FINAL

Energy Labelling and Minimum Energy Performance Standards for Appliances and Lighting in Fiji

Expanding the Coverage of the Program to Additional Products

Prepared for the

Department of Energy, Fiji

and the

Secretariat of the Pacific Community

by

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Executive Summary

In January 2012 Fiji implemented a mandatory energy labelling and minimum energy performance standards (MEPS) program for refrigerators and freezers. Once the regulatory framework is established, and suppliers and consumers become familiar with its operation, the cost of expanding MEPS and labelling (MEPSL) to other products is usually moderate.

This study was initiated by the Fiji Department of Energy (FDOE). The objectives are to:

1. Propose the decision criteria for inclusion of additional products in the scheme;
2. Identify at least three and up to six suitable electrical appliances for incorporation into the existing MEPSL program, and indicate how they meet the decision criteria;
3. Propose the most effective strategy for each product – energy labelling, MEPS or both; and.
4. Undertake a Costs and Benefits analysis of implementing Energy Labelling and/or Minimum Energy Performance Standards for each selected appliance.

The following selection criteria are proposed:

- The share of Fiji electricity use that the product accounts for, both in the household sector and in other sectors;

- Whether there are existing Australian and New Zealand (AS/NZS) MEPSL standards that could be readily adopted as Fiji standards;

- Whether there is already a high level of voluntary use of the Australian and New Zealand (ANZ) energy label;

- The administrative load on FDOE, and the compliance load on importers and retailers, given the number of products imported annually and the number of stakeholders that the FDOE would need to deal with;

- The regional support available for the product – e.g. whether it is already part of the ANZ MEPSL program and/or under consideration in the countries participating in the Pacific Appliance Labelling and Standards (PALS) program; and

- Strategic value – the extent to which MEPSL would support other Fiji energy policies and programs, including the energy efficiency provisions proposed for the Fiji Building Code, rural electrification objectives, the UNEP en.lighten project and the development of product energy testing capabilities in Fiji.

The six product groups indicated in Table 1 are recommended for inclusion in an expanded Fiji MEPSL program. This covers 15 distinct product types, so a significant work-load would be involved. The report sets out a 5-year work program to spread the work-load add phase in the products.

The first stage will involve a comprehensive review of the legislation and regulations, as the method used to implement the existing MEPSL for domestic refrigerators and freezers (A Fiji Government Trade Standards Order) would be unsuitable, and has created a number of administrative and legal problems which would need to be addressed in new regulations.

Table 1 Products recommended for inclusion in the Fiji MEPSL program

Product group	Energy use	Standard	Label presence	Admin difficulty	Regional support	Strategic value
Domestic refrigerators and freezers (in place)	High	ANZ	High	Medium	PALS, ANZ	High
Air conditioners	High	ANZ	Low	Medium	PALS, ANZ	High
Lighting products (AC and MV)	High	ANZ (some types)	NA	Medium	PALS, ANZ UNEP	High
Commercial refrigeration	High	ANZ	NA	High	ANZ, Kiribati	Med
Televisions	Medium	ANZ	Medium	Low	ANZ	High
Clothes washers	Low	ANZ	High	Low	ANZ, Cook Is	Med
Dishwashers	V. low	ANZ	Medium	High	ANZ	Med

This report also estimates the monetary costs and benefits of expanding the MEPSL program as indicated. Over the period 2015-2030, the projected energy savings from new MEPSL measures is projected to be about 4.2 times as great as the energy savings from MEPSL already implemented from domestic refrigeration. By 2030, annual electricity savings will total about 118 GWh/yr (23 GWh/yr from domestic refrigerators and freezers, and 95 GWh/yr from the other products), a reduction of nearly 17% of 'business as usual' (BAU) electricity consumption of the sectors affected.

The value to consumers of the electricity saved has been calculated on the assumption that current electricity prices remain constant in real terms (which is a conservative assumption). Without MEPSL, it is projected that average household electricity bills will increase from FJD 532 in 2012 to FJD 615 in 2030, due to rising ownership of household appliances and greater use of lighting.

