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SEYCHELLES

**Technical report: Energy review and micro-computer based energy
planning in the Republic of Sychelles***

**Prepared for the Government of Seychelles by the
United Nations Industrial Development Organization**

**Based on the work of Tomas Müller, expert in energy modelling
on behalf of the Institute für Kernenergetik und Energiesysteme (IKE)**

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* This document has not been edited.

EXPLANATORY NOTES

Exchange rate (January 1989)

1 Seychelles Rupee = 0.19 US Dollar

1 US Dollar = 5.14 Seychelles Rupee

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ABSTRACT

This report, "Energy Review and Micro-computer based Energy Planning in the Republic of Seychelles", is based on the findings of a mission of Mr. Tomas Müller, on behalf of the Institut für Kernenergetik und Energiesysteme (IKE) of the University of Stuttgart, financed under contract No. E599445, Special Service Agreement key code No. US/SEY/86/141-51, by the United Nations Industrial Development Organization (UNIDO).

The consultant spent 2 weeks on site, from January 7 -20, 1989. The counterpart organization was the Energy Planning Unit of the Industry Division of the Ministry of National Development of the Seychelles at Victoria, Mahé. During his stay, the consultant visited the Seychelles Electricity Corporation and the Information Systems Division at the President's Office.

To show the importance of energy planning in the context of overall economic planning, a lecture on energy planning in general and energy planning instrument MESAP (Micro-computer based Energy System Analysis and Planning package) was given.

Within the overall frame of the project, the purpose of this mission was to review the present economy and energy situation, to review the data availability in light of requirements for energy planning, to select and specify computer equipment and software packages for energy planning, to arrange for training of counterparts abroad, and to make a workplan for the follow-up activities to be carried out after the first mission and to identify the counterpart activities required before the training course and/or the consultant's second mission.

The major findings of the mission may be summarized as follows:

- The availability of general energy, economic and socio-economic data is satisfactory but detailed information in some sectors are required for energy planning.
- Sophisticated energy planning tools are presently not in use.
- The computer equipment available for day-to-day operations is adequate.

It is recommended that

- the present activities to establish an appropriate energy data base should be enforced in light of the requirements of energy models expected for use,
- energy balances should be established,
- energy planning models should be used to support energy planning strategies,
- adequate computer hard- and software for sophisticated energy planning tools should support energy planning activities, and
- training of experts should accompany the familiarization in the use of energy planning tools.

RECOMMENDATIONS

The major recommendations are:

1 - Training Course in Energy Planning

It is recommended to accomplish a training course for 1-2 experts of the Energy Planning Unit of the Ministry of National Development. This training course should provide the participants with information on energy planning techniques in general and on specific mathematical planning tools. This training course should take place at the consultants premises. The experts of the Ministry of National Development will be trained on the microcomputer based energy planning package MESAP (micro-computer based Energy System Analysis and Planning system). (A description of the MESAP approach is attached in Annex F.) During the training course, focus should be drawn on an energy demand and an investment model. These are the most required models for energy system analysis presently in Seychelles. Energy supply planning using appropriate models, although an equally important activity as energy demand planning, should be accomplished in a later stage when familiarization with energy demand planning is achieved.

2 - Energy Balance Format

Energy balances are presently not available in Seychelles. For the understanding of the country's energy flow from its primary up to the final and possibly useful energy level and as basis for energy planning, energy balances are prerequisites.

It is therefore recommended that the Energy Planning Unit at the Ministry of National Development applies the energy balance format as presented in Annex E. This structure and nomenclature follows the general structure internationally agreed upon [9] however adapted to the Seychelles' situation.

The format of the energy balance is of the matrix type. The columns identify the type of fuels presently used in Seychelles or considered for future use whilst the first row displays the disaggregated supply, transformation and consumption side.

In order to consider adequately the consumption structure of final energy, a subdivision into agriculture, household, industry, transport, commerce, services, and government is recommended.

3 - Computer Equipment

Given the fact, that local hardware support for IBM products appear to be sufficiently available and in anticipation of the energy programs to be applied for energy planning, the following computer and peripheral hardware is recommended:

Equipment (Hardware)

- IBM PS2/80, 70 MB hard disk, 3 MB RAM, 1 floppy drive (5 1/2 inch) with 1.44 MB / 740 KB, 1 floppy drive (5 1/4 inch) with 1.2 MB , mathematical co-processor 80387, Color Monitor with VGA video adapter card,
- Laser printer

Equipment (Software)

- The operating system MS/DOS and either XENIX, OS/2 or AIX
- Compiler: FORTRAN and C
- Models (e.g. MESAP energy planning package)
- Graphical software package, e.g. FREELANCE

This project should be viewed in the broader context of overall energy planning. The recommendations given in this paper are meant to identify the first step towards the accomplishment of a Seychelles Energy Plan.

INTRODUCTION

For the Seychelles, the project entitled "Energy Review and Micro-computer based Energy Planning in the Republic of Seychelles", is an integral part of the "Energy Policy Research Programme", providing technical assistance to the Energy Planning Unit of the Technology for Development Division of the Ministry of National Development in the field of application of energy models (energy demand, energy supply) using micro and/or desk top computers.

For this reason, the viability of this project has to be seen in the general framework of energy planning activities of the Seychelles Government and requires follow-up activities.

The aim of energy planning cannot be found in the energy system itself but in its contribution to development jointly with other goods and services to satisfy the needs of the population. Consequently, the conceptual starting point for energy planning will not be confined to any part of the energy sector or even in the energy system taken as a whole. It will consist in a reflection on the nature of development and the way energy systems relate to the development process.

Energy planning is part of overall development planning since the ultimate aim of energy planning is not to maximize the supply of energy but rather to build up the energy system of the country to meet its socio-economic needs.

The interdependence between energy and other economic sectors, the need for a long-term view and the financial constraints require integrated long-term planning of the energy sector. This type of planning is a complex task requiring an iterative procedure.

However, it should not be forgotten that planning is not an end in itself. The object and aims of the plan and the results achieved can be measured only against the final target set by the decision-maker.

The general purpose of the project covers a broad spectrum of activities to be covered by different specialists. The original objectives of the activity were concerned mainly computer hard- and software oriented activities. In light of the specific requests from the Government of Seychelles (US/SEY/86/141/11-51) the activities had been revised to respond more precisely to the request. Under the present assignment, specific emphasis was given to support the continuing planning capability by training local manpower in the application of planning methodologies and the use of computer based planning models.

The activities carried out by the consultant under the revised project activities during his assignment were concerned with the assessment of data availability in the energy, economy and socio-economic sector, the analysis of the kind of energy planning tools applied in support of energy strategies and the review of the computer facilities available for the accomplishment of this task. The consultant discussed the different topics with representatives of different departments in the Ministry of National Development and the President's Office. Furthermore, the problems related to electricity tariffs were briefly touched but a topic specific consultation would still be required. In addition, some aspects with regard to electricity generation and the possibilities for co-generation were discussed on site at the Seychelles Electricity Corporation.

To summarize, the objectives of the assignment were attained. The energy and economy situation was reviewed on basis of the available data and compared with the history. The general availability of energy specific data required for energy planning tools was assessed. The questionnaires of the energy survey for the different customers, which are partly already available and ready for data entry, partly still needed to be submitted to customer, were discussed. For those questionnaires still awaiting submission, additional questions were elaborated to be asked for in light of a comprehensive information data base on energy consumption and in light of the energy planning tools expected for application. The questionnaires covering the household sector and which are already available and ready for data entry, had gone in for a preliminary examination.

The computer equipment placed at the disposal of the Energy Planning Unit is considered suitable for the application of day-to-day operations but requires upgrading if sophisticated energy planning tools are to be implemented.

1. THE MACRO-ECONOMIC SITUATION

The Republic of Seychelles includes 100 islands off the coast of East Africa with a total land area of 400 square kilometers and a population of about 65,600 in 1986. About 88% of the population live on the island of Mahé [1].

The Seychelles economy is very small, open, and highly dependent on tourism. Over the period 1981 - 1985, the country's economy (on constant prices) grew at an average annual rate of 2.46%. However, this figure does not reveal the downward trend in constant Gross Domestic Product (GDP) during the individual years 1982 (-2.07% over the proceeding year), and 1983 (-0.6%) which could be attributed partly to the decline in the hotel and restaurant, and building and construction sector. (The development in Gross Fixed Capital Formation would support the latter statement.) Starting with 1984, the economy recovered and experienced growth rates of +3.11% (1984) and +9.84% (1985). The details of the economic development can be taken from table 1.

Table 1 Gross Domestic Product by Industrial Origin in Million Seychelles Rupees at constant (1976) Market prices

	1981	1982	1983	1984	1985
Agriculture, Forestry and Fishery	44.8	34.9	37.9	33.9	32.4
Industry	31.1	32.0	36.5	36.9	39.0
Electricity and Water	7.2	7.0	7.4	9.0	12.3
Building and Construction	38.4	27.4	21.3	25.8	31.7
Transport., Distribution, Communicat.	129.8	132.5	135.0	146.6	154.1
Hotels and Restaurants	31.4	25.1	32.8	37.5	40.1
Finance and Business Services	146.7	152.4	136.8	130.2	143.6
Private non- profit	2.3	2.5	3.1	2.5	3.6
Services	7.9	9.6	7.2	6.6	7.0
Import Duty & Dummy Financ.	19.1	25.8	28.4	32.9	42.0
GDP	458.7	449.2	446.4	461.9	505.8

Source: Republic of Seychelles, Statistical Abstract 1986, Information Systems Division, Mahé, Seychelles

At the same time, merchandise exports remained fairly stable at about 22-23 Million SR while imports rose significantly during the period 1981 - 1985 amounting nearly to 1.4 times the GDP in 1985. Even considering re-exports in 1985, the balance of trade would just balance the GDP of that year. The trends in export since 1981 are shown in table 2.

