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19020

Distr.
RESTRICTED

IO/R.199
19 June 1991

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ORIGINAL: ENGLISH

IV, +5p.
tables
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ESTABLISHMENT OF AN INDUSTRIAL SCIENTIFIC AND TECHNOLOGICAL DOCUMENTATION CENTRE

TF/GLO/88/907

REPUBLIC OF SEYCHELLES

Technical report: A National Energy Efficiency Programme for Seychelles*

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

Based on the work of Gary J. Gaskin,
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Institutional Infrastructure Branch

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* This document has not been edited.

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EXPLANATORY NOTES

CURRENCY EQUIVALENTS

Currency: Seychelles Rupees (SR)

1 US$	=	SR 7.83	(1976)
1 US$	=	SR 6.32	(1979)
1 US$	=	SR 6.55	(1982)
1 US$	=	SR 5.30	(1991)

ACRONYMS

ACCT	Agence de Cooperation Culturelle Technique
CID	Centre of Industrial Development
DTCD	Department of Technical Cooperation and Development
DI	Department of Industry
GOS	Government of Seychelles
IDC	Island Development Company
PER	Ministry of Planning and External Relations
NRDC	National Research and Development Council
ORSTOM	Office pour le Recherche Scientifique et Technique d'Outre Mer
OTEC	Ocean Thermal Energy Conversion
TSSD	Technology Support Services Division
SIEP	Seychelles Integrated Energy Project
SPTC	Seychelles Public Transport Corporation
UNFSSTD	United Nations Financing System for Science and Technology Development
WECS	Wind Energy Conversion System
WEL	Works Enterprise Limited
ISD	Information Systems Division, Ministry of Manpower and Administration

ABBREVIATIONS

EI	Energy intensity
EC	Energy consumption
FEC	Final energy consumption
PEC	Primary energy consumption
GDP	Gross domestic product
MR	Million rupees
LPG	Liquefied petroleum gas

MEASUREMENTS

Bbl	Barrel	=	42 US gallons; 159 litres
boe	barrel of oil equivalent	=	5.99 million btu
TOE (toe)	tonnes of oil equivalent	=	39.68 million btu, 10 million kcal

ENERGY CONVERSION FACTORS

Fuel TOE per Physical Units

Liquid Fuels (tonnes)		
	Avgas	1.04
	LPG	1.08
	Gasoline	1.05
	Kerosene/Jet Fuel	1.03
	Gas Oil	1.02
	Marine Diesel Oil	1.10
	Fuel Oil	0.98
Electricity (MWh)		0.25
Biomass Fuels (tonnes)		
	Fuelwood	0.35
	Coconut Husk	0.40
	Coconut Shell	0.50
	Sawmill Offcuts	0.35
	Cinnamon Residues	0.[illegible]

ABSTRACT

A short term assignment of three weeks was undertaken by Mr. G. Gaskin Chief Adviser BEI Australia, to advise the Government of Seychelles on how to improve the country's use and management of energy. the report broadly reviews energy use within the Republic of Seychelles and outlines a framework for developing a National Energy Efficiency Programme to promote the efficient use of energy throughout the whole nation.

Seychelles is virtually totally dependent on imported oil based energy. Since the first energy crisis in 1974 many alternative energy options have been explored but the final analysis is that Seychelles, for the foreseeable future, will continue to be nearly totally dependent on imported oil. the realization of this situation has led the government to conclude that efficient use of energy resources must be a key element in its national development plan.

The mission found that energy consumption was well above established norms and that since mid 1980 the situation had deteriorated placing great strains upon the energy supply infrastructure particularly electrical energy supplies.

The report recommends a National Energy Efficiency Programme which is to be developed in three phases, all of which are consistent with the National Development Plan 1990 - 1994. the first phase consists of 12 pre-feasibility studies of key sectors which analyze and rank options using financial and economic criteria.

The second phase consists of building a framework and mechanism to implement the options chosen in phase one. the third and final phase consist of implementing the selected options at the national level, and is heavily dependent upon institution-building and training of the main energy consumer. This final phase involves government, commerce, industry and wide cross-section of the community.

CHAPTER 1 ENERGY AND THE ECONOMY

A. Country Background

Seychelles is an archipelago occupying the Western part of the Indian Ocean and is spread over an Exclusive Economic Zone of approximately 1.3 million square kilometres. There are over 100 named islands with the main population centred on the island of Mahe and to a lesser degree the island of Praslin. Seychelles has a mean temperature of 30.3 C and an average sunshine of 7.0 hours per day.

The island of Mahe is 27 km long and 12 km wide and approximately 88 % of the total population lives on the island. The total population of Seychelles in mid 1989 was estimated 67,036. Over the period 1901-1989 the population trend rate was 1.43 % p.a. however by 1989 the rate had fallen to 0.8 % p.a.

In 1976 the country achieved independence and the Government started on a programme to improve education and health, particularly for the poorer sections of the community. The government has developed an open economy with tourism being an important source of foreign exchange.

B. Economic Growth

Since independence growth has generally been strong and as Table 1-1 shows after the world slow-down in 1982/83 GDP grew strongly and averaged 6 % p.a. between 1983-1987.

Table 1-1 Gross Domestic Product

Millions of 1986 Rupees	1983	1984	1985	1986	1987	1988
GDP	1069.6	1155.3	1274.2	1283.9	1337	1447.3
Change %	-1.7	8	10.3	0.8	4.1	8.2

Source:GOS

Considering that the population was growing at 0.8 % p.a. the strong growth translated into rising disposable incomes which has significant ramifications for energy consumption. GNP per capita rose from R 15,292 (US$ 2260) in 1983 to R 19,334 (US$ 3452) in 1987.

Over the period 1983-87 growth has been strong in manufacturing (6.6 % p.a.), building and construction (6.1 % p.a.), commercial and transport (4.1 % p.a.), hotels and restaurants (8.6 % p.a) and general government (3.8 % p.a.).

Growth in the tourist industries has been strong with the number of bednights increasing from 568,400 in 1983 to 790,000 in 1989 (5.6 % p.a). Similarly there has been strong growth in the supporting transport sector.

The generally strong grow has centred on activities which are heavily dependant on energy in its various forms (electricity, gasoline, diesel fuel, LP gas) to support the activity.

C. Investment and Savings

Domestic savings has been extremely low with consumption exceeding GDP in 1983 and equal to 98 % of GDP in 1987. The capital investment required to support the strong economic expansion has been mainly financed through overseas borrowing. Over the period 1983-87 overseas capital financed 73 % of gross capital formation. As Table 1-2 shows over half the expenditure was for equipment. Within the equipment category most requires energy in one form or another for its operation. The strong expansion of the country has increased the investment in energy consuming equipment and in-turn the demand for energy to operate the equipment. As nearly all energy and equipment is imported the national cost of energy in foreign currency terms is high. Of the total imports of R 930 Million in 1989 more than R 420 Million (45 %) was for energy consuming equipment.

It is essential to ensure that the growing capital stock of energy consuming equipment is efficient in its operation due to the high cost of imported energy relative to other factors of production.

The long term cumulative cost to a nation which allows the development of an efficient capital stock is high. Foreign exchange expenditure on excessive energy imports reduces the standard of living. For manufacturing, high energy cost means lost markets and in-turn lower employment opportunities for the population.

Table 1-2 Gross Capital Formation

Millions 1986 Rupees

	1986			1987		
	Equipment	Buildings	Total	Equipment	Buildings	Total
Manufacturing	16.951	19.646	41.941	33.727	13.072	53.536
Hotels & Restrts	2.564	9.828	12.488	12.256	24.662	38.661
Other	127.454	110.541	238.382	87.778	64.096	156.178
Total	146.969	140.015	292.811	133.761	101.830	248.375

Total includes Stock Changes

Source:GOS

D. Balance of Payments

The increase in economic activity has been accompanied by an increasing trade deficit as exports failed to keep up with imports. In 1988 the trade deficit was US$ 112.5 Million while the current account deficit was US$ 22.4 Million. The extremely poor trade performance was offset to a large degree by tourist revenue.

As shown in Table 1-3 the basic balance of the nation (current account plus long term capital) was fairly good while the performance balance shows little reliance on short term capital to fund the importation of goods.

Oil imports represent about 10 % of imports (excluding re-exports) however, as pointed out above, energy related imports (oil, electrical appliances, transport equipment and electrically dependant machinery) are approximately 42 % of imports.

Table 1-3 Seychelles-Balance of Payments 1986-1989

US$ Mill

	1985	1986	1987	1988	1989
Current Account	-19.2	-33.3	-21.1	-22.4	
Exports	4.6	4.4	8.1	16.9	12.4
Other Gs & Service	114.2	125.3	147.6	167.4	
Imports	-84.1	-89.3	-96.2	-129.2	-164.8
Basic Balance	-2.8	0.9	-3.4	-3.5	
Performance Balance	-0.1	-1.4	4	-4.3	
Change in Reserves	-3.1	0.8	-6	5	
R/US$	7.1343	6.1768	5.6	5.3836	5.6457

Source:IMF

SR*1000

Oil Imports	184445	110753	94682	150455	169040
Re-export:Oil	164111	81665	72520	74164	107522
Nett Import-Oil	20334	29088	22162	76291	61518
Oil/Imports	3.39	5.27	4.11	10.97	6.61
Oil/Exports+Service	2.4	3.6	2.5	7.7	

Source:GOS MIS

E. The Nation's Capital Stock and Energy.

In pursuing strong economic grow the nation is developing an infrastructure which is becoming heavily dependent upon imported energy to ensure its operation. The recent rapid build up of the capital stock gives cause for concern. Firstly, because of its growing dependence upon imported oil for its operation. Secondly, and more importantly, 17 years after the first energy crisis there is no market mechanism in place to ensure that an energy efficient capital stock is being built. As shown in Table 1-4 the planned public sector expenditure for 1990-1994 will focus on developing sectors which heavily dependent upon energy. Expenditure on housing, agriculture, fisheries, industry, marine, air, land transport, telecommunications amounts to 54 % of the total expenditure of R 3.7 Billion. All of these activities are heavily dependent upon energy, the main source being imported oil, which must be paid for with scarce foreign currency. As will be discussed, the capital stock built under the last five year plan is grossly inefficient in its use of energy.

