

**THE NATIONAL ENERGY SUPPLY / DEMAND
DATABASE MANUAL**

Tuvalu

RUPENI MARIO

Energy Unit, South Pacific Applied Geoscience Commission

February 2001

SOPAC MISCELLANEOUS REPORT 400

TABLE OF CONTENTS

	<i>Page</i>
List of Acronyms	3
Introduction and Background	4
Description of the Modified Database	5
The Energy Database Directories and Data Requirements	
Factors	6
New and Renewables	7
Petroleum	8
Power	11
Energy Balance	13
Annexes	
Annex 1 Conversion Factors	16
Annex 2 Short Cuts and Assumptions	17
Annex 3 Regional Standard Industrial Classifications	18
Annex 4 Map of Tuvalu	19

LIST OF ACRONYMS

~~///~~ New and Renewable 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 (Petrleum)

- **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

~~///~~ Others

- **BP** – British Petroleum
- **GDP** – Gross Domestic Product
- **LPG** – Liquid Petroleum Gas
- **OTEC** – Ocean Thermal Energy Conversion
- **PICs** – Pacific Island Countries
- **SOPAC** – South Pacific Applied Geoscience Commission
- **TEC** – Tuvalu Electricity Corporation
- **TGC** – Tuvalu Gas Company

INTRODUCTION AND BACKGROUND

Tuvalu comprises of nine low-lying atolls which have a total land area of 26 square kilometers dispersed over an exclusive economic zone of about 1.3 million square kilometers. The atolls with a maximum elevation of about 5m lie within the tradewind belt and have a variable rainfall with an average of 3000mm per annum and a mean temperature of 30°C.

Tuvalu, like many neighbouring Pacific Island Countries (PICs) relies on imported petroleum products for its energy source. The Energy Office within the Ministry of Natural Resources, Energy and Environment is responsible for national energy policies, energy conservation and renewable energy implementation. Energy data as one of the necessities in planning Tuvalu's future in energy requirements is vital. However, the absence of well-documented energy data in Tuvalu and the region has put decision making a difficult task.

A national energy database set up by the Forum Secretariat¹ Energy Division² in 1994 had the long-term goal of establishing a regional energy database where energy data from the respective PICs can be stored. The progress in the collection and input of energy data in the region 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, has led the SOPAC Energy Unit to carry out the necessary modifications.

The modification comprises the desegregation of the petroleum sector and the combining of related worksheets into a single workbook. Detailed information on conversion factors, short cuts and assumptions, and classifications of the end-use sectors are provided in Annexes 1, 2 and 3.

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.

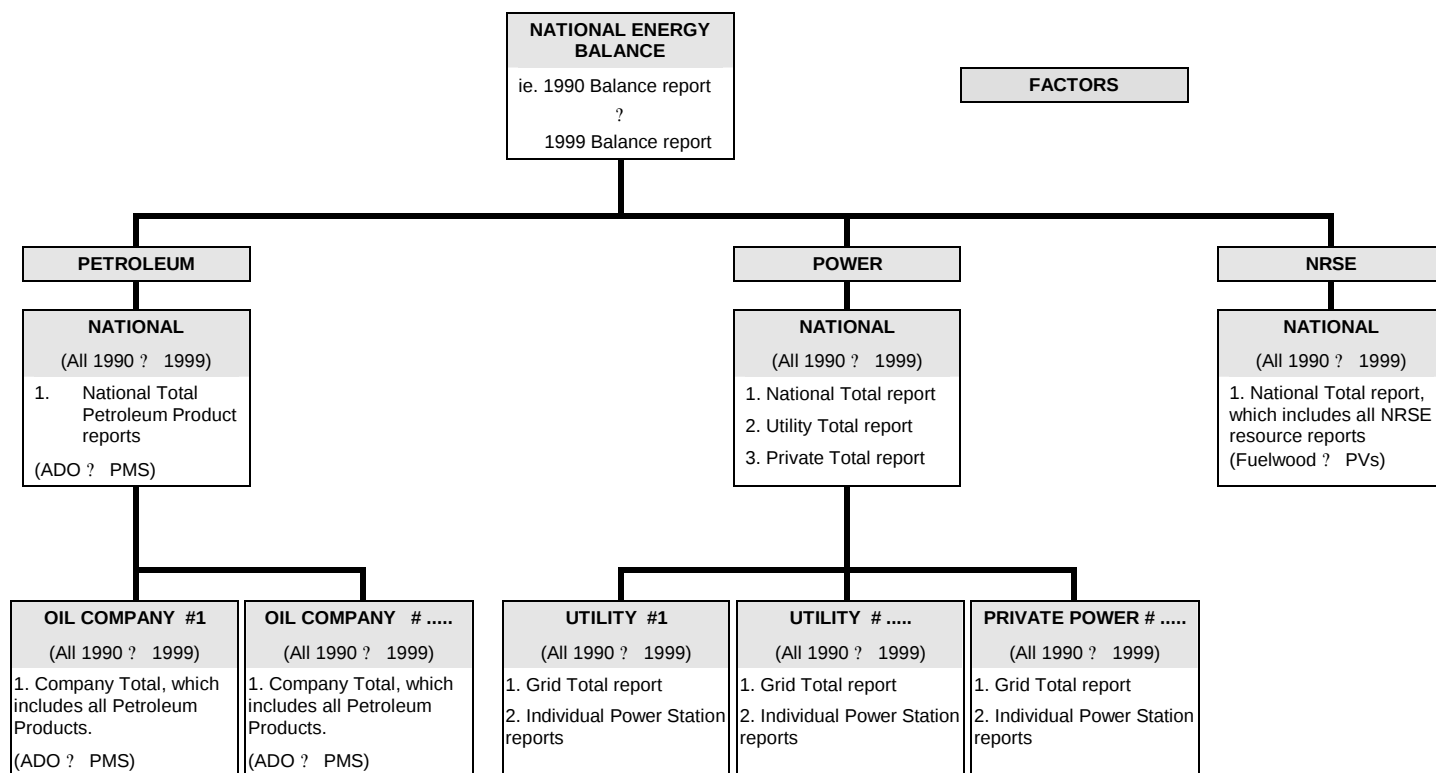
The purpose of this manual/report is to provide the Tuvalu Energy Office with an insight of the energy database and assist in sourcing, collecting and input of energy data.