Table 2 Summary of External Trade 1981 - 1985 in Million Seychelles Rupees

	1981	1982	1983	1984	1985
Imports cif	589.0	641.3	594.1	618.7	704.7
Exports fob	27.5	20.3	25.3	21.4	21.8
Re-exports fob	80.9	79.8	112.0	160.1	177.8
Balance of Trade	-480.6	-541.2	-456.8	-437.2	-505.1

Source: Republic of Seychelles, Statistical Abstract 1986, Information Systems Division, Mahé, Seychelles

Imported mineral fuels for the years 1981-1985 account for between 20 and 30% of the total import bill (Table 3). The burden of this expenditure on the economy is obvious, consuming for example about 36% in 1985 of the total GDP for the import of these commodities.

Table 3 Value of Import by Major Commodity in Million Seychelles Rupees

	1981	1982	1983	1984	1985
Food and live animals	101.7	116.5	92.5	102.1	104.0
Beverages and tobacco	14.6	14.3	13.1	11.5	14.3
Crude material inedible	9.1	9.3	8.2	6.9	6.6
Mineral fuels	130.4	129.0	148.5	186.4	184.4
Animal and vegetable oil	5.5	6.3	7.2	8.3	7.7
Chemicals	32.7	41.3	33.5	36.0	41.2
Manufactured goods	103.8	106.2	88.3	88.6	94.7
Machinery and transport equipment	122.2	142.5	135.8	115.2	179.4
Miscellaneous n.e.s	58.9	69.7	64.8	54.8	68.8
	10.2	6.1	2.2	2.9	3.6
TOTAL IMPORTS	589.1	641.2	594.1	618.7	704.7
%Oil in Total	22.1	20.1	25.0	30.1	26.2

Source: Republic of Seychelles, Statistical Abstract 1986, Information Systems Division, Mahé, Seychelles

II. PETROLEUM SUBSECTOR DEMAND/SUPPLY REVIEW

Petroleum derivatives are the dominant energy source commercially used in Seychelles. The World Bank/UNDP [2] estimated that 90% of all energy consumed could be attributed to liquid hydrocarbons leaving the remainder for fuelwood, charcoal and other biomass. The actual consumption of the latter fuel is fairly unknown. However, as fuelwood, charcoal and other biomass are mainly used in the household sector, a more precise picture on the consumption can be expected after the final evaluation of the Energy Survey presently underway (for more detail on the survey see chapter IV).

The most recent statistics on the petroleum sector are available at the Energy Planning Unit. For comparison with earlier years, access was made to the statistics provided in the Joint UNDP/World Bank ESMAP report which based their review for the years 1978 - 1982 on the information provided by the former Shell Company of the Islands (Seychelles) (The petroleum product management is run by the Seychelles Petroleum Company since 1985.).

The energy situation in 1987 shows the following pattern for the fossil fuel supply (Table 5):

Table 5 Petroleum Fuel Situation in 1987

toe	Imports	Intermediate Consumption	Domestically Available
Motor Gasoline	6238.612		5656.511
Gas Oil	64393.525	5356.461 1/ 52424.838 2/	10066.145
Fuel Oil	22656.404	10995.340 1/ 8297.856 2/	3363.208
Jet Fuel	17232.269	11699.536 3/	538.314
Aviation Gas	247.646		342.807
LPG	255.384		225.564
TOTAL	111023.820	88774.031	20192.549

1/ Seychelles Electricity Corporation

2/ International marine bunker

3/ International aviation

Note: Totals do not add due to stock movements unconsidered.

Source: Ministry of National Development, Energy Planning Unit

Data of earlier years [2] indicate for 1975, 1979 and 1982 petroleum derivatives available for local uses (excluding the use of gas and fuel oil of the electricity sector) at 18,000, 27,800, and 28,100 toe respectively. On basis of the information provided

in table 5, total petroleum fuel supply for domestic use accounted in 1987 to 36,544 toe. This would imply an annual average increase during the period 1975 - 1986 of about 6.1%. However, the average annual increase during the years 1982 -1986, a period characterized by declining world crude oil and petroleum derivatives prices, indicates a growth of about 7.1% by about one percent point higher than for the period 1975 - 1986.

Table 6 gives the historical breakdown of domestic fuel sales of petroleum products by fuel type between 1975 and 1987. Total sales increased from about 18,000 toe in 1975 to 33,000 toe in 1987 (average growth: 5.28%/year). Taking 1979 as point of separation in sales due to the economic recession, the growth rates of the respective fuels read as shown in table 7.

Table 6 Domestic Sales of Petroleum Products (1975-1987)

	1975		1979		1982		1987	
	toe	%	toe	%	toe	%	toe	%
LPG	---	---	149	0.5	132	0.5	225	0.7
AVGAS	147	0.8	374	1.3	371	1.3	880	2.6
Gasoline	4054	22.6	5822	21.0	5103	18.1	5656	17.0
Kerosene	1752	9.8	2270	8.2	2456	8.7	2661	8.0
Gas Oil	12009	66.8	19158	69.0	15917	60.2	12887	38.7
Fuel Oil	...	...	...	...	3135	11.2	10995	33.0
Total	17962	100.0	27773	100.0	28116	100.0	33304	100.0

Sources: Ministry of National Development, Energy Planning Unit
Shell Company of the Islands (Seychelles) [2]

Table 7 Average Annual Growth of Petroleum Products for the Periods 1975-1979 and 1979-1987

%	1975-1979	1979-1987
LPG	...	5.2
AVGAS	26.3	11.3
Gasoline	9.5	- 0.4
Kerosene	6.7	2.0
Gas Oil	12.4	- 4.8
Fuel Oil	...	...
Total	11.5	2.3

The consumption of petroleum derivatives in power generation represented in 1987 nearly 45% of the amount of fuel locally available for supply. Owing to the latest policy, it is heavy fuel that is being used in power generation. More than 76% of the fuel oil domestically available was used for power generation.

Details on local sales of petroleum products in 1987 to major customers by the Seychelles Petroleum Company yield the pattern of fuel type and users as shown in table 8.

Table 8 Domestic Direct Fuel Sales according to Fuel Type and Sector, 1987 (excluding power generation)

toe	Motor Gas.	Jet Fuel	Fuel Oil	AV GAS	Kerosene	Gas Oil	LPG
Industry						431	
Transport							
Road	36					1176	
Water	1					325	
Air		442		228			
Services						312	105
Government	71	92		92	1	451	
US Track.	36				2	2020	
Others	322	4	115	1	21	2816	74
TOTAL	466	538	115	321	24	7531	179

Source: Ministry of National Development, Energy Planning Unit

The differences appearing through the comparison of table 8 with table 5 are due to sales for retail which are not counted for in table 8 (Motor Gasoline: 5190 mtoe, Aviation Gasoline: 21 mtoe, Kerosene: 2637 mtoe, LPG: 46 mtoe.). It can be assumed that motor gasoline will be mainly used in the transportation sector for private transportation while kerosene and LPG will be used in the household sector. Detailed information on the use can be expected after the evaluation of the Energy Survey (see to that chapter IV).

111. POWER SUBSECTOR DEMAND/SUPPLY REVIEW

In 1986, the installed capacity reached 24.396 MW (22.380 MW on Mahé Island and 2.016 MW on Praslin Island). Gross production for that year rated at 66.253 GWh. Compared to the situation in 1978 (only Mahé was electrified that year), it implies a nearly doubling of the installed capacity and an increase of about 75% in the gross production [1].

The sales of electricity by sector for both years, 1978 and 1986 respectively, are shown in table 9.

Table 9 Sales of Electricity by Sector, 1978 and 1986

	Household		Commerce, Industry & Government		Street Lighting		TOTAL	
	MWh	%	MWh	%	MWh	%	MWh	%
1978	11395	30.0	26269	69.3	269	0.7	37933	100
1986	18427	32.6	37975	67.2	136	0.2	56538	100
aver. annual incre. %/a	6.19		4.71		-0.08		5.11	

Source: Republic of Seychelles, Statistical Abstract 1986, Information Systems Division, Mahé, Seychelles

The information on domestic sales points clearly to the over-proportional growth of electricity sales to the domestic sector during the period 1978 - 1986. At the same time, electricity consumption for street lighting reduce by nearly 50% accounting in the electricity sales pattern of 1986 to only 0.2%.

IV. INFORMATION SITUATION REVIEW

Information pertaining to the economic, energetic and socio-economic activities in Seychelles is mainly centered at the Information Systems Division at the President's Office. However, with regard to the energy sector, it is the Energy Planning Unit at the Ministry of National Development that keeps track of energy data and the activities been carried out in the energy sector.

The availability of information is difficult to estimate, on the one hand due to the different authorities collecting, processing and using information, on the other due to the non-periodically data gathering process for some of the data. In the following chapters, an overview will be provided on the authorities dealing with information-gathering and processing (in the energy and economy sector) and on type of information available.

