence local production. We have, therefore, assumed that in 1986 copper consumption in this sector represents only 10% of the total copper and copper alloy requirement with the major portion being in the form of gun-metal castings and smaller quantities of brass castings and brass rod also being required. In total some 200 tons of semi-finished products would be required by this sector in 1986, with around half of this total being gun-metal castings.

o <u>Screws and Fasteners</u>

Although there is no manufacture of screws and fasteners in Nigeria at the present time, this is the type of industrial sector which we believe should be developed and the type of sector which can be developed in a relatively short period. We have assumed, therefore, that some 50% of the demand for non-ferrous screws and fasteners will be locally manufactured in 1986. One company is already planning to manufacture copper rivets for brake shoes for which the demand is about 20 tons. Using ratios and norms which prevail in other countries to build up the product mix we estimate that close to 200 tons of copper and copper alloy semi-finished products will be required with the major portion of this being in the form of alloy rod, wire and strip.

o <u>Coinage</u>

The Security Printing and Minting Company in Lagos is responsible for the minting of all coins in Nigeria. In the past this company has purchased coin blanks from the UK. The number of coins minted each year totals around 50 million, with some 10 million 5 Kobo coins, and some 40 million 10 Kobo coins being the average breakdown. The one Kobo coin has not been minted for many years. The rate of production is unlikely to increase, although 25 Kobo coins have been issued recently and it is probable that a 50 Kobo coin or even a 1 Naira coin will be introduced in the foreseeable future.

The opinion of the local Security Printing and Minting Company is that if alloy strip of a suitable quality was available locally, it would be purchased. Assuming that production continues at the present rate, the total requirements for alloy strip by this sector would be some 168 tons in 1986.

o Process Plant

There will be considerable installation of plant in Nigeria over the forthcoming decade. Much of this plant will be concentrated in the petroleum and petrochemical industries but important projects in the steel industry, cement, paper mills, food and beverage sectors, as well as the power generation sector, are planned for implementation in the Fourth Plan. Although most of the equipment requirements will be met by imports it is important to realise that in this sector maintenance requirements can be significant, particularly in the petroleum and petrochemical sectors. In the absence of detailed information, we have estimated that in total 1,000 tons of copper and copper alloy semi-finished products would be required by this sector in 1986. The major portion of this demand would be for maintenance purposes, but some of the simpler process units could be fabricated locally. In total, we have assumed this demand for copper and copper alloy semi-finished products divides in such a manner that some 60% of it comprises copper alloy tube, with 20% being copper alloy rod and 20% castings.

o Brassware and Holloware

There is a considerable demand for brassware for cooking and decorative purposes in Nigeria. One factory, which it is estimated currently serves some 80% of domestic demand, consumes some 1,600 tons per year of brass sheets, which are purchased as blank discs. By 1986, this company plans to increase production to 3,000 tons per year, although we believe that beyond this the market is unlikely to rise significantly as traditional cooking methods and utensils are progressively replaced and this segment of the market increasingly must rely on the "decorative" sub-segment of the market.

The traditional bronze industry around Benin consumes large quantities of copper alloy products. There are a multitude of small craftsmen in Benin (we estimate at least 1,000) who consume, on average, some 150 kg per month of bronze which would suggest an annual consumption of the order of 1,600 tons. Our discussions with various authorities concerned with this industry, suggest that the demand could be even double the above figure. The raw material, however, for this industry, is scrap and as such we have excluded it from this project. Clearly, the cost of virgin material would be so high that the whole economic structure of this traditional crafts industry would be destroyed and we have, therefore, left this area outside the scope of this project.

Based on the requirement of the existing and prospective industry in this area, for an annual consumption of some 3,000 tons of product in the form of holloware, a total production of brass sheet and strip of 3,500 tons would be necessary from the semi-finished products manufacturing plant to serve this sector.

o <u>Gas Bottles</u>

High pressure gas bottles and LPG gas bottles each have brass valves. The consumption of high pressure bottles currently totals some 17,000 units per year and is expected to rise to 80,000 units by 1986. Current demand for LPG gas bottles is of the order of 320,000 units and this is projected to rise to 520,000 units by 1986. The total volume of valves required for high pressure bottles is such that it is unlikely any local assembly or production would commence before 1986. For lower pressure LPG valves, the situation is somewhat different and it has been assumed that up to 50% of LPG bottle valves will be manufactured alongside the manufacture of bottles which is already planned. As such, some 168 tons of copper alloy rod will be required in 1986 in this sub-sector.

