

**TA 7798-REG: Promoting Energy Efficiency in the Pacific (Phase 2)**

# **Urban Household Appliance & Energy Use Survey: Port Vila & Luganville, Vanuatu (2013)**

## **Volume 1: Main Report (Final Report; 20 March 2014)**

*Prepared for*

**THE GOVERNMENT OF VANUATU  
PORT VILA, VANUATU**

and

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\* Annex 3 is a huge spreadsheet with nearly 470 columns for data entry. It is not attached as it would be unreadable on A4 (or larger) paper. It is available as a separate xlsx file.

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## **CONTENTS OF VOLUME 2: TRAINING MATERIALS (SEPARATE VOLUME)**

Volume 2 (April 2013) consists of the following training materials in a separate volume, mainly in the form of PowerPoint® presentations:

1) Training Workshop Agenda	2 pages
2) Introduction to Main Components of the Survey Cycle	24 slides
3) Background, Objectives and Key Deliverables	12 slides
4) Vanuatu Questionnaire Design & General Survey Pointers	16 slides
5) Detailed Walk-through of Vanuatu Survey Questionnaire	131 slides

**To obtain this report:**

Electronic versions of this report (volume 1, volume 2 with extensive annexes available as separate documents) can be obtained from:

The Director of Energy, Department of Energy  
Ministry of Climate Change Adaptation, Meteorology, Geo-Hazards, Environment & Energy  
Government of Vanuatu

There may also be limited numbers of printed copies available.

## ACKNOWLEDGMENTS

This survey was carried out by the Asian Development Bank's *Promoting Energy Efficiency in the Pacific*, phase 2 (ADB PEEP2) project, which is responsible for results, but with considerable support from others.

The UNDP Pacific Centre in Fiji provided several weeks of the time and expertise of Mr Thomas Lynge Jensen, its Environment and Energy Specialist, to modify similar survey materials developed by PEEP2 for Tonga, train the surveyors, and oversee the Port Vila component of the survey. Mr Jensen has carried out a number of household energy surveys in the Pacific, including a small survey in 2010 of randomly selected households in Port Olry, Vanuatu. He made a number of useful comments on an earlier draft and his input has been invaluable.

The Energy Component of the SPC-GIZ regional programme "Coping with Climate Change in the Pacific Island Region" (CCCPIR; 2009-2015) has provided support to the Government of Vanuatu for collection and management of energy sector data. CCCPIR supplemented the US\$25,000 PEEP survey budget with an additional \$6,000 (an extra 24%) enabling the extension of the survey to cover Luganville and improving the statistical relevance of results. CCCPIR's Energy Advisor, Katerina Syngellakis, also commented on drafts of this report.

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There has also been significant support from the Government of Vanuatu and the URA:

- The Department of Meteorology (Meteo) handled the engagement of surveyors, provided the training venue, arranged catering, and managed the analysis of data. Meteo also provided an advance allowing the survey to begin prior to the receipt of initial ADB funding. The key officer at Meteo was Patricia Mawa, who was very supportive and carried out the analysis of raw survey data. The Director of Meteo, Mr Jotham Napat, was also very supportive.
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## ACRONYMS AND ABBREVIATIONS

A/C	air conditioning
ADB	Asian Development Bank
CCCPIR	Coping with Climate Change in the Pacific Islands Region (SPC/GIZ)
CFL	Compact Fluorescent Light
DOE	Department of Energy
ESMAP	Energy Sector Managements Assistance Program of the World Bank & UNDP
FTL	Fluorescent Tube Light
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit, Gmbh (German aid)
GoV	Government of the Republic of Vanuatu
hh	household or households
HIES	Household Income and Expenditure Survey
IIEC	International Institute for Energy Conservation
IL	Incandescent Light
IUCN	International Union for the Conservation of Nature
LED	Light Emitting Diode
MEPs	Minimum Energy Performance Standards
Meteo	Department of Meteorology and Geohazards
PALS	Pacific Appliance Labelling and Standards Programme (of SPC)
PC	personal computer
PDMC	Pacific Developing Member Country of ADB
PEEP2	Promoting Energy Efficiency in the Pacific, phase 2 (ADB/IIEC)
PIC	Pacific Island Country
REEEP	Renewable Energy and Energy Efficiency Partnership
SPC	Secretariat of the Pacific Community
UNDP	United Nations Development Programme
UNELCO	Union Electrique du Vanuatu ,Ltd.
URA	Utilities Regulatory Authority
VNSO	Vanuatu National Statistics Office
VUI	Vanuatu Utilities and Infrastructure, Ltd.

## BACKGROUND MATERIALS USED

ESMAP, 2003	Household Energy Use in Developing Countries – A Multicountry Study
Government of Vanuatu, 2010	2009 National Population and Housing Census: Basic Tables Report Volume 1; Analytical Report Volume 2
Government of Vanuatu, 2012	Vanuatu Household Income and Expenditure Survey 2010: Report
IIEC, 2010	Situation Analysis and Feasibility Study on the Impacts of Introducing an Appliance Labelling Programme in Samoa, Tonga and Vanuatu: Final Study Report. Prepared for REEEP and SPC (October)
IIEC, 2012	Report on Survey Designs. Prepared for ADB/IIEC PEEP2 (November)
IIEC, 2012	Technical Analysis of Appliance Markets to Support the Pacific Appliance Labelling and Standards (PALS) Programme: Main Report. Prepared for REEEP (November)
IIEC, 2012	Technical Analysis of Appliance Markets to Support the Pacific Appliance Labelling and Standards (PALS) Programme: Country Report for Vanuatu. Prepared for REEEP (November)
Jensen, Thomas Lyng, 2010	Port Olry Biofuel Project in Vanuatu -Household Survey Report (September)
Jensen, Thomas Lyng, 2011	Rakahanga Atoll, Cook Islands - Energy Survey Report (March)
PEEP2/ADB, 2013	Status and Preliminary Results: PEEP Urban Household Appliance and Energy Use Surveys, 2013 (Peter Johnston; presented at PALS Project Workshop & Steering Committee Meeting, SPC, Suva, Fiji; 26 August)
PEEP2/ADB, 2013	Urban Household Appliance and Energy Use Survey In Vanuatu: Project Proposal & Budget (by Peter Johnston & Jerry Lapi; Revised: February)
PEEP2/ADB, 2014	Save Money on Your Electricity Bill: A Guide for Residential Consumers in Vanuatu
UNELCO, 2013	Data for Consumer Categories (from Annual Technical Report for 2012)
URA, 2010	Luganville Electricity Tariff Setting: Final Determination (Stage 1; August)
URA, 2014	Preliminary Decision and Notice of Request for Comments and Public Consultation in the matter of the Application from VUI Ltd. for a tariff decrease for electricity services in Luganville (Case U-0001-14; January)
VUI, 2013	2012 Annual Performance Report for Luganville Concession by Vanuatu Utilities and Infrastructure, Ltd. (draft)

## EXECUTIVE SUMMARY

In late March and early April 2013, surveys of appliance and electricity use were carried out in electrified urban households (hh) in Port Vila (1,115 households visited and 1,109 surveyed) and Luganville (352 visited and 329 surveyed). This constitutes a sample size of over 10% of electrified households, chosen by the Vanuatu National Statistics Office as statistically representative. 48 people were trained and then employed as enumerators for Port Vila and 18 for Luganville.

The survey objectives were to reduce data gaps regarding residential energy use in electrified urban households, and use the information to develop initiatives to assist households reduce electrical energy use without compromising the quality of services. After the survey field work was completed, results were used to develop energy efficient residential lighting projects for both urban centres.

Electrical energy consumption for all electrified households in Port Vila and Luganville based on the survey findings is summarised in Table 1 below.

**Table 1: Summary of Estimated Electricity Use in Port Vila and Luganville**  
(All Electrified Households)

Electricity Use	Port Vila (8,910 electrified hh)		Luganville (2,010 electrified hh)	
	Energy (GWh)	Percent of Total	Energy (GWh)	Percent of Total
Lighting	2.14	20%	0.58	27%
Freezers / refrigerators	2.05	19%	0.35	16%
Fans & air conditioning **	2.35	21%	0.50	23%
Electric cooking	1.0	9%	0.14	7%
TVs & PCs	1.43	13%	0.31	15%
Other small appliances	2.0	18%	0.25	12%
Total based on survey *	11	100%	2.1	100%
Total based on utility sales *	15		2.2	

\* Totals rounded off      \*\* Nearly all of this (95%) is used for cooling fans

Assuming that the surveyed households are representative of urban electricity use overall, some findings are summarised below.

### Port Vila

- **Lighting.** On average, there were 4.5 lights per household, of which 46% were Compact Fluorescent Lights (CFL), 39% were linear Fluorescent Tube Lights (FTL) and 12% were Incandescent Lights (ILs). Many CFLs are low-quality lights likely to have a limited lifetime. 70% of the FTLs are the old fat T12 type, which are inefficient and are suitable for cost-effective replacement, especially where used outdoors for night-time security lighting. All incandescent lights would also be suitable for replacement with good quality CFLs or FTLs.
- **Refrigeration.** 43% of hhs have refrigerators but these account for only 19% of electricity use. Very few have energy efficiency labels. About a fifth of refrigerators and freezers have leaking or poorly fitting door seals. Replacing these should result in considerably less electricity use for cooling food and drinks.
- **Fans & air-conditioning (A/C).** There are few residential A/C but over 20% of electricity appears to be for cooling fans. Many are inefficient models but there is not enough information to judge savings potential from newer models.

- Cooking is dominated by wood-burning (87% of households of which over 60% report using wood over half of the time) and to a lesser extent liquid petroleum gas (LPG). About 60% of electric cooking is on electric stoves, which are a very costly cooking source.
- TVs/computers. About 80% of households have at least one TV set, most of which (80%) are older inefficient tube-type. Less than 20% have flat-screens, which are considerably more energy-efficient for the same size screen size. A third of households have a personal computer (PC), mostly newer models with a flat screen (whether desktop or laptop). Half of TVs & 60% of computers are always plugged in, which can waste electricity (even with the appliances turned off) unless the outlets are switched off.
- Other small appliances. 92% of households have mobile phones (3.6 per household), 60% have hair straighteners and about 30% have electric kettles and rice cookers. There are many other small appliances in a small percentage of households.

### **Luganville**

Households use less electricity than those in Port Vila but usage patterns are broadly similar:

- Lighting . On average, there are 4.3 lights per household, 47% of which are CFLs, 41% are FTLs, and 11% are incandescent lights. 61% of FTLs in the surveyed households are the old, inefficient T12s. As in Port Vila, these are suitable for cost-effective replacement.
- Refrigeration. 28% of hhs reportedly have refrigerators (compared to 43% in Port Vila). Very few have energy efficiency labels. As in Port Vila, about a fifth of refrigerators have leaking or poorly fitting door seals, which should be replaced to improve energy efficiency.
- Fans & air-conditioning (A/C). There are few residential A/C, but nearly 23% of electricity appears to be for cooling fans. As in Port Vila, many are inefficient but there is not enough information to judge savings potential from newer models.
- Cooking. 76% of hhs cook with wood, over 71% of whom report using wood over half of the time. LPG is used by nearly half of hhs. Electric stoves are used by only 14% of hhs. About 45% of electric cooking is probably on electric stoves, a very costly cooking source.
- TVs/computers. About 80% of Luganville hhs have at least one TV set, of which 95% reportedly are older inefficient tube-type. 16% of households have a personal computer (PC), mostly (70%) newer models with a flat screen. 27% of TVs & 30% of computers are always plugged in, which can waste electricity.
- Other small appliances. 92% of Luganville hhs reported that they have mobile phones (3.0 per household), 40% have hair straighteners and about 22% have rice cookers. There are many other small appliances in 4-10% of households.

## 1. BACKGROUND AND INTRODUCTION

### 1.1 Background

In September 2008 the ADB approved a regional technical assistance project (RETA) for *Promoting Energy Efficiency in the Pacific (PEEP)*. Undertaken in two phases, the first phase was completed in May 2011 and the second began in January 2012. The objective of phase two (PEEP2) is to implement energy efficiency measures in five ADB Pacific Developing Member Countries (PDMCs: Cook Islands, Papua New Guinea (PNG), Samoa, Tonga and Vanuatu). The International Institute for Energy Conservation (IIEC), Thailand was selected as the Technical Assistance (TA) Consultants for the implementation of this project.

The PEEP2 work-plan for Vanuatu includes support for the development of an energy use database. A major data gap in establishing an energy use/energy efficiency baseline for the residential sector is poor information on the percentage saturation of electrical equipment, appliances and lighting products in households, and their characteristics and energy consumption. Although Household Income and Expenditure Surveys (HIES) were carried out in Vanuatu in 2006 and 2010, these contain little information on electricity use. Therefore PEEP2, in cooperation with the Government of Vanuatu, the UNDP Pacific Centre, and the Energy Component of the SPC/GIZ *Coping with Climate Change in the Pacific Islands Region (CCCPIR)* programme, agreed to undertake a statistically-relevant survey of electrified households in the two urban centres of Vanuatu (Port Vila and Luganville), to provide basic data and to improve planning for a practical and effective energy efficiency (EE) programme.

The methodology used is consistent with: i) the methodology of similar surveys carried out under PEEP2 in Samoa and Tonga in early 2013, and ii) the approach of the Vanuatu National Statistics Office (VNSO) for ensuring statistically representative sample surveys such as for the 2010 *Household Income & Expenditure Survey (HIES)*. The Vanuatu training materials, questionnaire, and analysis are based on the survey format and procedures used in Tonga and Samoa, which were developed by PEEP2 International Consultant for Tonga, Dr Herbert Wade. Some questions were modified or added to address Vanuatu conditions.

Essentially the same methodology has been used for PEEP2 surveys carried out during 2013 in PNG, Samoa, Tonga & Vanuatu and surveys planned by UNDP and SPC for 2014 in Tuvalu and UNDP and IUCN in Nauru. Thus there should be reasonably comparable 2013/2014 household appliance and energy use results for these six PICs.

### 1.2 Introduction

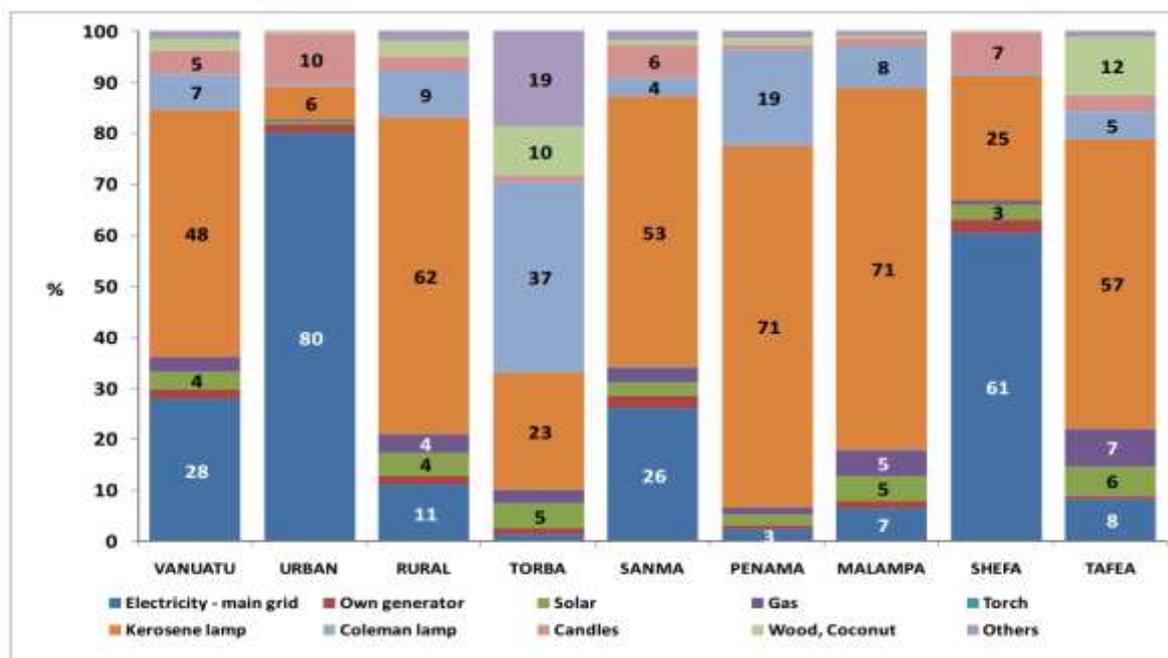
Vanuatu consists of six provinces (Torba, Sanma, Penama, Malampa, Shefa, and Tafea) spread over an ocean area of 612,300 km<sup>2</sup> in the South Pacific with a total land area of 12,281 km<sup>2</sup>, stretching from Hiu Island in the north to Mathew and Hunter Islands in the south. It consists of 83 islands, of which about 63 are permanently inhabited. Port Vila, the capital and largest of two urban centres, is located on the island of Efate (Shefa province) which is the most populous island. The smaller urban centre of Luganville is on Espiritu Santo, Vanuatu's largest island in terms of land area, located in Sanma province. The 2009 census counted a total of 47,373 private households in Vanuatu with 228,883 household members or 4.8 people per household on average (Table 1-1). However, only

28% of all households had access to electricity from the grid (Figure 1-1), 80% of which are urban households. 61% of households had grid-connected electricity in Shefa province (e.g. Port Vila and nearby peri-urban areas) followed by 26% of households in Sanma province (e.g. in and near Luganville). The subsequent 2010 Household Income and Expenditure Survey carried out by VNSO estimated that there were 50,740 households nationally of which 9,760 were in or near Port Vila and 2,700 in or near Luganville.

**Table 1-1: Population and Households by Province (2009)**

Place of residence	Number of people in private households			Number of private household			Average Household size		
	1989	1999	2009	1989	1999	2009	1989	1999	2009
<b>VANUATU</b>	<b>142,419</b>	<b>186,678</b>	<b>228,883</b>	<b>27,167</b>	<b>36,415</b>	<b>47,373</b>	<b>5.2</b>	<b>5.1</b>	<b>4.8</b>
<i>URBAN</i>	25,870	40,094	56,016	4,576	8,258	11,606	5.7	4.9	4.8
<i>RURAL</i>	116,549	146,584	172,867	22,591	28,157	35,767	5.2	5.2	4.8
<b>TORBA</b>	5,985	7,757	9,189	1,074	1,339	1,766	5.6	5.8	5.2
<b>SANMA</b>	25,542	36,084	44,287	4,771	6,970	9,213	5.4	5.2	4.8
<b>PENAMA</b>	22,281	26,646	29,926	4,488	5,371	6,620	5.0	5.0	4.5
<b>MALAMPA</b>	28,174	32,705	36,060	5,721	6,483	7,991	4.9	5.0	4.5
<b>SHEFA</b>	38,023	54,439	77,047	6,713	10,888	15,930	5.7	5.0	4.8
<b>TAFEA</b>	22,414	29,047	32,374	4,400	5,364	5,853	5.1	5.4	5.5

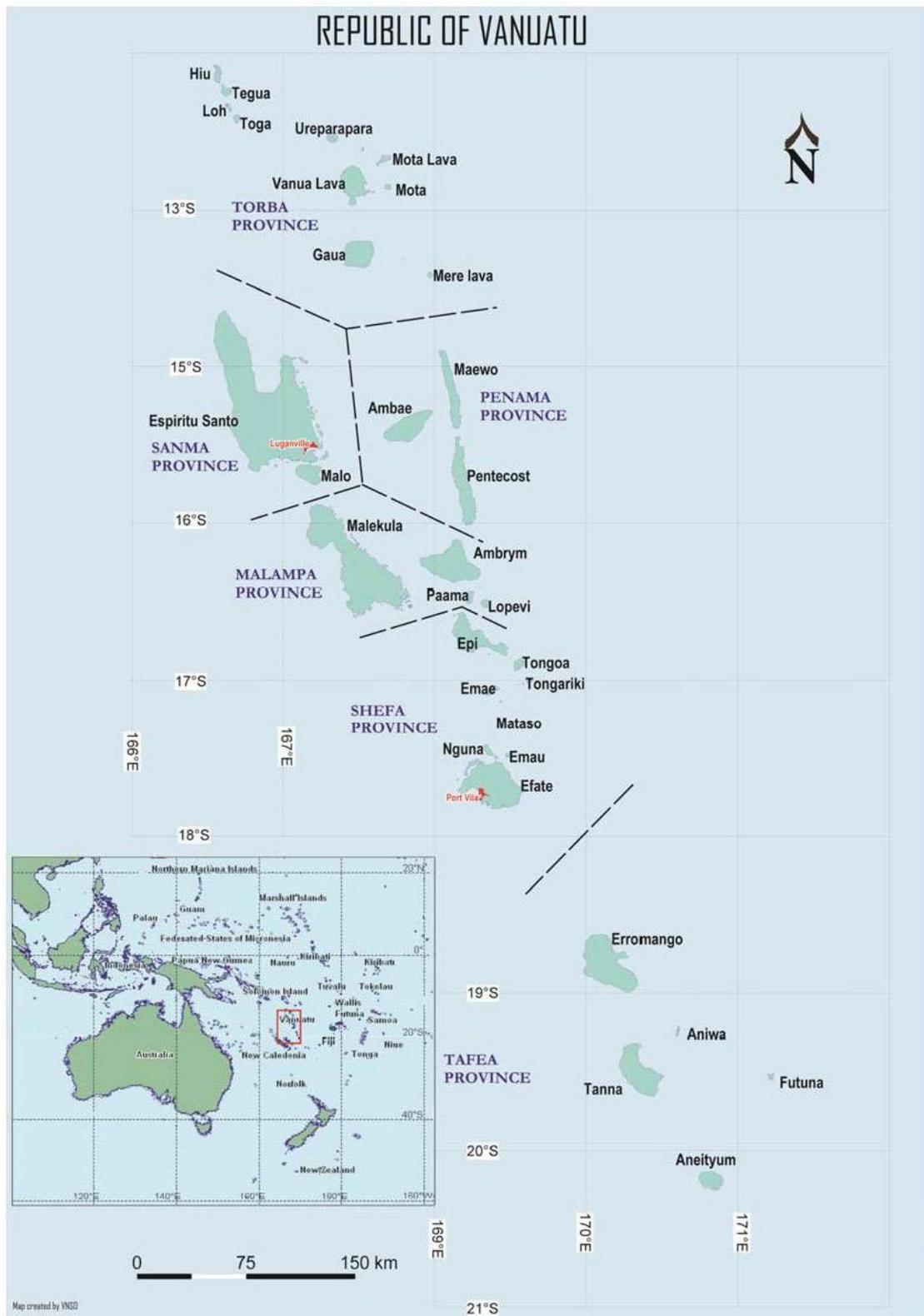
Source: 2009 National Population and Housing Census, Analytical Report, Volume 2 (VNSO)



**Figure 1-1: Main Source of Household Lighting (2009)**

Source: 2009 National Population and Housing Census, Analytical Report, Volume 2 (VNSO)

Figure 1-2 below is a map of Vanuatu showing its location in the Pacific (inset), provincial names and boundaries, and the two main urban centres of Port Vila (Shefa province) and Luganville (Sanma province).