¹ now known as the Pacific Islands Forum Secretariat

² 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 a schematic of the general layout of the energy database.



Note that the Factors Workbook is not linked to the energy balance. All fields in each of the worksheets, other than those requiring data input, are protected to avoid accidental tempering³, see below.

Petroleum Company Annual Operations - Vanuatu

Company and Depot Location: Mobil, Vanuatu		Petroleum Product: Automotive Diesel Oil (ADO)											
Company Imports, Re-exports, Inter-province Transfers/Receipts, Stock Change, and Sales										Company Own Use and Losses			
Year	Imports (kl)	Re-exports (kl)	Inter-province Receipts (kl)	Inter-province Transfers (kl)	Stock Level at 1 January (kl)	Stock Level at 31 December (kl)	Stock change (kl)	Calculated Sales (kl)	+/- Statistical Discrepancy (kl)	Actual Sales (kl)	Own Use (kl)	Losses (kl)	
1990								0	0	0			
1991					0			0	0	0			
1992					0			0	0	0			
1993					0			0	0	0			
1994					0			0	0	0			
1995					0			0	0	0			
1996					0			0	0	0			
1997					0			0	0	0			
1998					0			0	0	0			
1999					0			0	0	0			

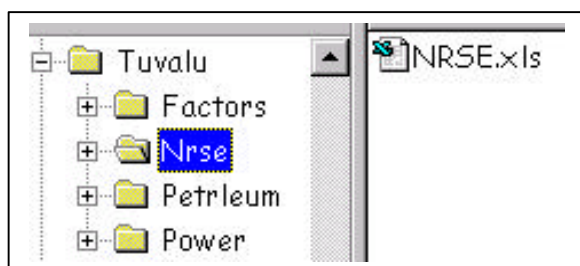
Protected cells (indicated by orange arrows pointing to cells containing 0 or blank values in the Stock Level, Stock change, Calculated Sales, +/- Statistical Discrepancy, and Actual Sales columns).

These cells are not protected – requires data input (indicated by blue arrows pointing to cells in the Imports, Re-exports, Inter-province Receipts, Inter-province Transfers, and Stock Level at 1 January columns).

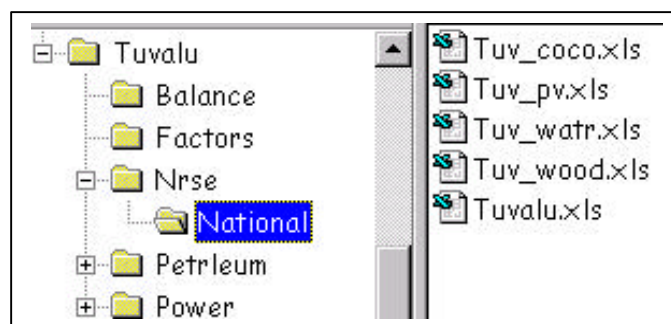
Worksheet showing unprotected and protected cells

³ 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 modified structure has basically incorporated all individual worksheets into single workbooks.