A. Information Systems Division

General responsibility for the data collection, provision and refinement for the Seychelles is in the hands of the Information Systems Division (former Statistics Section) at the President's Office. All country related data as well as adequate international information is gathered and processed. Specific information on selected subjects are available at the respective Ministries and Authorities. The Information Systems Division publishes statistical information on regular basis since 1976. (A list of the published information available at the information Systems Division is attached in Annex A.) Summary statistical information is provided in the yearly issued Statistical Abstract.

This Abstract brings together a summary of available statistics relating to climate, land areas, demography, tourism, external trade, the economy and finance, agriculture and industry, prices, employment, health, education and crime. More detailed information are available for most of the series which appear in the abstract.

Separate monthly bulletins are produced for tourism and retail prices. Quarterly bulletins represent data on external trade and production whilst employment and demographic data are up-dated in half-yearly bulletins. The monthly issued Statistical Bulletin covers the fluctuations in selected markets and provides information on revisions of statistical basis.

Major information is gathered on regular basis from respective local authorities and establishments. Further information is collected on an ad-hoc basis through surveys.

Economic Data

The information pertaining to the economy system covers statistics on external trade, the national accounts, finance, capital formation, prices, wages and employment.

An important parameter for the analysis of the activities in the energy sector, Domestic Product (GDP), is available since 1976 on total and by industrial origin in nominal as well as constant prices (1976=100). Information pertaining to national income in current prices, Gross National Product in current and constant prices, balance of payments cover at the period 1978 - 1986 and statistics on final expenditure of domestic disposable income are available from 1982 till 1986.

Summaries on external trade statistics are provided in the Statistical Abstract since 1975. The values of imports and exports by major commodities are classified according to the SITC Code. Information on the main countries of destination for exports and countries of origin of imports are available as well as export and import price indices.

Socio-economic and Other Data

Statistics on demography, migration, tourism, education and health are available in quite detail since 1975. Average weather statistics are provided in the Statistical Abstract since 1975 indicating that detailed information on that subject could be available through the Meteorological Office.

Information concerning the transport sector covers for land transports the amount of public roads, motor vehicles registered and air traffic.

Except of the information provided in both Household Surveys, 1978/79 and 1982/1983, no further information on the household sector is available.

B. Energy Planning Unit

Energy and Electricity Data

The Energy Planning Unit at the Ministry of National Development was established in 1987 with the objective to provide decision-maker with detailed information on the energy system, to elaborate on strategies on appropriate energy use and to set up strategies for energy demand management and overall energy planning. Before the establishment of the unit, energy planning in the Seychelles was under the Ministry of Planning and External Relations. Information concerning the energy system was mainly in the hands of the local energy supplying institutions (Seychelles Petroleum Company (SEPEC) the former Shell Company of the Island (Seychelles) Ltd. and Seychelles Electricity Corporation (SEC)). On request of the Statistics Department, information was supplied

to the respective authorities.

Starting with June 1986, a good data base with regard to energy supply data is available at the Energy Planning Unit. On monthly basis, stocks (at different locations), bunkers and sales data (according to fuel type and major consumer) of petroleum products (motor gasoline, gas oil, jet fuel, av. gas, fuel oil, LPG) are filed. The time series of average retail prices of four derivatives (motor gasoline, kerosene, gas oil, LPG) dates back to 1982. This information is supplied since 1986 directly by the Seychelles Petroleum Company to the Energy Planning Unit on a regular basis (A sample of the information provided is attached in Annex C.). For the period 1977 - 1986, statistics on imports and sales of the above mentioned fuels are available at the Seychelles Petroleum Company (SEPEC).

A similar data situation prevails for the electricity sector. Detailed information is available on operation and fuels used for both power stations on Mahé Island (fuel input according to fuel type, generated units, peak load, station and mean load, load variation for the day on hourly basis, etc.). This information is supplied by the Seychelles Electricity Corporation to the Energy Planning Unit since May 1987 on a regular basis (An example of the information provided to the Energy Planning Unit is attached in Annex D.). Prior to the year 1987, information concerning the sales of electricity by sector are obtainable through the Information Systems Division at the President's Office.

Whereas the energy supply side is therefore quite sufficiently covered, the information situation on the energy consumption side is rather weak.

The Energy Survey

Under the auspices of the Technology for Development Division of the Ministry of Planning and External Relations an energy survey programme was started in 1985. The objective of the programme was to obtain representative detailed information on energy consumption of the economic sectors of the country for the years 1982-1986 by fuel type and use in order to establish a comprehensive and reliable data base. The survey programme encompasses the following sectors: residential, commercial, government, transport, telecommunication, and industry. The first phase of the programme was concerned, among other tasks, with the energy mix and equipment being used in the residential sector (As an example, the questionnaire of the household sector is attached in Annex B.).

The Energy Planning Unit of the Ministry of National Development followed-up these activities in 1986 and submitted those questionnaires concerned with the energy information of the sectors commercial, government, tourism and construction to the respective customers. With regard to these sectors and with a few exceptions, all those questionnaires sent out since the commencement of the programme in 1985 are back and presently either under examination or prepared for data entry. The questionnaires for the transport and telecommunication sector will be sent out soon as well as the questionnaires for the

different subsectors of the industry (forestry, agriculture, agro-industry, manufacturing, mining) after some tailoring of the questions.

The surveys cover representative samples in each of the economic sectors if not all establishments. On basis of the presently available information, table II depicts the number of questionnaires sent out and the estimated total number of each of the sectors surveyed.

Table II Sample Questionnaires vs. Totals in each Sector

	Total Number (est.)	Number of Questionnaires Expected (est.)	Percentage of Expected in Total
Residential	13,500	1,480	10.9
Commercial	420	270	64.3
Industry			
Forestry 1/	4	4	100.0
Agriculture 1/	10	10	100.0
Agro-industry 1/	15	12	80.0
Manufacturing 1/	35	30	85.7
Mining 1/	2	2	100.0
Construction	13	13	100.0
Fishery	data will be taken from secondary sources		
Tourism	65	41	63.1
Telecommunic. 1/	4	4	100.0
Transport 1/	10 + taxis	10 + taxis	100.0
Others (embassies, clubs, religious organ., etc.)	30	15	50.0

1/ Still to be sent out

Source: Ministry of National Development, Energy Planning Unit

The data received through the questionnaires will represent detailed information on consumption in the household sector for the years 1985 and/or 1986. A separation in either one year is difficult and would in fact not enhance the information on the subject even more it might distort the picture due to the resulting low number of questionnaires available for the analysis.

The analysis is performed by using the computer facilities of the Energy Planning Unit, a micro computer (EPSON PCe MS-DOS), with Monochrome Monitor, 5 1/4 floppy disk drive (360 kB), a printer and the dBase III plus software package.

A preliminary overview of the household data reveals a low per caput electricity and energy consumption. The electricity

pattern among lighting, refrigerators, cooking and other uses (including water heating) shows 26:36:16:22 for 1985/86. The results of the preliminary analysis on major data of the household sector are summarized in table 12.

Table 12 Summary of the Preliminary Results of the Household Survey

Number of households surveyed	1480
Total number of person surveyed	7349
Average number of persons per household	4.9
Energy consumption per household in MJ 1/	18,910.5
Electricity consumption per household in kWh	1,158.6
Energy consumption per caput in MJ 1/	3,814.4
Electricity consumption per caput in kWh	233.3
Total number of households in Seychelles	13500
Energy consum. in the househ. sect. in MJ 1/	255.7
Electricity con. in the househ. sect. in MWh	15641.1

1/ Energy excludes electricity, fuelwood and charcoal

Source: Ministry of National Development, Energy Planning Unit

A preliminary examination of all information obtained through the survey on all sectors of the economy can be expected towards the end of 1989. This would place the Government of the Seychelles in the position to establish country energy balances, and to identify the domestic energy demand on a disaggregated basis.

Studies carried out in the Energy Field

Given the country's intention to diversify its energy supply pattern, which presently is centered on liquid hydrocarbons, and to steer the electricity consumption adequately, a number of analyses have been carried out by different international clients since 1982.

The energy sector as a whole has been analyzed in the Energy Sector Management Assistance Program by the joint World Bank/United Nations Development Program [2]. Other studies focussed on the potentials of all renewable sources of energy available in Seychelles. Additionally, detailed studies on the possible contribution from solar, wind, wave and hydro energy to the energy mix have been carried out.

In a study sponsored by the United Nations Department of Technological Cooperation for Development (UNDTCD) [3], the potentials of wind energy, producer gas, photovoltaics, biogas and solar water heating were assessed. The results of the study are summarized in table 13.

The "solar" study, carried out by the French company TECSOL/SOLEFIL [4] was not available to the consultant. Through secondary material and discussions with the counterpart, information was conceived that this study focussed on the possibilities of solar energy to substitute for electricity in the low grade temperature range for water heating in the hotel sector. It was concluded that solar water heating was one option, financially and economically viable, to diversify the energy mix and to substitute for electricity in the low grade temperature range.

A wind energy pilot programme is currently being carried out on Ste. Anne to identify the potentials of wind energy on the Island. This programme is sponsored by the Commission of the European Communities.

The "wave" study carried out by the Norwegian company OCEANOR [5] focussed on the possible contribution of wave energy to the energy pattern. On basis of published material, available from the Marine Data Bank in the United Kingdom, and the computer program MNINET, two locations, at Point du Sud on Mahé and on La Digue, could be identified as potential candidates. However, further analysis and on site tests were recommended to improve the statistics on waves in both locations and to complete the survey.