Table 1-4 Projected Public Sector Expenditure 1990-1994

(R*1000 at 1989 Prices)

	1990	1991	1992	1993	1994	Total	Total PS	%
Environment	2000	10495	11906	5395	5663	29220	29220	0.79
Agriculture	37920	39050	21590	7660	7860	114080	114080	3.08
Land Use	62170	9610	4050	3550	2000	81380	81380	2.20
Fisheries	83300	60450	75600	54900	34400	318750	318750	8.62
Industry	67662	30600	51265	31000	30180	146585	252707	6.83
Home Industries	1900	100	100	100	100		4900	0.13
Pet & Mineral	11875	3395	3419	3167	3205	28305	9330	0.25
Tourism	33700	16200	39200	17700	140414	88474	0	0.00
Trade & Commerce	5750	5000	10000	0	0	21250	20750	0.56
Outer Is Develop							87500	2.37
Maritime Transport	10300	100	150	150	0	95200	95200	2.57
Land Transport	26280	15865	10800	10800	10800	82580	82530	2.23
Air Transport						162200	162200	4.38
Water & Sanitation	79600	148400	136050	85050	62550	601550	512150	13.85
Telecommunications	28658	52847	28319	35105	36051	173381	173381	4.69
Energy	42828	27224	27464	36714	37114	256733	255753	6.91
Science & Technology							12170	0.33
Education	80960	82510	73870	46960	43760	328160	328160	8.87
Health	18960	20575	5400	13500	2700	67135	67135	1.81
Housing	108340	108340	108340	105090	105090	535200	531950	14.38
Social Development	18656	24506	27706	18156	18156	126180	126180	3.41
Culture							38870	1.05
Sport	4220	26220	17040	1260	0	118540	119740	3.24
Information	27925	8960	15600	5250	9750	67485	67485	1.82
Internal Affairs	0	600	0	0	1000	38705	40305	1.09
Public Sector Mngmt	22000	32197	29750	20300	20000	142247	142247	3.85
Development Inst	18000	7000	0	0	0	25000	25000	0.68
Total Expenditure	793004	730244	697619	501807	570793	3648340	3699073	100

Source:Nation Development Plan 1990-1994

Table 2-1 Seychelles-National Energy Balance 1988

UNIT : TJ	Mogas	Jet A-1	Kerosene	Avgas	Diesel	H.F.O.	L.P.G.	Electric	Charcoal	Fuelwood	TOTAL
Primary Energy Prod										65.00	65.00
Import	301.26	981.06		21.74	4,386.63	338.72	10.58				6,039.99
Export											0.00
Aviation Bunker		800.20									800.20
Marine Bunker					3,418.35	36.98					3,455.33
Stock Change	(29.96)	20.05		(9.73)	(176.76)	47.70	0.65				(148.04)
Interproduct transfer	0.59	(42.66)		(0.59)	42.44	0.22					0.00
Energy Supply	271.89	158.25	0.00	11.42	833.97	349.66	11.23	0.00	0.00	65.00	1,701.42
Jet A-1/Kerosene		(117.96)	117.96								0.00
Charcoal Production									23.00	(23.00)	0.00
Electricity Generation					(467.05)	(336.82)		803.87			0.00
Conversion Losses								(513.05)	(10.20)		(523.25)
Own Consumption								(6.26)			(6.26)
Distr & Transp.Losses								(22.76)			(22.76)
Final Energy Supply	271.89	40.29	117.96	11.42	366.92	12.84	11.23	261.80	12.80	42.00	1,149.15
Households	0.43		116.00				1.75	75.41	12.00	34.00	239.59
Commerce,Trade,Fin	0.16		1.03		0.20		0.48	39.20			41.07
Industry	1.26	0.00	0.85	0.00	35.09	15.55	0.09	23.67	0.00	0.00	76.51
Agriculture	1.26							2.56			3.82
Manufacturing			0.85		29.53	15.55	0.09	17.70			63.72
Mining					5.02			0.67			5.69
Construction					0.54			2.74			3.28
Services	0.07	0.00	0.08	0.00	17.85	0.00	9.04	68.23	0.80	0.00	96.07
Tourism	0.07		0.08		17.85		9.04	54.50	0.80		82.34
Telecommunication								13.73			13.73
Transport	263.56	31.48	0.00	11.32	233.30	0.00	0.00	0.73	0.00	0.00	540.39
Road	231.37				139.84			0.73			371.94
Coastal Waterways	15.29				22.80						38.09
Air		31.48		11.32							42.80
# Special Govt	16.90				70.66						87.56
Government	0.13							35.55		8.00	43.68
Others	1.74				78.95			9.69			90.38
Stat Difference	4.54	8.81	(0.00)	0.10	1.53	(2.71)	(0.13)	9.32	0.00	0.00	21.46

Source: TSSD

CHAPTER 2 THE ENERGY SECTOR.

A. Energy Supplies.

Table 2-1 is the National Energy Balance for 1988. As the balance shows, the nation is almost entirely dependant on oil as its source of energy. All of the oil is imported, with the main supply coming from Kuwait while LPG is supplied from the Republic of South Africa (RSA). A substantial amount of oil base products are re-exported for ships bunkering and international aircraft.

Approximately half the imported diesel fuel and nearly all the heavy fuel oil is used for electric power generation.

Of the final energy supply the main sources are gasoline (271.89 TJ),Kerosene (117.96 TJ), Diesel (366.92 TJ), and Electricity (261.8 TJ). Renewable energy sources supply less than 5 % of the total energy.

The conversion of oil in-to electricity is achieved at an efficiency of 32.5 %. Such a low level is normal for the technology used, however the important consideration is that for every unit of energy saved on the demand side the national savings of imported oil are multiplied by a factor of 3.1. Thus in approximate 1/ terms, every Rupee saved at the electric meter represents a 3 Rupee saving in foreign exchange.

As reported in the National Development Plan 1990-1994 (Annex II) success with renewable energy technology has generally been disappointing, with the solar energy option being the only one which may be economically viable. Considerable resources have in the past been devoted to renewables. With no successful option to imported oil being identified, there is a grow realization that the nations focus should have been on developing strategies to use oil based products more efficiently.

Apart from solar energy, the medium to long term outlook for Seychelles's energy supplies is that imported oil will be continue to be the major source.

B. Energy Demand.

As shown in Table 2-1 the main energy forms demanded are Gasoline (271.89 TJ), Kerosene (117.96 TJ), Diesel (366 TJ), and electricity (261.80).

The petroleum fuels of gasoline and diesel are mainly used for transport while the kerosene is used for cooking. The use of electricity is widely spread however, the household sector is the largest consumer (75.41 TJ) followed by the tourist sector (54.5 TJ).

1/ *Electricity charged at the meter has a capital and energy component. However most of the capital charge is items which are imported and are financed by overseas debt.*

C. Demand for Petroleum Products.

The demand for petroleum products is shown in Table 2-2. The large fall in diesel in 1982 was due to the power company switching to fuel oil to operate their electric generators. Over the period shown there is no trend for gasoline however kerosene demand was growing at a trend rate of 2.5 % p.a. The demand for LPG remained subdued due its high cost.

Table 2-2 Petroleum Demand 1977-1988
(Metric Tons)

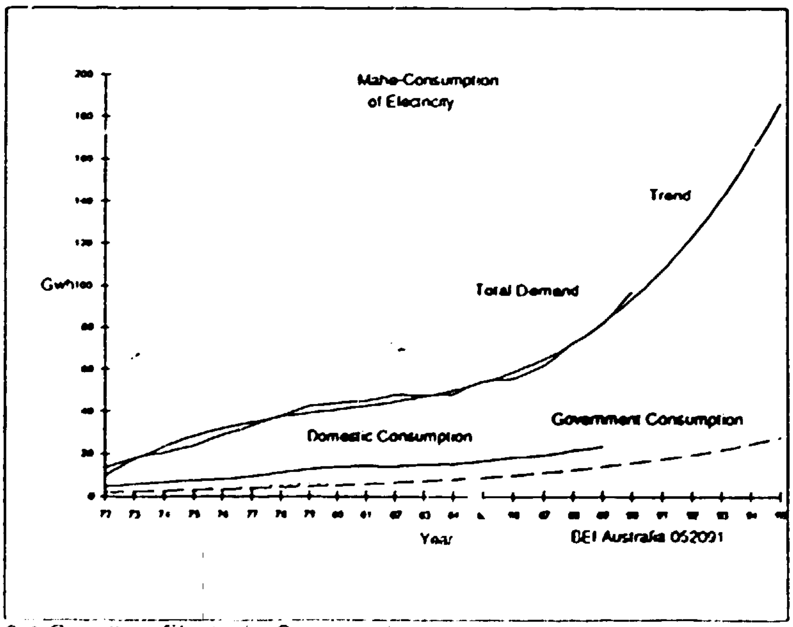
LPG	Gasoline	Kerosene	Diesel	Fuel Oil	
1977	34	4791	1926	19268	
1978	109	5264	2050	18100	
1979	138	5545	2204	18782	
1980	145	5537	2319	20903	
1981	139	5359	2364	21209	
1982	122	4862	2384	16585	3135
1983	158	4797	2450	12261	8791
1984	160	4791	2498	11371	8848
1985	182	4848	2610	14837	6760
1986	187	5227	2662	19689	5373
1987	226	5659	2661	15490	[illegible]
1988	249	5967	2742	20223	8572

Source:GOS National Development Plan 1990-1994

D. Demand for Electricity.

While the demand for petroleum products showed no discernible rise with the strong economic growth the demand for electricity increased dramatically.

As shown in Graph 2-1 the consumption of electricity rose dramatically from 1985 on-wards growing at a compound rate of 15 % p.a. While the demand by domestic consumers grew steadily the demand by other sectors rose significantly. As consumption grew so did the load curve for the electricity system.

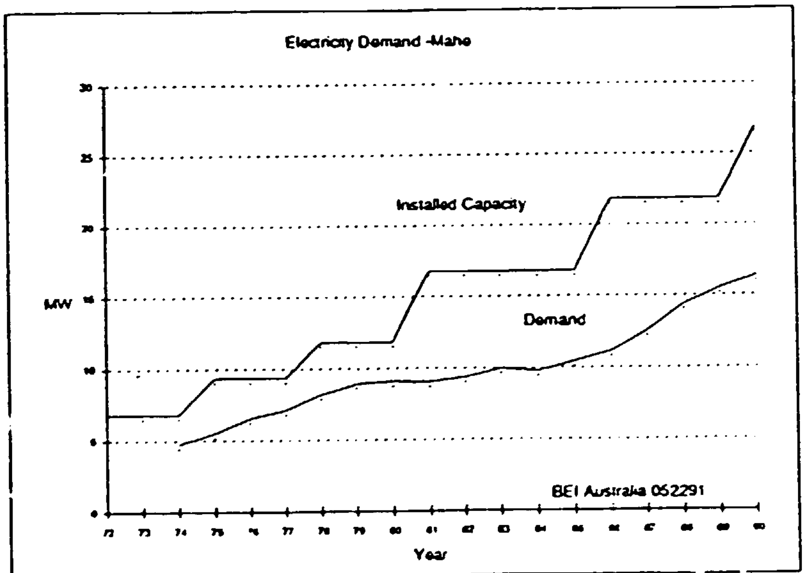


2-1 Growth in Electricity Consumption

As Graph 2-2 shows the system demand grew strongly from 1985 on-wards. The system capacity grew strongly due to the installation of 5 MW sets against the traditional 2 MW sets. The installation of larger sets brings economy in operation but as Graph 2-2 shows the failure of one of the larger sets would leave the systems little capacity to meet the strongly growing demand. A National Energy Efficiency Programme will, in the future be important in delaying the costly installation of future generation capacity 2/.

Due to the limited categories in Public Utilities Commissions tariff structure it was not possible to identify the sectors responsible for the significant increase in energy consumption, however, Phase I of the National Energy Efficiency Programme will identify where the demand is coming from. The suspected sectors are air-conditioning in buildings and refrigeration in many sectors. The peak demand at approximately 1900 hrs is due to the domestic sector which would be a combination of lighting, television and electric cooking.

The significant increase in the demand for electricity is of concern mainly due to the significant foreign exchange required to develop the electric supply infrastructure and the cost of imported appliances. For every R 2100 spent on increasing electrical supply capacity by 1 KW 3/ approximately R 942 are spent on the demand side for imported appliances, all of which consume foreign exchange. A successful energy efficiency programme is a double edged sword. Savings made on the demand side also mean savings in fuel and investment in energy supplies.



2-2 Growth in Peak Demand for Electricity

2/ *The proposed Victoria C station is estimated to cost R 75 Million. The recently installed 5 MW set was budgeted to cost R 28 Million. The bulk of the R 225 Million public sector expenditure on energy in the National Development Plan is for expanding electrical supplies*

3/ *Based on the Long Run Marginal Cost calculated by the World Bank Report No 021/84 Seychelles Electric Power System Efficiency Study*

E. Household Sector.

As shown in Table 2-3 by 1988 electricity was connected to 77 % of the population. This high penetration was an outcome of the Governments plan to increase the standard of living of the poorer population. The two main energy forms used by households is kerosene (9.5 GJ/yr) and electricity (4.34 GJ/yr) and to a lesser degree LPG (0.108 GJ/yr).

