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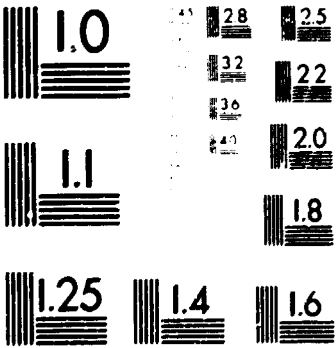

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NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Distr.
LIMITED
UNIDO/IS.507
7 January 1985
ENGLISH

14286

ELECTRIC POWER EQUIPMENT PRODUCTION IN DEVELOPING COUNTRIES: OPTIONS AND STRATEGIES
AN ANALYSIS OF ELEVEN COUNTRY CASE STUDIES

Sectoral Working Paper Series

No. 25

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Sectoral Studies Branch
Division for Industrial Studies

V.85-20284

SECTORAL WORKING PAPERS

In the course of the work on major sectoral studies carried out by the UNIDO Division for Industrial Studies, several working papers are produced by the secretariat and by outside experts. Selected papers that are believed to be of interest to a wider audience are presented in the Sectoral Working Papers series. These papers are more exploratory and tentative than the sectoral studies. They are therefore subject to revision and modification before being incorporated into the sectoral studies.

This document was prepared by James R. Kirtley and Richard D. Tabors of Meta Systems as UNIDO consultants. The designations employed, the presentation of material and the views expressed in this document are those of the consultants and do not necessarily reflect the views of the UNIDO secretariat.

Preface

This document has been prepared for the Sectoral Studies Banch, Division for Industrial Studies, as part of the background documents for the Second Consultation Meeting on Capital Goods to be held in Stockholm in June 1985. The objective of this report is to present in a systematic way the situation of the electric power equipment industry in eleven developing countries, to search for commonalities and to draw tentative conclusions about suitable strategies for developing the electric power equipment industry. The study should be read in conjunction with the document entitled "Electric power equipment production in developing countries: a typology and elements of strategy".

The basis for this study was eleven country case studies prepared by national consultants to UNIDO, representing the electric power sector of the various countries. For the definition of common terms of reference for the case studies an Expert Group Meeting was convened in UNIDO headquarters in Vienna in December 1983. The central data from the case studies are issued in volume II of this working paper.

META Systems, a consulting firm, has carried out the work presented in this Sectoral Working Paper. This document will also be used as input to the ongoing study programme on the capital goods industry which is carried out by the Sectoral Studies Branch.

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EXPLANATORY NOTES

References to dollars ($) are to United States dollars, unless otherwise stated.

A comma (,) is used to distinguish thousands and millions.

A full stop (.) is used to indicate decimals.

A slash between dates (e.g., 1980/81) indicates a crop year, financial year or academic year.

Use of a hyphen between dates (e.g., 1960-1965) indicates the full period involved, including the beginning and end years.

Metric tons have been used throughout.

The following forms have been used in tables:

Three dots (...) indicate that data is not available or is not separately reported.

A dash (-) indicates that the amount is nil or negligible.

A blank indicates that the item is not applicable.

Totals may not add up precisely because of rounding.

Besides the common abbreviations, symbols and terms and those accepted by the International System of Units (SI), the following abbreviations and contractions have been used in this report:

Economic and technical abbreviations

AC	Alternating current
DC	Direct current
GDP	Gross domestic product
GW	Gigawatt
HP	Horsepower
kW	Kilowatt
kWh	Kilowatt hour
kV	Kilovolt
kVA	Kilovolt-ampere
MVA	Manufacturing value added
MW	Megawatt
R and D	Research and Development

1. INTRODUCTION

The electrical power equipment sector within the developing countries has been identified as a significant contributor to overall growth in the economy and as an important import substitution sector for the economies of many countries. Despite its central position in many countries, little is known about either the process of development of the sector or, in most instances, of policies suitable for creating an environment in which that sector can expand.

The electric power equipment industry contains virtually the complete range of diversity and complexity to be found in all of the manufacturing and construction sectors. Complexity in manufacturing ranges from wood and concrete distribution poles to gas turbine combined cycle generation systems. The role of the electric power equipment industry in the developing countries historically, and more importantly in the future, has and will depend upon a series of factors within the nation, within the region and the world. The UNIDO country case studies have allowed to develop a series of axes along which individual countries fall and along which nations tend to proceed as they develop the electric power equipment industry.

It can be argued that virtually any nation could, with sufficient expenditure in effort, training and financial commitment, enter into the market for import substitution and possible export promotion. This argument does, however, reflect a significant decision on allocation of scarce human resources and must therefore be evaluated within the context of the overall resource allocation policy.

The overall objective of this paper has been to develop the background and to evaluate the assembled information on the growth in the electric power equipment sector in a number of countries. The objective of this document is to summarize and synthesize the information developed in the set of country case studies and to develop conclusions and recommendations concerning the evolution of the sector across developing countries. The report also includes recommendations to the funding agencies for additional information required for more complete understanding of the international technology transfer process as it applies to this sector.

This paper consists mainly of two parts. In the first part strategies for development of the electric power equipment industry in the developing countries are analyzed and evaluated, based on the information from the case studies and additional national data. In the second part a summary of the electric power equipment sector of eleven case study countries is presented.

The first part of the study is contained in chapter 2. Here the report presents the observations, evaluation of the constraints, conclusions and recommendations. These are based upon the country case studies, as well as independent information. An effort has been made to go beyond the available information to recommend a set of strategies for both further evaluation of the sector and for paths to development of the electric power equipment sector. Many seem obvious from the data available to date. Others will be far more controversial.

Chapter 3 presents a series of analyses of individual countries and a synthesis of these data around a table developed for this study. This table has taken each individual aspect of the construction and manufacturing of electric power equipment and, from the case studies, graded a country's indigenous industry into:

- Manufactures for export and for internal market
- Manufactures for internal use only
- Manufactures less than half of internal requirements
- Start up industry

In addition, for the categories listed above an effort was made to identify, if possible, the source of the technology and financial arrangement of the manufacturing or construction venture:

- Entirely self financed (ubiquitous or local technology)
- Licensing arrangement with manufacturers in a developed country
- Joint venture (capital and technology) with a manufacturer in a developed country.

The main conclusions that appear from the analysis are:

(a) It is possible to define a linear progression of goods and services in the electric power equipment industry from the least to the most complex. These goods and services can be grouped into six areas from basic equipment such as wooden poles to the most complex of electrical equipment, the gas turbine. As countries advance in their capabilities they add new and more complex products to the product mix. These new goods and services generally require two critical components, increased skills pool and increased capital per unit of output. In addition, the skills are more and more specialized, i.e. not transferable between manufacturing groups and, most significantly, the capital requirements are product specific. An example is that equipment required to produce electrical boxes is sheet metal equipment, such as cutting tools, bending tools and punch presses which can be transferred from electrical power equipment to other uses such as metal storage cabinets for home or office use. Equipment required for manufacture of electrical meters, on the other hand, is dedicated to that use alone.

(b) The second conclusion is that there is a logical progression along the development line and that by and large, there is no evidence of a country leap-frogging from a lower manufacturing group to one two levels above. The picture was not entirely clear, but the stepping functions appeared consistent. It appeared that to go from an industry made up only of rudimentary civil works capability and the dipping of poles to construction of large power transformers without first having developed an industry to build distribution transformers (pole transformers) is impractical.

(c) The third conclusion was that external forces may have a major impact on the sectoral development. Several independent forces which have a negative impact on the development of an indigenous industry were identified. These were:

(i) Policies of packaging large power generation and transmission projects which effectively excludes local participation;

(ii) Policies by funding agencies of placing incentives both on speed of construction and reliability of final system that would actively prejudice against all but established firms, i.e. those operating in the international market;

(iii) De facto actions on the part of, for instance utility decision makers, who believe that, for the reason of product quality, reliability or consistency or simply from habit, equipment must be purchased from a foreign supplier.

(d) The fourth conclusion concerns a critical aspect of the electric power equipment manufacturing sector structure that was not covered in the country case studies themselves. The electric power equipment sector world-wide is dominated by a relatively small pool of technology. This technology is generally licensed or joint ventured prior to any in-country independent technological developments. No direct information was gathered on the structure of the technology transfer process. Critical questions of the origin of technology and the specific structure by which technologies were transferred were missing in the country case studies and thus information about the actual development process was not available. Experience has shown that transnational corporations have a major impact on markets outside of their own countries by virtue of their licensing arrangements. These arrangements may be once only, may have a continued financial burden, may offer exclusivity in a country, or may simply be patent purchase arrangements. These structures have dramatically different impacts upon the capital development process, upon the training of skilled manpower for production and for plant management, and upon the time frame under which technology is transferred from the more developed to the lesser developed countries.

Associated with these conclusions are a set of recommendations. They are to:

(a) Recognize the pathway along which development in the electric power equipment sector proceeds.

(b) Encourage national utilities and international funding agencies to unbundle project development and project funding so that indigenous manufacturers of electric power equipment can participate in projects.

(c) Finally, evaluate the institutional structures surrounding the transfer of technology in the electric power equipment sector. It is hypothesized that this information would greatly enhance understanding of the process by which production is initiated in individual countries studied.

2. TOWARDS A STRATEGY FOR THE DEVELOPMENT OF THE ELECTRIC POWER EQUIPMENT INDUSTRY

2.1 Observations

The electric power equipment sector is not unlike other manufacturing sectors within an economy. For it to be successful it is necessary that there is a demand for the products either internally or externally or both. Furthermore there must be the human and financial capital to develop the industry. Therefore some of the statements are as applicable to the heavy metals industry as they are to the electric power equipment sector. The major observations, recommendations and conclusions of this study of the electric power equipment sector in developing countries are heavily process related.

To begin it is necessary to ask a set of questions:

(a) Should any individual country develop or encourage the development of an electric power equipment sector?

(b) Is the final market aimed at import substitution or export promotion or both?

(c) Which measures will the Government adopt in the establishment of the sector, direct investment, incentives to private sector, or a combination of both?

(d) How integrated will the sector be, also with regard to other industrial sectors in the economy?

These questions are both overly simplistic with regard to the manner in which development decisions are made as well as in attributing intent to governmental policy. On the other hand, as is pointed out in the country case studies, such countries as India and the Republic of Korea have made conscious governmental decisions to achieve import substitution for electric power equipment and they have had major success in their ability to implement that decision. In contrast the industry of Pakistan and Egypt has not developed to the same extent though outwardly the policies have been the same.

The fact that emerges in all of the country case studies and which has also been experienced elsewhere is that a relatively uniform pattern of development in the electric power equipment sector exists which follows a particular path. The path appears to have six plateaus or groupings of manufactured goods and services each of which is characterized by a relatively common set of skill requirements and capital output ratios. It is important to note that it seems impossible to skip over one plateau along the path to development of the sector as a whole. These groupings are mentioned in chapter 3 and are expanded upon here. They are:

2.1.1 Basic goods and services

This category includes the civil construction services that are an integral part of the process of development of an electric power sector, the levelling or movement of earth, the pouring of concrete for footings and foundations and the erection, generally from indigenous materials, of the buildings surrounding the electrical project. In addition this lowest classification includes other items based on indigenous materials, most specifically wooden distribution poles. It is worth underlining that in some instances, even at this most basic level, there is significant imported technology in that the processes for the dipping of the poles is often brought in from industrialized countries.

Several characteristics of this technological development level are of significance. The material used for the product is indigenous, the labour component is significant whether on the service or the manufacturing side, and, most significantly, the technology can easily be absorbed with very limited capital investment requirements. In all of the case study countries some basic services and goods were provided.

2.1.2 Low technology goods and services

There are a set of goods and services which are critical to the expansion of an electric power sector. These can be manufactured with a relatively low level of skills and require only minimal capital goods for production. These goods frequently do not utilize indigenous materials, they offer, however, the beginnings of the linkage between the electric power equipment sector and other industrial sectors either because of direct inter-industry goods flows or because the skills and production facilities required are frequently the same for these goods as for others in the economy.

The first example of goods in this category are metal products such as transmission towers which are cut and assembled from 'I' or channel beam components. The second example is simply extruded or twisted wire such as ACSR (aluminum) cable or distribution cable or copper wire. The third example is hardware made from sheet steel such as washers, hangers, etc. In these three instances the level of skills required is minimal and the level of capital per unit of output is relatively small. The metal working shops in some of the countries studied are more akin to cottage industries than to automated assembly facilities. Human energy generally is used to the exclusion of any automated product movement equipment.

The actual level of manufacturing within this sector is relatively small, though distribution transformer technology is at least the beginnings of a higher technology component of the overall electric power equipment sector. It must be pointed out, however, that when distribution transformers are discussed in this grouping they contain considerable quantities of imported material. These countries frequently do not make porcelain bushings for transformers and often do not have electrical steel rolling capability. Thus they import two of the key elements of distribution transformers.

In the area of services provided, this level of sectoral activity generally implies an ability to develop plant design and detailed specifications in-country, the ability to assemble and to install equipment, most specifically thermal and small-scale hydro equipment, and the ability to design and to develop all aspects of the rural distribution system.

2.1.3 Medium technology goods and services

The medium technology goods and services represent the first point at which the technology will, in all likelihood, need to be imported or if not then developed by trained manpower from within. The manufactured equipment in this category is distribution equipment, switchgear and, significantly, medium and small scale motors. It also includes insulators for high voltage suspension systems. On the services side, this appears to be the point at which construction supervision switches for most projects away from expatriate personnel to in-country supervisors. The construction of both substations and transmission systems also shifts to local firms.

This category may require imported technology that has been negotiated for through direct purchases or through licensing arrangements. As will be discussed with each of the groupings which follow, the question of the method by which technology is acquired was not sufficiently well covered in the country case studies. In any future analyses of this nature, this question will need to be covered in considerably greater detail as these methods of acquisition may determine both the manner in which a country decides to enter into a specific type of arrangement and the relative cost of that agreement to the country, specifically in terms of capital investment.

2.1.4 Moderately advanced goods and services

The equipment in this category generally requires both better trained manpower and significantly greater capital per unit of output than has been required by the earlier classifications. The requirements for production of power transformers and for substation transformers require technology, considerable capital equipment, some testing equipment and a major commitment to quality control. The same applies to large alternating current motors, or to water turbines. These are all production items that require skills in manufacture, large capital outlays in equipment and attention to quality control. Again, the acquisition of the technology itself becomes critical. There are a relatively small number of firms world wide that produce large power transformers or that make large water turbines. It is unlikely to be efficient to begin to design the equipment or the manufacturing facility from scratch.

It is important to recognize that there is a qualitative difference between small pieces of certain types of equipment and larger items of the same equipment. For example, large power transformers are substantially more difficult to build than are distribution transformers. The same is true for turbine generators as opposed to small- or medium-sized motors.

The distinction is more profound than just a difference in scale. As electric power equipment gets larger in rating it does, for a while, just scale in size. However, at some point in rating electrical stress in insulation becomes greater, mechanical stresses in rotor iron and in end bearings become higher and so forth. The largest equipment becomes truly high-tech in nature, as its materials are called on to perform to their inherent limits.

The distinctions between small and very large transformers and rotating electric machines include not only the materials themselves, but also how they are used. Design of large electric power apparatus requires careful and clever modelling and prediction of performance of the final product. This is one of the most important qualitative distinctions between small and large equipment and one of the reasons why power transformers, very large motors and generators are made only by relatively advanced industries.

2.1.5 High technology goods

High technology goods require the most sophisticated manpower and capital stocks. These include boilers, steam turbines, electric generator sets at the macro level and such items as measuring and control instruments at the micro scale. Once again, the development of such industrial components builds generally on a mature industrial structure both in the electric power equipment sector as well as in other manufacturing sectors. This is particularly significant in such areas as measuring and control instrumentation where the items themselves are related to other components of the industrial sector. These linkages are both typical of interindustry linkages of goods as well as linkages in manpower, i.e. cross linkages in the economy that allow for a labour pool from which to draw the skills necessary to accomplish any given set of tasks.

2.1.6 Goods not produced in developing countries

At the present time one product, gas turbines, is not produced within any of the case study countries though there is some evidence that the Republic of Korea is contemplating this development. A gas turbine requires the highest possible technology, the most precision in tooling and in skilled manpower, there is a finite demand for the systems world wide and there is a tremendous capital background needed to enter the market. In addition the gas turbine technology requires high performance materials which puts considerable pressure on the interindustry linkages in the economy.

From this example it is possible to see that the market for such goods is extremely limited. With the possible exception of the Republic of Korea and conceivably India, such technology is not expected to be developed in the other developing countries in the foreseeable future.

The case study countries also do not produce nuclear steam systems even though the Republic of Korea is currently constructing several of its own nuclear power plants. The reason for this is probably less the complexity of the technology than the market size. It is not worth the investment given the small and shrinking market world wide.

One can see in virtually all of the country case studies the progression along a development line that proceeds from the least capital intensive and most labour intensive activities to those technologically based products that require the most significant amounts of capital and with it the most highly skilled manpower. The pathway is not perfectly straight but it is monotonic in that no country seems, from the case studies, to have successfully skipped over one stage and begun manufacture of, for instance, steam turbines, without already manufacturing medium- and small-scale motors.

There is at least one other development pathway that requires some discussion. That is the question of market size and the ability to support a specific level of production in either the electric power equipment sector or one of the important services. A priori one would expect that large countries would have a more developed electric power equipment sector than small countries with roughly the same level of development. One can argue for basic economies of scale in many of these activities and, in essence, this can be seen. India has had a major programme for import substitution and export promotion in the electric power equipment sector for a number of years and the basic market size is sufficiently large to allow for a major industry in India, while Sri Lanka which is similar geographically, has a similar per capita income and electricity production, is virtually fully dependent upon imported capital goods, although some emphasis is now placed on transformer production. The importance of this cannot be overlooked when considering those nations where an electric power equipment sector is likely to be perceived as the next step in development. Later in this chapter the issue of potential regional co-operation and the impact that may have on the issue of minimum market size will be discussed.

2.2 Constraints

There is a wide set of constraints which are faced by the developing countries as they develop an electric power equipment sector. These constraints range from demographic through perceptual, but all have the effect of either directly or indirectly discouraging the development of the sector.

2.2.1 Demographic constraints

Throughout the country case studies it is apparent that the constraint over which the individual countries had the least control was that of the skills pool with which to develop the sector. Training of skilled or semi-skilled manpower takes time and as a result cannot be solved with a single loan (capital) or the passage of a law (indigenous production). The demographic constraint appears in two forms, macro and micro:

At the macro level, there is a requirement for sufficient skills within the economy to support the manufacturing sector broadly and to support the background skills required in electric power equipment. The skills required come in several different forms. A rough classification of the types of skills required is the following:

- Manual skills are required for almost all manufacturing operations, such as machining, winding, assembling, etc.

- Technical skills are required by production managers and industrial engineers to operate manufacturing facilities.

- Managerial and accounting skills are required by those who will administer the manufacturing operations.

- Some level of literacy is required in the work force. The manufacture of items of more than elementary technology requires workers to follow written instructions.

- Skill at sales and marketing are required if products made by the manufacturing operation are to be successfully marketed. These skills are demonstrated not only by selling products, but also by the ability to formulate a product line which will have utility.

These skills form the core of what might be called an industrial tradition, something considered to be essential for the founding of anything more than rudimentary manufacturing operations. Required in addition to these skills is an attitude towards manufacturing that will lead people to consider making things as an acceptable and possible economic activity. In countries that lack an industrial tradition there is no tendency to found manufacturing companies and consequently there is little manufacture. The Bolivian case study mentioned this specifically as a constraint. It is also a major factor in Egypt, Cameroon and Tanzania.

Micro level skills are required for the establishment of specific industries. For example, there is a need for personnel trained in specific areas of electrical engineering for the establishment of architectural/engineering firms to lay out transmission and distribution systems. Civil engineering skills are required for hydroelectric plant design. Higher and more specialized skills are required to make power transformers or large motors. Training of personnel for the electric power equipment industry goes far beyond the organized educational process. There is much on-the-job training of engineers and production people. The skills that are developed and passed on in on-the-job or plant-specific training constitute a large fraction of the technology possessed by the manufacturing company, and these are among the hardest parts of the technology for a developing country to acquire.

It seems likely that those countries which have been able to accelerate the training process at both the macro and micro levels have been the most successful at advancing the electric power equipment sector. At the macro level these countries have relatively high levels of literacy. The availability of trained personnel is always at issue but those nations that have been able to accelerate the training process at the more macro level have been the most successful at moving the sector forward.

2.2.2 Capital constraints

Within all of the developing countries it is lack of capital and in many cases lack of a capital market that is argued to have the single largest impact on development of all of the manufacturing sectors. This is clearly seen in countries like Cameroon or Tanzania where all sectors of the economy compete heavily for scarce local and foreign exchange. Again this constraint takes a set of forms for the electric power equipment sector, macro constraints, market constraints and micro constraints.

At the macro level, virtually all of the countries studied are heavily dependent upon foreign borrowing. The impact of this borrowing is that for the electric power equipment sector as well as for other manufacturing sectors there is a limited availability of foreign exchange which makes up an increasingly large component of the capital requirement as one proceeds along the path of development of the electric power equipment sector. The effect is one of competition for the capital. The competition is among all sectors and includes the human services sectors of health and education as well as the industrial sectors. As a result, governmental structure has a significant effect on who is allocated how much, and what the relative emphasis will be. Tanzania offers one pole in governmental structure with a highly centralized socialistic structure and to a large extent Sri Lanka offers another pole with what is today an effort at establishment of a market economy.

The development of the capital market within any country also has a major impact on the development of the electric power equipment sector. It is useful to look at the example of India in this regard. Within India there has been a 30 year history of import substitution in a number of sectors, among them the electric power equipment sector. This has meant an effort on the part of the Government to encourage manufacture through regulations controlling imports within the sector. At the same time, however, it is necessary to recognize that India has for centuries had an active and relatively mature indigenous capital market. As a result, while the Government has clearly been responsible for the higher technology components of the sector, private industry has manufactured the fuses, small motors, switchgear, etc. The effect is significant from the perspective of the financial/capital market in-country, the Government need not be either the supplier of the capital or the supplier of the skills necessary to organize and manage the enterprise.

At the micro level the capital constraints are probably the most severe for the higher technological groupings of the electric power equipment sector than for some of the other manufacturing sectors. Technologies are imported, the importation requires licenses or partnerships that themselves must be capitalized on a one at a time basis. These licenses must be renewed and new licenses sought when technologies evolve otherwise obsolete equipment is produced. Providing the constant stream of capital required may be difficult particularly if the market size is not sufficient to support a profitable industry.

Access to capital is critical in the electric power equipment industry. While it is possible to manufacture at the lower stages with minimal capital, foreign or domestic, both become more critical as one proceeds in the development process. At the higher level the capital requirements become tightly tied to technologies which themselves transfer into capital requirements in either licenses or into highly specific manufacturing equipment requirements. Capital constraints become frequently binding when the markets themselves are not large enough to support a world scale manufacturing facility.

The access to capital is a constraint that, while severe, sometimes has an aspect of being self-imposed. Foreign capital is often available in the form of subsidiary companies or as partners in joint ventures. This will be true, however, only in those situations in which the foreign owner of capital feels that the investment carries an appropriate return for risk.

Mexico is an example of a nation with significant foreign investment. Many of the enterprises that make up the electric power equipment sector in Mexico are identifiable as subsidiaries of United States firms. In many cases these are joint ventures involving Mexican capital.

On the other hand, countries such as Egypt and Tanzania have little private foreign investment in manufacturing industries.

2.2.3 Market size constraints

As has been foreshadowed above, the size of the market can and does play a major role in the ability of a country to establish successful production units of the electric power equipment industry. Market size has three separate components to it, in-country demand, export demand, both open market and common market, and timing.

The temptation in an analysis such as this is to attempt to develop a market size descriptor for each of the categories of goods and services described above. This is not possible for two reasons. The first is that the economic structures of the individual countries would make it difficult to distinguish the self sustaining industrial units from those that are essentially governmentally supported. The second is that the definitions themselves are not clear. If one uses the theoretical arguments in economic geography it is possible to see that the economic market will support fewer manufacturers or suppliers of the higher order goods and services. Thus *a priori* the market for poles will be greater and there will be more production units world wide than will be the case for, for instance, gas turbines which are a world class product.

Focusing only on the internal demand for equipment, groups 1 and 2 are generally supportable from internal demand alone and are frequently not extensively traded on the international markets. Both groups produce mostly from indigenous materials or indigenous primary products. In neither of these groups is the capital requirement dedicated to only electric power equipment. Even electrical poles are not unique in that the technology and equipment is required for rail ties or for simple construction techniques for support structures etc. Clearly the case is the same with products requiring the cutting, bending or punching of metals. The lower technology groups of electric power equipment do not require a major market because the capital and skills themselves are not unique and can, therefore, be adapted to another application if, either permanently or temporarily, the market evaporates.

Development of industries in groups 3, 4 and 5 requires considerably more attention to market size as in all of these areas the capital stock is more or less dedicated to sectoral production. For these groups the size of the internal market plays a major role in defining the level of sectoral development. As an example, the markets in India, Mexico and the Republic of Korea are sufficient to maintain an active market structure - and a relatively consistent one - while the markets in Bolivia, Sri Lanka and Tanzania are not sufficient to support an active market in many of these higher order goods and services.

An international market for goods is developed in one of two ways, either through active export promotion in a free market environment or through some forms of limited trade in common market structures. The development of free market exports is a goal of several of the countries studied but has been implemented in only a limited number. Both India and the Republic of Korea have an active export market which is well developed. In both instances these countries are providing both components and turnkey installations to other developing countries and the technologies and manufacturing sectors were well developed prior to entering the export market. Significantly, both countries provide a relatively inexpensive labour base which may account, at least in part, for their pricing structures.

A second area of interest in development of export markets is one that has not been seen in the case studies but is hypothesized to be a potential area for co-operation and that is the potential for a regional market for the higher level goods. It is possible in a common market type of structure to have the market be the size of two or more countries and as a result have one country specialize in, for instance, transformers, while another specializes in electric motors. This theoretically attractive alternative appears not to be politically or administratively feasible under most circumstances, though one might argue it is the only way in which some of the countries studied in the case studies will be able to enter into the higher technology groups within the electric power equipment sector.

The final issue in market size is that of timing. No industry can exist in an environment of dramatic peaks and troughs. Even though there may be a large demand for a particular component of electric power equipment, the fact that the demand is directly associated with specific aspects of hydro projects which are constructed only once every ten years is not sufficient to allow for the market to mature and therefore for an industry to develop which manufactures that component. The higher groups discussed above offer a number of examples of this phenomenon. Hydro turbines are a high level technology. Without a consistent demand for the turbines the capital stock is underutilized and the cost/benefit ratio insufficient to justify the overall investment in manufacturing capacity. The same argument holds for large scale boilers and other electric power equipment in the fourth and fifth groups. Even if on average the demand is there, the peak load problem followed by off peak periods when demand is virtually zero, prevent development of the industry.

Bolivia, according to the case study, is a case in point. Due to a financial situation described as a crisis, Bolivia has scaled down drastically all construction activity in the electric utility sector. As a result, practically all of the electrical consulting firms in the country have gone out of business, and it is thought that the engineers in those firms may have emigrated, leaving the country with diminished human resources.

2.2.4 Perceptual constraints

One of the most interesting and least well understood of the constraint sets identified could be labelled as perceptual.

The quality of goods produced is clearly of major concern to an electric power company. They are held responsible for overall system reliability. On the other hand one can question the need to purchase glass insulators from a company in an industrialized country when they can be purchased locally. Local electric power equipment manufacturers will neither grow nor improve in their product delivery patterns if there is no demand. By the same token, civil works contractors will not be able to invest in reliable equipment if the majority of the civil work undertaken is contracted to expatriate firms. The line between necessary imports and honest desire for greater consistency and reliability is a thin one yet, clearly countries such as Cameroon, Sri Lanka or Tanzania could manufacture far more of their lower level goods and provide more service requirements than is presently the case.

A second perceptual constraint is associated with the need for testing of equipment manufactured in-country. The Pakistan country case study mentioned the absence of transformer test facilities as a major constraint to manufacture and acceptance of products. It further suggested that these test facilities should be established at a local university (implying a significant expense). The apparent concern is for quality testing as well as a quality product and for unbiased testing. Open market competition may be one way of encouraging product reliability and quality.

This constraint is due primarily to a lack of experienced personnel at the manufacturing or operating level. Operations such as high voltage test facilities require a very high level of experience and skill for safe and accurate operation. They are, on the other hand, relatively dangerous. High voltage facilities are relatively fragile and can be affected by causes that may not be obvious to people who are not highly experienced and do not fully understand their operation.

Finally there is the perception of the need to import technology for products and/or processes which are relatively rudimentary. An example is Bolivia which imported the technology for dipping wooden utility poles from the United States.

How do these perceptual constraints arise? A likely explanation is training. In many countries the electric power system operators have been trained in the United States, the United Kingdom, France or the Soviet Union. The result is that they have learned how to build a power system along specific lines. It is not unlikely that persons may even have worked an intern year with a manufacturer or an electric power company while they were receiving their academic training. It is far easier to explain the reason for these perceptions than it is to develop ways to separate the rational from the irrational and then to move on to more locally manufactured goods.

2.2.5 Funding package constraints

Within the developing countries virtually all of the larger construction projects for electric power supply systems, from generation through transmission and distribution are funded by international bilateral and multilateral agreements and/or international bonding. The result is that the international financial community has a tremendous influence upon the structuring of the projects themselves. While this is unlikely to impact on the consumer end of the electric power equipment manufacturing sector, e.g. electric motors, it can and does have a major impact on the power supply equipment end. Projects come as packages. Take the package as offered or locate another fundor willing to provide better terms, possibly more indigenous equipment supplies, guarantees or use of indigenous labour. Several issues and constraints arise. Should these projects be packaged? Are the success criteria defined correctly, i.e. should local participation be included in the set of criteria that a contractor uses in the construction of a large supply system project?

The country case studies have in some instances pointed to the problem with international agency funding practices as a constraint to the development of indigenous industries, yet, the pattern is clear and the statements made by officers of national power companies indicate strongly the influence which the international agencies have upon the structure of projects and the structuring of economic conditions surrounding projects. Of the countries studied, Colombia dealt explicitly with the question of project packaging and Bolivia discussed a proposal before the government to unbundle the large development projects. The Colombian project is useful. There, an effort has been made to unbundle projects and at the same time to develop plans for projects to a sufficient level of detail that it will be possible for a local entrepreneur to see the level of demand for particular components up to five years in advance. When the government or a parastatal organization is the purchaser, it is critical to have a clear idea of the demand sufficiently far in advance to plan for the development of capabilities. This same set of legislation has placed additional conditions on project funding to guarantee local participation.

