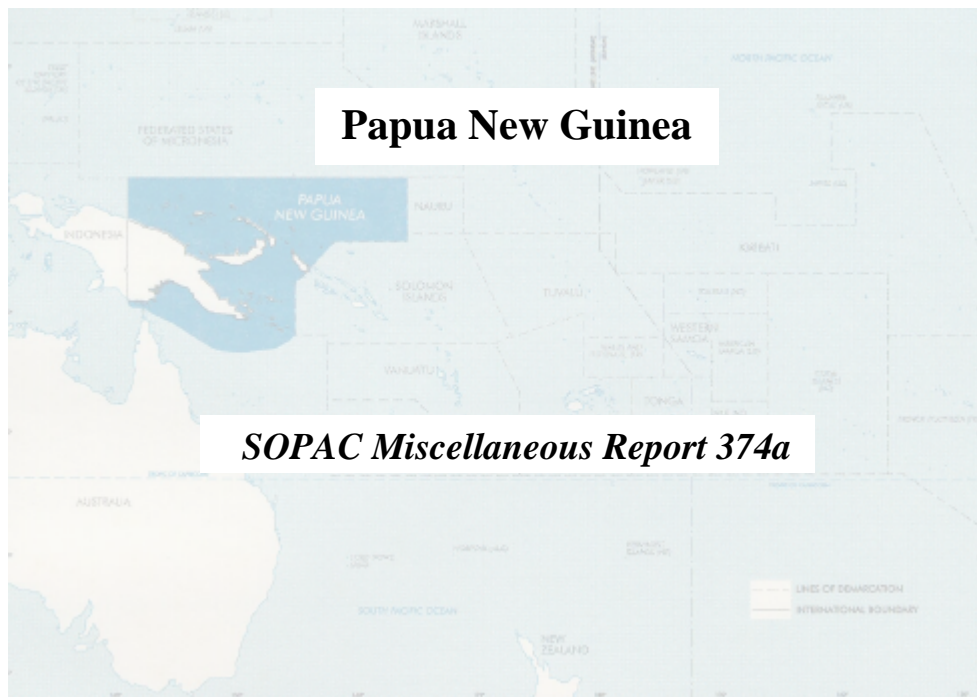


MODIFICATIONS TO THE NATIONAL ENERGY DEMAND/SUPPLY DATABASE



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INTRODUCTION AND BACKGROUND

Papua New Guinea (PNG) has an estimated population of 4.7 million, mid year estimate 1999¹, with 85% living in the rural areas. Being the largest of the Pacific Island countries (PICs), both in terms of population and in terms of economic size, PNG has a relatively low per capita income.

PNG, unlike other PICs, is richly endowed with reserves of oil, gas, hydro potential, geothermal potential, and a large supply of biomass. The cost of developing these energy resources is high due to factors such as the general inaccessibility and rugged terrain of the country, and the issues relating to the negotiation of land acquisition and compensation.

An energy database was first set-up by the Forum Secretariat² Energy Division³ in 1994. The progress in the collection and input of energy data over the past years has been unsatisfactory due to the amount of work involved in sourcing the information. A request by the PICs' Energy Planning Units/Energy Departments to modify the existing structure to reduce complexity, minimize workload in collection/input of energy data and be more user friendly, have led the SOPAC Energy Unit to carry out the necessary modifications.

The modification comprises the desegregation of the Petroleum Sector and combining the individual sheets to single workbooks. The annexes in this report provide detail information on conversion factors (Annex 1), short cuts and assumptions (Annex 2), classification of the end-use sectors (Annex 3), abbreviations used (Annex 4) and workbook structures (Annexes 5 – 9).

The National Energy Demand/Supply Database was established to enable Pacific Island Countries (PICs) to source, record and store energy data not only to develop their policies but also to be made available to donors and other regional organizations for their appropriate responses.

This report aims to assist the Papua New Guinea Energy Division of the Department of Petroleum and Energy in sourcing, collecting and input of energy data into the modified structure of the energy database.