Table 2-3 Overview of Household Sector 1985/86 and 1988

	1985/86 (survey)	1988	Change %
estimated number of households	13500	16000	18.5 %
persons per household	4.95	4.33	-14.3 %
share of households having electricity supply	68.4 %	77 %	
total annual energy consumption in sector (excl.transport)3	189 TJ	194 TJ	2.4 %
total annual energy consumption per household (excl.transport)3	14 GJ	12 GJ	-2 %
annual energy consumption per household per fuel type			
Electricity	4.34 GJ	4.71	GJ
Kerosene	9.5 GJ	7.25	GJ
LPG	108 MJ	108	MJ
Gasoline (excl.transport)	27 MJ	27	MJ

1/ Census 1987
2/ ISD estimation 1986
3/ Commercial fuels only, electricity, motor gasoline

Source:GOS/TSSD.

Within the house hold sector the high income group consume nearly three times more electricity than the low income group. As shown in Table 2-4 the low income group uses an average of 691.7 kWh/yr compared with 1952.8 kWh/yr for the higher income group. Further the low income group is the major user of kerosene (59 %) while the high income group is the major user of LPG (79.3 %). The above usage patterns provides useful information for developing the house-hold strategy component of the National Energy Efficiency Programme. The potential for major savings resides with the high income group.

Table 2-4 Energy Consumption Pattern by Income Grouping.

	TOTAL	LOW	ALL
Number of households surveyed	1485	880	605
in % of TOTAL	100 %	59.3	40.7
Number of people surveyed	7353	3900	3453
in % of TOTAL	100 %	53.0	47.0
Average number of people per household	4.952	4.43	5.71
Number of households having electricity supply	1015	498	517
Share of households with electr. supply in income class in %	68.4	56.6	85.5
Total annual electr. consumption in income class in GWh	1.79	0.61	1.18
in % of TOTAL	100	34.1	65.9
Annual electr. consumption in kWh per household	1205.5	691.7	1952.8
per capita	243.5	156.1	342.1
Total annual consumption of different fuels in income class (excl. transport) in % of TOTAL			
Kerosene	100	59 %	41 %
LPG	100	20.7 %	79.3 %
Motor Gasoline	100	14.7 %	85.3%

Source:GOS/TSSD

F. Energy Efficiency in Seychelles.

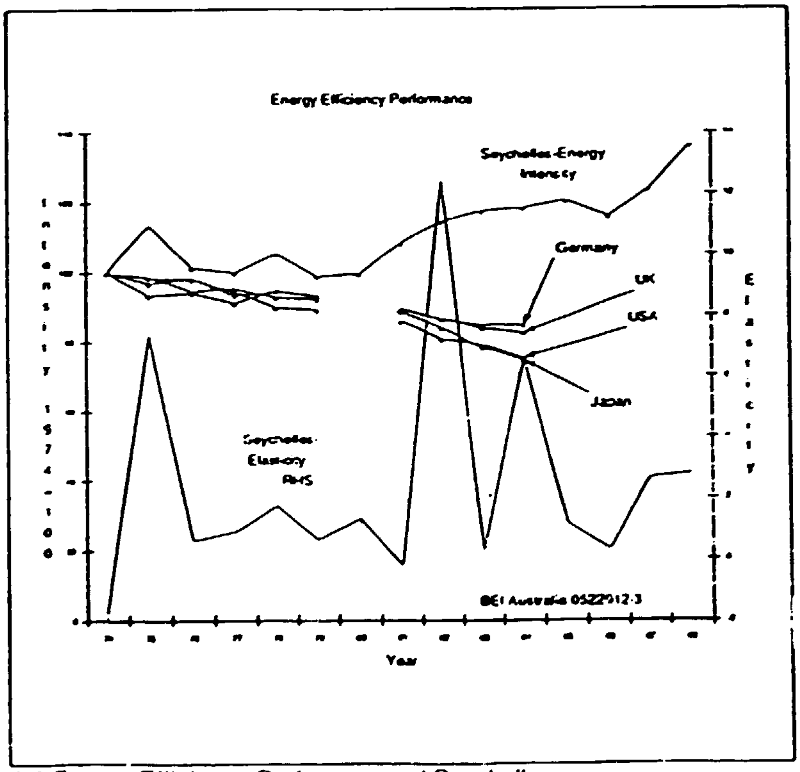
Most developing countries use economic growth as the mechanism to raise the population's standard of living. As part of this programme industrialization is usually the favourite path because of the employment opportunities it presents. Thus a country pursuing such a course can expect the energy intensity per unit of production to increase as the economy takes on a more energy intensive structure. Therefore rising energy consumption per unit of production can be expected with industrialization. Thus the first step in analysing energy efficiency is to analyse structural change. It can be seen in Table 2-5 that over the period of rapid increase in electricity demand the structure of the Seychelles economy basically remained the same. Most sector continued to provide their usual contrib''tion to economic growth.

Table 2-5 Structural Change Contribution to GDP
(Constant 1986 Rupees)

	1983	%	1985	%	1987	%
Agriculture and Forestry	54.1	5.1	47.3	3.7	42.8	3.2
Fishing	30.1	2.8	25	2.0	21.6	1.6
Manufacture and Handicrafts	103.5	9.7	113	8.9	133.6	10.0
Electricity and Water	21.6	2.0	37.3	2.9	26.3	2.0
Building and Construction	49	4.6	71.6	5.6	62.1	4.6
Whole & Retail Trade,Trans	321.6	30.1	368.4	28.9	377.5	28.2
Hotels & Restaurants	86.8	8.1	110.5	8.7	120.6	9.0
Fin & Business Services	114.7	10.7	114.5	9.0	161	12.0
Government Services	179.1	16.7	188	14.8	208.1	15.6
Non-Profit and Other	34.5	3.2	34.4	2.7	34.1	2.6
GDP	1069.6	100.0	1274.2	100.0	1337	100.0

Source:National Development Plan 1990-1994

Thus in the case of Seychelles with a constant structure it would be expected that since the first energy crisis energy consumed per unit of GDP would fall as the economy became more energy conscious. An offset against the fall would be rising income per capita as the increasing disposable income allowed the purchase of energy consuming appliances such as refrigerators, TV and motor vehicles. Thus in evaluating a country's performance growing disposable income and structural change are important considerations.



2-3 Energy Efficiency Performance of Seychelles

There are two basic measures of performance. The first is energy intensity/unit of GDP and secondly the elasticity of energy demand 4/. There is no single absolute measure of a country's energy efficiency performance however these two measures do provide a guide as to how a country is performing.

It can be seen in Graph 2-3 that the energy intensity 5/ of Seychelles has increased considerably since the first energy crisis. Compared to the G5 countries, the performance has been poor however, it must be remembered that these countries already had an energy intensive base. However, as previously discussed the structure of the Seychelles economy has not changed significantly therefore it is concluded that for the same economic activity energy consumption has grown by nearly 40 % for the same unit of output. Such a large growth in energy per unit of output indicates that gross inefficiencies exist. There is an urgent need to identify the high consuming activities to prevent building an inefficient capital stock which could take decades to dismantle and replace with a more resource efficient one.

The next measure in evaluating a country's performance 6/ is energy elasticity, and, as Table 2-6 shows, marginally, the economy is becoming more and more energy intensive while performing the same basic economic activity. This growing marginal value signals that excessive energy consumption in certain sectors of the economy is growing 7/.

In summary the two major indicators of national energy efficiency indicate that "prima facie" Seychelles has a well below average performance and is becoming less efficient as time passes by. Further, the nation is building an energy in-efficient capital stock which it will have to service in the future by building and operation an unnecessarily large electric supply system 8/.

The growing system will require large amounts of foreign capital to build, and a continuous supply of foreign exchange to operate.

4/ *The elasticity is a marginal concept. It is the ratio of percentage change in energy use to percentage change in GDP. The object is to identify whether at the margin the nation is gradually improving its energy performance.*

5/ *Note that as complete long term data was not available for all energy forms, only electricity consumption is used.*

6/ *Energy Intensity is the ratio of energy used per unit of real output. Energy elasticity is the ratio of the percentage change in energy per percentage change in real output.*

7/ *A usual value for elasticity is in the order of 0.6 such as in 1979*

8/ *Appliance efficiency standards are important in building a capital stock. The American Council for an Energy-Efficient Economy(ACEEE) estimates, that appliance standards will by the year 2000 save consumers (net)US$28 billion-US$300/household and investment in power plants will be reduced by 22,000 megawatts with a estimated saving of US$25 Billion*

Table 2-6 Seychelles-Energy Efficiency Performance.

Year	Elec/GDP	Elasticity
73		13.8
74	100.0	-1.8
75	113.7	7.4
76	101.4	0.6
77	99.9	0.9
78	105.3	1.7
79	98.6	0.6
80	99.5	1.3
81	108.2	-0.2
82	114.4	12.4
83	117.5	0.3
84	118.3	6.6
85	120.6	1.2
86	115.8	0.3
87	123.6	2.7
88	136.5	2.8

Source:BEI

CHAPTER 3

NATIONAL ENERGY SAVINGS PROGRAMMES

A. National Issues

A National Energy Efficiency Programme is about resource efficiency first, and energy efficiency second. This basic concept must be clear to all those associated with developing the national plan.

A national energy efficiency programme that is designed on a narrow energy sector focus will in all likelihood fail. The national programme must take into consideration existing and future sector policies of the particular sector and then ensure that the proposed energy efficiency policies are consistent and complementary.

The key to a successful nation energy programme is to ensure the benefits out-weigh the costs and that an attractive return on invested time and capital is received. Accordingly each element of a national energy efficiency plan must be analysed and ranked on a priority basis. There is nothing special about energy, it is like any other factor of production and, investment in reducing its consumption, must recognize the opportunity costs of other investments such as housing, education, health and manpower planning.

In the case of Seychelles the main objectives of the proposed national energy-economic efficiency programme are follows:

1. to ensure that the National Energy Efficiency Programme's policies are consistent and complementary to existing and future macro economic sector objectives;
2. to achieve structural change which will increase energy efficiency and assist economic growth;
3. to minimize the long term foreign exchange cost of the energy sector.

The programme will identify investments in energy demand thus allowing comparison with investments in energy supplies and ensure the optimization of available resources.

In order to achieve the above objectives a it is necessary to develop an analytical framework to review and develop policies for such diverse issues as energy pricing, fiscal and monetary incentives, industrial policy and efficiency standards, technology transfer, institutional responsibilities and resource requirements and allocation.

A multitude of cost-benefit options need to be analyzed and include:

1. fuel substitution alternatives such as using LPG for cooking in place of electricity and kerosene. The use of solar water heating in place of electric and diesel fuelled water heating.;
2. improvement of transport efficiency, and impact on mode switching and urban development;
3. the investment and foreign debt impacts from improvements in the efficiency of household appliances, air conditioners, electrical motors, and other electricity using equipments, machines and devices;

4. energy savings cptions for the tourist sector were energy costs are a significant part of operating costs.

Proposed improvements in energy efficiency have to be economically justifiable and technically feasible. Usually the problem is that approximately half of technical solutions are not economic and thus do-not warrant funding.

The development of an National Energy Efficiency Programme has three phases. The first phase, which is the subject of this report, consists of identifying the main issues and specifying the terms of reference for the next phase.

The second phase addresses the issues and details specific policy options for the government to implement together with the costs and benefits of the various options.

This second phase also addresses implementation issues, definition of funding requirements, human resource requirements and the complex organizational structure to implement and monitor the programme.

The third and final phase is the implementation of the selected policies. Resources are allocated, objectives set, and continuous review of the programmes success is undertaken so that corrective action can be taken at an early date.

It is important to realise that once the structural change has been achieved there is no need for special incentives and they should be with-drawn.