The "hydro" prefeasibility study being carried out by TATA Consulting Engineers, India in 1982 [6] has been extensively reviewed by China National Complete Plant Exportation Corporation in 1988 [7]. Seven hydro power stations that might be implemented in the near future have been proposed, e.g. Mamelles 2nd stage, Cascade 1st stage, Grand Saint Louis, Seche, Mare aux Cochons, l' Islette, and Jouanis. The installed capacity and annual generation is 1.4 MW and 4.083 Million kWh respectively. One important aspect focussed on the importance of water supply to Seychelles and it is stated in the report that "the exploitation and utilization of water resources on Mahé is, in the first place, to meet the needs of water supply for domestic, agricultural, industrial and commercial use, as well as to appropriately control and conserve water resources throughout the Island. Electric power generation can be substituted by either non-renewable resources such as coal, gas, oil, or by renewable energy resources such as biomass, wind power, solar energy, tidal power, etc. But fresh water cannot be substituted by any means." [7]

An "electricity tariff" study, carried out by the Electricite de France [8], focussed on the present tariff structure of electricity in Seychelles. Based on the concept of Long Run Marginal Costs (LRMC) an economic evaluation of electricity prices was performed and an electricity price structure recommended.

Summary of the potential for various energy generation technologies in different applications relative to conventional generation. "Viability" refers to economic viability. All economically viable technologies also happen to be financially viable.

Technology	Mahe grid	Praslin grid	St. Anne grid or comparable	Intermediate scale remote (10-40 kW peak)	Small scale remote (100 - 2000 W peak)
Wind Electric*	Probably not viable; Even with high conventional fuel cost, a 5.8 m/s mean windspeed is required.	May be viable. Requires 5.6 m/s mean windspeed for viability under low fuel cost scenario. More wind data needed.	St. Anne saturated by EEC wind project - should provide valuable experience. May be viable on other similar grids in the future.	Wind-diesel hybrid not viable even with 5.5 m/s mean windspeed and high fuel cost scenario.	Viable in certain cases but generally not as good as PV due to mediocre wind regime. Limited applications.
Producer Gas	Marginally viable under best of conditions. Does not deserve further consideration unless cogeneration application is identified.	May be viable but potential limited by small biomass resources. More operating cost data required.		Large biomass resources at some remote sites. May be viable, but requires more data on operating costs.	Not applicable.
Photovoltaics	Not viable.	Not viable.	May be viable assuming medium term improvements in cost and performance.	Not assessed due to high current costs of the technology.	Viable in certain cases particularly with small loads (i.e. less than a few kWh/day). Limited applications.
Biogas	May be viable in large cogeneration applications. Lack of large, centralized sources of biogas materials limits potential.			May be viable only where it can displace diesel (i.e. electric generation or shaft power) at sites with sufficient animal population (e.g. Coetivy); hence, applications are limited.	Not assessed due to limited applications and availability of other biomass fuels.
Solar Water Heating	Viable in probably all hotels and guesthouses and in a small but significant number of households. Total annualized net economic savings could reach nearly US\$ 30,000 per year. Deserves further government support for the development of financing schemes and local assembly capability.				

* Mean windspeed at Seychelles International Airport measured at 6 m is 4.2 m/s.

Table 13 Summary Results of UNDP/CTI study

V. COMPUTER FACILITIES

The Energy Planning Unit at the Ministry of National Development is concerned with the analysis of the energy system and the development of energy planning strategies. For its tasks, the Energy Planning Unit uses desk top computers having the following specifications:

- IBM AT 30 MB hard disk, 3 MB RAM, 1 floppy drive (5 1/4 inch) with 1.2 MB high density, Color Monitor with EG Card
- IBM PS2/30 20 MB hard disk, 2 floppy drives (5 1/2 inch) with 750 KB, Monochrome Monitor
- EPCON PC+ 20 MB hard disk, 640 KB RAM, 1 floppy drive (5 1/4 inch) with 360 KB, Monochrome Monitor
- EPCON PC- 20 MB hard disk, 640 KB RAM, 1 floppy drive (5 1/4 inch) with 360 KB, Monochrome Monitor

The peripheral equipment consists of:

- EPCON IQ 1000 Matrix - Printer
- HP 7475 Platte.

The planning activities are supported by the following software packages:

- LOTUS 1-2-3 Spreadsheet software package
- dBase III plus Data management software package
- Multimate Word processor software package
- ENERPLAN Energy planning tool on energy balance basis
- COMFAR UNIDO package
- StatPac Statistical software package
- SIMNOK Simulation software package

VI. WORKPLAN AND TIME SCHEDULE

A. Workplan

For the successful continuation of this project, the following workplan is recommended. Due to involvement of the MESAP energy Planning package, it is recommended further that the Energy Planning Unit of the Ministry of National Development will be the counterpart of the Institut für Kernenergetik und Energiesysteme (IKE), University of Stuttgart, Federal Republic of Germany.

Activities to be carried out:

- 1) After the submission of supporting material on the MESAP energy planning package in general, the MAED (Model for Analysis (the Energy Demand) energy demand model and the INCA (Investment Calculation) in specific, the counterpart is expected to get familiar with the MESAP and MAED approach.
- 2) In addition, the counterpart will receive the executable version of the MESAP package available on desk top computer to practice a first hands-on experience. The executable version on desk top computer includes MAED energy demand model, and INCA investment calculation model. The executable version is available on IBM or compatibles under the operating system MS-DOS. In order to get familiar with the MAED energy demand model, the didactic level of the MAED will be supplied along with the model.
- 3) The computer equipment recommended will be purchased either on subcontract by the Institut für Kernenergetik und Energiesysteme (IKE) on behalf of the UNIDO or by UNIDO itself, but will be at the disposal to the IKE for the training course.
- 4) The experts of the consultant will test the computer equipment and install the MESAP package installable under MS-DOS and test the package.
- 5) A one-month training course will be arranged at the premises of the Institut für Kernenergetik und Energiesysteme (IKE) to train the counterpart on the usage of the MESAP energy planning package. During this training course specific emphasis will be drawn on the establishment of energy balance tables, the energy demand model MAED and the investment model INCA. Due to the limitations of memory under the operating MS-DOS, the training will be on a PCS micro-computer. The counterpart will however be trained in parallel on those MESAP components installable under MS-DOS on the equipment purchased. After the training course the counterpart will be supplied with the source code if requested. The copy rights however remain with the Institut für Kernenergetik und Ener-

The project input in terms of training costs and manpower involved summarize to:

Tasks 4 and 8	4 Man-months
Tasks 6 and 9 (excl. travel cost, etc.)	1 Man-month
Task 5 (for 1-2 experts, excl. accommodation etc.)	US\$ 18,000.--

Annex A

Statistics Published at Information Systems Division

STATISTICAL PUBLICATIONS

The following publications are available from Information Systems Division. P.O. Box 206, Victoria, Mahe, Republic of Seychelles.

Title	Year	Prices
Census Report	1977	R 80
Household Expenditure Survey	1978	R 60
Household Expenditure Survey	1983-84	R 45
Agriculture Survey	1978	R 60
Statistical Abstract	1977	R 60
	1978-1980, 1982	R 50 each
	1984-1986	R 60
Trade Report	1978-1980	R 60 each
	1982-1983	R 60 each
	1984-1986	R 70 each
Source and Methods of Estimating National Accounts for Seychelles at current and constant prices	1984	R 110
Migration and Tourism Statistics	1978	R 15
	1979, 1980	R 25 each
	1983-1986	R 15 each
Seychelles in Figures Statistical Bulletin:	1983-1986	R 2.50 each
Quarterly	1980, 1981	R 25 each
New series introduced since July 1982		
-Tourism	Monthly	R 5.00
-External Trade	Quarterly	R 5.00
-Retail Prices	Monthly	R 2.50
-Production Indicators	Quarterly	R 2.50
-Employment and Earnings	Half-yearly	R 5.00
-Population and Vital Statistics	Half-yearly	R 5.00
-Tourism	Weekly	R 1.50
-Tourism	Annually	R 10.00

Prices are as indicated plus air mail or surface mail postage and packaging. Inclusive prices can be provided for specific publications on request.

Annex B

Energy Questionnaire for the Household Sector
(excerpt)

REPUBLIC OF SEYCHELLES

STATISTICS DIVISION
DEPARTMENT OF FINANCE
PRESIDENT'S OFFICE

NATIONAL ENERGY SURVEY
HOUSEHOLD SECTOR

SEPTEMBER 1984

CODE NUMBER

--	--	--	--	--	--	--	--	--	--

FORM NES-HOU-1

2. Table 1: Household Information

No.	Name	Sex (M/F)	Age (Years)	Occupations or Type of Work	Industry or Gov't Division	See *	Net ** Income (SR/month)	Remarks
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								
HOU/014/1..	HOU/015/1..	HOU/016/1..	HOU/017/1..	HOU/018/1..	HOU/019/1..	HOU/020/1..	HOU/021/1..	Outgoing payments from household Loan/Rent <input type="checkbox"/> HOU/023 (SR/month)

FT = Full time
 PT = Part time
 FES = Full employment scheme
 NYS = National Youth Scheme
 TU = Totally unemployed
 Pol = Polytechnique
 P = 01 - P9
 Otherwise blank

** Salaries, pensions, other benefits, Family support, incoming alimony, and all other earned income should be included.

Total Gross Income of household (SR/month) HOU/022 A

Alimony (SR/month) HOU/024

Family Support (SR/month) HOU/025

Total outgoing Payments (SR/month) HOU/022B

Table 1: Household Information

HOU/016

No.	Name	Sex (M/F)	Age (Years)	Occupations or Type of Work	Industry or Gov't Division	See *	Net ** Income (SR/month)	Remarks
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
...	HOU/015/1..	HOU/016/1..	HOU/017/1..	HOU/018/1..	HOU/019/1..	HOU/020/1..	HOU/021/1..	