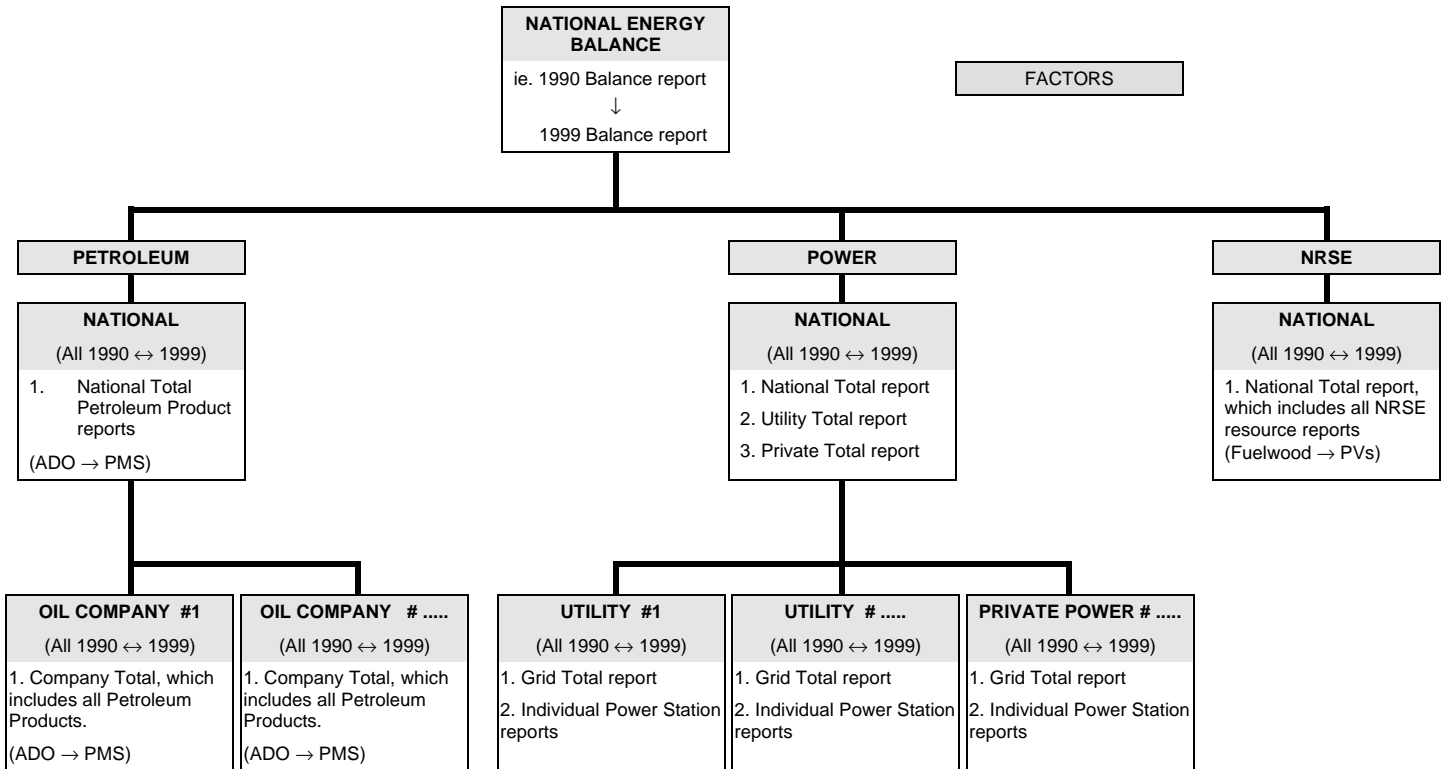
¹ Pacific Islands Data – South Pacific Community

² now known as the Pacific Islands Forum Secretariat

³ physically relocated to SOPAC in January 1998

DESCRIPTION OF THE MODIFIED DATABASE

The modified Energy Supply/Demand Database is a series of inter-linked worksheets and workbooks in Microsoft Excel format. Given below is an illustration of the linkages (in bold lines) to the Energy Balance.



Note that the Factors Workbook is not linked to the energy balance. All cells in the worksheets, other than those requiring data input, are protected to avoid accidental tempering⁴.

The modified structure has basically incorporated all individual product worksheets into single workbooks. The desegregation of the petroleum sector has done away with the need to source energy data at provincial level; however, there is still a need for provincial level energy data in the power sector.

⁴ It is recommended that the cell protection not to be turned off/removed. Note that it is not necessary to turn off/remove the protection to input energy data.

THE ENERGY DATABASE DIRECTORIES AND DATA REQUIREMENTS

The energy database template consists of the directories: Factors (Annex 5), New and Renewables (NRSE – Annex 6), Petroleum (Annex 7), and Power (Annex 8). Their contents and data requirements are summarized below. The data provided by oil companies and other energy data sources are usually not in the format required by the database. Thus the ‘raw’ energy data has to be converted to the appropriate form; see Annex 1 for the necessary conversion factors.

Factors

The single worksheet in this workbook, Annex 5, shows PNG’s Economic/Demographic Indicators and Current Retail Energy Prices with the following data requirement.

Economic/Demographic Indicators

- GDP values (current prices, constant prices, per capita and by sector);
- value of total imports/exports;
- exchange rate;
- population;
- number of households, etc.

Current Retail Energy Prices

- current prices/litre for all petroleum products; and
- current electricity prices/kWh for Industrial, Commercial, Residential, and Government.

New and Renewables

Biomass resources, including fuelwood, sawmill and logging residues, and agricultural residues; gasifiers, biogas are in abundance in PNG, however not all are economically exploitable. Solar energy, as usual, is quite economically attractive and these are already in widespread use in PNG.

The New and Renewables workbook, see Annex 6, contents are summarized below.

- Total NRSE - summary of consumption of new and renewables by sectors (units = GJ)
- Solar Hot Water Heaters - shows the total energy supplied by SHW systems in MWh and GJ
- PV - shows the energy provided by PVs in MWh and GJ
- Coconut wood & residue - calculates the energy obtained from coconut wood & residue in GJ and te.
- Fuel wood & Woodwaste - gives the total consumption in GJ and te.
- Bagasse - tables the tonnes used for electricity generation and co-generation heat
- Oil Palm Residues - Gives the tonnes used for electricity generation and co-generation heat

The *end-use sectors*⁵ in New and Renewables are: Agriculture, Forestry and Fishing; Manufacturing (produce drying, sawmills, oil processing, etc); Electricity Generation; Wholesale, Retail Trade and Recreation which includes hotels, resorts, restaurants, etc; Transport and Communication (warehousing, post & telecommunications, etc); Community and Social Services (street lighting, schools/educational institutes, local government administration services, etc); and Residential (Urban & Rural).