Modified version



Old version

The above diagrams illustrate the basic difference in the two versions of the database. The individual worksheets (Tuv_coco.xls, Tuv_pv.xls, Tuv_watr.xls, Tuv_wood.xls and Tuvalu.xls) have been incorporated into a single workbook, NRSE.xls, as in the modified version. The same has been done for petroleum and the energy balance.

THE ENERGY DATABASE DIRECTORIES AND DATA REQUIREMENTS

The energy database consists of the directories: Factors, New and Renewables, Petroleum, and Power. Their contents and data requirements are summarized below. The data provided by oil companies and other 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 details Tuvalu's Economic/Demographic Indicators and Current Retail Energy Prices with the following data requirement.

Economic/Demographic Indicators

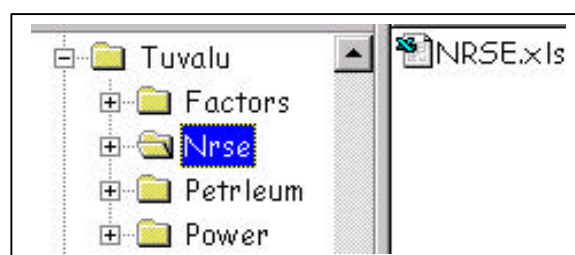
- ?? GDP values (current prices, constant prices, per capita and by sector);
- ?? value of total imports/exports;
- ?? exchange rate;
- ?? population;
- ?? number of households, etc.

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 Sources of Energy (NRSE)

The New and Renewables workbook (Nrse.xls, Figure on the right) consists of five worksheets, Tot NRSE, Water (solar water heater), PV (photovoltaics), Wood (fuelwood & woodwaste) and Coco (coconut wood & residue). The Tot NRSE worksheet summarizes the total consumption by the respective end-use sectors.



The New and Renewables workbook

The calculations in the Tot NRSE worksheet (see Figure below) is based on the input of indicative values such as the number of operating PV modules and solar hot water systems; average area⁴ per module/collector (m²); average system efficiency⁵ (%); insolation rate⁶ (MJ/m²/day); number of households (urban & rural); and average consumption rate of biomass per household in their respective worksheets.

</

The Tot NRSE worksheet of the NRSE workbook

The consumption of fuelwood & woodwaste and coconut wood & residue in the residential sector can be calculated using the figures in the Table below.

⁴ typical collector areas: SHW = 2.98 m² (180 litre system) & 3.98 m² (300 litre system); PV modules ? 2 m²

⁵ average efficiency values: SHW = 20% - 30%; PV = 10% - 15%

⁶ Funafuti = 18.3 MJ/m²/day; latitude 8°S

Biomass consumption rates in Tuvalu

Location	Residential consumption environment	Biomass Consumption per Household per Year (lbs/HH/yr)	Biomass Consumption per Household per Year (kgs/HH/yr)	% of Fuelwood vs % of Coconut residue (%)	Methodology
Tuvalu - urban	Atoll environment, urban population, with 90% of households consuming biomass	6393 (2.43 lb/person/day)	2900 (= 1.1kg/person/day)	20%/80%	Funafuti Household Energy Survey, May 1987
Tuvalu - rural	Atoll environment, rural population, with 100% of households consuming biomass	10582 (=4.41 lb/person/day)	4800 (= 2.0kg/person/day)	20%/80%	Vaitupu Household Energy Survey, March 1986

Source: Manual for the National Energy Supply/Demand Database

Sample calculations

Fuelwood consumption rate (20% of average biomass consumption rate)

Urban: $0.20 \times 2900 \text{ kg/hh/yr} = 580 \text{ kg/hh/yr}$

Rural: $0.20 \times 4800 \text{ kg/hh/yr} = 960 \text{ kg/hh/yr}$

Coconut residue consumption (80% of average biomass consumption rate)

Urban: $0.80 \times 2900 \text{ kg/hh/yr} = 2320 \text{ kg/hh/yr}$

Rural: $0.80 \times 4800 \text{ kg/hh/yr} = 3840 \text{ kg/hh/yr}$

Therefore the average fuelwood consumption per household is 580 kg/hh/yr (urban) and 960 kg/hh/yr (rural), and coconut residue consumption as 2320 kg/hh/yr (urban) and 3840 kg/hh/yr (rural). The Figure below is a general layout at the end-use sector of the residential section in the NRSE workbook.