The constraint, then, is the requirement by the external funding agencies that projects be implemented quickly, that the capital be developed and brought on line quickly and that the systems operate reliably. The result is that there is a clear incentive on the part of expatriate contractors to purchase all goods and services from well known suppliers, generally not indigenous suppliers and to purchase goods whose reliability is well known. Multi-million dollar projects ought not to be hampered by lack of or failure in a twenty five cent part, particularly if there is a performance bond.

It is interesting to note that there have been reactions on the part of several countries to the actions of international funding agencies. In the case studies, Algeria turned down World Bank funding because of the conditions placed on the loan. The Government of the Philippines has also seriously considered going to independent financial markets rather than to the multilateral agencies, again because of excessive pressures placed on them by the conditions of the proposed loans. The Republic of Korea stated that turnkey projects demanded by many international loan agencies hampered the development of local industry and the Republic of Korea will no longer allow such contract structures. Clearly the objectionable pressures are more than simply the lack of indigenous manufactured goods within the scope of project. The lack of indigenous goods represents one aspect of the greater problems, but an aspect that can offer a binding constraint to development of the electric power equipment sector even in countries in which the market by other standards is of sufficient size to more than justify the existence of relatively large scale manufacturing facilities.

2.2.6 De facto government actions

The final constraint to establishment or development of the electric equipment sector is the actions of the government. These actions may take a number of forms, currency valuation, tariff policies, governmental instability, etc.

Under most circumstances the undervaluation of a currency tends to assist in the development of an indigenous supply sector such as electrical equipment, however, the undervaluation may have a mixed effect. If the electric power equipment sector is heavily involved in an export business then the undervaluation will have a positive effect, it will make the products more competitive. If the sector produces entirely for the local market, the impact may be less easy to predict. On the one hand it will be substituting for relatively more expensive imported goods, but at the same time the entrepreneur may see that his best capital decision will be not to manufacture for the local market but rather to manufacture for the export market (an entirely different product) and thereby utilize capital, a scarce resource and undervalued labour to either establish a niche in the international market or simply to export the undervalued labour as a part of the cost of manufactured product. The result under these circumstances would be a bias against the electric power equipment sector.

In much the same manner the tariff policy of a government, even one designed to protect infant industries, may favour industry aimed at export rather than at a local market. This counteracts the avowed intent of the tariff.

However, protective tariffs often do not seem to achieve the desired result. For example, in Pakistan there is a very high tariff on certain electrical goods, and yet this tariff is not high enough to prevent the import of electric motors. The reason for this is that cost is not enough of a determinant for the success of a product such as an electric motor. Quality, reliability, appropriateness for a particular task, availability on time, etc. are also important. Particularly in industrial plants where the cost of the motor is small relative to the cost of the installation, the actual cash cost of a piece of equipment is really not important. In these cases tariffs will have only a small impact on the choice between domestic and imported equipment and will result in higher costs for the consumer.

2.2.7 Infrastructure

The lack of a developed infrastructure is sometimes cited as a constraint on development of an electric power equipment industry. Problems with the general infrastructure can be important, such as in Bolivia with no seaports and poor roads. This effect serves as a constraint for many of the countries studied. Indeed, the reliable and economical delivery of electricity itself is recognized as a critical element in the industrial infrastructure.

The development of industry in general is also part of the infrastructure serving the electric power equipment industry. The availability of basic services such as steel casting and forging is important to the manufacture of many types of electric power apparatus, from transmission line hardware to motors and generators.

The case studies further cite a number of facilities as absent and affecting the development of electric power equipment industries in the various countries. Among the most prominent of these were electrical steel manufacturing facilities: sheet rolling mills, non-ferrous metals industries (copper and aluminium), including primary production and rod and drawing facilities and facilities for making porcelain.

2.3 Policies

2.3.1 Policies discussed in the country case studies

A. Infant industry protection

The case studies show some effort on the part of the governments towards infant industry protection in the electric power equipment sector as well as in other manufacturing sectors. This protection has been in the form of import restrictions and favourable tariff policies. In cases such as India the protection has extended to an active governmental policy of 30 years' duration to substitute all imported electric power equipment with locally manufactured equipment. Egypt follows a policy of prohibiting the import of manufactured goods that are also manufactured in-country. The policy in Colombia has been to unbundle development projects to guarantee increased access by local concerns. Bolivia has stated an intention to do the same.

B. Direct governmental investment

In a significant number of cases, particularly in the more centrally planned of the countries, the government has been the investor in the electric power equipment sector. India again offers one example in which the government has played a major role, particularly in the more capital intensive portions of the industry by the development of the heavy electric power equipment manufacture. This is also true of Algeria and Egypt.

The involvement of government appears to coincide again with the groups of industries identified in the earlier section of this report. The higher the group, the greater the tendency for direct governmental involvement. This is not a perfect correlation because centrally planned economies tend to have the majority of all of their industrial development with a direct governmental involvement.

C. Entry level incentives

The case studies point to a number of mechanisms by which individual countries have been able to encourage new entrants into the sector. The Colombian example is probably the most interesting in that the encouragement is predominantly in the form of access to information concerning longer term trends in governmental power sector demands.

Bolivia has a policy to encourage investment in industry. New investment can be granted exemption from certain taxes for an extended period of time, including tariffs on imported capital machinery and income taxes. It can also petition to have tariffs raised on imported goods which compete with the product of the new factory. The effects of this policy are not sufficiently known.

D. Influence of national electric utilities

The electric power equipment sector is not a free market but rather a split market, one portion of which is an oligopoly the second portion of which operates like an open market. In as much as the national electric utility is the market for goods and services produced, the market is an oligopoly. The attitude of the utility (or its employees) towards import versus domestically produced products can and does have a significant impact on the development of a portion of the sector. In so much as the utility is constrained in its actions by its sources of capital, domestic producers become marginal. With no established export market, the ability of a producer to control his destiny under these circumstances is extremely limited.

The case of the Republic of Korea is most important in this regard. Korea has a single national electric utility which has developed extensive engineering skills and which has even developed some equity in manufacturing firms. This utility now serves as its own general contractor for plant construction, contracting for specialized design services in those cases in which it does not yet have the expertise. This utility has made the decision to purchase locally manufactured equipment at various times and so has made possible, the development of local manufacturing industries. These decisions were made as conscious government policy and involved not only commitments to purchase locally made equipment but also financial investment and technical assistance in and for the local manufacturer. Where necessary, technology has been licensed.

2.3.2 Additionally required information

The country case studies omitted one class of information which is critical to understanding the structure and operation of the electric power equipment sector in most of the developing countries. That information relates to the source of technology and to the structure by which the technology was acquired.

As this report has pointed out, the requirements for imported technology increase as the complexity of the product groups increases. The source of this technology becomes, therefore, more important as does the manner in which that technology is acquired. It was not possible to identify patterns in the acquisition of technology that would be likely to lead to a better understanding of how electric power equipment manufacturing firms are started, the impact of changes in government on their existence, and their ability to undergo transitions with changes in their licensing arrangements. Such questions as whether there are once only licensing fees charged, whether there are joint venturing arrangements, who provides the capital, who owns the stock, etc. are critical to a full understanding of the functioning of the sector but especially to an understanding of the manner in which manufacture of the higher technology components of the sector are begun and then mature.

2.4 Conclusions

The conclusions and recommendations from this study have been divided into three categories, those that apply to the countries developing or attempting to develop electric power equipment sectors, and one set which applies to the major lending agencies.

The conclusions reached concerning the development of the electric power equipment sector for the developing countries are, largely, contained in the sections which immediately preceded. They fall into two categories, the first, general in many instances to all of the manufacturing sectors and the second, specific to the electric power equipment sectors.

In general it seems clear that the electric power sector requires considerable capital and skilled manpower at the higher technology end of the spectrum. As a result it appears that a detailed analysis of the sectoral requirements separated into the consumer end, e.g. motors, and the producer end, e.g. transformers, must be carried out if there is to be a significant in-country understanding of the likely patterns of growth in the sector. It is particularly important to define the oligopolistic component of the market and to understand the implications of the lumpiness of demand inherent in a situation in which there is but one customer, a national utility. As has been pointed out, the lumpiness may not only be a function of the building cycle of the utility but may be heavily influenced by the sources of funding for any given project.

The recommendation which emerges from this general conclusion is that there is a need to understand the two markets for electric power equipment, the consumer market and the utility market and that these are completely different in their requirements.

The second conclusion for the countries developing an electric power equipment sector is far more specific and, in all likelihood the most important of this study. There is a logical progression of plateaus or groups of products in the electric power equipment sector through which countries must progress. These groups of products and services have a logic to them that tracks both the level of skilled manpower required and some proxy of the capital output ratio. What is significant to the electric power equipment sector is that these groups seem to be relatively clearly and relatively unambiguously defined in the evidence presented in the country case studies. The lowest common denominator represents services (civil works) and products (wooden poles) that can be seen as ubiquitous in virtually all countries and that require a minimum of skills and a minimum of dedicated capital stock. By comparison, the highest grouping includes boilers, turbine-generator sets, measuring and control instruments, etc., all of which require highly trained manpower and significant dedicated capital requirement.

Each group requires successively more capital, skilled labour and infrastructure support. In turn, each group seems to require a larger specific market for the goods and services.

Countries attempting to develop their electric power equipment industries must recognize the existence of these groupings and their meaning. It is important to see that movement from one group to the next must be done in an orderly way and cannot be done without the appropriate support from other sectors. In order to manufacture goods and services in one of these groups it is necessary that a country possess the proper general educational level, specific skills and infrastructure. It must also have a sufficient domestic or combined domestic export market to support the industry. The absence of any of these ingredients is likely to make the attempted expansion fail.

The recommendation that we see arising from these conclusions is that countries recognize the nature of the development path in the electric power equipment sector. A further recommendation is that for national policy decisions governments provide the infrastructure where it is lacking, that the governments provide the help both in legislation (tariffs) and in capital. National utilities can be of use in promoting industry through purchasing decisions.

The second recommendation which results from the conclusions concerning the logical progression is that the government be very cognizant of the importance of market stability, particularly when small private firms meet the oligopolistic national utility. If the objective is creating an industry there will be a need to guarantee that utility is also a part of that objective and recognizes a role in purchasing the locally produced goods and services and in creating, where possible, a smoother demand path. This may also require some negotiating with funding agencies to guarantee that where possible products that can be purchased locally are in fact purchased locally.

A third recommendation is that governments recognize that capital development can take many forms. In the three countries with the highest grouping three different types of capital formation are seen, each one apparently successful. In Mexico there is a large amount of foreign investment. The Republic of Korea appears to be developing capital with a mix of government and private funds. India finances its industry primarily from private capital. These methods all seem to be successful. In contrast, some of the least developed of the countries have climates for capital formation that are considerably less favourable.

Finally, the importance of the country's demographic development cannot be overstated. Development of technologically based industry depends on having both a work force that is literate and more specialized engineers, managers, accountants and sales people. Governments can have major favourable impacts by taking steps to ensure that these skills are available in the market place.

The indirect role of the funding agencies in the structuring of the electric power equipment sector is not totally intuitive yet when objectively evaluated it is a logical one. In order to guarantee a fair return on investment, the funding agencies are both concerned with the speed at which invested capital becomes productive capital (the issue of long lead times in construction) and they are concerned with the relative levels of reliability for the system as a whole (the ability of the system to amortize the investment with the maximum number of kWh). From the perspective of a funding agency these two objectives may mean the importation of all components and services of a project based on the assumption that the foreign supplier is more reliable both in delivery time and final performance of the product. This general attitude may be directly contradictory to the in-country objectives of developing a solid electric power equipment manufacturing capability based largely on the demand of the power company for delivery of reliable equipment. These somewhat conflicting objectives must be rationalized.

This study would recommend that comments made in the studies of Cameroon, Colombia and Bolivia be investigated further and their importance be evaluated by individual funding groups. There must be tradeoffs between performance of a component of the power system and the performance of significant components of the electric power equipment manufacturing sector. It is recommended that the objectives of project funding be widened or relaxed to include industrial development along with electric power system performance.

3. SUMMARY OF COUNTRY CASES

This synthetic study centres around a group of country case studies of eleven different developing countries. These are:

1. The Republic of Korea
2. Mexico
3. Colombia
4. Egypt
5. Algeria
6. Bolivia
7. Pakistan
8. India
9. Cameroon
10. Indonesia
11. Tanzania

Each of the studies was done by an expert of the country in question. In addition, information from other sources about these countries and additional information about a few other countries is included.

This section of the report consists of two parts. In the first part an attempt is made to develop a classification of the countries and the technologies for production of electric power equipment in each of them. The second part of this section is a summary of each of the eleven country case studies done in what is intended to be a uniform fashion. Obviously these studies vary in completeness and comparability. They have been put together in a set of abstracts in a way that might allow comparisons to be drawn.

Table 1 illustrates some of the most pertinent similarities and differences between the countries involved in this study. There are really two parts to this table. The first part, at the top, gives some general information about the countries.

Table 1. Manufacturing capacities of case study countries

		Rep. of Korea	Mexico	Colombia	Egypt	Algeria	Bolivia	Pakistan	India	Cameroon	Indonesia	Tanzania	SriLanka
Country Class		7	7	6	6	6	3	6	7	3	6	3	4
Population million		39	71	26	43	20	6	85	690	9	150	19	15
kWh/yr/person		1030	904	790	430	310	250	200	170	144	47	37	127
Income$/yr/person		1490	1980	1260	550	1940	570	310	230	730	450	270	270
MVA/Year	Nuclear	942	82	0	200	0	0	.0	94		0	0	
	Thermal	0	1597	42	801	213	9	536	3594		1381	0	
	Hydro	319	692	603	90	0	31	322	1205		402	25	
	Other	0	63	0	0	0	0	0	0		50	0	
	Subs	5938		792	5447		176				2755		
Km/Year	Trans	1092	2157	342	1667		100		14351		.730		
	Dist	7002		1650	2571	7500	301		44066		15744		
	Group 1: Basic Item												
Maint. and Oper		B1	B1	B1	B1	B1		C/B	B1	B		C1	B
Distr Poles				B1	A1	B1	B2	C1	B1	B2	C	B1	B1
Civil Construction		B1		C1	B1	C1	B1	C1	B1		C		B
	Group 2: Low Technology Items												
Distr Hardware		B1	C1					B1	A1		B1	B2?	C1
Trans Towers		B1	A1	B1	B1	B1		B1	A1	C2	B2		B1
Distr Transformers		A2	B2?	C1	C2	D3	B1?	B	A1		C2	B2	D
Distr Cable		B1	B3		A2	B1	B2?	B1	A1			B2	B1
ACSR Wire		B1			B2		B2	B3	A1		B1	B2	
Copper Wire		B1			B2	B1	B2	B1	A1		B1		
Plant Des+spec		D3		C1	B1?	C1	C1		A1?		B		
Assembly+Install		B1		C1	B1?	C1		C1	D1		C		B
Rural Dist Constr				B1?	B1	B1		B1	B1		B	C1	B
	Group 3: Medium Technology Items												
Distr Equipment		B1	B1		C2	B1?		B1	A1		B2		C1
Distr Switchgear		B1	B3		C3	B1		C1	A1		B2	B2	
Suspension Insulat		B2	B1					B1	A1		C2		
Med+Small Motors		A1	B3	B1,C1		C1?		B1	A1		B2	B2	C2
Supervision		D3		C1	B1?	C1	B1		B1		C		B
Substa Constr				C1	B1	C1		C1	B1				B
Trans Constr				C1	B1	B1		C1	B1		B		B
	Group 4: Relatively Advanced Technology Items												
Power Transformers		A2	B2	C1					A1		C2		
Subst Transformers		A2	B2	C1		D3		B	A1		C2		D
Large AC Motors		B?	B3	C1,C3		D3		B1	A1				
Water Turbines		B?	B3	C1,C3					A1		B1		C
Post Insulators		E1						B1	A1		B1		C1
	Group 5: High Technology												
Boilers		C3	C3	A1					A1				
Other Plant Equipt		C3				C1			A1				
Steam Turbines		C3							A1				
Electric Generator		C3?						B1?	A1				
Trans Switchgear		B2	B3					C1	A1				
Bushings		B1							A1				
Trans Cable		B2						C1	A1		B		
Meters			B3			D2		B1	A1				
Static Converters			B3?						A1				
Inductors			B3	C1									
Capacitors		B1							B1				
	Group 6: Not done in LDC's												
Gas Turbines		C?											

A Make for export and internal use
B Make for internal use only
C Make less than 1/2 of needs

1 Internal funding and technology
2 License arrangement with DC
3 Joint venture with DC

The first line, the country class, is taken directly from a UNIDO document entitled "The electric power equipment production in developing countries: a typology and elements of strategy".

In that document, all of the developing countries of the world are organized into seven groups, ranging from those less able to develop electric power industries (type 1) to those most able to do so (type 7). Of the countries in this study, three are in class 7: Republic of Korea, Mexico and India, five are in class 6: Colombia, Egypt, Algeria, Pakistan and Indonesia and three in class 3: Bolivia, Cameroon and Tanzania. Classes one, two, four and five are not represented.

There are several different indices which might be used to order the countries. These include not only the above mentioned typology classification but also such statistics as population, GDP, GDP per capita, consumption of electrical energy per capita, and so forth. While some of these indices coincide, there are also important variations.1/

One might expect the two indices of country classification, per capita income and consumption of electrical energy per year to, at least roughly, coincide. With some variation, they do. There are exceptions, however. For the purposes of this discussion the countries were arranged in the table according to electrical energy consumption.

Egypt has a high electrical energy consumption per capita, relative to its income per capita, because of large hydroelectric developments in the south of the country with concurrent development of primary aluminium and fertilizer industries.

1/ For a closer discussion see the above-mentioned typology study.

Bolivia has a low classification in the typology because it has a small population and little industrial development. Its mining industry and rich natural resources give it a relatively high income and consumption.

Algeria has a high income per capita because of its oil and natural gas resources. The country is using these to build its capabilities in other industries, including electric power equipment production.

India and Indonesia have high typology classifications because of their size. Both are very poor countries, when measured in terms of income or energy consumption per capita. However, both countries are large enough to support substantial electric power equipment industries.

Seven lines in the table are devoted to expansion plans. The purpose of this is to show where major expansion plans will result in large markets for electric power equipment in the near future. The five lines entitled "MVA/year" are intended to show the average increase in capacity planned for the next years. These are not done on an absolutely consistent basis because the country case studies were not consistent. Some gave data for three years, some for six. This has been normalized to expansion plans per year over whatever period was offered. Similarly, transmission and distribution line expansions were lumped together and expressed as line kilometres to be installed, on average, over the next years.

As might be expected, the largest and most prosperous markets have the biggest expansion plans. Countries with falling water seem to be planning hydroelectric developments. Others are planning thermal generation. The smallest of the countries, in terms of installed capacity, are planning the smallest expansions.

Information on expansion plans was not complete in the country case studies. Thus it was not possible to fill out the top of the table completely.

The second part of the table is an approximate display of the manufacturing capabilities of each of the countries of the survey. These capabilities were taken from the country case studies. In particular omissions in the case studies will appear as non-capacity in this table. However, this is nearly a fair way of describing capacities.

The products were separated into six categories, according to the level of technology involved in their manufacture. One point which evolves from this study is that there seems to be a one-dimensional path of technology that all countries go through. It seems as if each of the countries has a domain on that one dimension and that domain reaches from the beginning to a particular level of technology. Each of the countries seems to produce most of the goods that fall within that domain.

The six categories, or groups range from very low to very high technology operations and products that are out of the range of virtually all developing countries. The groups are:

(1) Basic materials and services: civil construction, wooden poles and maintenance of ordinary equipment.

(2) Low technology items, from distribution hardware made from galvanized sheet iron to small distribution transformers. These are within the reach of any society that can invest a little capital for simple machinery. They require very little training of production people.

(3) Medium technology items, including supervision of construction to production of medium and small motors. Items in this classification may or may not require the import of technology from other, more developed countries. They require a moderate degree of sophistication and in some cases some capital equipment.

(4) More advanced technology items, including power transformers, large motors and water turbines. These require substantial investment in plant facilities and more sophistication than those items in group 3. Typically they require the presence of casting, forging and rolling facilities.

(5) High technology items, such as large boilers, steam turbines and generators. These require substantial sophistication, including a large corps of professional design engineers and skilled workers. They also require very large amounts of capital investment and access to many primary facilities and a good industrial infrastructure. Only a few of the developing countries considered have any capabilities within this group.

(6) Very high technology items, including nuclear reactors and gas turbines. These are typically not made in the developing countries. Indeed, they are made in only a few of the most industrialized nations.

Certain products that might be included in group 6 are items of new technology. These include electronic relaying equipment, computers and computer-based dispatch and control centres. These products are not really relevant here because they are not produced in any of the subject countries, and in fact are not mentioned in any of the case studies.

As might be expected from this description of the different groupings, the number of countries active in each product line becomes smaller as the group number increases. The three countries classified in group 7, manufacture items from each of the first five product groups. Basically the Republic of Korea and India manufacture just about all of the goods identified as being part of the electric power equipment industry. The Republic of Korea is even making an attempt to make gas turbines.

There are five countries in group 6. Within that group, Pakistan makes goods in groups one through five. Colombia and Indonesia make goods in groups one through four with isolated manufacturing operations in group five. Algeria manufactures some items in group four with minor, specialized ventures in group five. Egypt manufactures items in groups one to three only.

Finally, the three countries in the lowest classification are limited to manufacturing goods in groups one and two. There are two exceptions to this situation, Bolivia does some construction supervision and Tanzania has some manufacturing activities in group three.

Two conclusions may be drawn from an examination of this table. First, with a few exceptions, manufacture of electric power equipment seems to follow a one-dimensional path of development. The types of equipment that are manufactured seem to fall naturally within the six groups that were defined. Countries which make equipment seem to progress from low numbered groups to high numbered groups in a monotonic fashion. No country skips a group: equipment of lower technology classification is made before equipment of higher classification.

The second conclusion to be drawn from this table is that the typology developed seems to be meaningful in that the type groupings that were developed are directly correlated with the progress of the the ranges of products manufactured.

The following sections (3.1 to 3.11) are summaries of the 11 country case studies.[2/]

3.1 Republic of Korea

3.1.1 Introduction

The Republic of Korea is the most heavily developed of the eleven countries selected for the case study. It is almost fully electrified and has a substantial industrial structure which is highly competitive in many world markets.

The Republic of Korea's Government policy does seem to involve allocation of industrial resources to certain areas with a view to reduce duplication of efforts by Korean companies. It is not clear from the country case study just how this policy is implemented or enforced.

2/ The case studies are available in the UNIDO secretariat, in original languages and draft English translation wherever applicable.

KEPCO: There is one, large electric utility company in the Republic of Korea, the Korean Electric Power Corporation (KEPCO). It has two important non-utility subsidiaries, the Korea Power Engineering Company (KOPEC) and Korea Heavy Industries Company (KHIC). There is also an emerging producer of nuclear fuel, the Korea Nuclear Fuel Company.

KOPEC is an architectural/engineering firm. It performs traditional services such as plant design and supervision of construction. It has emerged fairly rapidly from having a very small role in power plant construction to being the principal contractor for nuclear plant projects.

KHIC is a manufacturer of large apparatus such as boilers, steam turbines and generators. It also operates maintenance facilities for power plant components and takes primary responsibility for maintenance of plant equipment after the warranty period.

It appears that the combination of the utility, equipment manufacturer and architectural/engineering firm gives some advantage to the local industry, since purchases of equipment by the utility can be directed towards the other subsidiary companies.

There are a large number of other companies which manufacture electrical equipment, some of which have licensing agreements with other countries.

3.1.2 Future electric power development in the Republic of Korea

It should be noted that the process of electrification is nearly complete in the Republic of Korea. At the writing of the country case study, there were plans for electrification of some 5,638 houses over the next two years at a total cost of $US 11.4 million. All of these houses are on islands or are remote. Thus, all growth in electric power demand will come from economic growth and from redistribution of energy sources away from oil towards nuclear, hydroelectric, and coal.

As a result of the developments of the oil markets, the Republic of Korea seems to have made the decision to invest heavily in nuclear generating capacity. The country case study report discloses twelve nuclear units, of which nine are still under construction or in the planning stage. Current projections show nuclear generation exceeding conventional thermal generation in 1990. Between 1984 and 1990, nuclear capacity will increase to 8,516 MW from 2,866 MW.

There is no net increase in conventional thermal capacity planned for the rest of the decade.

There are plans for a modest increase in hydroelectric capacity, from the present 1,202 MW to 3,115 MW in 1990. These plans include some development of small-scale hydro-electric plants.

There will be modest increases in transmission and distribution facilities. Transmission lines of 345 kV will increase from 3,025 km to 4,695 km and 154 kV lines will increase from 7,830 km to 9,620 km. There will be retirements of lower voltage lines. Distribution lines will increase from 151,565 km to 172,572 km. In the same period, there will be four 345 kV substations and four 154 kV substations built, with a good number of retirements of 66 and 22 kV substations.

3.1.3 Development of capability

There has been a consistent pattern of utilization of plant acquisition as learning instruments. As it has acquired power plants, KEPCO has insisted that Korean engineering firms be given some of the work. KEPCO can control the allocation of work because it serves as its own general contractor. As local engineering firms became more capable, they were able to handle a larger fraction of the work. Thus, while KOPEC had only about 5 per cent of the engineering work in the first two nuclear units to be built in the country, it will be the primary A/E firm, doing over 70 per cent of the work for the eleventh and twelfth units. The learning process is continuing, for even with these latest two units there will be foreign engineering firms participating.

KOPEC has, through this mechanism, developed the capability to do complete engineering and construction jobs for conventional thermal plants.

In the electric power equipment business, Korean industry makes use of licensing arrangements as learning devices. As an example, KHIC has licenses with General Electric, Combustion Engineering, Babcock and Wilcox, Neyrpic, Alsthom Atlantique, Hitachi, Framatome, Wooley Ltd. and Westinghouse for technology related to thermal, hydraulic and nuclear plants.

In contrast to the steady progress made by KOPEC in power plant design and construction supervision, KHIC has made rapid and recent inroads into construction of equipment for power plants. Prior to 1979, KHIC manufactured no equipment at all for new KEPCO power plants. Starting in 1979, KHIC has manufactured substantial parts of the boilers, turbine-generator sets and components of the balance of plant. For the latest fossil fired plant to be commissioned, the Sao Hae plant, KHIC was responsible for 50 per cent of the boiler, 36 per cent of the turbine-generator set (including construction of the generator) and 64 per cent of the balance of plant. Of the major categories of plant equipment, only the plant substation does not have substantial involvement of local industry.

3.1.4 Constraints

The country case study discusses only a few perceived constraints to further development of the electric power equipment industry in the Republic of Korea, including a lack of skilled manpower and uncertainty in capital equipment markets. It might also be noted that the market will soon become saturated. As Korean industry takes over all parts of equipment manufacture and plant construction, there will be no foreign component to replace. Further, since the country is at present fully electrified, there will be no further contribution to the local market from electrification.

Finance is of concern primarily because it reflects uncertainty in future markets. The domestic market in the Republic of Korea is limited in size: it is not a large country and it is practically fully electrified. The size of the electric power system in the Republic of Korea will grow in pace with economic growth, which, in the industrialized world, has not been high in recent years.

This may not be a serious problem for the Republic of Korea, which successfully manufactures many goods and can be expected to become active in the export market for some types of electrical equipment. On the other hand, that market is becoming more competitive because many countries have electric power equipment capabilities which are underutilized.

Another constraint mentioned is that of manpower. There are not enough highly skilled people in the country to staff a growing electric power equipment industry.

3.1.5 Recommendations

In the country case study only a few recommendations are made for measures to be taken to increase the domestic production of electric power equipment. These include carrying through a scheduled investment by KOPEC in KHIC and continued acquisition of technology from around the world.

3.2 Mexico

3.2.1 Introduction

Mexico is a large and newly industrializing country. Over the past few years it has experienced financial problems, and this has hampered its industrial development. However, there are expectations of better times ahead.

Mexico has substantial indigenous energy resources, and is in fact a large net exporter of energy, chiefly as petroleum. Both oil and natural gas are found in quantity. Mexico has some coal, although to date it has been used primarily in metallurgical applications. Efforts are underway to use some of Mexico's coal reserves for the generation of electricity. There are some hydroelectric resources which are partially exploited.

The electric power system in Mexico is nationalized and covers most of the country. Its plans for expansion are extensive, but have been and may be in the future limited by national resources.

Mexico has a substantial industrial base, manufacturing many of the component parts required by the power system. At present steam and gas turbines and large generators are not made in the country. However, Mexico is starting to produce water turbines and manufactures most of the other components.

The electric power system is maintained locally, with help from foreign sources primarily for major or warranty repairs. Training of Mexican nationals is carried out both locally and in foreign locations.

Mexico has susbstantial capabilities for planning and specifying the power system and major components. Foreign help is required in detailed design of power plants. Mexico exports civil engineering and civil works capability.

Access to technology is through several different channels, including licensing, association with foreign enterprises and joint ventures. There is some skepticism regarding subsidiaries of foreign companies. It is felt that these yield little local benefit.

Mexico feels several constraints towards the development of a local electric power equipment industry. The local market is felt to be too small to support a fully-fledged industry. Further, the market is dominated by a few companies which are poorly organized. There are a few constraints which have to do with the industrial infrastructure, including a lack of capacity for manufacture of rolled steel and porcelain insulators. Access to technology seems to be a major problem.

3.2.2 Electric power system

In 1983, the Mexican electric power system had an installed capacity of about 18 GW. Of that capacity, 36 per cent was hydroelectric, 60 per cent was thermal, including steam turbine as well as internal combustion engines. The rest was mostly geothermal.

Over the next 15 years, Mexico is planning a major expansion of the electric power system. Over that period about 38 GW of capacity will be installed, including 25 GW of thermal capacity, 11 GW of hydroelectric capacity and roughly 1 GW each of geothermal and nuclear capacity. There will be transmission and distribution expansion to match.

Beyond the expansion of capacity, Mexico plans to integrate system planning and operation, to result in increased reliability and economy of system operation, the reduction of losses for improved efficiency, promotion of cogeneration where applicable and improved labour productivity in the industry.

The size of the market described indicates that it will support a substantial equipment industry, although it will not be appropriate to make the larger pieces of equipment, turbine generators and so forth, solely for the Mexican market.

3.2.3 Power equipment: general comments

Mexico has no firms which manufacture steam or gas turbines. A new enterprise is just starting to manufacture hydraulic turbines. National content of these is limited by the lack of capacity for large-scale steel casting and forging.