Data requirements for New and Renewables are as follows:

- number of operating PV modules and solar hot water systems
- average area⁶ per module/collector (m²)
- average system efficiency⁷ (%)
- insolation rate (MJ/m²/day)
- number of households (urban & rural)
- estimated number of persons per household
- an average consumption rate of biomass per sector

Biomass consumption rate for PNG

Country	Residential Consumption	Biomass consumption per	%fuelwood vs %coconut residue	References
PNG	Island environment, urban and rural population, with 95% of households assumed consuming biomass	1000 (urban) (= 0.4kg/person/day) 2400 (rural) (= 1.0kg/person/day)	Assumed 95%/5% as for island environment	PREA estimate, PNG Household Energy Survey, August 1987.

The following ratios may be used in calculating coconut residue (shell & husks) consumed by the copra industry:

- 2.5 tonnes coconut residue consumed / 1 tonne of copra produced using traditional smoke dryers; or
- 1.25 tonnes coconut residue consumed / 1 tonne of copra produced using "hot-air-dryers".

⁵ see Annex 3 for a detailed classification of the end-use sectors

⁶ typical collector areas: SHW = 2.98 m² (180 litre system) & 3.98 m² (300 litre system); PV modules ≈ 2 m²

⁷ average efficiency values: SHW = 20% - 30%; PV = 10% - 15%

Examples of calculations for residential biomass consumption rates

Fuelwood consumption rate (from table, page 6, 95% of average biomass consumption rate)

Urban: $0.95 \times 1000 \text{ kg/hh/yr} = 950 \text{ kg/hh/yr}$

Rural: $0.95 \times 2400 \text{ kg/hh/yr} = 2280 \text{ kg/hh/yr}$

Coconut Residue consumption rate (from table, page 6, 5% of average biomass consumption rate)

Urban: $0.05 \times 1000 \text{ kg/hh/yr} = 50 \text{ kg/hh/yr}$ (or $1000 - 950 = 50 \text{ kg/hh/yr}$)

Rural: $0.05 \times 2400 \text{ kg/hh/yr} = 120 \text{ kg/hh/yr}$ (or $2400 - 2280 = 120 \text{ kg/hh/yr}$)

Petroleum

The petroleum sector comprises of the following workbooks: Boral gas; BP; Highlands; Mobil; Shell, Niugini Oil, (Napa Napa Refinery, PNG Gas – for the 2000-2009 template) and TotPet. Each workbook has a series of interlinked sheets containing data for the respective petroleum products.

The end-use sectors are categorized according to product type. For example, Avgas will only have Wholesale, Retail Trade & Recreation, and Transport (International Air & Domestic Air); for ADO the end-use sector comprises of Agriculture, Forestry & Fishing, Mining & Quarrying, Manufacturing, Electricity Generation, Water Supply, Construction, Wholesale/ Retail Trade & Recreation and Transport (rail, road & sea), see Annex 7 for a detail structure of the Petroleum Sector.

Data requirements in the petroleum sector are as follows:

- import figures for petroleum products;
- purchase of local product;
- re-export figures, if any
- stock levels at 1st January and 31st December for each year;
- actual sales figures; and
- consumption per end-use sectors.

Power

The structure of the power sector remains unchanged. The end-use sector comprises: Agriculture, Forestry and Fishing; Mining and Quarrying; Manufacturing; Water and Sewerage; Construction; Wholesale/Retail Trade and Recreation; Transport and Communication; Finance and Business Services; Community and Social Services; Street Lighting; and Residential. The worksheets in Annex 8 are only the totals of the C_Centres, Private Generators, Utilities, and National.

Data requirements in the power sector are as follows:

- installed capacity (kW);
- derated capacity (kW);
- gross generation (MWh);
- station's own use & losses (MWh);
- lubricant oil used (kl);
- ADO used in the power generation (kl);
- maximum station demand (kW);
- purchases from self generators (MWh), if applicable;
- sales to self generators (MWh), if applicable;
- transmission losses (MWh);
- distribution losses (MWh);
- estimate of pilferage and unmetered sales (MWh);
- maximum system demand (kW); and
- consumption by the end-use sectors (MWh).

Energy Balance

The energy balance workbook consists of ten sheets (ten energy balances; e.g., 1990 – 1999). This is the final stage of the energy database where it summarises details of individual national energy sources and consumption. The energy balance is inter-linked to the New and Renewables, Petroleum and Power Workbooks, see Annex 9.

List of possible data sources

Oil/Gas Companies	Power Utilities	Airlines
Customs Departments	Solar Utilities	Shipping Agencies
Statistical Publications ⁸	Meteorological Offices	
Statistics Offices	Energy Survey Results	

Establishing data sources with a company/organization will generally require a formal and senior-level approach. It is crucial that a good working relation be established and maintained, and data collection/exchange is on a regular and consistent basis.

⁸ examples: by the ADB, SPC & UN

ANNEXES

ANNEX 1 CONVERSION FACTORS

The following **factors are indicative**, because a fuel's specifications varies with source, time, place, temperature, etc. The energy factors measure the gross energy content of the fuel.

