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Computer Aided Electricity Demand Management And Supply Planning

Final Technical Report

13. June 1990

SI/SEY/86/141, Activity Code J13317

Seychelles

Prepared for the Government of Seychelles, President's Office, TSSD
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United Nations Industrial Development Organization, Vienna, Austria

Hardware and Software Report

Project Title: [illegible] Engine

Contract No.: [illegible]

Project No.: [illegible] SEY/86 141

Activity No.: [illegible]

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7000 Stuttgart 80

Date: [illegible] 13, 198[illegible]

Hardware and Software Report

The following report gives a complete list of hardware and software supplied by the contractor.

The hardware consists of two IBM PS/2 Model 70 computer systems with laserprinter. One system will be shipped to Seychelles, the other system will be sent to UNIDO Vienna. The systems will be set up, configured and tested at the IFE in Stuttgart, where the operating systems and the MESAP software will be installed. The MESAP software is tailored for the IBM-UNIX operating system AIX. AIX and all MESAP modules will be installed on the fixed disk of computer system 1 for the Seychelles. Since no AIX operating system has been purchased for computer system 2, all MESAP modules will be supplied to UNIDO in Vienna on AIX formatted 3½" Floppy Disks.

MESAP Software Modules

MAED	Model for the Analysis of Energy Demand. Medium- to long-term simulation model, based on scenario method.
MADE II	Model for the Analysis of the Demand of Energy. Regionalized medium- to long-term energy demand analysis model, combining simulation and econometric methods.
WASP III	Optimization for the expansion planning of an electricity grid, finding the economically optimal electricity generation expansion policy for an utility system.
MESSAGE III	Dynamic linear programming model optimizing the energy supply system with a given energy demand according to a selected objective function.
INCA	Investment Calculation of NPVfor power plants, given the investment, cost and revenue cash flows.
EBL	Energy Balances. Integrated tool to create comprehensive energy statistics including all stages of energy production and consumption.
FIT	Regression Analysis. Tool for linear, exponential, logistic and multiple regession analysis.
RSYST	The Database stores and retrieves all data relevant to the operation of the above mentioned modules.

Due to a software error in the IBM-AIX FORTRAN compiler, we are unable at the moment to compile the modules MESSAGE, EBL and RSYST. We are in discussions with the supplier (IBM) of the compiler to correct this error. Thus the above mentioned modules will be supplied as soon as the new compiler is available.

<u>Computer System 1 Hardware and Operating System</u>

Shipping Address: Ministry of National Development
Seychelles
For the Attention of Dr. Selwyn Gendron
Principal Secretary

SEYCHELLES

Item	Quantity	Description
1	1	IBM PS/2 Model 70-121, 20 MHz, 120 MB
2	1	US Keyboard
3	1	Mouse
4	2	Memory expansion 2MB
5	1	Math. Coprocessor 80387, 20 MHz
6	1	Monitor 16", Color, Type 8514
7	1	PS/2 Monitor Adapter Card 8514/A
8	1	IBM PC DOS 4.0 and Reference Handbook
9	1	IBM Operating System/2 Extended Edition
10	1	IBM OS/2 Graphics Development Toolkit
11	1	IBM DOS Graphics Development Toolkit
12	1	Microsoft C-Compiler Ver. 5.1
13	1	Microsoft FORTRAN Compiler Ver 4.1
14	1	AIX PS/2 Base Operating System
15	1	AIX PS/2 DOS Merge
16	1	AIX PS/2 X-Windows
17	1	AIX PS/2 VS FORTRAN
18	1	AIX PS/2 C Language
19	1	AIX PS/2 Appl. Development Toolkit
20	1	Sysgen, external 5.25" Drive 1.2MB
21	1	HP Laser Jet Series II Laser Printer
22	1	Memory Expansion 1MB for HP LJ II
23	1	Cable for HP Laserjet II
24	10	Toner Cartridges for HP Laserjet II
25	1	80 MB Tape Streamer
26	1	Streamer Software, DOS
27	5	Tapes 3M DC 2000 HC
28	50	Floppy Disk, 5¼", DS/DD
29	50	Floppy Disk, 5¼", DS/HD
30	50	Floppy Disk, 3½", HD/2MB

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Report on the

Training Course on

MESAP

for

the Government of Seychelles

funded by

UNIDO

Stuttgart, August/September 1989

INTRODUCTION

The aim of this project is to implement and apply a micro-computer based energy sector analysis and planning software system and to familiarize two participants from the Government of the Republic of Seychelles with the planning package.

The course was held from the 21.August to 22.September, 1989, at the IKE Stuttgart, F.R.G.. The two participants from the Government of Seychelles were Ute Naya and Terence Coopoosamy, working at the Technological Support Services Division in the Department of Industry of President's Office Seychelles.

Although the main objective of the course was to familiarize the participants with the energy planning model MESAP, necessary peripheral lesssons on general energy planning problems of a country, like

- tools for energy planning,
- energy and environment, and
- econometrics

were also included in the course. Furthermore, the participants had a chance to deepen their knowledge about basic and advanced mathematical methods and tools used in econometrics with special regards to those methods, which are being used in the MESAP model.

ENERGY SITUATION OF SEYCHELLES

1. Petroleum Demand and Supply

Petroleum derivatives are the dominant energy source commercially used in Seychelles. The World Bank/UNDP estimated that 90 % of all energy consumed could be attributed to liquid hydrocarbons, the rest are fuelwood, charcoal and other biomass.