Energy is one of many resources that the government must ensure is used wisely and efficiently by the people of the nation.

B. Potential Savings in Energy.

Since the first energy crisis experience has shown that there is no fast solution to improving the energy efficiency of the capital stock. Normally aggregate energy improvements are in the range of 1-3 % p.a. however over time the saving compound into substantial savings. A 3 % p.a savings over ten years results in a 34 % savings from the baseline consumption 1/.

The first estimate of potential energy savings is carried out by projecting trends forward and use these projections as the baseline case. Savings are then calculated using the scenario of 1 % savings as the low case and 3 % as the high case. The potential savings for Seychelles over the first ten years of a National Energy Efficiency Programme are shown in Table 3-1. It can be seen that the low case (1 % savings) results in savings of R 28.1 Million (US$ 4.9 M) and the high case (3 % savings) of R 78.7 Million (US$ 13.9 M). Discounting the savings at 10 % results in a Nett Present Value (NPV) of R 12.9 Million (US$ 2.3 M) for the low case and R 36.5 Million (US$ 6.5 M) for the high case.

1/ *From 1974 to 1983 Japan reduced its unit energy consumption by 25 %.*

Table 3-1 The Energy Savings Potential of Seychelles
(1989 Rupees)

	Low Savings 1 %	High Savings 3 %
Fuel Savings		
Energy Savings US$		
Electricity	2200050	6168593
Diesel	1217828	3419751
Gasoline	794392	2232100
Kerosene	443393	1244522
Total US$	4,655,665	13,064,968
Total Rp	26,253,297	73,673,359
Capital Savings		
Total US$	327,404	890,599
Total Rp	1,848,429	5,028,058
Energy & Capital Savings		
Grand Total US$	4,983,070	13,955,568
Grand Total Rp	28,101,727	78,701,418
Nett Present Value of Energy & Capital Savings		
NPV 1% Savings US$		2,288,021
NPV 3% Savings US$		6,465,898
NPV 1% Savings Rp		12,917,483
NPV 3% Savings Rp		36,504,523

Source:BEI

Considering the large increase in energy intensity (refer Graph 2-3) and elasticity for Seychelles from the mid 1980s the savings obtained would be more towards the high case (3 % savings per year). The analysis assumes no rise in oil prices and is in 1989 Rupees, thus, at market prices the foreign exchange savings will be higher. It is important to realize that nearly all the savings are in foreign exchange and that incremental costs are also in foreign exchange.

C. Elements of a Successful National Energy Efficiency Programme

Once potential savings are identified the next step is to develop a strategy to mobilize resources to obtain the benefits of increased energy efficiency.

The development of a successful national energy efficiency programme are complex and success requires attacking inefficiency in many sectors of the economy. The major elements to be addressed in developing the programme generally fall into the following groupings.

1. Energy Prices.
2. Laws and Regulations
3. Technology Transfer & Institutions.
4. Incentives & Disincentives
5. Funding for an Energy Efficient Capital Stock.

The importance of each element varies from country to country however the basic strategy is to harness market forces and identify where the market has failed to deliver energy savings which are in the national interest.

D. Energy Prices

Correct energy pricing is the foundation stone of a successful programme. Pricing resources at their true cost to the nation ensures that the users know the true value. Low prices of energy encourages excessive consumption and impedes the introduction of energy efficiency technology.

1.0 Petroleum Prices

Petroleum prices in Seychelles have reflected their cost to the nation. Table 3-2 shows the cost of importation and retail prices paid for a range of petroleum products. The margin on kerosene is low and is part of the government's strategy to subsidize low income households. The margins on LPG are high however with the introduction of a bulk bottling facility the cost of LPG should drop considerably.

Table 3-2 C.I.F. and Retail Prices for Petroleum Products

Year: 1983	C.I.F. in SR/l	Retail in SR/l	Margin in SR/l
Motor Gasoline	1.89	4.64	2.75
Jet Fuel(Kerosene)	1.99	2.00	0.01
Gas Oil (Diesel)	1.88	3.75	1.87
L.P.G. (in SR/kg)	7.35	16.50	9.15
Year: 1986	**C.I.F. in SR/l**	**Retail in SR/l**	**Margin in SR/l**
Motor Gasoline	1.80	4.87	3.07
Jet Fuel(Kerosene)	1.72	2.10	0.38
Gas Oil (Diesel)	1.63	3.94	2.31
L.P.G. (in SR/kg)	6.30	16.50	10.20

In summary all petroleum products are sold at above their border price and are thus sending the correct signals to the consumer. The introduction of lower priced LPG will help PUC reduce the peak load as people move toward gas rather than electricity for cooking, although it is expected that as incomes continue to rise LPG will substitute for kerosene rather than electricity in cooking.

1.1 Electricity Prices.

Electricity tariffs have generally not been sending the correct signals on the cost of supply. The large increases in electrical energy used per unit of output is a sign that excessive consumption is taking place and low energy prices in the domestic sector are contributing towards the excessive use 2/. Electricity tariffs have not changed for many years however there is proposal before government 3/ to introduce tariffs which send the correct pricing signals to consumers. The tariff should be introduced without delay and a mechanism set up to ensure that changes in foreign exchange costs are reflected in the tariffs at regular intervals. The large increases in electricity consumption (Graph 2-1) are placing a burden on the electric supply system, and firm capacity, and the reserves required for system reliability are at dangerously low levels.

The new tariff structure should be implemented as soon as possible, however there is usually political resistance to increase costs for the poorer sections of the community. An important part of the National Energy Efficiency Programme is directed at education, and the education component of the programme will assist the government in explaining the need to increases prices and use electricity wisely.

Table 3.3 Existing & Proposed Electricity Prices

	Basic Cost SR/kWh	Trades* Tax SR/kWh	Total Cost SR/kWh	Proposed Av SR/kWh
Domestic Sector				
0 - 50 kWh/month	1.27	0.06	1.33	
> 50 kWh/month	1.31	0.07	1.38	1.528
with a minimum monthly charge of 10.50 SR				
Industrial, Commercial and Tertiary				
0 - 500 kWh/month	1.47	0.07	1.54	1.314
501 - 1000 kWh/month	1.31	0.07	1.38	
> 1000 kWh/month	1.27	0.06	1.33	
Public Lighting				
Flat Rate	1.33	0.07	1.40	

*Trades Tax Rate is 5% of basic cost.

Source: PUC

2/ *The World Bank report "Electric Power System Efficiency Study" August 1984 found cost of supplying small domestic consumers to be double what they were actually paying. It also found that large efficient consumers were paying more than the Long Run Marginal Cost of supply.*

3/ *"Proposal for a New Structure of Seychelles Electricity Tariffs" Ref TSS/EN/G/103*

E. Laws and Regulations

Laws and regulations are used in a national energy efficiency programme where it is found that the market mechanism has failed and individual energy efficiency is not in the national interest.

The government of Seychelles has not reviewed existing laws and regulations to evaluate their impact of energy efficiency. Tariff and excise structures should be reviewed to evaluate their impact on the availability of energy efficient equipment. Efforts by TSSD to have the tax reduced on high efficient lighting were successful after a one year delay. In April 1991 the trade tax rate was reduced from 40 % to 5 % .

The sole local solar water heater manufacturer is heavily protected by the tax system. No tax is paid on imports however a 10 % sales tax is paid on the final installation. The tax system also prevents the importation of more efficient collectors to compete with the local manufacturer. It appears that the local laws are severely retarding the penetration of solar energy into the capital stock and the projects recommended in this report address the problem.

The present tax system relies heavily on energy taxes through the various taxes on imported oil and appliances. From a revenue collection view point the existing system is easy to administer however there has been no review of what distortions, if any, the present tax system is causing.

The tax regime has several objectives namely, price control, tariff protection and revenue collection. The present law has three components, they are a maximum wholesale margin, a trades tax, and maximum retail margin. The trade tax varies from 5 % on efficient lighting up to 50 % on air-conditioning and electric hot water heaters. A review of the tax regime is necessary to ensure that it is not encouraging the present excessive consumption of energy.

With low savings ratio's the population is heavily influenced by the initial capital cost of an energy consuming appliance. Normally the cheaper the appliance the greater its long term energy consumption. However a balance between price and operation cost (from a national perspective) must be made. Thus appliance standards which embody national objects are an important tool in ensuring that the market works efficiently and national efficiency is achieved in energy consumption. The report recommends a pre-feasibility study on appliance and building standards. In most countries appliance standards are common however in Seychelles there are none.

F. Energy Efficiency Standards.

1.0 Electrical Appliances.

The growth rate of imported electrical appliances has been substantial. As Table 3-4 shows the rate of growth of imported electrical appliances has been significant. The fall in imported appliances in 1983 and 1988 was matched by a fall in foreign exchange. In 1983 foreign exchange reserves fell from US$13.1 Million to US$ 9.97 Million while in 1988 reserves fell from US$ 13.7 Million to US$ 8.7 Million. Thus, if it was not for foreign exchange constraints, the continued growth in imported electrical appliances would have been huge and caused the energy supply system to collapse. During the mission period grid shut-downs occurred at frequent intervals. There is a need for the Government to ensure that the large investment in electrical appliances which are being added to the capital stock are technically suitable for Seychelles and efficient in economic terms.

Table 3-4 Imported Electrical Appliances.
(in Rupees)

Year	TOTAL	% ch.
1980	8021449	
1981	15728633	96.1
1982	18012298	14.5
1983	7154462	-60.3
1984	13125972	83.5
1985	n/a	
1986	13493556	
1987	15689836	16.3
1988	13840751	-11.8
1989	14493280	4.7

Source:TSSD

1.1 Refrigerators

With increasing income/capita the growth of imported refrigerators has increased significantly as shown in Table 3-5. The general growth has been extremely strong with refrigerators being the major import. The fall in 1984 and 1987 once again was due to lack of foreign exchange rather than a fall in demand for refrigerators and freezers.

Table 3-5 Imported Refrigerators & Deep-Freezers
(Rupees)

Year	Total	% ch.	refrig.	% ch.	Deep-Freez.	% ch.
78	1917054					
79	1784766	-6.9				
80	2521400	41.3				
81	844337	-66.5	336720		507617	
82	2907865	244.4	2253805	569.3	654060	28.8
83	3456371	18.9	2507340	11.2	949031	45.1
84	2860840	-17.2	2303814	-8.1	557026	-41.3
85						
86	3573441		2970577		602864	
87	3145231	-12.0	2065220	-30.5	1080011	79.1
88	4044109	28.6	3209727	55.4	834382	-22.7
89	4129888	2.1	3164028	-1.4	965860	15.8

Source:TSSD

With such a large increase in demand for imported refrigerators and freezers it is essential that the Government ensures that they are economically suitable for Seychelles. The Government must guard against the importation of initially cheap refrigerators which over the long run are not economic. Table 3-6 shows representative data on electricity consumption by existing American, Brazilian, Japanese and European refrigerators. It is important to notice that the unit energy consumption of some refrigerators is double those of others and thus it is essential to ensure those imported into Seychelles are in the national interest.

The introduction of new technology for this appliance has been rapid and design improvements in heat exchangers, compressors, wall insulators, internal design, and thermal circuits will continue.