o Miscellaneous

In addition to the above mentioned products a variety of other products and industry sub-sectors were considered in the course of this assignment. In particular, we reviewed :

- Construction machinery and equipment
- Stationery engines
- Machine tools
- Textiles
- Bearings
- Agricultural machinery
- Refrigeration and air-conditioning units (industrial)
- Sewing machines
- Fire extinguishers

In the case of construction machinery it is considered unlikely that developments will progress beyond the assembly of SKD or CKD kits by 1986. Likewise the manufacture of stationery engines in Nigeria is considered unlikely during the 1980's. For machine tool products, although some local assembly may commence in Nigeria during the 1980's these products consume very limited quantities of copper and copper alloy products and as such can be ignored for the purpose of this assignment. In the textile industry copper rollers are used in roller printing of textiles, but this process is being superceded and it is unlikely that Nigeria would embark on the manufacture of equipment employing an obsolete technology. As such this sector will not be a significant user of copper or copper alloy products in 1986.

The bearings industry is a high precision product sector and as such it is unlikely that a significant manufacturing activity will take place in this area in Nigeria in the foreseeable future.

The only item of equipment within the agricultural machinery sector in which copper consumption is significant, and which is likely to be produced in Nigeria in the foreseeable future, is the agricultural tractor. Already two companies have commenced assembly of such products in Nigeria, although plans for introduction of local content are extremely modest. This factor, coupled with the relative importance (or unimportance) that component manufacturers assign to this area is such that we believe it is unlikely that even agricultural tractor radiators will be locally fabricated in 1986. The transport equipment component manufacturers are likely to concentrate their activity initially on meeting the requirements of passenger cars, followed by light and then heavy commercial vehicles and only in the final phase are they likely to commence production of components for agricultural tractors.

The manufacture of industrial and/or commercial refrigeration and air-conditioning equipment is unlikely to commence on a significant scale in Nigeria in the 1980's. Some consumption of copper and copper alloy products will be generated by this sector, particularly in the context of installation, but in total we believe the demand will be so small as to be still somewhat insignificant in 1986.

Of the other products studied in this sector of industry, available data would suggest that sewing machines will still be assembled from CKD kits in 1986, fire extinguishers are today manufactured in such a manner that they incorporate no copper or copper alloy products and other general engineering products either will not be locally produced in Nigeria in the foreseeable future or being produced in such a way that copper consumption is negligible or, indeed, insignificant.

Table 3.17 summarises the estimates for all the general engineering products. It is important to realise that in preparing these estimates we have assumed that a significant development will occur in this sector although, as can be seen from the quantities involved, it is only the production of one factory which is likely to significantly influence the total demand and requirements from the semi-finished products manufacturing facility.

TABLE 3.17 : SUMMARY OF DEMAND FOR COPPER AND ALLOY SEMIS BY NIGERIAN MANUFACTURERS OF GENERAL ENGINEERING PRODUCTS AND COPPER CONTENT OF ALL PRODUCT (TONS)

Item	Copper Semis 1986					Copper Alloy Semis 1986					1986 Copper Content of local Manu-facturer
	Wire	Winding Wire	Rod	Strip	Tube	Wire	Rod	Strip	Tube	Casting	
Pumps								48		46	48
Engineering Valves							71			123	100
Screws and Fasteners	7			5		56	79	45			89
Coinage								268			141
Process Plant Maintenance							200		600	200	444
Brassware								3540			1800
Gas Bottle Valves							168				60
Total	7			5		56	518	3901	600	369	2682

Vol. 1, p.202

e) Construction Industry

In many countries, the construction industry is one of the most important sectors in terms of consumption of copper and copper alloy semi-finished products. For example, within Europe the construction sector accounts for between 12-18% of total copper consumption, with the sector being proportionately more important in the UK and less important in Italy. The large variations which occur in Europe are largely a function of the extent to which different building practices have been adopted and different material usage patterns are found in plumbing and related systems.

Data on the construction sector in Nigeria is extremely sparse and generally aggregated. Within the housing sector, a detailed breakdown of urban and rural housing activity is not available, neither is reliable data on the type of unit constructed in terms of material usage and facilities. It has, therefore, been necessary within the framework of this study, to develop our own estimates, although we have been able to rely on data from a study carried out for the Ministry of National Planning, entitled "Strategy for Meeting Housing Needs in Nigeria's Urban Centres".