The management of petroleum product is the responsibility of the Seychelles Petroleum Company and statistics on the petroleum sector are supplied to the Energy Planning Unit of the Department of Industries. There is a lack of data on the actual consumption of biomass, which is mainly used in household sector.

The energy situation in 1987 shows the following pattern for fossil fuel supply (Table 1).

Table 1 Petroleum Fuel Situation in 1987

toe	imports	intermediate consumption	Domestically available
Motor Gasoline	6238.612		5656.511
Gas Oil	64393.525	5356.461 1/ 52424.834 2/	10066.145
Fuel Oil	22656.404	10995.340 1/ 8297.856 2/	3363.208
Jet Fuel	17232.269	11699.536 3/	538.314
Aviation Gas	247.646		342.807
LPG	255.384		225.564
Total	11023.820	88774.031	20192.549

1/ Seychelles Electricity Division
2/ International Marine Bunker
3/ International Aviation

Note : Total do not add as stock movement not considered.

The consumption of Petroleum derivatives in power generation was nearly 45 % of the amount of fuel locally available for supply in 1987.

2.Electricity Demand and Supply

In 1986, the installed capacity for the islands of Mahe and Praslin
was 24.396 MW. The other islands have small diesel private generators. The gross production for the year was 66.253 GWh (for Mahe and Praslin only). When compared to the situation in 1978, it implies a nearly doubling of the installed capacity and an increase of about 75 % in the gross production.

The sales of electricity by sector for both years, 1978 and 1986 respectively, are shown in table 2.

Table 2 Sales of Electricity by Sectors, 1978 and 1986

	Household		Commerce, Industry & Government		Street Lighting		Total	
	MWh	%	MWh	%	MWh	%	MWh	%
1978	11395	30.0	26269	69.3	269	0.7	37933	100
1986	18427	32.6	37975	67.2	136	0.2	56538	100

A new 5.0 MW set will be commissioned by the middle of 1990 and the islands around Victoria harbour will be connected to the grid on Mahe via submarine cable by the end of 1990.

An 'electricity tariff' study carried out by the 'Electricite de France', focussed on the present tariff structure of electricity in Seychelles. The electricity price structure recommended by the study is being analysed by the Seychelles government.

3. Data Availability

Information pertaining to economic, energetic and socioeconomic activities in Seychelles is mainly centred at the Information Systems Division of the Ministry of Administration, but the Energy Planning Unit of the Department of Industry keeps track of the energy data and other related activities in the energy sector.

4. Energy Planning Unit

Energy and Electricity Data

The Energy Planning Unit of the Department of Industry at the President's Office was formed in 1987 with the objective to provide decision makers with detailed information on the energy system, to elaborate on strategies on appropriate energy use and to set up strategies for energy demand management and overall planning. Starting with June 1986, a good data base related to energy supply data is available at the Energy Planning Unit.
An energy survey programme was started in 1985. The objective of the programme was to obtain representative detailed information on the energy consumption of the economic sectors of the country for the years 1982 - 1986 by fuel type. All questionnaires sent out since the commencement of the programme are presently being analysed for data entry.

A preliminary examination of all information obtained through the survey on all sectors of the economy can be expected toward the end of 1989. This will place the Seychelles goverment in the position to establish the country energy balances.

Studies carried out in the Energy Field

The government intention is to diversify its energy supply pattern, which is presently centred on liquid hydrocarbons, and to steer the electricity consumption adequately. A number of analysis on the energy situation have been carried out by different international clients since 1982.

The energy sector as a whole has been analysed in the Energy Sector Management Assistance Programme by joint World Bank / UNDP programme. Other studies focussed on the potentials of all renewable sources of energy available in Syechelles. Detailed studies on possible contribution from solar, wind, wave and hydro energy to the energy mix have been carried out.

The potential of wind energy, producer gas, photovoltaics, biogas and solar water heating were assessed. The results are summarized in table 1.

Table 1

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

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

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

ENERGY POLICY RESEARCH - SEYCHELLES (Background)

This project was initiated in 1984 in cooperation with IDRC and was planned for a duration of 3 years. It was then prolonged until the end of 1989 because of arising personnel and data collection problems. The aim is to finish the project in December, 1989.

The overall objective of this project is to establish a comprehensive data base on energy supply and demand for the Republic of Seychelles in order to provide a sound foundation for formulation of energy policies. It includes such major activities like :

- Identification of economic sectors for the purpose of energy survey,
- Preparation of questionnaires,
- Data collection,
- Analysis of energy demand and supply.

The objectives of the energy analysis are :

a) to collect current and where possible for the past five to ten years, energy supply and consumption data in all economic sectors of Seychelles;
b) to identify trends of key energy indicators in all of the economic sectors of Seychelles;
c) to set up a system of ensuring the report of energy data from key sectors supply and demand in a systematic manner;
d) to prepare preliminary recommendations for energy conservation, inter fuel substitution and other policy measures.

The present project should also be seen as a continuation of this policy research project for the results of the energy analysis (a-c) form the major part of the data set used by MESAP, and because the MESAP package enables the Energy Planning Unit to carry out a profound analysis of the present and future energy situations and to prepare sound policy recommendations (d).

THE MESAP SYSTEM IN SEYCHELLES (Training and Prospects)

The MESAP package is a set of comprehensive and acknowledged energy planning tools as well as modules related to basic methods and data management. For the country, MADE-II and MESSAGE will be the most important and most often used energy planning tools.

Generally, the parts of the package are very flexible, i.e. they are easy to adapt to the conditions in Seychelles. The development of input controllers for various modules is well under way. The completion of the input controllers will enable people, who do not know the FORTRAN programming concepts, to work with the energy planning modules. With the input controllers the handling of the package will be menu-driven throughout the whole program.