1. Liquid Fuels

(Note: gallons and tons are US measures)

	Megajoules per Litre	Megajoules per Gallon	Litres per Tonne	Gallons per Ton	Gigajoules per Tonne	Gigajoules per Ton
LPG (Propane)	25.3	95.8	1960	469.7	49.6	45.0
LPG (Butane)	27.7	104.9	1730	414.6	49.0	44.5
Aviation Gasoline (Av Gas)	33.2	125.7	1410	337.9	46.8	42.5
Motor/Automotive Gasoline (Mogas)	34.6	131.0	1340	321.1	46.4	42.1
Dual Purpose Kerosene (DPK)	36.8	139.3	1260	302.0	46.4	42.1
Automotive Diesel Oil (ADO)	38.6	146.1	1180	282.8	45.6	41.4
Industrial Diesel Oil (IDO)	39.0	147.6	1150	275.6	44.9	40.7
Fuel Oil - high sulphur (FO)	40.8	154.4	1050	251.6	42.9	38.9
Ethanol (PNG only)	23.4	88.6	1266	303.4	29.6	26.9
Solvents/White Benzene	34.0	128.7	1420	340.3	48.1	43.6
Lubricants and Greases	38.8	146.9	1120	268.4	43.4	39.4
Bitumen	44.0	166.6	980	234.9	42.7	38.7
Crude Oil (PNG Kutubu Light)	35.9	135.9	1249	299.3	44.9	40.7
Coconut Oil	34.9	132.1	1100	263.6	38.4	34.8

2. Petroleum crude specific gravities (approximate figures at 15°C)

Degrees API	Specific gravity	Litres per Tonne	MJ per Litre
25	0.903	1108	39.7
26	0.898	1114	39.5
27	0.892	1123	39.2
28	0.886	1129	39.1
29	0.881	1136	38.9
30	0.875	1144	38.6
31	0.870	1150	38.5
32	0.865	1157	38.3
33	0.859	1165	38.1
34	0.854	1172	37.9
35	0.849	1179	37.7
36	0.844	1187	37.5
37	0.839	1193	37.3
38	0.835	1198	37.2
39	0.829	1207	37.0
40	0.824	1215	36.8
41	0.820	1220	36.6
42	0.815	1228	36.4
43	0.810	1235	36.3
44	0.805	1243	36.1
*45	0.801	1249	35.9
46	0.796	1257	35.7
47	0.792	1263	35.6
48	0.788	1270	35.4
49	0.783	1278	35.2
50	0.779	1284	35.1

* "Kutubu Light", PNG.

3. Solid Fuels

	Gigajoules per Tonne	Gigajoules per Ton
Black Coal - steaming coal (Fiji only)	30.1	27.3
Charcoal	30.0	27.2
Fuelwood/Woodwaste (40% mcwb) ¹	10.8	9.8
Fuelwood/Woodwaste (13% mcwb) ²	17.1	15.5
Coconut Palm Wood	11.5	10.4
Coconut Residues ³ :		
Shell (15% mcwb _{harvested})	14.6	13.2
Husk (30% mcwb _{harvested})	12.0	10.9
Average (air dry _{shell and husk}) ⁴	14.0	12.7
Palm Oil Residues:		
Shell	17.5	15.9
Fibre	12.5	11.3
Average	15.0	13.6
Empty Bunches	7.5	6.8
Bagasse	9.7	8.7

1. Typical moisture content of undried sawmill residue and timber merchant fuelwood.
2. Typical moisture content of air dried fuelwood and residue.
3. Average yield of 2.93 air dry tonnes of residue per tonne of copra produced.
4. Proportion: kernel 33%, shell 23 % and husk 44% by dry weight.

4. Gaseous Fuels

	Megajoules per Cubic Metre	Megajoules per Cubic Foot
Natural Gas	39.0	1.1
Methane	37.7	1.1

* Approximate figures at 15°C.

5. Electricity

	Megajoules per kWh
Electricity	3.6

Sources for the above tables:

- regional specifications.
- Department of Primary Industries and Energy, Australia.
- World Bank PREA reports 1992.
- Energy Data and Conversion Factors (New Zealand Energy R&D Committee 1984).

Compiled from the Petroleum Economist and the Steinmuller 'Pocket Book', based on the international system of units (SI). Factors are either exact or correct to six significant figures.

Length

1 inch
= 25.4 millimetres (mm)

1 foot
= 12 inches (")
= 0.333333 yard
= 0.3048 metre (m)

1 yard
= 36 inches (")
= 3 feet (')
= 0.9144 metre (m)

1 metre
= 39.3701 inches (")
= 3.28084 feet (')
= 1.09361 yards
= 0.001 kilometre (km)

1 kilometre
= 1,000 metres (m)
= 0.621371 mile

1 mile
= 1,760 yards
= 1.60934 kilometres (km)

1 international nautical mile
= 1.85318 kilometres (km)
= 1.15088 miles

1 square inch
= 645.16 square millimetres (mm²)

1 square foot
= 0.0929030 square metres (m²)

1 square yard
= 9 square feet
= 0.836127 square metres (m²)

1 square metre
= 10.7639 square feet (squ.ft)
= 1.19599 square yards

1 acre
= 4,840 square yards
= 4,046.86 square metres (m²)
= 0.404686 hectares

1 hectare
= 10,000 square metres (m²)
= 2.47105 acres
= 0.01 square kilometres (km²)

1 square kilometre
= 100 hectares
= 0.386102 square miles

1 square mile
= 640 acres
= 258.999 hectares
= 2.58999 square kilometres (km²)

Volume

1 cubic inch
= 16.3871 cubic centimetres (cm³)

Area

1 pint

= 0.568261 cubic decimetres (dm³)

= 0.158757 cubic metres (m³)

1 litre (l)

= 61.0238 cubic inches (cu")

= 1.75975 pints

= 1 cubic decimetre (dm³)

= 0.264170 American gallons

= 0.219969 Imperial gallons

= 0.0353147 cubic feet (cu ft)

1 cubic metre

= 1,000 litres (l)

= 264.170 American gallons

= 219.969 Imperial gallons

= 6.29894 American barrels (bbl)

= 35.3147 cubic feet (cu ft)

1 hectolitre

= 100 litres

1 kilolitre (kl)