Table 3-6 - Energy performance of typical refrigerators/freezers

BRAND (ORIGIN)	MODEL TYPE	CAPACITY (litre)	ENERGY CONSUMPTION (kWh/yr)	(kWh/l.yr)
Average, 45 Models (USA)(1983)1 door				
		363	703	1.94
Hitachi (Japan)	617 A	169	230	1.36
Gram (Europe)	K 215	215	270	1.26
Kenmore (USA)	56486111	311	370	1.19
National (Japan)	211	207	205	0.99
Laden (Europe)	40830	305	290	0.95
Bosch (Europe)	KS 2680SR	255	220	0.86
Gram (Europe)	K 395	395	315	0.87
Brastemp (Brazil)	BRM-365	324	515	1.59
Climax (Brazil)	RCI-240/127	219	508	2.32
Consul (Brazil)	EC-2845/127	253	540	2.13
Prosdocimo (Brazil)	134801/127	307	626	2.04
Average, 448 Models(USA)	(1983)	2 doors		
		518	1,275	2.46
Bosch (Europe)	KS 3180ZL	310	550	1.77
Amana (USA)	TSC18E	510	870	1.71
National (Japan)	291(HV/T)	290	480	1.65
Amana (USA)	ESR14E	402	635	1.58
Electroluz (Europe)	TR1 120C	315	475	1.51
Toshiba (Japan)	GR411	411	540	1.31

Sources:
"Energy for a sustainable World", J. Goldemberg, T.B. Johansson, A.K.N. Reddy, R.H. Williams, Princeton University, 1985. Brazilian refrigerator's data were measured by CEPEL, Eletrobras, in 1986.Gaskin/Houkai "Energy Efficiency in Venezuela"

a/ Consumption values for different countries may not be directly comparable due to differences in standards. Brazilian standards are comparable to US and Canadian standards 4/.

Experience in many countries has shown that high efficiency refrigerators turn out to be very cost-effective for consumers. In the US, for example, high efficiency models typically cost about 10-15% more but simple pay-backs are less than three years and internal rates of return in excess of 40%

4/ *Gaskin/Houkai found that the introduction in Venezuela of the latest refrigerator technology would reduce the electrical energy consumption by half over a 14 yr period.*

1.2 Air Conditioners

Air conditioners will become more important in Seychelles due to its tropical climate and the growing income per capita.

As Table 3-7 shows the rate of growth of imported air-conditioning and non household refrigeration has been significant particularly in 1984 and 1989. The large falls in 1983 and 1988 due to foreign exchange constraints were replaced by large increases in the following year. The figures all point to a strong demand for air-conditioning and non-household refrigeration. With continued large growth and a heavily loaded electrical grid it is essential to ensure that the imported appliances are the most appropriate for Seychelles conditions.

Table 3-7 Imports of Air-conditioning & Non Household Refrigeration

Year	Refrig. Non-house type	% ch.	Air-con.	% ch.
80	1637151		1343346	
81	2044739	24.9	6146418	357.5
82	5252419	156.9	5690456	- 7.4
83	1002088	-80.9	828995	-85.4
84	7372304	635.7	1036814	25.1
85				
86	6103597		2115343	
87	6732688	10.3	3877448	83.3
88	1796786	-73.3	4491118	15.8
89	3133782	74.4	3774045	-16.0

Source: TSSD

Approximately 80% of the total energy consumed by air conditioners is used to drive the compressor and new rotary compressors consume about 80% less electricity than conventional reciprocating compressors. Further heat exchangers and air circulating motors and fans are being significantly improved. Variable frequency control drivers are being introduced to control compressors and motors so as to follow the load demand and thus save up to 30% of electricity consumption. In one country, Venezuela, it was found that the introduction of high efficiency air-conditioners could reduce the electricity consumption by 50 % 5/.

5/ *Gaskin/Houkai found that the introduction of energy efficient air-conditioners would over 14 years reduce the energy consumption by half. In 1986 air-conditioners consumed 1.69 TWh and 770 MW of installed capacity In 2000 it was estimated that efficient air-conditioners would consume 1.97 TWh and 903 MW instead of 2.89 TWh and 1,319 MW of the no improvement base case.*

The USA Association of Home Appliance Manufacturers (AHAM) estimates that between 1972 and 1984 refrigerator efficiency increased 71%, air-conditioners 25%, clothes washers 55%, and dishwashers 54%. It estimates that as a result of new standards proposed for 1988 that by 1994 efficiencies would increase by 18.2% for refrigerators, 19.8% for freezers, and 14.7% for air-conditioners. The American Council for an Energy-Efficient Economy(ACEEE) estimates that by the year 2000 consumers would save (net) US$ 28 billion - US$ 300/household and investment in power plants will be reduced by 22,000 megawatts with a estimated saving of US$ 25 Billion

In many countries the average efficiency is EER=7.5 BTU/Wh; consumption per unit of 1.2 kW including peak demand hours while latest technology air-conditioners have a EER=11BTU/Wh.

The short pay-back achieved in many countries is a function of electricity prices thus it is important to have electricity tariffs at their marginal cost levels.

1.3 Television and Irons

While the efficiency of cloths irons is difficult to increase through new technology the use of energy in TV sets has seen large improvements and recent development such as the tubeless plane crystal screen indicate that efficiency increases will continue. In 1986 Japanese colour TV sets consume 64% of the energy used in 1983. The electrical efficiency of the locally produced TV should be evaluated particularly as it TV is a major component of the Mahe peak load.

1.4 Lighting

Significant reductions in electricity consumption used for lighting has been achieved in industrialized countries using the following new technologies.

(a) For indoor household lighting, compact fluorescent light bulbs, with the reactor inside the bulb, can produce the same amount of lumens but using only one quarter of electricity. The initial investment is 12 to 18 times more than incandescent lamps however, they consume 70% less energy and have an economic life which is five times longer. The net result is that investing in this technology gives high rates of economic return.

(b) For indoor commercial lighting several new technologies are being introduced. These include reflexive lamp fixtures, improved fluorescent lamps and electronic ballasts. Some prototypes fabricated and tested in Brazil have shown consumption reductions of approximately 70% through a combination of reflexive lamp fixtures and electronic ballasts of 25 kHz.

1.5 Residential Water Heating

From a national resource efficiency point of view the electric thermodynamic cycle for water heating is very inefficient in a technical sense. For example, after taking energy conversion and losses into account only 20 % of the imported is effectively used in heating the water the other 80 % (foreign exchange) is lost to the nation. In most countries a typical electric water heater requires 1000W to 1500 W with a water capacity between 27 and 35 litres and an average consumption of 270 kWh per month.

As seen in Table 3-8 the number of units fell significantly in early 1980 however by 1987 solid growth in imports resumed. The report recommends under the solar water heating project (NEEP#8) that the use of electric water heaters should be reviewed to identify options for solar substitution.

Table 3-8 Imports of Electric Hot Water Heaters
(Rupees)

Year		% ch.
81	5626347	
82	1774067	-68.5
83	157297	-91.1
84		
85		
86	114400	
87	190944	66.9
88	218335	14.3
89	274912	25.9

Source:TSSD

G. Building Standards.

Energy Savings in Buildings

The main energy end-uses in buildings are elevators, air conditioning and lighting. The electrical load is a function of many factors but purpose for use is a major determinate. For public buildings and banking, air conditioners are the largest consumers. For schools, lighting is the predominant energy end use. Typical electrical power installation in warmer climates run at 20 W for each sq. m. for a conventional commercial building and 100 W/sq.m. for buildings with large external glass areas.

Energy is also an important component of the building materials themselves. For example in Brazil 96.4% of the total energy spent to construct 1 sq. m. of typical apartment building is due to the fabrication of construction materials such as bricks, steel, glasses and cement, with the remaining 3.6% spent in the construction work . The total energy spent for the construction of a house is typically equivalent to 33 years of energy consumed in its operation. For conventional office buildings without air conditioning this reduces down to 10 years of operation, while for air conditioned glass faced buildings is only 2 years.

The mission observed many buildings with no passive solar design incorporated and many window air-conditioners adjacent to high leakage windows. It is obvious that there are considerable energy savings to be made in commercial buildings particularly in the capital of Victoria.

H. Motor Vehicles and Transport.

Automobile energy consumption performance has shown dramatic improvement since the first oil shock of the mid 1970s. Table 3-9 shows the latest commercial vehicles available in industrialized nations. Under test conditions some of the best vehicles in Europe and Japan can obtain performance levels of 30 to 55 km-1. In Seychelles there is no strategy to improve the fuel efficiency of the transport fleet. An audit of the fleet's performance is necessary so as to ensure imported gasoline, and diesel fuel is being used as efficiently as possible.

Table 3-9 Comparison of Fuel Efficiency Performance.

(4-5 passenger vehicles)

FUEL PERFORMANCE	(Km-liter) Urban	Highway
USA-EUROPE-JAPAN 1-		
1985 Ford Escort-Mercury Lynx (a) diesel	20.3	28.3
1985 Chevrolet-Suzuki Sprint (a)gasoline	22.0	28.8
1986 Chevrolet-Suzuki Sprint (a)gasoline	25.8	32.6
1985 Nissan Sentra (a) diesel	21.1	27.1
1985 Volkswagen Golf, Jetta (a) diesel	17.3	25.0
1985 Volkswagen Jetta (Turbocharger) (a) diesel	17.3	22.8
1985 Honda City Jar (Jazz) (b)gasoline	22.4	
1985 Toyota Starlet (b)gasoline	25.8	
1985 Daihatsu Charade (b)diesel	23.7	
1985 Peugeot 205 (c)diesel	23.3	23.1
1986 Honda CRX (a)gasoline	24.5	30.9
BRAZIL 1984 2-		
Fiat 147-C gasoline	12.1	16.0
Ford Corcel gasoline	7.4	10.2
GM Chevette alcohol	8.1	10.4
GM Monza gasoline	9.3	14.5
VW Golf alcohol	8.2	11.4
VW Golf gasoline	10.8	14.8
VENEZUELA 1983 3-		
Average gasoline	4.0 - 5.0	
PROTOTYPES		
VW E 80 (d) diesel	31.3	41.9
Renault Vesta (e) gasoline	44.0	52.5
Toyota Lightweight (f) diesel	33.8	

Sources:

1- Robert H. Williams, Centre for Energy and Environmental Studies, Princeton University.

2- Brazilian Automobile Manufacturer's Association - ANFAVEA. Brazilian gasoline with 20% alcohol has 87 octanes.

3- Estimate of MTC - Venezuela.

Note:

a - As determined in the US-EPA laboratory test. The combined EPA test corresponds to 55% urban driving and 45% highway driving.

b - Measurements were based on the Japanese driving cycle, which is an urban driving cycle.

c - Measurement were based on the European driving cycle.

d - Three cylinder, direct injection gasoline. Polo size flywheel start-stop. The higher power version has a supercharger.

e - Lightweight materials; low aerodynamic drag.

f - Three cylinder, direct injection diesel; continuous variable transmission; light weight materials; larger interior volume.

Energy savings in gasoline are a combination of pricing and technology effects and while vehicle testing to various driving cycles shows that the largest percentage is due to technology it is important to realize that increasing energy prices was the driving force for technical innovation. Economic research on pricing elasticity for the transport sector has clearly shown that the tonne of gasoline used per car varies between countries approximately inversely with the price of gasoline. This effect appears to operate mainly through the size of car: consumption increases a little more slowly median engine capacity which is inversely proportional to price. While there is little controversy over the relationship there is statistically significant variations in the elasticity values put forward by various researchers 6/. The mission recommends that a survey of vehicle consumption patterns and efficiency of the public transport system be undertaken (NEEP#9). The objective will be to ensure that the existing fleet is technically efficient in that the high milage vehicles are the latest fuel efficient technology. Accordingly project NEEP#9 will review fuel pattern usage so that the high consumption sectors can be targeted and it is expected that the tourist hire sector will be a considerable user of gasoline.

A preliminary review of the public bus service identified that substantial savings are possible. The present dead milage is 20 % and in some cases routes have 19 % load factors. Further the buses are used on a combination of hilly and flat terrain. The same bus on a hill route uses twice as much fuel as it does on a flat route. The problem is that the bus cannot be optimized for the hill route because it is also used on flat route. There is a need to investigate the potential for matching the bus with the terrain it must travel. Preliminary estimates are that through a combination of gear box technology and computerized routing fuel savings of 8 % can be achieved 7/.