In the following an attempt will be made to outline the activities and experience of the participants during the course as well as to describe the methods and prospects for the use of the program modules in Seychelles.

1. MAED and MADE-II

After a theoretical introduction to energy demand models and a short exercise with MAED the participants were introduced to the structure of model MADE-II. Here, the main problem is to create the data INPUT file MADE.GEN, which has to be written in a specific format :

First approach : Change the data set in the existing file for Casena case study;

Second approach : Write a new input file.

Both approaches were practised by the participants with the help of a handbook which gives explanations and the order in which the data has to be entered. After discussing the Casena input file and the handbook the participants quickly felt it easier to write a new input file for Seychelles themselves. Unfortunately, not all energy data for Seychelles was available to the participants during the course, so that the establishing of an input file for Seychelles had to be limited to the household sector data. Thus, the first input file is not a comprehensive file, but it might serve as example for simple analysis, e.g. in the household sector. An input file can be updated at any time according to the data available and the required demand analysis.

The execution of the program has to be done in two steps : The first is to run the program module from the EXECUTE menu. After execution the module has to be told which output tables have to be prepared. Whilst in input mode, this can be specified in files called

MADE.CIF - calculation instruction file, and

MADE.CVF - control variables file.

Again, these two files are written in a specific format but the main activities are easy to understand. The second step of execution is to run the CAP postprocessor which calculates the output tables according to the instructions just given.

Now the data is ready for OUTPUT. The results of the analysis may be printed both in the form of a table and/or plotted as diagrams. For plotting the figures it is necessary to transfer data either to the RSYST - data management system or use commercial packages like Lotus. The data management system RSYST has not been implemented on AIX, because compilation problems were encountered. However, it is hoped that these problems will be solved by the IKE and IBM in the near future. Since RSYST was not available on the operating system AIX during the training course, the graphic results of the case study were drawn with the help of Lotus.

It should be pointed out that, under certain circumstances, parts of MADE-II can be used not only for energy demand analysis, but for demand analysis in general.

Main activities in MADE-II :

MENU LEVEL	ACTIVITY	
INPUT	1. MADE.GEN	general input file
EXECUTE	2. RUN MADE	program execution
INPUT	3. MADE.CIF 4. MADE.CVF	calculation instruction file control variables file
EXECUTE	5. CAP	postprocessor
OUTPUT	6. TABLES	output file

2. REGRESSION ANALYSIS

This statistical program gives the user a chance to do preliminary calulaticns, which are necessary to run various models, e.g. to find price elasticities. Apart from that it can be used independently of MESAP for other tasks. However, the user should be well acquainted with statistics before using this module.

Following theoretical and practical lessons, the participants were able to use the module, but they also felt the need for further studies of statistical methods in order to make full use of this option in MESAP.

3. INCA

The model INCA (INvestment CAlculation) is specially tailored for energy investment calculations. Its main outputs, using the Present Value method, are :

- NPV
- PV
- Specific electricity generation costs versus plant factor
- amortization period.

The participants had a close look into the structure of the model, although they did not use it for own investment calculation during the course. However, the model might prove to be useful for Seychelles when it comes to do a revision of feasibility analysis for investments in the energy sector with special regards to renewable energy sources. IKE has planned to introduce special options for investment calculation for renewable energy technologies into the model INCA.

4. MESSAGE II

Lectures were held to introduce the model, the structure and limitations of the model were pointed out to the participants. A case study for Nigeria was reviewed as an example of the use of MESSAGE II to investigate an energy related problem of a country.

The format of the input file for a case study, which is used for training purposes, was analyzed with the help of an expert. The same format was explained in detail while learning about the input file for MADE -II.

As an exercise, the participants defined an ene.gy related problem for Seychelles, such that the analysis of this problem was to be undertaken with MESSAGE II. The reference energy system for' Seychelles was developed and this was followed by data entry on computer.