**Figure 1-2: Map of Republic of Vanuatu**  
 Source: 2009 National Population and Housing Census, Volume 1

## 2. INFORMATION ON URBAN HOUSEHOLD ENERGY AND APPLIANCE USE PRIOR TO THE 2013 SURVEY

### 2.1 National Population Census of 2009

The 2009 Vanuatu Population Census Report provides limited information on the ownership of various household items including refrigerators, freezers, TVs, computers, etc. The percentage ownership of some selected appliances among electrified households in Vanuatu is estimated in Table 2-1 below from data in the census report, which is somewhat dated, does not include air conditioners, and does not indicate if refrigerators and freezers are single or separated units. Some reported ownership also seems to be unrealistically high. The age of the major appliances and their size and condition was not indicated nor their country of manufacture and whether they are labelled according to their energy efficiency. There is no indication of the types of electric lighting (or their efficiency) or numbers of lights. Nonetheless, it provides a broad overview of electrical appliance ownership in 2009.

**Table 2-1: Saturation of Household Appliances (2009 Census Report)**

Place of Residence	Estimated Electrified Households <sup>1</sup>	Fridge / Freezer		TV		DVD		Computer	
		No. of Items	%	No. of Items	%	No. of Items	%	No. of Items	%
<b>Vanuatu</b>	13,264	7,670	58%	19,583	148%	19,963	151%	4,979	38%
<i>Urban</i>	9,285	5,090	55%	9,354	101%	9,050	97%	3,458	37%
<i>Rural</i>	3,934	2,580	66%	10,229	260%	10,913	277%	1,521	39%
<b>Torba</b>	35	45	127%	306	866%	342	968%	59	167%
<b>Sanma</b>	2,395	1,179	49%	3,658	153%	3,902	163%	677	28%
<b>Penema</b>	199	230	116%	1,359	684%	1,458	734%	154	78%
<b>Malampa</b>	559	322	58%	2,055	367%	2,313	414%	177	32%
<b>Shefa</b>	9,717	5,657	58%	10,974	113%	10,677	110%	3,700	38%
<b>Tafea</b>	468	237	51%	1,231	263%	1,271	271%	212	45%

Note 1. Estimated based on the total number of households and % of main source of lighting

### 2.2 IIEC Appliance Labelling studies of 2010 and 2012

In 2010, IIEC prepared a study on the impacts (in terms of costs and savings) of introducing an appliance labelling programme in Samoa, Tonga and Vanuatu, based on import data from national Customs authorities. Data were incomplete, and covered imports for only 2007-2009, but (as shown in Table 2-2) suggested an annual market for roughly 1,000 one-two door refrigerators/freezers in Vanuatu, 500-600 chest/upright freezers and 200-300 air conditioners. Table 2-3 on the next page indicates the typical size in litres of cooling appliances purchased in Vanuatu during the same period compared to Samoa and Tonga.

**Table 2-2: Approximate Annual Market for Selected Electrical Appliances**

Type of Appliance	Samoa		Tonga		Vanuatu	
	Annual Market Size (Units)	Brands	Annual Market Size (Units)	Brands	Annual Market Size (Units)	Brands
Refrigerator-Freezer <sup>1</sup>	1,200 – 1,400	Fisher & Paykel, LG, Mitsubishi, Panasonic, Samsung, Sharp, Simpson, Westinghouse	400 - 500	Akita, Fisher & Paykel, LG, Sharp, Simpson, Westinghouse	1000	Panasonic, Sharp, Westinghouse, Whirlpool, Chinese brands
Chest and Up-right Freezer	200 - 250	Akira, Fisher & Paykel, Simpson, Westinghouse	400 - 500	Akira, Fisher & Paykel, Kelvinator (Electrolux) Prema (house brand), Simpson	500-600	Sunyo, Chinese brands
Air-Conditioner <sup>2</sup>	1,000 – 1,500	Akira, Polar Ice, Sharp	500 - 600	Fujitsu, Hitachi, Simmons	200-300	Fujitsu, Panasonic
Clothes Washer	-	Fisher & Paykel, Panasonic, Toshiba	-	Fisher & Paykel, Simmons, Simpson	-	Fisher & Paykel, Chinese brands

Note: 1. 1-door and 2-door top-freezer are the popular types for refrigerator-freezers in Samoa.  
2. Both unitary (window) type and split-type are available in the market.

Source: Table 3.11 of IIEC, 2010

**Table 2-3:  
Typical Volumes (Litres) of Refrigerators & Freezers in Vanuatu, Samoa & Tonga**

Country	Refrigerator-Freezer (1-door) <sup>1</sup>	Refrigerator-Freezer (2-door) <sup>2</sup>	Chest Freezer
Samoa	170 - 220	220 - 500	210 - 700
Tonga	170 - 250	300	170 - 700
Vanuatu	170 - 185	250 - 470	200 - 300

Note: 1. Bar-type fridges are not included.  
2. Most 2-door refrigerator-freezer are of top-freezer models.

Source: Table 3.10 of IIEC, 2010

A number of Pacific Island countries, including Vanuatu, are establishing Minimum Energy Performance Standards (MEPS), which require labelling to indicate the approximate annual electricity use of selected appliances and in some cases impose minimum energy efficiency requirements. These efforts are through the Australian Government-supported SPC Pacific Appliance Labelling and Standards Programme (PALS). Table 2-4 estimates the benefits and costs for Vanuatu consumers of a 10 year MEPS effort for refrigerators, freezers and air conditioners.

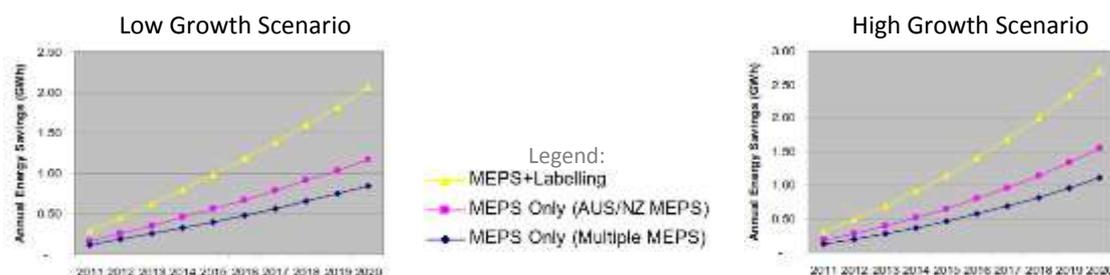
**Table 2-4:  
Approximate Benefits & Costs of Cooling Appliance MEPS & Labelling Programme in Vanuatu**

S&L Implementation Scenario in Vanuatu	Ownership Cost (million Vatu)	Programme Cost (million Vatu)	Programme Benefits (million Vatu)	Benefit/ Cost Ratio
<b>5% Discount Rate</b>				
Business as Usual	4,233			
I. MEPS Only (multiple S&L schemes)	4,108	86	125	<b>1.45</b>
II. MEPS Only (AUS/NZ Scheme)	4,081	99	152	<b>1.55</b>
III. MEPS+Labelling (AUS/NZ Scheme)	4,009	99	224	<b>2.27</b>
<b>10% Discount Rate</b>				
Business as Usual	3,189			
I. MEPS Only (multiple S&L schemes)	3,098	68	91	<b>1.35</b>
II. MEPS Only (AUS/NZ Scheme)	3,079	78	110	<b>1.42</b>
III. MEPS+Labelling (AUS/NZ Scheme)	3,029	78	160	<b>2.07</b>

Source: Executive Summary of IIEC, 2010

Assuming low growth in appliance imports, savings from a national MEPS and labelling effort for cooling appliances, based on Australian/New Zealand standards, would be fairly modest, about 224 million vatu (roughly US\$2.5 m) if costs and benefits are discounted annually at 5%, but considerably more if the economy (and appliance imports) grow more rapidly.

Based on estimated patterns of energy use, the study indicates (Figure 2-1) electricity savings from a MEPS and labelling programme. With a low assumed growth in appliance imports (5%/year), this would reach 3.5 GWh (3.5 million kWh) after a decade, or nearly 5 GWh with high growth (10%) in appliance imports.



**Figure 2-1: Estimated Energy Savings from a Cooling Appliance MEPS Programme**

Source: Figure 5.5, Annex E of IIEC, 2010

Note that the 2010 IIEC study looked at *total* imports of refrigerators, freezers and air conditioners, not those for household use, so potential household savings from new efficient cooling appliances under the same assumptions would be considerably lower.

More recently, IIEC carried out a Technical Analysis of Appliance Markets to Support SPC’s Pacific Appliance Labelling and Standards (PALS) Programme (IIEC, 2012). This provided import values (but not numbers of appliances imported) for a wider range of electrical appliances covering 2007 - 2011. The findings are summarized in Table 2-5 below.

**Table 2-5: Imports of Electrical Appliances to Vanuatu by Value (vatu) from 2007 - 2011**

Electrical Appliance	2007	2008	2009	2010	2011
(Linear) Fluorescent Lighting	8,000,000	10,000,000	8,000,000	11,000,000	7,000,000
Air Conditioners (all sizes)	10,000,000	9,000,000	5,000,000	40,000,000	42,000,000
Domestic Dish Washers	2,000,000	2,000,000	4,000,000	2,000,000	4,000,000
Domestic Washing Machines	9,763,614	17,362,219	20,780,443	12,070,150	17,444,928
Electric Water Heaters	2,000,000	7,000,000	8,000,000	1,000,000	3,000,000
Electric Fans	23,000,000	21,000,000	29,000,000	21,000,000	19,000,000
Freezers	30,000,000	29,000,000	44,000,000	19,000,000	40,000,000
Other Lighting	30,000,000	63,000,000	19,000,000	22,000,000	18,000,000
Refrigerators	29,000,000	45,000,000	53,000,000	27,000,000	33,000,000
Televisions	-	-	30,937,408	36,297,372	13,746,946

Note – Large difference between annual values might indicate bulk purchase of appliances by wholesalers, retailers or private companies, assuming no change in customs department interpretation of harmonized system codes. The (-) sign indicated information was not available

Source: Table 5.1 of IIEC, 2012

Table 2-5 provides total imports by value, not imports for private households, so it is not directly useful as supplementary information for this household survey. However, it provided a checklist of appliances to be included in the survey. It also suggests that there may possibly be scope for more

energy efficient lighting, as fluorescent tube lights,<sup>1</sup> which are relatively efficient, accounted for only 22% by value of lighting imports during the five-year period.

### 2.3 Household Income and Expenditure Survey of 2010

The 2010 HIES covered 10% of national households. There were several objectives including “to provide data for assessing the impact on household living conditions of existing or proposed economic and social measures, particularly changes in the structure of household expenditures and in household consumption.” The final report, dated December 2012, was not available to the PEEP2 household energy survey team until April 2013, shortly after the Port Vila fieldwork was completed.

Some results are summarised in Table 2-6 below. Of the total population, it was estimated that 74% are rural and 26% urban. Of the urban population, about 20% live in Port Vila and 6% in Luganville. Food is the major expenditure item for urban and rural households at 56% of national household (hh) expenditure, followed by housing and household operations,<sup>2</sup> which accounted for 19 % of national hh expenditure. Of this, about two thirds was for household operations including fuel and lighting.

**Table 2-6: Some Results of 2010 Household Income & Expenditure Survey**

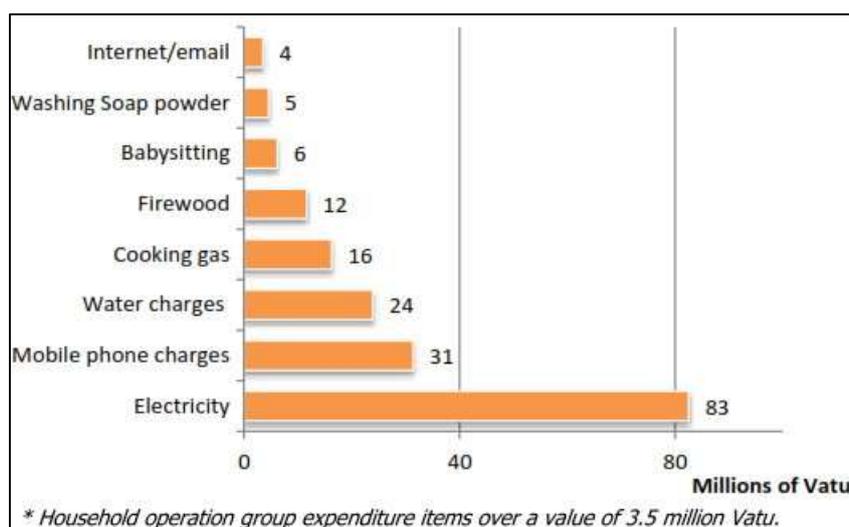
Indicator	Vanuatu	Rural	Urban total	Urban population:	
				Luganville	Port Vila
Population	249,850	185,290	64,560	15,110	49,450
Households	50,740	38,270	12,470	2,700	9,760
Ave household size	4.9	4.8	5.2	5.1	5.2
Ave hh expenditure (vatu per month)	76,000	69,300	97,300	77,700	102,700
Expenditure on food (% of total)	56%	64%	42%	-	-
Electricity as main lighting source (% of hh)	42%	30%	80%		
Kerosene as main source of lighting (% of hh)	34%	42%	11%		

Source: Various tables, Vanuatu Household Income & Expenditure Survey, 2010

For urban households, as shown in Figure 2-2 on the next page, energy costs (particularly electricity but also cooking gas and firewood) dominated the major annual expenditure items within household operations.

<sup>1</sup> Linear fluorescent lights, also known as Fluorescent Tube Lights (FTLs). There is no information on imports of the screw-in compact fluorescent lights (CFLs) but most of those imported to Vanuatu are of believed to be of low quality.

<sup>2</sup> These are household transactions for housing (including rent, home improvements, maintenance and the construction of new dwellings owned by the household) and household operation (furniture, furnishings, firewood, appliances, supplies such as batteries, washing soap, toilet paper, household services such as babysitting, telephone and communication and fuel and lighting expenses).



**Figure 2-2: Major Urban Household Operation Expenditures (2010)**

Source: Figure 3.9 of Vanuatu 2010 Household Income & Expenditure Survey

Of households using electricity, 91% were supplied through UNELCO (in Shefa, Malampa and Tafea) or VUI (in Sanma) compared with 3% using household generators and 2% through the provincial government. Types of lighting used in urban households (electrified and electrified) are summarised in Table 2-7 below and expenditures for fuel and lighting are shown in Table 2-8.

**Table 2-7: Type of Lighting Used by House Type in Urban Areas in 2010**

Main Source of Lighting	Traditional House	Permanent House	Mixed House	Makeshift House	Other (e.g. flat)	Total *	% of total
Electricity	170	5,430	1,950	1,750	290	9,960	80
Candle	30	190	300	540	10	1,140	9
Kerosene	60	90	310	300	10	770	6
Other	10	110	70	30	20	240	2
Coleman lantern	20	20	30	70	0	140	1
LP Gas	0	80	0	30	0	120	1
Wood/coconut	0	10	40	30	20	100	< 1
Total	290	5,930	2,700	2,750	350	12,470	

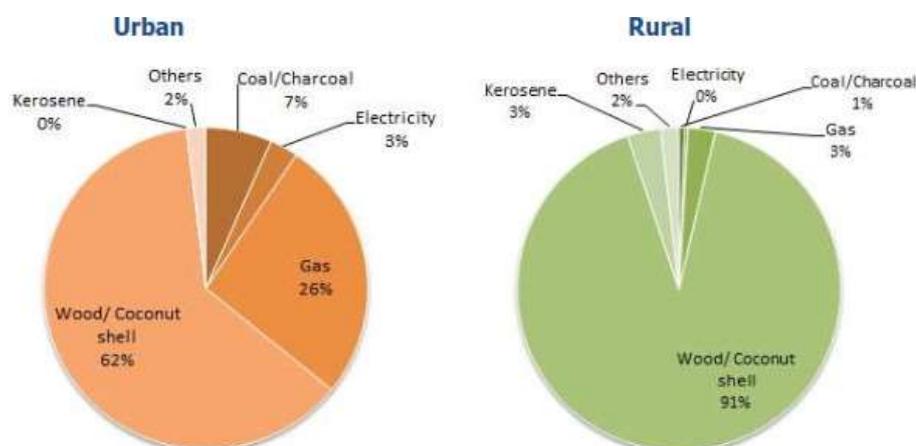
Source: Table 3-9 of 2010 Vanuatu HIES; \* Discrepancies in total are in the original table

**Table 2-8: Expenditure (Purchases) of Urban Households on Fuel and Lighting in 2010**

Source of Fuel or Lighting	Total National Expenditure (vatu/m)	Number of households	Vatu/m for urban hh using this fuel
Electricity	82,537,200	10,020	8,237
Liquid Petroleum Gas	16,235,800	2,430	6,581
Kerosene	249,800	360	694
Other fuel & light	129,400	40	3,235
Firewood *	2,450,700	4,580	535
Charcoal	936,600	300	3,122
Total	102,539,500	-	

Source: Annex 2 of 2010 Vanuatu HIES. \* Excludes 9.16 m vatu home-produced  
Excludes water charges, which the HIES includes in the energy expenditure category

The use of wood and/or coconut shells for cooking was almost universal in rural areas, and only in urban areas were liquid petroleum gas (LPG) and other types of fuel significant in 2010. Even in Port Vila and Luganville, over six of every ten households mainly used wood for cooking (Figure 2-3).



**Figure 2-3: Main Cooking Fuel for Urban and Rural Households (2010)**

Source: Figure 3.3 of Vanuatu 2010 Household Income & Expenditure Survey

There is no information in the 2010 HIES on appliance ownership. However, total urban expenditure per month on appliances in 2010 was 14.785 million vatu or US\$143,544/month (at average 2010 exchange rate of US\$1.00 = vatu 103) for the appliances shown in Table 2-9.

**Table 2-9: Urban Household Expenditure, Appliances (2010; vatu/m)**

Appliance	Expenditure	No of hh
Washing machine	744,600	150
Refrigerator	1,353,000	410
Freezer	1,440,200	260
Electric jug	170,200	420
Food processor	17,800	20
Gas & electric stove	760,200	800
Gas Burner	638,100	380
Television	828,500	620
Radio/Stereo	955,300	710
Vacuum cleaner	50,300	20
Sewing machine	293,900	280
Home computer/Printer	1,158,400	210
Kerosene Stove		
Electric Frying Pan	56,600	140
Microwave Oven	93,400	90
Blender	154,800	270
Egg Beater	2,800	20
Coffee Percolator	5,300	20
Rice Cooker	466,400	720
Pressure Cooker		
Electric toaster	31,400	80
Chillybin (Cooler)	2,000	20
Telephone (fixed)/fax machine purchase	88,900	130
Mobile phone purchase	3,184,700	4,550
Video player / VCD	671,700	490
DVD player	1,014,900	1,820
Playstation, nintendo	259,600	200
Other home appliances NEC	26,300	310
<b>Electric fans</b>	<b>315,300</b>	<b>770</b>

Source: Annex 2 of Vanuatu 2010 Household Income & Expenditure Survey

## 3. SURVEY OBJECTIVES AND METHODOLOGY

### 3.1 Survey Objectives

The objectives of the survey were: 1) to eliminate or reduce key data gaps regarding residential energy use in electrified urban households in an accurate and statistically relevant manner with a focus on determining the size, age, configuration, source, use patterns, conditions and related information about electricity-using equipment and appliances; and 2) subsequently use the information to develop initiatives to help households reduce electrical energy use without compromising the quality of services, such as cooling, lighting, communications, etc. Thus the formulation of practical residential energy efficiency measures can be based on more accurate and up-to-date information.

### 3.2 Sample Selection and Size

The relevant sample size and assuring a random sample was discussed with the Director and staff of the Vanuatu National Statistics Office (VNSO) and the ADB Liaison Officer, who is a former Director of the VNSO. To be statistically representative, a sample size of around 1,000 households (10%) is sufficient considering that there are approximately 10,000 electrified households in Shefa province (Port Vila) and Sanma province (Luganville). It was decided to survey 1,500 households overall (1,150 in Port Vila and 350 in Luganville) that allowed for non-responsive, incomplete or inconsistent returned questionnaires.

The VNSO worked with the survey team to obtain a representative selection of households. As part of the 2009 census, all private dwellings were reportedly identified and mapped. This database was later used to select and identify households for the 2010 HIES. The same database and approach was used to select and identify households for the household energy survey.

### 3.3 Survey Questionnaire

A comprehensive survey questionnaire developed by PEEP2 for a similar 2013 survey in Tonga (and based on experience with numerous past appliance and energy use surveys in the Pacific islands) was modified slightly for Vanuatu conditions and translated into the dominant local language, Bislama. The bi-lingual questionnaire, in English and Bislama, is attached to this report as Annex 1, a hand-out provided to households is Annex 2 and the data entry spreadsheet is Annex 3.