Based on our own findings and data contained in the above mentioned study, and other statistical sources within Nigeria, we estimate that the total number of new houses which will be constructed in urban areas will rise, as shown in Table 3.18.

TABLE 3.18 : FORECAST OF CONSTRUCTION OF NEW HOUSING UNITS IN URBAN AREAS

Year	New Housing Units
1980	130,000
1981	140,000
1982	155,000
1983	170,000
1984	190,000
1985	210,000
1986	260,000

Vol. 1, p.217

We have further assumed that the breakdown of urban housing by type is as shown in Table 3.19

TABLE 3.19 : BREAKDOWN OF FURTHER URBAN HOUSING BY TYPE OF UNIT

Year	Number of Units		
	Low Cost	Medium Cost	High Cost
1980	39,000	71,500	19,500
1981	42,000	77,000	21,000
1982	46,500	85,300	23,200
1983	51,000	93,500	25,500
1984	57,000	104,500	28,500
1985	63,000	115,500	31,500
1986	70,000	143,000	47,000

Vol. 1, p.218

As far as copper consumption within this sector is concerned, electric and telephone wiring, along with with electrical components have all been dealt with in other parts of this report. Within the construction sector, we are concerned only with copper and brass hardware as used in the construction sector and in plumbing systems. In particular, within this sector, we are concerned with :

- Brass, bronze, valves and taps
- Copper tubing
- Copper and brass fittings
- Brass hinges
- Brass locks, door and window fittings
- Brass screws, nuts and bolts
- Miscellaneous copper and brass fittings

Today virtually all water supply piping used in Nigeria is of galvanised steel. Waste piping and some cold water piping is in PVC. The use of copper tubing in buildings in Nigeria at the present time is negligible. Indeed, copper tubing is normally found only in a few prestige buildings such as hotels, hospitals, and in total usage is almost insignificant.

It is worthy of note that the standard specification for public works of the Ministry of Works recommends copper piping, but the Ministry does not insist on it and galvanised steel is specified as a less desirable, but acceptable (and less expensive) alternative.

From our field research, it is quite clear that the introduction of copper tubing into the construction sector will required considerable "selling" and possibly even legislation or regulation. Indeed, without the introduction of strict control on the import of galvanised tube, we would doubt that the low and medium cost segment of the housing market could be converted to copper tube within the time horizon under consideration. Indeed to convert all new high cost housing constructed in 1986 will, we believe, be extremely difficult, although through control on import duties, etc., it should be possible if the Government are prepared to take such a course of action. Assuming such action was taken, and adding the requirements which would be generated by commercial and public sector building (offices, hospitals, etc.), a total potential exists for 2,086 tons of copper tube for the residential sector and 588 tons for the commercial and industrial sector. The amount of this which realistically can be achieved is, we believe, an open question. In the absence of any positive action by the Government to promote usage of copper, we believe the total amount of copper tube used in plumbing systems in Nigeria will be minimal, probably totalling no more than 200 tons in 1986. For the purpose of this exercise we have assumed a penetration level of 40% of the 1986 requirement mentioned above, namely a total of 1,070 tons of copper tube and some 7.5 tons of fittings.

TABLE 3.20 : SUMMARY OF REQUIREMENTS FOR SEMIS CONSTRUCTION SECTOR 1986

Item	COPPER (Tons)						COPPER ALLOY (Tons)					CASTINGS (Tons)
	Av.Wt.of Component g.	Wire	Winding Wire	Rod	Strip	Tube	Av.Wt.of Component g.	Wire	Rod	Strip	Tube	
Plumbing Tube						1189*						
Plumbers Fitting						8						
Hinges										257		
Locks and builders hardware									71	19		
Taps and Valves									717			406
Total						1197			788	275		406

* Scrappage assumed at 10%.
Vol. 1, p.233

The area of valves and taps represents the largest single copper consuming sector within the construction area. Virtually all valves and taps used for water distribution are made of brasses and/or bronze. Cast iron bodied valves are not generally available in sizes below 1½ inches. Based on the assumption that local industry will be able to meet two-thirds of total requirements in 1986, over 1,000 tons of copper alloy semi-finished products will be required, namely just over 700 tons of brass rod and just over 400 tons of brass castings.