MEPSL for refrigerators and freezers will reduce bills by FJD 35 per year, and MEPSL for air conditioners, television and lighting by a further FJD 60. By 2030 the total savings will reach by FJD 95 per household per year. Against this, it is projected that the increased purchase cost of more efficient appliances will cost households an average of about FJD 30 per year by 2030. An expanded MEPSL program is projected to be even more cost-effective for non-residential customers, who will account for more than half of the energy savings.

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Glossary

AC	Alternating current
ANZ	Australian and New Zealand
AS/NZS	Australian/New Zealand Standard
BAU	Business as usual
CFL	Compact fluorescent lamp
DC	Direct current
E3	Equipment Energy Efficiency (the ANZ MEPSL program)
FDOE	Fiji Department of Energy
FEA	Fiji Electricity Authority
FJD	Fiji dollars
FNBC	Fiji National Building Code
FS	Fiji Standard
GWA	George Wilkenfeld and Associates
HH	Household
IIEC	International Institute for Energy Conservation
IL	Incandescent lamp
LED	Light-emitting diode
LV	Low voltage
MEPS	Minimum energy performance standards
MEPSL	Minimum energy performance standards and (energy) labelling
MV	Mains voltage
MVH	Mains voltage halogen
PALS	Pacific Appliance Labelling and Standards program
PEEP 2	Promoting Energy Efficiency in the Pacific – Phase 2
PICT	Pacific island countries and territories
PV	Photovoltaic
SPC	Secretariat of the Pacific Community
UNEP	United Nations Environment Program
USD	United States Dollar
WELS	Water efficiency labelling and standards

Background

The Fiji MEPSL Program

Fiji has implemented a mandatory energy labelling and MEPS program for refrigerators and freezers, which took effect in January 2012, following cabinet approval on 15 March 2011.[1] This is part of a strategy to reduce reliance on imported fossil fuels, which accounted for a third of Fiji's total imports in 2011.

The origins of the program date back to 1996. It was finally implemented, after extensive consultations with stakeholders, via the Government Trade Standards (Household Electric Refrigerating Appliances) Order 2007 (originally published 27 September 2007). The Order designates the relevant Australian and New Zealand testing and labelling standards (AS/NZS 4474 Parts 1 and 2) as Fiji Standard FS/AS/NZS 4474 and mandates compliance for refrigerators and freezers imported to and sold in Fiji.[2]

Expansion of the Program

Geographically

The regulatory impact of the Fiji program is of course limited to the territory of the Republic of Fiji. However, several other Pacific Island Countries and Territories (PICTs) are also in the process of implementing regulations for mandatory energy performance standards and labelling (MEPSL) as part of the Pacific Appliance Labelling and Standards (PALS) program. PALS is being managed by the Secretariat of the Pacific Community (SPC) with funding from the Australian Government.

At the time of writing the Cook Islands, Kiribati, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu had cabinet approval to implement MEPSL, and all except Solomon Islands and Tuvalu had prepared draft regulations for that purpose. As other PICTs are likely to cover the same group of products and use the same technical standards as Fiji, the links between the PALS countries will need to be considered.

Many of the product suppliers in Fiji also operate in other PICTs, so co-ordination of product coverage would have benefits to commercial operators, and would simplify administrative arrangements for all the countries concerned.

Product Coverage

At present the only product groups subject to MEPS and mandatory energy labelling requirements in Fiji are household refrigerators and freezers. Historically, most of the 81 MEPSL programs in the world have started with refrigerators and freezers, but nearly all have expanded to other products (EES 2014).

[1] http://www.fdoe.gov.fj/index.php/energy-security/energy-conservation-efficiency/mepsl
[2] The Fiji Department of Energy (FDOE) has called for tenders for an evaluation of the program so far.

Once the regulatory framework for MEPSL is established, and suppliers and consumers become familiar with its operation, the cost of expanding it to other products is usually moderate. Other product classes also account for significant energy use, and may meet the criteria for inclusion as strongly as refrigerators and freezers.