23	Consumption by End-use Sectors (continued)									
24	Year	Consumption by End-use Sectors (continued)								
25	Residential									
26	Urban Residential				Rural Residential				Total Residential	
27	ave. consumed	no. of urban	total urban consumption		ave. consumed	no. of rural	total rural consumption		Consumption	
28	per household	households			per household	households				
29	(kg/house/yr)		(t/c)	(GJ)	(kg/house/yr)		(t/c)	(GJ)	(t/c)	(GJ)
30	1930		0	0			0	0	0	0
31	1931		0	0			0	0	0	0
32	1932		0	0			0	0	0	0
33	1933		0	0			0	0	0	0
34	1934		0	0			0	0	0	0
35	1935		0	0			0	0	0	0
36	1936		0	0			0	0	0	0
37	1937		0	0			0	0	0	0
38	1938		0	0			0	0	0	0
39	1939		0	0			0	0	0	0
40	NOTE: Production = Total Consumption. For the purpose of this table, 'Production' = the aggregate of 'Consumption by End-use Sectors'.									
41	Manufacturing = includes the processing and manufacture of coconut/palm oils, sawn timber, etc.									

◀ ▶ 🔍 Tot NRSE Bagse Water PV Wood Coco ▶▶

The end-use section of the Residential sector in the fuelwood & woodwaste worksheet

As for coconut wood & residue consumption used in drying copra, the following assumptions are made.

When not sun dried, the copra industry generally burns the coconut residue (shell and husks) to heat and dry the copra. Based on tonnes of copra produced by heated air drying method, you may wish to use the following equations:

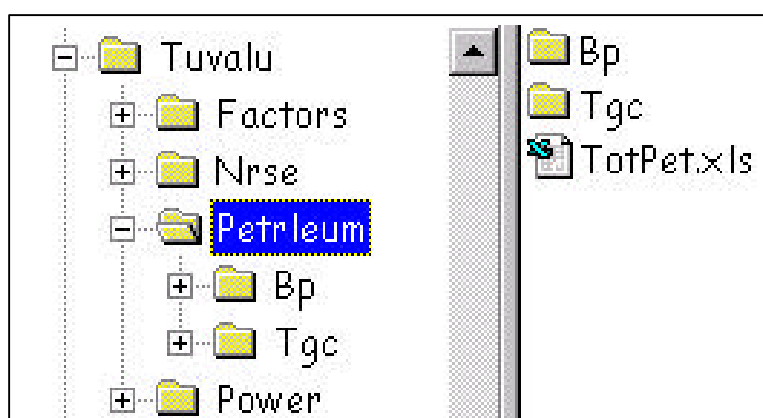
- ? 2.5 tonnes (or 2.8 American ton) coconut residue consumed / 1 tonne (or 1.1 American ton) copra produced using traditional “smoke driers”; or
- ? 1.25 tonnes (or 1.38 American ton) coconut residue consumed / 1 tonne (or 1.1 American ton) copra produced using “hot-air driers”.

Petroleum

All petroleum products are imported and marketed by BP and Tuvalu Gas Company (TGC), which handles all the LPG (liquefied petroleum gas).

The petroleum sector of the energy database comprises the workbooks: BP, TGC and TotPet, see Figure on the right.

Each worksheet (or product sheet) of a workbook in the petroleum sector has two sections.



The petroleum sector of the energy database

The first being the supply side detailing imports, stock levels, and actual sales and the second section is the consumption by the end use sectors, see Figure below.