= 1,000 litres (l)

= 6.29894 American barrels (bbl)

1 American gallon

= 231 cubic inches (cu")

= 3.78544 litres (l)

= 0.832679 Imperial gallons

= 0.133681 cubic feet (cu ft)

= 0.0238095 American barrels (bbl)

= 0.00378544 cubic metres (m³)

1 gross ton (shipping)

= 2.83168 cubic metres or 100 cubic feet
of permanently enclosed space

1 Imperial gallon

= 277.42 cubic inches (cu")

= 4.54609 litres (l)

= 1.20094 American gallons

= 0.160544 cubic feet (cu ft)

= 0.0286355 American barrels (bbl)

= 0.00454609 cubic metres (m³)

1 ounce (ozs)

= 28.3495 grams (g)

1 pound

= 0.453592 kilograms (kg)

= 0.00892857 hundredweight

1 cubic foot (cu ft)

= 28.3168 litres (l)

= 7.48047 American gallons

= 6.22884 Imperial gallons

= 0.178366 American barrels (bbl)

= 0.0283168 cubic metres (m³)

1 kilogram (kg)

= 2.20462 pounds (lbs)

= 0.001 tonne (te)

1 hundredweight

= 112 pounds (lbs)

= 50.8023 kilograms (kg)

1 American barrel (bbl)

= 9,687.95 cubic inches (cu")

= 158.757 litres (l)

= 42 American gallons

= 34.9725 Imperial gallons

= 5.60645 cubic feet (cu')

1 American (short) ton

= 2,000 pounds (lbs)

= 0.892857 long tons

= 0.907185 tonnes (te)

1 Imperial (long) ton

Mass

= 2,240 pounds (lbs)
= 1.12 short tons
= 1.01605 tonnes (te)

1 tonne (te)
= 2,204.62 pounds (lbs)
= 1,000 kilograms (kg)
= 1.10231 short tons
= 0.984206 long tons

Energy and Power

1 international table (IT) calorie
= 4.1868 joules (J)

1 megacalorie (IT)
= 1,000,000 calories
= 3968.32 British thermal units (BTU)
= 1163 watt hours (Wh)
= 4.1868 megajoules (MJ)

1 joule (J)
= 0.238846 calories (IT)

1 megajoule (MJ)
= 1,000,000 joules (J)
= 947.817 British thermal units (BTU)
= 277.778 watt hours (Wh)
= 238,846 calories (IT)
= 0.0238846 kilograms of oil equivalent

1 kilogram of oil equivalent (koe)
= 41.868 megajoules (MJ)
= 10 megacalories

1 tonne of oil equivalent (toe)
= 41.868 gigajoules (GJ)
= 10 gigacalories

1 kilowatt hour (kWh)
= 3,412.14 British thermal units (BTU)
= 859.845 kilocalories (IT)
= 3.6 megajoules (MJ)
= 1.34102 horsepower hours

1 metric horsepower (Pferdesaerke or Cheval
Vapeur)
= 735.499 watts (W)
= 542.476 foot pounds force/second
= 0.986320 Imperial horsepower

1 Imperial horsepower
= 745.700 watts (W)
= 550 foot pounds force/second
= 1.01388 metric horsepower

1 kilowatt (kW)
= 737.562 foot pounds force/second
= 1.35962 metric horsepower
= 1.34102 Imperial horsepower

ANNEX 2 SHORT CUTS AND ASSUMPTIONS

2. Short Cuts and Assumptions

This end-use sector disaggregation is assisted by the fact that, for most FICs, some fuels will be consumed in only one or two end-use sectors. Consequently, valid assumptions can be made regarding the end-use picture for those fuels. The database reports and the survey forms reflect these assumptions.

The assumptions are based on the equation:

$$\text{Total supply/sales} = \text{demand in end-use sector A} + \text{demand in end-use sector B} + \dots$$

Consequently, if data for total supply and data for sales to end-use sectors B, C, etc, are known, then demand in sector A can be derived. For example:

- **Total sales of Aviation Gasoline (Av Gas) = Demand in Domestic Air Transport sector.** Consumption of Av Gas for International Air Transport is likely to be negligible.
- **Total sales of DPK = Demand in International Air Transport + Demand in Domestic Air Transport + Demand in Community/Social Services + Demand in Residential.** Demand for DPK in other sectors is likely to be negligible.
- **Total sales of LPG = Demand in Hotels/Restaurants + Demand in Community/Social Services + Demand in Residential.** Demand for LPG in other sectors is likely to be negligible.
- **Total sales of Motor Gasoline = Demand in Agriculture/Forestry/Fishing + Demand in Road Transport + Demand in Community/Social Services + Demand in Residential.** Demand in other sectors is likely to be negligible.
- **Total Biomass supply/demand = Demand in specific Agro-industries + Demand in Community/Social Services + imputed Demand in Residential.** Demand in other sectors is likely to be negligible.
- **Total Solar Hot Water Heater supply/demand = imputed contribution of total number of panels in Hotels/Restaurants + Community/Social Services + Residential.** Demand in other sectors is likely to be negligible.
- **Total Solar Photovoltaic supply/demand = imputed contribution of total number of panels in Community/Social Services + Residential.** Demand in other sectors is likely to be negligible.

While the above assumptions (and others) will apply to most FICs, it is essential that they be examined for their validity on an individual country basis

- a check list of fuels and their likely end-use sectors in which they are consumed is on the following pages for your consideration and review.