The questionnaire includes:

1. House type, size, condition, materials, sanitary facilities and people normally resident
2. Numbers and types of vehicles owned by the household
3. Sources of income
4. Lighting types, number, wattage, location and times of use
5. Air-conditioner types, number, wattage, location and times of use
6. Small electrical appliance types, number and time of use (including fans, microwave ovens, TVs, DVD players, phones, etc.)
7. Questions regarding computer use
8. Water heaters (electric, gas, solar, etc.)
9. Use of energy for cooking (electrical, gas, kerosene, wood, other)

### 3.4 Surveyor Selection and Training

There were advertisements for surveyors in the Vanuatu Post daily newspaper (weekday and weekend edition) and information was posted at institutions where prospective surveyors are likely to be available (e.g. Vanuatu campus of the University of the South Pacific; Vanuatu Institute of Technology). Local surveyors were engaged through the Vanuatu Meteorology and Geohazards Department (VMGD or 'Meteo') which includes the Government's Climate Change Unit, with a strong interest in energy use. Prospective surveyors were interviewed and selected by PEEP2 and Meteo staff.

It was planned to have 25 survey teams for Port Vila (preferably with one male and female surveyor in each team) and 10 teams in Luganville. There were in fact 24 teams of two surveyors for Port Vila and 9 teams of two in Luganville. Although balanced teams (one male, one female per team) were preferred, there were 18 females and 30 males for Vila and 5 females and 13 males for Luganville. One female had to leave the survey after the first days due to competing priorities.

Port Vila surveyors underwent an intensive two-day training program led by Thomas Lynge Jensen of UNDP's Pacific Center, assisted by two local survey supervisors, PEEP2's Jerryson Lapi and Christopher Simelum from the Department of Energy (DOE).<sup>3</sup> The training covered the background to this survey, the survey cycle, general survey pointers, questionnaire familiarisation, detailed walk-through of the questionnaire, survey field tests, feed-back from surveyor, planning (including logistics for the main survey) and writing survey and identification codes for a total of 1,152 questionnaires.

The training programme is provided in detail in a lengthy (185 pages) second volume of this report, with five annexes. For Port Vila, training took place on Tuesday and Wednesday, 19-20 March 2013, with the actual survey from Friday afternoon 22 March through Thursday 28 March.

Jerryson Lapi was scheduled to carry out a similar programme of training and surveys in Luganville beginning Monday 25 March 2013. However, as explained in Section 6.2 on key issues faced in implementing the surveys, the Port Vila training and surveys were delayed and not completed until 28 March 2013, with Luganville delayed until the week of 8 April.

### 3.5 Survey Implementation

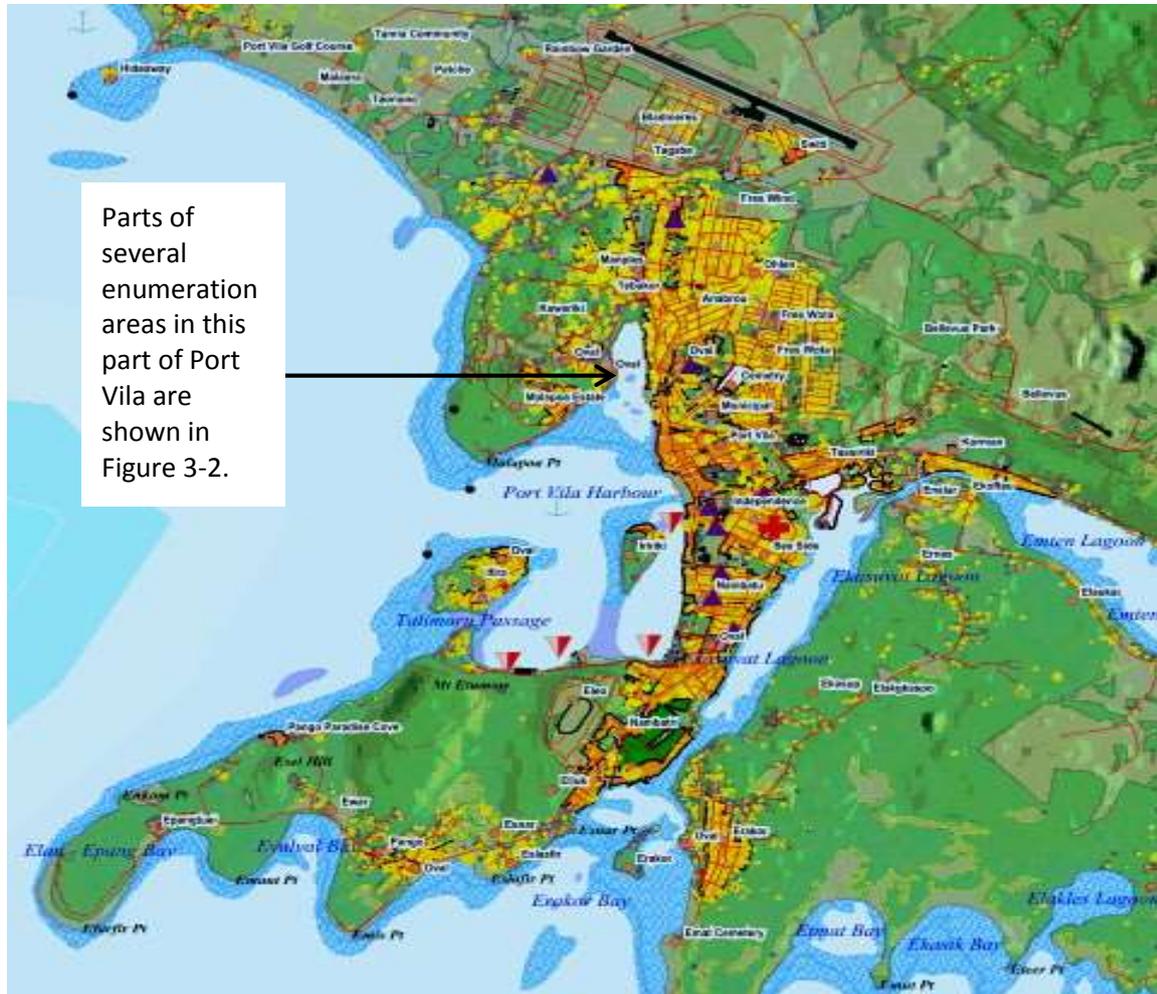
**Port Vila.** For Port Vila, the VNSO provided 107 separate digital maps showing enumeration areas, with each house identified by a unique code. All homes to be included in the survey were selected in consultation with VNSO. The 24 teams of enumerators visited 1,105 homes from which 1,009 acceptable questionnaires (91%) were analysed, as shown in Table 3-1.

**Table 3-1: Households Surveyed in Port Vila**

Response	Number	%
HH visited	1,105	100%
Refused to Participate	22	2%
No electricity	7	< 1%
Missing Forms	62	6%
HH vacant	2	~ 0%
Electricity temp. out of service	3	~ 0%
<b>HH Surveyed</b>	<b>1,009</b>	<b>91%</b>

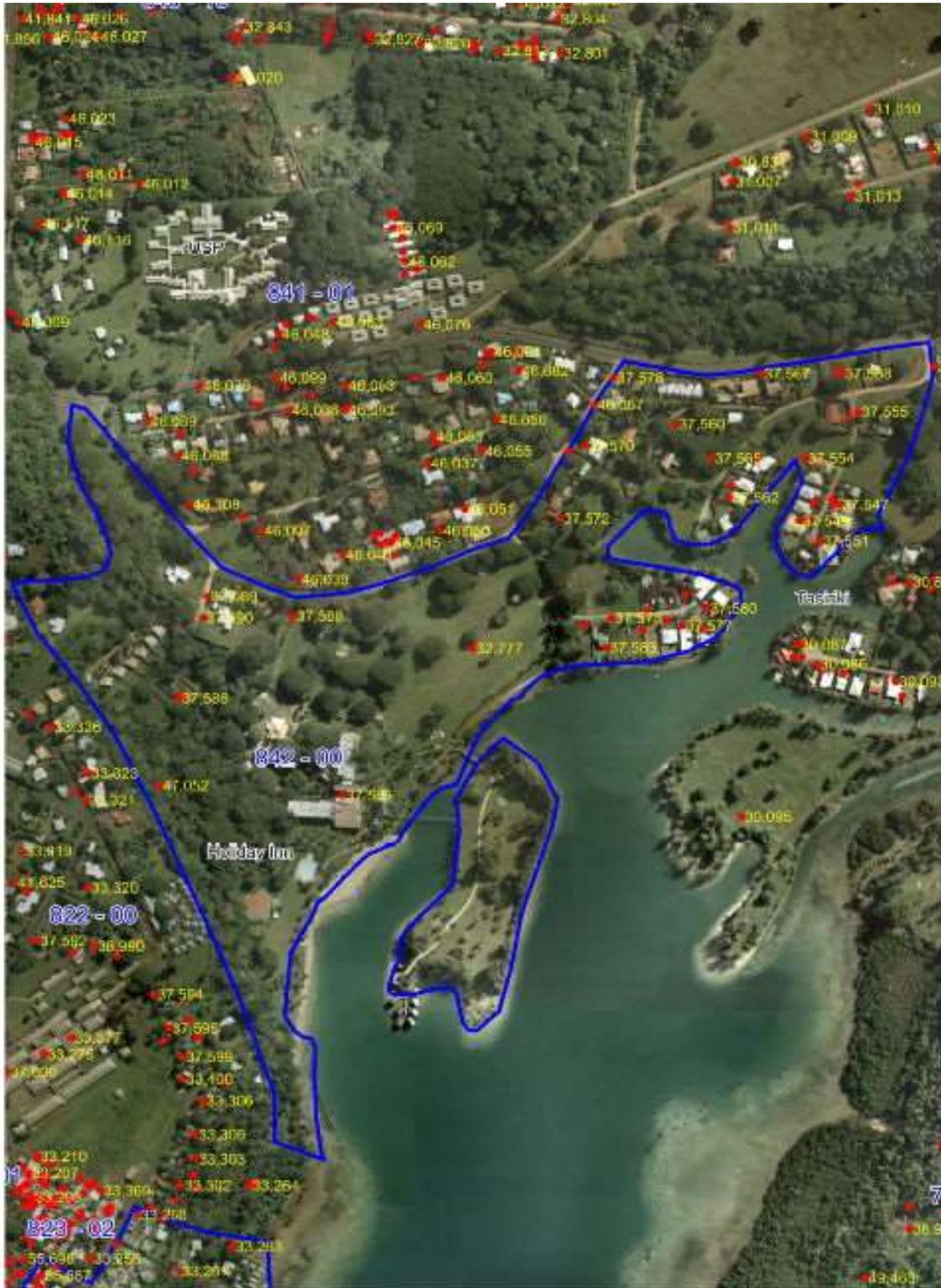
<sup>3</sup> At the time of the survey, it was the Department of Energy, Mines and Minerals (DEMM). At the time of report finalisation, there had been a government restructuring and the new DoE was part of a Ministry of Ministry of Climate Change Adaptation, Meteorology, Geo-Hazards, Environment and Energy.

Figure 3-1 below illustrates Port Vila and nearby rural areas. Figure 3-2 shows parts of several Port Vila enumeration areas in more detail.



**Figure 3-1: Port Vila and Surroundings** (Source: Government of Vanuatu, 2010)

Figure 3-2 on the next page illustrates parts of several Port Vila enumeration areas located near the Vanuatu campus of the University of the South Pacific (USP, the complex of light-coloured buildings in the mid-upper left portion of the map), with the boundaries of one enumeration area clearly delineated (blue line) and with each individual house clearly identified (code in yellow).



**Figure 3-2: Sample of Port Vila Enumeration Area** (Source: VNSO)

**Luganville.** Luganville on the island of Espiritu Santo (see location on the map, Figure 1-2) is a 50 minute flight from Port Vila so a new team of local surveyors was interviewed, trained and selected for the second survey. For the smaller Luganville exercise, Mr Lapi managed the survey with Mr Simelum as the sole enumerator supervisor. Figure 3-3 below shows the main Luganville town area.



**Figure 3-3: Aerial View of Luganville** (Source: Google Maps, 2013)

There were 18 surveyors in Luganville divided into 9 teams. Interviews and selection were carried out on 3 April, training was from 8-9 April, and the fieldwork (surveys) from 10-12 April. A total of 350 households were visited from which 329 acceptable questionnaire forms (93%) were available for analysis. For Luganville, 27 separate maps were provided by VNSO indicating enumeration areas and boundaries (green line), with codes for all houses. An example is shown in Figure 3-4 below.



**Figure 3-4: Sample Map Indicating an Enumeration Area of Luganville** (Source: VNSO)

As shown in Table 3-2, a total of 352 households were selected in Luganville. Of these, 329 (93%) were surveyed with completed questionnaires of acceptable quality.

**Port Vila and Luganville total.** For Port Vila and Luganville combined, there were 1,338 households surveyed with acceptable returned questionnaires, or 13% more than the 1,000 electrified households required for satisfactory results.

**Table 3-2: Households Surveyed in Luganville**

Response	Number	%
HH visited	352	100%
Refused to Participate	17	5%
No electricity	0	0%
Missing Forms	6	2%
HH vacant	0	0%
Electricity temp. out of service	0	0%
<b>HH Surveyed</b>	<b>329</b>	<b>93%</b>

### 3.6 Analysis of Data

At the completion of the survey when all completed questionnaires had been returned, a quick check was carried out to note if responses were missing/omitted, and to note any refusal to participate, and possible errors that might have been committed during field work for both the Port Vila and Luganville surveys. The questionnaires were arranged into piles of hundreds according to the codes each survey form had been given. Information collected was then entered into a computer using an Excel spreadsheet similar to the one developed and used for the 2013 PEEP2 Tonga survey. The data entry process and much of the analysis was carried out by Patricia Mawa of the Department of Meteorology and Geo-hazards (Meteo). All completed questionnaires were stored in a safe and secure place at the end of the data entry and data analysis for future reference or until it is agreed to dispose of them. Completed questionnaires are not available to those outside of the survey team, to ensure confidentiality of responses.

### 3.7 Extrapolating from Surveyed Households to All Urban Electrified Households

**Port Vila.** Extrapolating the survey results to all Port Vila households is not straightforward. The 2010 HIES estimated 12,400 urban households in Vanuatu, of which 9,960 (80%) were electrified from the grid. Of Port Vila's 9,760 hh at the time, this suggests that about 7810 hh were electrified in late 2010. The national census of late 2009 reported Port Vila households growing at 3.9% per year over the decade. There would thus be about  $1.039 \times 1.039 \times (1.039)^{0.333} \times 7,810 = 8540$  electrified Port Vila households at the time of the survey at the end of March 2013, assuming the electrification percentage had not changed.

As summarised in Table 3-3, UNELCO's 2012 Annual Technical Report indicates 8,907 metered domestic customers for the Port Vila Concession at the end of December 2012, consuming about 15.11 million kWh of electricity. Assuming some growth in the percentage of electrified households, this is reasonably consistent with the extrapolation in of the previous paragraph. Therefore this analysis assumes that there were 8,910 metered household consumers at the time of this survey. The survey sample results can be extrapolated to Port Vila overall by a factor of 8.83, which is 8,910 total electrified households divided by 1,009 surveyed households. However, this will overestimate households numbers to some extent, as not all of UNELCO's customers in the concession area live within the borders of Port Vila. Actual UNELCO sales will be compared to consumption as estimated by survey findings in Chapter 6.

**Table 3-3: UNELCO Port Vila Household Customers and Sales in 2012**

Tariff Category	Number	Annual kWh Sales	kWh/m/consumer
Domestic *	4,737	3,304,783	58.1
Prepaid	112	50,210	37.4
Other domestic **	4,058	11,751,466	241.3
Totals & Average kWh/month	8,907	15,106,459	141.3

\* Domestic tariff based on a kWh (energy) charge

\*\* Other (higher consumption) low voltage based on a demand plus energy charge

**Luganville.** The 2010 HIES estimated a total of 2,700 Luganville households, of which 1991 (74%) were metered for electricity at the end of 2012. This is based on data in VUI 2013 for consumer categories 1 and 2, which are defined in URA 2010 as small domestic consumers and other low voltage domestic consumers respectively. During 2012 domestic consumers grew by 3% suggesting about 1% growth to 2010 domestic (or household) consumers metered at the time of the survey in April 2013. The survey sample results can be extrapolated to Luganville overall by a factor of 6.61, that is 2010 total electrified households divided by 329 surveyed households..

As shown in Table 3-4, sales to domestic/household consumers in 2012 totaled 2.16 million kWh. These actual VUI sales in Luganville will be compared to consumption as estimated by survey findings in Chapter 6.

**Table 3-4: VUI Luganville Household Customers and Sales in 2012**

Tariff Category	Number	Annual kWh Sales	kWh/m/consumer
Small domestic (1)	1716	1,465,177	71
Other domestic low voltage (2)	275	697,632	211
Totals & Average kWh/month	1991	2,162,809	91

## 4. RESULTS OF PORT VILA SURVEY

### 4.1 Electricity Used for Lighting in Port Vila

#### 4.1.1 Types of Lighting

The 1,009 Port Vila households surveyed had, on average, 4.5 lights each. Of these (Table 4-1), 46% were Compact Fluorescent Lights (CFL), 39% were linear Fluorescent Tube Lights (FTL), 12% were Incandescent Lights (ILs), and about 3% were other types. Assuming that the survey is representative of electrified households in Port Vila overall, there are over 40,000 lights installed in the capital's households.<sup>4</sup>

Most CFLs have integrated electronic ballasts (e.g. they can directly replace standard incandescent screw-in or pin-type lights) with a separate ballast. Most CFLs imported into Vanuatu are believed to be of poor-quality, with short life-times.<sup>5</sup>

Most Fluorescent Tube Lights (FTLs) are the old, relatively inefficient T12s, with fewer standard T8s and only a few of the more efficient T5s.

Incandescent lights (mostly pin-type) account for an estimated 12% of Port Vila lighting. Other lights account for only 3% of the total, equally split among the energy-efficient Light Emitting Diode types (LEDs), inefficient halogens, and others. Of all lights in Port Vila households, about 85% are fluorescent, the main types illustrated in Figure 4-1 below.

**Table 4-1:  
Total Surveyed Household  
Lighting by Type, Port Vila**

Type of Lighting	No.	% *
Compact Fluorescent Lights (CFL)		
CFL (integr. ballast)	1,477	32.3
CFL (separate ballast)	628	13.7
<i>Total CFL</i>	<i>2,105</i>	<i>46.1</i>
Fluorescent Tube Lights (FTL)		
T12 (fat)	1,257	27.5
T8 (thinner)	388	8.5
T5 (thin)	129	2.8
<i>Total FTL</i>	<i>1,774</i>	<i>38.8</i>
Incandescent Lights		
Screw-in	136	3.0
Pin (bayonet type)	396	8.7
<i>Total incandescent</i>	<i>532</i>	<i>11.6</i>
Other Lights		
LED	49	1.1
Halogen	57	1.2
Other	51	1.1
<i>Total Other</i>	<i>157</i>	
<i>Total of all types</i>	<i>4,568</i>	<i>100%</i>

\* Percentages rounded off

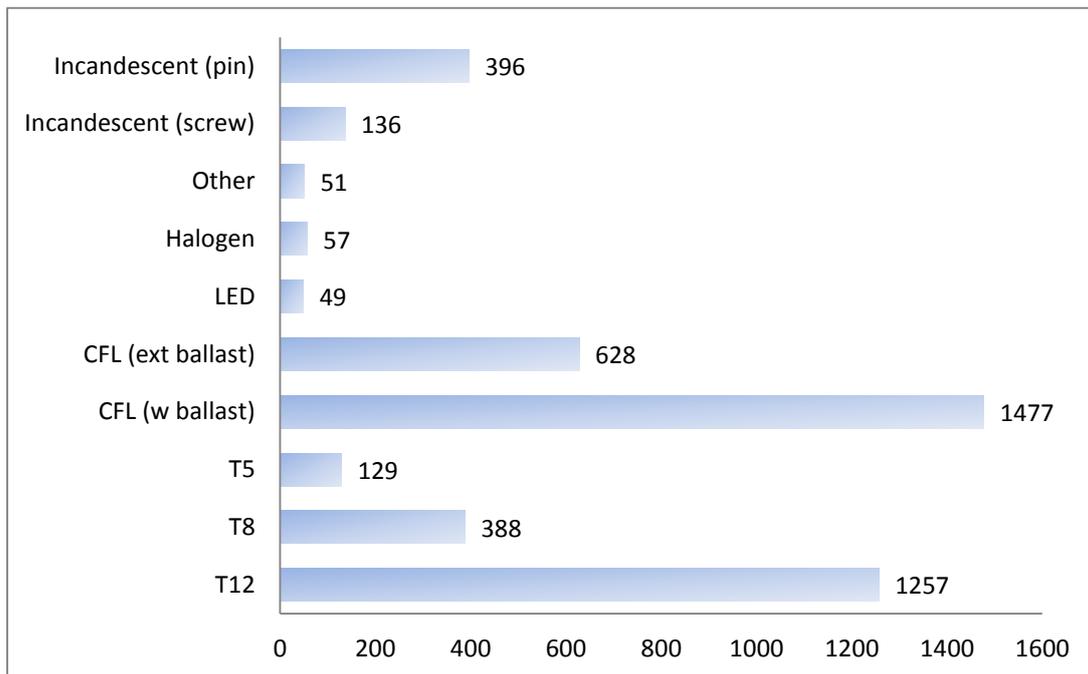


**Figure 4-1: Fluorescent Lighting Types Common in Port Vila**

<sup>4</sup> To extrapolate from the survey sample to all of Port Vila's electrified houses, multiply 4,568 by 8.83 = 40,335. See Table 3-3 for an explanation.

<sup>5</sup> This is not a finding of the survey but rather based on informal checks of shops in Port Vila selling CFLs.