The Table 2 lists the product categories covered or proposed to be covered in Fiji and in the PICTs that are most advanced with MEPSL regulations. In all cases to date, the Australian and New Zealand standards for product energy testing, labelling and MEPS are referenced.

Table 2 Current scope and status of MEPSL in the Pacific Region

PICT	Status of regulations	Refrigerators and freezers	Air conditioners	Lighting	Other
Fiji	Enacted	Covered			
Samoa	Draft	Covered	Covered	Covered	
Tonga	Draft	Covered	Covered	Covered	
Cook Islands	Draft	Covered	Covered		Clothes washers
Kiribati	Draft	Covered	Covered	Covered	Commercial refrigeration
Vanuatu	Draft	Covered	Covered	Covered	

This Study

Terms of Reference

This study was initiated by the Fiji DOE. As the outcomes will also be relevant to other PICTs, the PALS program (through the SPC) is meeting the costs of the project, and its ultimate coverage of other PALS countries as well. However, the terms of reference focus on the needs of Fiji at this initial stage. The objectives are to:

1. Propose the decision criteria for inclusion of additional products in the scheme;

2. Identify at least three and up to six suitable electrical appliances for incorporation into the existing MEPSL program, and indicate how they meet the decision criteria;

3. Propose the most effective strategy for each product – energy labelling, MEPS or both; and.

4. Undertake a Costs and Benefits analysis of implementing Energy Labelling and/or Minimum Energy Performance Standards for each selected appliance.

First Stage - Inception Report

During this stage we carried out research into the ownership, energy consumption, importation and purchasing trends of various electrical appliances in Fiji, interviewed relevant stakeholders and prepared an Inception Report covering the first and second objectives. Initial discussions with FDOE and meetings with selected commercial stakeholders took place in Suva in late May 2014.

The Inception Report, submitted to the FDOE in August, proposed the following selection criteria:

- The share of Fiji electricity use that the product accounts for, both in the household sector and in other sectors;
- Whether there are existing Australian and New Zealand (AS/NZS) MEPSL standards that could be readily adopted as Fiji standards;
- Whether there is already a high level of voluntary use of the Australian and New Zealand energy label;
- The administrative load on FDOE, and the compliance load on importers and retailers, given the number of products imported annually and the number of stakeholders that the FDOE would need to deal with;
- The regional support available for the product – e.g. whether it is already part of the ANZ MEPSL program and/or under consideration in the countries participating in the Pacific Appliance Labelling and Standards (PALS) program; and
- Strategic value – the extent to which MEPSL would support other Fiji energy policies and programs, including the energy efficiency provisions proposed for the Fiji Building Code, rural electrification objectives, the UNEP en.lighten project and the development of product energy testing capabilities in Fiji.

The Inception Report analysed a number of products against these criteria. The conclusions are summarised in Table 3. Refrigerators and freezers are included in the table for purposes of comparison.

Table 3. Summary of Conclusions on Decision Criteria

Product group	Energy use	Standard	Label presence	Admin difficulty	Regional support	Strategic value
Domestic refrigerators and freezers (in place)	High	ANZ	High	Medium	PALS, ANZ	High
Air conditioners	High	ANZ	Low	Medium	PALS, ANZ	High
Lighting products (AC and MV)	High	ANZ	NA	Medium	PALS, ANZ UNEP	High
Fans (ceiling, pedestal etc)	Medium	Yes - Other	NA	High	None	Low
Commercial refrigeration, icemakers	High	ANZ	NA	High	ANZ, Kiribati	Med
Televisions	Medium	ANZ	Medium	Low	ANZ	Med
Clothes washers	Low	ANZ	High	Low	ANZ, Cook Is	Med
Dishwashers	V. low	ANZ	High	Low	ANZ	Med
3-phase motors	Med-high	ANZ	NA	High	ANZ	Med
Solar lighting and systems (DC and LV)	Low	No	NA	High	UNEP	High

The Inception Report concluded that it would most likely be beyond the resources of the Fiji Department of Energy to extend the MEPSL program to all of the products which have a significant impact on Fiji electricity use, at the one time, and recommended the following order of priorities:

1. Air conditioning products. This does not necessarily mean all sub-categories of these products, so further analysis would be required to develop MEPSL priorities and strategies for:
   a. Smaller capacity single-phase air conditioners (the categories that are subject to energy labelling as well as MEPS in Australia and New Zealand);
   b. Larger capacity and 3-phase air conditioners (the categories installed in non-residential buildings);
   c. Chillers (as used in central air conditioning systems in larger commercial buildings).