Tuvalu Annual Petroleum Supply and Demand											
Location: Tuvalu											
Petroleum Product: Automotive Diesel Oil (ADO)											
Region Imports, Re-exports, Stock Change, and Sales								Suppliers' Own Use and Losses			
Year	Imports	Re-exports	Stock Level			Calculated Sales	+/- Statistical Discrepancy	Actual Sales	Suppliers' Own Use and Losses		
	(kl)	(kl)	at 1 January	at 31 December	= Stock change	(kl)	(kl)	(kl)	Own Use	Losses	
			(kl)	(kl)	(kl)				(kl)	(kl)	
1990	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0	0
NOTE: Stock Change = Decrease/increase in stock level at year end due to stock drawdown/stock build respectively. NOTE that 'Stock Level' at 1 January must be equal to 31 December in the year before. Calculated Sales = Imports - re-exports - stock build + stock drawdown. NOTE that 'Calculated Sales' INCLUDES oil suppliers' depot use (vehicle fuel) and losses (spillage and evaporative loss). Actual Sales = The booked Sales figure (INCLUDING the oil supplier's own use and losses). Any difference between the 'Actual Sales' and the 'Calculated Sales' is the 'Statistical Discrepancy'.											
Region Sales and Consumption by End-use Sectors											
Year	Actual Sales = Consumption	Consumption by End-use Sectors									
		Agriculture, Forestry and Fishing	Mining and Quarrying	Manufacturing	Electricity Generation*	Water Supply	Construction	Wholesale/ Retail Trade and Recreation	Transport and Communication		
	(kl)	(kl)	(kl)	(kl)	(kl)	(kl)	(kl)	(kl)	Rail	Road	Sea
1990	0										
1991	0										
1992	0										
1993	0										
1994	0										
1995	0										
1996	0										
1997	0										
1998	0										
1999	0										
NOTE: Actual Sales = Total Consumption. The aggregate of 'Consumption by End-use Sectors' MUST BE EQUAL to 'Actual Sales' as shown in above tables; otherwise an 'ERROR' message will show. Total Consumption includes oil suppliers' depot use and losses. Include own use under 'Road Transport' and losses under 'Wholesale/Retail Trade and Recreation'. * ADO shown here as consumed for 'Electricity Generation' MUST CLOSELY APPROXIMATE that amount shown in the 'POWER' Tables.											
▶ ▶ Tot Pds TUV ADO / TUV AVGS / TUV DPK / TUV LPG / TUV MOGS / ◀ ◀											

A product sheet in an oil company workbook

The Totpet.xls workbook summarises the petroleum sector of Tuvalu. The calculations in the supply side of this workbook is based on the input of import figures for petroleum products; re-export figures - if any, stock levels at 1st January and 31st December for each year; and actual sales figures in the individual product sheets of each oil company.

The demand side (or end-use sector) data is difficult to source in any comprehensive and accurate form as it involves a wide range of energy consumers. In the absence of a comprehensive demand side data, assumptions are usually based on the supply industries' sales information. This is an adequate substitute for actual consumption.

The demand side data is critical to understand Tuvalu's energy sector for policy purposes and for forecasting its future needs and the implications for energy infrastructure developments.

Data input in the end-use sectors of petroleum product reports has to be re-entered in the next level above as the data provided by the oil companies (if any) will not be able to provide information on their re-sellers sales.

Company Sales to Resellers and End-users											
Year	Actual Sales	Sales to Resellers	Sales to End-users [Note: this is only a guide to actual end-use consumption]								
			Agriculture, Forestry and Fishing	Mining and Quarrying	Manufacturing	Electricity Generation	Water Supply	Construction	Wholesale/ Retail Trade and Recreation	Transport and Communication	
	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)
1990	0										
1991	0										
1992	0										
1993	0										
1994	0										
1995	0										
1996	0										
1997	0										
1998	0										
1999	0										

NOTE: Actual Sales = 'Sales to Resellers' plus 'Sales to End-users'. If not equal, then 'ERROR' message will show. Include the oil suppliers' depot use (under 'Road Transport') and losses (under 'Wholesale/Retail Trade and Recreation'). *ADD shown here as consumed for 'Electricity Generation' MUST CLOSELY APPROXIMATE that amount shown in the 'POWER' Tables.

Tot Pdt's BP ADD BP AVGS BP DPK BP MOGS BP SOLVS BP LUB

The end-use sector of a product sheet in an oil company workbook

It is notable that the end-use sector in the Totpet workbook in the petroleum sector has no column for sales to re-sellers.

National Sales and Consumption by End-use Sectors											
Year	Actual Sales	Total Consumption	Consumption by End-use Sectors								
			Agriculture, Forestry and Fishing	Mining and Quarrying	Manufacturing	Electricity Generation	Water Supply	Construction	Wholesale/ Retail Trade and Recreation	Transport and Communication	
	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)	(kt)
1990	0										
1991	0										
1992	0										
1993	0										
1994	0										
1995	0										
1996	0										
1997	0										
1998	0										
1999	0										

National Sales and Consumption by End-use Sectors (continued)