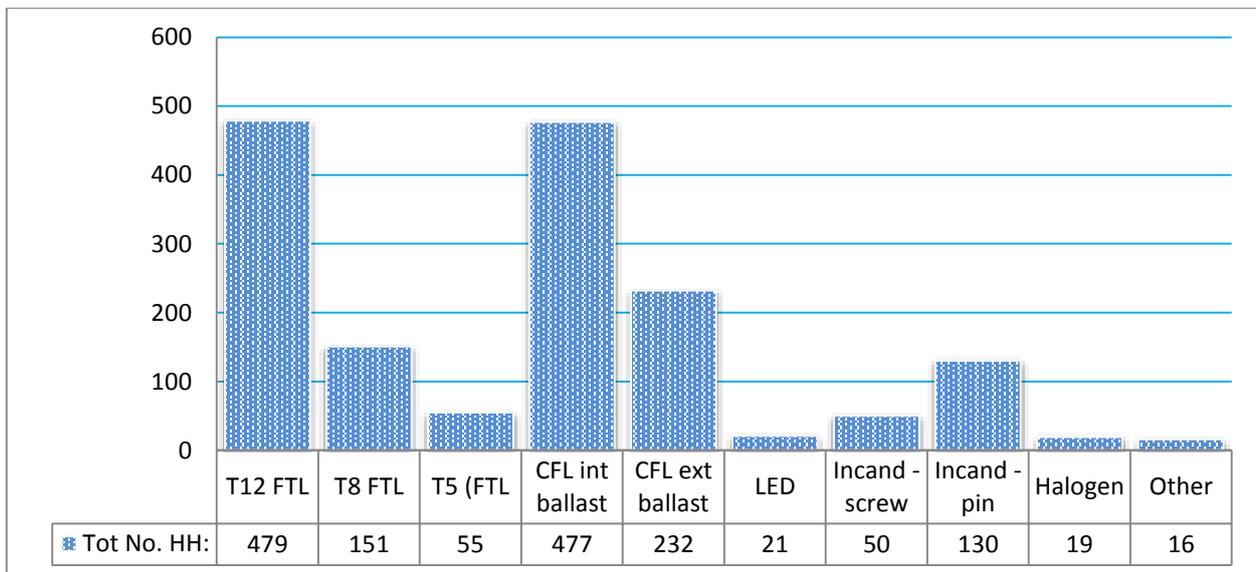
Lighting by type in the Port Vila surveyed households is presented graphically in Figure 4-2 below:



**Figure 4-2: Lighting by Type in Port Vila Surveyed Households (2013)**

Source: PEEP2/GoV HH survey, 2013

Of course, the above lighting types are not evenly distributed among all households. In Figure 4-3, the numbers of surveyed households with different types of light are shown graphically. Nearly half of all the surveyed Port Vila households use older T12 FTLs and self-ballasted CFLs:



**Figure 4-3: Number of Surveyed Households with Different Lighting Types, Port Vila**

Figure 4-4 below shows the typical usage patterns of different light types in surveyed Port Vila households in hours per day.

Type	T12	T8	T5	CFL internal	CFL external	LED	Incand. (screw)	Incand. (pin)
Ave.	7.0	6.1	6.2	5.4	4.8	5.2	5.2	4.3
Median	5.75	4	4	4	4	4	4	3.7

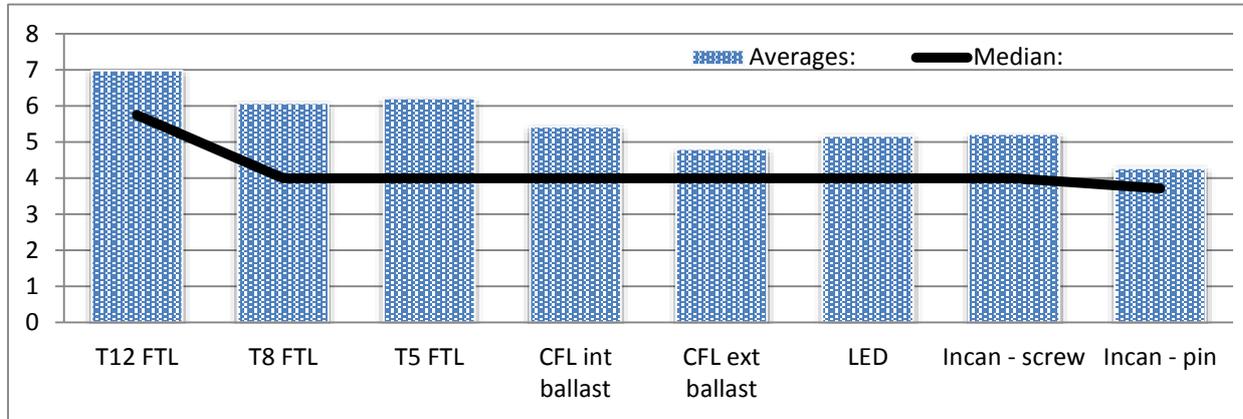


Figure 4-4: Average & Median Usage of Light Types in Surveyed Port Vila Households (hours/day)

Figure 4-5 summarises the wattage of various light types according to the questionnaire categories. <sup>6</sup>

Lights:	717	540	292	96	85	44	1138	339	408	220	118	18	307	89	42	7	55	2	36	15
No. HH:	289	231	119	40	37	20	372	137	155	98	38	12	103	32	15	6	17	2	12	5

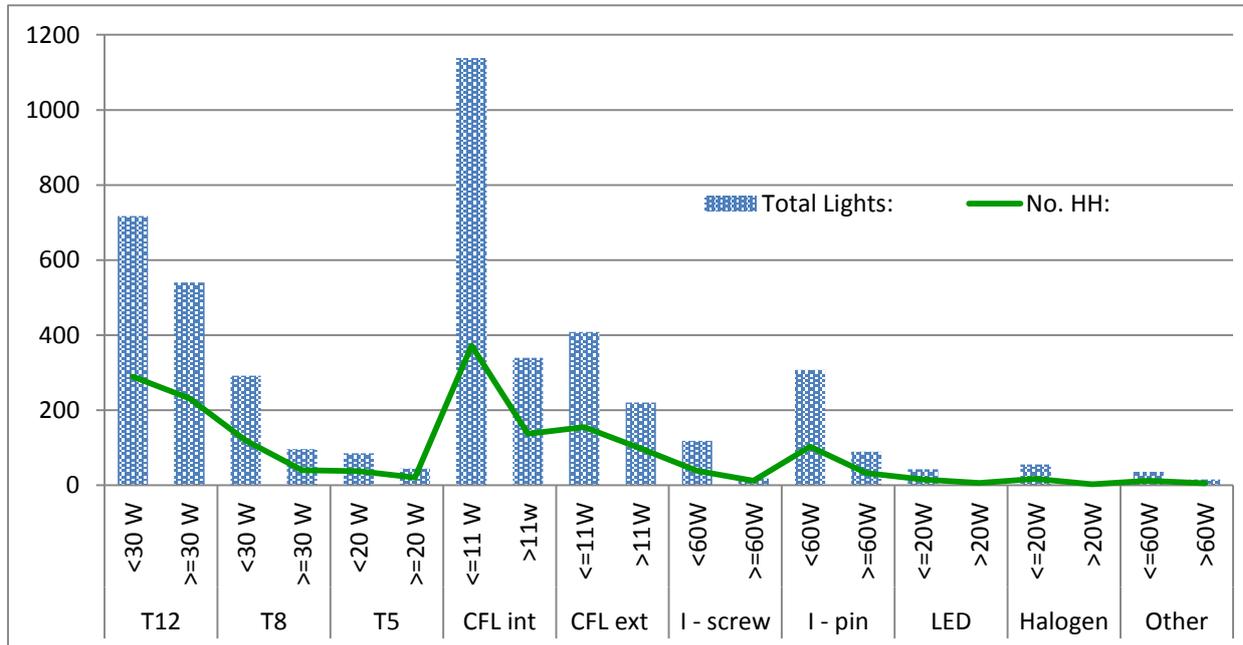


Figure 4-5: Total Numbers of Lights by Type, Wattage and Number of Surveyed Households with the Lights, Port Vila

<sup>6</sup> For calculating electricity use for lighting, the following assumptions were made regarding average wattage per light type: T12 (including ballasts) 53w & 30w for long (4 ft) & short (2ft) tubes; T8 46w & 27w; T5 31w & 16w; CFL self-ballasted 14w & 11w; CFL external ballasts 25 & 14w; incandescent 40w & 70w; LEDs 20 & 9w; halogen 50 & 20w; & other 70 & 40w.

#### 4.1.2 Electricity Consumption for Lighting

The electricity used for lighting for all Port Vila households can be estimated from the survey results on daily use of each type of light and the wattage of the lights. Household lighting for the sample of households surveyed accounts for 266,500 kWh per year. Extrapolated to all Port Vila households, lighting accounts for about 2.1 million kWh per year. As Table 4-2 shows, 49% is accounted for by T12 FTLs, 10% by T8 FTLs, 2% by T5 FTLs, 20% by CFLs, 15% by incandescent lighting, and less than 3% by others. Overall (that is for all electrified households in Port Vila), the survey results suggest that about 62% of electricity for lighting is from FTLs and 20% from CFLs.

**Table 4-2: Estimated Electricity Used for Lighting in all Port Vila Households**

Light type		Reported use (hours/day)	Watts *	Number	Estimated kWh/year	% kWh by light type
FTL (T12)	4 feet	7	53	4,686	634,611	27.9%
	2 feet	7	30	6,223	476,945	21.0%
FTL (T8)	4 feet	6.1	46	834	85,356	3.8%
	2 feet	6.1	27	2,535	152,359	6.7%
FTL (T5)	4 feet	6.2	31	381	26,762	1.2%
	2 feet	6.2	16	737	26,714	1.2%
CFL (with internal ballast)		5.4	14	2,994	81,184	3.60%
		5.4	11	10,049	214,124	9.40%
CFL (external ballast)		4.8	25	1,943	83,631	3.70%
		4.8	14	3,603	86,853	3.80%
LED		5.2	25	61	2,866	0.10%
		5.2	10	371	6,916	0.30%
Incandescent (screw-in)		5.2	70	159	20,728	0.90%
		5.2	40	1,042	77,715	3.40%
Incandescent (pin)		4.3	70	786	84,817	3.70%
		4.3	4	2,711	16,726	7.40%
Halogen		5	50	17	1,562	0.10%
		5	20	485	17,414	0.80%
Other		5	70	132	16,587	0.70%
		5	40	317	22,778	0.40%
Total for Port Vila households HH (rounded off)				40,035	2,136,647	100.0

Note: \* Average per light type; includes ballast, if any

612 of the surveyed households (61%) have outdoor lighting reportedly used on average for 10.6 hours per night. Of those with external lighting, 90% had only one or two outside lights and over 96% used FTLs or CFLs. Over half of the external lights were T12s suggesting an excellent opportunity for efficient external light retrofitting.

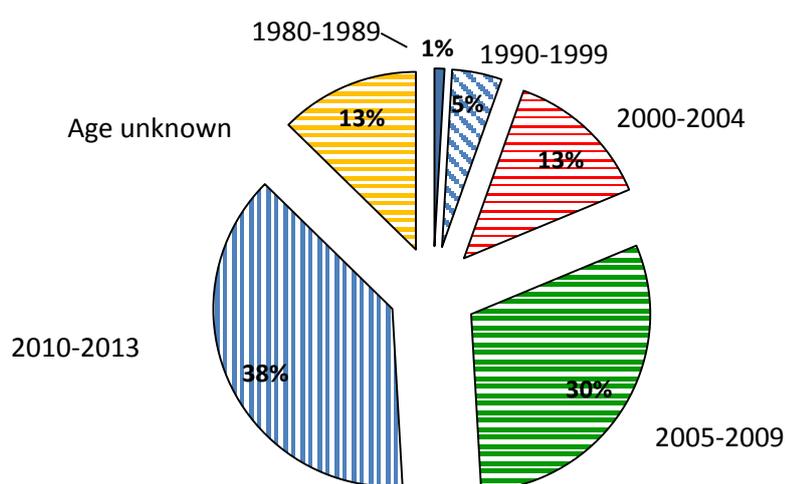
## 4.2 Electricity Used for Household Refrigerators and Freezers in Port Vila

### 4.2.1 Refrigeration

As shown in Table 4-3 and Figure 4-6, of the 1,009 Port Vila households surveyed, 434 (43%) reported one or more refrigerators.<sup>7</sup> Only 1% had a second refrigerator. About one household in eight did not report a year of purchase. For those who did, about 6% of fridges were bought before 2000, half from 2000 through 2009, and 44% between 2010 and early 2013. Nearly half of all refrigerators were fairly new, less than three years old.

**Table 4-3: Estimated Numbers and Ages of Household Refrigerators in Port Vila**

Age of Refrigerator	Fridge 1	Fridge 2	Total	% of Total	% for which year of purchase is known
1980-1989	4	0	4	0.9%	1.0%
1990-1999	20	0	20	4.5%	5.2%
2000-2004	58	1	59	13.3%	15.2%
2005-2009	134	1	135	30.4%	34.8%
2010-2013	163	7	170	38.3%	43.8%
Age not known	55	1	56	12.6%	-
Total	434	10	444	100.0%	
% of hh with refrigerators	43.0%	1.0%	-	-	
<i>For those bought refrigerators from 2010-2013:</i>					
bought in 2010	49	2	51	11.5%	
bought in 2011	44	4	48	10.8%	
bought in 2012	61	1	62	14.0%	
bought in 2013 (by March)	9	0	9	2.0%	
Total: 2010-March 2013	163	7	170	38.3%	



Percentages are rounded off

**Figure 4-6: Year of Purchase of Household Refrigerators in Port Vila**

<sup>7</sup> This is substantially lower than urban Shefa province households as reported in the 2009 census (58%; see Table 2-1). However, the census reported total numbers of refrigerators for electrified households, not households with one or more refrigerator, so 58% is an overestimate.

As shown in Table 4-4 and Figure 4-7, 65% of refrigerators (52.2+2.8+9.8) had a separate freezing section, while 35% had a small freezing section within the fridge, or no freezing section. About 75% of refrigerators were purchased or otherwise obtained new and 25% used. Although half of all refrigerators are under 3 years old, less than 20% who reported on labelling had an energy consumption label indicating the likely electricity use. However, there are inconsistencies in reporting,<sup>8</sup> so the number of stars (which is indicative of energy efficiency) and the country of labelling are not provided in this report. Although not shown in the table, 54% of households reported that refrigerators were self-defrosting, which is higher than expected and can significantly increase electricity consumption.

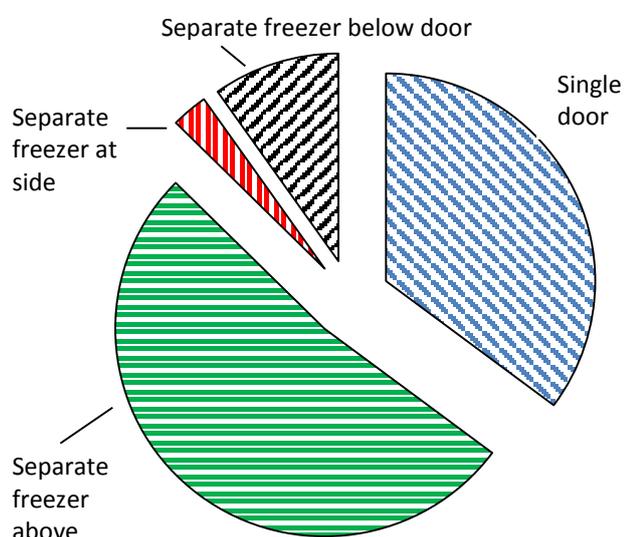
**Table 4-4: Type of Refrigerator and Energy Use Labelling**

Refrigerator / Freezer Arrangement			Bought New or Used ?			Energy Use label ?		
Refrigerator Type?	Number	%	New?	Number	%	Label?	Number	%
Single door *	137	35.2	New	326	75.3	No	289	81.6
Separate freezer above fridge	203	52.2	Used	107	24.7	Yes	65	18.4
Separate freezer at side of fridge	11	2.8	Total	433	100	Total	354	100.0
Separate freezer below fridge	38	9.8	Unknown	11		Unknown	90	
Total refrigerators	389	100.0						
Unknown **	55							

\* Usually with a small inside freezing section at top of fridge interior;

\*\* It is assumed that 'unknowns' don't significantly affect the percentages of refrigerator types

Three fourths of respondents said they had no plans to purchase a new refrigerator in the near future (generally within 12 months). 82% of refrigerators reportedly had good door seals but 18% had poorly-fitted or damaged seals, which can significantly increase electricity use. The same percentage of refrigerators had doors in poor condition (probably but not necessarily the same units as those with poor seals), also indicative of high energy use. There may be opportunities for relatively inexpensive improvements to reduce electricity use in about a fifth of refrigerators by replacing or improving existing seals.<sup>9</sup> Damaged or badly closing doors are more difficult to fix.



**Figure 4-7: Refrigerators by Type in Port Vila**

<sup>8</sup> For those households that reportedly had one refrigerator, 63 reportedly had energy labels. However, the total number of energy efficiency labels by country (Australia/NZ, China, Japan, Thailand) was 154! The reason for this error is not known but some enumerators may have indicated the refrigerator's country of origin, rather than the country of labelling.

<sup>9</sup> Some years ago, the main author of this report reduced electricity use of a 10-year old refrigerator by nearly 20% simply by smearing a small amount of petroleum jelly on the freezer seal, dramatically reducing cold air leakage.

**Table 4-5: Refrigerator Replacement Plans, Door Seal Quality and Door Condition**

Replacement Plans?			Door Seal Quality?			Door Condition?		
To be replaced?	No.	%	Seal?	No.	%	Door?	No.	%
No	296	75.3	Good	355	81.8	Good	355	81.8
Yes	97	24.7	Bad	79	18.2	Bad	79	18.2
Total	393	100.0	Total	434	100.0%	Total	434	100
Unknown	50		Unknown	10		Unknown	10	

98% of those who responded reportedly spend under 10,000 vatu/month (about US\$100) on electricity for their refrigerator, which is unsurprising considering that a large proportion of households use 60 kWh/m or less in total, although 41% did not provide information and past PIC survey experience suggests that households are often poor at estimating household expenditures for specific appliances.

#### 4.2.2 Freezers

Only 51 households (5%) reported that they had separate freezers. As summarised in Table 4-6 below, 60% were obtained before 2000, 90% were bought new, 33% have an energy use label and only 30% of households plan to buy new freezer within the next year or so. 80% of freezers have an opening door on the top, whereas 20% are lower-efficiency models with doors at the front (allowing cold air to flow out whenever the door is opened). All of those who responded reported spending under 10,000 vatu/month for electricity for freezers, but only 45% responded. The percentage of good door seals was the same as for refrigerators (82%). However, the number of reported freezers was small so results may not be representative of Port Vila overall.

**Table 4-6: Characteristics of Household Freezers in Port Vila**

Date Purchased or Obtained?			New or Used?			Door Opening?		
Year	No.	%	New?	No.	%	Location	No.	%
Before 2000	22	60	New	45	90	Top	28	68
2000 to present	15	40	Used	5	10	Double top	5	12
Total	37	100	Total	50	100	Front	8	20
Date unknown	14		Unknown	1		Total	41	100
						Unknown	10	
Freezer Replacement Plans?			Door Seal Quality?			Energy Use Label?		
To be replaced?	No.	%	Seal?	No.	%	Yes or No?	No.	%
No	25	69	Good	40	82	Yes	9	33
Yes	11	31	Bad	9	18	No	40	67
Total	36	100	Total	49	100	Total	49	100
Unknown	15		Unknown	2		Unknown	2	

### 4.2.3 Estimated Electricity Use for Refrigerators and freezers

From the survey data it is not possible to calculate the amount of electricity used for household refrigeration and freezers as the size of appliances and their energy efficiency are not known. Typical estimated consumption of electricity for refrigerators/freezers is shown in Table 4-7 based in part on information from the PEEP2 publication *Save Money on Your Electricity Bill: A Guide for Residential Consumers in Vanuatu*<sup>10</sup> which reflects Australian usage, but not necessarily Port Vila, where higher ambient temperatures suggest higher energy use. Table 2-3 of this report indicates typical volumes of units imported to Vanuatu as follows: one-door refrigerator 170-185 litres, two-door refrigerator (generally with a freezer on top) 250-470 litres, and chest-type freezer 200-300 litres.

**Table 4-7: Typical Annual Electricity Use of Refrigerator/Freezers**

Size & Energy Efficiency Rating	kWh
Small (200 litre) - 1 Star Rating	456
Medium (350 litre) - 1 Star Rating	552
Large (500 litre) - 1 Star Rating	716
Small (200 litre) - 3.5 Star Rating	239
Medium (350 litre) - 3.5 Star Rating	290
Large (500 litre) - 3.5 Star Rating	375

Table 4-8 estimates the number of refrigerators and freezers in Port Vila households with electricity consumption for these appliances of about 2 million kWh per year in 2013.<sup>11</sup>

**Table 4-8: Estimated Annual Consumption of Electricity for Household Refrigerators and Freezers in Port Vila**

Type of Refrigerator or Freezer *	Number from Surveyed Households	Estimated Number for all Port Vila HHs**	kWh per unit/year ***	Estimated Total kWh per year for all Port Vila HHs
Small 1-door (< 200 l)	155	1,369	450	615,927
Medium 2-door (250 l)	289	2,552	500	1,276,007
Freezer (250 l)	51	450	350	157,624
Total	495	4,371	n/a	2,049,559

\* From Table 4-4, 35% of refrigerators are single-door & 65% are two-door models.

\*\* Multiply households surveyed by 8.83

\*\*\* About half of fridges <3 years old, over half are apparently self-defrosting, and efficiency is probably poor. 80% of freezers are top-loading but 60% bought before 2000.

<sup>10</sup> This was completed in early 2014 but had not yet been printed at the time this survey report was finalised. The publication will be available in Bislama, French and English from the Department of Energy, and possibly UNELCO and VUI. It may be available electronically at their websites and at the URA.

<sup>11</sup> Port Vila accounts for the bulk of national electricity use and appliance purchases. Table 2-2 indicated a market in Vanuatu of about 1000 refrigerators and 500 freezers per year (prior to 2010). It is hard to know if this is consistent with 2013 survey results as many refrigerators are used in businesses and the bulk of freezers are almost certainly used in businesses, not homes.

## 4.3 Electricity Used for Household Air Conditioning and Cooling Fans in Port Vila

### 4.3.1 Air Conditioning

Only 7 of 1,009 households surveyed (0.7%) reportedly have air conditioning (A/C) systems, although for 96 households (9.5%), there was no data. All households with A/C reported that they were bought new, had a remote control and were purchased locally. Five of the seven were bought before 2010. There was insufficient reported data to judge A/C condition (no data for 4 of the 7), efficiency (6 of 7), labelled wattage (6 of 7), BTU rating (7 of 7) or manufacturer (7 of 7). None of those reporting had plans to replace their systems. The reported hot season usage average 7.7 hours daily (minimum 1, median 7, maximum 12) but no households reportedly used A/C during the cool season. Estimated monthly cost of operating an A/C was 6,333 vatu (minimum and median 5,000, maximum 9,000). Judging from the lack of much information on A/C systems in Port Vila, it appears that the enumerators/surveyors did not physically inspect them, as they were supposed to. Table 4-9 summarises typical A/C energy consumption.