On the final demand side the transport sector is the largest user of imported petroleum products (refer to Table 2-1 the national energy balance sheet) thus it is essential to determine the efficiency at which the sector is operating. Presently the sector efficiency is not know.

6/ *To estimate possible price effects on demand a price elasticity of -0.9 would be suitable for Seychelles. Refer to "International Comparisons of Cars and Car Usage"by J.C. Tanner, Transport and Road Research Laboratory, Crowthorns,Berkshire, United Kingdom,*

7/ *Presently over 60 % of the bus fleet of 150 units is over 6 years old and fuel consumptions are in the range of 3.5 to 3.2 Km/lt for the 12 tonne Tata buses*

I. Technology Transfer and Institutions.

1.1 Technology Transfer

The basic thrust of the programme is encourage the introduction of new energy efficient technology either through the purchase of new equipment or retrofitting old energy technology.

For cost reasons it is generally cheaper to import technology rather than developing it at the local level. Be that as it may, it is still important to ensure that most appropriate energy efficiency technology is used in the country.

New standards of economic-energy efficiency will have to be developed on a partnership basis between the government and the private sector. Overseas standards will have to be reviewed and modified to suit local conditions however the government will have to guard against local standards becoming a barrier to overseas technology. While local manufacture of overseas technology is preferable for employment reasons encouragement should only be given where clear comparative advantage is demonstrated. This is a complex area and institutional mechanisms have to be designed so that Seychelles can optimize its adoption of the vast array of overseas technology. It is important to avoid the past over investment in technologies not suitable for the Seychelles environment.

1.2 Institutions

In designing a national energy efficiency programme it is important to realize that improved energy efficiency is achieved by a combination of new technology and improved operating procedures. Thus investment and training are the core focus of the basic national strategy. Training requires a wide range of institutions to involved therefore institutional linkages must be identified. The strengths and weakness of the various institutions must be identified to ensure that the implementation phase (Phase III) of the programme is successful. The first step it identify those organizations which influence the supply and demand for energy. Also, institutions that will ensure the flow of technology and financial resources must be identified.

Constraints to energy efficiency technology transfer should be identified. The sectors should be closely examined to identify technical assistance opportunities for bilateral and multilateral aid and ensure that coordinating mechanisms are in place. The flow of energy efficiency knowledge from developed countries is important, however it is equally important that Seychelles does not commit funds to develop new technology. Time should only be spent on well proven and commercially available technology which can be supported by the private sector in Seychelles.

The Government must show leadership and ensure that a separate programme for the Government sector is developed. The Government directly and indirectly is a large consumer of energy in Seychelles and presently their is no system in place to monitor Government expenditure on energy particularly air-conditioning for Government buildings.

The report recommends an pre-feasibility study to identify the linkages and institutions in Seychelles that are necessary for an National Energy Efficiency Programme. Further the development of a Government Energy Efficiency Programme is a high priority. Other projects recommended include institutional building and the development of a long term public education programme.

1.3 Incentives & Disincentives

Most countries that have been successful have used a combination of incentives and disincentives to encourage efficiency in the use of energy. There is a strong correlation between the size of the incentive and the response of the private sector. Small incentives are usually ignored by the privates sector.

The following gives a range of incentives used in various countries.

Japan

Fiscal Incentives

Deduct 7% of investment cost from income tax income tax for 3 years or deduct 25% of the investment in the year of installation. Reduction of 1/3 in fixed assets tax for 3 years.

Monetary Incentives

Interest on loans approx 0.4% below commercial rates. Debt/equity 50%. Funds available:1981, Japan Development Bank US$135 Mill, Small Enterprise Fin Corp US$40 Mill

USA

Tax credit of 10% of capital cost of equipment. Introduced 1978, expired 1982. The incentive was a failure as the private sector made little use of the incentive because it was consider the cost of claiming the credit outweighed the benefit received.

Sweden

Grants of up to 35% of the energy efficiency installation. Grants ceased in December 1980. Total grants given amounted to US$ 104 Million. Grants of US$ 193 Million are proposed in a follow-up 3 year oil substitution programme.

Canada

Accelerated depreciation(2-3 year write-off) for efficiency and substitution equipment. Deductions estimated at US$4 Million/yr. Regional grants of up to 50% of oil conversion to natural gas.1984/5 budget US$ 7 Million.

United Kingdom

Grant of US$ 190 per audit. Grant of US$7,700 for heat recovery consulting costs.(Budget US$ 2.3 Million over 3yrs). Grants of up to 25% of coal conversion cost to gas or coal (US$58 Million 1982 to 1983)

Low cost loans for 50% conversion cost by European coal firing loan scheme(US$35 Mill) plus US$12 Mill foreign exchange risk cover.

Finland

Grants of US$102 Mill 1981-83 for energy efficiency investments.

Loans of US$224 Mill efficiency investments.

Subsidised loans(low interest)US$4.7Mill, 1981-1983. Long term credit though Mortgage Bank of Finland.Loans of US$40 Mill(1982)for energy conservation and environmental protection .

Every country is different and Seychelles will have to develop its own set of incentives and disincentives to use energy efficiently. The report recommends a pre-feasibility study on incentives and disincentives for Seychelles.

J. Funding an Energy Efficient Capital Stock

An important element in a national energy efficiency programme is the availability of funds to implement projects which are in the national interest. In Seychelles where household savings levels are extremely low the availability of funding will be important in the domestic sector and to a lesser degree the tourism sector.

The report recommends investigating whether a National Energy Efficiency Trust Fund is necessary for Seychelles. One objective will be to analyse the networks of existing financial institutions to establish whether they can be used to implement the National Trust Fund should it be found necessary to establish one.

The following chapter, Chapter 4, details twelve pre-feasibility studies required to develop the National Energy Efficiency Programme.

CHAPTER 4

CONCLUSIONS

The UNDIO mission found that since the first energy crisis in 1974 the Government had devoted considerable resources in to the investigation of alternative energy resources, particularly renewable sources. Like many other island economies a gradual realization surfaced that the alternatives had either technical limitations or more importantly were simply not economic or financially viable.

Since independence in 1976 the Government quite correctly focussed on social issues and raising the standard of living of the population. In this regard the Government has been quite successful, however rising standards of living have bought with them rising oil imports.

Realizing that the most appropriate option for Seychelles was to use the imported resource more efficiently the focus has recently moved to efficiency in both the supply and demand for energy. Thus over the 17 years since the first energy crisis virtually no coordinated action has consciously been taken to ensure that the energy supply and demand systems were operating efficiently.

The mission found that at the national level the use of energy per unit of GDP to be excessive, from 1974 to 1988 energy intensity in Seychelles rose 36.5 % while in energy efficient countries it fell by more than 30 %. Even after allowing for structural changes, climatic conditions and increasing income per capita the basic conclusion is that energy use in Seychelles is excessive and that gross inefficiencies existed. Further marginal analysis revealed a worsening situation in energy efficiency as the yearly energy elasticity continues to increase. In 1988 the elasticity was 2.8 indicating that for every one percentage point increase in GDP electricity consumption increased 2.8 percentage points, an extremely high value.

On the supply side 1/ there have been isolated cases of efficiency improvements but these are the exception rather than the rule.

On the demand side there has been no effort to improve energy efficiency either through appliance operation or selecting energy consuming equipment on the basis of the highest return to the nation.

The starting point for planning an national energy efficiency programme is to analyse energy use and identify the priority targets. Planning is a process based on data and without data the first step cannot be undertaken. Fortunately in 1985 the Department of Industry through the Technological Support Services Division started work on an energy data base. While not complete, the data base provided the mission with valuable information and an insight as to energy use in Seychelles. This information allowed a broad framework to be designed which, over time, can be developed into a highly successful national energy efficiency programme.

1/ *The UNDP/World Bank Report -"Seychelles:Issues and Options in the Energy Sector" (Report No 4693-SEY 1984) was followed up by a electric power system efficiency study in August 1984.*

It is important to put the potential undertaking at hand in perspective and sound a note of warning that national energy efficiency programmes in developing countries have been more characterised by their failures than successes. The core problem has been the failure to recognize that as energy is used by the population at large and that complex institutional systems must be developed to deliver the energy savings and monitor the programme's success.

RECOMMENDATIONS

A key success factor in a national plan is Government leadership. The programme requires commitment by the Nation's leaders. The commitment must not only be confined to words but action. Government departments must allocate a percentage of their budget to energy efficiency and report yearly on their success in reaching stated objectives.

National strategies must not be centralized. The responsibility for improvement must be decentralized, however, the monitoring of success must be centralized so that poor performers can be identified and action taken. The following recommendations are based on the potential benefits of a national energy efficiency programme. Further, in directing the use of scarce resources the Government must ensure that benefits outweigh costs and that the rate of return received exceeds the opportunity cost of other government projects.

The mission recommends a three phase program with the first phase consisting of twelve separate projects which are inter-linked to varying degrees. This is the pre-feasability phase.

The twelve projects outlined below should be under the control of the Department of Industry, Technological Support and Services Division (TSSD). It is recommended that TSSD seeks financial support to carry out the projects as soon as possible due to the urgent need to reduce the excessive use of imported energy.

It is recommended that no long term international expert be appointed to the project. Experience has shown that due to the, many technologies involved, the multitude of sectors using energy, and the long-term nature of energy savings, that a core of expertise be developed in Seychelles and that sustainable institutional systems be developed by UNIDO.

1.0 Benefits

The mission based the potential annual national savings on two scenarios. The low scenario is based on an annual savings of 1 % while the high scenario is based on a 3 % annual savings. A 3 % annual savings has been recorded in many developed countries. Over 10 years the 1 % savings will amount to R 28.1 Million (US$ 4.9 Million) while the 3 % savings will amount to R 78.7 Million (US$ 13.6).

1.1 Costs

Discounting the savings generated at 10 % resulted in a Nett Present Value (NPV) of R 12.9 Million (US$ 2.3 Million) for the 1% savings and R 36.5 Million (US$ 6.5 Million) for the 3 % savings. Thus expenditure for the total program should be in the order of R 37.2 Million (US$ 6.5 Million).

A. The National Programme

The National Energy Efficiency Programme design is based on implementation experience in many other countries and two similar island economies in particular 2/. However, Seychelles has unique population and cultural features which will require the Government to ensure that the final design takes into account the nation's culture and attitudes towards energy consumption.

The plan has three distinct phases. The first phase - Phase I-is where pre-feasibility studies on 12 projects are undertaken. For each project the detailed costs and benefits to the nation are calculated and the projects ranked as to their return. Most projects are dependent upon inputs from others thus a time priority ranking must be implemented. The timing details are explained in Annex III.

The next phase, is Phase II, where those projects which are accepted by the government proceed to full development. Under this phase detailed plans are made such that when funds are available they are fully implemented.

The final phase, Phase III, is when the program is launched officially to the nation at large. Decentralized activities to save energy start and the centralized monitoring of success is activated.

1.0 Phase I

The first phase consists of analysing and ranking options using internationally accepted financial and economic methodologies. The objective is to ensure that those projects selected meet national investment criteria before additional funds are committed to developing the project in detail.

There are 12 separate projects in this stage costing R 2.1 Million (US$ 403,500). The cost for each project is show in Table 4-1.

The first step is to complete the Project Evaluation course which will ensure that all Seychelles planners know how to evaluate projects in financial and economic terms. Many valuable years of time would have been saved had many of the renewable energy projects been subject to economic and financial analysis prior to committing scarce government funds and technical resources to projects which after many years have not been successful. Seychelles cannot afford to become a testing country for new technology, the renewable projects moved the focus away from the most obvious first solution for Seychelles - resource efficiency in energy supply and use 3/.