The use of brass hinges on doors and furniture in Nigeria is surprisingly somewhat more extensive than one might anticipate. There is, however, no local manufacture at the present time, although a number of projects are under consideration. We believe it is quite reasonable to assume that one or more of these projects goes ahead and as such have assigned a total demand equivalent to some 150 tons of copper to this sub-segment. In the area of locks and builders' hardware, there is already a significant activity within this sector in Nigeria. Indeed, we would see no reason why the demand for this type of product could not be met entirely by the local industry in 1986. Based on demand projections we estimate a total requirement for some 90 tons of copper alloy products primarily in the form of brass rod and strip.

In summary the requirements of the construction sector for copper and copper alloy semi-finished products will be as shown in Table 3.20. The total consumption by this sector could be significantly increased if Government action to positively promote the usage of copper tube in the construction sector is taken.

o <u>Summary</u>

In summary, therefore, in 1986 the total demand for copper and copper alloy semi-finished products will be as shown in Table 3.21.

TABLE 3.21 : REQUIREMENTS FOR COPPER AND COPPER ALLOY SEMIS - ALL NIGERIAN INDUSTRY - 1986

Sector	Copper (Tons)					Copper Alloy (Tons)				Castings (Tons)
	Wire	Winding	Rod	Strip	Tube	Wire	Rod	Strip	Tube	
Electrical Engineering	16,425	1,405**	88	346	27		209	1,171	3	
Domestic Appliance	232*	401*		34	513		53	117	20	8
Transport	273*	85*	3	396			4	878	605	
General Engineering	7			5		56	518	3,901	600	369
Construction					1,197		788	275		406
TOTAL	16,432	1,405	91	781	1,737	56	1,572	6,342	1,228	783

* Excluded from final total as also included in Electrical Engineering Sector.

** Of this total, some 300 tons is heavy wire for transformer windings.

Vol. 1, p.2

3.2 Export Opportunities

The assessment of export opportunities for the new Nigerian plant has been primarily concentrated on assessing export opportunities in Zambia, a partner in the venture, and in seven neighbouring countries of West Africa. In the course of this project, the assumption which had initially been made, that significant opportunities for a developing country fabricator were unlikely to be found outside its immediate geographic zone, were largely confirmed in the course of carrying out this project. Opportunities for the new Nigerian company outside Africa are unlikely to be substantial enough to warrant the marketing effort that would be required to secure them, at least in the foreseeable future.

The seven countries which were chosen for the export survey (the inclusion of Zambia was because of its participation in the project) are amongst the most important consumers of copper and copper alloy semi-finished products within Africa. Furthermore, all of these countries have relatively good links with Nigeria and as such could be served by the new Nigerian company. In several cases, the countries have economies which are exhibiting a quite high rate of growth, particularly in a regional context. The countries chosen, however, do cover a very wide spectrum both in terms of the present level of development and the rate of development. At one end of the spectrum is a country such as the Ivory Coast which has already undergone significant development, whilst at the other end of the spectrum, Upper Volta, a country still at the beginning of the development spectrum.

In total, the following countries were included in the export survey :

Benin
Cameroon
Gabon
Ghana
Ivory Coast
Upper Volta

TABLE 3.22 : PROJECTED IMPORT REQUIREMENT FOR COPPER AND COPPER ALLOY SEMI-FINISHED PRODUCTS - 1990

Country	Copper					Copper Alloy		
	Wire*	Winding Wire	RBS	PSS	Tube	RBS	PSS	Tube
Zambia **	-	50**	1,500***	573	56	138	83	22
Benin	60	13**	-	-	18	20	-	-
Cameroon	1,525	100**	-	70	50	-	10	50
Gabon	30	20	10	5	75	-	5	-
Ghana	1,500	50	-	25	180	-	25	20
Ivory Coast	1,250	110	-	70	290	20	30	100
Togo	13	5	5	-	18	-	-	-
Upper Volta	21	6	15	-	9	16	-	-
TOTAL	4,399	354	1,530	743	696	194	153	192

* Including wire rod

** Based on maximum export opportunity for the new Nigerian company

*** Insulated transformer strip

Vol. 2

Each of the above mentioned countries, along with Zambia, have been surveyed during the course of this project. The fieldwork programme in each country concentrated on establishing the existing and planned copper processing industry, the demand for all types of copper and copper alloy semi-finished and finished products, and the general level of industrial development in the main copper consuming sectors. The above fieldwork programme enabled us to assess the total demand for copper and copper alloy products and the portion of this total demand which would, firstly be met by imports, and secondly be available for the new Nigerian company.