- FT = Full time
- PT = Part time
- FES = Full employment scheme
- NYS = National youth scheme
- TU = Totally unemployed
- Pol = Polytechnique
- P = P1 - P9
- Otherwise

** Salaries, pensions, other benefits, Family support, incoming alimony, and all other earned income should be included.

13. Total Number of People in Household HOU/113

14. Total Number of Rooms (include outside kitchen and verandah with permanent fixtures; exclude toilets, stores and other outside buildings). HOU/114

15. Where do you do your cooking?
 (Tick (✓) appropriate box)
- . Kitchen within house HOU/115
 - . External Kitchen (sheltered from the weather) HOU/116
 - . Open external kitchen with or without roof HOU/117

16. For how many people - not necessarily living in household - are following meals prepared

	WEEKDAYS	SATURDAYS	SUNDAY	
6.00 a.m. tea/coffee				HOU/118/1 - 3
Breakfast				HOU/119/1 - 3
10.00 a.m. tea/coffee				HOU/120/1 - 3
Lunch				HOU/121/1 - 3
After lunch coffee/tea				HOU/122/1 - 3
3.00 p.m. tea/coffee				HOU/123/1 - 3
Evening Meal				HOU/124/1 - 3
Bed Time Drink				HOU/125/1 - 3

17. Information On Use Of Hot Water.
 (Exclude tea, coffee, and cooking purposes)

	YES/NO	No. of each per week	Remarks	
Bath (exclude shower)				HOU/126/1 - 2
Shower				HOU/127/1 - 2
Washing Up				HOU/128/1 - 2
Laundry				HOU/129/1 - 2

19. What fuel do you presently use for the following:

Indicate with (✓) which fuel or fuels used. If more than one type of fuel used indicate fraction of each - estimate on a weekly basis (H - Hourly; Quarter - Q; Half - H; more than half of the time - N).

	Electricity	Gas	Kerosene	Charcoal	Wood	Coconut Oil	Candles	Boiler Water Heating
Lighting								
Cooking								
*Water Heating								
Coffee/Tea making								
Refrigeration								
Ironing								

MOU/146/1 - 6

MOU/147/1 - 6

MOU/148/1 - 6

MOU/149/1 - 6

MOU/150/1 - 6

MOU/151/1 - 6

* Exclude for cooking purposes

Remarks:

20. Indicate evolution in time, starting with present use and going back into the past until 1970, of type of fuel used for each type of activity:

E.g. Consider cooking: if you are presently using electricity (E), before which you were using kerosene (K), in turn before which you were using charcoal (C), and so on, indicate as follows:

COOKING

E	K	C			
---	---	---	--	--	--

Use the following symbols

- E - Electricity
- G - Gas
- K - Kerosene
- C - Charcoal
- W - Wood
- CO - Coconut Oil
- CA - Candles
- S - Solar Water Heating

(a) Lighting

--	--	--	--	--	--

NOU/152

(b) Cooking

--	--	--	--	--	--

NOU/153

(c) Water Heating

--	--	--	--	--	--

NOU/154

(d) Coffee/Tea Making

--	--	--	--	--	--

NOU/155

(e) Refrigeration

--	--	--	--	--	--

NOU/156

(f) Ironing

--	--	--	--	--	--

NOU/157

21. Do you use a thermos flask (Y/N)

.....

NOU/158

22. Do you use a pressure cooker (Y/N)

.....

NOU/159

NOI/NO4

29. Inventory of electrical appliances in use for domestic purposes

Room No.	Description of use of room	Quantity
	Light Bulbs	
	Tube Lights	
	Television	
	TV with Video	
	NIFT	
	Radio (electric)	
	Cooker with (large)	
	Cooker with Grill + Plates	
	Cooker with Grill	
	Plates and Cans	
	Refrigerator	
	Fridge with Freezer	
	Deep Freezer	
	Microwave Oven	
	Blender/Mixer	
	Kettle	
	Toaster	
	Rice Cooker	
	Silver Cooker	
	Water Heater	
	Water Heater Storage	
	Water Heater Shower	
	Washing Machine	
	Wash Dryer	
	Sewing Machine	
	Iron	
	Telephone	
	Fan	

Indicate number of appliances in use in each box; in addition if any are for purely commercial purposes indicate these with an (*)
 continue on separate sheet provided for extra equipment not shown on list.

30. What is the size of your trip-switch?
(Indicate with (✓)).

- | | | |
|-----------|--------------------------|-----------|
| 20 - Amps | <input type="checkbox"/> | HOU/205/1 |
| 40 - Amps | <input type="checkbox"/> | HOU/205/2 |
| 60 - Amps | <input type="checkbox"/> | HOU/205/3 |
| 80 - Amps | <input type="checkbox"/> | HOU/205/4 |

31. May we check your electricity consumption records with Seychelles Electricity Corporation? (Y/N)

..... HOU/206

IF NO GO TO 34

32. What is your electricity meter number?

..... HOU/207

33. What was your last electricity bill?
(SR for one month)

..... HOU/208

GAS USAGE

34. Do you use gas in this household?
(Y/N) HOU/300

IF NO GO TO 41

35. Which of the following gas equipment do you have IN USE?

<u>Equipment</u>	<u>Quantity</u>	
(a) Gas stove	HOU/301/1 - 2
(b) Gas cooker with oven	HOU/302/1 - 2
(c) Gas cooker with grill	HOU/303/1 - 2
(d) Gas refrigerator	HOU/304/1 - 2
(e) Other specify	<u>Quantity</u>	
.....	HOU/305/1 - 2
.....	HOU/306/1 - 2
.....	HOU/307/1 - 2
.....	HOU/308/1 - 2

36. What size of gas cylinders do you buy?

48 - kg HOU/309/1

9 - kg HOU/309/2

(Tick (✓) appropriate box)

37. What is your gas bill?
(SR/month) NOU/ 310
38. How many cylinders do you buy?
(Quantity/month or other unit) NOU/ 311
39. Where do you buy gas from?
(Specify place and name of seller) NOU/ 312
.....

KEROSENE USAGE

40. Do you use kerosene in this household?
(Y/N) HOU/400

IF NO GO TO 47

41. Where do you buy kerosene? (Indicate with (✓)).

- . Shop HOU/401/1
- . Shell Station HOU/401/2
- . Other HOU/401/3
(Specify)

42. How much do you pay a litre of
kerosene for? (SR/Litre) HOU/402

43. What is your monthly kerosene bill?..... HOU/403
(SR/month).

44. How much kerosene do you buy monthly
(Litres) HOU/404

FORM S/1

SEYCHELLES PETROLEUM COMPANY LIMITED

DATE: 20th May, 1988

MAHE BUNKERING COMPANY LIMITED

Stock of fuel, lubricants and LPG as at 30th April, 1988

PRODUCTL O C A T I O N

	NEW PORT	AIRPORT	STE. ANNE	TOTAL
M.S.P.	1223848	-	-	1223848
GASOIL	6807351	-	787292	7594643
JET A-1/KERO	1899125	1602416	-	3501541
AVGAS	366646	21647	-	388293
FUELOIL	2805588	-	-	2805588
L.P.G.	52729	-	-	52729
LUBRICANTS	180058	1033	-	181091

(Quantities expressed in litres at observed temperature except LPG expressed in kg)

Statistics provided by Seychelles Petroleum Company
(Example: April 1988)

FORM S/2

SEYCHELLES PETROLEUM COMPANY LIMITED

DATE:.....20th May, 1988.....

MAHE BUNKERING COMPANY LIMITED

IMPORTS FOR THE MONTHApril, 1988.....

PRODUCT	MEASUREMENT UNIT	QUANTITY	F O B	INSURANCE	FREIGHT	C I F
M.S.P.	M. Tonne					
GASOIL	M. Tonne	5261.550* 2880.21 2380	-	-	-	159.07 163.16
FUELOIL	M. Tonne	-	-	-	-	
JET A-1	M. Tonne	1575.00	-	-	-	172.75
AVGAS	M. Tonne	242.794	-	-	-	925.93
LUBRICANTS	Litres	165243	-	-	-	1.22
L.P.G.	Kilos	-	-	-	-	-

Unit price expressed in US\$

Import quantities are as per Bill of Lading

* GIFT TO SEYCHELLES GOVERNMENT FROM USSR

FORM S/3

SEYCHELLES PETROLEUM COMPANY LIMITED

DATE:.....20th May, 1988.....