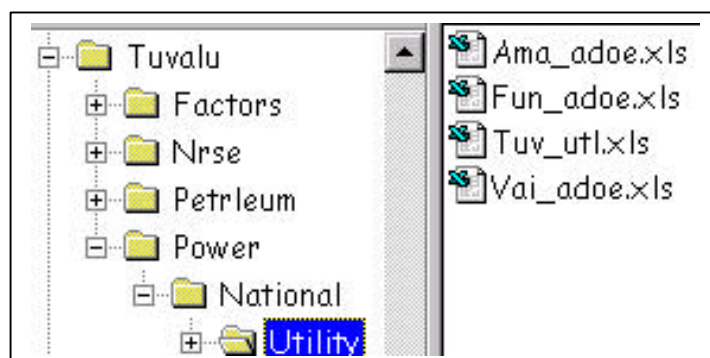
Year	Transport and Communication	Community and Social Services	Residential
	(kt)	(kt)	(kt)
1990			
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999			

NOTE: Actual Sales = Total Consumption = the aggregate of 'Consumption by End-use Sectors'. If not equal, then an 'ERROR' message will show. Include the oil companies use under 'Road Transport'.

The end-use sector of a product sheet in the Totpet workbook

Power

The power system in Tuvalu is operated by the Tuvalu Electricity Corporation (TEC). The power sector in the energy database is segregated into islands Amatuku, Funafuti and Vaitupu, with each island having their own generator operated by TEC. Tuv_utl.xls is an overview of the power sector of Tuvalu.



The power sector

The basic power sector worksheet has 3 sections:

- (i) System generation operation, fuel/lubricant usage and station generation indicators, see Figure below;

Tuvalu Power System Annual Operation (Utility)

Utility: Tuvalu Electricity Corporation
System name: Tuvalu System

System Generation Operation and Fuel/Lubricant Usage

Summary of Thermal/ADO/Reciprocating Engine Generation

Year	Capacity		Generation			Fuel and Lubricant Usage			
	Installed Capacity	Derated Capacity	Gross Generation	Station Own Use and Losses	Net Generation Sent Out	Automotive Diesel Oil (ADO) (reciprocating engine)		Fuel Use Efficiency	Lubricant Oil
	(kW)	(kW)	(MWh)	(MWh)	(MWh)	(kl)	(GJ)	(%)	(kl)
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00
1993	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00
1995	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00
1996	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00
1997	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00
1998	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00
1999	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!	0.00

Year	Generation Indicators	
	Average Station Capacity Factor	Maximum Generation Demand
	(%)	(kW)
1990	#DIV/0!	0.00
1991	#DIV/0!	0.00
1992	#DIV/0!	0.00
1993	#DIV/0!	0.00
1994	#DIV/0!	0.00
1995	#DIV/0!	0.00
1996	#DIV/0!	0.00
1997	#DIV/0!	0.00
1998	#DIV/0!	0.00
1999	#DIV/0!	0.00

NOTE:

Sole Generator = Power station that produces electricity only, as opposed to a Co-generation power station that produces both electricity and process heat.

Co-generator = Power station that produces both electricity and process heat for consumption by its associated industry (such as a saw mill or water distillation plant), and possibly for input to the grid.

Power Station Type = Either Hydro(run-of-river, or storage) or Thermal/Fuel(reciprocating engine, gas turbine, or boiler).

Installed Capacity = Sum of the 'Installed Capacity' of the power stations within the System.

Derated Capacity = Sum of the 'Derated Capacity' (if applicable) of the power stations within the System.

Station Own Use and Losses = Sum of the 'Station Own Use and Losses' of the power stations within the System.

Net Generation Sent Out = 'Gross Generation' minus 'Station Own Use and Losses'.

Fuel Use Efficiency = The energy equivalent of the 'Gross Generation' (plus the 'Process Heat Produced', if applicable) divided by the energy equivalent of the total fuel input, expressed as a percentage.

Average Station Capacity Factor = Ratio of the System's power station's 'Gross Generation' to their potential generation had their generator unit been operated at their maximum (derated) capacity for 365 days x 24 hours.

▶▶ TFC Tuvalu
◀◀

- (ii) Bulk purchases/sales, transmission & distribution losses, and operational indicators, as shown below; and

Bulk Purchases/Sales, Losses, Sales to End-use Sectors, and Operational Indicators											
Year	Net Generation Sent Out	Bulk Purchases/Sales ^[a]			Transmission/Distribution				Operational Indicators		
		Purchased from	Sold to	Total Power into System	Transmission Losses	Distribution Losses	Pilferage and Unmetered Sales to end-use Sectors (estimate)	Sales to	Maximum System Demand	System Load Factor	Total System Own Use and Losses
	(MWh)	(MWh)	(MWh)	(MWh)	(MWh)	(MWh)	(MWh)	(MWh)	(kW)	(%)	(MWh)
1990	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
1991	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
1992	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
1993	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
1994	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
1995	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
1996	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
1997	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
1998	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
1999	0.00			0.00				0.00	#DIV/0!	0.00	#DIV/0!
NOTE: ^[a] Total 'Purchased' and 'Sold' of electricity by 'UTILITIES' from/to the Private Self Generators MUST BE EQUAL to that shown in the 'PRIVATE SELF GENERATORS' Tables.											