Petroleum

Fuel	End-Use Sectors	Relevant for you?
Automotive Diesel Oil (ADO)	Agriculture	
	Forestry and Logging	
	Fishing and Fish Farming	
	Mining and Quarrying	
	Manufacturing - all subsectors	
	Electricity Generation	
	Water and Sewerage	
	Construction	
	Road Transport	
	Rail Transport	
	Sea Transport	
	Communication	
	Wholesale/Retail Trade and Hotels and Restaurants	
	Community, Social and Personal Services	
Residential		
Aviation Gasoline	International Air Transport	
	Domestic Air Transport	
Benzine	Community, Social and Personal Services	
	Residential	
Bitumen	Bitumen, Lubricants & Solvents	
Crude Oil (PNG only)	Manufacturing	
	Electricity Generation	

Fuel	End-Use Sectors	Relevant for you?
Dual Purpose Kerosene (DPK)	International Air Transport	
	Domestic Air Transport	
	Community, Social and Personal Services	
	Residential	
Ethanol (PNG only)	Road Transport	
Fuel Oil (FO)	Manufacturing	
	Electricity Generation	
	Sea Transport	
	Community, Social and Personal Services	
Industrial Diesel Oil (IDO)	Manufacturing	
	Electricity Generation	
	Sea Transport	
	Community, Social and Personal Services	
Liquefied Petroleum Gas (LPG)	Manufacturing	
	Wholesale/Retail Trade and Hotels and Restaurants	
	Communication	
	Finance, Insurance, Real Estate and Business Services	
	Community, Social and Personal Services	
	Residential	
Lubricants and Greases	Bitumen, Lubricants & Solvents	

Fuel	End-Use Sectors	Relevant for you?
Motor Gasoline (Mogas, Petrol)	Fishing and Fish Farming	
	Road Transport	
	Community, Social and Personal Services	
	Residential	
Regular Motor Gasoline (FSM only)	Fishing and Fish Farming	
	Road Transport	
	Community, Social and Personal Services	
	Residential	
Super Motor Gasoline (FSM only)	Road Transport	
Pre-Mix (2 stroke gasoline)	Fishing and Fish Farming	
	Road Transport	
	Community, Social and Personal Services	
	Residential	
Solvents	Bitumen, Lubricants & Solvents	

New and Renewable Sources of Energy (NRSE)

Fuel	End-Use Sectors	Relevant for you?
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Bagasse (sugar cane residue)	Electricity Generation (co-gen.)	
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Coconut Wood and Residues	Agriculture	
	Manufacturing	
	Community, Social and Personal Services	
	Residential	

Fuelwood and Woodwaste	Agriculture	
	Manufacturing	
	Electricity Generation (co-gen.)	
	Community, Social and Personal Services	
	Residential	

Oil Palm Residues	Electricity Generation (co-gen.)	
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Solar Photovoltaics (PVs)	Communication	
	Community and Social Services (including Street Lighting)	
	Residential	

Solar Hot Water	Wholesale/Retail Trade and Hotels and Restaurants	
	Community, Social and Personal Services	
	Residential	

Black Coal

Fuel	End-Use Sectors	Relevant for you?
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Black Coal (export thermal)	Manufacturing - all subsectors	
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Natural Gas

Fuel	End-Use Sectors	Relevant for you?
Natural Gas	Electricity Generation	

Electricity

Fuel	End-Use Sectors	Relevant for you?
Electricity	Agriculture	
	Forestry and Logging	
	Fishing and Fish Farming	
	Mining and Quarrying	
	Manufacturing	
	Electricity Generation	
	Water and Sewerage	
	Construction	
	Wholesale/Retail Trade and Hotels and Restaurants	
	Storage and Communication	
	Finance, Insurance, Real Estate and Business Services	
	Community, Social and Personal Services	
	Street Lighting	
	Residential	

Co-generation Heat

Fuel	End-Use Sectors	Relevant for you?
Co-generation Heat	Manufacturing	
	Water and Sewerage	

ANNEX 3

**REGIONAL STANDARD INDUSTRIAL
CLASSIFICATIONS**

Regional Standard Industrial Classification (RSIC)

Division Sub-division Group Sub-group

A (0000)

Agriculture, Forestry, Fishing and Hunting

0100		Agriculture (includes cleaning and processing when done on site. Further processing is part of 'Div. C: Manufacturing')
	0110	Sugar cane growing
	0120	Coconut growing
	0130	Rice growing
	0140	Oil palm growing
	0150	Tobacco growing and curing
	0160	Fruit, vegetables and other crops growing
	0170	Poultry and egg production
	0180	Milk and cream production
	0190	Other livestock production
0200		Services to agriculture
0300		Forestry and logging (excludes sawmilling which is part of 'Div.C - Manufacturing')
	0310	Forestry except logging
	0320	Logging
0400		Fishing and fish farming
0500		Hunting
0600		Subsistence agriculture, fishing and hunting

B (1000)

Mining and Quarrying

1100		Metallic ore mining and beneficiation
1200		Coal mining
1300		Oil and gas extraction
1400		Construction material quarrying
1500		Other mining and quarrying nec
1600		Geological and prospecting activities

C (2000)

Manufacturing

2100		Food, beverages and tobacco
	2110	Foods (includes animal feeds)
	2111	Meat products
	2112	Dairy products
	2113	Fruit and vegetable products
	2114	Fish and marine food products
	2115	Margarine and oils/fats nec
	2116	Grain mill and cereal food products
	2117	Bakery products
	2118	Sugar refining and products
	2119	Other food products nec
	2120	Beverages
	2121	Spirits and wines
	2122	Beer and stout
	2123	Cordials and carbonated drinks
	2130	Tobacco products
2200		Textiles, clothing and footwear
	2210	Textiles
	2220	Clothing
	2230	Footwear
	2240	Leather goods except footwear
2300		Wood, wood products, cane and furniture
	2310	Wood and cane products except furniture
	2311	Sawmilling and other wood milling
	2312	Wooden and cane containers
	2313	Wood and cane products nec