MAHE BUNKERING COMPANY LIMITED

SALES SUMMARY

A.	LOCAL SALES	M.S.P.	GASOIL	JET A-1	FUELOIL	AVGAS	KERO	LUBES	L.P.G.
	TOTAL RETAIL	602650	180185	-	-	-	255520	7950	3808
	TOTAL CONSUMERS	45190	1515950	-	930 000	-	10800	32138	15492
	TOTAL AVIATION	-	-	85460	-	24100	-	469	-
	TOTAL LOCAL	647840	1696135	85460	930 000	24100	266320	42557	19300
B.	INTERNATIONAL SALES								
	MARINE BUNKER	-	7769830	-	9700	-	-	209	-
	AVIATION	-	-	2073765	-	-	-	-	-
	OTHERS	-	-	-	-	-	-	-	-
	TOTAL INTERNATIONAL	-	7769830	2073765	9700	-	-	209	-

All quantities expressed in litres except LPG expressed in kg.

FORM S/4

SEYCHELLES PETROLEUM COMPANY LIMITED

DATE: ... 20th May, 1988

DETAILS OF MAJOR CONSUMERS

LOCAL CONSUMERS	M.S.P.	GASOIL	KEROSENE	JET A-1	FUELOIL	AVGAS	LUBS	L.P.G.
USAF Tracking Station	4550	160000	-	-	-	-	-	-
Electricity Division (P.U.C.)	-	801000	-	-	900 000	-	16600	-
Conserveries De L'Ocean Indien	-	2500	-	-	30000	-	384	-
Marine Charter	-	23360	-	-	-	-	-	-
ASL/DCA	-	6700	-	-	-	-	-	-
Police Division	4000	-	-	-	-	-	200	-
Port Division	-	39000	-	-	-	-	-	-
Sheraton Hotel	-	10000	-	-	-	-	-	1632
Reef Hotel	-	8000	-	-	-	-	-	288
Beau Vallon Bay Hotel	-	13600	-	-	-	-	-	768
Seychelles Breweries	-	34000	-	-	-	-	200	-
S.P.T.C.	4000	112000	-	-	-	-	3784	-
Tea & Coffee Company	-	5000	-	-	-	-	-	-
Baie Ste. Anne Supplies	-	-	-	-	-	-	-	240
Grandcourt	-	-	-	-	-	-	-	2064
Equator Hotel	-	-	-	-	-	-	-	1200
Coral Strand Hotel	-	-	-	-	-	-	-	1536
Fisherman's Cove Hotel	-	-	-	-	-	-	-	768

LOCAL CONSUMERS	M.S.P.	GASOIL	KEROSENE	JET A-1	FUELOIL	AVGAS	LUBS	L.P.G.
Air Seychelles	-	-	-	70910	-	21988	469	-
Government of Seychelles	-	-	-	14550	-	2112	-	-
Local Marine	-	5200	-	-	-	-	2000	-
Barbarons Beach Hotel	-	-	-	-	-	-	-	1296
Others	32640	295590	10800	-	-	-	10970	5700
Total	45190	1515950	10800	85460	930000	24100	34607	15492
INTERNATIONAL CUSTOMERS								
Air Seychelles	-	-	-	1133210	-	-	-	-
British Airways	-	-	-	136755	-	-	-	-
Air France	-	-	-	533310	-	-	-	-
Aeroflot	-	-	-	17000	-	-	-	-
Alitalia	-	-	-	121870	-	-	-	-
Air Tanzania	-	-	-	24340	-	-	-	-
Japan Tuna Fisheries	-	839150	-	-	-	-	-	-
French & Spanish Fishing vessels	-	6065300	-	-	9700	-	209	-
Visiting Navy	-	865380	-	-	-	-	-	-
Others	-	-	-	82940	-	-	-	-
Total	-	7769830	-	2073765	9700	-	209	-

All quantities expressed in litres except LPG expressed in kg.

Weekly Stock Position ...06-01-89.....

	SE.PE.C DEPOTS STOCK			ELECTRICITY DEPT		U.S.T.S		TOTALS		DECALITRES AT 20°C	IMPORT IN M TONS
	DECALITRES	M TONS	DAYS	DECALITRES	M TONS	DECALITRES	M TONS	DECALITRES	M TONS		
MOGAS	162463	1181	74					162463	1181	161215	
KEROSENE											
GASOIL *	523751	4415	13	32956	278	26757	225	583464	4918	521073	4500-00 5500-00 (3) *(1)
JET A-1 AIRPORT	188994	1482	23					188994	1482	187482	
JET A-1 DEPOT	121427	952	15					121427	952	120455	1800-00 (3)
AVGAS AIRPORT	4388	31	41					4388	31	4340	
AVGAS DEPOT	41140	296	414					41140	296	40688	
MEDIUM FUELOIL	134640	1270	N/A	23289	219			157929	1489	-133549	5000-00 (2)
TOTAL.											

* Gasoil at Ste. Anne of
2483 M/Tons included

Notes (1) Conversion Factors Mogas
Jet A-1/Kerosene
Gasoil
Avgas
Medium Fueloil

Kilolitres x 0.727 = M Tons
Kilolitres x 0.784 = M Tons
Kilolitres x 0.843 = M Tons
Kilolitres x 0.720 = M Tons
Kilolitres x 0.943 = M Tons

Vessel 1 MT Myrtea Import * (1)
2 Mochi/Sub 20/25/01/89 (2)
3 Aditya Vardhan 15/16/01/89 (3)

*Special Product L.P.Gas = 571 x 48 KG'S full cylinder's

	Date	MOGAS			GASOIL		
		Decalitres	M. Tons	Days	Decalitres	M. Tons	Days
Act. Stock	06-01-89	162463	1181	74	523751	4415	13
Deliveries			114			197	
Bunkers						2253	
Import MT	Myrta in Port					5500	
Est. Stock	13-01-89		1067	67		7465	21
Deliveries			114			197	
Bunkers						1256	
Import	15/16/01/89					4500	
Est. Stock	20-01-89		953	60		10512	30
Deliveries			114			197	
Bunkers						1154	
Import							
Est. Stock	27-01-89		839	53		9161	26
Deliveries			114			197	
Bunkers						1163	
Import							
Est. Stock	03-02-89		725	46		7801	22
Deliveries			114			197	
Bunkers						1139	
Import							
Est. Stock	10-02-89		611	39		6465	18

(1) Conversion Factors

Mogas	Kilolitres x 0.727 = M. Tons
Jet A1/Kerosine	Kilolitres x 0.784 = M. Tons
Gasoil	Kilolitres x 0.843 = M. Tons
Avgas	Kilolitres x 0.720 = M. Tons

	DATE	JET A-1/KEROSINE						AVGAS					
		Depot			Airport			Depot			Airport		
		D'litres	M. Tons	Days	D'litres	M.Tons	Days	D'litres	M.Tons	Days	D'litres	M.Tons	Days
Act. Stock	06-01-89	121427	952	15	188994	1482	23	41140	296	414	4388	31	41
Deliveries			437			390						5	
Import													
Est. Stock	13-01-89		515	8		1482	23		296	414		26	34
Deliveries			437			390						5	
Import	15/16/01/89		1800										
Est. Stock	20-01-89		1878	30		1482	23		296	414		21	27
Deliveries			437			390						5	
Import													
Est. Stock	27-01-89		1441	23		1482	23		296	414		16	20
Deliveries			437			390						5	
Import													
Est. Stock	03-02-89		1004	16		1482	23		296	414		11	13
Deliveries			437			390			31			5	
Import													
Est. Stock	10-02-89		567	9		1482	23		265	371		37	51
Deliveries													
Import													
Est. Stock													

Notes (1). Conversion Factors
Mogas Kilolitres x 0.727 = M. Tons
Jet A1/Kerosine Kilolitres x 0.784 = M. Tons
Gasoil Kilolitres x 0.843 = M. Tons
Avgas Kilolitres x 0.720 = M. Tons

Annex D

Statistics provided by Seychelles Electricity Corporation
(Example: August 1988)

PUBLIC UTILITIES CORPORATION - ELECTRICITY DIVISION

MAHE

GENERATION STATISTICS

MONTH : AUGUST
YEAR : 1988

ITEM		A	B	SYSTEM
UNITS GENERATED	kWh	431 137	5 759 400	6 190 537
UNITS GENERATED (L.F.O)	kWh	431 137	3 624 000	4 055 137
UNITS GENERATED (H.F.O)	kWh	-	2 131 400	2 131 400
STATION UNITS	kWh	10 363	295 700	306 063
UNITS SENT OUT	kWh	420 774	5 463 700	5 884 474
FUEL CONSUMPTION (LFO)	Litres	126 610	997 171	1 123 781
FUEL CONSUMPTION (LFO)	kg	106 112	835 729	941 841
FUEL CONSUMPTION (HFO)	Litres	-	530 554	530 554
FUEL CONSUMPTION (HFO)	kg	-	507 210	507 210
SPECIFIC FUEL CONSUMPTION (LFO)	kg/kWh	0.2461	0.2306	0.2323
SPECIFIC FUEL CONSUMPTION (HFO)	kg/kWh	-	0.2380	0.2380
LUB - OIL CONSUMPTION	Litres	1 150	18 701	19 851
SPECIFIC L.O. CONSUMPTION	L/kWh	0.002667	0.003247	0.003207
MAXIMUM DEMAND	kW	1 550	11 000	12 300
THERMAL EFFICIENCY (LFO)	%	32.25	34.42	34.17
THERMAL EFFICIENCY (HFO)	%	-	34.65	34.65
STATION LOAD FACTOR	%	37.33	70.37	67.65
UNITS GENERATED PER DAY	kWh	13 908	185 787	100 535
MEAN LOAD	kW	579	7 741	6 321