Opportunities can be divided into two distinct areas. In the first instance there are those opportunities for the supply of copper wire rod to the wire and cable manufacturing industries which are, or will be, located in most of the countries included in this export survey, by the mid-1980's. The second area of opportunity relates to the supply of copper and copper alloy semi-finished products to the intermediate traders and/or direct to original equipment manufacturers and/ or other end-users. In the latter area the main products are copper alloy rods, bars and sections, copper tube, and to a more limited extent, flat copper and brass semi-finished products. In the course of carrying out this survey, opportunities for finished wire and cables were also considered, although in general these products fall outside the scope of the new Nigerian project, being presently manufactured in Nigeria by several private sector companies.

In Table 3.22 the total requirement for copper and copper alloy products for each of the countries which is likely to be met by imports in 1986 is shown. On the basis that the new Nigerian company could secure 10% of the total available market in 1985/86 and some 20% in 1990, in total this would entail exports of some 550 tons of product in 1986 and over 1,000 tons in 1990. Obviously, such global percentages can only be indicative and, indeed, in all probability the route which will be chosen will be to concentrate marketing effort on one or two of these countries in the earlier phase, with a level of penetration by 1990 being above 20% in some countries and less than 20% in others. Likewise, the Nigerian company will find that it is able to produce certain products at highly competitive prices, whilst on other products, due largely to the internal demand for the product, the company is less competitive in the international market.

Within the framework of this project, we have treated export as the "icing on the cake" and have considered project viability based entirely on the domestic demand for each product type. Adequate capacity has been planned into the project to enable exports in excess of those shown in Table 3.22, to achieve in 1990. In 1986, however, exports are unlikely to be realised since the production facility will still be building up its capacity and for almost all products annual outputs in 1986 will fall below domestic demand and as such product will not be available for export.

3.3 Feasibility Study

Within the framework of this project, technical and economic feasibility of a factory to meet the market demands identified in Nigeria, and having a capacity to satisfy export opportunities in 1990, has been studied in detail within the framework of this project.

The proposed scheme consists of a versatile brass mill and a wire rod and winding wire plant to make 19 different groups of semi-finished copper and copper alloy products. It uses up-to-date proven technology.

Implementation will take five years, after which production will begin with single-shift working at a rate of altogether 15,550 tonnes per annum. Within a further five years, the output will build up to the 1990 target of 58,350 tonnes produced by working ` shifts a day, 240 days per year.

Five generally suitable locations in Wes ,Eastern and Northern Nigeria were evaluated according to a range of criteria. The results led to a shortlist of three, namely the greater Port Harcourt area as far North as Aba, the greater Lagos area including the extreme South of Ogun State, and Enugu in this order of preference. Rail access and availability of natural gas are highly desirable although liquefied petroleum gas could be used as an alternative fuel.

The shipment of refined copper and zinc from Zambia has marginal cost advantages to the Metal Marketing Corporation of Zambia. The principal attractions of this project to Zambia lie, however, in an assured market for about 10% of its copper production and in part ownership of the proposed enterprise.

The report presents outline specifications with layout drawings and a capital cost estimate which adds up to the following investments :

	Naira (Million)
Site Work	3.8
Factory Building	21.7
Process Plant	45.2
Diesel Generating Station	16.0
Other Services	1.8
Offices and Staff Amenities	0.7
Vehicles	0.4
Pre-Production Expenses	2.4
TOTAL	92.0

When in full production, the operation will have 800 people on its payroll, most of them highly skilled. It will spend close to ₦ 3 million per year on salaries wages and fringe benefits and thus render a major socio-economic contribution to wherever it will be located.

A technical partner, preferably committed to the success of the project through participation in the equity, is regarded as absolutely essential to the viability of this project. This partner should be a prominent group in the copper industry with in-house expertise in the manufacture of semi-finished products and will introduce adequate training, production programming, maintenance and, last but not least, product quality.

The financial analysis includes profit and loss, cash flow and balance sheet projections based on an equity to fixed capital loan ratio of 1:2 and on a 5 year tax holiday under the Pioneer Status Scheme.

Working capital requirements, including cash in hand, will rise to a maximum of ₦ 17.8 million in the 5th year of operation, when the turnover should have reached ₦ 105 million.