**Tuvalu 1990 Energy Balance
(Terajoules)**

	Black Coal	Bagasse, Coconut & Palm Residue	Coconut Fuelwood & Wood Biomass & ORFs	Crode CADO	AVGAS	DPK	FO	IDO	LPG	MOGAS	Solvents, Lubricants & Bitumens	Natural Gas	Hydro- Electric	Geo- Electric thermal	Electric Solar	Co- generated Heat	TOTAL
ENERGY PRODUCTION AND SUPPLY																	
Indigenous Production		0.0	0.0	0.0												0.0	0.0
Imports					0.0	0.0	0.0		0.0	0.0	0.0	0.0					0.0
Re-exports					0.0	0.0	0.0		0.0	0.0	0.0	0.0					0.0
Stock Changes					0.0	0.0	0.0		0.0	0.0	0.0	0.0					0.0
Statistical Discrepancy					0.0	0.0	0.0		0.0	0.0	0.0	0.0					0.0
= TOTAL ENERGY SUPPLY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONVERSION SECTOR																	
Petroleum Refining												0.0					0.0
Electricity Generation				0.0								0.0			0.0		0.0
Co-generation Industries				0.0								0.0			0.0		0.0
Own Fuel Use & Losses				0.0								0.0			0.0		0.0
= NET OR FINAL ENERGY SUPPLY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
END-USE SECTOR CONSUMPTION																	
Agriculture, Forestry & Fishing		0.0	0.0	0.0							0.0				0.0		0.0
Mining & Quarrying				0.0								0.0			0.0		0.0
Manufacturing			0.0	0.0	0.0				0.0			0.0			0.0		0.0
Road Transport				0.0							0.0				0.0		0.0
Rail Transport				0.0								0.0			0.0		0.0
Air Transport				0.0			0.0	0.0				0.0			0.0		0.0
Sea Transport				0.0								0.0			0.0		0.0
Water Supply				0.0											0.0		0.0
Commercial Sectors				0.0	0.0	0.0	0.0		0.0	0.0				0.0	0.0	0.0	0.0
Community & Social Services			0.0	0.0			0.0		0.0					0.0	0.0	0.0	0.0
Residential			0.0	0.0			0.0		0.0					0.0	0.0	0.0	0.0
Solvents, Lubricants & Bitumens											0.0	0.0					0.0
= FINAL ENERGY CONSUMPTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(A) If 'Stocks' have decreased (shown as a negative) then they have been made available for consumption and consequently add to the 'Total Energy Supply'. An increase in the 'Stocks' level (shown as a positive) represents the energy lost in the conversion of fuels into electricity in the thermal electricity generation process. Conversion losses are of the order of 10% of the fuel.

(B) 'Total Energy' for 'Electricity Generation' represents the energy lost in the conversion of fuels into electricity in the thermal electricity generation process. Conversion losses are of the order of 10% of the fuel.

(C) 'Co-generation Industries' convert input fuels to both electricity and process heat. The conversion process is shown in the 'Conversion Sector', while final consumption of the electricity and process heat is shown in the 'End-Use Sectors'.

(D) 'Own Fuel Use and Losses' is the sum of power stations' and petroleum refineries' own use, plus the losses involved in power transmission and distribution.

(E) After generation, 'Hydro-electricity' and 'Geothermal Electricity' combine with 'Electricity' generated in thermal power stations to become part of the general electricity supply. 'Indigenous Production' of 'Hydro-Electricity' is a measure of the electricity generated from these energy sources.

Energy Balance

ANNEXES

ANNEX 1 CONVERSION FACTORS

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).

Annex 1

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.