NUMBER OF DAYS: 31

UTILITIES CORPORATION - ELECTRICITY DIVISION

MAHE

MONTH : AUGUST
YEAR : 1988

GENERATION COSTS

	%	SR	TREND %
FUEL (LFO)	66.63	3 416 294	-22.86
FUEL (HFO)	24.96	1 278 636	191.52
LUBRICATING OIL	3.54	181 391	-1.66
WAGES OPERATIONAL	2.22	113 845	-5.31
WAGES MAINTENANCE	2.60	133 225	9.35
MA TERIALS	0.00	0	ERR
TOTAL	100	5 123 391	-3.22
COST PER UNIT		0.8276	-4.86

UNITS GENERATED	100	6 190 537	1.73
UNITS GENERATED (LFO)	65.51	4 055 137	-24.23
UNITS GENERATED (HFO)	34.43	2 131 400	130.66

UTILITIES CORPORATION - ELECTRICITY DIVISION

MAHE

MONTH : AUGUST

YEAR : 1988

kWh METER READINGS

STATION A

SET	PRESENT	PREVIOUS	DIFFERENCE
2	1 579 970	1 280 358	299 612
3	5 976 400	5 976 400	0
4	6 550 425	6 509 025	41 400
5	6 640 440	6 550 315	90 125
		TOTAL	431 137

STATION B

SET	PRESENT	PREVIOUS	DIFFERENCE
1	14 173 600	13 465 100	708 500
2	46 502 350	46 493 100	9 250
3	29 428 200	28 465 600	962 600
4	9 945 800	8 555 300	1 390 500
5	23 070 850	20 386 300	2 684 550
6	45 194 350	45 190 350	4 000
		TOTAL	5 759 400

STATION UNITS

STN	PRESENT	PREVIOUS	DIFFERENCE
A	517 292	506 929	10 363
B1	9 153 660	9 056 620	103 040
B2	2 773 120	2 580 460	192 660
B3	-	-	-
		TOTAL	306 063

UTILITIES CORPORATION - ELECTRICITY DIVISION

RECONCILIATION STATION A

MONTH : AUGUST
YEAR : 1988

	LFO
OPENING STOCK	20 400
FUEL RECEIVED	122 400
FUEL INTO SERVICE TANKS	132 600
CLOSING STOCK	10 200

LFO (LITRES)

SET	PRESENT	PREVIOUS	DIFFERENCE
2	3 368 685	3 279 940	88 745
3	240	240	0
4	774 625	762 140	12 485
5	782 680	757 300	25 380
		TOTAL	126 610

LUBRICATING OIL (LITRES)

	STN A	STN B
OPENING STOCK	2 537	5 797
OIL RECEIVED	0	30 000
OIL CONSUMED	1 150	18 701
CLOSING STOCK	1 387	17 036

UTILITIES CORPORATION - ELECTRICITY DIVISION

MONTH : AUGUST
YEAR : 1988

FUEL RECONCILIATION STATION B

	LFO	HFO
OPENING STOCK	216 628	201 616
FUEL RECEIVED	900 000	600 000
FUEL INTO SERVICE TANKS	983 611	545 144
CLOSING STOCK	133 017	256 472

LFO (LITRES)

SET	PRESENT	PREVIOUS	DIFFERENCE
1	12 642 300	12 442 975	199 325
2	12 614 510	12 611 400	3 110
3	2 605 070	2 582 830	22 240
4	6 195 005	6 159 231	35 774
5	4 065 430	3 328 708	736 722
6	1 985 448	1 985 448	0
C+S	1 120	960	160
		TOTAL	997 171

LFO
STATION METER
TOTAL

NA

HFO (LITRES)

SET	PRESENT	PREVIOUS	DIFFERENCE
1	0	0	0
2	7 182 320	7 182 320	0
3	8 188 489	7 954 200	234 289
4	543 804	220 954	322 850
5	9 273 188	9 273 188	0
6	8 652 654	8 652 634	20
		TOTAL	557 159
		CORRECTED	530 554

TOTAL INTO SERVICE
TANKS (CORRECTED) 545 144

HFO CORRECTION
FACTOR 1.056145

UTILITIES CORPORATION - ELECTRICITY DIVISION

SET PERFORMANCE

MONTH : AUGUST

YEAR : 1988

STATION A

SET	2	3	4	5
HOURS	391	0	125	246
kWh LFO	299 612	0	41 400	90 125
LFO kg	74 377	0	10 464	21 271
SFC LFO	0.2482	ERR	0.2527	0.2360
LUB OIL	1 062	0	28	60
SLC	0.003545	ERR	0.000676	0.000666

STATION B

SET	1	2	3	4	5	6
HOURS	380	9	534	680	739	0
kWh LFO	708 500	9 250	76 250	145 450	2 684 550	0
LFO kg	167 054	2 606	18 639	29 982	617 447	0
SFC LFO	0.2358	0.2818	0.2445	0.2061	0.2300	ERR
kWh HFO	0	0	886 350	1 245 050	0	0
LFO kg	0	0	213 285	293 907	0	18
SFC HFO	ERR	ERR	0.2406	0.2361	ERR	ERR
LUB OIL	703	1 800	2 926	2 014	11 258	0
SLC	0.000332	0.194595	0.003040	0.001448	0.004194	0.000000

NOTE: SFC - SPECIFIC FUEL CONSUMPTION (kg/kWh)
 SLC - SPECIFIC LUBRICATING OIL CONSUMPTION (l/kWh)

REMARKS:

UTILITIES CORPORATION - ELECTRICITY DIVISION

MONTHLY OVERHAULS REPORT

MONTH : AUGUST
YEAR : 1988

STATION A

SET	HRS LMO	TOT HRS	REMARKS
2	14 894	45 055	
3	248	52 038	OUT OF ORDER
4	14 739	47 369	
5	6 110	44 738	

STATION B

SET	HRS LMO	TOT HRS	REMARKS
1	3 541	59 414	
2	9	76 548	UNDER OVERHAUL
3	13 407	69 772	
4	9 278	56 678	
5	11 759	37 558	FAULTY LFO METER
6	11 817	11 820	

UTILITIES CORPORATION - ELECTRICITY DIVISION

LOAD VARIATION FOR THE DAY WITH MAXIMUM DEMAND

TIME	kw STN A	kw STN E	TOTAL
01.00	0	5 800	5 800
02.00	0	5 650	5 650
03.00	0	5 750	5 750
04.00	0	5 500	5 500
05.00	400	5 500	5 900
06.00	1 200	5 900	7 100
07.00	800	8 200	9 000
08.00	1 200	8 200	9 400
09.00	800	9 700	10 500
10.00	1 200	10 650	11 850
11.00	1 200	10 600	11 800
12.00	1 200	10 400	11 600
13.00	800	9 600	10 400
14.00	1 200	10 100	11 300
15.00	1 200	9 700	10 900
16.00	800	9 800	10 600
17.00	300	8 600	9 400
18.00	300	9 200	10 000
19.00	1 550	10 100	11 650
19.30	1 550	10 100	11 650
20.00	1 550	9 450	11 000
21.00	600	9 700	10 300
22.00	0	9 050	9 050
23.00	800	7 050	7 850
24.00	0	6 700	6 700

Annex E

Energy Balance Table Format for Seychelles

Year: _____ (Unit: TJ)	non-renewables				
	LPG	Motor Gas.	Jet Fuel	Aviat. Gasol.	Kero-sene
Primary Energy Product.					
Import					
Export					
Aviation Bunker					
Marine Bunker					
Stock Change					
Domestic Energy Supply					
Power Generation					
Own Consumption					
Conversion Losses					
Distribution & Transportation Losses					
Final Domest. Ener. Sup.					
Agriculture					
Household					
Industry					
Fishing					
Forestry					
Mining					
Manufacturing					
Construction					
Transport					
Road					
Coastal waterways					
Air					
Commerce, Trade & Fin.					
Services					
Telecommunication					
Tourism					
Government					
Others					
Stat. Difference					

Annex F

MESAP

(Micro-computer based Energy System Analysis and Planning Package)

M E S A P

a

**Microcomputer based Energy Sector
Analysis and Planning - system**

A.Voss, A.Reuter

**Stuttgart University
Institut fuer Kernenergetik
und Energiesysteme (I K E)
Pfaffenwaldring 31
D - 7000 Stuttgart - 80
FRG**

Tel.: 0711-686-2138

IKE-DC-85/10

version 3.3 January 1987

MESAP : DESIGN FEATURES

MESAP was conceptualised with the following basic characteristics:

- **FLEXIBILITY:** It is very flexible in that it can be easily adapted to the several diverse nature of the energy situation in developing countries.
- **TRANSFERABILITY:** MESAP, which is designed as a complete package of hardware and software, can be easily transferred to developing countries, where financial, manpower, and institutional requirements may be a constraint.
- **SUITABILITY:** The representation of the reality of certain socio-economic and cultural characteristics of developing countries in the analytical models makes it suitable for developing countries.
- **MODULARITY:** Its modular nature allows for expansion of the system with the users additional requirements.
- **USER FRIENDLY:** The central data base is accessible to all other components the system; the whole system is dialogue - oriented.
- **LOW COST:** Compared with its equivalent system executed on a main frame computer, the MESAP package is less costly. It requires no implementation cost, since hardware plus software go as one tested package.