P & L projections are based on the premise that products must be competitive with imports, hence selling prices correspond to current market prices cif Nigerian port plus the modest Import Duties currently applicable to semi-finished copper products.

A project thus defined calls for the following maximum funding :

	Naira (Million)
Share Capital	30.0
Fixed Capital Loans at 9% Interest	62.6
Working Capital Loan at 11%	11.0
TOTAL	103.6

All loans can be repaid after 11 years of operation.

Selling prices of semi-finished copper and brass products are tied to prevailing metal prices, which are quoted daily on the London Metal Exchange and can fluctuate considerably. Hence profits do not depend on raw material costs except insofar as the manufacturer speculates on futures. It is the conversion market which concerns the manufacturer primarily.

The manufacturing costs of the various products depends not only on each other, but also on the production schedule and on the availability and choice of equipment capacity. A rough analysis indicates that all of the 19 product groups contribute adequately to the profitability of the project.

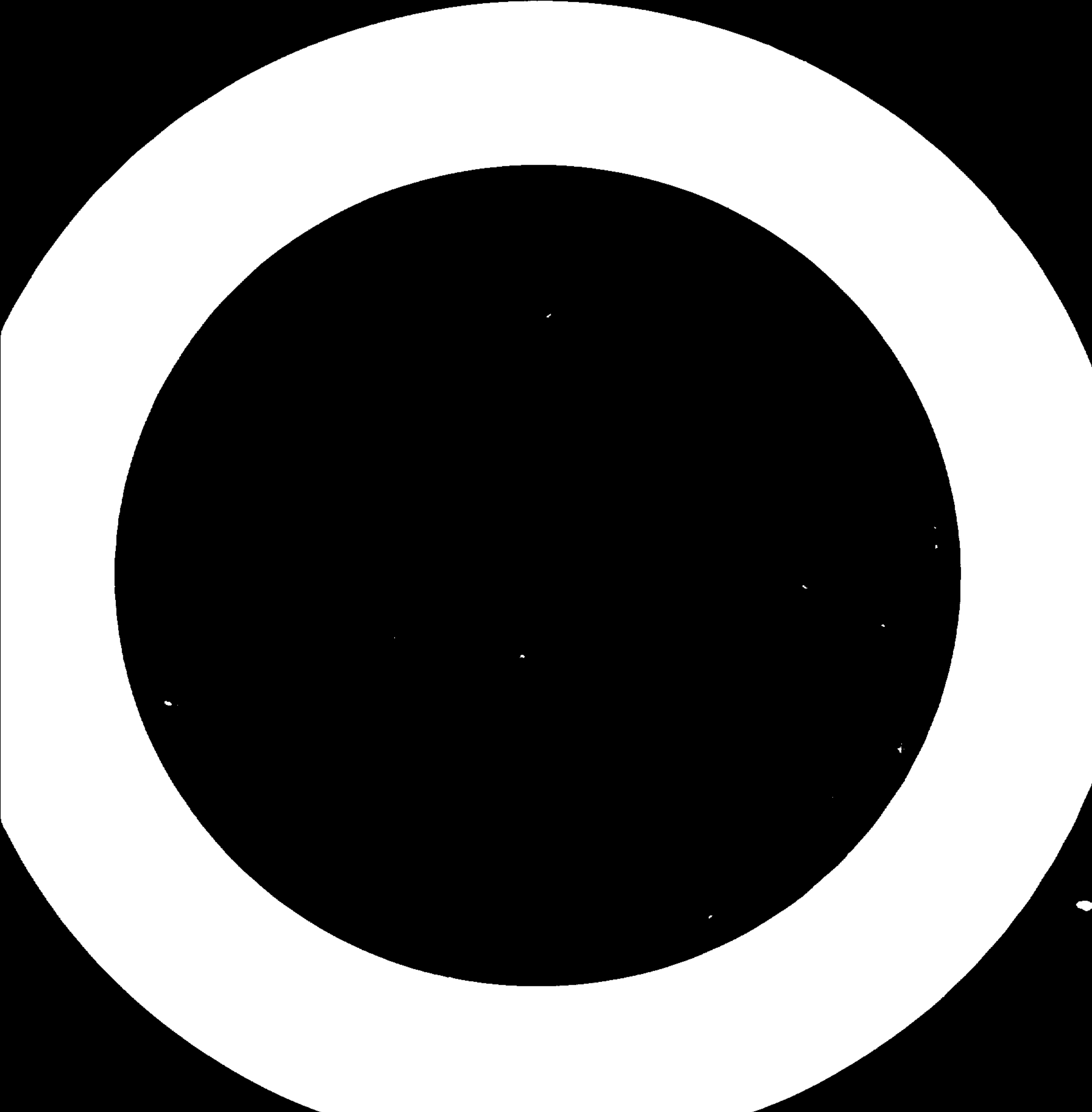
The overall profitability was examined by four criteria, namely pay-back period, simple rate of return, net present value and internal rate of return. With regard to the pay-back period, investments can be recovered after six years of operation. The simple rate of return works out at 9%. The net present value shows a positive outflow at a cut-off discount rate of 11%, which means that lending institutions should be prepared to extend the required fixed and working capital loans.