**Table 4-9: Typical Air Conditioning Electricity Use**

Type of A/C	kWh/yr
Single split - 2 star	2160
Single split - 4.5 star	1605
Wall (2600 w Output)	2307
Wall (1650 w Output)	1489

Source: ADB/PEEP2, 2014

### 4.3.2 Cooling Fans

41% of households surveyed (413 of 1,009) had one or more fans with a total of 630 fans or 0.62 fans per electrified household overall, and 1.52 fans per household for those which had fans. As shown in Table 4-10, nearly half of all fans were floor-standing models, 30% were ceiling fans, 20% were table fans, and less than 3% were other types. Assuming that the households surveyed are representative of Port Vila, the total estimated number of fans in the city is about 5,600. About 12% of households had two fans, 6% had three, 3% had four and 1% had five fans or more (Table 4-11). The maximum number of fans in surveyed households was eight.

**Table 4-10: Number & Type of Cooling Fans in Port Vila**

Type of Fan	Number for Households Surveyed	Estimated Total for all Port Vila HHs *	%
Standing (floor)	294	2,596	46.7%
Ceiling	191	1,687	30.3%
Table	128	1,130	20.3%
Wall Mounted	12	106	1.9%
Window	4	35	0.6%
Other	1	9	0.2%
Total fans	630	5,563	100.0%

\* Rounded off

**Table 4-11: Fans per Household**

No.	%
1	40.9%
2	11.6%
3	5.5%
4	2.8%
≥ 5	1.0%

### 4.3.3 Estimated Electricity Use or Air Conditioning and Cooling Fans

There was insufficient information to indicate the location of fans. Average hot season fan usage was reportedly 8.26 hours per day (minimum 0, median 6, maximum 24) and cool season 2.43 hours (minimum 0, median 1, maximum 24). Typical energy use per fan can't be accurately estimated because almost no data were provided on nameplate wattage.<sup>12</sup> Based on

typical Australian usage, a standing pedestal (floor) or ceiling fan uses about 584 kWh per year. 400 kWh is more reasonable for Port Vila where fans tend to be smaller and usage may be less in the cooler season. This provides indicative – and possibly not very accurate – energy consumption (Table 4-12) of 2.35 million kWh for A/C and fans in all households in Port Vila.

**Table 4-12:**  
**Indicative Energy Use for Household A/C & Fans in Port Vila**

Appliance	kWh/year per unit	Estimated Total Number in all Port Vila HHs	Estimated Total kWh/year for all Port Vila HHs
Air conditioning	1,500	62	93,000
Cooling Fans	400	5,563	2,252,000
Total	-	-	2,345,000

Number assumes survey results are representative of Port Vila overall.

## 4.4 Energy Used for Household Cooking in Port Vila

### 4.4.1 Cooking Patterns in Port Vila: Energy Types and Frequency of Use

As shown in Table 4-13, cooking in Port Vila is dominated by wood-burning stoves (used by 87% of households of whom over 60% report using wood over half of the time<sup>13</sup>) and LPG (gas) stoves (64% of households of whom 60% reported using LPG over half the time). Electric stoves are used by 24% of households, 28% of which say they use electricity for over half of cooking. Other fuels (mostly charcoal) are used by less than 20% of families. The reported percentages of energy sources used for half or more of all cooking add up to 113% suggesting that respondents' estimates for some energy types are slightly too high but not unreasonable.<sup>14</sup>

**Table 4-13: Type of Energy for Cooking and Frequency of Use in Port Vila**

Type of Cooking Appliance by Fuel	Electric stove		LP Gas		Kerosene		Wood		Other *	
	No.	%	No.	%	No.	%	No.	%	No.	%
HH with cooker (yes)	230	24%	612	64%	35	4%	831	87%	177	18%
HH without cooker (no)	728	76%	348	36%	909	96%	127	13%	780	82%
Total reporting	958	100%	960	100%	944	100%	100%	100%	957	
HH providing no data	96		49		65				48	
Total surveyed	1008		1009		1009		1007		1005	
<i>Usage of cooking unit:</i>										
Small (once in awhile)	88	38%		20%		24%		17%	172	17%
Medium (≤ half of time)	78	34%		20%		30%		20%	213	21%
Large (> half of time)	65	28%		60%		46%		63%	625	62%

Note some discrepancies in number of households surveyed. Throughout the table, % rounded to nearest whole percent

\* This includes charcoal, coal, coconut oil, sawdust & unspecified fuels.

<sup>12</sup> This is not always easy to obtain. In the home of the main author of this report, the nameplate rating is unavailable in 5 of 7 fans because there is none (one floor standing fan) or the label is not accessible (four ceiling fans).

<sup>13</sup> This is similar to the 62% of all urban households that reported wood/charcoal as the main cooking fuel in 2010 (from the *Household Income & Expenditure Survey*; see Fig 2-3.)

<sup>14</sup>  $(24\% * 28\%) + (64\% * 60\%) + (4\% * 46\%) + (87\% * 63\%) + (18\% * 62\%) = 113\%$ . This is actually not bad considering that respondents are only estimating energy or fuel use for cooking, not actually measuring it.

Figure 4-8 shows clearly the dominance of wood and LPG as the main sources of energy for cooking on stoves, with electricity a relatively minor source.

#### 4.4.2 Electricity Use for Cooking

Before estimating electricity used for cooking overall, other electric appliances used for heating food or water should be considered. These can include electric fry pans, griddles, microwave ovens, rice cookers, table-top electric ovens, electric kettles and other appliances.

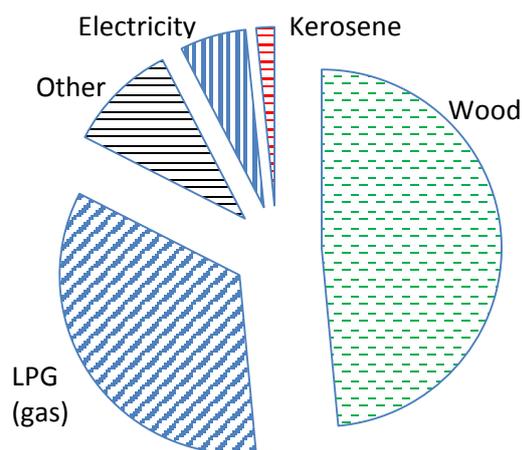
Only 126 households explicitly said they did or didn't have microwave ovens, of whom 78 answered yes. Only about 8% of households use microwave ovens for cooking. Of these 34% were knob-type and 76% controlled by buttons. There was insufficient information for useful conclusions regarding typical nameplate wattage or hours of daily use. 38% of respondents kept the microwave ovens plugged in all of the time and 62% unplugged the oven (or switched it off at the wall) when they were not in use. When left plugged in, some electricity is consumed even if the oven is not being used.

The ownership of various electrical cooking appliances is summarised in Table 4-14 below. Fewer than a third of households have a rice cooker or electric kettle. Under 10% use any of the other appliances listed and very few that do have an appliance have more than one per household.

**Table 4-14: Other Electrical Cooking Appliances in Surveyed Households, Port Vila**

Appliance	Rice Cookers	Kettles	Toasters	Microwave Ovens	Fry Pans	Griddles	Table-top Ovens
Total number	329	316	88	78	50	17	11
HH with appliance (no.)	321	309	85	78	49	17	11
HH with appliance (%)	31.8%	30.6%	8.4%	7.7%	4.9%	1.7%	1.1%
Appliances per HH with the appliance (number)	1.025	1.023	1.035	1.00	1.020	1.00	1.00

From the data collected and the way the analysis spreadsheet is structured, it is very difficult to calculate the average wattage for each type of appliance listed or the typical usage patterns. Nonetheless a rough estimate can be made of overall electricity use for cooking. Table 4-15 shows typical electricity use for various cooking appliances based on usage in Australia. Table 4-16 provides a rough indication of electricity used for cooking in Port Vila. Ignoring toasters, fry pans, electric



**Figure 4-8: Source of Energy for Over Half of Cooking in Port Vila**

**Table 4-15: Typical Electricity Use for Cooking Appliances Use**

Cooking Appliance	Assumed kWh/year
Electric Stove (oven & 4 elements)	1,460
Electric Stove (2 elements only)	876
Microwave Oven	137
Rice Cooker	82
Electric kettle	37

Source: See ADB/PEEP2, 2014 in Background Materials

griddles and table-top ovens (for which consumption is low but unknown), the total is roughly 1 million kWh.

**Table 4-16:  
Approximate Annual Consumption of Electricity for Household Cooking in Port Vila**

Type of Cooking Appliance	Number from Surveyed HH	Estimated Total Number in All Port Vila HHs	Assumed kWh per unit/year	Estimated Total kWh per year in all Port Vila HHs
Electric stoves *	230	2031	280	568,684
Rice cookers	329	2905	82	238,229
Kettles	316	2790	37	103,246
Microwave ovens	78	689	137	94,363
Total				1,004,522

\* No information from the survey on the type. Most are probably 2 element so assume 1000 kWh on average. From table 4-13, assume 28% of cooking is with electricity: 38%\*20% + 34% \*20% + 28%\*50%. 28% of 1000 kWh = 280 kWh. (This ignores the 13% over-estimate for cooking in Table 4-13).

## 4.5 Electricity Used for Televisions and Computers

### 4.5.1 TVs, DVD players and Game Consoles

As shown in Table 4-17, 819 households (81%) reported at least one TV set. 42 households reported a second TV and nine households a third, with about 0.9 TVs per household responding.<sup>15</sup> 18% of TVs are flat-screen models, which are considerably more energy-efficient than the older Cathode Ray Tube (CRT) types of the same size, 94% of respondents are satisfied with their TV and only 19% plan to replace them in the near future.<sup>16</sup> 23% have a satellite TV set-up box and 79% a DVD player. Only 46 respondents (13% of 363 who responded) have a game console (not shown in the table). There was no information on the TV screen size but the average nameplate power was reported by 256 respondents as 350 watts.

**Table 4-17: Television and DVD Player Ownership in Surveyed Households, Port Vila \***

Location of Television			Screen Type			Satellite TV box		
Location	No.	%	Type	No.	%	Yes or No	No.	%
Living room	655	80.0	Flat	146	17.8	Yes	179	22.9
Bedroom	154	18.8	CRT	672	82.2	No	602	77.1
Dining room	9	1.1						
Kitchen	1	0.1						
Total reporting (hh)	819	100.0	Total	818	100.0	Total	781	100.0
Satisfaction with TV			Plans for TV Replacement?			Do You have DVD Player?		
Satisfied?	No.	%	Yes or No	No.	%	Yes or No	No.	%
Yes	754	93.8	Yes	150	18.9	Yes	632	78.9
No	50	6.2	No	643	81.1	No	169	21.1%
Sample	804	100.0	Sample	793	100.0	Sample	801	100.0

\* Table 4-17 & 4-18 cover the first TV set and other appliances listed only

<sup>15</sup> The 2009 census reported a slightly higher number: 1.01 TVs per urban household nationally. See Table 2-1.

<sup>16</sup> Of 109 households reporting on when they plan to get a new TV, the minimum time was 0 months, median 7 months, average 8.45 months and longest time 36 months.

Usage patterns for television sets (TVs), DVD players and Game consoles are reported in Table 4-18. Average TV usage ranged from 5.7 hours daily on school days and Sundays to a high of 6.7 hours during school holidays. (However, the reported maximum daily usage of 24 hours is very unlikely, so the averages may be too high.) Those who responded reported using 7.3 DVDs per week on average (although 250 maximum seems to be a reporting error). The few people who reported having game consoles average 3.6 hours per week of use. Although not shown in either table, of 653 households that reported, 49% said their TVs are always connected to the power and 51% said they unplug the TV (or switch off the power at the wall), when it is not in use. Leaving a TV with a satellite box plugged in can use a considerable amount of stand-by power.<sup>17</sup>

**Table 4-18: Reported TV, DVD and Game Console Usage in in Surveyed Households, Port Vila**

TV Use	School Days (hours/day)	School Holidays (hours/day)	Saturdays (hours/day)
Average	5.7	6.7	6.2
Median	4	5	5
Minimum	0	0	0
Maximum	24	24	24
Total reporting (hh)	759	708	711
TV, DVD & Games	TV on Sundays (hours/day)	DVD Usage (DVDs per week)	Game Console Usage (hours/week)
Average	5.7	7.3	3.6
Median	4	4	2
Minimum	0	0	0
Maximum	24	250	28
Total reporting (hh)	703	585	49

#### 4.5.2 Personal Computers

351 Port Vila households (34.8%) reported at least one personal computer (PC). 28 households had a second PC, seven had a third, two had a fourth, and one reported eight PCs<sup>18</sup>, for a total of 392 PCs. As summarised in Table 4-19, the main use reported (by 347 households) for PCs was writing (33%), school work (24%), games (12%) and social media such as Facebook, Twitter, You Tube, etc.

22% of reported PCs were desktop models, 87% were flat screen models, 76% were bought new, and 74% were bought locally. Of those households with PCs, about a quarter have an ink-jet printer, a laser printer or both.

73% of PCs have been bought since 2010 and only 17% of those with PCs plan to replace them in the near future. For those who

**Table 4-19:  
Main Use of PCs in Surveyed  
Households, Port Vila**

Use	No.	%
Writing	116	33.4
Other	84	24.2
School	63	18.2
Games	40	11.5
Facebook	28	8.1
Research	11	3.2
Email	5	1.4
Total	347	100.0%

<sup>17</sup> Monitoring of 5 satellite TV set-up boxes in Fiji several years ago indicated an average of use of 15 watts (equivalent to a typical compact fluorescent light) when it was plugged in but not being used. Assuming the TV is used 7 hours daily, this is 15w used unnecessarily for 14 hours per day or nearly 77 kWh/year. At an assumed charge of 50 vatu/kWh, this is 3800 vatu per year wasted, assuming that the satellite boxes in Vanuatu use about the same amount of power. The only benefit of keeping it plugged in is a bit faster star-up.

<sup>18</sup> The household could have had more than 8, as that was the maximum the spreadsheet could accommodate.

plan to obtain a new PC, the average time until planned replacement is 7.0 months. Among computer users, Internet access was high at nearly 70% although only about one in five (22%) have Internet access through wi-fi. Table 4-20 summarises most of this data.

**Table 4-20: Personal Computers and Printers in in Surveyed Households, Port Vila \***

Desktop or Laptop PC?			Bought New or Used?			Bought Locally?		
Type	No.	%	Type	No.	%	Where	No.	%
Desktop	77	21.9	New	264	76.1	Locally	249	74.3
Laptop	274	78.1	Used	83	23.9	Overseas	86	25.7
Total reporting (hh)	351	100.0	Total	347	100.0	Total	335	100.0
Do you have an ink-jet printer			A Laser printer?			Plans to Replace PC?		
Yes or No?	No.	%	Yes or No	No.	%	Yes or No	No.	%
Yes	70	23.1	Yes	84	25.3	Yes	59	17.0
No	233	76.9	No	248	74.7	No	289	83.0
Total reporting (hh)	303	100.0	Total	332	100.0	Total	348	100.0
Internet Access?			Always connected to power?			Approx. Year Obtained?		
Yes or No ?	No.	%	Yes or No	No.	%	Yes or No	No.	%
Yes	232	68.8	Yes	205	60.8	2010 or after	178	73.4
No	105	31.2	No	132	39.2	Before 2010	77	46.6
Total reporting (hh)	337	100.0	Total	337	100.0	Total	255	100.0

\* Table 4-20 & 4-21 cover the first computer per household only.

Daily hours of reported personal computer use are summarised in Table 4-21, with least use during school days and most during school holidays and Saturdays. As with reported TV viewing, the maximum of 24 hours daily suggests some reporting errors.

**Table 4-21: Personal Computer Daily Usage in Surveyed Households, Port Vila (hours/day)**

Measure	School Days	School Holidays	Saturdays	Sundays)
Average	4.6	5.5	5.6	4.9
Median	3	4	4	3
Minimum	1	0	0	0
Maximum	24	24	24	24

#### 4.5.3 Electricity Use of Televisions and Personal Computers

Electricity use of different TVs and PC equipment, even if the hours per day use are accurate, can vary considerably depending on screen size, screen type, make, model, and how they are used (e.g. whether energy-saving features such as low power mode for TVs and sleep/hibernate for PCs are used). Any estimates of electricity for these appliances in Port Vila are no more than roughly indicative. Table 4-22 on the next page suggests that TVs and PC equipment use approximately 1.43 million kWh per year.

**Table 4-22: Indicative Estimate of Electricity Used  
for Household Televisions and Personal Computers in Port Vila**

Appliance	kWh per year each	No. in surveyed households	Estimated Total in All HHs, Port Vila	Estimated Total kWh/year in All HHs, Port Vila
Desktop PC with CRT	263	46	406	106,831
Desktop PC with flat screen	175	31	274	47,905
Laptop, flat screen	70	274	2420	169,369
TV, CRT screen	140	672	5934	830,773
TV, flat screen	202	146	1289	260,429
Laser printer	15	84	742	11,126
Inkjet printer	2	70	618	1,236
Total				1,427,669

Notes: 1) Desktop PC with CRT 150w, desktop with flat screen 100w laptop 40w, all operating 5 hrs/day.  
2) TV with 19" CRT screen 80w, with 32" flat screen 115w, all operating 5 hours/day  
3) Laser printer 300w, inkjet printer 30w, all 1 hour per week assumed.

#### 4.6 Other Electrical Household Appliances in Port Vila

92% of all surveyed hh reportedly had mobile phones, with an average of 3.61 per household, a minimum of none and a maximum of eighteen. Reportedly, 36% leave their chargers plugged in while not in use (which can continue to consume electricity).

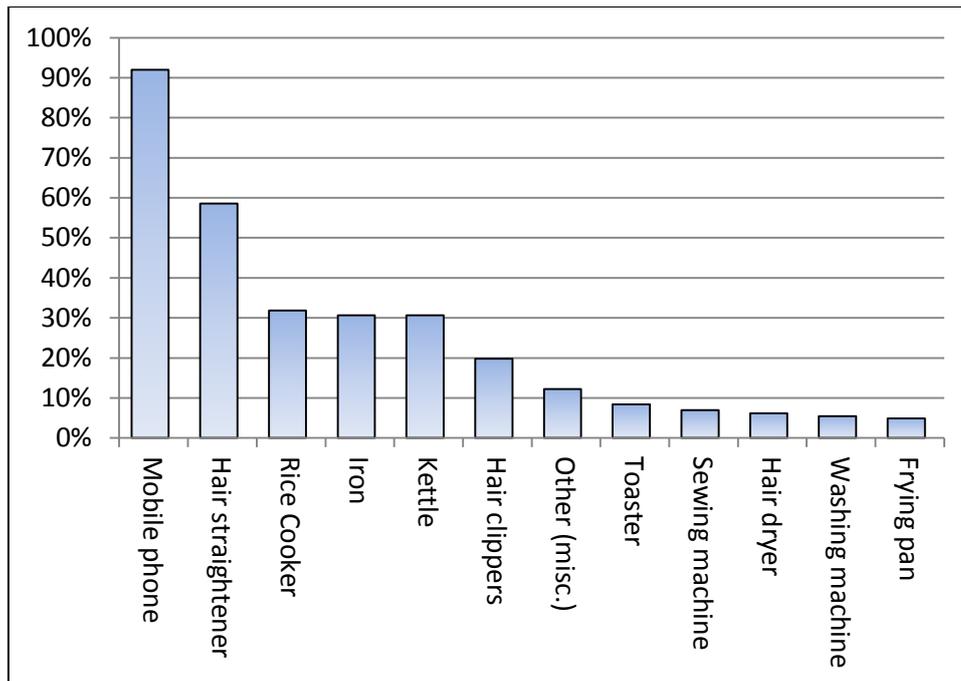
Only 682 households (67.6%) reported any other household electrical appliances. Data are summarised in Table 4-23. Other than mobile phones, the most common small appliance is the hair straightener, with nearly 1,900 in 591 households (nearly 60% of households). Over 30% of households had electric rice cookers, irons and kettles. A fifth had hair clippers, with other appliances in less than 10% of households.

Figure 4-9 illustrates other appliance ownership for appliances reported in about 5% or more of households.

**Table 4-23: Other Electrical Appliances  
in Surveyed Households, Port Vila**

Appliance in surveyed households	Total appliances	HH with appliance	% HH with appliance
Hair straightener	1,894	591	58.6%
Rice Cooker	329	321	31.8%
Iron	320	309	30.6%
Kettle	316	309	30.6%
Hair clippers	203	200	19.8%
Other (misc.)	135	123	12.2%
Toaster	88	85	8.4%
Sewing machine	72	70	6.9%
Hair dryer	68	62	6.1%
Washing machine *	56	55	5.5%
Frying pan	50	49	4.9%
Griddle	17	17	1.7%
Oven (table-top)	11	11	1.1%
Clothes dryer	10	9	0.9%
Hot water dispenser	7	7	0.7%
Water cooler	5	5	0.5%
Dish washer	2	2	0.2%
Total in surveyed hh	3,583		
Estimated total in all hh, Port Vila **	31,638		

\* Of 56 washing machines 27 (50%) are top-loading single tub, 18 (32%) are top-loading dual tub, 6 (11%) are ringer-type, and 4 (7%) are front-loading. \*\* Assuming 8.83 x number in surveyed households



**Figure 4-9: Other Electrical Appliance Ownership in Port Vila**  
(% of Port Vila households based on surveyed households)

Only 19 Port Vila households, or less than 2% of those surveyed, had water heating. Most (11) were solar systems but the sample size may be too low to be representative of Port Vila. Water heating systems are summarised in Table 4-24.