Due to the time limitations, it was not possible to complete the data entry necessary for a run of MESSAGE. It is expected that the course participants will continue this exercise in Seychelles, when all data is available, so that a run of MESSAGE can be undertaken.

```
;                 INPUT DATA FOR MODEL "MADE-II"
;                      FILE MADE.GEN
;
;
;                SCENARIOS
;
; Scenario  LOW: 1. The total population in each period is given
;                   exogenously. This variant will be called
;                   variant 04.
;                2. The increase of coefficient of Pareto-
;                   improvement is given exogeneously.  This
;                   variant will be called variant 10.
;
; Scenario  REF: 1. Population data for each period is given
;                   exogenously.
;                   This variant will be called variant 05.
;                2. The increase of coefficient of Pareto -
;                   improvement is given exogenosly in each period
;                   This variant will be called variant 15.
;
; Scenario HIGH: 1. Population data are given exogenously. This
;                   variant will be called variant 06.
;                2. The coefficient of Pareto-improvement is given
;                   exogenously in each period. This variant will
;                   be called variant 20.
;
; Scenarios are then defined as combination of scenario parameters.
; Two scenario parameters, ie., growth of population and changes
; in the coefficient of Pareto-improvement, have been defined.
; Combinations of these scenario parameters represent the scenarios
; of energy demand.
;
; It will be assumed that:
; Scenario 04 and 10 make up the LOW scenario of energy demand.
;
;
!!LOW:+04/10      ; LOW useful energy demand
;
!!REF:+05/15      ; REF useful energy demand
;
!!HIGH:+06/20     ; HIGH useful energy demand
;
;
;
;==============================================================
```

```
;
;                          GENERAL INPUT DATA (Block 1)
;
;
SEYCHELLES ;
# Analysis of Energy Demand for households by Income Distribution
# and for sectors in Industry.
;
;
1    ; switch for the identifier of the levels
;
L    ; level identifier; On this level L a combination of various
;      energy carriers is being considered.
;
; Energy carriers being considered at level L :
;
e-Electricity     ; Electricity in households and industry
;
k-Kerosene        ; Kerosene for cooking in household sector
;
g-L.P.G.          ; L.P.G. for cooking in household sector
;
*                 ; end of identifier of energy carriers
;                   energy level L
;
*                 ; End of level identifier
;
1986                     ; Reference year
;
4                        ; Number of periods
;
4.0 5.0 5.0 10.0         ; Length of periods
;
;
REPORT                   ; Report of input data
;
;==========================================================
;
;                 REGIONAL DATA
; Only one region is being considered in this example.
;
S-SECHEYLLES      ; Identifier of region
;
;==========================================================
```

```
;                  POPULATION DATA (Block 2)
;
P-Population              ; Identifier of population data
;
t-Total_Population        ; Identifier of total population
;
;  Population in each period in million persons
!+04 1  0.0656 0.066 0.0675 0.068 0.0682

;
;  Population increases with a constant rate
!+05 2 0.0656 1.0145
;
;  Annual rate of increase is different in each period
!+06 3 0.0656 1.014 1.0145 1.0145 1.015
;
u-Urban_Population_Share  ; Identifier of urban population
;
0 100.0          ; Share of urban population [in %] in total
;                  population
;
;---------------------------------------------------------
;
;The following block shows the possibility of keeping data
;in the input file while not using it at the moment.
;
;l-Labour_Force_Share        ; Identifier of labour force
;
;1 46.0 46.0 47.0 48.0 49.0 ; share of labour force on total
;                           ; population in %
* ;  no labour force data required
;
;e-Employment                ; Identifier of employment
;
;1 62.0 62.0 65.0 68.0 70.0 ; share of employment on labour
;                           ; force in %
* ;  no employment data required
;------------------------------------------------------------
;
;        ; End of population data
;
;============================================================
```

```
;                 ECONOMIC DATA (Block 3)
;
E-Economy         ; identifier for economic data
;
1                 ; switch for option chosen
;
1  2400.0 2700.0 3200.0 3900.0 4200.0    ; GDP (Mio. MU)
;
a-Agriculture 1  6.2 6.0 5.8 5.5 5.3     ; identifier of sector
;
c-Construction 1  8.6 7.7 6.7 6.0 5.7    ; identifier of sector
;
m-Mining 1  3.2 3.0 3.6 4.5 5.0          ; identifier of sector
;
i-Industry 1  13.8 15.5 17.0 19.0 24.0   ; identifier of sector
;
e-Energy 1  4.2 4.5 5.1 5.5 6.0          ; identifier of sector
;
s-Service 1  64.0 63.3 61.8 59.5 54.0    ; identifier of sector
;
*                 ; end of sectors
;
;=================================================================
;                 URBAN HOUSEHOLDS (Block 4)
;
U-Urban_Households  ; Identifier of data on Urban Households
;
1                   ; iswuhld switch for option
;
; For coefficient of Pareto-improvement only switch 1 is valid.
; The value of this coefficient is 0 in the reference year.
;
!+10 1 0.0 0.02 0.05 0.07 0.13 ; coefficient of Pareto-improvement
;
!+15 1 0.0 0.01 0.09 0.15 0.27 ; coefficient of Pareto-improvement
;
!+20 1 0.0 0.10 0.25 0.41 0.80 ; coefficient of Pareto-improvement
;
;
;
;          SR/a        %       [kWh/Pza ]  [      MJ/Pza        ]
;          income      pop     Elec         Kero        LPG
a-group_1  8400.00     40.00   e  180.00    k 2200.00   g  0.00 *
b-group_2 14400.00     59.00   e  240.00    k 1500.00   g 20.00 *
c-group_3 40000.00     01.00   e  450.00    k 0000.00   g 25.00 *
;
;
*               ; End of data of Urban Household groups
;
;=================================================================
```

```
;                 RURAL HOUSEHOLDS (Block 5)
;
*               ; Rural Households data not considered
;
;==========================================================
;                 ECONOMIC SUBSECTORS (Block 6)
;
*               ; Economic sub-sectors not considered
;
;==========================================================
;                 TRANSPORT SECTOR (Block 7)
;
*               ; Transport data not required
;
;==========================================================
;
;                 End of data for region 1 (Seychelles)
;
* ;
●               ; End of input data
●
```