2. Lighting products (mains voltage). This does not necessarily mean all sub-categories of these products, so further analysis would be required to develop priorities and strategies for:
   a. Eliminating incandescent lamps;
   b. Setting minimum performance standards for compact fluorescent lamps (CFLs), linear fluorescent lamps (LFLs) and light-emitting diode (LED) lamps;
   c. Setting minimum performance standards for LFL ballasts;
   d. Setting minimum performance standards for outdoor and street lights.

3. Clothes washers, dishwashers and televisions. Although this group makes a lower contribution to electricity use, there is already a high level of voluntary compliance with AS/NZS labels, and formal coverage would reinforce the overall energy labelling program.

4. Commercial refrigeration products. These account for a significant share of total Fiji electricity use, but there are many product subcategories, so further research is necessary to assess which are the most important.

5. Fans (ceiling, pedestal and desk). These account for a significant share of household energy use, and probably non-residential energy as well, but as there are no relevant AS/NZS standards for adoption, it would require some time and effort to research and establish the necessary standards.

6. Off-grid solar lighting and systems. These are strategically important in providing energy services to the 30% or so of Fiji households without access to mains electricity, but as there are no relevant AS/NZS standards for adoption, it would require some time and effort to research and establish the necessary standards.

7. Electric motors (3-phase). Industrial consumers account for about 30% of Fiji's electricity use, and it is likely that a large share of this is used in motors. However, further research would be necessary to establish if this is the case, and the current level of efficiency in the motor stock, before MEPS can be considered.

8. The establishment of a lamp testing facility in Fiji should also be investigated.

Second Stage- Final Report

FDOE considered the Inception Report and requested the further investigation of MEPSL for the following product groups:

1. Air conditioners (including chillers)
2. Lighting products
3. Commercial Refrigeration
4. Clothes washers
5. Dishwashers
6. Televisions

FDOE advised that off-grid solar lighting products and solar installations and three-phase electric motors may be considered in the future.

There were further interviews with suppliers of the selected products in Suva on September 24-25 2014. This Final Report is based on those interviews, as well as further data from Fiji Customs. It covers:

1. Cost Benefit Analysis for each of the identified appliances separately and in combination;

2. Consideration of the effects of regulating individual/personal imports, possible impacts on trade and possible unintended consequences, if any;

3. Recommendations on the manner of incorporating selected appliances i.e. an implementation plan with the appliance's order of incorporation, suitable duration between each incorporation, etc;

4. Recommendations on developing a plan for monitoring and market surveillance of the appliances proposed for regulation; and

5. Recommendations on the most effective means of informing stakeholders locally as well as overseas on the proposed introduction of MEPSL for the selected products.

FDOE requested that the final report should outline a five-year work program to implement the recommendations. Table 19 outlines a suggested five-year work program in three phases: Phase 1 (the first year), Phase 2 (years 2-3) and Phase 3 (years 4-5).

Following the completion of the Fiji stages of the study, GWA will extrapolate the findings to the other PICTS, in a separate report to SPC.

Interviews and Data Sources

Information on the ownership of appliances in Fiji households is not as detailed or as recent as for other PICTs. However, the patterns of household energy use are in many ways similar to those in neighbouring PICTs. The data collected for the Promoting Energy Efficiency in the Pacific – Phase 2 (PEEP 2) project in Samoa, Tonga and Vanuatu has been used as a basis for assumptions about appliance ownership in Fiji.

Fiji Customs has very detailed information on the import of appliances, and some of this data (covering air conditioners, refrigerators, freezers, commercial refrigeration products and lighting products) was made available for this study. Other import data was sourced from trade flow studies undertaken for PALS (REEEP 2012).