With such limited information on a large number of different appliances, with unknown daily usage patterns, any indications of their electricity use are necessarily only crude estimates. Assume that the appliances listed in Table 4-23 were used on average about 5 hours per week. The average nameplate rating is 985 watts. Assuming average consumption of 300w, energy use is about 0.3 million kWh for the sample households or 2.5 million for Port Vila overall. Subtracting energy use for rice cookers, kettles and microwave ovens, the total is 2.0 million kWh.

**Table 4-24:**  
**Water Heaters, Port Vila**

Type	No.	% of hh
Solar flat	6	0.6
Solar tube	5	0.5
Solar with back-up	7	63.6 *
Tank-type electric	4	0.4
Tank-type gas	0	0
Instant-on electric	4	0.4
Instant-on gas	0	0
Total	19	1.7

\* % of those hh with solar systems  
All percentages rounded off

#### 4.7 Overall Electricity Use in Port Vila Households

Adding the estimates from previous sections, rounded off, the estimated total Port Vila residential consumption is about 11 GWh (11 million kWh) as summarised in Table 4-25. This is somewhat less than UNELCO sales of about 15 GWh to households. Some of the error is no doubt due to inaccurate reporting by households, and the estimates used in this chapter on the electricity consumption of specific appliances. Also as noted in Section 3.7, the Port Vila electricity concession

**Table 4-25: Estimated Electricity Use in all Households, Port Vila**

Appliances	Source of Estimate	Estimated Energy (GWh)	Percent of Total
Lighting	Table 4-2	2.14	20
Freezing /fridges	Table 4-8	2.05	19
Fans & A/C	Table 4-12	2.35	21
Electric cooking	Table 4-16	1.0	9
TVs & PCs	Table 4-22	1.43	13
Small appliances	Section 4.6	2.0	18
Total		10.97	100%

extends beyond the city but the survey covered only Port Vila proper, introducing some error. Another source of error is discussed in the next section: the sharing of one meter by several or more households.

#### 4.8 Sharing of Household Electricity Meters in Port Vila & Paying for Electricity

As shown in Table 4-26, of the 1,009 households surveyed, 691 (68.6%) have their own meter, that is the meter is not shared with any other household. Of the 31.5% of households that share a meter, about half reportedly share with one other household and about half share with more than one household. If the surveyed households reported accurately, and the households are representative of Port Vila, the weighted average is about 1.8 households per meter, almost certainly primarily low-income households with low electricity usage. Depending on the cost of metering individual households, there could be opportunities for considerably more households to be charged at the Port Vila concessionary rate for use below 60 kWh per month.

The estimates of households sharing a meter seem to be very high, and discussions with the URA indicate that they believe the actual figure is considerably lower.

**Table 4-26: Sharing of Household Electricity Meters in in Surveyed Households, Port Vila**

Households	Meter not shared	Number of households Sharing an Electricity Meter							Maximum number of hh sharing one meter	Total Households
		2	3	4	5	6	7	>7		
HH per meter	1	2	3	4	5	6	7	>7		
No of HH	691	143	58	43	31	14	14	15	13	1009
% of HH	68.5%	14.2%	5.7%	4.3%	3.1%	1.4%	1.4%	1.5%	1.3%	100%

99% of those who reported (978 households) pay for electricity by cash, 0.3% electronically and 0.7% by other means. UNELCO has a base rate which varies monthly. For households, the cost is highly subsidised (effectively a Lifeline Tariff) for consumption  $\leq 60$  kWh/m (18.4 vatu/kWh in April 2013), the cost was 65.3 vatu/kWh for all consumption from 61-120 kWh/m, and 162.0 vatu for consumption above 120 kWh/m. For those using about 140 kWh/m,<sup>19</sup> it is less expensive to shift to a fixed fee of 3563 vatu per month for 15 amp service plus 47 vatu/kWh.

Figure 4-10 shows the cost of electricity for Port Vila households in April 2013 for a consumption level of zero through 300 kWh per month, including fixed charges and value-added tax (VAT). The 756 surveyed Port Vila households that estimated their monthly electricity bill are shown in Table 4-27. The implied consumption in kWh/m is from Figure 4-10 (or the data behind the figure).

**Table 4-27: Monthly Electricity Cost & Consumption in Surveyed Households, Port Vila**

Measure	Cost vatu/m	Implied kWh/m
Average	5,662	117
Median	3,000	82
Min	200	10
Max	45,000	> 750

<sup>19</sup> This cut-off consumption level varies slightly each month (as tariffs are recalculated monthly according to the concession agreement) and also the customer's consumption during the previous three months.

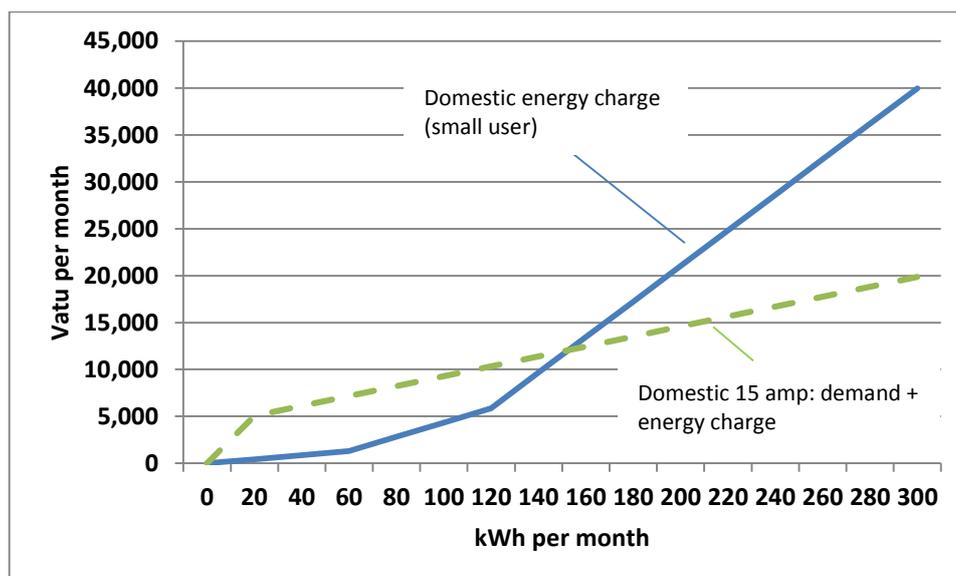


Figure 4-10: Household Cost of Electricity in Port Vila for 0 to 300 kWh/month

#### 4.9 Information on Port Vila Households Unrelated to Electricity Use

This section provides a number of tables of information which is not directly related to household electricity use but may be of interest. There is no text as the information is self-explanatory. The data refer to those households that were surveyed in Port Vila.

Table 4-28: Main Building Surveyed - Construction Materials and Colour

Material	Walls	Roof	Colour	Walls	Roof
Blank	116	118	Blank	108	110
Unknown	20	22	Unknown	12	14
Corrugated Iron	254	885	No paint/galvanised	428	619
Wood	99	3	white color	244	110
Bricks/Stone	103	2	light color	193	116
Concrete block	485	18	dark color	78	64
Fale/coconut	1	1	medium color	54	86
Steel Frame	30	4			
Other	17	74			
Total hh surveyed	1,009	1,009	Total hh surveyed	1,009	1,009

Table 4-29: Type of Sanitary Facilities

Response	Number	Percent
Flush toilet	774	77
Water sealed	131	13
Outside pit	59	6
None	0	0
Unknown	45	4
Total hh	1,009	100

Table 4-30: Households Washing with a Washing Machine

Response	Number	Percent
Unknown	38	3.8
Yes	98	9.7
No	870	86.5
Total HH	1,006	100.0

Average of 2.9 loads per week but sample was very small

**Table 4-31: Age Distribution of People in Surveyed Households, Port Vila (years)**

Number	Under 5	5-10	11-17	18-35	36-50	51-65	Over 65
Blank	260	282	275	189	258	335	418
unknown	164	186	179	93	162	239	322
Average	0.98	0.85	1.04	2.24	1.23	0.53	0.13
Median	1	1	1	2	1	0	0
Min	0	0	0	0	0	0	0
Max	5	8	9	10	8	4	10
HH Surveyed	1,009	1,009	1,009	1,009	1,009	1,009	1,009

**Table 4-32:  
Type of residence in Surveyed  
Households, Port Vila**

Type	No.	%
Unknown	18	2
Single storey	902	89
Double storey	15	2
Over shop (not owner)	68	7
Three or more storey	1	<<1
Over shop (owner)	1	<<1
Other	3	<<1
Total hh	1,008	100

<<1 = much less than 1%

**Table 4-33: Residents  
Owning & Registering a Motor Vehicle in  
Surveyed Households, Port Vila**

Response	Number	Percent
Unknown	15	1.5
Yes	232	23.0
No	762	75.5
HH Surveyed	1009	100.0
Type of vehicle:	Number	Percent
Automobiles	99	36.3
Motorcycles	14	5.1
Trucks	49	17.9
Vans	107	39.2
Buses	4	1.5
Total vehicles	273	100.0

Total vehicles > yes responses as some hh own more than one. Average of 0.36 vehicles/hh; maximum of 6

**Table 4-34: Reported Sources of Income in Surveyed Households, Port Vila**

Source of Income	Main Income	2nd Income	3 <sup>rd</sup> Income	4 <sup>th</sup> Income	5 <sup>th</sup> Income	6 <sup>th</sup> Income
Unknown / NA	36	438	825	971	1000	1005
Government	326	35	6	1	0	0
Salaried Private	480	233	53	16	8	3
Farming	7	20	3	3	0	0
Skilled Worker	23	62	22	4	0	0
Own business internal *	94	139	57	3	1	1
Own business external *	23	49	19	4	0	0
Fishing	0	5	2	1	0	0
Pension	10	9	1	1	0	0
Remittances	6	14	21	4	0	0
Other	4	5	0	1	0	0
HH Surveyed	1,009	1,009	1,009	1,009	1,009	1,009

\* Internal refers to business based at the home; external is business away from the homes

## 5. RESULTS OF LUGANVILLE SURVEY

### 5.1 Electricity used for Lighting in Luganville

The 329 Luganville households surveyed had, on average, 4.3 lights each. Of these (Table 5-1), 47% were Compact Fluorescent Lights (CFL), 41% were Fluorescent Tube Lights (FTL), 11% were Incandescent Lights, and 2% were other types. These percentages are similar to those of Port Vila. Of all lights, 87% are fluorescent, the main types illustrated in Figure 10 of Section 4 of this report. Assuming that the survey is representative of electrified homes in Luganville overall, there are over 9,000 household lights installed in all households in Luganville.

As in Port Vila, most CFLs used in Luganville are plug-in type CFLs with a separate ballast. The remainder have integrated electronic ballasts (e.g. they can replace standard incandescent screw-in or pin/bayonet-type lights).

61% of Fluorescent Tube Lights (FTLs) in the surveyed households in Luganville are the old, inefficient T12s, with fewer standard T8s and very few of the more efficient T5s.

Inefficient standard incandescent bulbs account for 11% of surveyed lights, of which 60% are the pin type. Other lights account for only 2% of the total, mostly efficient Light Emitting Diode (LED) type, with very few inefficient halogens.

Lighting by type in the Luganville surveyed households is presented graphically in Figure 5-1:

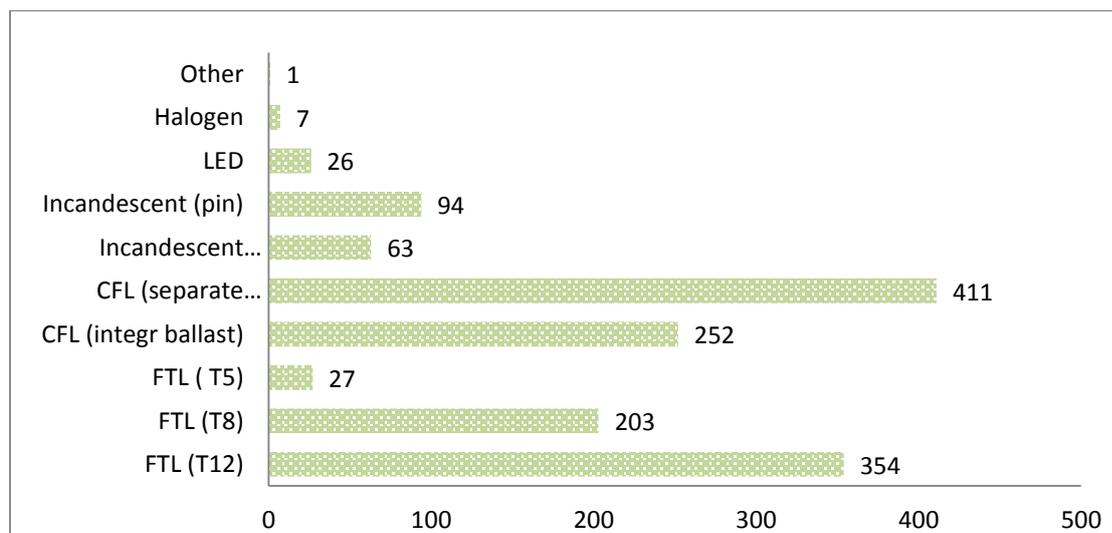


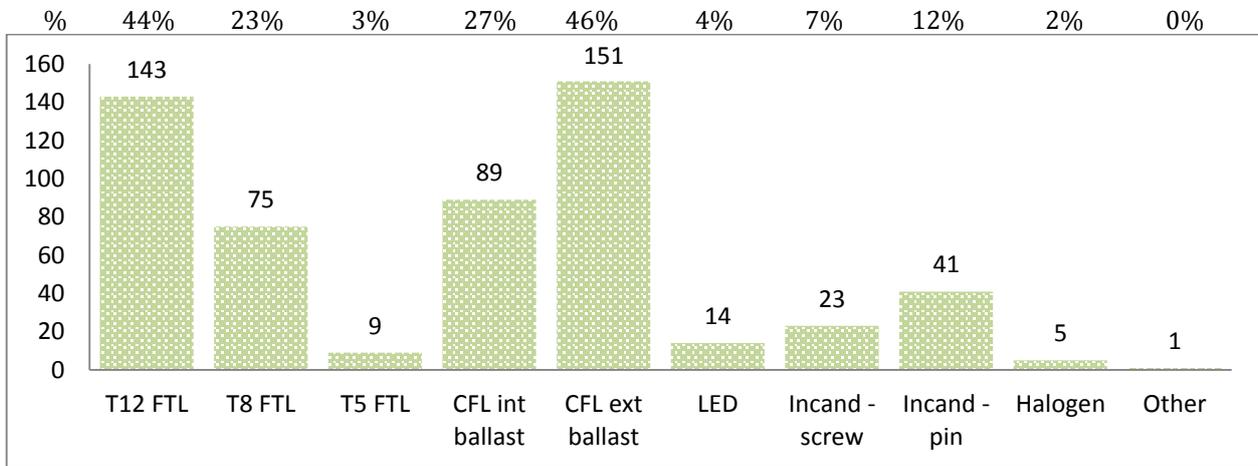
Figure 5-1: Lighting by Type in Luganville Surveyed Households (2013)

Table 5-1:  
Total Surveyed Household  
Lighting by Type, Luganville

Type of Lighting	No.	%*
Compact Fluorescent Lights (CFL)		
CFL (integrated ballast)	252	18%
CFL (separate ballast)	394	28%
<i>Total CFL</i>	<i>646</i>	<i>46%</i>
Fluorescent Tube Lights (FTL)		
T12 (fat)	351	25%
T8 (thinner)	203	14%
T5 (thin)	27	2%
<i>Total FTL</i>	<i>581</i>	<i>41%</i>
Incandescent Lights		
Screw-in	63	4%
Pin (bayonet type)	94	7%
<i>Total incandescent</i>	<i>157</i>	<i>11%</i>
Other Lights		
LED	26	2%
Halogen	7	~0%
Other	1	~0%
<i>Total Other</i>	<i>34</i>	<i>2%</i>
<i>Total of all types</i>	<i>1,418</i>	<i>100%</i>

Note: \* Percentages rounded off

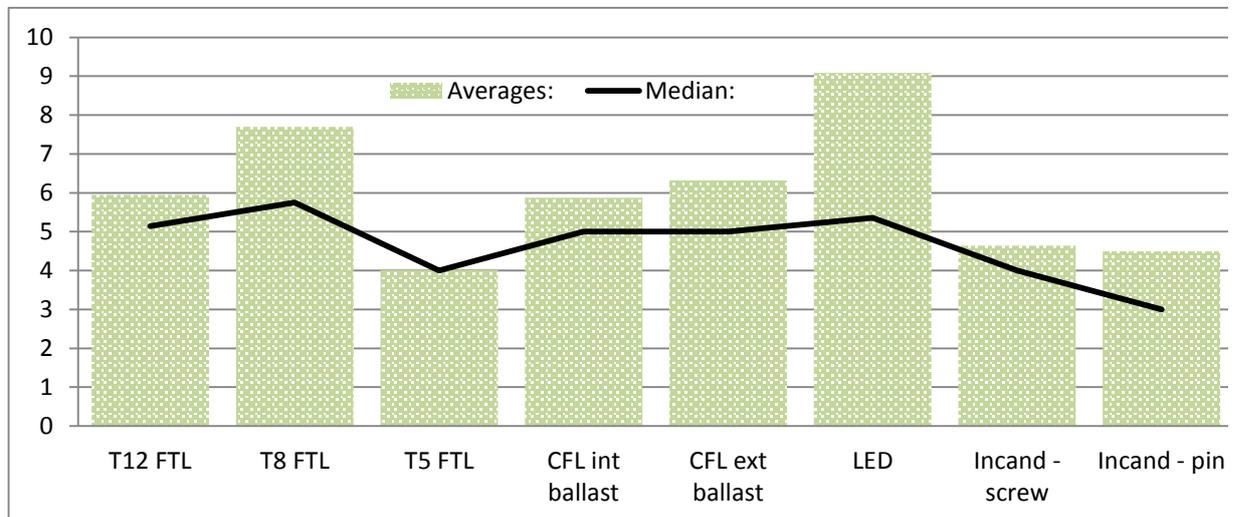
Lighting types are not evenly distributed among all households. In Figure 5-2, below the percentages and numbers of surveyed households with various types of lighting are summarised. Nearly half of all Luganville households have CFLs with separate ballasts and nearly as many use older inefficient T12 FTLs:



**Figure 5-2: Number of Surveyed Households with Different Lighting Types, Luganville**

Figure 5-3 below shows the typical usage of different light types in surveyed Luganville households in hours per day:

Average	5.9	7.7	4.0	5.9	6.1	9.1	4.6	4.5
Median	5	5.75	4	5	5	5.4	4	3

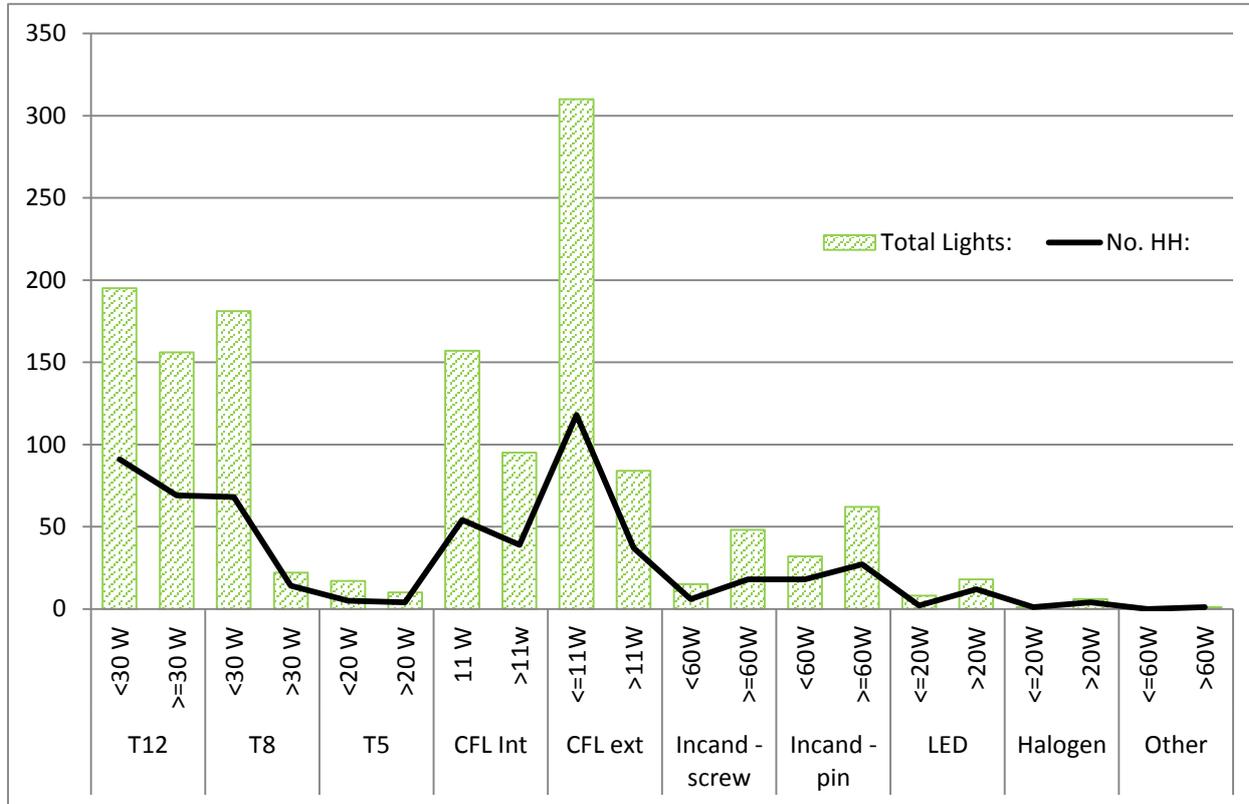


**Figure 5-3: Average and Median Usage of Light Types in Surveyed Luganville Households (hours per day)**

LED, halogen & other are not illustrated in Figure 5-3

Figure 5-4 summarises the wattage of various light types according to the questionnaire categories in surveyed households in Luganville.

<b>Lights</b>	195	156	181	22	17	10	157	95	310	84	15	48	32	62	8	18	1	6	0	1
<b>No. HH:</b>	91	69	68	14	5	4	54	39	118	37	6	18	18	27	2	12	1	4	0	1



**Figure 5-4:**  
**Total Numbers of Lights by Type, Wattage**  
**and Number of Surveyed Households with the Lights, Luganville**

Electricity used for lighting for Luganville households is shown in Table 5-2. Older inefficient T12 FTLs accounting for 35% of the total, T8s for 19%, CFLs for 24%, incandescent lights 18% and other types less than 1%.