Division Sub-division Group Sub-group

		2320	Furniture and fixtures, primarily of wood
	2400		Paper, paper products and printing/publishing
		2410	Paper, paper products and paperboard
		2420	Printing, publishing and allied industries
	2500		Chemical, petroleum, coal, rubber and plastics
		2510	Chemicals and chemical products
		2511	Industrial chemicals
		2512	Paints, varnishes and lacquers
		2513	Soaps, cosmetics and toilet preparations
		2514	Chemicals products nec
		2520	Petroleum refining
		2530	Petroleum and coal products nec
		2540	Rubber products
		2550	Plastic products
	2600		Non-metallic mineral products
		2610	Glass and glass products
		2620	Clay products and refractories
		2630	Cement and cement products
		2640	Other non-metallic mineral products
	2700		Basic metal products
		2710	Basic iron and steel
		2720	Basic non-ferrous metals
		2730	Casting of metals
	2800		Fabricated metal products, machinery and equipment
		2810	Fabricated metal products except machinery and equipment
		2811	Furniture and fixtures primarily of metal
		2812	Structural metal products
		2813	Fabricated metal products except machinery/equipment nec
		2820	Machinery and equipment except electrical (includes manufacture and repair)
		2821	Agricultural machinery and equipment
		2822	Machinery and equipment nec
		2830	Electrical machinery, equipment and appliances (includes manufacture and repair)
		2840	Transport equipment (includes manufacture and repair)
		2841	Ship building and repair
		2842	Transport equipment manufacture and repair nec
		2850	Professional and scientific equipment (includes manufacture and repair)
	2900		Other manufacturing
		2910	Jewellery and related articles
		2920	Manufacturing nec
D (3000)			Electricity, Gas, Water and Sewerage
	3100		Electricity supply
		3110	Public electricity
		3111	Sole generator, ie produces electricity only
		3112	Co-generator, ie produces electricity and process heat
		3120	Private electricity
		3121	Sole generator, ie produces electricity only
		3122	Co-generator, ie produces electricity and process heat
	3200		Gas reticulation
	3300		Water treatment and supply (including water distillation)
	3400		Sewerage collection, treatment and disposal

Division	Sub-division	Group	Sub-group	
E (3500)				Construction
	3510			Building construction, repair and demolition
	3520			Other construction
F (4000)				Wholesale/Retail Trade and Restaurants/Hotels
	4100			Wholesale trade
	4200			Retail trade
	4300			Restaurants/bars and hotels/lodging
		4310		Restaurants, cafes, bars and clubs
		4320		Hotels, resorts and lodging
G (5000)				Transport, Storage and Communication
	5100			Transport
		5110		Road transport includes all public and private road transport
			5111	Bus transport
			5112	Taxi transport
			5113	Road freight transport
			5114	Personal vehicle transport
			5115	Road transport nec
		5120		Rail transport includes all public and private rail transport
		5130		Water transport, includes all public and private water transport
			5131	Sea cruises and tours
			5132	Ocean, coastal and inland water transport
			5133	Salvage, towing and stevedoring services
		5140		Air transport, includes all public and private air transport
			5141	International air transport
		5142	Domestic air transport	
	5200		Warehousing, cargo handling and services allied to transport	
	5300		Communication services includes post, telecommunications, etc	
H (6000)				Finance, Insurance, Real Estate and Business Services
	6100			Banking, finance and investment services
	6200			Insurance services
	6300			Real estate and business services
I (7000)				Community, Social and Personal Services
	7100			Public administration, public order and defence
		7110		Central and local government administration services
		7120		Public order and safety
		7130		Defence
	7200			Street lighting
	7300			Sanitation, pest control and similar services
	7400			Social and community related services
		7410		Education and education services
			7411	Schools and general education
			7412	Technical, vocational, commercial and tertiary education
			7413	Education services nec
		7420		Medical, dental, veterinary and other health services nec
		7430		Welfare institutions and services (includes orphanages, old peoples homes, Salvation Army, Red Cross, etc)
	7440		Business, professional and labour associations	

Division Sub-division Group Sub-group

		7450	Religious, social and community services nec (includes churches, temples, youth organisations (Scouts, YMCS, YWCA, etc)
		7500	Recreational, cultural and sporting services (includes cinemas, television/radio stations, libraries, museums, sporting clubs and associations)
		7600	Personal and household services nec
		7700	International and extra-territorial agencies
J (8000)			Residential
		8100	Urban residential
		8200	Rural residential
K (9000)			Solvents, Lubricants and Bitumen

nec = not elsewhere classified.