Many other components of power systems are made, including transformers, switchgear and transmission lines. Some component parts are imported, including electrical steel sheet, porcelain bushings, some types of insulators and load tap changers.

3.2.4 Maintenance activities

Most maintenance activities are carried out with local personnel. Mexican power plants generally have machine shop facilities which can make component parts. Regular maintenance and minor repairs are made locally.

Foreign assistance is required for major repairs, particularly to complex components such as steam or gas turbines. Of course repairs made during warranty periods are also carried out by foreign nationals.

Foreign nationals are involved in training Mexican nationals for plant maintenance and repairs. This training is carried out in several different modes: there are practical courses taught by middle level technicians (who are often local themselves), visits to manufacturing plants abroad (often involving training sessions), and on-the-job training which may be supervised by locals, foreigners or a combination of both. It is felt that these maintenance activities help to develop local manufacturing capabilities.

3.2.5 Engineering and consultancy

Mexico has developed substantial capabilities in planning and engineering design. There are two major offices within the public utility which deal with plant construction: a Planning Office and a Construction Directorate. It appears as if Mexico has the capabilities for planning not only the power system but also the first-order design of its plants.

The utility gets help from foreign enterprises when planning for specific pieces of equipment is required. It is usually the manufacturer of the equipment that gives the assistance.

Mexico has a highly developed civil works industry. It exports civil engineering services and civil work to other countries.

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3.2.6 Electric power equipment industry

The electric power equipment industry in Mexico dates back to the 1940s. It was promoted by the Federal Electricity Commission, presumably to enhance national independence. The country case study gives a complete rundown on various component parts of the industry, and a brief summary of that rundown is contained here.

Boilers are made in Mexico by two firms: Cerrey, which is related to Combustion Engineering (United States), makes component parts of boilers and sells boilers made in the United States. Babcock and Wilcox de Mexico (related to B+W of the United States) makes small boilers and components and engineering for large boilers.

A firm to manufacture water turbines (TEISA) was established in 1979 with equity participation of Sulzer of Switzerland. It will have the capability to make hydraulic turbines of up to 200 MW capacity. A national content of 90 per cent will be possible as soon as Mexico obtains the necessary steel casting capability.

Electric motors have been made in Mexico since 1950. Initially only small integral horsepower motors were built. At present motors range up to 10,000 HP for AC motors and 200 HP for DC motors. Many firms make electric motors. Before the current economic recession plant utilization of this industry was about 90 per cent. These firms supply virtually all of Mexico's needs for electric motors.

Four enterprises make generators. Two of these are limited to very small units. The largest generators made in Mexico are rated at 15 MW.

Transformers have been made in Mexico since the late forties. There are now 40 companies which make transformers, including 14 which supply the national utility. About 25 per cent of the value of transformers must be imported because Mexico has no capacity for rolling electrical steel sheet and does not make high voltage porcelain bushings. Mexico does make copper and transformer oil. These firms supply most of the country's needs and are becoming more competitive. In 1977 they supplied 71 per cent of installed transformer capacity and 85 per cent in 1981.

A wide range of switches is made in Mexico, including:

- Low voltage switches, moulded and non-moulded, to 5,000 A
- Oil switches rated from 7.5 to 34.5 kV
- High voltage switches, to 420 kV, SF_6.

It should be noted that with switchgear, particularly in high voltage ranges, a large part of the value can be in insulators and bushings. These are generally imported. Mexican industry is said to be non-competitive in some types of switchgear, notably 34.5 kV magnetic breakers. There is now excess capacity for the largest switchgear (high voltage SF_6).

Mexican industry produces electric switchboards, using both local and imported technology. It is expected that some of this equipment will be exported in the near future. Mexico supplies most of its own needs in this area, while the more complex switchboards associated with power plant controls are still imported.

Transmission towers and distribution towers and poles are exported from Mexico. Some types of insulators, including glass suspension insulators are made in the country, although larger porcelain insulators are imported. Some special purpose plastic insulators and smaller porcelain insulators are made in the country. Wire, cable and most other types of transmission and distribution apparatus is made in the country. It is felt that the manufacture of transmission apparatus is fragmented and that fewer larger producers would be more effective. There is a lot of competition from abroad, particularly from the French and Japanese.

3.2.7 Organization of production

Despite the fact that the electric utilities in Mexico are nationalized, the associated manufacturing industry is largely private enterprise. There are about 2,000 companies with about 170,000 employees manufacturing electrical equipment.

3.2.8 Mastering of technology

Several sources for technology are discussed. Technicians are trained abroad, chiefly by foreign suppliers of complex equipment, to maintain that equipment. In contracting for design services and in following the process of design the country can acquire important techniques.

There is a local Electrical Research Institute which maintains testing facilities, has expertise of its own and extensive foreign contacts.

Finally, the technical staff of the manufacturing enterprises within Mexico make visits abroad to keep abreast of technical developments in other countries.

Mexican industry has followed a path that seems to be fairly common. It started its technological development with repairs to equipment made abroad and has progressed through starting to make that equipment locally.

3.2.9 Access to foreign technology

Mexico has access to foreign technology through all of the normal channels. In some cases it purchases licenses from foreign firms, in some cases it forms associations with foreign companies, and in some cases it forms joint ventures or subsidiaries of transnational companies are formed.

A law concerning the transfer of technology resulting from licensing regulates the transfer, by controlling the duration of contracts, the payment of royalties, exclusive rights in the national market and the guarantee of participation in external markets. Similarly, there are regulations concerning the participation of foreign investment in the country.

Subsidiaries of foreign companies contribute little to technological development of Mexico because, according to the case study, they operate under strict control from their parent enterprises, which prevents them from revealing their processes.

3.2.10 Constraints

There are a few constraints which seem to be hampering the development of an electric power equipment industry in Mexico. Among the most serious are the nature of the market and financing considerations.

The market for electric power equipment is limited in Mexico. There are only three enterprises which use such equipment. Being government owned and operated, these organizations are subject to extraneous constraints such as the austerity measures recently enforced.

Financial considerations are very serious. The user agencies have a tendency not to pay their bills on time. Coupled with inflation, this creates major problems for equipment suppliers, since the value of unpaid notes deteriorates with time.

There are a few problems associated with the industrial infrastructure of the country. There is a lack of capacity for making insulators and bushings and for rolling electrical sheet steel. No insulating paper is manufactured in Mexico. These items must be imported.

Availability of labour does not seem to be a problem. Mexico has an adequate supply of skilled labour.

Access to technology is a serious problem for Mexico. In particular, it does not seem to be able to gain access to the technology required for manufacturing complex items of equipment such as steam and gas turbines and large generators.

3.2.11 Linkages with other capital goods industries

With respect to raw materials, there are sufficient supplies of steel and copper (except for the lack of electrical sheet steel rolling capability). Mexico has no bauxite but aluminum refining and processing capacity exists.

Mexico has the capability of making small forgings and castings. A large plant for forging and casting is under construction, with Japanese technology. It will be able to produce forgings of 70 tons and steel castings up to 100 tons.

It appears as if some of the manufacturing facilities which could be used to produce large electric power equipment are regarded as heavy industry plants, and as such are being used for making other types of machinery for use in mining, cement, iron and steel and petroleum industries. Because of this capability, the plants are not severely vulnerable to swings in demand for their equipment.

3.2.12 Policies and strategies

The objectives of national policy are, inter alia, to reduce idle capacity in manufacturing facilities, to stimulate the substitution of locally manufactured capital goods, to increase the opportunities for small- and medium-sized firms, to reduce concentration of investment, to prevent foreign capital from acquiring efficient Mexican enterprises, to raise the level of technological development and to generate exports. To implement that national policy there are a number of measures.

One of the major policy tools is the behaviour of public sector firms, primarily the electric utility system. This is said to be oriented towards minimizing idle capacity and stimulating the import substitution process. Further, subcontracts are being used to incorporate a larger number of smaller firms since it is felt that small and medium sized firms contribute more to employment than do larger firms.

An apparently complex system of protection and promotion is being used to promote joint ventures which will contribute both to the balance of payments, the development of local technology and the protection of infant industries.

3.3 Colombia

3.3.1 Introduction

Colombia is a relatively advanced nation within the set of country cases studied. The electric power sector is predominantly based on hydro-electricity and coal. Hydro-power accounts for over 60 per cent of both the capacity and energy, the remainder being thermal capacity, primarily coal. Projections to 1995 indicate that the thermal capacity will grow by less than 25 per cent while the hydro capacity will more than double.

The importance of hydro in Colombia can be seen in the fact that Colombia reportedly accounts for 20 per cent of the hydro potential in Latin America. At the present time the power sector in Colombia is publicly owned either at the national or the municipal level. In contrast to this the industrial sector in Colombia is privately owned though, as is frequently the case, subject to considerable governmental influence.

Within Colombia a significant amount of the equipment for the electric power system is available. Recent governmental rulings now favour locally manufactured goods over imported goods in the sector. This ruling may, in the intermediate run, have a very positive impact on the electric power equipment sector both from the perspective of supporting local industrial development and from the perspective of allowing for xtended utilization of production facilities. Currently a number of the manufacturing facilities lack sufficient demand for products to go beyond single shift operation. Expansion to multiple shift operation will have the effect of lowering both average and marginal costs.

3.3.2 Interconnection Electrica S.A. (ISA)

ISA was established in 1967 to interconnect the existing utilities in Colombia, specifically Empresa de Energia Electrica de Bogota, Empresas Publicas de Medellif, Corporacion Autonoma Regional del Cauca, Electraguas, and Corporación Eléctrica de la Costa Atlantica (CORELCA). ISA also had the function of planning for the system as a whole. After several related actions of the Government, the powers of ISA were modified in 1979 so as to allow for broader sectoral planning. The result was a set of studies and plans for development of the electric power sector, specifically the hydroelectric potential. This development is financed through the Financiera Eléctrica Nacional with authority to raise funds from domestic and international debt as well as from domestic savings.

As a portion of the effort to encourage local participation in development activities in the electric power sector, a ruling in 1979 required ISA to break down expected capital equipment requirements by category by year required. This is intended to encourage local manufacturers to plan for and invest in required capacity to supply capital equipment and services to the utilities.

3.3.3 Future electric power development in Colombia

The direction of future electric power development in Colombia is towards hydro power. Total installed capacity is projected to increase from 6,885 MW in 1984 to 13,979 MW in 1995. Of this hydro capacities will increase from 4,726 MW to 11,354 MW. The remainder will be accounted for by thermal capacity, primarily coal. The major thrust of the utilities in Colombia has been towards electrification of rural areas. The National Rural Electrification Plan implemented between 1981 and 1983 provided electricity to

145,000 dwellings required 23,000 km of high and low voltage lines and 10,000 transformers. Similarly the Integrated Rural Development Programme begun in 1976 benefitted 40,000 families with 5,200 km of transmission lines. To fulfil demand on the Atlantic coast and San Andres by 1995 a further plan has been started which will require over 2,000 km of transmission lines to reach 345 small and medium sized local centres.

While there has been limited implementation of systems, considerable study has gone on in alternative sources of energy. The most promising for Colombia would appear to be small hydroelectric systems for rural and marginal urban settlements that are isolated from the grid. The present plan calls for implementation of 60 projects between 500 and 20,000 kW. Other projects are being considered in solar, geothermal and biomass energy.

3.3.4 Development of manufacturing capability

At the present time there is capacity within Colombia for the supply of many components of electric power systems and to supply manpower for consultant services.

Colombia has a strong base in consultancy firms capable to carry out civil and other engineering services ranging from exploratory work to operational start-up. These firms dominate both the manpower and funding for civil and engineering activities in the electric power sector. It is interesting to note that the number of foreign consultants required is in part determined by the requirements of the foreign lending agencies.

Colombia currently produces both fire-tube and water-tube boilers of medium size. These are produced both for the domestic and the export market. There is excess capacity in this sector at the present time. This sector supplies industrial boilers and some utility boilers in Colombia.

Transmission towers are supplied by local manufacturers for whom this is only one part of their metal working business.

There are no firms manufacturing gas turbines but one firm manufactures water turbines. These are up to 120 kW, 100 m head and 100 gallons per minute.

Both one and three phase motors are manufactured in Colombia in a significant number. Three large manufacturers with foreign participation produce both motors and transformers. The majority of the producers are smaller in size and have, apparently, technical limitations. Those firms that produce high voltage transformers have only an electric utility market and must compete with foreign suppliers.

There are eleven firms involved in substations, switchboards and high-voltage gear. Those firms involved in the high-voltage business are competitive with foreign firms in quality and price. In the smaller firms specializing in low and medium-voltage equipment there is considerable underutilization of capital stock.

While no direct figures are available, the largest section of imports is accounted for by large transformers and generators primarily because of quality constraints in local manufacture. The second largest amount is accounted for by turbines and finally by auxiliary equipment required such as condensers for boilers.

3.3.5 Constraints

Constraints to the development of the electric power equipment sector in Colombia stem primarily from lack of available skills within the economy and from capitalization in a market economy. The skills requirements are being built up through requirements for maintenance from within the country. There is considerable belief that the maintenance operations have led to the establishment of competitive production facilities within Colombia.

3.3.6 Recommendations

Colombia is developing a relatively active market for electric power equipment. Given the dominance of hydropower in its future growth path, the expansion of capabilities into the intermediate sized development projects may be advisable. The development of skills in civil works for the hydro development is also likely to encourage employment and relieve some of the requirements for foreign expertise.

3.4 Egypt

3.4.1 Introduction

Egypt, having some oil resources, is a net exporter of energy. There is also some coal in the Sinai region of the country and hydroelectric power is available from the Nile. There are substantial gas fields which are currently underutilized but which may provide a lot of energy in the future.

The electric power system in Egypt has been growing at a relatively rapid pace for the last two decades and projections are that it will continue to grow for several years. Fuelling this expansion is growth in the Egyptian economy and an aggressive rural electrification programme. Current projections are that most of the expansion in generation will be oil or natural gas fired. There are plans for two large nuclear units. There will be little hydroelectric development, largely because the Nile in Egypt is almost fully developed already.

3.4.2 Electric power system

Egypt has a single electric power system with a fairly complicated administrative structure. This system has had a striking number of reorganizations over the last twenty-five years. Effectively, however, there is one organization that generates electricity which is marketed through municipalities and the rural electrification authority.

The largest single source of electric energy is High Dam at Aswan. The smaller Aswan Dam also provides substantial electricity generation. These are both in the south of the country, away from the major population centres, Cairo, Alexandria and the Nile delta. They are connected to the north by a pair of 500 kV transmission lines. Generation in the north comes from thermal power plants, generally steam turbine plants burning heavy oil, but there are some gas turbine plants burning kerosene.

The Egyptian electric power system has experienced substantial growth in recent decades, and that growth is expected to continue. Currently under construction are 11 oil fired units totalling 2,170 MW, three gas fired units totalling 233 MW, and four hydroelectric units totalling 270 MW. The latter are at a second powerhouse at Aswan Dam.

Not yet under construction but planned for the next years are two nuclear units of 1,000 MW each; 210 MW of additional hydroelectric units to be installed in three low-head locations, one pumped hydroelectric storage facility, four coal fired units rated at 300 MW each and three oil or gas fired units rated at 300 MW each.

The current generating capacity of the Egyptian system is about 6,000 MW, so the additions currently planned for the next seven to ten years represent more than a doubling of installed generating capacity.

The transmission and distribution systems will also experience substantial growth. Currently under construction are over 2,000 km of transmission line rated between 33 kV and 500 kV. Planned but not yet under construction are 1,000 km of 500 kV line, 5,800 km of 220 kV line, 200 km of 132 kV line and 3,000 km of 66 kV line. All of this is planned to be in operation before 1990. It is also planned to build about 20,000 MVA of substation capacity in that period.

Distribution facilities are heavily influenced by the rural electrification programme. At the present time about 80 per cent of the population of Egypt has some sort of electrical service, although much of that has a nominal rating of only 40 watts per person. Over the next decade Egypt intends to extend rural electrification to virtually all of the rest of the populace. There are plans for 10,000 km of distribution lines at 11 and 20 kV and 8,000 km of distribution cable.

3.4.3 Maintenance activities

To date, virtually all major electric power facilities have been built by foreign firms using foreign equipment. Egyptians have provided some input to plant construction, primarily in civil works and fabricated steel. These will be discussed later on in this document. The major role played by Egyptians in the electric power system is in operation and maintenance.

Most routine maintenance, after applicable warranty periods, is carried out locally. Egypt makes it a practice to buy enough spare parts for generating stations and substations to last for several years. Special tools and fixtures required for maintenance and repair are also purchased initially. Some renewal parts are made in Egypt.

Substantial assistance comes from the manufacturers of equipment. Egypt sends maintenance people abroad to the factories of suppliers to learn about plant equipment. In addition, there is local training of maintenance people, conducted both by foreigners and by Egyptians. Difficult maintenance problems are sometimes solved in part by consultation with foreigners.

The country report suggests that Egyptians trained abroad have had substantial effect on the development of an electric power equipment manufacturing industry in Egypt.

3.4.4 Development of local capabilities

Egypt has, in recent years, developed some capacity for system and plant planning and design. It should be noted, however, that virtually all of the generation and transmission capacity in the country has been produced through turnkey arrangements. Almost all major equipment is produced entirely outside of the country.

Egypt's Ministry of Electricity has sufficient planning capability to specify, in general terms, the type, location and rating of new plant capacity. Detailed design of new power plants is still done by the plant constructors, who are always foreigners.

Egypt has developed a civil works capacity which is highly competent and apparently competitive. All civil work is done by Egyptian companies. In addition, Egypt has developed the capability to manufacture steel towers and steel and concrete poles.

3.4.5 Domestic production of electric power equipment

There are nine major firms which produce equipment or supplies relevant to the electric power system. Details of these firms are summarized below. Of the nine firms, six are entirely government owned and one has only one per cent private ownership.

Of the group of nine firms, four can be said to make electric power products. The El Nasr Company for the Manufacture of Transformers and Electrical Products makes transformers and disconnect switches. The Egyptian Electric Cables Company makes cables and insulated wire. Two recently founded firms, EGEMAC and ARABB, make switchgear and other related equipment. These are joint ventures with Siemens and Brown Boveri, respectively.

The remaining five firms include three steel fabricators, one non-ferrous metal fabricator and one manufacturer of asbestos and concrete pipes and poles and bricks.

Regarding the basic materials, copper is practically all imported and aluminium is produced in Egypt, but at great expense. Bauxite is imported and refined into aluminium metal using standard electrolytic techniques. Since Egypt is burning oil to make its marginal electricity, it does not have a comparative advantage in aluminium production. Egypt does have a steel industry, however, and most steel required for electrical equipment is produced or could be produced in the country.

3.4.6 Mastering of technology

A major problem facing Egypt is the mastering of technology. Training is strongly connected with the source country of equipment, as if all technology were associated with one or another form of equipment imports.

Egypt has certain research and development resources. In addition to the universities there are national institutes, including the National Research Centre and a High Voltage Research Centre which is owned by the Ministry of Electricity.

The problem with mastering of technology lies in the relative lack of manufacturing of equipment with technological components. A review of large firms making electrical equipment makes this case quite clear.

There have been some imports of technology. For many years this was through licensing arrangements. Egypt has had a wide range of technology licenses, from France, Germany, Switzerland, Hungary, Czechoslovakia, the United Kingdom and other countries.

In 1974 Egypt made an attempt to attract foreign capital in manufacturing industries by allowing joint ventures. Two of the nine major firms are of this category, making electrical equipment for the Egyptian market. There is still very little indigenous electrical equipment industry in Egypt, and none that seems to export or to compete in world markets.

3.4.7 Linkages with other capital goods industries

The electric power equipment industry uses the same raw materials as other industries: copper, aluminium and steel. Of course those materials are produced by industry, and other industries such as automobiles and construction use them as well. In addition, the electric power equipment industry uses casting facilities used by other industry.

Finally, a relatively large part of local electric power equipment manufacture is in poles and towers, and the companies which produce those also make tanks, cranes, boats, truck bodies and so forth.

3.4.8 Constraints

There are two general types of constraints. One of these deals with the size of the markets involved. It suggests that the domestic market is not large enough to support a local electric power equipment industry. It puts forward the recommendation that developing countries should co-operate and buy different types of electric power equipment from each other.

A second class of constraints is that of financing. The country report points out that no private capital participates in large industries, and that the government does not always have enough foreign exchange to invest.

3.4.9 Policies and strategies

Capital goods industries get priority in national planning, and that the electric power equipment industry has received substantial emphasis. The government invests in this industry and affords the industry substantial protection from outside competition. As an example, it is forbidden to import electric power equipment which is also manufactured in Egypt.

3.5 Algeria

3.5.1 Introduction

Algeria is a producer of petroleum and natural gas and is a member of OPEC. Its oil production has produced some prosperity and financed much capital investment. A large amount of indigenous natural gas is a fuel for local use as well as export.

There has been a lot of investment in the electric power system. This has involved a large increase in generation as well as expansion of rural electrification. At the present time over two-thirds of the dwelling units in the country are electrified and it is planned to have complete electrification by the end of this decade.

Algeria has a strictly planned economy. The public electric utility is making efforts to promote the growth of domestic manufacturing companies. It does this by purchasing what goods and services it can locally and by requiring foreign contractors to work with local firms.

At the present time Algeria has capabilities for making most of the low- and medium-technology components of electric power system, including towers, cables and wire, fittings, cabinets, meters, some motors, generators and transformers. It does all civil and most assembly work in-country. Algeria does not have the capacity to make turbines, large generators nor large transformers.

3.5.2 General information

Algeria is a geographically large country 80 per cent of which is desert. It has a population of about 20 million people. It is a member of the Organization of Petroleum Exporting Countries (OPEC) and is indeed a major producer of oil and natural gas.

Petroleum is very important to the Algerian economy, accounting for about one third of the Gross Domestic Product. The prosperity resulting from rising petroleum prices over the last decade has had a major effect on the country, financing a large amount of capital invesment.

The economy is centrally planned and virtually all industry is owned by the government. There is very little privately owned manufacturing, except for small workshops.

Industrial development in Algeria has been directed towards making equipment essential for agricultural development, certain household appliances and capital equipment for those industries. A major consideration has been to maximize local content.

3.5.3 Electric power sector

Algeria has a single utility supplying both electricity and natural gas (SONELGAZ). Over the last fifteen years it has seen an aggregate growth rate of approximately 14 per cent. Thus, it has had to build a substantial amount of capacity in that time. In 1982 the installed generating capacity was 2,458 MW.

In 1982 the mix and relative fractions of generation capacity were:

Hydroelectric	11.5 per cent
Steam turbine	37.0 per cent
Gas turbine	49.0 per cent
Diesel	2.5 per cent

The predominant fuel for generation of electricity is natural gas. There is some hydroelectric generation but apparently the water supplies, which are already limited, will be needed for other uses. Diesel generation and some of the gas turbines are used in remote locations.

Algeria has embarked on a programme of rural electrification. In 1969 just over one third of dwelling units had electricity. At present that number is about two-thirds and by 1990 it is intended that the country be fully electrified.

All of the rural electrification is being accomplished with locally produced resources. That is, local labour is being used for construction and civil work, poles, cables, fittings and so forth are all made in Algeria.

3.5.4 Manufacture of electric power equipment

The major theme of the country case study is that the public utility could promote the development of local industry by requiring a share in construction and manufacturing for power system needs. SONELGAZ has taken a major role in such development.

Specific actions are taken on behalf of local industry. In particular, long-range planning the utility allows manufacturers to know what equipment requirements will be. Standardization reduces the number of items which must be developed and produced. Technical assistance is given by the utility to local manufacturers in situations in which it seems to be appropriate.

The overall development strategy is outlined in the National Plan. This describes links between the iron and steel industry and the electric utility industry, targets the manufacture of certain capital goods and directs which consumer durables will be manufactured.

Virtually all manufacturing in Algeria is done in the government sector. There is no foreign capital participating in the manufacturing of electric power equipment. Private investment is limited to small enterprises making, at the most, small parts.

The number of enterprises which make electric power equipment is small enough to be enumerated:

(1) The Societé Nationale de montage et de construction de matériel électrique et électronique (SONELEC) was founded in 1969. It makes cables, transformers and other types of medium and low voltage equipment. It has built higher-voltage equipment, having participated in a 150 kV line and builds much equipment for the rural electrification programme.

(2) The Societé Nationale de constructions métalliques (SN.METAL) was founded in 1967. It makes fabricated steel structures and boilers. SN.METAL makes all transmission towers for SONELGAZ. It is also involved in fabrication of structure and sheet metal work in power plants.

(3) The Societé Nationale de constructions méchaniques (SONACOME) was founded in 1969. It makes electric motors, pumps, machine tools and forgings and castings. It also makes vehicles, buses and tractors.

(4) The Office National du Matériel Hydraulique (ONAMHYD) makes reinforced concrete poles.

The large nationalized firms have been reorganized into a larger number of more specialized firms. These firms have developed shops for maintenance and repair of heavy machinery, but these shops are inadequate to the task.

SONELGAZ itself has built workshops for manufacturing and maintaining switchboards, cabinets and accessories. Among these are the following:

(5) The El Ulma meter manufacturing factory (SETIF) is a new enterprise built by foreign constructors. It will use Swiss and United States technology for manufacturing metering, measuring and control apparatus. Water and gas meters as well as electrical apparatus will be manufactured. Technology transfer from the foreign firms involves licensing, training of Algerian workers and executives, supervision and the supply of specialized equipment and tools. At present the local content of the product of this work is about 65 per cent. It is expected to meet all domestic demand in 1985. It is also expected to begin manufacture of circuit breakers in 1985.

(6) The El-Achour electro-mechanical unit. This factory is attached to the national enterprise for the electrical engineering industries (ENEL) which itself was formed as part of a restructuring of SONELEC. It manufactures low- and medium-voltage apparatus, including distribution cabinets and substations. By 1986 it is expected to meet all national requirements.

(7) The Azazga (Tizi Ouzou) complex of industrial electrical equipment is also attached to ENEL. It uses German technology to make medium-sized (up to 1.6 MVA) transformers, small (up to 180 kVA) alternators, some meters and medium-sized (18.5 to 400 kW) electric motors. National content of its product varies between 75 per cent and 85 per cent. By 1986 this factory will supply all national requirements for MV/LV transformers.

(8) The National Enterprise of Electric and Telephone Cables (ENACAB) is a result of the restructuring of SONELEC. As its name implies, it makes cables, although its product is restricted to bare wires and low- and medium-voltage cables. At present, all high voltage cable is imported.

There are other restructured and expanded enterprises that make reinforced concrete poles, transmission line towers and metal poles. When the expansions now underway are completed the country will have the capacity for making enough poles for its needs. At present, the country is importing a number (about 20,000 in 1983) of timber poles.

3.5.5 National integration in thermal station construction

The utility system, being the customer for design services, can help in the development of local capability. In order to do this, which of course involves channelling work to local firms, SONELGAZ has set about to increase its own capabilities in planning, in standardization, to reduce the number of pieces of equipment which must be designed, and in engineering.

Three specific measures are used to promote local capabilities. These are local maintenance of control, not making use of turnkey contracts and systematic use of national industry. The purpose of all of these measures is to ensure that whatever work can be done by local industry is so directed.

3.5.6 Mastering of engineering

Apparently the strategy employed by SONELGAZ to promote local industry is successful, for participation by Algerian firms in power system construction is increasing. In addition to the founding and operation of technical institutes, Algeria has pursued the objective of replacing foreign consultants in a number of roles, including site studies, co-ordination and control of work, transport and custom clearance.

Civil engineering and assembly constitute about half of the cost of a steam plant. Algeria gives priority to the development of skills in these areas. As a result, all civil engineering work and 70 per cent of assembly is now carried out by Algerian firms. SONELGAZ owns enterprises for civil works and for plant assembly.

In constructing electrical plant, SONELGAZ is the client and the general contractor. Some plant work, including civil engineering and building construction, is contracted directly, and much of that is directed to local firms. It is possible to direct some work to Algerian firms through agreement in the original contract even for that part of the plant which is contracted to foreign firms. This is most often done for assembly of foreign made equipment such as turbine-generator sets.

At present, Algerian firms carry out about 43 per cent of all work on specific power plants. It is expected that this may be increased by manufacture of heavy equipment. At present, however, local enterprise participation is mostly limited to that part of the plant which can be built on site.

Plans are underway for a new national enterprise (CEMEL) which would build steam and gas turbines, turbine generators, large motors and diesel engines. Apparently there has not been a firm commitment to go ahead with this enterprise, but studies of its feasibility are part of the next five-year plan (1985-89).

Over the next 25 years, Algeria expects to install another 20 GW of generation capacity together with transmission and distribution apparatus. This is a large enough market to justify the development of a heavy equipment industry. Further, other countries in the region will also require turbine generators, transformers and so forth. Discussions have been held with BHEL (India) and other outside firms.

Algeria appears to have been quite successful in mastering some of the technologies. It is self-sufficient in civil engineering and construction and makes distribution poles, transmission towers and wire, switchgear cabinets, etc.

3.6 Bolivia

3.6.1 Introduction

Bolivia is the smallest country considered in this group with a population of only about six million people. It is a relatively less developed country in Latin America. The country case study gives several reasons for this, including a dispersed, heterogenous population, the fact that the country is landlocked and a lack of industrial tradition. Bolivia is highly dependent on external sources for virtually all of its industrial goods.

Bolivia is a geographically large country with a rich array of natural resources. It has sufficient oil and natural gas for its own needs, and in fact exports natural gas. Bolivia has enough falling water to produce more than enough hydroelectricity to supply all of its needs. It has extensive forest land which produces timber, and it has substantial deposits of metal ore.

Most of Bolivia's energy production is in the form of oil and natural gas with a little coal production. Charcoal is produced for the tin industry. There is some trade between Bolivia and other countries in petroleum products, but that is apparently just to balance patterns of use and production of different petroleum fractions.

Hydroelectricity is important, yielding about 70 per cent of all electrical energy produced.

Bolivia has very little domestic industry of any kind. The principal activities are mining and forestry. There is some smelting of non-ferrous metals: tin, silver, lead and antimony, but apparently no further processing of those materials exists. Bolivia is a large exporter of high quality timber.

In the electric power equipment industry, Bolivia has firms which manufacture distribution transformers, a limited array of cables and some distribution system fittings and poles. All other electric power equipment is imported.

3.6.2 Electric energy production

The electric power system of Bolivia is quite small. In 1982 the installed capacity totalled 510 MW. Of that, 52 per cent was hydroelectric, 33 per cent was in gas-fired thermal stations and the balance was in diesel units, mostly in small isolated systems.