**Table 5-2: Estimated Electricity Used for Lighting for Surveyed Households and all Households, in Luganville**

Light type	Ave Use Hours/day	Watts *	Number of lights	Estimated kWh/year	Estimated % Energy Use by Light Type
FTL (T12) 2 feet	5.9	30	195	12,598	14.5%
	5.9	53	156	17,805	20.4%
FTL (T8) 2 feet	7.7	27	181	13,735	15.8%
	7.7	46	22	2,844	3.3%
FTL (T5) 2 feet	4	16	17	397	0.5%
	4	31	10	453	0.5%
CFL (internal ballast)	5.9	11	157	3,719	4.3%
	5.9	14	95	2,864	3.3%
CFL (external. ballast)	6.1	14	310	9,663	11.1%
	6.1	25	84	4,676	5.4%
LED	9.1	10	8	266	0.3%
	9.1	25	18	1,495	1.7%
Incandescent (screw -in))	4.6	40	15	1,007	1.2%
	4.6	70	48	5,641	6.5%
Incandescent (pin)	4.5	40	32	2,102	2.4%
	4.5	70	62	7,128	8.2%
Halogen	5	20	1	37	0.0%
	5	50	6	548	0.6%
Other	5	40	0	0	0.0%
	5	70	1	128	0.1%
Total for survey sample			1,418	87,106	100%
<b>Total for Luganville</b> (See note **)			<b>9,373</b>	<b>575,771</b>	

Notes: \* Average per light type; includes ballast if any.

\*\* From Section 3.7, multiply the surveyed households by 6.61 to extrapolate to Luganville overall.

231 Luganville households (70% of those surveyed) have eternal lighting reportedly used on average for 10.8 hours per night for security. Of those with external lighting, 99% had only one or two outside lights. Over half of these lights were inefficient T12/T8s or incandescent, suggesting considerable scope for cost-effective retrofits.

## 5.2 Electricity Used for Household Refrigerators and Freezers in Luganville

### 5.2.1 Refrigeration and freezers

As shown in Table 5-3, of the 329 Luganville households surveyed, 275 responded to questions on refrigeration. Of these, only 77 (28%) reported one or more refrigerators,<sup>20</sup> with only one household reporting a second refrigerator. 17% did not report a year of purchase. For those who did, 44% were purchased since 2010.

**Table 5-3: Numbers and Ages of Household Refrigerators in Surveyed Households, Luganville**

Year of Purchase	Fridge 1	Fridge 2	Total	% of Total
Before 2010	30	0	30	38%
2010 - April 2013	34	0	34	44%
<i>Year not known</i>	13	1	14	18%
Total	77		78	100%
% of hh with refrigerators	28%	< 1%	-	-

As shown in Table 5-4 and Figure 5-5, for those who provided information, 61% of refrigerators (48+8+5) had a separate freezing section, while 39% had either a small freezing section within the fridge, or no freezing section. About 75% of refrigerators were purchased or otherwise obtained new and 25% used. Over 40% of all refrigerators are under 3 years old, but only 6% who reported had an energy consumption label indicating the likely electricity use. Although not shown in the table, 34% of 74 households reported that refrigerators were self-defrosting, and 66% manual defrosting. Self-defrosting units can significantly increase electricity consumption.

**Table 5-4: Type of Refrigerator and Energy Use labelling in Surveyed Households, Luganville**

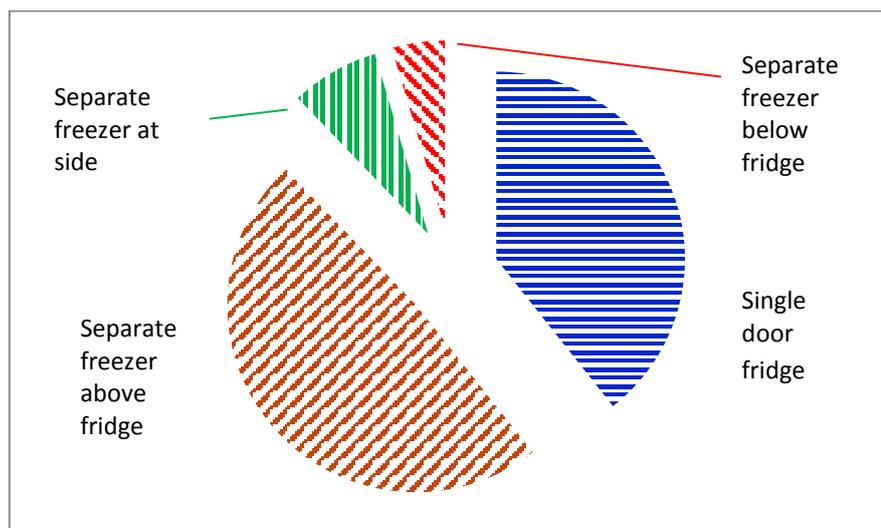
Refrigerator / Freezer Arrangement			Bought New or Used?			Energy Use label?		
Refrigerator Type?	Number	%	New?	Number	%	Label?	Number	%
Single door *	26	39	New	55	75	No	60	94
Separate freezer above fridge	32	48	Used	18	25	Yes	4	6
Separate freezer at side of fridge	5	8	Total	73	100	Total	64	100
Separate freezer below fridge	3	5	Unknown	5		Unknown	14	
Total refrigerators	66	100						
Unknown	12							

\* Usually with a small inside freezing section at top of fridge interior;

\*\* It is assumed that 'unknowns' don't significantly affect the percentages of refrigerator types

<sup>20</sup> This is far lower than urban Sanma province households as reported in the 2009 census (49%; see Table 2-1). The census reported total numbers for electrified households, not households with one or more refrigerator, so 49% is a slight overestimate.

Over 80% of the 44 households who responded said they had no plans to purchase a new refrigerator in the near future (generally within 12 months). 79% of all refrigerators reportedly had good door seals but 21% had poorly-fitted or damaged seals, which can significantly increase electricity use.



**Figure 5-5: Refrigerators by Type in Luganville**

The same percentage of refrigerators had doors in poor condition (probably but not necessarily the same units as those with poor seals), also indicative of high energy use. There may be opportunities for relatively inexpensive improvements to reduce electricity use in about a fifth of refrigerators by replacing or improving existing seals. Damaged or badly closing doors are more difficult to fix. 94% of those who responded reportedly spend under 10,000 vatu/month (about US\$100) on electricity for their refrigerator, which is unsurprising.

**Table 5-5: Refrigerator Replacement Plans, Door Seal Quality and Door Condition**

Replacement or Purchase Plans?			Door Seal Quality?			Door Condition?		
To be Replaced?	No.	%	Seal?	No.	%	Door?	No.	%
No	36	82	Good	60	79	Good	60	79
Yes	8	18	Bad	16	21	Bad	16	21
Total reporting	44	100	Total	76	100	Total	76	100

As shown in Table 5-6 below, 56 households, or 21% of the 273 that reported, have a stand-alone freezer. Of those who reported, 93% had the more efficient top-opening models, 84% bought the freezers new, and 88% had no labels indicating electricity consumption. For the 49 households that reported, 82% purchased the freezers since 2000, an 18% had older models.

**Table 5-6: Type of Freezer & Energy Use labelling in Surveyed Households, Luganville**

Freezer Ownership			Bought New or Used ?			Energy Use label ?		
Door Arrangement?	Number	%	New?	Number	%	Label?	Number	%
Single door at top	31	72	New	46	84	No	36	88
Two doors at top	9	21	Used	9	16	Yes	5	12
Front Opening	3	7	Total	55	100	Total	41	100
Total freezers	43	100	Unknown	1		Unknown	15	
Unknown	13							

83% of those who replied have no plans to purchase a freezer in the next 12 months. As shown in Table 5-7, about 90% reportedly have good quality door seals and the doors are not loose-fitting or damaged. For the other 10%, fixing the doors and seals could result in significant energy savings.

**Table 5-7: Freezer Replacement Plans, Door Seal Quality and Door Condition in Surveyed Households, Luganville**

Replacement or Purchase Plans?			Door Seal Quality?			Door Condition?		
To be Replaced?	No.	%	Seal?	No.	%	Door?	No.	%
No	58	83	Good	49	91	Good	49	91
Yes	12	17	Bad	5	9	Bad	5	9
Total reporting	70	100	Total	54	100	Total	54	100

### 5.2.2 Estimated Electricity Use for Refrigerators and freezers

In Luganville, as in Port Vila, it is not possible from the survey data to calculate the amount of electricity used for household refrigeration and freezers as the size of appliances and their energy efficiency are not known. Typical estimated consumption of electricity for refrigerators/freezers is shown Table 4-7 (of Section 4.2.3). Table 2-3 in Section 2.2 of this report indicates typical volumes of units imported to Vanuatu as follows: one-door refrigerator 170-185 litres, two-door refrigerator (generally with a freezer on top) 250-470 litres, and chest-type freezer 200-300 litres.

Table 5-8 indicates the number of refrigerators and freezers in Luganville households with an estimated electricity consumption for these appliances of about 0.35 million kWh per year in 2013.

**Table 5-8: Approximate Annual Consumption of Electricity for Household Refrigerators and Freezers in All Households, Luganville**

Type of Refrigerator or Freezer *	Number from Surveyed Households	Estimated Number in all HHs in Luganville**	Assumed kWh per unit/year ***	Estimated total kWh per year in all HHs in Luganville
Small 1-door (< 200 l)	31	205	420	86,062
Medium 2-door (250 l)	47	311	480	149,122
Freezer (250 l)	56	370	320	118,451
Total	134	886	n/a	353,635

\* Estimated. From Table 5-4, 39% of refrigerators are single-door & 61% are two-door models.

\*\* Multiply Luganville households surveyed by 6.61.

\*\*\* About 44% of fridges are less than 3 years old, and a third are reportedly self-defrosting. Efficiency may be a bit better than Port Vila. Over 90% of freezers are top-loading with nearly 20% bought before 2000.

### 5.3 Electricity Used for Household Air Conditioning and Cooling Fans in Luganville

Only two households (of 306 which responded to the question) reported having air conditioning. Even for those two, almost no information on type age or energy use was available.

35% of households surveyed (114 of 329) had one or more fans with a total of 181 fans or 0.6 fans per electrified household overall, and 1.59 fans per household for those which had fans. As shown in Table 5-9, nearly two-thirds of all fans were floor-standing models, 20% were ceiling fans, 10% were table fans, and 4% were wall mounted. Assuming that the households surveyed are representative of Luganville, the total number of fans in the city is about 1,200. Nearly 75% of fans are in the bedroom (Table 5-10) and 25% in the living room.

**Table 5-9:  
Number & Type of Cooling Fans in Luganville**

Type of Fan	No. for Households Surveyed	Estimated Total for all HHs in Luganville *	% of total *
Standing (floor)	117	773	65
Ceiling	37	245	20
Table	19	126	10
Wall Mounted	8	53	4
Window	0	0	0
Other	0	0	0
Total fans	181	1,197	100

\* Rounded off

**Table 5-10:  
Location of Fans in Surveyed Households, Luganville**

Room	%
Bedroom	73
Living	25
Work area	1
Other	1
Total	100

Percentages for 177 fans; rounded off

f

Based on reporting from about 100 households, average hot season fan usage was reportedly 6.5 hours per day (minimum 0, median 5, maximum 24) and cool season usage was 1.9 hours (min 0, median 0, max 10). Typical energy use per fan cannot be accurately estimated because almost no data were provided on nameplate wattage. Based on typical Australian usage, a standing pedestal (floor) or ceiling fan uses about 584 kWh per year. Assume 400 of this for Luganville where fans tend to be smaller. This provides indicative – and probably not very accurate – energy consumption (Table 5-11) of 0.5 million kWh for A/C and fans in Luganville.

**Table 5-11:  
Indicative Energy Use for Household A/C & Fans in Luganville**

Appliance	Assumed kWh/year per unit	Estimated Appliances in all HHs, Luganville	Estimated Total kWh/year in all HHS, Luganville
Air conditioning	1,500	13	19,500
Cooling Fans	400	1,197	478,800
Total	-	-	498,300

Number assumes survey results are representative of Luganville overall.

## 5.4 Energy Used for Household Cooking in Luganville

### 5.4.1 Cooking Patterns in Luganville Vila: Energy Types and Frequency of Use

As shown in Table 5-12, cooking in surveyed households in Luganville is dominated by wood-burning stoves, used by 76% of the 261 households who reported. Of those who cook with wood, 71% report

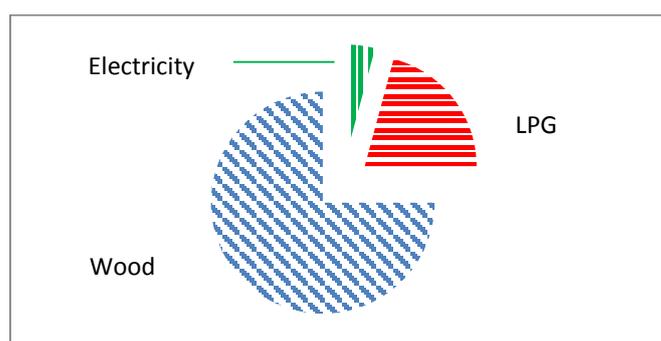
using wood over half of the time. Liquid petroleum gas (LPG) stoves are used by 48% of households of whom 32% report using LPG for over half of cooking. Electric stoves are used by 14% of households, about a fifth of whom say they use electricity for over half of cooking. Kerosene and other fuels are reportedly hardly used for cooking. The reported percentages of energy sources used for half or more of all cooking add up to only 72%, suggesting that respondents' estimates for some energy types are too low, and also because other cooking fuels such as charcoal or coconut oil may not have been reported.<sup>21</sup>

**Table 5-12: Type of Energy for Cooking and Frequency of Use in Surveyed Households, Luganville**

Type of Cooking Appliance by Fuel	Electric stove		LP Gas		Kerosene		Wood	
	No.	%	No.	%	No.	%	No.	%
HH with cooker (yes)	37	14	124	48	2	1	199	76
HH without cooker (no)	224	86	137	52	258	99	62	24
Total reporting	261	100	261		260	100	261	100
HH providing no data	68		68		69		68	
Total surveyed	329		329		329		329	
<i>Usage of cooking unit:</i>								
Small (once in awhile)	19	51	31	25	2	100	23	12
Medium (≤ half of time)	11	30	53	43	0	0	35	18
Large (> half of time)	7	19	40	32	0	0	141	71
Total	37	100	124	100	2	100	199	100

% are rounded to nearest whole percent; No households reported charcoal or other fuel use for cooking.

Figure 5-6 shows the dominance of wood as the main source of energy for cooking on stoves, followed by LPG, with electricity a minor source.



**Figure 5-6: Source of Energy for Over Half of Time Spent Cooking in Luganville**

<sup>21</sup>  $(14\% \times 19\%) + (48\% \times 32\%) + (1\% \times 0\%) + (76\% \times 71\%) = 72\%$ .

### 5.4.2 Overall Electricity Use for Cooking

Before estimating electricity used for cooking overall, other electric appliances used for heating food or water should be considered, such as electric fry pans, griddles, microwave ovens, rice cookers, table-top electric ovens, electric kettles and other appliances.

The ownership of various electrical cooking appliances as reported by some households is summarised in Table 5-13 below. However, only 147 households of the 329 surveyed reported having any appliances so the results are questionable. 182 households (55%) provided no data on appliances. In Table 5-13 below, the bottom row indicates the percentage of households with the listed appliance among all 327 surveyed households (i.e. assuming that non-reporting households have no appliances). Actual appliance ownership may be considerably higher than this estimate.

**Table 5-13:  
Numbers of Other Electrical Cooking Appliances in Surveyed Households, Luganville**

Appliance	Rice Cookers	Kettles	Toasters	Microwave Ovens	Fry Pans	Griddles	Table-top Ovens
Total number of appliances	72	53	13	29	6	1	0
HH with appliance (number)	72	52	13	29	6	1	0
HH with appliance (% of all surveyed households)	22%	16%	4%	9%	2%	<1%	0

Only 35 households explicitly reported on microwave oven ownership, of whom 29 reported yes. It is assumed that others did not have microwave ovens. If this is accurate, only about 9% of households use microwave ovens for cooking. Of these, 86% were button-type and 14% controlled by knobs. There was some limited information typical nameplate wattage and hours of daily use; reported averages were 710 watts and 53 minutes respectively. 55% of respondents say they kept the microwave ovens plugged in all of the time and 45% unplugged the oven (or switched it off at the wall) when not in use. When plugged in, electricity is consumed even if the oven is not being used.

From the data collected and the way the analysis spreadsheet is structured, it is difficult to calculate the average wattage for each type of appliance listed or the typical usage patterns. Nonetheless a rough estimate can be made of overall electricity use for cooking. Table 4-15 (in Section 4.4 of this report) indicates typical electricity use for various appliances. Then Table 5-14 below provides a rough indication of electricity used for cooking in all households in Luganville. Ignoring toasters, fry pans, electric griddles and table-top ovens (for which consumption is low but unknown), the total is roughly 0.14 million kWh.

**Table 5-14: Approximate Annual Consumption of Electricity  
for Household Cooking in all Households, Luganville**

Type of Cooking Appliance	Number from Surveyed HH	Estimated Number for all Luganville HHs	Assumed kWh per unit/year	Estimated total kWh per year in all HHs, Luganville
Electric stoves *	37	245	260	63,700
Rice cookers	72	476	82	39,032
Kettles	53	350	37	12,950
Microwave ovens	29	192	137	26,304
Total				141,986

\* No information from the survey on the type. Most are probably 2 element so assume 1000 kWh on average. From table 5-12, assume roughly 26% of cooking is with electricity: 51%\*20% + 30% \*20% + 19%\*50%. 26% of 1000 kWh = 260 kWh.

## 5.5 Electricity Used for Televisions and Computers in Luganville

### 5.5.1 TVs, DVD players and Game Consoles

As shown in Table 5-15, 263 households (80% of all households surveyed) reported at least one TV set with 276 total TVs (or 1.05 TVs per household for those households with TVs). Reportedly only 5% of TVs are flat-screen LCD models, which are considerably more energy-efficient than the older Cathode Ray Tube (CRT) types of the same screen size, Over 90% of respondents are satisfied with their TV and only 20% plan to replace them in the near future, typically within 6 months. 6% have a satellite TV set-up box and 84% a DVD player. Only 8 respondents (9% of the 86 who responded) have a game console (not shown in the table). The average nameplate power was reported by 130 respondents as 365 watts.

**Table 5-15: Television and DVD Player Ownership in Surveyed Households, Luganville \***

Location of Television			Screen Type			Satellite TV box		
Location	No.	%	Type	No.	%	Yes or No	No.	%
Living room	216	79	Flat	14	5	Yes	17	6
Bedroom	51	19	CRT	262	95	No	258	94
Dining room	2	1						
Other	4	1						
Sample size	273	100	Total	276	100	Total	275	100
Satisfaction with TV			Plans for TV Replacement			Do You have DVD Player?		
Satisfied ?	No.	%	Yes or No	No.	%	Yes or No	No.	%
Yes	251	92	Yes	54	20	Yes	232	84
No	23	8	No	217	80	No	43	16
Sample size	274	100		271	100		275	100

\* Table 5-15 covers the first TV set and other appliances listed only

Usage patterns for TVs, DVD players and Game consoles are reported in Table 5-16. Average TV usage ranged from about 5 hours daily on school days and Sundays to a high of 8.7 hours during school holidays. (However, the reported maximum daily usage of 24 hours is very unlikely, so the averages may be too high.) Those who responded reported using 6.7 DVDs per week on average. The few people who reported having game consoles average 3.0 hours per week of use.

Although not shown in either table, of 199 households that reported, 27% said their TVs are always connected to the power and 73% said they unplug the TV (or switch off the power at the wall), when it is not in use. Leaving a TV with a satellite box plugged in can use a considerable amount of stand-by power.

**Table 5-16: Reported TV, DVD and Game Console Usage in Surveyed Households, Luganville**

TV Use	School Days (hours/day)	School Holidays (hours/day)	Saturdays (hours/day)
Average	7.5	8.7	5.0
Median	5	6	4
Minimum	0	0	0
Maximum	24	24	24
TV, DVD & Games	TV on Sundays (hours/day)	DVD Usage (DVDs per week)	Game Console Usage (hours/week)
Average	5.2	6.7	3.0
Median	4	4	1.5
Minimum	0	1	1
Maximum	24	42	8

### 5.5.2 Personal Computers

Of the surveyed households, 53 (16%) reported at least one personal computer (PC). As summarised in Table 5-17, the main use reported (by 50 households) for PCs was writing (42%), school work and miscellaneous (16% each), games (12%) and social media such as Facebook, Twitter, You Tube, etc. (8%).

30% of reported PCs were desktop models, 70% were flat screen models, 72% were bought new, and 66% were bought locally. Of those households with PCs, about 12% have an ink-jet printer, and 14% a laser printer.

72% of PCs have been bought since 2010 and 22% of those with PCs plan to replace them in the near future. For those who plan to obtain a new PC, the average time until planned replacement is 8 months. Among computer users, Internet access was low (22%) and only 8.5% of those with PCs have Internet access through wi-fi. Table 5-18 below summarises most of this data.

**Table 5-17: Main Use of PCs in Surveyed Households, Luganville**

Use	No.	%
Writing	21	42
Other	8	16
School	8	16
Games	6	12
Facebook	4	8
Accounts	2	4
Research	1	2
Sample	50	100

**Table 5-18: Personal Computers and Printers in Surveyed Households, Luganville \***

Desktop or Laptop PC?			Bought New or Used?			Bought Locally?		
Type	No.	%	Type	No.	%	Where	No.	%
Desktop	16	30	New	36	72	Locally	33	66
Laptop	37	70	Used	14	28	Overseas	17	34
Total reporting (hh)	53	100	Total	50	100	Total	50	100
Do you have an ink-jet printer?			A Laser printer?			Plans to Replace PC?		
Yes or No?	No.	%	Yes or No	No.	%	Yes or No	No.	%
Yes	6	12	Yes	7	14	Yes	11	22
No	46	88	No	45	87	No	39	78
Total reporting (hh)	52	100	Total	52	100	Total	50	100
Internet Access?			Always connected to power?			Approx. Year Obtained?		
Yes or No ?	No.	%	Yes or No	No.	%	Yes or No	No.	%
Yes	11	22	Yes	16	30	2010 or after	23	72
No	38	78	No	37	70	Before 2010	14	28
Total reporting (hh)	49	100	Total	53		Total	37	100

Daily hours of reported personal computer use are summarised in Table 5-19, with least use on Sundays and school days and most during school holiday.