INPUT FILE MADE.CIF

```
Development of Demand for
Electricity in Households
1           ;E(5,2,1) PLOTTER CTRL
3           ;E(5,2,2) FORMAT CRTL
2           ;E(5,2,3) LABEL CTRL
-1          ;E(5,2,4) HEADER CTRL
GWh/a       ;E(5,2,5) units
GWh/a       ;E(5,2,6) UNITS OF VARIABLES IN OUTPUTS
1.0         ;E(5,2,7) MULTIPLIER (E(5,2,5)*E(5,2,7)=E(5,2,6))
1.0E-6      ;E(5,2,8) MULTIPLIER SCALING
●
'1  Development of Demand for Electricity in Households
'TIME          1986    1990    1995    2000    2010    2020
'UNIT                   GWh/a
Elec     = SLUea:ACT + SLUeb:ACT + SLUec:ACT
●
+
Development of Demand for
Cooking Energy (Final)
1           ;E(5,2,1) PLOTTER CTRL
3           ;E(5,2,2) FORMAT CRTL
2           ;E(5,2,3) LABEL CTRL
-1          ;E(5,2,4) HEADER CTRL
TJ/a        ;E(5,2,5) units
TJ/a        ;E(5,2,6) UNITS OF VARIABLES IN OUTPUTS
1.0         ;E(5,2,7) MULTIPLIER (E(5,2,5)*E(5,2,7)=E(5,2,6))
1.E-6       ;E(5,2,8) MULTIPLIER SCALING
●
'1  Development of Demand for Cooking Fuels in Households
'TIME          1986    1990    1995    2000    2010    2020
'UNIT                   TJ/a
Kerosene= SLUka:ACT + SLUkb:ACT + SLUkc:ACT
L.P.G.   = SLUga:ACT + SLUgb:ACT + SLUgc:ACT
●
+
Development of Demand for
Energy
1           ;E(5,2,1) PLOTTER CTRL
3           ;E(5,2,2) FORMAT CRTL
2           ;E(5,2,3) LABEL CTRL
-1          ;E(5,2,4) HEADER CTRL
TJ/a        ;E(5,2,5) units
TJ/a        ;E(5,2,6) UNITS OF VARIABLES IN OUTPUTS
1.0         ;E(5,2,7) MULTIPLIER (E(5,2,5)*E(5,2,7)=E(5,2,6))
1.E-6       ;E(5,2,8) MULTIPLIER SCALING
●
'1  Development of Demand for Energy in Households
'TIME          1986    1990    1995    2000    2010    2020
'UNIT                   TJ/a
Kerosene= SLUka:ACT + SLUkb:ACT + SLUkc:ACT
L.P.G.   = SLUga:ACT + SLUgb:ACT + SLUgc:ACT
Elec     = (SLUea:ACT + SLUeb:ACT + SLUec:ACT) * [3.6]
●
●
```

INPUT FILE   MADE.CVF

```
1 ; E(3,1,1) switch for plotting
0 ; E(3,1,2) for later
0 ; E(3,1,3) error message on unit 6
0 ; E(3,1,4) switch for interpolation
0 ; E(3,1,5) switch for extrapolation
0 ; E(3,1,6) MEDEE data
0 ; E(3,1,7) Message Data
1 ; E(3,1,8) MADE Data
0 ; E(3,1,9) from IMPACT file
0 ; E(3,1,10) from LP solution
0 ; E(3,1,11) from supplementary
5 ; E(3,1,12) no of time steps
1 ; E(3,1,13) formatting control
4 ; E(3,1,14) plot labeling
4 ; E(3,1,15) tick marks
1 ; E(3,1,16) time steps
1986 1990 1995 2000 2010 2020  ; E(3,2,1) periods
(10A1,10(F9.1,1X)) ; E(3,3,1) format
 - Development of Energy Demand in SEYCHELLES
```

OUTPUT TABLES

1 Development of Demand for Electricity in Households

TIME	1986	1990	1995	2000	2010	2020
UNIT		GWh/a				
Elec		14.3	15.3	17.9	20.4	26.2

2 Development of Demand for Cooking Fuels in Households

TIME	1986	1990	1995	2000	2010	2020
UNIT		TJ/a				
Kerosene		115.8	121.4	119.6	119.8	118.3
L.P.G.		.8	.8	1.0	1.1	1.5

3 Development of Demand for Energy in Households

TIME	1986	1990	1995	2000	2010	2020
UNIT		TJ/a				
Kerosene		115.8	121.4	119.6	119.8	118.3
L.P.G.		.8	.8	1.0	1.1	1.5
Elec		51.5	55.2	64.4	73.3	94.1