The internal rate of return amounts to 11.7% which, at current interest rates, should prove quite satisfactory to the shareholders who will realise a return of 21.6% on their investments. One must conclude that the project as it stands is just feasible from a financial standpoint at the current level of interest rates.

The financial analysis is based on a location in the Port Harcourt or Lagos regions. Enugu involves somewhat higher capital and raw material costs, but not enough to make any significant difference to the profitability.

The sensitivity analysis shows a break-even point of 40% of full production. Adverse events with regard to fuel, labour and operating material costs make little difference to the profit margin, and fluctuations in metal costs, none at all.

A 30% drop in production, however, which could occur on account of shortfalls in demand or operational problems, would cut the profit margin in half. A strong technical partner represents the best insurance against such an event.



4. ACTION PROGRAMME

Within the framework of this study, it is worthwhile to briefly consider the action which needs to be taken by the Nigerian and Zambian Governments in order to begin the process of implementation of this project. In this section, we briefly outline the main step to be undertaken, and devote most of the section to the question of the search for a technical partner, an aspect we see of paramount importance.

Within the framework of this action programme, we believe the first step which must be taken is that the two Governments establish in somewhat greater detail than is presently the situation, the relative role of each within the context of this project. Clearly interests may have changed since the initial protocol was signed and it is important that delays are not experienced as a result of uncertainty at this level. The question of the relative roles of the two Governments is outside the scope and Terms of Reference of this project and as such we do not consider it beyond highlighting its importance and urgency.

Within the framework of this study, we have talked with many of the leading copper and copper alloy semi-finished products manufacturers in different parts of the world. We have held extensive discussions with European, North American and Japanese fabricators and feel confident that there is sufficient interest and willingness that a technical partner can be found. Obviously, in the absence of a detailed project, it has not been possible to secure a firm commitment from any company towards collaboration, although a number of companies have expressed interest and requested that they be kept informed of developments and considered in the light of collaboration.

Firstly, we believe it is worthwhile to address the broader problem of an international technical partner and to consider the relative merits that he could offer the project. Indeed, it must be said that whilst equipment manufacturers are in general prepared and capable of installing the plant and commissioning it, the support they can give is, in reality, limited.

This support from equipment manufacturers has tempted many developing countries to set up industries of the type considered in this assignment without involving a technical partner, either as an equity partner or under a technical or licence type agreement. In general however, it must be said that many such ventures have in normal economic terms, failed particularly where the product being manufactured requires a significant technical input.

An alternative approach is to involve a foreign company conversant with technology, etc., as a technical partner employing him on a "fee" type basis under an agreement which covers a defined period of time. In certain cases such arrangements have worked extremely successfully. However, in many instances it is found that the foreign partner does not have a high degree of commitment to the project and as such does not assign his best people. Likewise, the project owners see the technical agreement as being costly and not yielding an adequate return and as such are tempted to progressively dilute it and eventually cancel it.

The third alternative is to involve a foreign company in the equity of the project. This ensures a commitment to the project and can, on occasions, enhance the export opportunities of the project in that the existing marketing organisation of the foreign company can be used to market products from the new company.

It is, however, important to recognise that foreign companies are only interested in such joint-venture agreements where they feel it satisfies their own requirements in terms of profitability and market opportunities. In the first case, companies will obviously cast a critical eye over profitability projection and if they are not considered adequate, will generally not invest. Often, however, such multinational companies are looking not just at the profitability when viewed in the context of the products to the manufactured, but also consider the project in a much broader context seeing opportunities for sale of other products (not to be produced within the framework of the project) in the market in question and as such view overall profitability rather than the profitability from the venture itself.