There are two major electric utility companies in Bolivia. One of these, Compañia Boliviana de Energia Eléctrica (COBEE) is privately owned (in fact by foreign capital), and serves the capital La Paz. It has 140 MW of hydro capacity, all fairly old. The other utility company is the Empresa Nacional de Electricidad S.A. (ENDE). This is government owned and produces 108 MW of hydro and 166 MW of gas fired thermal capacity. It also operates some isolated diesel units.

There is some electric generation capacity operated by other companies, principally by the Bolivian Mining Corporation (COMIBOL). Hydro and diesel electricity generation by mining companies utilizes about 10 per cent of all installed capacity in the country. There is also a small amount of energy generation by sugar and oil refineries from waste products.

There are several distribution companies in the country, and ENDE owns shares in each of them. There is a rural electrification effort, run by a government agency which operates a large number of small, isolated diesel units.

Bolivia has several geographically isolated systems which will eventually be interconnected.

3.6.3 Expansion plans

Demand growth predictions have been adversely affected by the economic crisis which entails a period of near zero or negative growth. The predictions that have been made range from no growth for some time to an optimistic projection of 7 per cent growth after 1986.

Short-term plans for generation expansion include two hydroelectric projects and very little thermal capacity, presumably for isolated areas. Several new hydroelectric projects are in various planning stages.

Bolivia has enormous hydroelectric potential. It is estimated that about 18 GW could be installed economically, enough to produce 90,000 GWh per year. A national electrification plan was completed in 1979, before the present economic crisis manifested itself, describing a large number of projects, some purely electrical in nature and some offering irrigation as well.

Thermal generation included in the country's plans will be fired by natural gas or will be geothermal. The latter is considered as long-range. Electricity generation using gas is considered only for certain areas and, presumably, for those times of the year when hydroelectricity is not abundant.

In line with the expansion of electricity generation, transmission and distribution systems will be built, to extend and reinforce existing distribution systems, to extend the system to new areas and to link existing centres. Only major load areas will be added to the national grid. The separate rural electrification scheme will be used for minor load centres.

3.6.4 Maintenance

Because of the remote location of most of Bolivia's power facilities, these have their own maintenance capability, such as machine shops and lifting apparatus. Repairs to generators, including production of many parts, can be done on-site. An adequate supply of spare parts is difficult to maintain because of the wide range of units used and the geographic location of plants.

Expertise at maintenance work is something of a craft in Bolivia. Those who possess the requisite skills pass them on to younger workers, often relatives. There seems to be little organized training of maintenance people. This, combined with a wide diversity of equipment, tends to make maintenance a closed and localized speciality.

The repair of some of the more complex equipment used in protection and communication is beyond the skill of local maintenance technicians. Only the larger companies have facilities for dealing with such equipment. However, increasingly complex equipment is now exceeding the capabilities of any Bolivian companies, so that foreign assistance is required even for repairs.

Maintenance work has had a positive role in developing domestic capabilities for manufacturing, at least in the case of a transformer repair facility which now assembles transformers.

3.6.5 Domestic engineering and consultancy companies

A law exists which demands that the role of domestic consultants should increase gradually over time. In 1978 there were a substantial number of consultants in Bolivia, 62 domestic firms were registered. Because of the economic recession there has been little work and the number is now down to only three to five firms. Domestic firms did about half of the engineering work on new plants.

Bolivia has civil engineering capability, and local firms are able to handle between 70 per cent and 90 per cent of requirements.

3.6.6 Domestic production of electric power equipment

A very limited range of equipment is produced in Bolivia. It consists of distribution transformers of up to 1,000 kVA in rating, aluminium transmission cable, insulated wire, wood and concrete distribution poles and some fittings made from sheet iron.

Transformers are assembled in one plant, from parts imported from Brazil. No foreign technology is involved. Two other transformer plants exist in the country, but they are mostly inactive now because of the recession.

There are two firms that make cables in Bolivia. Cablebol S.A. was started in 1973 with private capital and makes house wiring and telephone cables as well as aluminium overhead wire. It uses imported materials.

Another firm, Plasmar S.A. makes copper and aluminium conductors, also from foreign materials. It has a mix of domestic and foreign capital and uses German and Italian technology. It is at present running at a small fraction of its capacity.

A factory for making concrete poles, owned by an Argentine firm and using German machinery and technology, is now closed due to lack of a market. Another plant, built with local capital but using United States technology, treats wood poles.

3.6.7 Mastering of technology

Since there is no real manufacturing of electric power equipment, there can be no evidence of mastering of any technology. The non-ferrous metal industry has some smelting capacity and there is capability for forging and casting. Further, there is an ability to repair old machinery with locally fabricated spare parts.

Repair skills are acquired and passed on in a manner which is not conducive to the development of large-scale industry. Training facilities exist only in the major firms. An organization known as the Institute for the Training of Skilled Manpower was started in 1970 with co-operation from Spain, however it apparently has been ineffective. Other external organizations, including Electricité de France, have attempted to assist with training, also without apparent success.

A recent agreement between the University and the National Electricity Enterprise is supposed to bring some research capabilities to the University.

3.6.8 Transfer of foreign technology

There is little information available about the transfer of foreign technology. Because of the small amount of industry in Bolivia, it is assumed that very little technology has been transferred. It is felt that joint ventures and licensing agreements often prevent the transfer of technology to the country. A government agency, the Standards of Technology Directorate, attempted to regulate restrictive clauses in contracts, but these standards have been ignored.

In the electric power equipment industry, which has five firms, one has acquired technology by purchasing equipment and the other four have licensed external technology.

3.6.9 Constraints

The country case study cites a long list of constraints on the electric equipment industry in Bolivia. These include:

- A lack of infrastructure
- A lack of planning on the part of the utility industry
- Late start of development
- No industrial tradition in the country
- Excessive dependence on external technology

- Limited demographic development
- No university programmes
- No access to seaports
- Political and social instability

3.6.10 Linkages with other capital goods industries

There are not many other capital goods industries and most of those that do exist are oriented towards consumer goods. Thus, linkages are very limited.

There is a mining industry in Bolivia, but it supplies raw materials to other countries. A few non-ferrous metals, however, no copper or aluminium are smelted in the country. There is no basic iron and steel industry.

Plans exist for some steel industry. The first phase of this is a rolling mill for non-flat forms such as reinforcing bars, structural shapes made from imported material.

There is limited forging and casting capability in the country, mostly oriented towards the mining industry.

3.6.11 Policies and strategies

The basic objectives of the energy policy are to increase the availability of energy to the economy and to move away from hydrocarbon fuels. The principal policy action is to transfer assets from the hydrocarbon (oil and gas) industry to the electricity sector.

The tariff policy appears inconsistent with industrialization aims. There is a high tariff on equipment for the mining industry but a low tariff on consumer goods. In addition, a large number of exemptions and adjustments are made which confuse the policy. Prices for motor fuels are low. However, there is support for natural gas infrastructure.

A new law for investments attempts to provide inducements for building new plants in Bolivia. It makes exemptions from tariffs for imported equipment, accelerated depreciation and an option to gain the imposition of protective tariffs on imports which compete with the output of the plant.

A public purchase law gives locally manufactured goods a price advantage, however, this advantage is low in view of current exchange rates.

3.6.12 Measures to be taken

Several specific recommendations for policy changes are made in the country case study. These include:

- Reforms in tariffs
- Assignment of foreign exchange for materials
- Eventual replacement of foreign with local materials
- Adoption of procurement rules to ensure that local materials are used
- Establishing realistic exchange rates

Certain lines of production should be promoted. Goods to be made should have a large part of value added in the country. Investments made should be sound. To the extent possible, manufacturing should use technology already in hand. Products which meet these criteria are said to include glass insulators, transmission line fittings, sectioning switches and water turbines.

3.7 Pakistan

3.7.1 Introduction

Pakistan is a mixed, planned economy. The electric power sector is state owned and operated. The area surrounding Karachi is supplied by the Karachi Electric Corporation Limited (KESC) now owned by the government and government controlled financial institutions. The remainder of the country is supplied by the Water and Power Development Authority (WAPDA). The investment activities of both WAPDA and KESC are controlled by the Ministry of Water and Power.

Installed generating capacity is roughly half hydro and half thermal capacity with 2,547 MW of hydro and 2,317 MW of thermal. Transmission facilities on the WAPDA system are at 220 and 500 KV. There are over 16,000 kilometres of high voltage transmission lines in Pakistan.

Demand for electricity in Pakistan has been increasing at roughly 12 per cent since 1977 and it is projected to increase at roughly 15 per cent over the next five years. The areas surrounding Karachi are growing somewhat less rapidly than those in the remainder of the country. Demand growth is also supply limited as the WAPDA regions require curtailments in the winter months and until this past year the Karachi area required curtailments in the summer months. This has been relieved by the addition of a 210 MW thermal station.

Roughly 35 per cent of the villages in Pakistan and 25 per cent of the population has access to electricity. The average consumption per capita is 204 kWh.

3.7.2 Institutional organizacion

The two principal institutions are responsible for generation, transmission and sales. In addition WAPDA is responsible for water development, specifically in the northern portion of the country in the Indus basin where there is considerable hydro potential beyond that already under development. At present there is 2,547 MW of capacity out of reserves estimated between 20 and 40,000 MW. The location of the hydro resources in Pakistan is often far from the population centres. While development is moving more towards the centre of the country, much of the industry has remained in the Karachi area.

WAPDA has and will continue to receive the majority of their capital development funds from international lending agencies such as the World Bank and USAID. The large hydro projects are both for irrigation and power development.

3.7.3 Future electric power development in Pakistan

The generating capacity in Pakistan is projected to increase from its present level of 4,949 MW to 30,202 by 2000. This will be made up of 14,811 MW of hydro (relative to today's 2,547), 11,654 MW of conventional thermal (relative to today's 2,265) and 3,737 MW of nuclear (relative to today's 137).

This increase in capacity is required by the high rates of projected growth. The growth will stem from existing customers/areas and significantly from electrification of new areas.

3.7.4 Development of manufacturing capabilities

Pakistan has a relatively well developed industrial base and an established electric power equipment manufacturing sector. Because Pakistan has a mixed economy there are both government and private corporations competing within a number of the manufacturing areas.

Installed manufacturing capability exists in the following areas:

- Transformers up to 33 KV
- Small capability for 66 and 132 KV transformers
- Switch gear and control gear
- Generating sets up to 650 KVA
- Electric motors up to 375 KW
- PVC cables for low and high tension (11 KV)
- ACSR and all aluminium and copper conductors
- Electric meters
- Insulators
- 11 KV drop out fuse fittings.

All of the above industries supply private firms, the government and WAPDA and KESC. In all cases there is excess manufacturing capacity within the country for these products measured in terms of potential shifts of operation.

3.7.5 Constraints

Governmental policy may be a constraint to development of most of the products in the electric power equipment sector. While the capacity exists to supply a significant portion of the domestic market and in some instances to export, the current handling of import allowances (for raw materials) and import protection (against foreign goods) are not favourable for local production.

The role of protected industries in the electric power equipment sector is difficult to evaluate. It appears that a number of industries have been set up by the government to provide heavy electric power equipment at specific industrial sites such as the proposed Texila Heavy Electrical Complex to be situated near the Heavy Mechanical Complex and Heavy Foundry and Forge. It is difficult to establish whether indigenously produced goods can compete effectively with imported goods in such areas as high voltage transformers. Apparently there are no test facilities for these transformers within Pakistan at present. It is therefore unlikely that WAPDA or KESC will be willing to purchase signficant quantities of these transformers as their mandate is to produce reliable electricity.

The impact of international loans and credits on WAPDA's ability to purchase locally is difficult to assess. Such loans and agreements frequently restrict both the quality and the country of origin of equipment.

3.7.6 Recommendations

Two points seem to emerge in the country case study. The first is the need for a detailed evaluation of the level of underutilization of capital in the electric power equipment sector. The second is the need for a more global review of electric power projects and an analysis of the manner in which locally produced components could most effectively be integrated into those projects. The amount of construction propoced for the next decade and a half is clearly sufficient to satisfy the industry as it currently exists.

3.8 India

3.8.1 Introduction

Prior to 1948 electrical supplies in India were handled through private companies with the provincial and central government involved only in regulation. With independence there was a desire to rationalize the production and supply and to organize and co-ordinate planning for future supplies. The result was the establishment of State Electricity Boards (SEB) to co-ordinate development. In 1956 the Industrial Policy Resolution moved generation and distribution to the SEB and thereby paved the way to a nationalized industry.

The electricity sector has maintained a relatively high level of demand growth. In many portions of the country this has exceeded supply requiring rotating blackouts in major urban areas during the summer months. This has been particularly true during years in which rainfall has been low. Projected level of demand growth is 5.5 per cent per annum for the period to 1995.

The role of the central government has primarily been in co-ordination and in the development of hydropower schemes for all of India. A portion of these activities has been structured into a set of generation companies. Two are central, the National Thermal Power Corporation (NTPC) and the National Hydroelectric Power Corporation (NHPC). There is one centrally owned regional generation company, the North-Eastern Electric Power Corporation and one state generation company, the Mysore Power Corporation. In addition the Water and Power Development (Consultancy) Services Limited has been established to provide advice on hydro related activities.

In the private sector there are three utilities still in operation. These are the Tata Electric Company, the Calcutta and Ahmedabad Electric supply companies.

3.8.2 Future electric power development in India

India, like many of the developing countries is attempting to extend electricity to a majority of its villages both for social goals and for extension of agricultural pumping schemes. Without electricity pump sets are diesel or gasoline driven. These place a heavy import burden on the country. It is the goal of the 1985 to 1990 plan to electrify over 3 million pump sets. In the area of village electrification it is expected that there will be 367,000 villages electrified by 1985 with the goal being to add an additional 200,000 villages by 1990. These represent an ambitious plan for a nation the size of India but may be reasonable goals if other development objectives are met.

3.8.3 Industrial development capability

India offers an interesting case study of the electric power equipment sector. It is among the poorest, with the lowest level of consumption per capita yet it has a thriving electric power equipment manufacturing sector and has developed an export market for both its goods and services. In large part this is due to three or four factors. First, India has, for thirty years, had an active policy of import substitution in all sectors. In electric power equipment this has meant emphasis on lower order goods followed by increasingly greater efforts in higher order goods. Nuclear technologies are available in India even though the actual steam systems are not constructed at present. The second reason for the success is the tradition for private capitalization of industry within India. A number of companies have been able to expand their activities laterally to encompass additional manufactured goods. This has offered the required incentive in a protected market.

The third reason is the willingness in India to enter into joint manufacturing ventures with Western manufacturers. The list of collaborative activities includes virtually all of the Eastern and Western European countries, the United States and Canada. This interest has greatly expanded the manufacturing capability.

Finally, the government has played a significant role in the development of heavy industry sites within India at which specific types of goods can be manufactured. These tend to be joint ventures which today are selling on the export market.

3.8.4 Constraints

The internal market in India is sufficiently large to guarantee a market for almost all of the electric power equipment subsectors. The exceptions to this are the gas turbine technology and the nuclear island technologies. In both cases the market is really a world rather than a national market. The constraints to further development in India appear now to be capital and manpower related. Capital because there is limited amount available and it is likely that there are other ventures that now will begin to look more attractive. Manpower because there is a skills pool limitation which has, and will continue to have, a dampening effect on the growth of all of the manufacturing sectors.

3.9 Cameroon

3.9.1 Introduction

Cameroon is a nation with limited development in electrical power generation and transmission. The generation and transmission company SONEL (Societé Nationale d'Electricité du Cameroun) is a mixed economy joint stock company in which the government holds 86 per cent of the stock and other institutional buyers, primarily the National Bank hold the remainder. The industrial sector in Cameroon is also mixed with some important governmental involvement.

3.9.2 SONEL

SONEL currently supplies over 2,000 GWh of energy annually, primarily from hydroelectric facilities. This represents a doubling in energy supplied in the decade to 1982. SONEL was founded in 1974 as a result of the joint of East and West Cameroon into the United Republic of Cameroon. SONEL is a concessionaire responsible for four generation facilities, the distribution of electricity and for the supply of electricity to the three major cities. In addition it operates the secondary power stations in the former Western Cameroon and has responsibilities in rural electrification. In addition to the power supplied by SONEL, 20 companies in Cameroon have auto generation ranging in size from 80 kW to 8,800 kW.

3.9.3 Future electric power development in Cameroon

The reported average rate of requirements in recent years has been 1.25 per cent. Based on this the planning growth rates have been bracketed between 10 and 14.9 per cent per year. This growth includes the planned growth of two major government owned industries, ALUCAM-SOCATRAL and CELLUCAM. The majority of this demand will be supplied from extensions to existing hydroelectric facilities. In addition to changes in the system to supply additional demand, new hydro facilities will be coming on line to replace thermal facilities in the Northern region. With each of the new installations there will be a series of new transmission lines constructed.

A major governmental goal is the extension of electricity to the rural areas. This will begin with a ring around Yaounde, and in the first stage will cover 22 major market towns and roughly 100 villages. In the Northern province a similar project will be undertaken covering roughly one fourth of the number of towns in the South and coastal areas.

3.9.4 Development of capability

At present Cameroon has demonstrated little indigenous capability for planning and construction of electric power facilities and very limited capabilities in manufacture of electric power equipment. Only three industries exist which supply goods to the power sector. One supplies treated wood for poles, one supplies concrete poles and one supplies ALMELEC cables.

3.9.5 Constraints

There appears to be a significant number of constraints to the development of an active industry in electric power equipment in Cameroon. The most significant is the relative size of the market within the country. The second appears to be a constraint on skills available for development of such an industry. The third - according to the country case study - is a bias at SONEL against purchase of locally manufactured products, i.e. a prejudice in favour of imported goods where the quality can be assured to be more uniform. The fourth reason is that the projects developed are turnkey in nature which discourages participation of local firms.

3.9.6 Recommendations

Cameroon appears to have established a strategy for entry into the electric sector through manufacture of the simplest of components with the maximum of existing interindustry linkages. Both the concrete and wooden poles and the aluminium cables are such industries. It is likely that the most successful next step in the process will be towards other aluminium components and towards the maintenance/spares components of the industry. It is unlikely that the electric power equipment sector, specifically any heavy electrical equipment will in the near future play a significant role in the industrial sector of Cameroon.

3.10 Indonesia

3.10.1 Introduction

Indonesia is a large archipelago containing 3,000 inhabited islands, with the majority of the population concentrated on Java. Roughly 90 million live on this island which contains only 7 per cent of the total area of the country. The current per capita income is $US 450 and the consumption of electricity 60 kWh/capita. Electricity demand has been growing at over 20 per cent per annum for the last decade against a 7 per cent per annum growth in GDP. At present there are only roughly 4 million inhabitants with access to electricity.

Indonesia is energy rich with significant oil reserves, with coal reserves and with an increasing wealth in natural gas reserves. Indonesia also has had a long tradition of expatriate influence in natural resources and mining and with it a tradition in manufacturing. This extends into the electric power equipment sector.

3.10.2 Institutional organization

Indonesia has a relatively unique mixture of public and private generation. A large number of facilities in the country produce their own power. In 1973 the government operated only 780 MW of capacity while captive generation accounted for 1,250 MW. By 1983 the situation was reversed and the PNM accounted for 3,000 MW of capacity and captive generation for less than 2,700 MW.

3.10.3 Future electric power development in Indonesia

Significant increase in generating capacity is planned for Indonesia based on coal and on natural gas. This capacity will also be extended to other than the main island of Java. One of the primary issues in future development is the fact that the resources and the population demand centres are not located in close proximity.

The current strategy of the government is to encourage the development of indigenous non-exportable resources for use in the electric power sector in order to earn foreign exchange from the oil market. This has meant planning on lower quality coals for electricity. The government has also stated that it will allow entry of private investment into the electric generation industry.

3.10.4 Development of capability

The primary constraint to development of the electric power equipment sector in Indonesia appears to be manpower, since Indonesia has significant energy resources and has made efforts to increase their manufacturing sector. In addition as part of the ASEAN group, they have access to both technology and eventually to a more open common market for manufactured goods.

3.11 Tanzania

3.11.1 Introduction

Tanzania represents one of the least developed of the countries considered in this study. Population density is low with significant population groupings at only three major cities. At present only 5 per cent of Tanzania's population of 17 million have access to electricity, the majority of whom are in the major urban areas. The industrial sector of Tanzania is mixed with significant investment being governmental. The power company, Tanzania Electric Supply Company Limited (TANESCO) is completely owned by the government.

Electric power equipment manufacture in Tanzania is limited to distribution transformers, aluminum conductors and low voltage cables and poles. The interindustry structure of the economy is weak and as a result the impact of electric power equipment manufacturing is limited. The majority of the components for all manufactured equipment, except wood for the poles, is imported. At present the industry employs a total of only 250 individuals.

Construction of both thermal and hydro facilities in Tanzania has been carried out primarily by foreign firms. Tanzanian firms have been responsible for civil works on smaller projects and have been responsible for the labour component of the civil works on larger projects. This includes both generation and transmission and distribution.

3.11.2 Future electric power development in Tanzania

The direction of future growth in electric power will be determined by the ability of the Government to raise funds for individual projects. The interconnected system is based largely on hydro. There are a series of large-scale hydro projects underway or in the planning stage. The isolated system is currently dominated by diesel systems but the plan is for new locations in the isolated system to be served by mini hydro systems or interconnection. It is also planned that a larger component of the labour and equipment for these systems will be provided locally though there are no plans for manufacture of, for instance, small turbines.

Demand growth in Tanzania will be heavily influenced by the development goals. At present the emphasis is on rural electrification as one portion of a plan to move economic growth into the rural areas and thereby stabilize population movement. Such electrification schemes tend to orient investment towards transmission and distribution and away from plants. This will offer additional opportunity for Tanzanian involvement in construction.

The role of maintenance as a stepping stone to manufacture is discussed briefly in the country study. TANESCO has been able to manufacture some spares for the system though in general spares are imported from the original suppliers.

3.11.3 Development capability

The development of a capability for electric power equipment manufacture in Tanzania appears limited. The power company and government owned production units have too small a market to justify significant investment in capital stock. The potential for expanding manufacture of spares and of expanding the role in distributed systems such as mini hydro appears far greater as does the possibility for expanding the local role in civil works activities.

3.11.4 Constraints

Tanzania has both capital and manpower constraints in developing an electric power equipment industry. Given the structure of the electric supply system, only governmental involvement is likely to build an industry to supply components for power plants and further equipment for transmission and distribution. Given this, overall governmental constraints in capital formation will be binding for the electric power equipment manufacturing sector.

3.12 Sri Lanka

Sri Lanka was not a portion of the original country case study set of UNIDO. This section is based on data available to the research team.

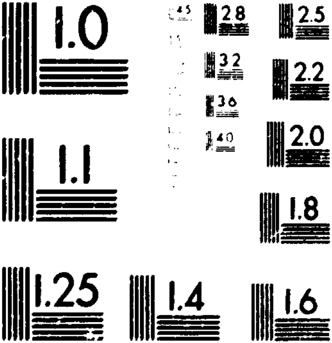
Sri Lanka is a relatively poor nation which falls into group 4 of the countries studied. Its per capita income was $US 270 in 1980 and the consumption of electricity was 113.5 kWh per capita. At the present time the most significant source of electricity is hydro power which accounts for 78 per cent of the generating capacity and 89 per cent of the energy generated.

The policy of the Government with regard to private investment has changed significantly as a function of their political posture. The current Government stimulates private sector development and as a result is both encouraging private investment and actively seeking divestiture of nationalized industrial activities.

Virtually all of the hydro power plants within Sri Lanka have been supplied/constructed by CGEE ALSTHOM of France with limited local participation. CGEE provides all spares and from in-country staff provides all of the maintenance capability as well.

At the present time the electric power equipment sector is relatively undeveloped given the small size of the internal market. A new industrial firm, Lanka Transformers Ltd is currently in the start up phase. Lanka will produce distribution and substation transformers for the local market. The company is a stock company with the majority of the stock held by the Government. The Government appoints some of the members of the board but does not have any influence on the day to day operations of the company.

The Sri Lankan Government is actively encouraging private sector industrial development. There are a number of incentives being applied such as tax benefits and capital availability as well as joint ventures similar to that described above. In addition a free trade zone has been established to



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encourage external investment as well as local investment aimed at an export market. Such international firms as Motorola and Harris are considering development of electronic manufacturing capabilities in these areas. It is not known whether these will involve any electronics for power systems.

The major planned electrical sector projects are in rural electrification. Because of the significance of Colombo and other larger urban areas which are electrified, the majority of the population has access to electricity. The extension to the rural areas will be expensive but necessary.

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Options and strategies
An analysis of eleven country case studies

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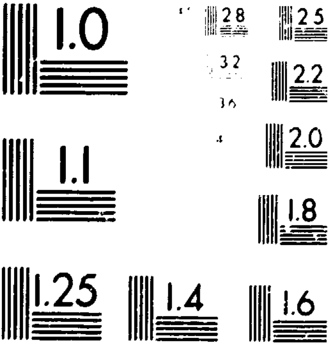
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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Distr.
LIMITED
UNIDO/IS.507/Add.1
6 February 1985
ENGLISH

ELECTRIC POWER EQUIPMENT PRODUCTION IN DEVELOPING COUNTRIES: OPTIONS AND STRATEGIES
AN ANALYSIS OF ELEVEN COUNTRY CASE STUDIES
STATISTICAL DATA

Sectoral Working Paper Series

No. 25, Volume II

Sectoral Studies Branch
Division for Industrial Studies

V.85-22048

SECTORAL WORKING PAPERS

In the course of the work on major sectoral studies carried out by the UNIDO Division for Industrial Studies, several working papers are produced by the secretariat and by outside experts. Selected papers that are believed to be of interest to a wider audience are presented in the Sectoral Working Papers series. These papers are more exploratory and tentative than the sectoral studies. They are therefore subject to revision and modification before being incorporated into the sectoral studies.

This document was prepared by James R. Kirtley and Richard D. Tabors of Meta Systems as UNIDO consultants. The designations employed, the presentation of material and the views expressed in this document are those of the consultants and do not necessarily reflect the views of the UNIDO secretariat.

Preface

This document has been prepared for the Sectoral Studies Branch, Division for Industrial Studies, as part of the background documents for the Second Consultation Meeting on Capital Goods to be held in Stockholm in June 1985.

This is volume II of the study entitled "Electric power equipment production in developing countries: Options and strategies. An analysis of eleven country case studies", Sectoral Working Paper Series No. 25 (UNIDO/IS.507).

The main statistical sources used in the elaboration of this report are the data contained in the eleven country case studies prepared by national consultants to UNIDO. The case studies are available in the UNIDO secretariat, in original languages and draft English translation wherever applicable.

The countries covered by these tables are as follows: Algeria, Bolivia, Cameroon, Colombia, Egypt, India, Indonesia, Republic of Korea, Mexico, Pakistan and Tanzania.

As in volume I, Meta Systems, a consulting firm, has undertaken the work presented.

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EXPLANATORY NOTES

References to dollars ($) are to United States dollars, unless otherwise stated.

A comma (,) is used to distinguish thousands and millions.

A full stop (.) is used to indicate decimals.

A slash between dates (e.g., 1980/81) indicates a crop year, financial year or academic year.

Use of a hyphen between dates (e.g., 1960-1965) indicates the full period involved, including the beginning and end years.

Metric tons have been used throughout.

The following forms have been used in tables:

> Three dots (...) indicate that data is not available or is not separately reported.
>
> A dash (-) indicates that the amount is nil or negligible.
>
> A blank indicates that the item is not applicable.
>
> Totals may not add up precisely because of rounding.

Besides the common abbreviations, symbols and terms and those accepted by the International System of Units (SI), the following abbreviations and contractions have been used in this report:

Economic and technical abbreviations

GDP	Gross domestic product
GW	Gigawatt
hp	Horsepower
kW	Kilowatt
kWh	Kilowatt hour
kV	Kilovolt
kVA	Kilovolt-ampere
MVA	Manufacturing value added
MW	Megawatt

Introduction

This statistical report contains the detailed data supporting the volume I of the study entitled "Electric power equipment production in developing countries: Options and strategies. An analysis of eleven country case studies", Sectoral Working Paper Series No. 25 (UNIDO/IS.507).

The basis for this report was eleven country case studies prepared by national consultants to UNIDO, representing the electric power equipment sector of the various countries. The main statistical data contained in the country case studies are included in this report.

The data are organized into seven tables for each of the case study countries, as follows:

Table 1: Domestic production of primary energy

These tables include available information on production data of primary energy in Terajoules - TJ (coal, other solid fuels, crude oil, natural gas, hydroelectricity and geothermal electricity) and their share of primary energy at country level. The tables cover in most of the cases a period of 12 years between 1972 and 1983.

Table 2: Installed capacity, production and consumption of electric energy

Table 3: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

Table 2 and 3 contain past and present data, planned future projections for electrical energy generation and consumption (installed capacity in MW for hydro, conventional thermal and geothermal power stations); electricity production in GWh; consumption in GWH by industry and construction, transport and household; ownership of generation plants, public and self-producer.

Table 4: Existing electric power generating stations, commissioned after 1970

In this table, data on the existing electric power generation plants are presented. It includes the year of commissioning, the plant size in MW, the equipment used in hydro, conventional thermal, gas turbine plants, the percentage of local content and foreign supplier.

Table 5: Existing electric power transmission facilities, commissioned after 1970

Table 6: Existing distribution equipment, commissioned after 1970

In these tables, data on existing transmission and distribution facilities are presented. They include the year of commissioning, voltage in KV, sub-station, transmission line and cable and the equipment available and the percentage of local content and foreign supplier. The preferred unit of measurement is metric tons. However, others such as km or number of units were also used depending upon the availability of statistical data.

Table 7: Domestic production of electric power equipment

The data included in this table refer to types and quantity of existing electric power generation, transmission and distribution equipment which are domestically manufactured: volume, value, manufacturer, local content and technology sources.

The countries covered by these tables are as follows:

1. Algeria
2. Bolivia
3. Cameroon
4. Colombia
5. Egypt
6. India
7. Indonesia
8. Republic of Korea
9. Mexico
10. Pakistan
11. Tanzania

While volume I presents in a systematic way the situation of the electric power equipment industry in the eleven developing countries, this volume II presents some statistical information supporting this analysis. The tables are - as far as possible - presented in a standard format. In several cases the information is incomplete or lacking.