Table 3: Development of Demand for Energy in Households

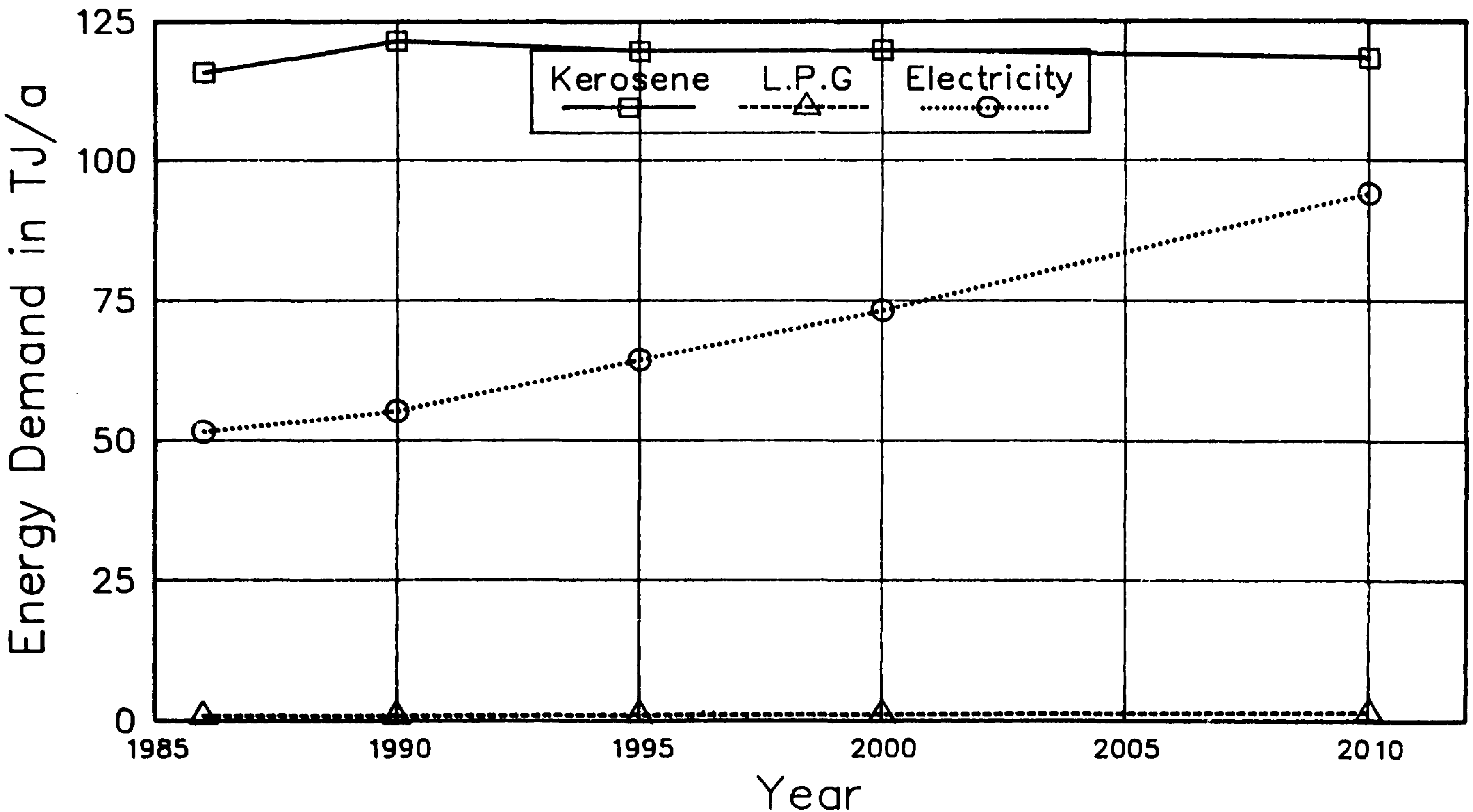


Table 1: Development of Demand for Electricity in Households

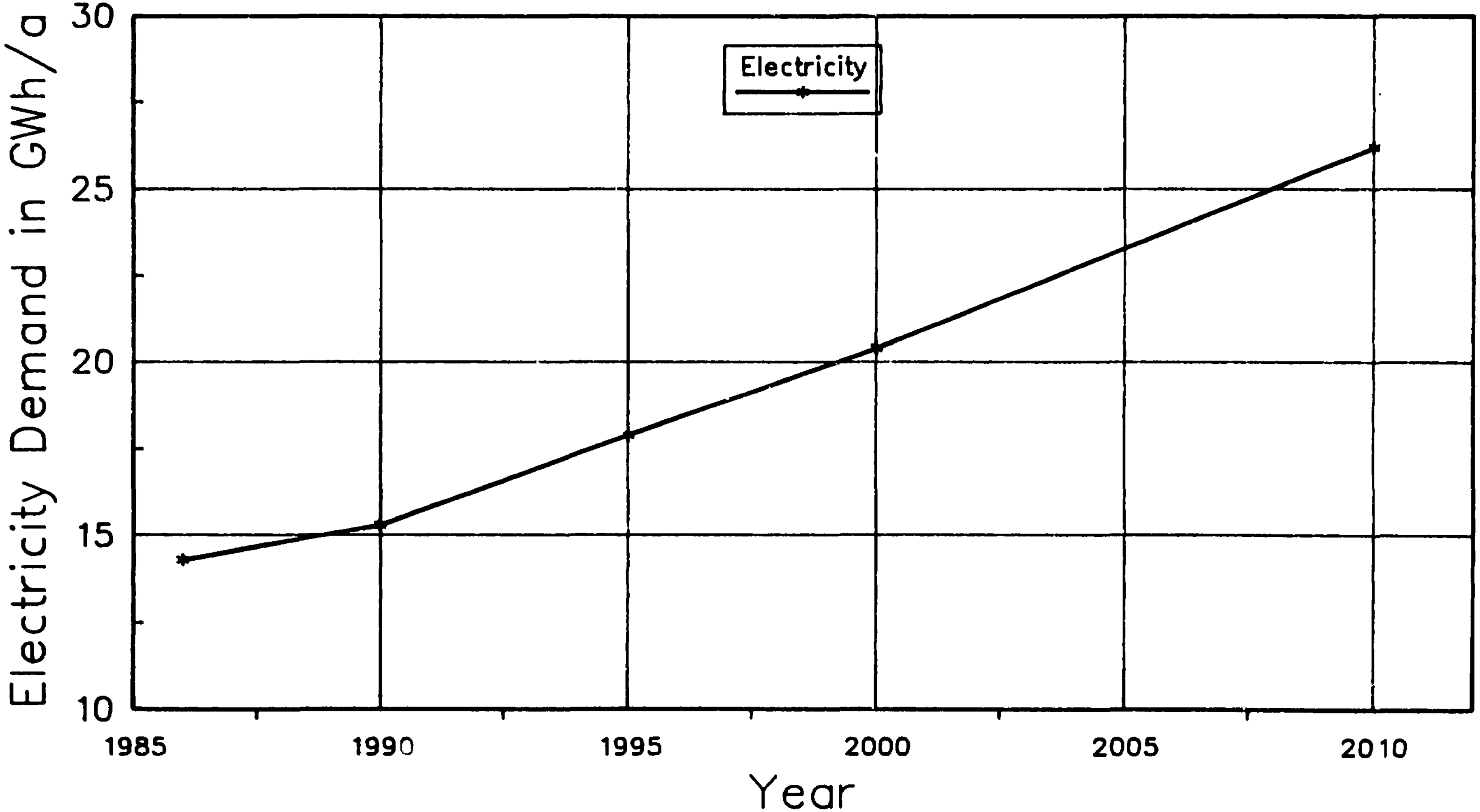
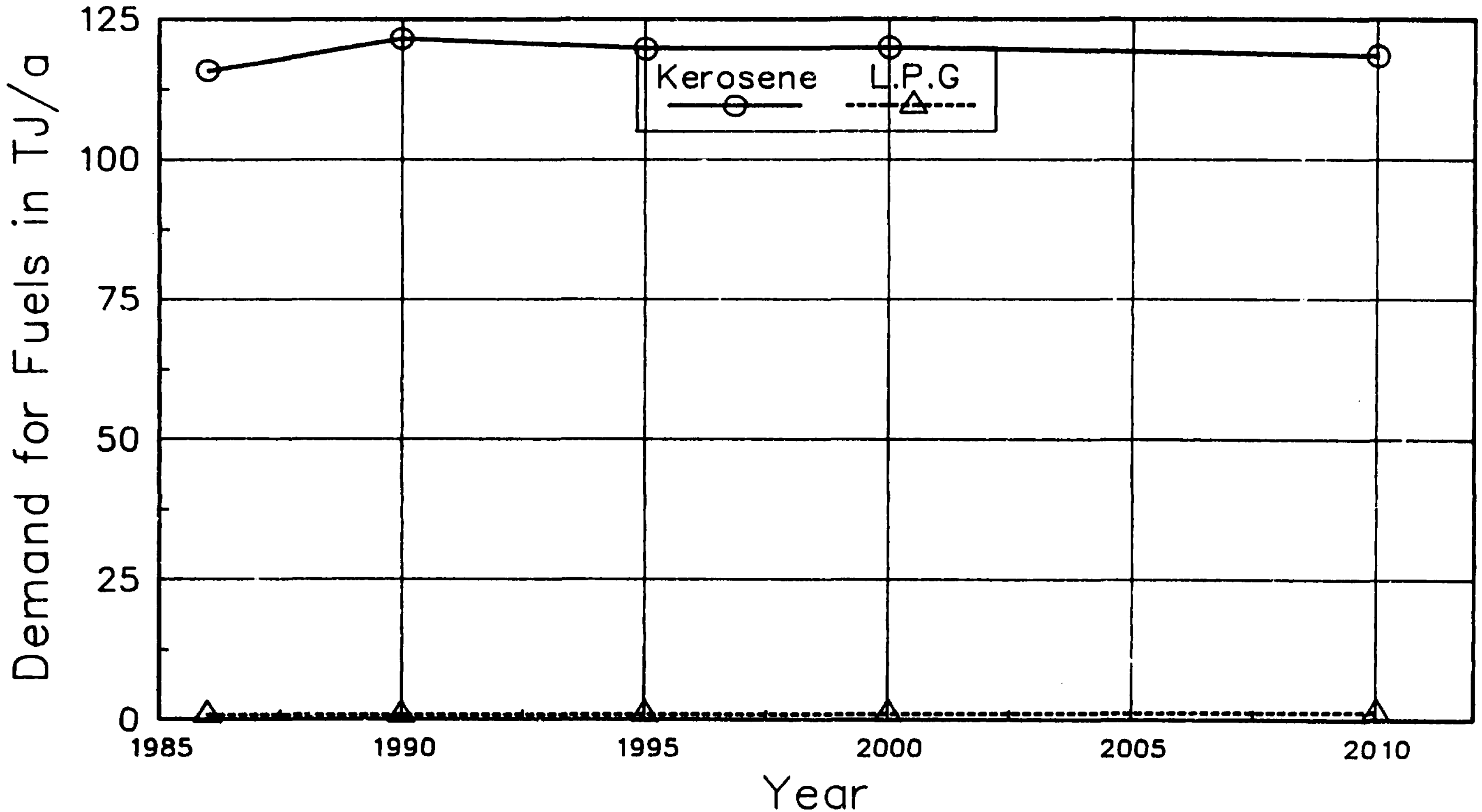


Table 2: Development of Energy Demand for Cooking Fuels in Households



MESAP Training Course for the Government of the Seychelles

1. Week
- General Introduction to MESAP
- Structure and Data Requirements for Demand Model MADE II

——— 1 Week interruption ———

2. Week
- MESAP Modules INCA and Regression Analysis
- Preliminary Analysis of Energy Demand
- Hard / Software Training

3. Week
- MESAP Modules WASP and MESSAGE
- MADE II Case Study (Island of Seychelles)

4. Week
- MESAP Experience and future Development
- Preliminary Study on Energy Supply System
- Sensitivity and Scenarioanalysis with MADE II

MESAP Training Course for the Government of the Seychelles

1. Week	Monday 21.8.	Tuesday 22.8.	Wednesday 23.8.	Thursday 24.8.	Friday 25.8.
9.00 10.30	Welcome and	Introduction to MESAP A. Reuter "S"	Introduction to to MADE/MAED Y. Saboohi	Exercises on MADE Participats Y. Saboohi	First Run with MADE Trouble Shooting Participants Y. Saboohi
10.30 12.00	Registration CDG	Energy and Environment Studies R. Friedrich Th. Müller A. Obermeier	Exercises on MAED Participants Y. Saboohi	Review of Input Data Set for Demand Analysis/ Choice of Options Participants Y. Saboohi	Presentation of the Energy System of the republic of Seychelles Naya/ Coopoosamy
14.00 15.30	Presentation of IKE and Introduction Program A. Voß	MESAP Handling and Exercise Book A. Reuter	Input Data Requirements for MADE F. Emhard	Set up of MADE	Review of Demand Analysis Results and Decision on further Schedule Participants A. Reuter Y. Saboohi
15.30	Tools for Energy Planning A. Reuter			Input Data Set Participants	