Within the framework of this study we have talked with many fabricators in both the wire mill and brass mill segments of the copper industry. Several companies have said that they would not be interested in participating in such a project, due either to their existing commitments in other countries, or seeing what they believe to be better opportunities in other areas. A number of companies, however, have expressed interest in the project and have said that assuming the project was viable, would be interested in holding further discussions with the company. In the latter context, we would mention :

- Kabel Metal
- Southwire
- Phelps Dodge
- McKechnie
- Nissho Iwai

In addition, Trefimetaux of France, Tonolli of Italy, Furukawa and Sumitomo of Japan, could, we believe, also be interested in this project.

Obviously, it has not been possible, or indeed fallen within the scope of this project, for us to contact even all the main copper and copper alloy semi-finished products manufacturing companies. Clearly, without a detailed project, such discussions are relatively meaningless since companies will make little commitment until they are aware of the profitability of a project and its overall scope.

The latter aspect is particularly important. The project as envisaged is in many respects unique. As has been mentioned in several parts of this report, the copper industry traditionally divides into two areas, a brass mill and a wire mill sector. Although several of the larger companies are involved in both areas, in general they operate completely autonomous units in each of the sectors, and indeed many companies operate dedicated plants for manufacture of each of the broader type of semi-finished brass mill product. Within the above list, the two companies capable of taking on such a broadly based project are Kabel Metal and Phelps Dodge. Southwire is concerned only with the continuous cast wire rod facility, although it must be said that this company is prepared to take equity in this aspect of the project, whilst McKechnie is concerned only with the brass mill industry and indeed tends to specialise in rod products within this industry.

The Japanese companies and the above mentioned French and Italian companies, are all able to take on a broadly based project, having expertise in both the wire mill and brass mill sectors.

Once the final agreement is developed between the Nigerian and Zambian Governments a systematic search for a technical partner should be undertaken. We believe it would be premature to carry out such an assignment before the basic agreement is made between the two Governments as the prospective partner will wish to know in detail other shareholders in the company and their roles before he is prepared to make any commitment.

Once a technical partner is found and an agreement reached, then he will take responsibility for many of the technical aspects in relation to implementation of the project. It is quite probable that he would want to appoint a specialist contractor such as GKN or Balfour Beatty to take overall control of the project, construction etc. This contractor would also be involved in preparation of detailed engineering and design studies with the technical partner merely providing a control and supporting function.

Several of the plant manufacturers who have been contacted in the course of this project, have expressed a willingness to carry out installation work and to undertake all training necessary to ensure that operators are conversant with the equipment and able to operate it to its designed capacity.

Nevertheless, before any equipment is ordered or design studies carried out, it is necessary, having found the technical partner, to find a suitable site and to secure this site. This activity can obviously commence immediately, although finalisation of the site should await the involvement of the technical partner since he may have valuable comments to make on alternative sites in terms of infrastructures, geological features, etc.

Following identification of a suitable site, engineering and design studies can be carried out. At this stage a formal company will probably be established in order that orders can be placed for equipment and site levelling and construction can commence. It is important to remember that for certain items of equipment, delivery periods are quite long and as such orders must be placed well in advance and planned in a coordinated manner. The technical partner or engineering consultant should be employed to inspect all machinery and equipment as it is constructed and to ensure it is adequately tested prior to shipment to Nigeria.

A final phase prior to commencement will be the recruitment and training of staff. The training programme will be an extremely important aspect of the overall project and will significantly influence the shorter term success and profitability. Training must be undertaken in a systematic manner and full use must be made of training facilities of equipment suppliers, the technical partner, as well as dedicated training courses established in the company or within Nigeria.

An implementation schedule for the whole project over a five year period is set out in Figure 4.1. In order to get the project moving, a number of decisions need to be taken as soon as possible. The most important step, after the decision to proceed has been taken, is to set up a joint Nigerian/Zambian working party able to take executive decisions, then to form a corporation and to seek a technical partner and conclude negotiations with the partner.

Throughout the whole of the above, it is important to be realistic in terms of planning and to recognise that in a country such as Nigeria, considerable time periods are necessary for training, etc. Clearly, however, from this project, it can be seen that a viable and successful copper and copper alloy processing industry can be established in Nigeria and such an industry would make a valuable contribution to the overall development of the country, as well as giving Zambia secure outlets for some of its copper production.

FIGURE 4.1 : IMPLEMENTATION SCHEDULE