With knowledge of project evaluation Seychelles planners will be able to evaluate external proposals and identify those which may not factor in the unique variables of the markets in Seychelles.

2/ *Namely National Energy Efficiency Programmes for Barbados (World Bank Project) and Jamaica (USAID/UNDP/CIDA Project) in the Caribbean. Other energy saving schemes such as UNIDO project THA/80/016 provide useful inputs.*

3/ *Even with all its technical resources Japan, soon after the first energy crisis promulgated a energy conservation law which required many sectors to use energy efficiently. Companies over certain sizes were required to appoint energy managers who reported to the government on the company's energy efficiency performance.*

During Phase I detailed costs and benefits for each project are prepared for acceptance or rejection by the government. The projects cover the three broad areas of standardization, education, and structural analysis for implementation. In Phase I international experts work closely with a wide cross-section of the Seychelles population to develop costs and benefits for their particular sector.

The proposed projects to be covered in Phase I are as follows:

NEEP #1 Institutional Review-Private/Public Sector.

The review will result in two basic networks. The first will be the establishment of an inter-ministerial committee to implement the government's energy efficiency programme. The second will be a joint government private sector group which will form the basis of developing the national standards and labelling programme.

Phase I Cost US$ 31,050

NEEP 4/ #2 Project Analysis and Evaluation.

This project is to train Seychelles planners in economic and financial analysis. The following projects can only proceed after this project is completed. A national energy efficiency monitoring programme is also implemented as a subset of this project.

Phase I Cost: US$ 35,800

NEEP#3 Review of Government Laws and Regulations.

The project will review and recommend changes to laws and regulations that mitigate against energy efficiency. For example, the electric lighting load is a major contributor towards the electrical system peak yet only recently the duty on efficient electric globes was reduced from 40 % to 5 %. The savings to the power company and the consumer are significant. A local lawyer will assist on this project.

Phase I Cost US$ 32,350

NEEP#4 Energy Audits of Industry & Commerce.

This project will sample a few key locations and identify where efficiency improvements can be made in hotels and to a lesser degree in industry. The audits will assist the operators identify where improvements can be made. Output will be a training programme in Phase II and detailed investment proposals for funding by multilateral or bilateral donors or international banks.

Phase I Costs:US$ 55,600

4/ *National Energy Efficiency Project*

NEEP#5 Domestic Appliance Standards.

This project will identify whether energy efficiency standards are required for Seychelles. It will cover Kerosene, LPG and electric stoves, electric refrigerators and air-conditioners. The objective is limit the importation of appliances which are inefficient or designed for cold climates such as Europe and are therefore unsuitable for conditions in Seychelles. Benefits will include reduced oil imports for electricity generation and reduced public capital expenditure in generating plant.

Phase I Cost: US$ 40,400

NEEP#6 Energy Labelling of Appliances.

This project will be the follow-on to the development of appliance standards. In conjunction with the education programme it will assist the population in selecting the most cost efficient appliance for Seychelles conditions.

Phase I Project Cost US$ 24,800

NEEP#7 Energy Efficient Building Standards

This project will assist in the development of building design which incorporate energy saving features without placing unnecessary constraints on architects who are designing buildings for Seychelles conditions. Further, for the poorer population the standards will take into consideration the long term benefits of reduced electric consumption while carefully avoiding unnecessary cost burdens on the low income sectors.
Through more efficient homes consumers will spend less on energy and have a greater disposable income which if saved will benefit the investment plans of the nation. Other benefits will include reduced oil imports for electricity generation and reduced public capital expenditure in generating plant.
For the first few years standards will be advisory and if the government believes they are in the national interest they will become mandatory.

Phase I Cost:$US 39,700

NEEP#8 Water Heating Using Solar Energy

Seychelles has ideal climatic conditions for using water heaters. Presently large amounts of imported energy in the form of electricity and diesel oil are used for water heating. Capital cost has been identified as one constraint however the fact that such a cost effective proven technology has such low market penetration warrants close investigation. There is potential to save substantial amounts of diesel oil and electricity in this sector.
Phase I Cost US$ 19,400

NEEP#9 Transport Sector Review

This project will identify areas where energy efficiency improvements can be made, firstly in the public sector and secondly in the private sector. The government bus organization estimates that it can save 8 % of its diesel oil fuel bill by implementing a energy efficiency program.

Phase I Costs:US$ 35,400

NEEP#10 Public Education and Technical Training Programme.

This project will identify how to educate the population at large as to the national importance of using energy efficiency. The vulnerability and cost to the nation of using energy inefficiency will be stressed. Training for a wide range of the community and business will be provided. A training programme for local engineers in energy efficiency will be undertaken in conjunction with the Project No 4 Energy Audits of Industry an Commerce.

The project is essential in that it will politically condition the population to understand and accept the need for higher electricity prices which are presently subsidized. Institutions will be identified who have the capability to provide on-going technical training in energy efficiency technology. Mechanisms to ensure an on-going flow of the latest efficiency developments in developed countries will be identified.

Phase I Cost:$US 27,500

NEEP#11 Public Sector Energy Efficiency Programme

The government will show national leadership by implementing its own internal energy management programme. Each department will be accountable for its own expenditure and performance in improving energy efficiency. Yearly reporting will become the norm. The project involves identifying energy wastage in the public and para-statal sectors and putting in place a system to gradually reduce the wastage. A key element will be a yearly reporting system on energy improvements and associated rewards for the best performance.

Phase I Cost US$ 29,200

NEEP#12 A National Energy Trust Fund

This will involve the funding of energy efficiency projects which are in national interest. Organizations such as the Seychelles Saving Bank, National Development Bank and the Seychelles Housing Development Corporation could provide the administration system for the fund. The project will identify the strength and weakness of the various financial institutions in Seychelles with a view to establishing the most cost effective method of administering the fund. The fund would be a roll-over fund and thus provide on-going support for investment in energy efficiency.

Phase I Cost US $32,300

Total Cost Phase I

US$ 403,500 (excluding Government in-kind costs.)
Rp 2,138,550

B. Implementation of Phase I

The implementation schedule for Phase I is shown in Annex III. Many projects are interdependent and correct scheduling is required. The project has been broken down into 12 separate Project Documents so that the project can start even if the total amount for the Phase I is not available. Those projects that provide data for follow-on projects should be started according to the work schedule in Annex III. The first project which must be completed is the Institutional Review for it defines the organizations, institutions and individuals who will be involved with all of the follow-on projects.

Project Budgeting

Projects have been prepared on the basis of standardized UNIDO costs. Due to potential slippage most projects have been based on 1992 cost schedules although the time-table calls for a start towards the end of 1991. Depending on the starting date project costs may have to adjusted upward or down-ward depending upon the actual implementation date. Because of the energy problems presently confronting the Government, particularly with power outages, it is expected that the Government will move quickly to start Phase I.

Phase II

Those projects identified in Phase I which meet the economic and financial criteria of the Government will proceed to Phase II. Under Phase II the projects will be developed to the stage where when funds are available they will be implemented as part of the National Energy Efficiency Programme. The cost of Phase II will be an output of Phase I

Phase III

This phase starts when the President of Seychelles officially announces the National Energy Efficiency Plan to the nation at large.

At this point all successful Phase II programmes are ready for implementing and the nation starts the journey towards more efficient energy use.

During Phase III the monitoring of national performance starts in detail. Success in energy efficiency is achieved by the cumulative sum of small percentage savings in the many sectors of the nation 5/. As the National Programme develops monitoring of success and failure will allow changes in direction to be made in light of prevailing economic and political circumstances. The programme must at all times be consistent with the Government's stated objectives in the National Development Plan 1990-1994.

While energy is important, it is only one resource among several that contributes to the better well-being of the nation.

Presently the nation is not using its imported energy resources wisely.

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5 / *For example, in Japan an estimated annual saving of 3 % in energy has been achieved thus since the late 1970's this has compounded into a total saving of approximately 40 % over the pre-1974 trend in energy consumption. Japan has developed extremely effective government policies based on a Cabinet decision(15 Feb 1977) to form a Cabinet sub-committee which was charged with the responsibility of developing the nation's energy efficiency policy. The net outcome has been the "The Law Pertaining to Rationalization in the Use of Energy" which was promulgated on June 22nd,1979 :the detailed nature of the law is illustrated by the fact it is approximately 1550 pages long. While it is not suggested that the Government of Seychelles follow the successful Japanese example it does illustrate the important role of government in improving national energy efficiency*

Table 4-1 National Energy Efficiency Plan - Phase I Costs.

Project NEEP#1 INSTITUTIONAL REVIEW - PUBLIC & PRIVATE				
INTERNATIONAL EXPERT				
	Energy Efficiency Expert	2	25100	
TRANSPORT				
	International			
	Energy Efficiency Expert		2800	
	Local Transport		2700	
EQUIPMENT				
	Expendable		450	
		Total	31050	31050
Project NEEP#2 PROJECT FINANCIAL & ECONOMIC ANALYSIS				
INTERNATIONAL EXPERTS			Man/Mth	Cost US$
	Project Analysis Expert	1	12550	
	Energy Efficiency Expert	1	12550	
TRANSPORT INTERNATIONAL				
	Project Analysis Expert		5900	
	Energy Efficiency Expert		2800	
EQUIPMENT				
	Expendable		2000	
		Total	35800	35800
Project NEEP#3 LAWS & REGULATIONS				
INTERNATIONAL EXPERT				
	Energy Efficiency Expert	2	26400	
INTERNATIONAL TRANSPORT				
	International		2800	
	Local Transport		2700	
EQUIPMENT				
	Expendable		450	
		Total	32350	32350
Project NEEP#4 ENERGY AUDITS, INDUSTRY & COMMERCE				
INTERNATIONAL EXPERTS				
	Energy Audit Expert -Industrial	1	13200	
	Energy Audit Expert-Hotels	1	13200	
	Energy Efficiency Expert	1	13200	
EQUIPMENT				
	Expendable		2000	
INTERNATIONAL TRANSPORT				
	Energy Audit Expert		3500	
	Energy Audit Expert		5000	
	Energy Efficiency Expert		2800	
	Local Transport		2700	
		Total	55600	55600
Project NEEP#5 NATIONAL ELECTRICAL APPLIANCE STANDARDS				
INTERNATIONAL EXPERTS				
	Energy Standards Expert	1	13200	
	Energy Efficiency Expert	1	13200	
EQUIPMENT				
	Expendable		2000	
INTERNATIONAL TRANSPORT				
	International			
	Energy Standards Expert		6500	
	Energy Efficiency Expert		2800	
	Local Transport		2700	
		Total	40400	40400
Project NEEP#6 ENERGY LABELLING PROGRAM				
	Energy Standards Expert	1	13200	
	Local Education Expert	1	2400	
INTERNATIONAL TRANSPORT				

	Energy Standards Expert		6500	
	Local Transport		2700	
		Total	24800	24800
Project NEEP#7 NATIONAL BUILDING CODE				
INTERNATIONAL EXPERTS				
	Energy Building Code Expert	1	13200	
	Energy Efficiency Expert	1	13200	
EQUIPMENT				
	Expendable		2000	
INTERNATIONAL TRANSPORT				
	Energy Building Code Expert		5800	
	Energy Efficiency Expert		2800	
	Local Transport		2700	
		Total	39700	39700
Project NEEP#8 SOLAR ENERGY				
INTERNATIONAL CONSULTANT				
	Solar Energy Expert	1	13200	
INTERNATIONAL TRANSPORT				
	Solar Energy Expert		3500	
	Local Transport		2700	
		Total	19400	19400
Project NEEP#9 TRANSPORT ENERGY EFFICIENCY STUDY				
INTERNATIONAL EXPERTS				
	Transport Efficiency Expert	1	13200	
	Energy Efficiency Expert	1	13200	
INTERNATIONAL TRANSPORT				
	Transport Efficiency Expert		3500	
	Energy Efficiency Expert		2800	
	Local Transport		2700	
		Total	35400	35400
Project NEEP#10 EDUCATION AND TRAINING				
INTERNATIONAL EXPERT				
	Energy Efficiency Expert	1	13200	
LOCAL EXPERT				
	Education Expert	2	9000	
INTERNATIONAL TRANSPORT				
	Energy Efficiency Expert		2800	
EQUIPMENT				
	Expendable		2500	
		Total	27500	27500
Project NEEP#11 PUBLIC SECTOR EFFICIENCY PROGRAM				
INTERNATIONAL EXPERTS				
	Energy Efficiency Expert	2	26400	
INTERNATIONAL TRANSPORT				
	Energy Efficiency Expert		2800	
		Total	29200	29200
Project NEEP#12 NATIONAL ENERGY TRUST FUND				
INTERNATIONAL EXPERTS				
	Energy Efficiency Expert	2	26400	
INTERNATIONAL TRANSPORT				
	Energy Efficiency Expert		2800	
	Local Transport		2700	
EQUIPMENT				
	Expendable		400	
		Total	32300	32300
	Total Cost Phase I		US$	403500
			Rp	2138550

Budgets Based on UNIDO Project Design Guide-lines A8a August 1988.