Table 1. Algeria: Domestic production of primary energy, 1969, 1972 to 1982

Year	Petroleum		Natural gas		Other sources*		Total	
	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent
1969	49,256	94.0	2,777	5.3	367	0.7	52,400	100
1972	55,106	93.4	3,481	5.9	413	0.7	59,000	100
1973	55,876	91.3	4,896	8.0	428	0.7	61,200	100
1974	51,840	90.0	5,357	9.3	403	0.7	57,600	100
1975	52,243	88.1	6,523	11.0	534	0.9	59,300	100
1976	55,141	86.7	8,014	12.6	445	0.7	63,600	100
1977	58,874	88.4	7,459	11.2	266	0.4	66,600	100
1978	62,867	83.6	11,882	15.8	451	0.6	75,200	100
1979	62,446	75.6	19,576	23.7	578	0.7	82,600	100
1980	56,692	80.3	13,273	18.8	635	0.9	70,600	100
1981	51,224	76.0	15,367	22.8	809	1.2	67,400	100
1982	50,408	70.5	20,020	28.0	1,073	1.5	71,500	100

* Other sources include hydro, coal, coke, etc.

Table 1. Bolivia: Domestic production of primary energy, 1972 to 1983

Year	Coal		Other solids		Petroleum		Natural gas		Hydro-electric		Total	
	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent
1972	144	0.1	13,570	5.5	92,373	37.1	140,332	56.4	2,556	1.0	248,975	100
1973	178	0.1	14,225	4.9	99,865	34.2	175,536	60.0	2,607	0.9	292,411	100
1974	169	0.1	14,769	5.3	96,053	34.2	167,321	59.5	2,750	1.0	281,062	100
1975	163	0.1	16,213	6.1	85,233	31.9	162,906	60.9	2,879	1.1	267,394	100
1976	225	0.1	18,165	6.3	85,951	29.7	182,437	63.0	3,011	1.0	289,789	100
1977	316	0.1	18,894	6.9	73,338	26.9	176,613	64.8	3,270	1.2	272,431	100
1978	407	0.1	18,594	6.8	68,526	25.0	182,659	66.7	3,472	1.3	273,658	100
1979	376	0.1	19,514	7.3	58,863	22.0	185,650	69.3	3,648	1.4	268,051	100
1980	567	0.2	38,849	13.4	50,358	17.4	195,929	67.7	3,891	1.3	289,594	100
1981	626	0.2	39,488	13.3	46,811	15.8	204,819	69.2	4,158	1.4	295,902	100
1982	692	0.2	37,762	12.1	51,596	16.5	218,050	69.8	4,341	1.4	312,441	100
1983*	713	0.2	38,594	13.0	46,858	15.8	206,655	69.6	4,287	1.4	297,107	100

* Estimate

Table 1. Cameroon: Domestic production of primary energy, 1972 to 1984

Year	Coal		Other solids		Petroleum		Natural gas		Hydro-nuclear		Total	
	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent
no data available												

Table 1. Colombia: Domestic production of primary energy, 1970 to 1981

Year	Coal		Other solids		Petroleum		Natural gas		Hydro-electric		Total	
	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent
1970	68	9.0	123	16.3	459	60.9	73	9.7	31	4.1	753	100
1971	...	...	...	...	...	...	...	...	...	...	...	...
1972	79	10.5	131	17.3	411	54.5	85	11.3	48	6.4	754	100
1973	...	...	...	...	...	...	...	...	...	..	...	...
1974	98	13.5	135	18.5	351	48.2	84	11.5	61	8.3	728	100
1975	...	...	...	...	...	...	...	...	...	...	...	...
1976	109	15.5	138	19.6	305	43.4	90	12.8	60	8.6	702	100
1977	...	...	...	...	...	...	...	...	...	...	...	...
1978	134	18.3	145	19.9	273	37.3	121	16.5	58	8.0	732	100
1979	138	18.5	149	19.9	258	34.5	132	17.6	71	9.5	748	100
1980	...	...	...	...	...	...	...	...	...	...	...	...
1981	...	...	...	...	...	...	...	...	...	...	...	...

Table 1. <u>Egypt</u>: Domestic production of primary energy, 1972 to 1983

Year	Coal		Petroleum		Natural gas		Electricity		Total	
	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent
1972	-	-	456,815	89.5	-	-	53,426	10.5	510,241	100
1973	-	-	361,318	87.1	-	-	53,386	12.9	414,704	100
1974	-	-	317,597	83.3	-	-	63,456	16.7	381,053	100
1975	-	-	500,024	87.4	1,535	0.3	70,314	12.3	571,873	100
1976	-	-	706,017	88.9	5,348	0.7	82,869	10.4	794,234	100
1977	-	-	888,317	88.7	19,530	2.0	93,583	9.3	1,001,430	100
1978	-	-	1,034,779	88.2	34,922	3.0	102,878	8.8	1,172,579	100
1979	-	-	1,121,113	88.3	49,523	3.9	99,494	7.8	1,270,130	100
1980	-	-	1,253,001	86.6	92,628	6.4	101,492	7.0	1,447,121	100
1981	-	-	1,352,972	86.[illegible]	100,440	6.4	105,777	6.8	1,559,189	100
1982	-	-	1,401,978	86.4	111,600	6.9	108,564	6.7	1,622,142	100
1983	-	-	1,529,817	86.6	134,850	7.6	101,645	5.8	1,766,312	100

Table 1. India: Domestic production of primary energy, 1972 to 1983

Year	Coal		Other solids		Petroleum		Natural gas		Hydro-nuclear		Total	
	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent
1972	2,263,133	81.6	34,979	1.3	311,972	11.2	61,035	2.2	102,124	3.7	2,773,242	100
1973	2,290,975	81.4	37,574	1.3	306,347	10.9	66,807	2.4	113,083	4.0	2,814,785	100
1974	2,593,430	82.5	33,173	1.1	327,441	10.4	79,599	2.5	108,468	3.5	3,142,111	100
1975	2,921,382	82.6	34,189	1.0	359,997	10.2	92,352	2.6	129,521	3.7	3,537,440	100
1976	2,961,240	81.9	45,359	1.3	379,173	10.5	94,692	2.6	137,307	3.8	3,617,771	100
1977	2,959,188	79.7	40,395	1.1	458,647	12.3	110,721	3.0	145,201	3.9	3,714,152	100
1978	2,987,910	78.4	37,235	1.0	495,721	13.0	109,629	2.9	179,988	4.7	3,810,482	100
1979	3,046,525	78.9	32,609	0.8	501,388	13.0	107,913	2.8	174,328	4.5	3,862,763	100
1980	3,341,359	81.2	54,160	1.3	447,738	10.9	91,962	2.2	178,546	4.3	4,113,765	100
1981	3,660,812	77.0	66,346	1.4	690,080	14.5	150,189	3.2	189,540	4.0	4,756,968	100
1982	3,857,173	74.2	72,327	1.4	897,436	17.3	192,504	3.7	181,213	3.5	5,200,653	100
1983	...	...	...	...	...	...	...	...	...	...	...	...

Table 1. Indonesia: Domestic production of primary energy, 1972 to 1983

Year	Coal		Other solids		Petroleum		Natural gas		Electricity*		Total	
	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent
1972	5,253	0.2	100,000	3.9	2,321,892	89.8	150,729	5.8	8,996	0.3	2,586,870	100
1973	4,362	0.1	100,000	3.2	2,867,706	90.6	182,801	5.8	10,557	0.3	3,165,426	100
1974	4,577	0.1	100,000	3.1	2,945,789	90.1	208,202	6.4	12,043	0.4	3,270,610	100
1975	6,049	0.2	100,000	3.2	2,799,139	88.9	228,701	7.3	13,573	0.4	3,147,462	100
1976	5,653	0.2	100,000	2.7	3,230,372	88.0	321,201	8.7	14,543	0.4	3,671,769	100
1977	5,503	0.1	100,000	2.3	3,610,772	84.1	558,517	13.0	16,398	0.4	4,291,190	100
1978	6,239	0.1	100,000	2.2	3,502,440	78.3	844,226	18.9	19,440	0.4	4,472,345	100
1979	6,590	0.1	100,000	2.2	3,407,071	74.6	1,027,786	22.5	23,965	0.5	4,565,412	100
1980	7,555	0.2	100,000	2.2	3,392,954	73.5	1,085,586	23.5	29,070	0.6	4,615,165	100
1981	8,944	0.2	100,000	2.1	3,433,001	72.5	1,156,980	24.4	35,028	0.7	4,733,953	100
1982	12,778	0.3	100,000	2.4	2,865,539	68.7	1,144,839	27.4	48,409	1.2	4,171,565	100
1983	...	...	...	...	...	...	...	...	...	...	...	...

* Includes hydro, geothermal and conventional thermal

Table 1. Republic of Korea: Domestic production of primary energy, 1972 to 1983

Year	Coal		Other solids		Petroleum		Natural gas		Electricity		Nuclear		Total	
	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent
1972	363,502	67.5	170,027	31.6	-	-	-	-	4,931	0.9	-	-	538,460	100
1973	397,733	71.2	156,476	28.0	-	-	-	-	4,630	0.8	-	-	558,839	100
1974	447,322	74.0	150,212	24.9	-	-	-	-	6,870	1.1	-	-	604,404	100
1975	515,609	77.3	145,737	21.8	-	-	-	-	6,066	0.9	-	-	667,412	100
1976	481,436	77.3	135,297	21.7	-	-	-	-	6,448	1.0	-	-	623,181	100
1977	506,084	78.6	132,826	20.6	-	-	-	-	5,021	0.8	256	-	644,187	100
1978	529,119	78.6	129,459	19.2	-	-	-	-	6,516	1.0	8,378	1.2	673,472	100
1979	533,633	79.2	120,681	17.9	-	-	-	-	8,394	1.2	11,362	1.7	674,070	100
1980	545,825	81.1	107,258	15.9	-	-	-	-	7,152	1.1	12,534	1.9	672,769	100
1981	582,195	82.2	106,192	15.0	-	-	-	-	9,764	1.4	10,433	1.5	708,584	100
1982	589,551	82.6	102,996	14.4	-	-	-	-	7,229	1.0	13,615	1.9	713,391	100
1983	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1. Mexico: Domestic production of primary energy, 1972 to 1983

Year	Coal		Petroleum		Natural Gas		Hydro-Electric		Geothermal		Total	
	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent	Tera-joule	Per cent
1972	50,115	3.4	792,532	53.1	593,723	39.8	55,513	3.7	...	...	1,491,883	100
1973	54,916	3.3	932,574	56.0	618,614	37.2	58,398	3.5	580	...	1,665,082	100
1974	59,400	3.0	1,187,066	59.7	680,689	34.2	60,290	3.0	1,669	0.1	1,989,114	100
1975	59,743	2.6	1,479,450	63.9	718,907	31.1	54,612	2.4	1,867	0.1	2,314,579	100
1976	61,827	2.5	1,657,595	66.5	705,479	28.3	62,038	2.5	5,083	0.2	2,492,022	100
1977	70,821	2.5	2,025,195	71.1	682,689	24.0	69,067	2.4	2,134	0.1	2,849,906	100
1978	69,776	2.0	2,503,076	71.8	854,580	24.5	58,354	1.7	2,155	0.1	3,487,941	100
1979	70,004	1.7	3,036,379	73.2	973,112	23.5	64,742	1.6	3,673	0.1	4,147,910	100
1980	70,004	1.3	4,007,409	75.2	1,187,000	22.3	60,787	1.1	3,298	0.1	5,328,498	100
1981	72,118	1.1	4,772,584	75.9	1,354,016	21.5	88,559	1.4	3,475	0.1	6,290,752	100
1982	71,404	1.0	5,668,962	78.3	1,414,509	19.5	82,268	1.1	3,597	...	7,240,740	100
1983	71,048	0.8	6,622,225	79.2	1,579,235	18.9	85,260	1.0	3,532	...	8,361,300	100

Table 1. **Pakistan**: Domestic production of primary energy, 1972 to 1983

Year	Coal Tera-joule	Coal Per cent	Other solids Tera-joule	Other solids Per cent	Petroleum Tera-joule	Petroleum Per cent	Natural gas Tera-joule	Natural gas Per cent	Hydro-electric Tera-joule	Hydro-electric Per cent	Total Tera-joule	Total Per cent
1972	24,122	3.8	453,058	71.3	18,000	2.8	125,843	19.8	14,371	2.3	635,394	100
1973	24,614	3.7	455,189	69.1	18,000	2.7	144,135	21.9	17,012	2.6	658,950	100
1974	24,943	3.6	468,979	67.8	18,000	2.6	164,112	23.7	16,176	2.3	692,210	100
1975	26,651	3.8	462,791	66.0	18,000	2.6	177,141	25.2	17,027	2.4	701,610	100
1976	21,712	3.1	464,718	66.1	18,000	2.6	177,276	25.2	21,234	3.0	702,940	100
1977	24,696	3.4	479,888	65.2	18,098	2.5	192,799	26.2	20,246	2.8	735,727	100
1978	25,746	3.4	492,895	64.7	18,941	2.5	195,578	25.7	29,164	3.8	762,324	100
1979	28,149	3.6	495,038	62.9	19,824	2.5	211,154	26.8	32,629	4.1	786,794	100
1980	34,785	4.2	494,641	59.0	19,108	2.3	255,087	30.5	34,054	4.1	837,675	100
1981	41,306	4.6	512,317	57.1	18,420	2.1	289,630	32.3	35,336	3.9	897,009	100
1982	51,634	5.5	525,364	55.6	19,077	2.0	311,504	33.0	37,210	3.9	944,789	100
1983	44,998	4.6	538,329	55.0	20,397	2.1	331,054	33.8	44,402	4.5	979,180	100

Table 1. Tanzania: Domestic production of primary energy, 1972 to 1983

Year	Coal Tera-joule	Other solids Tera-joule	Petroleum Tera-joule	Natural gas Tera-joule	Hydro-electric Tera-joule	Total Tera-joule
1972	...	...	-	-	1,689	1,689
1973	...	...	-	-	1,844	1,844
1974	...	...	-	-	1,913	1,913
1975	...	...	-	-	2,010	2,010
1976	...	...	-	-	2,149	2,149
1977	...	...	-	-	2,225	2,225
1978	...	...	-	-	2,450	2,450
1979	...	...	-	-	2,710	2,710
1980	...	...	-	-	2,881	2,881
1981	...	...	-	-	2,969	2,969
1982	...	...	-	-	2,992	2,992
1983	...	...	-	-	...	...

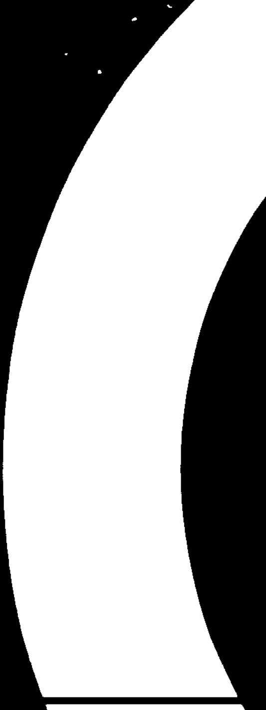


Table 2. Algeria: Installed capacity, production and consumption of electric energy, 1962, 1969, 1974, 1977 and 1982

	Installed capacity in MW				
	1962	1969	1974	1977	1982
Country total	460.0	626.0	988.0	1,518.0	2,458.0
Hydro	188.6	284.8	...	...	282.7
Steam thermal	225.4	284.8	...	...	909.5
Gas turbines	23.0	37.6	...	...	1,204.4
Diesel	23.0	18.8	...	...	61.5
Public total	460.0	626.0	988.0	1,518.0	2,458.0
Hydro	188.6	284.8	...	...	282.7
Steam thermal	225.4	284.8	...	...	909.5
Gas turbines	23.0	37.6	...	...	1,204.4
Diesel	23.0	18.8	...	...	61.5
	Production in GWh				
	1962	1969	1974	1977	1982
Country total	1,156.0	1,477.0	2,624.0	4,200.0	8,136.0
Hydro	404.6	376.6	...	...	488.2
All thermal	716.7	1,056.1	...	...	7,525.8
Diesel	34.7	44.3	...	...	122.0
Public total	1,156.0	1,477.0	2,624.0	4,200.0	8,136.0
Hydro	404.6	376.6	...	...	488.2
All thermal	716.7	1,056.1	...	...	7,525.8
Diesel	34.7	44.3	...	...	122.0
	Consumption in GWh				
	1962	1969	1974	1977	1982
Net consumption*	998.0	1,289.0	2,312.0	3,600.0	7,052.0
Industry and construction	...	...	...	...	...
Transport	...	...	...	...	...
Household and other	...	...	...	...	...

* Net consumption = net production + imports - exports - T & D losses

Table 2. Bolivia: Installed capacity, production and consumption of electric energy, 1972-1983

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
	Installed capacity in MW											
Country total	272.2	311.9	350.5	376.2	399.0	405.6	427.8	421.3	489.0	507.5	516.6	539.4
Hydro	178.5	214.6	241.5	241.5	241.5	241.5	241.5	238.4	264.8	282.8	282.8	282.8
Thermal	93.7	97.3	109.0	134.7	157.5	164.1	186.3	182.9	224 2	224.7	233.8	256.6
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	186.4	223.7	260.8	285.1	305.8	306.8	327.2	327 3	390.7	409.1	426.2	449.0
Hydro	151.1	187.1	214.1	214.1	214.1	214.1	214.1	214.1	241.1	259.1	259.1	259.1
Thermal	35.3	36.6	46.7	71.0	91.7	92.7	113.1	113.2	149.6	150.0	167.1	189.9
nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
	Production in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	891.0	918.0	995.2	1,057.0	1,132.0	1,259.7	1,353.8	1,432.7	1,564.8	1,677.3	1,677.7	1,659.1
Hydro	710.1	724.1	764.0	799.7	836.5	908.3	964.5	1,013.2	1,080.7	1,154.9	1,205.8	1,190.[illegible]
Thermal	180.8	193.9	229.2	257.3	295.5	351.4	389.3	419.5	480.1	522.4	471.9	504.3
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	615.0	638.8	705.7	770.0	849.5	971.1	1,051.3	1,126.3	1,260.2	1,375.0	1,382.1	1,397.9
Hydro	552.5	565.8	606.1	642.1	684.6	765.6	810.1	860.1	936.4	1,015.1	1,063.5	1,048.6
Thermal	62.5	73.0	100.6	127.9	164.9	205.5	241.2	266.2	323.8	359.9	318.6	349.3
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Net production	887.0	913.2	987.2	1,052.0	1,127.0	1,254.0	1,349.0	1,423.4	1,554.7	1,666.2	1,669.0	1,685.1
T & D losses	88.8	101.8	120.2	129.0	116.7	131.9	141.1	141.2	154.7	162.9	182.0	182.0
Imports	-	-	-	-	-	-	-	2.0	2.5	3.1	3.3	3.5
Exports	-	-	-	-	-	-	-	-	-	-	-	-
	Consumption in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Net consumption*	798.2	811.4	867.0	923.0	1,010.3	1,122.1	1,207.9	1,282.2	1,400.0	1,503.3	1,487.0	1,503.0
Industry and construction	512.4	520.1	549.7	581.1	633.4	724.9	762.5	780.0	851.1	899.9	875.3	870.0
Transport	-	-	-	-	-	-	-	-	-	-	-	-
Household and other	285.8	297.3	317.3	342.9	376.9	397.2	445.4	502.2	548.9	603.4	611.7	633.0

* Net consumption = net production + imports - exports - T & D losses. Consumption or production values supplied do not include import figures.

Table 2. Cameroon: Installed capacity, production and consumption of electric energy, 1970-1981

	Installed capacity in MW											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Country total	229	234	243	244	244	287	315	319	318	318	322	529
Hydro	203	203	203	203	203	245	266	266	266	266	266	458
Thermal	26	31	40	40	41	42	49	54	52	52	56	71
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	229	234	243	244	244	287	315	319	318	318	322	529
Hydro	203	203	203	203	203	245	266	266	266	266	266	458
Thermal	26	31	40	40	41	42	49	54	52	52	56	71
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-

Production in GWH											
1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981

No data available

Consumption in GWH											
1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981

No data available

Table 2. Colombia: Installed capacity, production and consumption of electric energy, 1972-1983

	Installed capacity in MW											
	1972	1973	1974	1975	1976	1977	1978	1979	1930	1981	1982	1983
Country total	2,491	2,674	2,674	3,119	3,185	3,793	3,987	4,179	4,462	4,521	5,232	5,440
Hydro	1,764	1,815	1,815	2,194	2,194	2,694	2,694	2,916	2,986	2,982	3,482	3,497
Thermal	727	859	859	925	991	1,099	1,293	1,263	1,476	1,539	1,750	1,943
Nuclear	-	-	-	-		-	-	-	-	-	-	-
Geothermal	-	-	-	-		-	-	-	-	-	-	-
Public total	2,278	2,461	2,461	2,906	2,972	3,580	3,744	3,936	4,219	4,278	4,989	5,197
Hydro	1,744	1,795	1,795	2,174	2,174	2,674	2,674	2,896	2,966	2,962	3,467	3,477
Thermal	534	666	666	732	798	906	1,070	1,040	1,253	1,316	1,527	1,720
Nuclear	-	-	-	-	-		-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-

	Production in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	10,464	11,445	12,498	13,423	14,732	15,304	17,434	19,106	20,533	21,163	22,787	24,364
Hydro	7,150	7,733	8,738	9,656	10,186	10,421	12,095	13,270	14,475	14,421	15,205	15,485
Thermal	3,314	3,712	3,760	3,767	4,546	4,883	5,339	5,836	6,058	6,742	7,582	8,879
Nuclear	-	-	-	-		-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-		-	-	-	-
Public total	9,181	10,226	11,200	12,137	13,484	14,129	16,132	17,796	19,428	19,631	21,487	23,064
Hydro	6,926	7,552	8,553	9,509	10,030	10,256	11,914	13,094	14,295	14,221	15,005	15,285
Thermal	2,255	2,674	2,647	2,628	3,454	3,873	4,218	4,702	5,133	5,410	6,482	7,779
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Net production	10,331	11,272	12,307	13,237	14,489	15,011	17,101	18,736	20,105	20,757	22,304	23,864
T & D losses	1,460	1,695	1,823	1,997	2,154	2,350	2,787	3,275	3,727	3,814	4,334	4,382
Imports	7	9	15	18	20	23	25	29	33	40	38	40
Exports	-	-	-	-	-	-	-	-	-	-	-	-

	Consumption in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Net consumption*	8,878	9,586	10,499	11,256	12,355	12,64	14,339	15,490	16,411	16,983	18,008	19,522
Industry and construction	3,895	4,083	4,369	4,489	4,896	4,838	5,362	5,631	5,494	5,971	5,776	...
Transport	-	-	-	-	-	-	-	-	-	-	-	...
Household and other	4,983	5,503	6,130	6,769	7,459	7,846	8,977	9,859	10,917	11,012	12,232	...

* Net consumption = net production + imports - exports - T & D losses. Consumption or production values supplied do not include import figures.

Table 2. Egypt: Installed capacity, production and consumption of electric energy, 1972-1983

	Installed capacity in MW											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	3,948	3,970	3,970	3,946	3,960	4,031	4,076	4,391	4,893	5,076	5,292	6,182
Hydro	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445
Thermal	1,503	1,525	1,525	1,501	1,515	1,586	1,631	1,946	2,448	2,631	2,847	3,737
Nuclear	-	-	-	-	-	-	-	-		-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	3,775	3,775	3,775	3,775	3,789	3,860	3,905	4,229	4,731	4,914	5,130	6,020
Hydro	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445
Thermal	1,330	1,330	1,330	1,330	1,344	1,415	1,460	1,784	2,286	2,469	2,685	3,575
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-

	Production in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	7,979	8,008	9,097	10,340	12,171	14,033	15,507	16,864	18,975	21,292	23,898	26,424
Hydro	5,159	5,156	6,128	6,790	8,003	9,038	9,935	9,608	9,801	10,215	10,484	9,816
Thermal	2,820	2,852	2,969	3,550	4,168	4,995	5,572	7,256	9,174	11,077	13,414	16,608
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	7,384	7,435	8,525	9,799	11,646	13,517	15,013	16,359	18,429	20,747	23,353	25,879
Hydro	5,159	5,156	6,128	6,790	8,003	9,038	9,935	9,608	9,801	10,215	10,484	9,816
Thermal	2,225	2,279	2,397	3,009	3,643	4,479	5,078	6,751	8,628	10,532	12,869	16,063
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Net production	7,107	7,155	8,238	9,470	11,285	13,128	14,591	15,845	17,848	20,061	22,552	24,952
T & D losses	938	977	1,343	1,162	1,623	1,639	1,868	2,722	3,052	3,410	3,811	4,217
Imports	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

	Consumption in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Net consumption*	6,169	6,178	6,895	8,308	9,662	11,489	12,723	13,122	14,796	16,651	18,741	20,735
Industry and construction	3,875	3,845	3,728	4,822	5,632	7,180	7,553	7,800	8,800	9,991	11,207	12,441
Transport	118	118	125	126	130	132	145	150	160	165	170	175
Household and other	2,176	2,215	3,042	3,360	3,900	4,177	5,025	5,172	5,836	6,495	7,364	8,119

* Net consumption = net production + imports - exports - T & D losses

Table 2. India: Installed capacity, production and consumption of electric energy, 1972-1983

	Installed capacity in MW											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	16,271	16,889	17,990	18,456	20,345	22,249	23,756	26,175	29,280	31,097	33,141	35,389
Hydro	6,383	6,612	6,786	6,965	7,529	8,464	9,025	10,020	10,833	11,384	11,791	12,171
Thermal	9,468	9,857	10,584	10,851	12,176	13,145	14,091	15,515	17,807	19,07[illegible]	20,490	22,358
Nuclear	420	420	640	640	640	640	640	640	640	6[illegible]0	860	860
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	14,709	15,254	16,282	16,664	18,317	20,1[illegible]7	21,469	23,669	26,682	28,448	30,214	32,389
Hydro	6,383	6,612	6,786	6,965	7,529	8,464	9,025	10,020	10,833	11,384	11,791	12,171
Thermal	7,906	8,226	8,876	9,059	10,148	11,013	11,804	13,009	15,207	16,424	17,563	19,358
Nuclear	420	420	640	640	640	640	640	640	640	640	860	860
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-

	Production in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	61,210	66,390	70,510	72,800	76,680	85,930	95,620	98,930	110,130	112,820	119,110	131,520
Hydro	25,250	28,030	27,200	28,970	27,880	33,300	34,840	38,010	47,160	45,480	46,530	49,500
Thermal	33,540	37,170	42,180	41,430	46,590	50,000	57,530	58,650	60,200	64,460	69,580	79,000
Nuclear	2,420	1,190	1,130	2,400	2,210	2,630	3,250	2,270	2,770	2,880	3,000	3,020
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	55,830	60,930	64,540	66,690	70,200	79,230	88,340	91,370	102,530	104,630	110,820	122,920
Hydro	25,250	28,030	27,200	28,970	27,880	33,300	34,840	38,010	47,160	45,480	46,530	49,560
Thermal	28,160	31,710	36,210	35,320	40,110	43,300	50,250	51,090	52,600	56,270	61,280	70,350
Nuclear	2,420	1,190	1,130	2,400	2,210	2,630	3,250	2,270	2,770	2,880	3,000	3,020
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Net production	57,770	62,620	66,470	68,540	71,820	80,610	89,500	92,500	103,440	105,470	111,090	122,790
T & D losses	9,310	10,860	12,230	12,930	13,560	14,530	16,450	16,530	19,360	20,080	21,280	23,570
Imports	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

	Consumption in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Net consumption*	48,460	51,760	54,240	55,610	58,260	66,080	73,050	75,970	84,080	85,390	89,810	99,220
Industry and construction	34,330	36,370	37,390	37,830	38,310	43,380	48,020	49,330	54,470	53,240	55,740	59,680
Transport	1,370	1,630	1,830	1,530	1,530	1,850	2,170	2,300	2,190	2,300	2,330	2,740
Agriculture	4,470	5,010	5,920	6,310	7,760	8,720	9,620	10,110	12,030	13,450	14,410	16,230
Household and other	8,290	8,750	9,100	9,940	10,660	12,130	13,240	14,230	15,390	16,400	17,330	20,570

* Net consumption = net production + imports - exports - T & D losses

Table 2. Indonesia: Installed capacity, production and consumption of electric energy, 1972-1983

	Installed capacity in MW											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	1,964	2,096	2,311	2,560	3,198	3 833	4,786	5,219	5,689	6,202	6,760	...
Hydro	...	...	...	...	...	...	...	...	489	508	722	...
Thermal	...	...	...	...	...	...	...	...	...	...	...	...
Nuclear	...	...	...	...	...	...	...	...	...	...	...	...
Geothermal	...	...	...	...	...	...	...	...	...	...	...	...
Public total	664	796	921	1,107	1,376	1,862	2,288	2,536	2,555	3,032	3,406	...
Hydro	184	279	279	321	321	322	351	378	379	398	437	...
Thermal	480	517	643	785	1,055	1,540	1,937	2,158	2,176	2,634	2,939	...
Nuclear	-	-	-	-	-	-	-	-	-	-	-	...
Geothermal	-	-	-	-	-	-	-	-	-	-	-	...

	Production in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	5,291	6,079	7,903	8,501	9,393	10,183	11,429	12,948	14,453	16,125	16,897	...
Hydro	...	...	...	...	...	...	...	...	...	...	...	...
Thermal	...	...	...	...	...	...	...	...	...	...	...	...
Nuclear	...	...	...	...	...	...	...	...	...	...	...	...
Geothermal	...	...	...	...	...	...	...	...	...	7	78	...
Public total	1,913	2,256	3,345	3,770	4,125	4,740	5,722	7,003	8,412	10,138	11,844	...
Hydro	686	903	1,794	1,960	1,778	1,785	2,188	2,230	2,100	2,504	3,887	...
Thermal	1,227	1,353	1,551	1,810	2,347	2,955	3,534	4,773	6,312	7,633	7,879	...
Nuclear	-	-	-	-	-	-	-	-	-	-	-	...
Geothermal	-	-	-	-	-	-		-	-	-	78	...
Net product	5,291	6,079	7,303	8,501	9,393	10,183	11,429	12,948	14,453	16,125	...	...
T & D losses	606	757	870	966	1,011	1,159	1,375	1,609	1,878	2,114	2,640	...
Imports	-	-	-	-	-	-	-	-	-	-	-	...
Exports	-	-	-	-	-	-	-	-	-	-	-	...

	Consumption in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Net consumption*	4,685	5,322	6,423	7,535	8,382	9,024	10,054	11,339	12,575	14,011	14,257	...
Industry and construction	313	535	715	880	978	1,142	1,443	1,910	1,722	2,240	2,996	...
Transport	-	-	-	-	-	-	-	-	-	-	-	...
Household and other	1,581	1,640	1,660	1,923	2,103	2,385	2,843	3,433	4,839	5,605	6,077	...