**Table 5-19: Personal Computer Daily Usage in Surveyed Households, Luganville (hours/day)**

Measure	School Days	School Holidays	Saturdays	Sundays)
Average	4.8	5.5	4.8	3.7

### 5.5.3 Electricity Use of Televisions and Personal Computers

Electricity use of different TVs and PC equipment, even if the hours per day use are accurate, can vary considerably depending on screen size, screen type, make, model, and how they are used (e.g. whether energy-saving features such as low power mode for TVs and sleep/hibernate for PCs are used). Any estimates of electricity for these appliances in all households in Luganville are no more than roughly indicative. Table 5-20 below suggests that TVs and PC equipment use approximately 0.31 million kWh per year.

**Table 5-20: Indicative Consumption of Electricity for Household Televisions and Personal Computers in All Households in Luganville**

Appliance	Assumed kWh/year each	Number in surveyed hhs	Estimated Number in all Luganville HHs	Estimated Total kWh/year in All HHs in Luganville
Desktop PC with CRT	263	16	106	27,878
Laptop, flat screen	70	37	245	17,150
TV, CRT screen	140	262	1732	242,480
TV, flat screen	202	14	93	18,786
Laser printer	15	7	46	690
Inkjet printer	2	6	40	80
Total				307,064

Notes: 1) Desktop PC with CRT 150w, desktop with flat screen 100w laptop 40w, all operating 5 hrs/day.

2) TV with 19" CRT screen 80w, with 32" flat screen 115w, all operating 5 hours/day

3) Laser printer 300w, inkjet printer 30w, all 1 hour per week assumed.

### 5.6 Electricity Used for Other Household Appliances in Luganville

92% of all Luganville surveyed households reportedly have mobile phones, with an average of 3.01 phones per household, a minimum of one and a maximum of thirteen for all households with phones. Reportedly, 34% leave their chargers plugged in while not in use (which can continue to consume electricity).

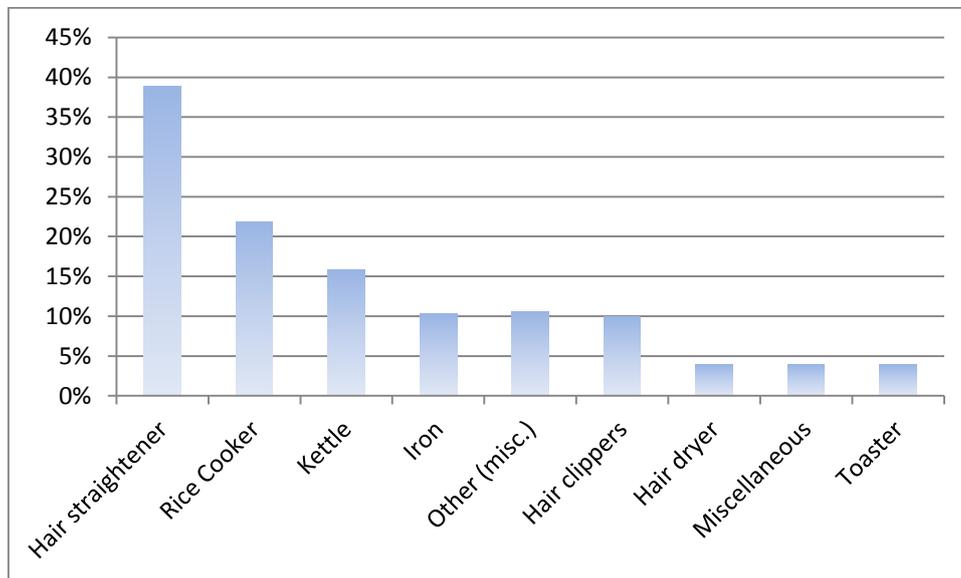
As noted in Section 5.4, only 147 households of the 329 surveyed (45%) reported having any other appliances so results on appliance ownership may be questionable. Data are summarised in Table 5-21. Other than mobile phones, the most common small appliance is the hair straightener, with 353 in 128 of the 329 surveyed households. There were rice cookers, kettles, irons, and hair clippers in 10% or more of surveyed households. No households reported table-top ovens, clothes dryers, hot water dispensers, water coolers or dish washers.

Figure 5-7 illustrates other appliance ownership for appliances reported in 4% or more of households.

**Table 5-21: Other Electrical Appliances in Surveyed and All Households, Luganville**

Appliances in surveyed households	Total appliances	HH with appliance	% HH with appliance
Hair straightener	353	128	38.9%
Rice Cooker	72	72	21.9%
Kettle	53	52	15.8%
Iron	35	34	10.3%
Other (misc.)	35	35	10.6%
Hair clippers	33	33	10.0%
Hair dryer	14	13	4.0%
Miscellaneous	14	13	4.0%
Toaster	13	13	4.0%
Sewing machine	7	7	2.1%
Frying pan	6	6	1.8%
Washing machine *	3	3	0.9%
Griddle	1	1	0.3%
Total in surveyed hh	639		
Total in Luganville **	4,224		

\* Of 3 washing machines 2 are top-loading single tub, and 1 is top-loading dual tub. \*\* Assuming 6.61 x number of surveyed households.



**Figure 5-7: Other Electrical Appliance Ownership in Luganville**  
(% of Luganville households as reported by surveyed households)

With such limited information on a large number of different appliances, with unknown daily usage patterns, any indications of their electricity use are necessarily only crude estimates. Assume that the appliances listed in Table 5-21 were used on average about 5 hours per week. Assuming average consumption of 300w, energy use is about 50,000 kWh for the sample households or 0.3 million for

Luganville overall. Subtracting energy use for rice cookers, kettles and microwave ovens, the total is 250,000 kWh.

### 5.7 Overall Electricity Use in All Luganville Households

Adding the estimates from previous sections, rounded off, the total Luganville residential consumption is about 2.13 GWh (213 million kWh) as summarised in Table 5-22. This is almost identical to actual reported VUI sales of 2.16 GWh to households in 2012 as shown in Table 3.4.

**Table 5-22: Estimated Overall Electricity Use in All Luganville Households**

Appliances	Source of Estimate	Estimated Energy (GWh)	Percent of Total
Lighting	Table 5-2	0.58	27%
Freezing / fridges	Table 5-8	0.35	16%
Fans & air conditioning	Table 5-11	0.50	23%
Electric cooking	Table 5-14	0.14	7%
TVs & PCs	Table 5-20	0.31	15%
Small appliances	Section 5.6	0.25	12%
Total		2.13	100%

### 5.8 Sharing of Household Electricity Meters in Luganville

As shown in Table 5-23, of the 329 households surveyed, 251 (65%) reported that they have their own metering. The meter is not shared with any other household in the building. Of the 35% of households that share a meter, about half share with one other household and about half share with more than one household. The weighted average is about 1.67 households per electricity meter.

**Table 5-23: Sharing of Electricity Meters in Surveyed Households, Luganville**

Households	Meter not shared	Number of households Sharing the Electricity Meter							Total Households
		2	3	4	5	6	7	8	
HH per meter	1	2	3	4	5	6	7	8	
No. of HH	215	62	25	14	6	1	5	1	329
% of HH	65.3%	18.8%	7.6%	4.3%	1.8%	0.3%	1.5%	0.3%	1

## 5.9 Information on Luganville Households Unrelated to Electricity Use

This section provides a number of tables of information which is not directly related to household electricity use but may be of interest. There is no text as the information is self-explanatory.

**Table 5-24: Main Building  
in Households Surveyed in Luganville - Construction Materials and Colour**

Material	Walls	Roof	Colour	Walls	Roof
Blank	24	25	Blank	25	25
Unknown	1	2	Unknown	2	2
Corrugated Iron	34	301	No paint/galvanised	145	230
Wood	122	1	white color	34	12
Bricks/Stone	69	3	light color	73	22
Concrete block	98	0	dark color	24	14
Fale/coconut	0	19	medium color	51	49
Steel Frame	2	2			
Other	3	0			
Total hh surveyed	329	328	Total hh surveyed	329	329

**Table 5-25:  
Type of Sanitary Facilities in  
Households Surveyed, Luganville**

Response	Number	Percent
Flush toilet	158	52
Water sealed	87	28
Outside pit	61	20
None	0	0
Unknown	0	0
Total hh	306	100

**Table 5-26: Washing with  
a Washing Machine in Households  
Surveyed, Luganville**

Response	Number	Percent
Unknown	26	8
Yes	5	1
No	298	91
Total HH	329	100

**Table 5-27: Age Distribution of People in Surveyed Households, Luganville (years)**

Number	Under 5	5-10	11-17	18-35	36-50	51-65	Over 65
Blank	31	28	30	25	28	39	42
Unknown	8	5	7	2	5	16	19
Average	1.1	0.95	1.0	2.0	1.2	0.40	0.13
Median	1	1	1	2	1	0	0
Minimum	0	0	0	0	0	0	0
Maximum	9	6	5	9	8	2	2
HH Surveyed	329	329	329	329	329	329	329

**Table 5-28: Type of Residence in Surveyed Households, Luganville**

Type	No.	Percent
Unknown	2	< 1
Single storey	317	96
Double storey	2	< 1
Over shop (not owner)	5	2
Three or more storey	1	< 1
Over shop (owner)	1	< 1
Other	1	< 1
Total hh	329	< 1

**Table 5-29: Residents Owning & Registering a Motor Vehicle in Surveyed Households, Luganville**

Response	Number	Percent
Unknown	4	1
Yes	61	19
No	264	80
HH Surveyed	329	100
Type of vehicle:	Number	Percent
Automobiles	44	63
Motorcycles	5	7
Trucks	15	21
Vans	5	7
Buses	1	1
Total vehicles	70	100

**Table 5-30: Reported Sources of Income in Surveyed Households, Luganville**

Source of Income	Main Income	2nd Income	3 <sup>rd</sup> Income	4 <sup>th</sup> Income	5 <sup>th</sup> Income
Unknown / NA	2	136	263	311	324
Government	74	6	1	1	0
Salaried Private	178	42	5	3	1
Farming	5	12	10	1	0
Skilled Worker	27	37	9	4	2
Own business internal	21	52	17	3	1
Own business external	7	30	10	1	0
Fishing	1	2	10	4	0
Pension	5	0	0	0	0
Remittances	6	4	1	1	1
Other	3	8	3	0	0
HH Surveyed	329	329	329	329	329

## 6. RESULTS, KEY ISSUES AND RECOMMENDATIONS

### 6.1 Summary of Results

In March and April 2013, surveys of appliance and electricity use were carried out in electrified urban households in Port Vila (1,115 households visited and 1,109 surveyed) and Luganville (352 visited and 329 surveyed), a sample size of over 10% of electrified households, chosen by the Vanuatu National Statistics Office as statistically representative. 48 people were trained and then employed as enumerators for Port Vila and 18 for Luganville.

The survey objectives were to reduce data gaps regarding residential energy use in electrified urban households, and use the information to develop initiatives to assist households reduce electrical energy use without compromising the quality of services. After the survey field work was completed, results were used to develop energy efficient residential lighting projects for both urban centres.

Results of energy consumption based on survey findings are summarised in Table 6-1 below and Figure 6-1 on the next page.

**Table 6-1: Summary of Estimated Electricity Use in Port Vila, Luganville and Overall**

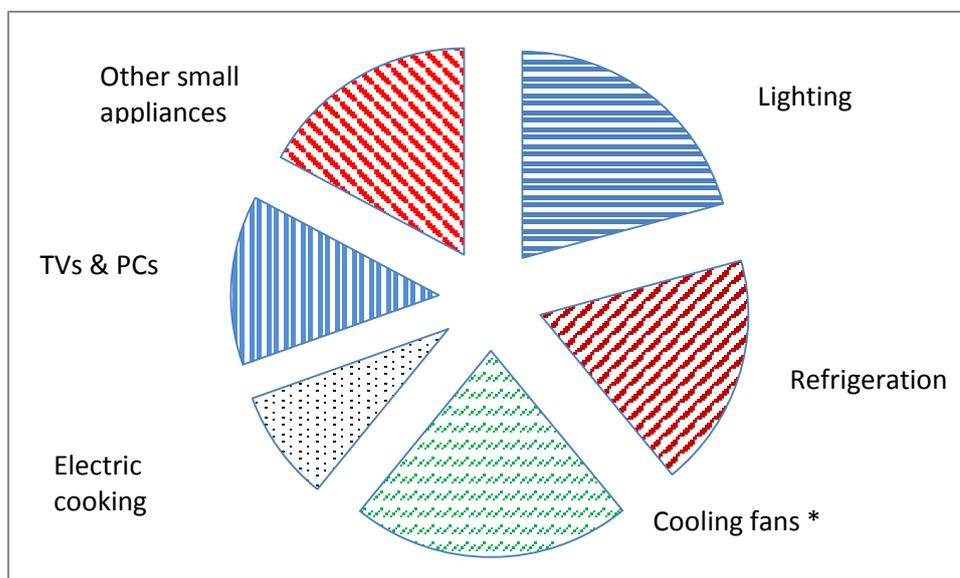
Electricity Use	Port Vila (8,910 electrified hh)		Luganville (2,010 electrified hh)		Overall (10,920 electrified hh)	
	Energy (GWh)	Percent of Total	Energy (GWh)	Percent of Total	Energy (GWh)	Percent of Total
Lighting	2.14	20%	0.58	27%	2.72	21%
Freezers /fridges	2.05	19%	0.35	16%	2.4	18%
Fans & air conditioning **	2.35	21%	0.50	23%	2.85	22%
Electric cooking	1.0	9%	0.14	7%	1.14	9%
TVs & PCs	1.43	13%	0.31	15%	1.74	13%
Other small appliances	2.0	18%	0.25	12%	2.25	17%
Total based on survey *	11	100%	2.1	100%	13.1	100%
Total based on utility sales *	15		2.2			

\* Totals rounded off      \*\* 95% of which) for cooling fans

Assuming that the surveyed households are representative of urban electricity use in Port Vila and Luganville overall, some findings are summarised below.

- Residents of Port Vila used more electricity per household than those of Luganville but the patterns of use were very similar.
- Lighting . On average, there are nearly 4.5 lights per household overall, of which 46% were Compact Fluorescent Lights (CFL), 40% were linear Fluorescent Tube Lights (FTL) and 12% were Incandescent Lights (ILs). Many CFLs were low-quality lights likely to have a limited lifetime. The majority of the FTLs were the old fat T12 type, which are inefficient and are suitable for cost-effective replacement, especially where used outdoors for night-time security lighting (which is common in Port Vila).
- Refrigeration. 40% of hhs had refrigerators (43% in Port Vila; 28% in Luganville) and these accounted for 18% of electricity use. Very few had energy efficiency labels. About a fifth of refrigerators and freezers had leaking or poorly fitting door seals. Replacing these should result in considerably less electricity use for cooling food.

- Fans & air-conditioning (A/C). There were very few residential A/Cs but over 20% of electricity appears to be used for cooling fans. Many were inefficient models but there was not enough information to judge savings potential from newer or more efficient models.
- Cooking was dominated by wood-burning (85% of all electrified households of whom 62% reported using wood for over half of cooking) and to a lesser extent liquid petroleum gas (LPG). About 56% of electric cooking was on electric stoves (rather than rice cookers, microwave ovens, etc.) and these stoves are a costly source of energy for cooking.
- TVs/computers. About 80% of households had at least one TV set, most of which were older inefficient tube-type models. Flat-screens are considerably more energy-efficient for the same size screen size. 28% of households had a personal computer (PC), mostly newer models with a flat screen (whether desktop or laptop). 46% of TVs & 55% of computers were always plugged in, which can waste electricity (even with the appliances turned off) unless the outlets are switched off.
- Other small appliances. 92% of households had mobile phones (3.5 per household) and 56% had hair straighteners. Other common appliances were electric kettles and rice cookers.



**Figure 6-1: Household Electricity Use by Percentage (Port Vila plus Luganville)**  
 \* Includes a small amount of air conditioning

## 6.2 Key Issues Encountered

Initially PEEP planned to undertake the household surveys of energy and appliance use from 18-23 March 2013 in Port Vila and 25 March to 2 April 2013 in Luganville. This was not possible, given delays in receiving funds to purchase survey materials. Field work was delayed by several days due to the inability of the VNSO to provide in a timely manner materials that were necessary for the survey to proceed. This included maps showing areas to be enumerated and the list of selected households to be interviewed in Port Vila urban areas. As households had to be selected using a statistically sound technique (to provide a statistically representative sample), the surveys were postponed.

Further to this was the need to drop interviews initially planned on Saturdays and Sundays as some surveyors were unavailable due to religious considerations. There was also generally a view among

supervisors that the weekend response rate might generally be less representative as most people would be attending religious services; limited time and attention would be given to the interview.

The delay in the Port Vila Survey led to a delay in Luganville. The Luganville survey had to begin a week later than planned, allowing sufficient time for the VNSO to provide the maps and the list of randomly selected households to be surveyed in Luganville, the purchase of stationery and printing of the questionnaires for the training and field work in Luganville. VUI assisted in the survey in Luganville, arranging the training facility at the Maritime Collage as well as the use of their catering services.

A draft report was prepared in May 2013, and slightly revised in June 2013, covering energy use for lighting and the types of lights in use, for both Luganville and Port Vila. The initial reporting focus on lighting was to provide sufficient data for the preparation of PEEP2 proposals for the replacement of inefficient residential lighting in the two main urban centres with more energy efficient alternatives.

Finalisation of the report was delayed for some months due to the slow analysis of data by the analyst because of conflicting pressures on time and availability. There were some inconsistencies in the data. Judging from the lack of much information on refrigerators and A/C systems, it appears that the surveyors/enumerators did not physically inspect them, as they were supposed to do. In some other cases, data appeared to be provided by the households but not always checked by enumerators.

### **6.3 Recommendations**

In general, the training and the conduct of the surveys appeared to have been done in a professional manner and the results are reasonably indicative of energy use in electrified households of Port Vila and Luganville. However, there is always room for improvement. The following suggestions are offered if similar surveys are carried out in the future:

- Although VNSO was involved in identifying households, providing maps, and was generally supportive, there should have been more dialogue with VNSO regarding their input and the specific person(s) within VNSO to deal with;
- More time should have been allowed for each household. It appears that some enumerators were unable to complete all of the expected work in the time allowed (e.g. physically confirming the existence of key appliances, rather than relying on household reports);
- The PEEP Vanuatu international consultant should have been more specific regarding the analysis expected and the time frame for its completion; and
- The assumptions regarding energy use for specific appliances was in too many cases estimated from usage elsewhere, such as Australia. Funds should have been allocated to measure actual consumption of key appliances in Vanuatu. For example, a sample of new and older household refrigerators with good door seals and poor seals should have been monitored for ideally several weeks in the cold season and hot season, providing a basis for estimating refrigerator energy consumption. (For lights, this is not an issue.)

### **6.3 Final Word**

Despite the above issues, the results should be practical and useful. The questionnaire developed for this and the other PEEP2 household energy surveys is more detailed and complete than those of similar earlier surveys in Pacific Island Countries. The same questionnaire has also been adopted by UNDP and SPC in other PICs, allowing comparisons of 2013-2014 household energy use in a number of countries. This approach is a good example of genuine cooperation among different organisations.

## **Annex 1: Survey Questionnaire (English and Bislama)**

### **MS Word**

In the MS Word® version of this report, this annex is a separate document, available as “Vol 1 Annex 1 - Vanuatu PEEP2 Household Survey Questionnaire.doc” (1.8 mb) or “Vol 1 Annex 1 - Vanuatu PEEP2 Household Survey Questionnaire.docx” (2.3 mb).”

### **PDF**

In the PDF® version of this report, this annex is included as part of this document (beginning on the next page) but is also available separately as “Vol 1 Annex 1 - Vanuatu PEEP2 Household Survey Questionnaire.pdf”(1.5 mb).

## **Annex 2: Hand-out to Households: Question and Answers**

### **Promoting Energy Efficiency in the Pacific Phase 2 (PEEP2) Port Vila Household Energy Survey**

#### **What is the Purpose of the Survey?**

Assess which electrical appliances are major users of electricity in households in Port Vila and have the most potential for efficiency improvements. The survey is to take an inventory of electrical appliances energy use in households use in Port Vila and Luganville

#### **What Settlement Areas in Port Vila will be surveyed?**

All areas

#### **How Many Households will be surveyed in Total?**

Around 1,000 households in Port Vila and 300 households in Luganville

#### **Is the information Provided Confidential?**

The questionnaire has been prepared in conformity with the Statistics Act CAP 83 including no individual or household will be identified in subsequent analysis

#### **What is the Survey Period?**

21-27 March 2013 in Port Vila and 2-10 April 2010 in Luganville

#### **What Agencies are involved in the Survey?**

The survey is part of the Pacific sub-regional *Promoting Energy Efficiency in the Pacific* (PEEP) Phase 2 project. The Vanuatu Department of Energy, Mines and Minerals (DEMM) is the lead PEEP agency in Vanuatu and the Department of Meteorology & Geohazards, Ministry of Infrastructure and Public Utilities (MIPU) is managing this exercise with PEEP. The International Institute for Energy Conservation (IIEC), Thailand is responsible overall for implementation of PEEP2 activities. In addition the Vanuatu National Statistics Office (VNSO), the United Nations Development Programme (UNDP) and the Energy component of SPC-GIZ Coping with Climate Change in the Pacific Island Region Programme (SPC-GIZ CCCPIR) support the Vanuatu household energy survey.

PEEP2 is funded by the Asian Development Bank (ADB), the Global Environment Facility (GEF) and the Government of Australia.

#### **Any additional Questions?**

If you have any additional questions or concerns please contact:

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