Information about the current market for selected electrical appliances and lighting products was obtained in interviews with retailers and wholesalers in Suva, and in internet research. The current patterns of energy labelling in a sample of Fiji retail outlets was observed in a small number of store visits in Suva and Nadi in May and September 2014.

The consultants wish to acknowledge the co-operation of the companies interviewed (see Appendix 1), Mr. Vishal A. Prasad of FDOE and Mr Josevata Qalubau of the Fiji Revenue and Customs Authority.

The information on total and household electricity use in Fiji came from the Fiji Electricity Authority (FEA) annual reports.

Criteria for Inclusion

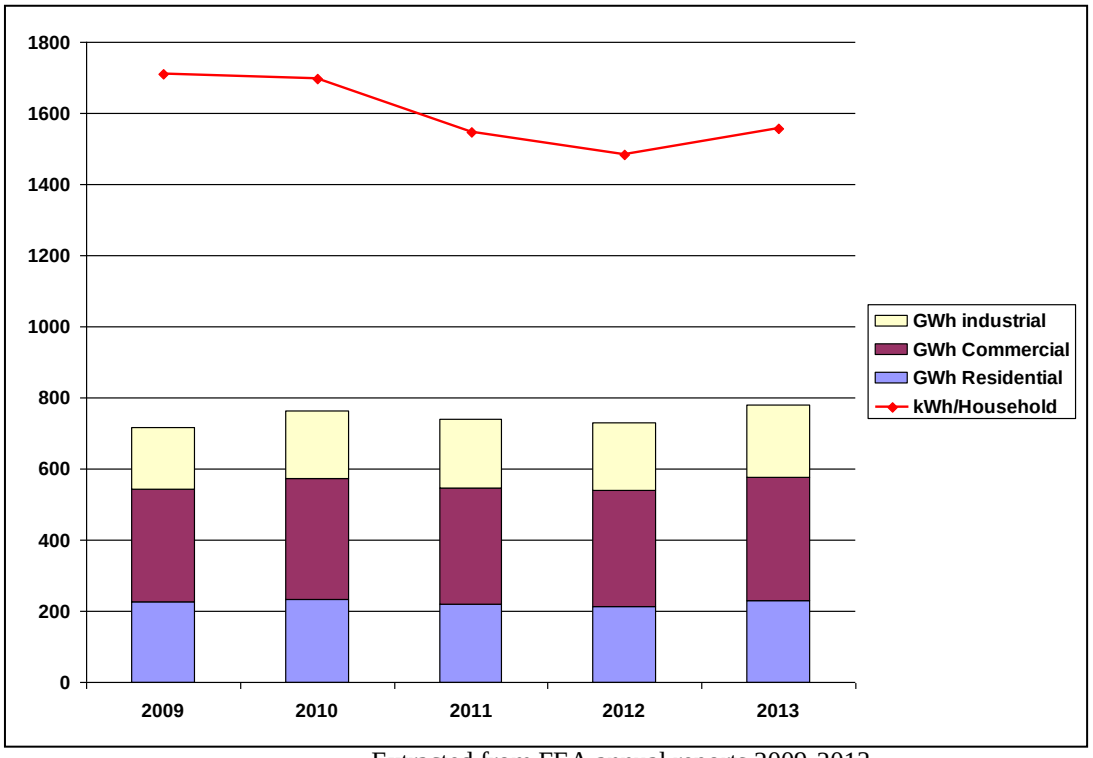
Contribution to Fiji Energy Use

Total Electricity Use

About 72% of the population of Fiji has access to the electricity grid (SPC 2012). The Fiji Electricity Authority reported annual sales of about 750 GWh per year between 2009 and 2013, broken down by sector as shown in Figure 1: about 30% to households, 45% to the commercial and government sector and 25% to industry. Average household electricity use reached a plateau of about 1,700 kWh/yr in 2009-10, declined in 2011 and 2012 and then increased. The average over the five years was 1,598 kWh/yr.