ANNEX I

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

THE REPUBLIC OF SEYCHELLES

JOB DESCRIPTION

TF/GLO/88/907/11-51/J12101

Post title: Consultant in Energy Conservation

Duration: Three weeks

Date required: As soon as possible

Duty station: Victoria, Seychelles.

Purpose of project: To advise the Government on ways and means of lowering the country's energy consumption and on the management and conservation of energy.

Duties: The consultant will work under the general supervision and guidance of the Director of The Technological Support Services Division, Department of Industry and will specifically be expected to:

1. Examine the present energy situation within Seychelles, vis a vis supply, demand, existing technologies and policies.

2. Identify key sectors where energy could be conserved.

3. Examine possible conservation measures that could be effectively implemented both for the short term and long term, for the key sectors identified.

4. Prepare a Technical Report analyzing the findings and outlining the recommendation to the Government on actions to be taken in the field of energy conservation.

5. Prepare a Project Formulation Framework and a Project Document for a UNDP/UNIDO technical assistance on energy conservation taking into the consideration the findings and recommendation of the above Technical Report.

..../..

Applications and communications regarding this Job Description should be sent to

Project Personnel Recruitment Branch, Department of Industrial Operations

UNIDO, Vienna International Centre, P.O. Box 300, A-1400, Vienna, Austria

Language: English

Qualifications: University degree or equivalent in engineering and/or economics with extensive experience in the field of energy conservatio.

Background Information: In the wake of rising energy costs and dwindling world energy resources, the management and conservation of energy and energy sources has become of crucial importance to economies of small states such as Seychelles.

In this regard, a large proportion of foreign exchange earnings is spent on importing petroleum fuels and technologies for the production of energy in order to meet growing demands resulting from economic development.

There exist two options which address this situation: either to increase the supply of energy resources or to control the demand and utilisation of energy. More sensibly, the latter option is the preferred one since this will yield nett savings.

In this context, the Government of Seychelles has strong interest in what is commonly termed "Energy Demand Management". It has undertaken, in its five year 1990-1994 Development Plan, to formulate a coherent/solid Energy Development and Utilisation Policy in which Energy Conservation is seen to have a major function in demand management strategy.

The Government of Seychelles holds the view that scope for making significant savings in energy exist in Seychelles. To realise these energy savings, the Energy Conservation Programme within the wider context of the Energy Demand Management Programme, will be undertaken. Both Programmes aim to help attain the objectives and aims of the country's Energy Policy, which although not complete at this stage; reflect the Government's preoccupation with the energy issues addressed in tis 1990-1994 National Development Plan.

The Energy Conservation Programme aims to reduce energy waste and to improve unit energy consumption efficiency so as to yield nett energy savings through:

(i) conservation of energy when not required

(ii) end-use efficiency improvements by significant energy utilising sectors.

(iii) use of appropriate and energy efficient technologies.

(iv) waste energy ercovery for use by other process (e.g. heat for refrigeration).

(v) lectrical power factor improvements by supply utilities and end-users.

(vi) ensuring that imported technologies are climatically adapted for tropical environments (e.g. refrigeration).

Government of Seychelles-Energy Goals & Objectives.

The Government's goals and objectives for energy are clearly articulated in the "National Development Plan 1990-1994". The following is the summary of the energy section.

INTRODUCTION AND SUMMARY

(1.1) The availability of energy is essential for the socio-economic development of the country. The Government of Seychelles therefore ensures that economic growth is promoted by the efficient allocation of energy resources within the economy. The more so, as the country depends heavily on imported energy, with solar energy for water heating purposes being the only feasible local source of energy exploited at present.

(1.2) This sector report deals with 4 forms of energy (electricity imported imported petroleum energy, renewable energies and energy conservation) which are available in Seychelles. The overall results of the first three sectors were well within the targets set during the last plan period. However, renewable energy sources identified, with the exception of solar energy for water heating, have not been tapped for reasons of uneconomic viability.

(1.3) Within this plan, attention will be given to energy conservation measures as this should be considered as a source of energy given the almost total dependence of the country on imported fuel to meet its energy needs.

(1.4) The environmental impact of energy use in Seychelles is largely in the form of effluent resulting from the combustion of hydrocarbon fuels and from the accumulation of heavy fuel oil sludge resulting from the use of heavy fuel oil for electricity generation at the main power station. In the first instance, effluents contain acids formed during combustion, heavy metals such as lead and zinc contained in motor gasoline and carbon monoxide which results from incomplete combustion processes. All are discharged into the atmosphere and this presents a source of concern. In the second instance, disposal of the heavy fuel oil residue produced is a most serious issue which needs to be settled at the earliest possible time.Another source of environmental concern is the current practice of disposing of the waste lubricating oil from engines directly into the environment. The study of the so-called new and renewable sources of energy and the emphasis on energy conservation as an energy source is the result of foreign exchange considerations and of a need to reduce of the negative effects of energy consumption on the environment.

(1.5) The labour shortage existing in the economy now is also a major constraint in the electricity and petroleum distribution sectors most particularly. However, due consideration will be given to the motivation of existing staff during the plan period.

(1.6) The energy service organisations will continue their efforts in translating, as far as possible, the government's energy policy in concrete terms. Since the country is heavily dependent on petroleum fuel imports for its economic development, emphasis will be placed, during the plan period on the following:

(a) To ensure that economic growth is promoted by the efficient allocation of energy resources within the economy.

This implies that energy resources should be available in sufficient quantities and at realistic prices such that future energy use is at optimum levels in relation to the national economy.

(b) To recognise that it is the social right of every citizen to be supplied with certain basic minimum energy needs at reasonable cost.

(c) To ensure that the energy service organisations (petroleum distribution and electricity) remain financially viable and have a certain degree of autonomy such that they are able to earn a reasonable rate of return on assets and able to self-finance an acceptable portion of the investments required to develop future energy resources.

(d) To prevent unnecessary energy waste by promoting energy conservation policies and programmes, such that the population and the economy are encouraged to utilise energy in a conscientious manner, hence ensuring that the foreign exchange burden of energy imports does not increase to unsustainable levels and contributing to a lessening of the negative effects of energy consumption on the environment.

(e) To ensure energy price stability to prevent shocks to consumers from large price fluctuations.

(f) To maintain simplicity in energy pricing structures to avoid confusing the public.

(g) Promoting the development of specific sectors (e.g. agriculture and export industries) by providing energy at competitive and realistic prices.

(1.7) These objectives are to be realised by making use of appropriate energy policies for the various sectors of the economy and by increasing public awareness of the benefits of energy conservation. Government will, in consultation with the energy service organisations (petroleum distribution and electricity), formulate a coherent and structured energy policy and energy conservation programme during the plan period covering such aspects as :

- energy pricing

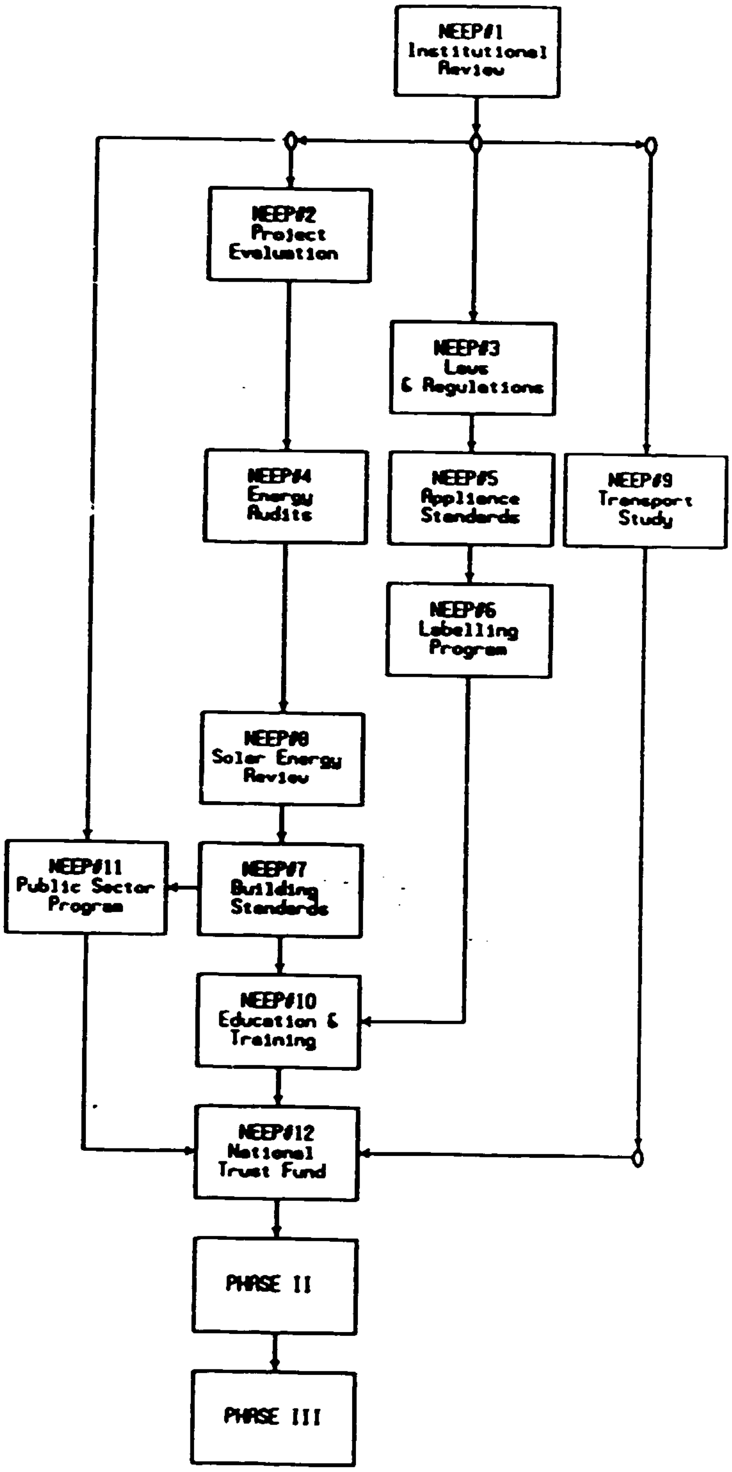
- energy conservation

- energy efficient technologies

- consumer awareness

- alternatives to conventional energy.

(1.8) Simultaneously, Government will closely monitor the world energy situation so as to be in a position to direct the economy towards the utilisation of the most cost-effective energy options.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