* Net consumption = net production + imports - exports - T & D losses. Total country figures are extrapolations at 9 per cent per year growth from 1979 to 1982.

Table 2. Republic of Korea: Installed capacity, production and consumption of electric energy, 1972-1983

	Installed capacity in MW											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	3,872	4,272	4,523	4,720	4,810	5,790	6,916	8,033	9,391	9,835	10,304	13,115
Hydro	341	621	621	621	711	711	711	912	1,157	1,202	1,202	1,202
Thermal	3,531	3,651	3,902	4,099	4,099	5,079	5,617	6,534	7,647	8,047	7,837	9,998
Nuclear	-	-	-	-	-	-	587	587	587	587	1,266	1,916
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	925	525	525	525	615	615	615	615	660	705	705	705
Hydro	-	200	200	200	290	290	290	290	335	380	380	380
Thermal	925	325	325	325	325	325	325	325	325	325	325	325
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-

	Production in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	11,839	14,826	16,835	19,837	23,117	26,587	31,510	35,600	37,238	40,207	43,122	46,850
Hydro	1,368	1,284	1,906	1,683	1,789	1,393	1,808	2,329	1,984	1,709	2,005	2,561
Thermal	10,471	13,542	14,929	18,154	21,328	25,123	27,378	30,119	31,777	34,601	37,340	36,575
Nuclear	-	-	-	-	-	71	2,324	3,152	3,477	2,897	3,777	7,714
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	1,953	2,450	2,406	2,530	2,510	2,736	2,532	2,727	2,119	2,779	2,543	2,287
Hydro	-	62	412	345	449	443	527	691	517	1,007	625	704
Thermal	1,953	2,388	1,994	2,185	2,061	2,293	2,005	2,036	1,602	1,771	1,918	1,583
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Net product	11,208	13,956	15,912	18,752	21,919	25,172	29,844	33,669	35,083	37,950	40,555	43,576
T & D losses	1,215	1,589	1,864	2,121	2,299	2,338	2,517	2,524	2,348	2,526	2,675	2,876
Imports	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

	Consumption in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Net consumption*	9,952	12,367	14,048	16,630	19,620	22,833	27,326	31,145	32,734	35,424	37,880	40,700
Industry and construction	8,850	10,640	12,195	14,500	17,160	19,843	23,367	36,191	27,626	29,780	31,564	33,958
Transport	-	-	-	-	-	-	-	-	-	-	-	-
Household and other	1,442	1,727	1,853	2,130	2,460	2,990	3,959	4,954	5,108	5,644	3,616	6,742

* Net consumption = net production + imports - exports - T & D losses

Table 2. Mexico: Installed capacity, production and consumption of electric energy, 1972-1983

	Installed capacity in MW											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	8,113	8,926	9,588	11,048	12,816	13,638	[illegible]	16,260	16,715	19,767	19,583	20,214
Hydro	3,302	3,520	3,595	4,114	4,611	4,793	5,295	5,289	6,062	6,618	6,600	6,600
Total thermal	4,811	5,331	5,918	6,859	8,130	8,770	10,542	10,821	10,503	12,969	12,803	13,434
Steam	3,509	3,860	4,108	4,256	5,922	6,082	7,803	8,070	8,055	9,965	9,772	10,372
Diesel	681	603	707	572	648	700	750	770	716	667	632	603
Gas turbine	621	868	973	1,421	950	1,268	1,269	1,261	1,192	1,797	1,859	1,919
Comb. cycle	-	-	130	610	610	720	720	720	540	540	540	540
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	75	75	75	75	75	75	150	150	180	[illegible]	180
Public total	6,913	7,726	8,371	9,830	11,460	12,092	13,992	14,298	14,625	17,677	17,493	18,124
Hydro	3,228	3,446	3,521	4,044	4,541	4,723	5,225	5,219	5,992	6,548	6,530	6,530
Total thermal	3,685	4,205	4,775	5,711	6,844	7,294	8,692	8,929	8,483	10,949	10,783	11,414
Steam	2,698	3,049	3,285	3,431	5,012	5,061	6,456	6,716	6,616	8,526	8,333	8,933
Diesel	368	290	389	251	274	247	249	234	137	88	53	24
Gas turbine	619	866	971	1,419	948	1,266	1,267	1,259	1,190	1,795	1,857	1,917
Comb. cycle	-	-	130	610	610	720	720	720	540	540	540	540
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	75	75	75	75	75	75	150	150	180	180	180
Self-producer total	1,200	1,200	1,217	1,218	1,356	1,546	[illegible]	1,962	2,090	2,090	2,090	2,090
Hydro	74	74	74	70	70	[illegible]	70	70	70	70	70	70
Total thermal	1,126	1,126	1,143	1,148	1,286	1,476	1,850	1,892	2,020	2,020	2,020	2,020
Steam	811	811	823	825	910	1,021	1,347	1,354	1,439	1,439	1,439	1,439
Diesel	313	313	318	321	374	453	501	536	579	579	579	579
Gas turbine	2	2	2	2	2	2	2	2	2	2	2	2
Comb. cycle	-	-	-	-	-	-	-	-	-	-	-	-
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-

	Production in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	34,026	36,750	40,518	43,421	47,205	52,349	57,084	62,219	66,109	72,125	77,419	80,883
Hydro	15,375	16,207	16,725	15,138	17,210	19,159	16,188	17,960	16,863	24,567	22,822	23,652
Thermal	18,651	20,382	23,330	27,765	29,416	32,598	40,298	43,240	48,331	46,594	53,599	56,251
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	161	463	518	579	592	598	1,019	915	964	998	980
Public total	31,533	34,244	38,008	40,879	44,632	48,945	52,977	58,070	61,868	67,879	73,200	76,664
Hydro	15,246	16,081	16,602	15,016	17,087	19,035	16,066	17,839	16,740	24,446	22,700	23,530
Thermal	16,287	18,002	20,943	25,345	26,966	29,318	36,313	39,212	44,213	42,469	49,502	52,154
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	161	463	518	579	592	598	1,019	915	964	998	980
Private total	2,493	2,506	2,510	2,542	2,573	3,404	4,107	4,149	4,241	4,246	4,219	4,219
Hydro	129	126	123	122	123	124	122	121	123	121	122	122
Thermal	2,364	2,380	2,387	2,420	2,450	3,280	3,985	4,028	4,118	4,125	4,097	4,097
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Net production	32,835	35,537	39,100	41,771	45,317	50,437	54,629	59,668	63,200	69,961	74,864	77,543
T & D losses	4,597	4,691	5,161	4,511	5,166	6,002	5,791	6,742	7,521	9,305	9,358	9,171
Imports	234	315	353	352	279	54	54	48	[illegible]	336	225	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

	Consumption in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Net consumption*	28,472	31,161	34,292	37,612	40,430	44,489	48,892	52,974	56,294	60,992	65,731	68,372
Industry and construction	-	-	-	-	-	-	-	-	-	-	-	-
Transport	-	-	-	-	-	-	-	-	-	-	-	-
Household and other	-	-	-	-	-	-	-	-	-	-	-	-

* Net consumption = net production + imports - exports - T & D losses

Table 2. **Pakistan**: Installed capacity, production and consumption of electric energy, 1972-1983

	Installed capacity in MW											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	1,837	1,836	2,135	2,255	2,450	3,150	3,265	3,395	3,605	4,174	4,174	5,084
Hydro	667	667	867	867	867	1,567	1,567	1,567	1,567	1,847	1,847	2,547
Thermal	1,033	1,032	1,131	1,251	1,446	1,446	1,561	1,691	1,901	2,190	2,190	2,400
Nuclear	137	137	137	137	137	137	137	137	137	137	137	137
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	1,837	1,836	2,135	2,255	2,450	3,150	3,265	3,395	3,495	4,064	4,06[illegible]	4,974
Hydro	667	667	867	867	867	1,567	1,567	1,567	1,567	1,847	1,[illegible]7	2,547
Thermal	1,033	1,032	1,131	1,251	1,446	1,446	1,561	1,691	1,791	2,080	[illegible]	2,290
Nuclear	137	137	137	137	137	137	137	137	137	137	137	137
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-

	Production in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Country total	7,570	8,514	9,096	10,050	10,286	10,755	12,376	13,085	14,694	16,195	18,206	20,308
Hydro	3,679	4,355	4,141	4,359	5,436	5,183	7,466	8,353	8,718	9,046	9,526	11,367
Thermal	3,843	3,722	4,500	5,087	4,208	5,181	4,680	4,626	5,974	7,000	8,497	8,780
Nuclear	48	437	454	605	642	391	2[illegible]1	106	2	150	183	162
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	7,570	8,514	9,096	10,050	10,286	10,755	12,376	13,085	14,654	16,120	17,738	19,654
Hydro	3,679	4,355	4,141	4,359	5,436	5,183	7,466	8,353	8,718	9,046	9,526	11,367
Thermal	3,843	3,722	4,500	5,087	4,208	5,181	4,680	4,626	5,974	6,924	8,030	8,126
Nuclear	48	437	454	605	642	391	231	106	2	150	183	162
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Net production	7,296	8,211	8,737	9,726	9,912	10,347	11,986	12,318	14,262	15,585	17,160	19,065
T & D losses	1,887	2,229	2,436	2,878	2,984	3,309	3,702	3,768	4,069	4,434	4,659	5,345
Imports	-	-	-	-	-	-	-	-	-	58	287	353
Exports	-	-	-	-	-	-	-	-	-	-	-	-

	Consumption in GWh											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Net consumption*	5,409	5,982	6,302	6,847	6,927	7,037	8,284	8,946	10,194	11,208	12,788	14,148
Industry and construction	3,409	3,676	3,881	3,803	3,802	3,724	4,189	4,531	5,001	5,482	5,951	6,687
Transport	-	-	42	63	45	43	42	43	46	44	42	44
Household and other	1,999	2,216	2,379	2,982	3,080	3,270	4,053	4,372	5,147	5,683	6,795	7,417

* Net consumption = net production + imports - exports - T & D losses. Energy figures supplied for years 1973, 1979 and 1983 do not balance.

Table 2. Tanzania: Installed capacity, production and consumption of electric energy, 1972-1983

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Installed capacity in MW												
Country total	121.8	153.8	154.8	249.8	244.6	245.4	266.0	267.8	374.6	380.2	388.3	...
Hydro a/	49.2	49.2	49.2	149.2	149.2	149.2	149.2	149.2	249.2	249.2	249.2	...
Thermal	72.6	104.6	105.6	100.6	95.4	96.2	116.8	118.6	125.4	131.0	139.1	...
Nuclear	-	-	-	-	-	-	-	-	-	-	-	...
Geothermal	-	-	-	-	-	-	-	-	-	-	-	...
Public total	121.8	153.8	154.8	249.8	244.6	245.4	266.0	267.8	374.6	380.2	388.3	...
Hydro	49.2	49.2	49.2	149.2	149.2	149.2	149.2	149.2	249.2	249.2	249.2	...
Thermal	72.6	104.6	105.6	100.6	95.4	96.2	116.8	118.6	125.4	131.0	139.1	...
Nuclear	-	-	-	-	-	-	-	-	-	-	-	...
Geothermal	-	-	-	-	-	-	-	-	-	-	-	...
Production in GWh												
Country total	468.6	511.7	530.8	557.6	590.5	617.4	680.2	752.0	799.4	823.7	830.7	...
Hydro	321.2	296.4	294.2	430.7	499.8	540.5	577.8	638.8	675.8	722.8	727.0	...
Thermal	147.4	215.3	236.6	126.9	90.7	76.9	102.4	113.2	123.6	100.9	103.7	...
Nuclear	-	-	-	-	-	-	-	-	-	-	-	...
Geothermal	-	-	-	-	-	-	-	-	-	-	-	...
Public total	468.6	511.7	530.8	557.6	590.5	617.4	680.2	752.0	799.4	823.7	830.7	...
Hydro	321.2	296.4	294.2	430.7	499.8	540.5	577.8	638.8	675.8	722.8	727.0	...
Thermal	147.4	215.3	236.6	126.9	90.7	76.9	102.4	113.2	123.6	100.9	103.7	...
Nuclear	-	-	-	-	-	-	-	-	-	-	-	...
Geothermal	-	-	-	-	-	-	-	-	-	-	-	...
Net production	468.6	511.7	530.8	557.6	590.5	617.4	680.2	752.0	799.4	823.7	830.7	...
T & D losses	67.7	74.6	67.6	60.7	89.2	91.1	100.0	94.7	64.5	70.8	111.8	...
Imports	-	-	-	-	-	-	-	-	-	-	-	...
Exports	-	-	-	-	-	-	-	-	-	-	-	...
Consumption in GWh												
Net consumption*	400.9	437.1	463.2	496.9	501.3	526.3	580.2	657.3	734.9	752.9	718.9	...
Industry and construction	281.0	229.0	322.0	338.0	342.0	357.0	384.0	442.0	482.0	499.0	382.0	...
Transport	-	-	-	-	-	-	-	-	-	-	-	...
Household and other	119.9	138.1	141.2	258.9	159.3	169.3	196.2	215.3	252.9	253.9	336.9	...

a/ Hydro capacity for 1973 corrected from original data.

* Net consumption = net production + imports - exports - T & D losses.

Table 3. Algeria: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

	Installed capacity in MW											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
	No data available											

Table 3. <u>Bolivia</u>: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Installed capacity in MW												
Total	564	567	567	577	627	776	786	797	...	...	1,023	1,253
Hydro	310	303	303	303	313	457	467	467	...	...	666	786
Thermal	263	264	264	274	314	319	319	330	...	...	359	447
Nuclear	-	-	-	-	-	-	-	-	...	...	-	-
Geothermal	-	-	-	-	-	-	-	-	...	...	-	-
Production in GWh												
Total (gross)	1,833	1,961	2,098	2,245	2,402	2,570	2,750	2,943	...	...	3,605	5,057
Hydro	1,289	1,379	1,569	1,736	1,885	2,100	2,298	2,459	...	...	3,012	4,225
Thermal	544	582	529	509	517	470	452	484	...	...	593	832
Nuclear	-	-	-	-	-	-	-	-	...	...	-	-
Geothermal	-	-	-	-	-	-	-	-	...	...	-	-
Imports and exports in GWh												
Imports	3.7	3.8	2.0	2.3	2.5	3.0	3.1	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. Cameroon: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

Installed capacity in MW											
1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
No data available											

Table 3. Colombia: Installed capacity, production and imports and exports of electric energy, projections for 1984-1995

	Installed capacity in MW											
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Total	6,885	7,907	8,090	8,706	9,206	9,449	9,649	10,909	11,879	12,479	13,979	13,979
Hydro	4,726	5,727	5,787	6,287	6,487	6,730	6,930	8,190	9,254	9,854	11,354	11,354
Thermal	2,159	2,180	2,303	2,419	2,719	2,719	2,719	2,719	2,625	2,625	2,625	2,625
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
	Production in GWh											
	1984	1985	1986	1987	1988	1989	199-	1991	1992	1993	1994	1995
Total (gross)	26,242	29,242	31,617	34,194	36,924	39,81-	42,891	46,218	49,811	53,692	57,883	62,353
Hydro	18,894	23,295	26,205	27,857	29,244	29,864	30,391	34,751	38,909	41,460	47,410	49,960
Thermal	7,348	5,947	5,412	6,337	7,680	9,946	12,500	11,467	10,902	12,232	10,473	12,393
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
	Imports and exports in GWh											
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Imports	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. **Egypt**: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

	Installed capacity in MW											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Total	7,823	9,443	9,543	9,693	9,693	10,893	...	...	...	...	16,493	23,693
Hydro	2,445	2,715	2,715	2,715	2,715	2,715	...	...	...	...	2,915	4,415
Thermal	5,378	6,728	6,828	6,978	6,978	8,178	...	...	...	...	10,878	10,878
Nuclear	-	-	-	-	-	-	...	...	...	...	2,700	8,400
Geothermal	-	-	-	-	-	-	...	...	...	...	-	-
	Production in GWh											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Total (gross)	32,000	35,400	38,600	42,060	45,840	49,960	...	...	...	...	73,400	102,900
Hydro	9,800	10,900	10,900	10,900	10,900	10,900	...	...	...	...	12,100	16,000
Thermal	22,200	24,500	27,700	31,160	34,940	39,060	...	...	...	...	41,300	44,900
Nuclear	-	-	-	-	-	-	...	...	...	...	20,000	42,000
Geothermal	-	-	-	-	-	-	...	...	...	...	-	-
	Imports and exports in GWh											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Imports	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. India: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Installed capacity in MW												
	No data available											
Production in GWh												
	No data available											
Imports and exports in GWh												
Imports	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. <u>Indonesia</u>: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

	Installed capacity in MW											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Total	4,116	5,245	5,546	6,786	7,572	8,616	10,195	12,149	14,404	16,132	...	...
Hydro	664	664	1,020	1,393	1,551	1,680	2,097	2,891	3,335	3,525	...	...
Thermal*	2,757	3,627	3,572	4,439	5,067	5,982	7,144	8,409	10,255	11,918	...	...
Gas turbines	695	954	954	954	954	954	954	849	814	709	...	...
	Production in GWh											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Total (gross)	14,135	17,037	20,977	24,452	28,656	34,024	41,293	48,293	56,252	65,609	...	...
Hydro	...	...	...	...	...	...	...	...	...	...	...	...
Thermal	...	...	...	...	...	...	...	...	...	...	...	...
Gas turbines	...	...	...	...	...	...	...	...	...	...	...	...
	Imports and exports in GWh											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Imports	No data available											
Exports												

* Includes steam thermal, geothermal and diesel sources.

Table 3. Republic of Korea: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Installed capacity in MW												
Total	14,616	16,574	17,604	18,564	19,514	20,464	22,174	...	...	...	...	...
Hydro	1,202	2,205	2,285	2,305	2,305	2,305	3,115	...	...	...	...	...
Thermal	10,548	10,553	10,553	10,543	10,543	10,543	10,543	...	...	...	...	...
Nuclear	2,866	3,816	4,766	5,716	6,666	7,617	8,516	...	...	...	...	...
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Production in GWh												
Total (gross)	53,138	58,928	65,340	71,615	78,456	85,936	94,068	...	...	...	...	...
Hydro	2,138	2,766	2,909	3,106	3,117	3,117	3,339	...	...	...	...	...
Thermal	38,409	37,730	36,295	36,247	40,538	42,124	44,185	...	...	...	...	...
Nuclear	12,591	18,429	26,136	32,262	34,801	40,695	46,544	...	...	...	...	...
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Imports and exports in GWh												
Imports	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. Mexico: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

	Installed capacity in MW											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995*	2000
Total	20,237	22,607	23,583	25,146	27,115	29,063	32,543	34,848	36,331	...	41,595	58,339
Hydro	6,530	7,426	7,702	7,812	8,073	8,073	10,283	10,613	10,963	...	12,551	17,603
Thermal **	11,140	11,930	12,608	14,061	15,005	16,923	18,083	19,918	21,051	...	24,289	34,597
Nuclear	-	654	654	654	1,308	1,308	1,308	1,308	1,308	...	1,308	1,308
Geothermal	620	620	620	620	730	730	840	950	950	...	1,090	1,525
Natural Gas	1,947	1,977	1,999	1,999	1,999	2,029	2,029	2,059	2,059	...	2,357	3,306

	Production in GWh											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Total (gross)	82,088	90,118	101,424	111,254	120,583	129,898	140,567	152,397	165,432	...	...	...
Total (net)	78,545	86,216	97,106	105,965	114,434	123,249	133,260	144,603	156,965	...	...	...
Hydro												
Thermal												
Nuclear	No data available											
Geothermal												
Natural Gas												

	Imports and exports in GWh											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Imports	No data available											
Exports												

* Unofficial estimates

** Includes combined cycle and diesel

Table 3. Pakistan: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

	Installed capacity in MW											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Total	5,504	6,414	6,414	8,214	8,724	1,090	...	...	...	...	20,622	30,202
Hydro	2,897	2,897	2,897	3,167	3,167	4,799	...	...	...	...	8,831	14,811
Thermal	2,470	3,380	3,380	4,910	5,420	6,154	...	...	...	...	9,854	11,654
Nuclear	137	137	137	137	137	137	...	...	...	...	1,937	3,737
Geothermal	-	-	-	-	-	-	...	...	...	...	-	-
	Production in GWh											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Total (gross)	25,534	28,914	32,249	35,893	40,144	44,886	...	...	...	...	75,450	116,290
Hydro												
Thermal						No data available						
Nuclear												
Geothermal	-	-	-	-	-	-	...	...	...	...	-	-
	Imports and exports in GWh											
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
Imports	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. Tanzania: Installed capacity, production and imports and exports of electric energy, projections for 1985-2000

Installed capacity in MW											
1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
No data available											

Table 4. <u>Algeria</u>: Existing electric power generating stations, commissioned after 1970
(local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Fabricated parts		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
no data available											

Table 4. **Bolivia**: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Fabricated parts: Local content	Fabricated parts: Supplier code	Turbines: Local content	Turbines: Supplier code	Generator: Local content	Generator: Supplier code	Sub-station: Local content	Sub-station: Supplier code	Control and instrumentation: Local content	Control and instrumentation: Supplier code
Hydro plants											
1973	36	-	...	-	A	-	B	-	C	-	D
1980	34	-	...	-	A	-	E	-	C	-	E
1981	18	-	...	-	A	-	E	-	F	-	D

Supplier code definitions
A = Voith
B = Mitsubishi
C = Varios
D = Brown Boveri

Year of commis-sioning	Plant size (MW)	Turbines: Local content	Turbines: Supplier code	Generator: Local content	Generator: Supplier code	Sub-station: Local content	Sub-station: Supplier code	Control and instrumentation: Local content	Control and instrumentation: Supplier code
Gas turbines									
1975	25.60	-	A	-	B	-	D	-	D
1976	25.60	-	A	-	B	-	D	-	D
1978	22.14	-	C	-	D	-	D	-	D
1980	22.14	-	C	-	D	-	D	-	D
1982	16.50	-	E	-	E	-	F	-	F
1983	22.14	-	C	-	D	-	D	-	D
Diesel motors									
1974	9.0	-	G	-	H	-	I	-	J
1977	6.6	-	K	-	J	-	I	-	I
1978	6.6	-	K	-	J	-	I	-	I
1981	2.24	-	L	-	M	-	I	-	I

Supplier code definitions
A = AEG - GE
B = AEG
C = Hitachi - GE
D = Hitachi
E = Rolls Royce
F = ASEA
G = Nordberg
H = Portec, Inc.
I = Varios
J = General Electric
K = Worthington
L = Fuji
M = Tanyo

Bolivia built no conventional thermal power plants after 1970.

Table 4. Cameroon: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Fabricated parts		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
no data available											

Table 4. Colombia: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Fabricated parts		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code

no data available

Table 4. Egypt: Existing electric power generating stations, commissioned after 1970
(local content in per cent and supplier codes)

Year of commissioning	Plant size (MW)	Fabricated parts: Local content	Fabricated parts: Supplier code	Turbines: Local content	Turbines: Supplier code	Generator: Local content	Generator: Supplier code	Sub-station: Local content	Sub-station: Supplier code	Control and instrumentation: Local content	Control and instrumentation: Supplier code

Hydro plants

Egypt built not hydro projects after 1970.

Conventional thermal plants

Year of commissioning	Plant size (MW)	Boiler and boiler house: Local content	Boiler and boiler house: Supplier code	Turbines: Local content	Turbines: Supplier code	Generator: Local content	Generator: Supplier code	Sub-station: Local content	Sub-station: Supplier code	Control and instrumentation: Local content	Control and instrumentation: Supplier code
1979	87	-	A	-	B	-	B	-	B	-	C
1980	220	-	D	-	D	-	D	-	D	-	D
1983	300	-	E	-	F	-	G	-	G	-	G
	300	-	H	-	I	-	I	-	J	-	K

Supplier code definitions
A = Babcock & Wilcox
B = Westinghouse
C = Bailly haggen
D = Skoda
E = Stein
F = C.E.M
G = Alsthom
H = Foster Wheeler
I = G.E.
J = McGraw Edison
K = Foxborough

Gas turbines

Year of commissioning	Plant size (MW)	Turbines: Local content	Turbines: Supplier code	Generator: Local content	Generator: Supplier code	Sub-station: Local content	Sub-station: Supplier code	Control and instrumentation: Local content	Control and instrumentation: Supplier code
1976	14	-	A	-	A	-	A	-	A
1977	40	-	B	-	B	-	B	-	B
1978	20	-	B	-	B	-	B	-	B
1979	40	-	C	-	C	-	C	-	C
	46	-	C	-	C	-	C	-	C
	192	-	B	-	B	-	B	-	B
1980	120	-	B	-	B	-	B	-	B
	26	-	C	-	B	-	B	-	C
	25	-	D	-	D	-	D	-	D
	37.5	-	D	-	D	-	D	-	D
1981	200	-	E	-	E	-	E	-	E
	100.5	-	F	-	F	-	F	-	F
1982	100.5	-	F	-	F	-	F	-	F
1983	200	-	B	-	B	-	B	-	B
	24	-	B	-	B	-	B	-	B
	99	-	A	-	A	-	A	-	A

Supplier code definitions
A = Westinhouse
B = G.E.
C = Alsthom
D = Steal Laval
E = Rolls - Royce
F = Brown Boveri

Table 4. India: Existing electric power generating stations, commissioned after 1970 (cont'd)
(local content in per cent and supplier codes)

Year of comis-sioning	Plant size (MW)	Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Hydro plants									
1976	200	25-60	E	25-60	E	No data available		No data available	
1977	115	25-60	Y	25-60	Y				
1978	115	25-60	Y	25-60	Y				
1978	110	25-60	Z	25-60	Z				
1980	200	-	C	-	C				
1981	106	-	C	-	C				
1977	165	...	Z	...	Z				
1978	165	...	Z	...	Z				
1979	330	...	Z	...	Z				
1978	180	...	Z	...	Z				
1979	60	...	Z	...	Z				
1970	20	-	C	-	C				
1977	65	above 60	Y	above 60	Y				
1980	65	above 60	Y	above 60	Y				
1974	225	above 60	Z	above 60	Z				
1976	75	above 60	Z	above 60	Z				
1980	120	above 60	Y	above 60	Y				
1981	60	above 60	Y	above 60	Y				
1970	30	25-60	Y	25-60	Y				
1971	15	25-60	Y	25-60	Y				
1981	15	25-60	Y	25-60	Y				
1978	60	25-60	Y	25-60	Y				
1971	23	-	D	-	D				
1978	35	25-60	Y	25-60	Y				
1979	70	25-60	Y	25-60	Y				
1973	11.3	10-25	Z	10-25	Z				
1974	11.3	10-25	Z	10-25	Z				
1979	135	10-25	Z	10-25	Z				
1980	135	25-60	Z	25-60	Z				
1981	135	25-60	Z	25-60	Z				
1982	135	above 60	Z	above 60	Z				
1979	55	-	E	-	E				
1976	89.1	10-25	Z	10-25	F				
1977	89.1	25-60	Z	25-60	Z				
1976	390	-	G	-	H				
1972	75	-	I	-	I				
1970	69	-	J	-	J				

Supplier code definitions

A = not used
B = not used
C = Hitachi, Japan
D = Genz, Hungary
E = USSR
F = IGE, USA
G = Neyerpic, France
H = C.G.E., Canada
I = Fuji Denki, Japan
J = Voith, FRG
K = Allis Chalmers, Canada
L = Canadian General Electric Co.
M = not used
N = Alsthom, France
O = Veyvey, Switzerland
P = Canadian Westinghouse
X = BHEL/Ganj Movaq, Hungary
Y = BHEL/Hardwar, India
Z = BHEL, India

Table 4. India: Existing electric power generating stations, commissioned after 1970 (cont'd)
(local content in per cent and supplier codes)

Year of comis-sioning	Plant size (MW)	Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Hydro plants (cont'd)									
1970	46	-	C	-	C	No data available		No data available	
1977	16	above 60	Y	above 60	Y				
1975	80	25-60	Z	25-60	Z				
1976	80	25-60	Z	25-60	Z				
1977	80	above 60	Z	above 60	Z				
1978	80	above 60	Z	above 60	Z				
1980	20	25-60	Z	25-60	Z				
1981	20	25-60	Z	25-60	Z				
1976	60	above 60	Y	above 60	Y				
1975	9	-	D	-	D				
1979	60	above 60	Z	above 60	Z				
1973	360	-	E	-	E				
1973	48	...	...	...	...				
1983	50	above 60	X	above 60	X				
1972	99	-	K	-	L				
1979	17	10-25	Y	10-25	Y				
1970	60	-	G	-	N				
1970	60	-	D	-	N				
1977	60	-	P	-	P				
1978	100	-	P	-	P				
1978	35	-	...	-	...				
1977	10	25-60	Z	25-60	Z				
1975	180	25-60	Z	25-60	Z				
1976	60	25-60	Z	25-60	Z				
1980	108	above 60	Y	above 60	Y				
1981	36	above 60	Y	above 60	Y				
1974	10	above 60	Y	above 60	Y				
1975	20	above 60	Y	above 60	Y				
1970	66	10-25	Z	10-25	Z				
1971	33	25-60	Z	25-60	Z				
1975	66	25-60	Z	25-60	Z				
1976	66	25-60	Z	25-60	Z				
1977	66	25-60	Z	25-60	Z				
1970	9	...	...	...	...				
1978	2	...	...	...	...				