MESAP : A COOPERATIVE PROJECT

The MESAP project is performed in the following steps :

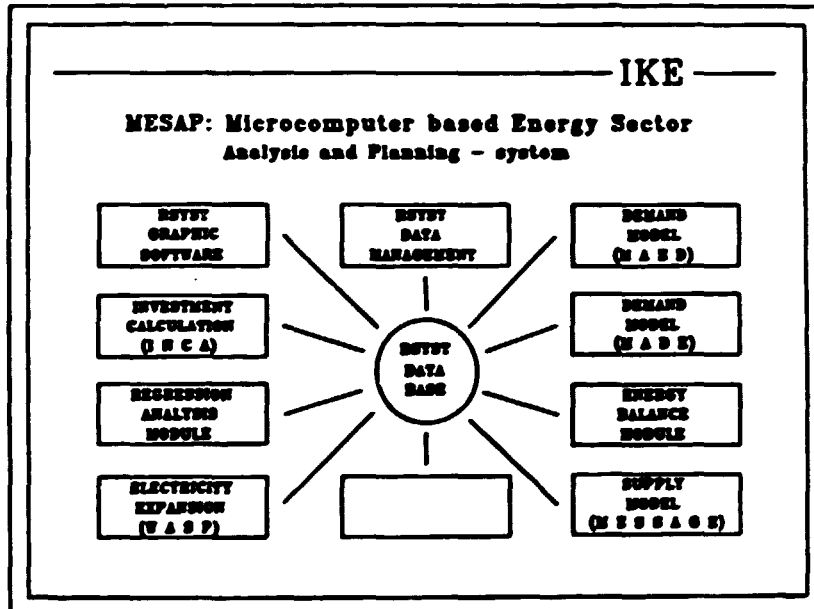
- **VALIDATED SOFTWARE:** Combine validated energy planning software, developed by IKE and other institutions from industrialised and developing countries and link them together via MESAP's data management system to form one powerful energy planning tool.
- **TRAINING:** Train experts from developing countries on MESAP.
- **TAILOR-MADE:** Include modules already in use in respective developing country, further develop the existing software, perform country specific changes and enhancements, develop new modules reflecting the specific needs of the country together with experts from the developing country counterpart.
- **TRANSFER:** Transfer hardware (microcomputer) plus tested software (MESAP) as one package to the country in question.
- **COOPERATIVE STUDIES:** Perform cooperative energy studies together with the developing country counterpart.

MESAP : Basic Structure

MESAP is the acronym for: Microcomputer based Energy Sector Analysis and Planning - System. It is a modular energy planning package with the specific needs of developing countries in mind. It is designed as a flexible planning instrument providing the energy analysts and planners with tools to perform complex energy analysis. It is made up of :

- Basic Techniques of Energy Planning
- Set of tested Energy Moduls
- Data Management and Processing Software

MESAP : Basic Structure

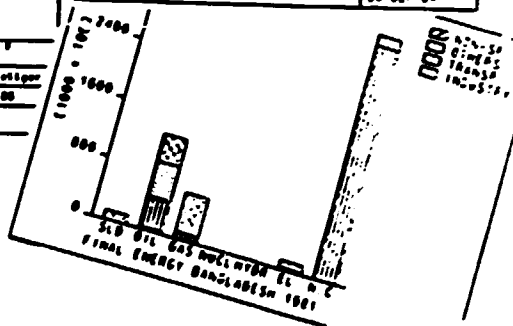
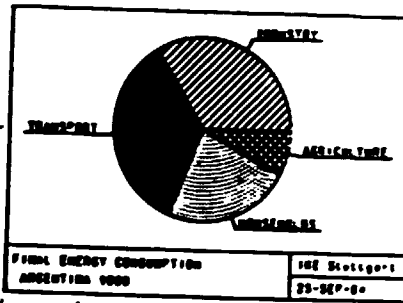
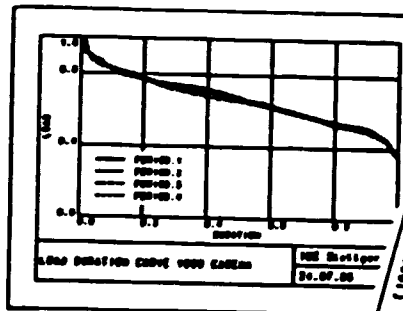


MESAP : DATA MANAGEMENT

At the heart of the MESAP system is a data management and processing system, called RSYST developed by IKE - Stuttgart.

- **RSYST DATA BASE** : The data base has a hierarchical structure with the choice of either an interactive communication or a batch job option. The standardised data blocks allow for flexible exchange of data between the different parts of the whole system.
- **RSYST DATA MANAGEMENT** : Data can be managed through this system by aggregation, disaggregation, grouping, creation, modification and deletion of data.
- **RSYST GRAPHIC SOFTWARE** : The graphic software permits the presentation of the data in the following manners :
 - HISTOGRAMS
 - SECTOR DIAGRAMS
 - TWO VARIABLE PLOTS

MESAP : GRAPHICS

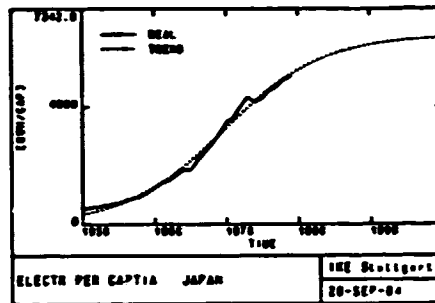


MESAP : BASIC METHODS

The following basic methods and techniques can be performed with ease by MESAP :

- **MATRIX ALGEBRA** : All kinds of matrix operations such as addition, multiplication, inversion, transposition, splitting and assembling of matrices and submatrices .
- **REGRESSION ANALYSIS AND TREND EXTRAPOLATION**

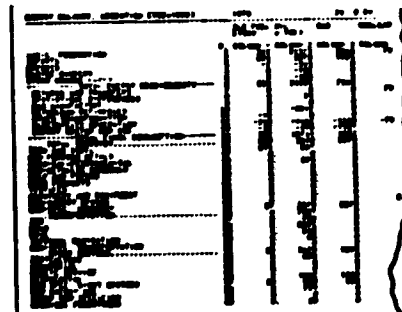
Two-variable or multi-variable regression analysis. Linear, polynomial, exponential and logistic functions.



- **ENERGY BALANCES** :

Energy balances can be set up to any desired degree of detail. Conversion to standard units and other various types of manipulation on the energy balance can be done.

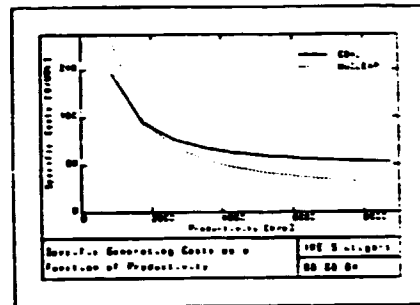
A flexible, user-defined Energy Balance Model is also available.



MESAP : ENERGY MODELS

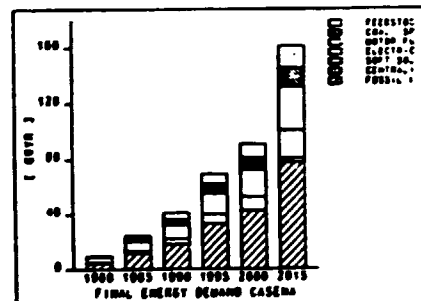
- INVESTMENT CALCULATION (INCA) :

This model is used to perform investment analysis of proposed energy investments. The methodology is based on the present value of the project. INCA determines the time-distribution of investments, specific power generating data, levelised cost and amortisation data...



- ENERGY DEMAND MODEL (MAED) :

MAED is a simulation model based on the scenario method and designed for evaluating the energy demand of a country in the medium and long term.



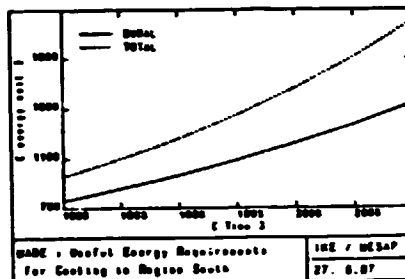
- ENERGY SUPPLY MODEL (MESSAGE) :

MESSAGE is a dynamic linear programming model for analysing the impacts of a given set of energy demands for the energy supply system according to a selected objective function.

MESAP : ENERGY MODELS

- ENERGY DEMAND MODEL (MADE) :

MADE is a follow up of MAED with more flexibility in the adaptation to the existing data base, in the selection of the sectors analysed and in the level of energy analysis (useful or final). MADE combines process engineering and econometric methods and utilizes the advantages of both techniques.



- ELECTRICITY EXPANSION MDEL (WASP) :

The "optimum" expansion plan is chosen by dynamic programming out of a list of user-defined candidates of electricity generating units and additional constraints.

The objective function consists in the sum of all discounted costs.

MESAP : MICROCOMPUTER

- **IMPLEMENTATION** : MESAP is presently available and implemented under UNIX operating system on a PCS - CADMUS and under VMS operating system on a DIGITAL - MICROVAX computer.

Microcomputer requirements (minimum) :

- . main memory ... 1 MB
- . mass storage ... 20 MB

- **FUTURE** :

- . graphic presentation of balances in flow-chart format
- . Marco - economic module
- . Input scanner for interactive, unformatted input for all modules.
- . Implementation of MESAP on different microcomputers.

Annex G

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