ANNEX 4 ABBREVIATIONS USED

Abbreviations Used

- New and Renewables Sources of Energy (NRSE)
 - BGSE – bagasse (sugarcane residue)
 - COCO – coconut wood and residue
 - PALM – oil palm residue
 - PV – solar photovoltaics
 - WATR – solar water heater
 - WOOD – fuelwood and woodwaste
 - Totl – Total

- Petroleum (Petroleum)
 - ADO – automotive diesel oil
 - AVGAS – aviation gasoline
 - BTMN – bitumen
 - BNZE – white benzene
 - DPK – dual purpose kerosene
 - FO – fuel oil
 - IDO – industrial diesel oil
 - LPG – liquefied petroleum gas
 - LUBE – lubricants and greases
 - MOGS – mogas, motor spirit, petrol
 - SOLV – solvents
 - SUPR – super mogas

- Electricity (POWER)
 - ADOE – automotive diesel oil / reciprocating engine
 - ADOT – automotive diesel oil / gas turbine engine
 - FOB – fuel oil / boiler
 - FOE – fuel oil / reciprocating engine
 - IDOE – industrial diesel oil / reciprocating engine
 - ROR – run-of-river / hydro
 - STR - storage engine
 - PRIV – private self generator
 - RURL – government rural generator
 - UTLY – utility

ANNEX 5 FACTORS WORKBOOK

Papua New Guinea Selected Indicators and Prices

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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Economic/Demographic Indicators

GDP (current prices)
GDP (constant prices)
GDP per capita
GDP growth of near large neighbour
Inflation rate (%)
Deflator
Exchange rate (local/\$US)
Disposable Income

GDP by Sector (Constant Prices):

Agriculture, Forestry and Fishing
Mining and Quarrying
Manufacturing
Electricity Generation
Water and Sewerage
Construction
Wholesale/Retail Trade and Recreation
Transport, Storage and Communication
Finance and Insurance
Real Estate and Other Services
Community and Social services

Value of Total Imports
Value of Total Exports
Imports/Exports
Imports/GDP
Exports/GDP
Trade Deficit
Balance of Payments

Population

% Urban, % Rural
Number of Households
% Urban, % Rural
Population in Wage & Salary Employment

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
--	------	------	------	------	------	------	------	------	------	------

Government Budget
Government Revenue
% Locally generated
Overseas Development Assistance
 ODA as % GDP
 ODA as % annual Budget
 ODA per capita

Role of Energy Imports

Value of Total Energy Imports
Value of Total Energy Exports
Energy Trade Deficit
Energy Imports Dependency (%)*

Value of Petroleum Imports
Volume of Petroleum Imports
Average Wholesale Price per Litre
Average Marker Crude Price
Average Wholesale Price/Average Crude Price

Petroleum Imports/Total Imports (%)
Petroleum Imports/Total Exports (%)
Petroleum Imports/Government Budget (%)
Petroleum Imports/ODA (%)

Retail Energy Prices (Current Prices)

Petroleum (Current Prices/litre):
 Automotive Diesel (ADO)
 Motor Gasoline (Mogas/Petrol)
 Kerosene (DPK)
 Liquefied Petroleum Gas (LPG)

* 'Energy Imports Dependency' = (Energy Imports - Re-exports - Stocks Change) / Total Energy Consumption

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
------	------	------	------	------	------	------	------	------	------

Electricity (Current Prices/kWh):

Industrial

Commercial

Residential - urban

- rural

Government

Street Lighting

Average Price, i.e. Sales(\$)/Sales(kWh)

Firewood**Selected Projections**

1995	1996	1997	1998	1999	2000	2005	2010
------	------	------	------	------	------	------	------

GDP (constant prices)

GDP per capita

GDP growth of near large neighbour

Disposable Income

GDP by Sector (Constant Prices):

Agriculture, Forestry and Fishing

Mining and Quarrying

Manufacturing

Electricity Generation

Water and Sewerage

Construction

Wholesale/Retail Trade and Recreation

Transport, Storage and Communication

Finance and Insurance

Real Estate and Other Services

Community and Social services

Population

% Urban, % Rural

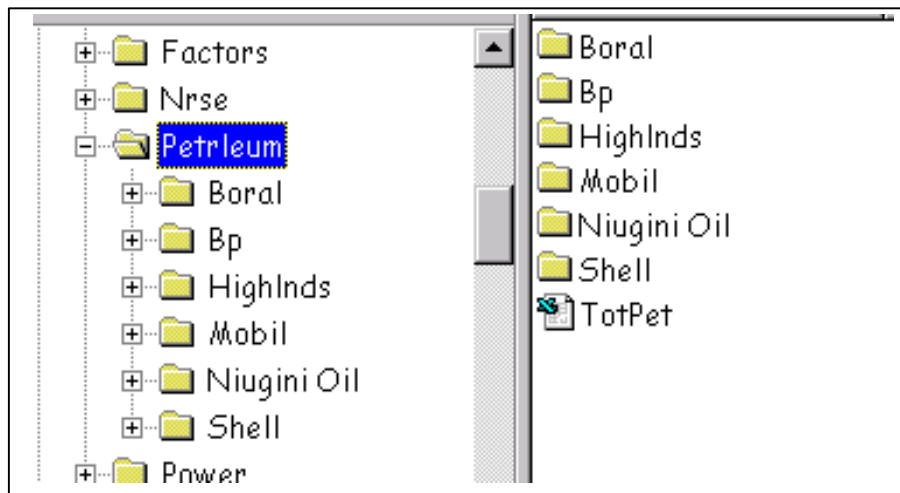
Number of Households

% Urban, % Rural

Population in Wage & Salary Employment

ANNEX 6 NEW AND RENEWABLES WORKBOOK

ANNEX 7 TOTAL PETROLEUM PRODUCT, GAS & OIL COMPANIES WORKBOOKS



The 1990 – 1999 structure.

Note that for 2000-2009 structure there are additions: Napa Napa Refinery and PNG Gas.

ANNEX 8 POWER WORKBOOKS



ANNEX 9 ENERGY BALANCE