Table 4. India: Existing electric power generating stations, commissioned after 1970
(local content in per cent and supplier codes)

Year of commissioning	Plant size (MW)	Boiler and boiler house		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Conventional thermal plants											
1974	220	25-60	Z	25-60	Z	25-60	Z	No data available		No data available	
1977	110	above 60	Z	above 60	Z	above 60	Z				
1978	110	above 60	Z	above 60	Z	above 60	Z				
1972	62.5	-	B	-	A	-	A				
1979	210	above 60	Z	above 60	Z	above 60	Z				
1980	210	above 60	Z	above 60	Z	above 60	Z				
1972	30	-	C	-	C	-	C				
1976	30	25-60	Z	25-60	Z	25-60	Z				
1981	60	above 60	Z	above 60	Z	above 60	Z				
1982	60	above 60	Z	above 60	Z	above 60	Z				
1971	50	-	E	-	D	-	D				
1970	50	-	G	-	F	-	F				
1971	100	-	G	-	F	-	F				
1972	100	-	G	-	F	-	F				
1977	110	above 60	Z	above 60	Z	above 60	Z				
1978	110	above 60	Z	above 60	Z	above 60	Z				
1983	110	above 60	Z	above 60	Z	above 60	Z				
1972	60	above 60	Z	above 60	Z	above 60	Z				
1974	120	25-60	H	25-60	Z	25-60	Z				
1975	120	25-60	H	25-60	Z	25-60	Z				
1979	120	25-60	H	25-60	Z	25-60	Z				
1978	110	above 60	Z	above 60	Z	above 60	Z				
1977	240	above 60	Z	above 60	Z	above 60	Z				
1976	240	above 60	Z	above 60	Z	above 60	Z				
1979	400	25-60	Z	25-60	Z	25-60	Z				
1982	210	above 60	Z	above 60	Z	above 60	Z				
1983	210	above 60	Z	above 60	Z	above 60	Z				
1974	60	above 60	Z	above 60	Z	above 60	Z				
1976	60	above 60	Z	above 60	Z	above 60	Z				
1981	60	above 60	Z	above 60	Z	above 60	Z				
1979	110	above 60	Z	above 60	Z	above 60	Z				
1980	110	above 60	Z	above 60	Z	above 60	Z				
1977	120	above 60	H	above 60	Z	above 60	Z				
1978	120	above 60	H	above 60	Z	above 60	Z				
1976	120	above 60	H	above 60	Z	above 60	Z				
1981	120	above 60	Z	above 60	Z	above 60	Z				
1970	62.5	-	H	-	A	-	A				

Supplier code definitions

A = IGE, USA
B = C.E., USA
C = Mitsubishi, Japan
D = Zamech Elblag & Dolmel, Poland
E = Pafco Raciberg, Poland
F = LMW, USSR
G = Taganrov, USSR
H = A.V.B. Durgapur, India
I = CEM, France
J = Babcock Atlantique, France
K = KWU, FRG
L = Franco Tosi, Italy
M = Electrim, Poland
N = Skoda, Czechoslovakia
O = KKEW, USSR
Z = BHEL, India

Table 4. India: Existing electric power generating stations, commissioned after 1970 (cont'd) (local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Boiler and boiler house: Local content	Boiler and boiler house: Supplier code	Turbines: Local content	Turbines: Supplier code	Generator: Local content	Generator: Supplier code	Sub-station: Local content	Sub-station: Supplier code	Control and instrumentation: Local content	Control and instrumentation: Supplier code
Conventional thermal plants (cont'd)											
1979	200	above 60	Z	above 60	Z	above 60	Z	No data available		No data available	
1980	210	above 60	Z	above 60	Z	above 60	Z				
1983	210	above 60	Z	above 60	Z	above 60	Z				
1979	62.5	above 60	Z	above 60	Z	above 60	Z				
1974	120	-	M	-	M	25-60	H				
1975	120	-	M	-	M	25-60	H				
1976	240	-	M	-	M	25-60	H				
1978	200	25-60	Z	25-60	Z	25-60	Z				
1982	210	above 60	Z	above 60	Z	above 60	Z				
1970	140	-	I	-	I	-	J				
1971	140	-	I	-	I	-	J				
1979	210	above 60	Z	above 60	Z	above 60	Z				
1980	210	above 60	Z	above 60	Z	above 60	Z				
1980	210	above 60	Z	above 60	Z	above 60	Z				
1982	120	-	K	-	K	-	K				
1971	30	-	Z	-	Z	-	L				
1972	30	-	Z	-	Z	-	L				
1980	210	above 60	Z	above 60	Z	above 60	Z				
1973	100	above 60	Z	above 60	Z	above 60	Z				
1974	100	above 60	Z	above 60	Z	above 60	Z				
1977	100	above 60	Z	above 60	Z	above 60	Z				
1978	210	above 60	Z	above 60	Z	above 60	Z				
1981	210	above 60	Z	above 60	Z	above 60	Z				
1982	410	above 60	Z	above 60	Z	above 60	Z				
1983	420	25-60	Z	25-60	Z	25-60	Z				
1982	110	above 60	Z	above 60	Z	above 60	Z				
1983	110	above 60	Z	above 60	Z	above 60	Z				
1974	110	above 60	Z	above 60	Z	above 60	Z				
1975	110	above 60	Z	above 60	Z	above 60	Z				
1978	110	above 60	Z	above 60	Z	above 60	Z				
1979	110	above 60	Z	above 60	Z	above 60	Z				
1970	60	10-25	Z	10-25	Z	10-25	Z				
1971	60	10-25	Z	10-25	Z	10-25	Z				
1972	110	-	N	-	N	-	N				
1973	110	-	N	-	N	-	N				
1970	100	-	F	-	F	-	G				
1979	210	above 60	Z	above 60	Z	above 60	Z				

Table 4. India: Existing electric power generating stations, commissioned after 1970 (cont'd) (local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Boiler and boiler house		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Conventional thermal plants (cont'd)											
1980	210	above 60	Z	above 60	Z	above 60	Z	No data available		No data available	
1982	210	above 60	Z	above 60	Z	above 60	Z				
1977	120	25-60	Z	25-60	Z	25-60	Z				
1978	110	25-60	Z	25-60	Z	25-60	Z				
1977	120	above 60	Z	above 60	Z	above 60	Z				
1971	50	-	F	-	F	-	O				
1973	100	25-60	Z	25-60	Z	25-60	Z				
1974	100	25-60	Z	25-60	Z	25-60	Z				
1975	200	above 60	Z	above 60	Z	above 60	Z				
1980	200	25-60	Z	25-60	Z	25-60	Z				
1979	200	25-60	Z	25-60	Z	25-60	Z				
1977	200	25-60	Z	25-60	Z	25-60	Z				
1981	200	25-60	Z	25-60	Z	25-60	Z				
1982	200	25-60	Z	25-60	Z	25-60	Z				
1976	110	above 60	Z	above 60	Z	above 60	Z				
1977	110	above 60	Z	above 60	Z	above 60	Z				
1974	120	25-60	Z	25-60	Z	25-60	H				
1975	120	25-60	Z	25-60	Z	25-60	H				
1978	120	above 60	Z	above 60	Z	above 60	H				
1981	120	above 60	Z	above 60	Z	above 60	H				
1982	210	above 60	Z	above 60	Z	above 60	H				
1982	60	-	...	-	...	-	...				
1983	110	above 60	Z	above 60	Z	above 60	Z				

Table 4. <u>Indonesia</u>: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Fabricated parts		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Hydro plants											
1970	4.5	-	A	-	A	-	B	-	C	-	D
	60	100	...	100	...	-	E	-	E	-	E
1971	90	-	F	-	F	-	G	-	G	-	G
1972	80	-	F	-	F	-	G	-	G	-	G
1973	20	-	H	-	H	-	H	-	H	-	I
	70	-	I	-	I	-	I	-	I	-	I
	540	-	J	-	J	-	J	-	J	-	J
	4.5	-	K	-	K	-	L	-	L	-	L
1974	120	-	F	-	F	-	G	-	G	-	G
	120	100	...	100	...	-	U	-	U	-	U
1976	80	-	F	-	F	-	M	-	N	-	N
	7	-	K	-	K	-	L	-	L	-	L
	70	-	O	-	O	-	O	-	O	-	O
1977	90	100	...	100	...	-	U	-	U	-	U
	120	-	F	-	F	-	G	-	G	-	G
	160	100	...	100	...	-	P	-	P	-	P
1978	54	-	O	-	O	-	L	-	L	-	L
	210	100	...	100	...	-	C	-	C	-	C
1979	120	100	...	100	...	-	U	-	U	-	U
1980	1	-	Q	-	Q	-	E	-	E	-	E
	10	-	H	-	H	-	H	-	H	-	R
	180	100	...	100	...	-	C	-	C	-	C
1981	3.5	-	K	-	K	-	L	-	L	-	L
	5.4	-	S	-	S	-	B	-	B	-	B

<u>Supplier code definitions</u>

A = Charmilles, Swiss
B = BBC, Swiss
C = Siemens, FRG
D = Coloremag, FRG
E = Unelec, France
F = G.Gilkes, England
G = MacFarlane, England
H = Fuji, Japan
I = Tahasha, Japan
J = Sponjone Bzeuska, Czechoslovakia
K = Ebora, Japan
L = Meidensha, Japan
M = Brush El, England
N = English Electric England
O = Tohiba, Japan
P = Dip. Ing., Inggris.
Q = Neyerpic, France
R = Takaoka, Japan
S = Andritz, Swiss
T = not used
U = Jyoty, India

Table 4. Indonesia: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes) (continued)

Year of commissioning	Plant size (MW)	Boiler and boiler house: Local content	Boiler and boiler house: Supplier code	Turbines: Local content	Turbines: Supplier code	Generator: Local content	Generator: Supplier code	Sub-station: Local content	Sub-station: Supplier code	Control and instrumentation: Local content	Control and instrumentation: Supplier code
Conventional thermal plants											
1971	25	-	A	-	B	-	C	-	C	-	D
1972	100	-	E	-	E	-	E	-	E	-	F
1974	25	-	A	-	B	-	C	-	C	-	D
1978	100	-	E		E	-	E	-	E	-	F
	106	-	G	-	H	-	H	-	H	-	I
1979	300	-	J	-	E	-	E	-	K	-	I
1981	200	-	E	-	E	-	E	-	E	-	L
1982	200	-	E	-	E	-	E	-	E	-	L

Supplier code definitions
- A = Durodakovic, Yugoslavia
- B = Yugoturbina, Yugoslavia
- C = Rade Koncar, Yugoslavia
- D = Durag, Germany
- E = Mitsubishi, Japan
- F = Shimadzu, Japan
- G = Foster Wheeler, USA
- H = General Electric, USA
- I = Bailey, USA
- J = Deutsche Babcock & Wilcox, FRG
- K = Merlin Getlin, France
- L = Babcock Bristol, U.K.

Year of commissioning	Plant size (MW)	Turbines: Local content	Turbines: Supplier code	Generator: Local content	Generator: Supplier code	Sub-station: Local content	Sub-station: Supplier code	Control and instrumentation: Local content	Control and instrumentation: Supplier code
Gas turbines									
1974	40.2	-	A	-	A	-	A	-	B
	21.8	-	C	-	D	-	E	-	B
	27.4	-	F	-	F	-	F	-	F
1975	27.5	-	F	-	I	-	F	-	F
	21.8	-	C	-	D	-	H	-	B
1976	120.6	-	A	-	A	-	A	-	B
	21.5	-	C	-	D	-	H	-	B
	127.6	-	F	-	F	-	F	-	F
	43.2	-	J	-	J	-	J	-	J
1977	40.2	-	A	-	A	-	A	-	B
	294.0	-	B	-	B	-	B	-	B
	14.5	-	J	-	J	-	J	-	J
1978	40.2	-	A	-	A	-	A	-	B
	14.5	-	J	-	J	-	J	-	J

Supplier code definitions
- A = Alsthorn, France
- B = General Electric, United States
- C = John Brown, England
- D = Brush El, England
- E = Powels, England
- F = Westinghouse, United States
- G = not used
- H = Bonar Long, England
- I = ACEC, United States
- J = Westinghouse, Canada

Table 4. Republic of Korea: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Fabricated parts		Turbines		Generator		Sub-station		Other	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Hydro plants											
1971	12.6	...	...	-	A	-	B	-	B	-	B
1973	80	...	...	-	C	-	D	-	B	-	...
	200	...	...	-	E	-	E	-	B	-	...
1976	90	...	...	-	E	-	E	-	E	-	...
1980	400	...	...	-	E	-	E	-	E	-	...
	45	...	...	-	F	-	F	-	F	-	...
1981	45	...	...	-	F	-	F	-	F	-	...

Supplier code definitions
- A = SFAC
- B = Alsthom
- C = Neyrpic
- D = Jeumont Schneider
- E = Fuji
- F = Toshiba

Year of commis-sioning	Plant size (MW)	Boiler and boiler house		Turbines/ generators		Sub-station		Buildings and other plant	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Conventional thermal plants									
1970	500	-	C	-	D	-	D	-	...
	200	-	J	-	K	-	K	-	...
	200	-	L	-	H	-	H	-	...
1971	200	-	L	-	H	-	H	-	...
1972	324.8	-	O	-	P	-	P	-	...
1973	200	-	G	-	H	-	I	-	...
	200	-	L	-	H	-	H	-	...
	560	-	L	-	P	-	P	-	...
	125	-	O	-	P	-	P	-	...
1974	500	-	C	-	C	-	C	-	...
1975	200	-	Q	-	R	-	S	-	...
1977	300	-	T	-	I	-	I	-	...
	200	-	I	-	I	-	I	-	...
1978	650	-	E	-	F	-	F	-	...
1979	10	52	A	22	B	...	...	88	...
	200	38	O	30	P	...	...	39	...
	100	-	I	-	I	-	I	-	...
	100	-	I	-	I	-	I	-	...
	220	-	V	-	D	-	...	-	...
	100	-	V	-	D	-	...	-	...
1980	10	52	A	22	B	...	...	88	...
	1,200	38	N	21	N	...	...	50	...
	700	52	O	22	P	...	...	60	...
1982	40	87	B	19	B	...	...	90	...
1983	700	52	O	22	P	...	...	60	...
	400	50	G	36	I	...	...	64	...

Supplier code definitions
- A = Mitsubishi
- B = Fuji
- C = I.H.I.
- D = Toshiba
- E = Stein Industries
- F = Alsthom
- G = C.E.
- H = M.A.N./Siemens
- I = G.E.
- J = M.A.N.
- K = A.E.G.
- L = Babcock, Atlantique
- M = Steinmuller
- N = Brown Boveri
- O = Babcock, Hitachi
- P = Hitachi
- Q = Stein & Roubaix
- R = Franco Tosi/Marrelli
- S = Ansaldo, San Giorgio
- T = Babcock & Wilcox
- U = not used
- V = United Technologies

Table 4. Republic of Korea: Existing electric power generating stations, commissioned after 1970 (cont'd)
(local content in per cent and supplier codes)

		Turbines		Generator		Sub-station		Buildings and other plant	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Gas turbines									
1974	55	-	A	-	B	-	...	-	...

Supplier code definitions
A = U.T.I.
B = Brush

Table 4. Mexico: Existing electric power generating stations, commissioned after 1970
(local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Fabricated parts		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Hydro plants											
1976	135	No data		-	G	-	G	No data		No data	
1976	45	available		-	F	-	B	available		available	
1976	90			-	F	-	B				
1975	180			-	E	-	D				
1975	1,000			-	E	-	D				
1973	75			-	C	-	C				
1973	75			-	C	-	C				
1973	75			-	C	-	C				
1973	240			-	C	-	C				
1980	300			-	C	-	A				
1980	300			-	C	-	A				
1980	300			-	C	-	A				
1980	300			-	C	-	A				
1981	1,500			-	C	-	A				
1978	180			-	C	-	A				
1978	180			-	E	-	A				
1977	1,080			-	E	-	A				
1973	180			-	E	-	A				
1976	180			-	E	-	A				
1975	180			-	E	-	A				
1978	180			-	E		A				
1978	900			-	E	-	A				

Supplier code definitions

A = ASEA
B = Brown Boveri
C = Mitsubishi, Japan
D = Toshiba, Japan
E = Esher Wyss
F = Creusot Loire
G = Hitachi

Table 4. **Mexico**: Existing electric power generating stations, commissioned after 1970 (cont'd)
(local content in per cent and supplier codes)

Year of commissioning	Plant size (MW)	Boiler and boiler house: Local content	Boiler and boiler house: Supplier code	Turbines: Local content	Turbines: Supplier code	Generator: Local content	Generator: Supplier code	Sub-station: Local content	Sub-station: Supplier code	Control and instrumentation: Local content	Control and instrumentation: Supplier code
Conventional thermal plants											
1973	37.5		A		I			No data available		No data available	
1973	37.5		A		I						
1979	37.5		A		I						
1979	37.5		A		I						
1981	180		A		I						
1975	158		B		H						
1976	158		B		H						
1973	84		B		H						
1973	84		B		H						
1979	150		...		...						
1980	468		...		...						
1982	300		C		...						
1982	300		C		...						
1983	300		C		...						
1983	1,200		C		...						
1973	84		D		J						
1973	84		D		J						
1974	477		D		C						
1982	300		F,H		...						
1976	300		E		C						
1975	300		E		C						
1977	300		F		C						
1978	300		F		C						
1982	1,500		C		...						
1970	153		B		H						
1970	153		B		H						
1974	766		F		L						
1971	159		C		H						
1970	156		C		H						
1977	300		E		C						
1978	916		G		M						
1970	37.5		Q		K						
1976	37.5		Q		K						
1976	112.5		Q		K						
1979	150		C		K						
1972	24.5		C		J						
1973	24.5		C		J						
1975	158		H		I						
1976	158		H		I						
1978	300		G		M						
1978	916		G		M						

Supplier code definitions

A = Pozo Geotermico
B = Mitsubishi (Comb. Eng.)
C = Mitsubishi
D = Carrey
E = Combustion Engine, Can.
F = Babcock and Wilcox
G = Borsig
H = Hitachi
I = Toshiba
J = Escher Wyss
K = General Electric
L = Brown Boveri
M = Franco-Tosy
N = BTH
O = not used
P = International Combustion
Q = Serrey

Table 4. <u>Mexico</u>: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of comis-sioning	Plant size (MW)	Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Gas turbines									
1976	65.0		A		A	No data available		No data available	
1976	65.0		A		A				
1976	240.0		A		A				
1974	17.3		A		A				
1973	20.9		B		B				
1980	27.4		B		B				
1980	108.5		B		B				
1973	20.9		B		B				
1970	14.0		B		B				
1970	15.0		B		B				
1970	15.0		B		B				
1975	15.5		B		D				
1973	60.9		B		D				
1972	15.8		A		A				
1972	31.5		A		A				
1971	15.0		B		B				
1971	29.9		B		B				
1971	13.7		C		C				
1974	65.0		A		A				
1974	65.0		A		A				
1975	65.0		A		A				
1975	65.0		A		A				
1976	110.0		A		A				
1976	480.0		A		A				
1973	20.9		B		B				
1973	41.7		B		B				
1974	31.5		E		E				
1977	22.1		D		D				
1977	75.6		D		D				
1977	15.0		D		D				

<u>Supplier code definitions</u>
A = Westinghouse
B = General Electric
C = Mitsubishi
D = Hitachi
E = Brown Boveri
F = Fiat
G = Pratt & Whitney Aircraft
H = Electric Machinery
I = E. Electric

Table 4. <u>Mexico</u>: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of comis-sioning	Plant size (MW)	Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
<u>Gas turbines</u> (cont'd)									
1974	14.0		A		A				
1975	14.0		A		A				
1981	58.0		F		...				
1972	44.2		G		C				
1972	44.2		G		C				
1975	38.7		G		H				
1975	171.3		G		H				
1972	38.7		G		C				
1972	38.7		G		C				
1972	38.7		G		C				
1977	160.3		G		H				
1972	33.2		G		H				
1972	33.2		G		H				
1973	105.1		G		C				
1972	16.0		F		I				
1972	32.0		F		I				
1970	14.0		C		I				
1980	30.0		C		...				
1980	60.0		A		...				
1981	20.5		...		...				
1981	41.0		...		...				
1970	14.0		E		E				
1973	43.0		B		D				

Table 4. **Mexico**: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of comis-sioning	Plant size (MW)	Motors		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Internal combustion									
1975	1.1		A		I	No data available		No data available	
1975	1.0		A		I				
1975	3.6		B		J				
1976	1.1		A		I				
1978	1.1		A		I				
1978	1.1		A		I				
1978	4.3		A		I				
1971	0.3		C		C				
1975	0.6		C		C				
1977	0.9		C		C				
1977	2.7		C		C				
1972	1.5		B		J				
1972	1.5		B		J				
1976	7.3		B		J				
1971	3.2		B		J				
1972	3.2		B		J				
1975	1.0		D		K				
1977	3.2		B		J				
1977	1.0		D		K				
1978	17.5		B		J				
1978	6.2		E		L				
1972	...		B		M				
1973	15.0		B		C				
...	0.1		C		C				
1977	0.1		C		C				
...	0.1		C		C				
1977	0.3		C		C				

A = MAN
B = Sulzer
C = Caterpiller
D = General Motors
E = C. Plaist
F = Pratt & Whitney
G English Electric
H = Orenda
I = Siemens
J = Oerlikon
K = Elliot C.
L = F. Morse
M = Machinery
N = Mitsubishi
O = Electric Machinery
P = Electro Motive Division

Table 4. Mexico: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of comis-sioning	Plant size (MW)	Motors		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Internal combustion (cont'd)									
1977	0.1		C		C				
1977	0.1		C		C				
1972	0.2		C		C				
1973	0.4		C		C				
1970	0.1		C		C				
1970	0.1		C		C				
1971	0.3		C		C				
1970	3.2		B		J				
1971	3.2		B		J				
1971	14.2		B		J				
1970	1.1		A		I				
1971	3.2		B		J				
1972	3.2		B		J				
1976	3.2		B		J				
1976	10.4		B		J				
1976	24.2		F		N				
1977	24.2		F		N				
1971	17.9		F		N				
1970	13.3		F		O				
1976	2.5		D		P				
1970	2.5		D		P				
1976	2.5		D		P				
1972	6.0		H		O				
1976	24.2		F		N				
1977	24.2		F		N				
1970	13.3		F		O				

Table 4. Pakistan: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Fabricated parts Local content	Fabricated parts Supplier code	Turbines Local content	Turbines Supplier code	Generator Local content	Generator Supplier code	Sub-station Local content	Sub-station Supplier code	Control and instrumentation Local content	Control and instrumentation Supplier code
Hydro plants											
1973	100	-	...	-	...	-	...	-	...	-	...
1974	100	-	...	-	...	-	...	-	...	-	...
1977	700	-	...	-	...	-	...	-	...	-	...
1981	200	-	...	-	...	-	...	-	...	-	...
1982	700	-	...	-	...	-	...	-	...	-	...

Supplier code definitions

none

Year of commis-sioning	Plant size (MW)	Boiler and boiler house Local content	Boiler and boiler house Supplier code	Turbines Local content	Turbines Supplier code	Generator Local content	Generator Supplier code	Sub-station Local content	Sub-station Supplier code	Control and instrumentation Local content	Control and instrumentation Supplier code
Conventional thermal plants											
1974	220	-	A	-	A	-	A	-	A	-	A
1977	125	-	B	-	B	-	B	-	C	-	D
1977	210	-	C	-	C	-	C	-	C	-	C
1980	120	-	C	-	C	-	C	-	C	-	C
1983	210	-	B	-	B	-	B	-	C	-	D

Supplier code definitions

A = Czechoslovakia
B = Hitachi, Japan
C = BBG, Germany
D = Kent/Hitachi/BBG
E = Russia

Year of commis-sioning	Plant size (MW)	Turbines Local content	Turbines Supplier code	Generator Local content	Generator Supplier code	Sub-station Local content	Sub-station Supplier code	Control and instrumentation Local content	Control and instrumentation Supplier code
Gas turbines									
1972	5.7	-	...	-	...	-	...	-	...
1973	12.25	-	...	-	...	-	...	-	...
1975	25	-	...	-	...	-	...	-	...
1975	200	-	...	-	...	-	...	-	...
1978	50	-	...	-	...	-	...	-	...
1979	100	-	A	-	A	-	A	-	A
1980	125	-	A	-	A	-	A	-	A
1981	50	-	...	-	...	-	...	-	...

Supplier definitions

A = Hitachi, Japan

Table 4. Tanzania: Existing electric power generating stations, commissioned after 1970 (local content in per cent and supplier codes)

Year of commis-sioning	Plant size (MW)	Fabricated parts		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Hydro plants											
1975	100	-	...	-	...	-	...	-	...	-	...
1980	100	-	...	-	...	-	...	-	...	-	...

Tanzania provided 100 per cent of the civil works and cement work for these plants.

		Boiler and boiler house		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Conventional thermal plants											
1978	18.0	-	...	-	...	-	...	-	...	-	...
...	55.8	-	A	-	A	-	A	-	A	-	A
...	3.2	-	B	-	B	-	B	-	B	-	B
...	12.4	-	C	-	C	-	C	-	C	-	C
...	7.4	-	B	-	B	-	B	-	B	-	B
...	19.5	-	C	-	C	-	C	-	C	-	C
...	2.3	-	D	-	B	-	B	-	B	-	B
...	1.6	-	E	-	E	-	E	-	E	-	E

Supplier code definitions
A = Pielstick, France
B = Wartsila, Finland
C = Mirrlees Blackstone English Electric
D = Caterpillar, USA
E = Frichs, Denmark

		Turbines		Generator		Sub-station		Control and instrumentation	
		Local content	Supplier code	Local content	Supplier code	Local content	Supplier code	Local content	Supplier code
Gas turbines									
1973	15	-	...	-	...	-	...	-	...

Table 5. Algeria: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent)		
			Transformer	Switchgear	Measuring and control equipment
Sub-station					
		No data available			

	km	Local content (per cent)			
		Tower	Conductor	Insulator	Fittings
Transmission line					
	No data available				

	Tons	Local content (per cent)
Cable		
1974	8,700	No data on local content available
1977	14,000	
1982	18,000	
1983	20,000	
1986	23,000	

Table 5. Bolivia: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent)		
			Transformer	Switchgear	Measuring and control equipment
Sub-station					
1973	115	30	–	2	–
1974	66	13	–	2	2
1976	69	5	–	2	5
1976	69	5	–	2	–
1976	69	25	–	2	–
1978	69	25	–	–	–
1978	25	15	–	–	–
1978	69	25	–	–	–
1979	69	10	–	–	–
1979	69	5	–	–	–
1980	115	25	–	–	–
1980	115	15	–	–	–
1980	115	30	–	–	–
1981	115	15	–	–	–
1981	115	6	–	10	5
1981	115	90	–	2	2
1981	115	...	–	2	2
1982	69	6	–	2	5

	Volts (kV)	Local content (per cent)		
		Conductor	Insulator	Fittings
Transmission line				
1972	69			
1973	115			
1974	66			
1975	25			
1975	115			
1976	25			
1976	69			
1976	115			
1976	69			
1977	25			
1977	25			
1978	115	No data on local content available		
1978	25			
1979	115			
1980	115			
1980	115			
1981	115			
1981	230			
1981	115			
1985	230			

	Tons	Local content (per cent)
Cable		
1972	30	
1973	15	
1974	165	
1975	33.6	
1976	254.7	
1977	39.2	
1978	157	No data on local content available
1979	42	
1980	999	
1981	1,670.7	

Table 5. Cameroon: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent)		
			Transformer	Switchgear	Measuring and control equipment
Sub-station					
		No data available			

	km	Local content (per cent)			
		Tower	Conductor	Insulator	Fittings
Transmission line					
	No data available				

	Tons	Local content (per cent)
Cable	No data available	

Table 5. Colombia: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent)		
			Transformer	Switchgear	Measuring and control equipment
Sub-station					
		No data available			

	km	Local content (per cent)			
		Tower	Conductor	Insulator	Fittings
Transmission line					
	No data available				

	Tons	Local content (per cent)
Cable	No data available	

Table 5. Egypt: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent) Transformer	Switchgear	Measuring and control equipment
Sub-station					
1975	220	115	No data on local content available		
1976	220	300			
1977	132	540			
1979	220	250			
1980	132	50			
1982	220	750			
1983	220	800			
1983	132	105			

	Volts (kV)	km	Local content (per cent) Tower	Conductor
Transmission line				
1976	220	136	-	-
1976	132	6	100	100
1979	220	5	100	100
1980	132	16	100	100
1981	220	18	100	100
1982	220	27	-	-
1982	220	85	100	100
1983	220	302	100	100
1983	220	5	-	-
1983	132	30	100	100

	Tons	Local content (per cent)
Cable	No data available	

Table 5. India: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent)		
			Transformer	Switchgear	Measuring and control equipment
Sub-station					
		No data available			

	km	Local content (per cent)			
		Tower	Conductor	Insulator	Fittings
Transmission line					
	No data available				

	Tons	Local content (per cent)
Cable	No data available	

Table 5. Indonesia: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent)		
			Transformer	Switchgear	Measuring and control equipment
Sub-station					
1970	70	40			
	150	...			
1971	70	71.5			
	150	12			
1972	70	21.5			
	150	40			
1973	70	21			
	150	40			
1974	70	63			
	150	108			
1975	70	27			
	150	120			
1976	70	50	No data for local content available		
	150	347			
1977	150	75			
1978	70	15			
	150	560			
1979	70	15			
	150	1,499			
1980	150	600			
1981	150	330			
1982	70	409			
	150	240			
1983	70	123			
	150	316			

	Volts (kV)	km	Local content (per cent)		
			Conductor	Insulator	Fittings
Transmission line					
1970	70	56.5			
	150	11			
1971	70	37.9			
	150	14			
1972	70	38.5			
	150	33			
1973	70	112.6			
	150	108.6			
1974	70	35.4			
	150	48.4			
1975	150	89			
1976	150	578	No data on local content available		
1977	150	102			
1978	150	102			
1979	70	14			
	150	751			
1980	150	303			
1981	70	29			
	150	1,024			
1982	70	645			
	150	159			
1983	70	346			
	150	1,010			

	Tons	Local content (per cent)
Cable		
1975	9,200	
1976	9,500	
1977	12,500	No data on local content available
1978	15,720	
1979	17,400	
1980	19,140	
1981	18,684	

Table 5. Republic of Korea: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Local content (per cent)		
		Transformer	Switchgear	Measuring and control equipment
Sub-station				
1970	154			
	66			
	22			
1971	154			
	66			
1972	154			
	66			
	22			
1973	154			
	66			
	22			
1974	154			
	66			
1975	154			
	66	No data on local content until 1982 available		
1976	354			
	154			
	66			
1977	354			
	154			
	66			
1978	354			
	154			
	66			
1979	354			
	154			
1980	154			
	66			
1981	354			
	154			
1982	354			
	154			
1983	354	70	50	33
	154	70	61	83

Table 5. Republic of Korea: Existing electric power transmission facilities, commissioned after 1970 (cont'd)

Year of commissioning	Volts (kV)	km	Local content (per cent)			
			Tower	Conductor	Insulator	Fittings
Transmission line*						
1970	154	...				
	66	...				
	22	...				
1971	154	10				
	66	34				
1972	154	167				
	66	56				
1973	154	85				
	66	158				
1974	154	90				
	66	178				
1975	154	107				
	66	159				
1976	354	195				
	154	56		Data on local content until 1982 not available		
	66	676				
1977	354	174				
	154	210				
	66	284				
1978	354	305				
	154	247				
1979	354	144				
	154	230				
	66	200				
1980	354	204				
	154	239				
1981	354	26				
	154	160				
1982	354	170				
	154	218				
1983	354	...	100	100	100	78
	154	...	100	100	100	100

	Tons	Local content (per cent)
Cable	No data available	

* Data for 66kV transmission lines are in route length, while for the other voltages they are given in circuit length.