The reasons for this lack of growth in average household (HH) electricity use are not clear, but they could include the fact that each year several thousand rural households are connected to the grid or to local diesel generators. The electricity use of these households prior to grid connection would have been negligible if they had no prior access to electricity, so their stock of appliances would be very low at first, and would take many years to catch up with urban households. If they were transferred from previous stand-alone generation to the grid their consumption would be low because of the high cost and constrained availability of energy (ie small generators are rarely run 24hrs/day). In either case, average consumption would be expected to start low but rise in the longer term.

Figure 1 Grid-supplied electricity use in Fiji, 2009-13



Extracted from FEA annual reports 2009-2013

Household energy use

One criterion for including a product in MEPSL is the magnitude of its contribution to household electricity consumption, now and expected in the future. As we are not aware of any recent surveys of appliance ownership in Fiji, we have built up an estimate based on other sources, including household surveys carried out for the PEEP 2 project during 2013 and 2014 (see Inception Report).

Table 4 presents an estimated breakdown of appliance ownership and electricity use in electrified households in Fiji. In the majority of cases a household will own only one of the products indicated. However, many homes have more than one TV, several fans and mobile phones and of course several lamps. It is estimated that the presence of refrigerators adds on average 480 kWh/yr to a household's electricity use. If 80% of electrified households own at least one refrigerator, the average electrified household has a 0.80 probability of a load of 480 kWh/yr, ie 0.80 x 480 = 384kWh/HH.

The presence of an air conditioner leads to very high energy use, but as few households have one, the impact on average consumption is still low. Fans account for a surprisingly high share of energy use, because there are usually two or three per house and they operate for long hours.

Table 4 Estimated electricity use per electrified household and total residential sector, 2014

Product	Ownership (a)	kWh/owner household (b)	Average kWh/HH	Res GWh (c)	FJD/yr	% of total expenditure	Category for Table 5
Refrigerator	0.80	480	384	51.5	127.1	24%	Refrigeration
Separate freezer	0.35	410	144	19.2	47.5	9%	Refrigeration
Television	0.90	240	216	29.0	71.5	13%	Other
Air conditioner	0.05	1500	75	10.1	24.8	5%	Cooling
Fan	0.40	300	120	16.1	39.7	7%	Cooling
Mobile phone (charging)	0.92	30	28	3.7	9.1	2%	Other
Iron	0.80	90	72	9.7	23.8	4%	Other
Hair straightener	0.60	20	12	1.6	4.0	1%	Other
Microwave	0.15	75	11	1.5	3.7	1%	Other
Kettle	0.40	100	40	5.4	13.2	2%	Other
Rice cooker	0.25	120	30	4.0	9.9	2%	Other
Clothes washers	0.10	150	15	2.0	5.0	1%	Other
Other appliances	1.00	160	160	21.5	53.0	10%	Other
Total of above		3675(d)	1306	175.2	432.4	81%	
Lighting kWh/yr (d)		301	301	40.3	99.5	19%	Lighting
Total kWh/yr		3976(d)	1607	215.5	531.9	100%	

(a) GWA estimates. (b) Takes into account multiple products per owning household (c) Assuming 137,000 residential customers, as at end 2013. (d) See GWA 2014. Products highlighted green are subject to MEPSL and products highlighted yellow are under consideration.

It is estimated that at present in Fiji, appliances account for an average of about 1,306 kWh/yr and lights for a further 301 kWh/yr, making a total of 1,607 kWh/yr per electrified household. There is obviously considerable potential for growth. If a household acquired all of the products listed, and maintained the same level of lighting

use, total consumption could rise by 147% to nearly 4,000 kWh/yr. This does not take into account the possibility that in future people might buy larger appliances with more features (whether TVs or refrigerators). On the other hand, the rise in energy consumption could be offset by greater energy-efficiency.

The current Fiji residential electricity tariff is FJD 0.331/kWh.[3] This means that the average household spends about FJD 532 per year on electricity. Refrigerators and freezers account for about 33% of this (FJD 175). The other product categories under consideration for MEPSL – televisions, air conditioners, clothes washers and lighting – account for a further 38% of the bill (FJD 201). This excludes dishwasher energy use, which is a very small component of the "other appliances" category.