"S" = Seminarraum

MESAP Training Course for the Government of the Seychelles

2. Week	Monday 4.9.	Tuesday 5.9.	Wednesday 6.9.	Thursday 7.9.	Friday 8.9.
9.00 – 12.00	Investment Calculation with INCA Introduction, Demonstration, Exercises A. Reuter C. Schlenzig U. Fahl		Regression Analysis Introduction, Demonstration Exercises U. Fahl (Introduction) A. Reuter		Round Table Discussion on Energy Demand Analysis of Energy Demand Participants [illegible]. Voß Y. Saboohi A. Reuter
14.00 -- 7.00	Preliminary Analysis of Energy Demand (MADE II) Participants Consultant: Y. Saboohi (F. Emhard)				

MESAP Training Course for the Government of the Seychelles

3. Week	Monday 11.9.	Tuesday 12.9.	Wednesday 13.9.	Thursday 14.9.	Friday 15.9.
9.00 12.00	Energy Supply System Model MESSAGE Introduction, Demonstration, Exercises R. Kühner A. Reuter			Electricity Expansion Planning with WASP Introduction, Demonstration, Exercises S. Schnabel	Round Table Discussion on Results of Case Study Participants A. Voß Y. Saboohi A. Reuter
14.00 -- 7.00	Case Study on Energy Demand (MADE II) Participants Consultant: Y. Saboohi				

MESAP Training Course for the Government of the Seychelles

4. Week	Monday 18.9.	Tuesday 19.9.	Wednesday 20.9.	Thursday 21.9.	Friday 22.9.
9.00 – 12.00	MESAP Experience A. Reuter	Future of MESAP - Decision Support System C. Schlenzig	Power Plant Management System M. Hanselmann	Technical Visit Pumped Storage Hydro Power Plant "Glems"	Round Table Discussion Participants A. Voß Y. Saboohi A. Reuter N.N.
14.00 – 17.30	Preliminary Case Study on Energy Supply System (MESSAGE) and Sensitivity/Scenario-Analysis with MADE Participants Consultants: R. Kühner, Y. Saboohi, A. Reuter				

OUTLINE OF A POSSIBLE FUTURE COOPERATION

between

Government of the Republic of Seychelles

and

Institut für Kernenergetik und Energiesysteme, Stuttgart

on

Studies on the Perspectives of the Energy Systems in the Republic of Seychelles - using the MESAP-system

Stuttgart, September 1989

The cooperation is envisaged to take place in the following phases:

PHASE 1:

Identification of energy situation on the Islands of Seychelles and selection of planning tools. (Mission of Dr.T. Müller to the Republic of Seychelles, December 1988)

PHASE 2:

Training of the experts of the Seychelles on the MESAP-system in Stuttgart.
(subject to UNIDO-contract, August-September 1989)

PHASE 3:

Transfer of the MESAP-system to the Republic of Seychelles.
(subject to UNIDO-contract, envisaged: November 1989)
Installation of the MESAP-system and familiarization with the different modules.

Envisaged future cooperation:

PHASE 4: Alternative A

Studies on the

"Perspectives of the Energy and Environmental System in the Republic of Seychelles",

including: energy conservation policies, interfuel substitution issues, strategies for the introduction of renewable energies, studies on electricity tariffs, analysis of energy supply options.

Step 1: Definition of the problems to be analyzed and of the objectives.
During this phase a (two weeks) visit of IKE experts to the Seychelles is recommended.

Step 2: Preliminary analysis using existing data.

- Collection of missing data.
- Selection of adequate methodologies.
- Preliminary Analysis.

Step 3: Discussion of preliminary analysis and set-up of framework for the detailed analysis.

During this phase a (one month) visit is recommended of the Seychelles experts in Stuttgart in order to discuss the preliminary results and the further procedure among the expert team at the IKE.

Step 4: Detailed analysis

- Collection of additional data
- Detailed analysis of energy and environmental system
- Sensitivity analysis

<u>Step 5:</u> Interpretation of results and recommendations.

- Discussion of findings
- Formulation of policies
- Final report

During this phase a (two weeks) visit is recommended of the IKE experts in the Seychelles in order to discuss the findings and to discuss possible recommendations.

PHASE 4: Alternative B

Tailor-Made version of the MESAP-system for the Seychelles

including: adaptation of MESAP-modules to the specific needs on the Seychelles, training on how to perform modifications and how to add new modules and commercial software.

Step 1: Definition of the issues to be implemented in tailor-made version.
During this phase a (two weeks) visit of an IKE expert to the Seychells is recommended in order to discuss the modifications for the tailor -made version among the expert team of the government of the Seychelles.

Step 2: Implementation of modifications for tailor -made version at the IKE together with experts from the Seychelles (3-4 months) in Stuttgart.

Step 3: Test and validation study of tailor-made version of MESAP.
At the end of this study, a (two weeks) visit of IKE experts to the Seychelles is recommended to discuss the results and possible improvements.

Alternatives A and B can be combined.
The time horizon of phase 4 is estimated at 1 - 2 years.