<u>Length</u>	<u>Area</u>
1 inch	1 square inch
= 25.4 millimetres (mm)	= 645.16 square millimetres (mm ²)
1 foot	1 square foot
= 12 inches (")	= 0.0929030 square metres (m ²)
= 0.333333 yard	1 square yard
= 0.3048 metre (m)	= 9 square feet
1 yard	= 0.836127 square metres (m ²)
= 36 inches (")	1 square metre
= 3 feet (')	= 10.7639 square feet (squ.ft)
= 0.9144 metre (m)	= 1.19599 square yards
1 metre	1 acre
= 39.3701 inches (")	= 4,840 square yards
= 3.28084 feet (')	= 4,046.86 square metres (m ²)
= 1.09361 yards	= 0.404686 hectares
= 0.001 kilometre (km)	1 hectare
1 kilometre	= 10,000 square metres (m ²)
= 1,000 metres (m)	= 2.47105 acres
= 0.621371 mile	= 0.01 square kilometres (km ²)
1 mile	1 square kilometre
= 1,760 yards	= 100 hectares
= 1.60934 kilometres (km)	= 0.386102 square miles
1 international nautical mile	1 square mile
= 1.85318 kilometres (km)	= 640 acres
= 1.15088 miles	= 258.999 hectares
	= 2.58999 square kilometres (km ²)

Volume

Annex 1

1 cubic inch	= 158.757 litres (l)
= 16.3871 cubic centimetres (cm ³)	= 42 American gallons
	= 34.9725 Imperial gallons
1 pint	= 5.60645 cubic feet (cu')
= 0.568261 cubic decimetres (dm ³)	= 0.158757 cubic metres (m ³)
1 litre (l)	1 cubic metre
= 61.0238 cubic inches (cu")	= 1,000 litres (l)
= 1.75975 pints	= 264.170 American gallons
= 1 cubic decimetre (dm ³)	= 219.969 Imperial gallons
= 0.264170 American gallons	= 6.29894 American barrels (bbl)
= 0.219969 Imperial gallons	= 35.3147 cubic feet (cu ft)
= 0.0353147 cubic feet (cu ft)	
1 hectolitre	1 kilolitre (kl)
= 100 litres	= 1,000 litres (l)
	= 6.29894 American barrels (bbl)
1 American gallon	1 gross ton (shipping)
= 231 cubic inches (cu")	= 2.83168 cubic metres or 100 cubic feet
= 3.78544 litres (l)	of permanently enclosed space
= 0.832679 Imperial gallons	
= 0.133681 cubic feet (cu ft)	<u>Mass</u>
= 0.0238095 American barrels (bbl)	
= 0.00378544 cubic metres (m ³)	1 ounce (ozs)
	= 28.3495 grams (g)
1 Imperial gallon	1 pound
= 277.42 cubic inches (cu")	= 0.453592 kilograms (kg)
= 4.54609 litres (l)	= 0.00892857 hundredweight
= 1.20094 American gallons	
= 0.160544 cubic feet (cu ft)	1 kilogram (kg)
= 0.0286355 American barrels (bbl)	= 2.20462 pounds (lbs)
= 0.00454609 cubic metres (m ³)	= 0.001 tonne (te)
1 cubic foot (cu ft)	1 hundredweight
= 28.3168 litres (l)	= 112 pounds (lbs)
= 7.48047 American gallons	= 50.8023 kilograms (kg)
= 6.22884 Imperial gallons	
= 0.178366 American barrels (bbl)	1 American (short) ton
= 0.0283168 cubic metres (m ³)	= 2,000 pounds (lbs)
1 American barrel (bbl)	
= 9,687.95 cubic inches (cu")	

Annex 1

= 0.892857 long tons

= 0.907185 tonnes (te)

1 Imperial (long) ton

= 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 Agroindustries + 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.

Annex 2

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.

Annex 2

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	

Annex 2

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	

Annex 2

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	

Annex 2

New and Renewable Sources of Energy (NRSE)

Fuel	End-Use Sectors	Relevant for you?
------	-----------------	-------------------

Bagasse (sugar cane residue)	Electricity Generation (co-gen.)	
-------------------------------------	----------------------------------	--

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.)	
--------------------------	----------------------------------	--

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?
------	-----------------	-------------------

Black Coal (export thermal)	Manufacturing - all subsectors	
------------------------------------	--------------------------------	--

Annex 2

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

Annex 3

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

Annex 3

Division Sub-division Group Sub-group

E (3500)	3510		Construction	Building construction, repair and demolition
	3520			Other construction
F (4000)	4100		Wholesale/Retail Trade and Restaurants/Hotels	Wholesale trade
	4200			Retail trade
	4300			Restaurants/bars and hotels/lodging
		4310		Restaurants, cafes, bars and clubs
		4320		Hotels, resorts and lodging
G (5000)	5100		Transport, Storage and Communication	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)	7100		Community, Social and Personal Services	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

Annex 3

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 MAP OF TUVALU