Table 5. Mexico: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent)		
			Transformer	Switchgear	Measuring and control equipment
Sub-station					
		No data available			

	Local content (per cent)			
	Tower	Conductor	Insulator	Fittings
Transmission line				
	No data available			

	Tons	Local content (per cent)
Cable	No data available	

Table 5. Pakistan: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent)		
			Transformer	Switchgear	Measuring and control equipment
Sub-station					
1970	132	80			
	66	20			
1971	132	40			
	66	20			
1972	132	20			
1973	66	20			
1974	132	10			
1976	132	40			
	66	20			
1977	132	80			
	66	20			
1978	132	30			
	66	10			
1979	132	30			
	66	20			
1980	132	40			
	66	5	No data cn local content available		
1981	132	20			
	66	10			
1982	220	250			
	132	30			
	66	20			
1983	220	250			
	66	10			
1971	...	83.5			
1972	...	591			
1973	...	538			
1974	...	853.5			
1975	...	575			
1976	...	622.85			
1977	...	684			
1978	...	734			
1979	...	466.5			
1980	...	582			
1981	...	661.5			
1982	...	735.5			

T̲able 5. **Pakistan**: Existing electric power transmission facilities, commissioned after 1970 (cont'd)

Year of commissioning	Volts (kV)	km	Local content (per cent)		
			Tower	Conductor	Insulator
Transmission line					
1971	132	241	-	-	-
1971	132	45	100	100	100
1971	66	27	-	-	30
1972	220	121	-	100	100
1972	132	49.8	-	-	100
1972	132	388	100	100	100
1972	66	79	100	100	100
1973	132	528	100	100	100
1973	66	32	100	100	100
1973	66	4.66	-	-	100
1974	132	363	100	100	100
1974	66	4.6	100	100	100
1975	220	3.2	-	100	100
1975	132	12.8	-	-	-
1975	132	734	100	100	100
1975	66	509	100	100	100
1976	132	267	100	100	100
1976	132	190	-	100	100
1976	66	438	100	100	100
1977	132	274.4	100	100	100
1977	66	232	100	100	100
1978	132	604.6	100	100	100
1978	132	6.3	-	-	100
1978	66	233	100	100	100
1979	500	329.6	-	100	100
1979	132	364.2	100	100	100
1979	132	103.15	-	-	100
1979	66	82.9	100	100	100
1980	500	519	-	100	100
1980	220	519	-	100	100
1980	132	416.2	100	100	100
1980	132	210.6	100	-	100
1980	66	259.2	100	100	100
1980	66	24.57	100	-	100
1981	132	308	100	100	100
1981	66	285	100	100	100
1982	220	77	-	100	100
1982	132	655	100	100	100
1982	132	81.8	-	-	100
1982	66	201	100	100	100
1982	66	10.68	-	-	100
1982	33	128	100	100	100
1983	220	38.7	-	-	100

	Tons	Local content (per cent)
Cable	No data available	

Table 5. <u>Tanzania</u>: Existing electric power transmission facilities, commissioned after 1970

Year of commissioning	Volts (kV)	Rating (MVA)	Local content (per cent)		
			Transformer	Switchgear	Measuring and control equipment
Sub-station					
1975	220				
1975	220				
1980	220/132				
1981	132				
1981	132		No data on local content available		
1983	132				
1983	132				
1984	220/33				
1984	220/132				

Year of commissioning	Volts (kV)	km	Local content (per cent)			
			Tower	Conductor	Insulator	Fittings
Transmission line						
1975	220	550				
1975	132	250				
1983	13	270				
1984	220	160		No data on local content available		
1984	220	130				
1981	132	43				
1981	132*	38				

	Tons	Local content (per cent)
Cable	No data available	

* Submarine cable

Table 6. Algeria: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
		No data available					

	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line								
	No data available							

	Tons	Local content (per cent)
Cable		
	No data available	

Table 6. Bolivia: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
115	4.5	1	-	1	-	1	-
115	1	1	-	1	5	1	2
115	3	1	-	1	2	1	-
69	5	3	-	3	2	3	-
24.9	5	1	-	1	-	1	-
33	2.5	1	-	1	2	1	-
115	5	1	-	1	2	1	-
69	2.5	2	-	2	5	2	-
69	3	2	-	2	2	2	-
69	1	2	-	2	2	2	-

Volts (kV)	Rating (MVA)	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line									
24.9	5.4	5,950	100	295	5	14,850	-	210	-
33	...	265	-	50	-	990	-	10	-
24.9	12.6	6,750	100	560	5	23,820	-	215	5
10	5.4	2,050	100	172	5	7,200	-	75	5
24.9	2	2,650	40	40	-	12,495	-	95	2
24.9	1.3	3,060	40	80	-	14,200	-	110	2
24.9	4.5	3,300	40	130	-	1,290	-	105	-
24.9	4.5	3,555	70	320	5	17,330	-	125	-
24.9	1	1,050	80	60	5	4,550	-	40	-

	Tons	Local content (per cent)
Cable	No data available	

Table 6. Cameroon: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
		No data available					

	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line								
	No data available							

	Tons	Local content (per cent)
Cable		
	No data available	

Table 6. Colombia: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
		No data available					

	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line								
	No data available							

	Tons	Local content (per cent)
Cable		
	No data available	

Table 6. Egypt: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
11	22 to 1,000	...	60	...	10	...	-

	km	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line									
11	27,075	...	93	...	100	...	-	...	100

	Tons	Local content (per cent)
Cable	12,980	60

Table 6. India: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer		Switchgear		Measuring and control equipment	
		No.	Local content (per cent)	No.	Local content (per cent)	No.	Local content (per cent)
Sub-station							
		No data available					

	Tower		Conductor		Insulator		Fittings	
	No.	Local content (per cent)	Tons	Local content (per cent)	No.	Local content (per cent)	Tons	Local content (per cent)
Transmission line								
	No data available							

	Tons	Local content (per cent)
Cable		
	No data available	

Table 6. Indonesia: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
		No data available					

	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line								
	No data available							

	Tons	Local content (per cent)
Cable		
	No data available	

Table 6. Republic of Korea: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
3.3	82.7	4,534	...	475	...	2	...
5.7	20.6	463	...	25	...	0	...
6.6	979	39,614	...	4,309	...	5	...
11.4	48	13,305	...	2,551	...	4	...
22.9	7510	287,006	...	49,907	...	37	...

	km	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line									
Under 0.6 kV	60,398	No data available							
Over 0.6 kV	77,251								

	Tons	Local content (per cent)
Cable	No data available	

Table 6. Mexico: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
		No data available					

	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line								
	No data available							

	Tons	Local content (per cent)
Cable		
	No data available	

Table 6. Pakistan: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
11	646.8	74	40	87	30	...	-
11	690.3	66	40	48	30	...	-
11	739.8	104	40	129	30	...	-
11	785.2	87	40	127	30	...	-
11	833.5	70	40	119	30	...	-
11	876.7	62	40	95	30	...	-
11	918.4	101	40	169	30	...	-
11	951.1	145	40	106	30	...	-
11	974.7	125	40	186	30	...	-
11	1,100.8	104	40	151	30	...	-
11	1,208.8	121	40	180	30	...	-
11	1,292.6	35	40	98	30	...	-
11	1,383.6	40	40	80	30	...	-

Volts (kV)		km	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line										
11	High tension	231	3,800	30	1,159	20	11,948	100	...	100
0.4	Low tension	2,352	27,000	30	11,771	20	179,796	100	...	100
11	High tension/ under ground	623	...	-	...	-	...	-	...	-
0.4	Low tension/ under ground	126.9	...	100	...	100	...	100	...	100

	Tons	Local content (per cent)
Cable	No data available	

Table 6. Tanzania: Existing distribution equipment, commissioned after 1970

Volts (kV)	Rating (MVA)	Transformer No.	Transformer Local content (per cent)	Switchgear No.	Switchgear Local content (per cent)	Measuring and control equipment No.	Measuring and control equipment Local content (per cent)
Sub-station							
33	15	1	-	1	-	1	-
33	5	1	-	1	-	1	-

Volts (kV)	km	Tower No.	Tower Local content (per cent)	Conductor Tons	Conductor Local content (per cent)	Insulator No.	Insulator Local content (per cent)	Fittings Tons	Fittings Local content (per cent)
Transmission line									
33	1,300	No data available							

	Tons	Local content (per cent)
Cable	No data available	

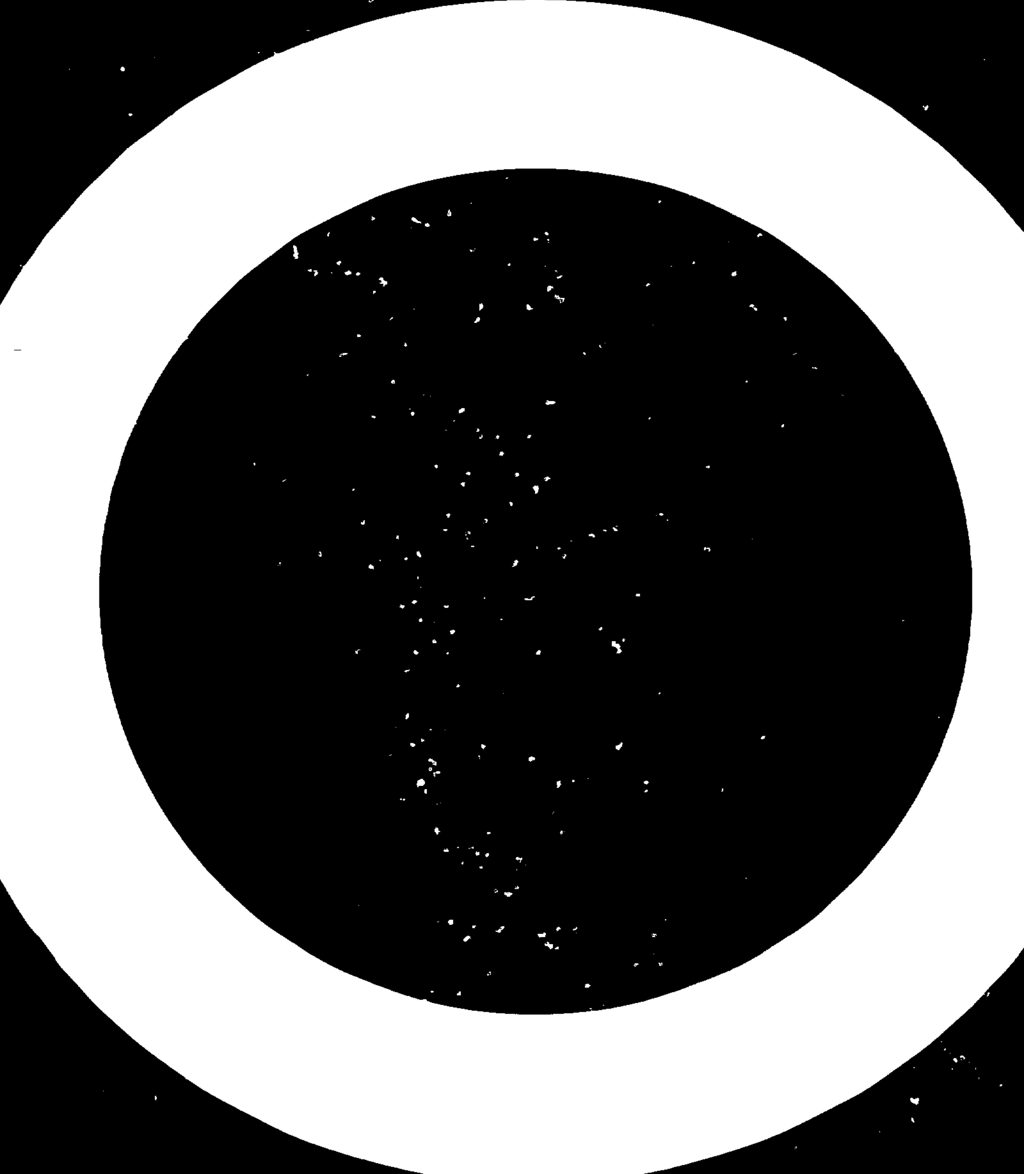
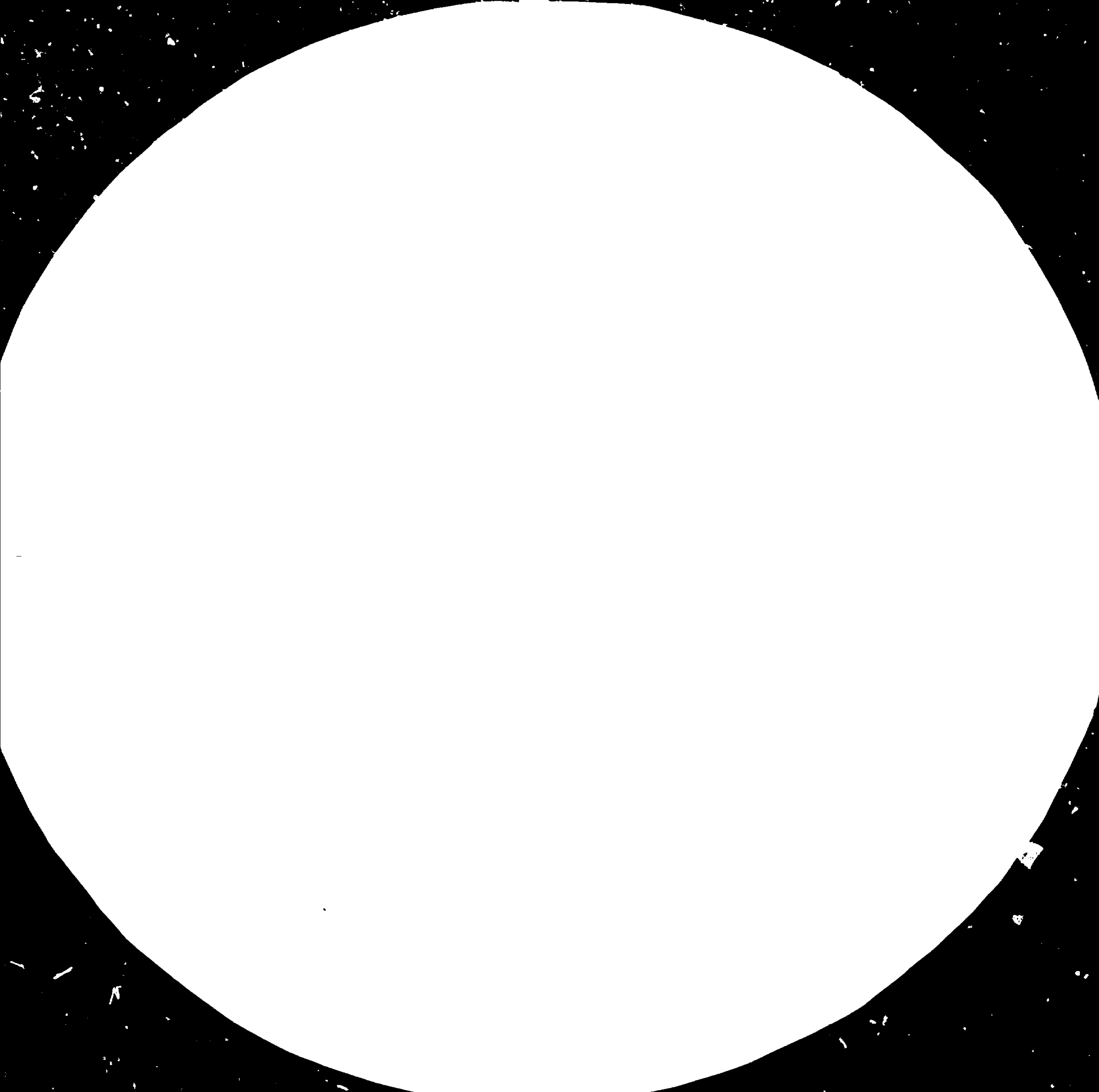


Table 7. Algeria: Domestic production of electric power equipment, 1974-1983

Type of equipment	Specification (kV & MW)	Unit	Annual production 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Local content (per cent)	Local manufacturers	Source of technology
Electric meters	...	No. 1000							35	100	117	132	70	El Eulmar	Landis & Gyr, Swiss
Cable	...	Ton	8,700			14,000					18,000		70	El Achour	West German consort.



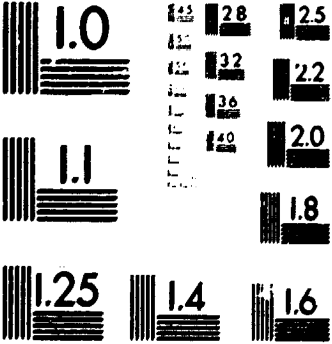


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Table 7. Bolivia: Domestic production of electric power equipment, 1977-1983

Type of equipment	Specification (kV & MW)	Unit	Annual production 1977	1978	1979	1980	1981	1982	1983	Local content (per cent)	Local manufacturers	Source of technology
Transformer	25 kV, 50-1000 kVA	No.	13	14	75	39	59	40	...	66	FATRA	Sindelen, Chile
Transformer	25 kV, 10-800 kVA	No.		57	68	72	54	51	...	...	Electromatic	Experiencia Propia
Cables-Distrib.	Alum., No.8	Ton				50	150	150	150	30	Cablebol	South Wire, USA
Cables-Distrib.	w/ACSR, No.8	Ton				25	75	75	75	30	Cablebol	South Wire, USA
Cables-Distrib.	Copper/insul. No.8	Ton				180	180	180	180	45	Plasmar	Thyssen, FRG
Cables-Distrib.	Copper/bare, 600 MCM	Ton				200	200	200	200	35	Plasmar	Sincro, Italy
Cables-Distrib.	Alumin/bare, 366.8 MCM	Ton				60	60	60	60	35	Plasmar	Plasmar, Bolivia
Wood poles treated	Classes 4-7	Miles	12	5	7	6	8	6	4	70	MATRA, S.A.	Kopers, USA
Wood poles	Classes 5-9	Miles	6	6	4	...	...	...	...	75	S.C.A.C.	Pfeiffer, FRG
Wood poles		Miles	1.5	1.5	1.5	0.4	...	...	...	75	Private	...

Table 7. Cameroon: Domestic production of electric power equipment, 1972-1983

Type of equipment	Specification (kV & MW)	Unit	Annual production												Local content (per cent)	Local manufacturers
			1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983		
No data available																

Table 7. Colombia: Domestic production of electric power equipment, 1972-1983

Type of equipment	Specification (kV & MW)	Unit	Annual production												Local content (per cent)	Local manufacturers
			1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983		
No data available																

Table 7. **Egypt**: Domestic production of electric power equipment, 1972-1983

Type of equipment	Specification (kV & MW)	Unit	Annual production 1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Local content (per cent)	Local manufacturers
Distribution transformers	11 kV	MVA	300	415	392	477	509	619	589	686	794	787	981	1,099	25	Elmaco
M.V outdoor D.L	11 kV	No.	-	-	-	-	-	-		-	-	1,097	2,595	1,714	70	Elmaco
M.V cables	11 kV	Ton	6,280	3,637	4,254	6,466	6,154	7,867	7,274	6,631	7,276	8,071	9,486	10,865	70	Egypt.Elect.Cab
L.V cables	0.38 kV	Ton	5,672	4,583	4,269	6,427	6,915	5,236	8,564	9,572	11,106	11,577	12,553	12,242	75	Egypt.Elect.Cab
Al. and SCA conductors	All volt.	Ton	2,422	3,291	2,609	2,189	3,925	3,996	3,417	4,063	5,125	6,182	4,955	6,000	60	Helwan Co. for No.
Steel towers	All volt.	Ton	1,000	1,000	1,000	2,000	2,000	2,000	3,000	3,000	3,000	4,000	4,000	4,000	100	Metalco.
Steel poles	11 kV	Ton	1,000	1,000	1,000	2,000	2,000	2,000	2,500	2,500	2,500	3,000	3,000	3,000	100	Metalco.
Steel towers	All volt.	Ton	-	-	-	3,600	3,600	3,600	4,000	4,000	4,000	4,500	4,500	4,500	100	Steelco
Steel poles	380 V	No.	31,600	32,800	29,200	34,850	44,760	48,800	58,100	130,990	91,810	75,180	41,580	46,500	100	El Nasr Co. for St.
Concrete poles	11 kV	Ton	5,300	5,300	5,300	7,200	7,200	8,100	9,300	10,200	11,400	12,500	12,500	12,500	80	Sigwart
Switchboards with C.B	11 kV	Cells	-		-	-		-		1,152	452	873	246	608	45	Egemac
Kiosks	11 kV	No.	-	-	-	-		-	-	267	393	634	521	381	50	Egemac
Kiosks	11 kV									-	-	-	700	640	50	Arab
Switchboards with L.B.S.	11 kV									38	404	417	305	351	45	Egemac
Switchboards with L.B.S.	11 kV										-	-	600	580	45	Arab
L.V switchboards	380 V									557	285	1,839	2,327	3,471	55	Egemac
L.V switchboards	380 V										-	-	1,249	1,592	55	Arab
Current and potential transformer	11 kV	No.										730	760	2,760	100	Egemac
Support insulators	11 kV	No.										450	3,800	7,800	100	Egemac

Table 7. India: Domestic production of electric power equipment, 1972-1983

Type of equipment	Specification (kV & MW)	Unit	Annual production												Local content (per cent)	Local manufacturers
			1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983		

No data available

Table 7. Indonesia: Domestic production of electric power equipment, 1975-1983

Type of equipment	Specification (kV & MW)	Unit	Annual production 1975	1976	1977	1978	1979	1980	1981	1982	1983	Local content (per cent)	Local manufacturers	Source of technology
Diesel engines	5 to 18 hp	No.									35,000	Not available	Yanhar Diesel	Not available
Diesel engines	4 to 18 hp	No.									30,000		Kubota Indonesia	
Diesel engines	5.5 to 18 hp	No.									10,000		Tri Ratna Diesel	
Diesel engines	30.5 to 105 hp	No.									8,000		Boma Bisma Indra	
Diesel engines	59 to 455 hp	No.									5,064		Mesindo Agung	
kWh meters		No.									200,000		Melcoinda	
kWh meters		No.									200,000		Fuji Dharma Electric	
kWh meters		No.									400,000		Melcoinda	
kWh meters		No.									24,000		Monsanto Pan Electrn.	
kWh meters		No.									120,000		Sigma Tirta Enginr.	
Cable	Varied	Ton	9,200	9,500	12,500	15,720	17,400	19,140	18,684	...	...			
Transformers	Varied	No.				1,400	1,375	2,331	3,890	...	...			
Generator	15-350 kW	No.									7,920		A. Van Kaich Neu-Isenburg, Imora Makmur, Eltab Indonesia, ECHO, Mewage Engineers, Adhiasa-Sakti, Metrika	
Generator	0-15 kW	No.									1,500		Uwgarah Multi Engineering	
Generator	5-500 kVA	No.									13,650		Denyo Indonesia	

Table 7. Republic of Korea: Domestic production of electric power equipment, 1972 to 1982

Type of equipment	Unit	Annual production 1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Local content (per cent)	Local manufac-turer
Transformer	KVA	1,070,411	2,079,843	2,927,527	3,308,598	3,063,152	4,976,165	10,318,458	19,464,721	7,289,764	9,137,077	13,840,770	No data available	
A.C generator	kV	-	-	17	1,768	10,092	14,298	1,669	516	29,802	2,847	2,193		
Circuit breaker 345 kV	ea	-	202	49	495	780	1,618	1,839	19,168	38,058	60,347	106,981		
Circuit breaker 154 kV	ea	-	13,721	40,254	108,660	248,317	357,040	748,921	1,187,808	1,100,504	1,042,180	1,461,980		
High voltage SW	ea	-	-	-	-	1,581	4,546	108,573	1,726	3,272	1,410	7,380		
Low voltage SW	ea	-	-	-	-	39,667	16,127	13,024	108,975	4,615	-	-		
Control panel	Sheet	-	-	-	-	2,001	3,399	8,108	20,575	425,535	29,986	6,399		
Distributing panel	ea	-	-	-	-	3,934	2,399	4,270	7,152	12,500	63,854	15,678		
High voltage condenser	KVA	-	-	-	-	355,480	416,801	460,140	308,638	287,365	332,651	268,791		
Tower	Tons	-	7,582	-	9,831	8,285	14,506	18,513	21,821	38,335	-	-		
Power wire and cable insulated	Tons	-	-	-	18,188	28,018	27,787	63,217	62,935	53,160	58,169	56,372		

Table 7. Mexico: Domestic production of electric power equipment, 1972-1983

Type of equipment	Specification (kV & MW)	Unit	Annual production												Local content (per cent)	Local manufacturers
			1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983		
No data available																

Table 7. Pakistan: Domestic production of electric power equipment, 1975-1983

Type of equipment	Specification (kV & MW)	Unit	Annual production 1975	1976	1977	1978	1979	1980	1981	1982	1983	Local content (per cent)	Local manufacturers	Source of technology
Fuse cut outs	400 A, 500 V	No.		6,510	4	2		3,500				-	Zenat Brothers	
Motor controls	3000 A, 500 V	No.		4	4	2	6	5	5			58	Zenat Brothers	UK/Japan
LT Switchboard	3000 A, 500 V	No.		27	47	31	51	49	8			58	Zenat Brothers	UK/Japan
Bus trunking	2000 A, 500 V	Ft.		203	325	143	293	130	771			52	Zenat Brothers	UK/Japan
LT distrib. board	100 A, 500 V	No.		136	146	63	146	240	333			58	Zenat Brothers	UK/Japan
Siemens														
Motors	500 hp, 400 V	hp		81,262	79,947	89,908	10,118	132,425	117,122	99,075		-	Siemens Pakistan	FRG
Motor control equipment	500 hp, 400 V	hp		42,585	41,105	17,392	104,201	200,056	24,929	19,682		-	Siemens Pakistan	FRG
Transformers	132 kV, 20 MVA	MVA		268	357	428	280	399	544	441		-	Siemens Pakistan	FRG
Welding sets	500 ADC	No.		52	45	77	141	120	35	...		-	Siemens Pakistan	FRG
Generating sets	1000 hp, 400 V	kVA		4,577	7,786	12,954	16,184	10,753	7,833	7,801		-	Siemens Pakistan	FRG
Switchgear and distribution	2500 A, 33kV	No.		1,501	1,054	742	1,484	1,500	1,517	1,524		-	Siemens Pakistan	FRG
Pakistan Switchgear, Ltd.														
Control and relay panel	66 to 132 kV	No.						149	120	362		30	J&P, Siemens,...	GEC, UK
Switches	15-800 A, BSS 88	No.						1,401	304	630		50	Faizi, PEL, ...	GEC, UK
HRC fuse fittings	2-800 A, BSS 88	No.						21,999	47,316	30,387		40	Imperial Electri	GEC, UK
AC/DC Aux panels	WAPDA, P-48:81	No.				50		30	20	30		40	Faizi	PEL, Pak.
Distrib. panels	Customized	No.						10	10	15	...	40	Group above	
Motors starters	Customized	No.						20	80	100	...	40		
Overhead bus bars	Upto 1500 A	Ft.						200	300	500	...	90		
Tube light fixtrs	Customized	No.						150	-	500	...	80		
Switchgear and miscellenous	.4-11 kV, 400 A	No.	82,000	90,000	99,000	109,000	120,000	133,000	145,000	190,000	177,000	25	Faiz Industry	Europe
LT Switchboard, distribution panel: switch fuses & cut outs	Upto 600 V, and 800 A	No.	11,200	13,600	13,600	15,000	16,500	18,150	19,900	21,900	24,100	75	General Industry Corp.	

Table 7. Pakistan: Domestic production of electric power equipment, 1975-1983 (cont'd)

Type of equipment	Specification (kV & MW)	Unit	Annual production 1975	1976	1977	1978	1979	1980	1981	1982	1983	Local content (per cent)	Local manufacturers	Source of technology
LT/HT switch gear	.4-11 kV, 400 A	No.	1,800	1,900	2,200	2,300	2,500	2,800	3,100	3,500	3,800	40	Johnson & Phillips	
Switch gears	400 V	No.	...	...	...	...	...	...	...	...	...	25	LA Electric	Local
HT switch gear	11 kV, 400 A, 350 MW		300	350	400	400	500	500	600	600	700	25	Pakistan Elect.	Europe/ Japan
LT Switch gear	400 V, 800 A	No.	160	175	200	200	240	260	290	300	650	40	Pak. Electric	Eur./Jap.
Distrib. boards	400 V, 800 A	No.	320	350	400	400	800	520	600	630	700	100	Pak. Electric	Eur./Jap.
Transformers	11 kV, 1 MVA	No.	12,900	14,000	15,600	17,000	18,900	20,700	2[illegible],000	25,000	28,000	20	Climax Ltd.	Europe
PVC/rubber insul. cables	230 V	No.	2,400	2,700	3,000	3,200	3,600	4,000	4,700	4,700	5,200	75	Atlas Rubber	UK
Enamelled conductors		Ton	75	82	90	100	110	120	145	145	160	25	Atlas Rubber	UK
Copper wire, 44-14 SWG	230-400 V	Ton	1,400	15,700	17,500	19,500	21,600	24,000	2,900	29,000	33,000	25	Pakistan Cable, New Age Cable, Atlas Rubber, AGE Ltd., Poiner Cable, Beco-Plastic Industry, Choudhry Wire and Cable Ltd. and others	
H.D.B.C. enammelled wire conductor	600 V, 300 A	Ton	96	105	115	127	140	154	170	186	200	26	New Age	Local
H.D.B.C. insulated wire conductor	600 V, 300 A	Ton	1,300	1,400	1,500	1,700	1,800	2,000	2,000	2,300	2,500	25	Pakistan Cable	BICC, UK
AAC/ACSR cables			650	700	800	850	900	1,000	1,100	1,252	1,400	25	Pakistan Cable	BICC, UK
Maintenance circuit breaker	600 V, 100 A	No.	10,800	11,000	12,000	13,00	13,600	14,000	15,000	16,000	1,700	25	AEG Pakistan	AEG, FRG
Fuse Units	500 V, 15/60 A	No.	700,000	800,000	850,000	950,000	1,000,000	1,100,000	1,275,000	1,400,000	1,500,000	100	(MFG) Electric Equipment Man.	Local

Table 7. Tanzania: Domestic production of electric power equipment, 1979–1983

Type of equipment	Specification (kV & MW)	Unit	Annual production 1979	1980	1981	1982	1983	Local content (per cent)	Local manufacturers	Source of technology
Transformers	500-800 kVA	No.				200	214	0.5	Saw Millr	Norway
Cables			537	557	316	412	421	-		Japan

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Options and strategies
An analysis of eleven country case studies
Statistical data

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