Other Sectors

About 45% of electricity use in Fiji takes place in the commercial and government sectors. Unfortunately, information about how that energy is used is scarce. GWA (2014) estimated energy use for lighting in commercial and government buildings and in street and outdoor lighting for all PICTs, including Fiji. The breakdown of other end uses is largely speculative, but air conditioning is almost certainly the largest single component, followed by lighting (Table 5).

There is no available information about industrial electricity use. However, most of it would be for electric motors and specialised equipment, rather than in mass-produced appliances and lighting products which dominate electricity use in the other sectors. Table 6 indicates that, based on 2009-2013 average usage and 2014 tariffs, the total cost of electricity for all sectors in 2014 is over FJD 274 million. About FJD 174 million, 63% of the total cost, is used by products that are, or could be covered by MEPSL.

Table 5 Estimated electricity used by main sector, 2014 (excludes industrial)

	Residential GWh/yr(a)			Comm. & Govt			Combined		
	GWh	% GWh	MFJD	GWh	% GWh	M FJD	GWh	% GWh	M FJD
Lighting (b)	41.1	19%	13.6	113.4	34%	47.4	154.5	28%	61.0
Cooling (c)	26.7	12%	8.8	140.0	42%	58.5	166.7	30%	67.4
Refrigeration	72.2	33%	23.9	40.0	12%	16.7	112.2	20%	40.6
Other	79.9	36%	26.5	39.3	12%	16.4	119.3	22%	42.9
Total	220.0	100%	72.8	332.7	100%	1379.1	544.2	100%	211.9

(a) From Table 4 (b) From GWA (2014) (c) Air conditioners and fans

Table 6 Estimated share of electricity use, costs and potential MEPSL coverage

Sector	GWh	% GWh	FJD/kWh	M FJD	Covered by MEPSL	% cost covered
Residential	220	30%	0.33	72.8	51.4 (a)	71%
Commercial	333	45%	0.42	139.1	122.6 (b)	88%
Industrial	190	25%	0.35	66.5	0	0%
Total	743	100%	0.37	274.1	174.0	63%

(a) Categories highlighted in Table 4. (b) Comm & Govt lighting, cooling and refrigeration in Table 5.

[3] http://www.fea.com.fj/your-home/electricity-tariffs-and-rates/ Consumers using less than 75 kWh/month are eligible for a government subsidy of FJD 0.159/kWh.

Potential of MEPSL to improve energy efficiency

MEPSL works best where there are many models on the market and they vary in their energy-efficiency. This creates scope to transform the market by excluding the least efficient products and increasing the market share of the more efficient ones. Some categories of product will not respond to MEPSL due to one or more of the following:

- The products are already improving in efficiency due to market changes or regulations in other countries, so no additional efforts in Fiji are necessary. This would be the case if the Fiji market were supplied only from countries with high product standards. However Fiji imports products from many countries. Some have high energy efficiency standards and enforce them, some have standards but do not enforce them, and some have no standards at all.

- The basic technology is so simple that it cannot easily be improved. This would be the case for all products with small electric resistance heating elements, which are all nearly 100% efficient at converting electricity to heat – eg irons and electric kettles. (Electric water heaters can vary in their overall efficiency due to differences in their insulation and heat losses, not the efficiency of their resistance elements).

- Only a relatively few products are imported, and they are so specialised that it is difficult to interchange models and types. This is generally the case for industrial equipment (apart from electric motors, which are found in many types of industrial equipment). Although labelling is not appropriate for such products, because they are rarely inspected and compared in physical showrooms, MEPS are often very cost-effective because each unit consumes a very large amount of electricity during its working life.

Existence of Suitable Standards

AS/NZS Standards

It is a long and expensive process to develop energy test methods and energy labels, and to incorporate them into documents such as published standards, which can be called up in regulations. Therefore smaller countries generally adopt standards already in use elsewhere. This is the case for the existing Fiji MEPSL program, which draws on Australian and New Zealand standards. Table 7 summarises the products included in the Australian and New Zealand MEPSL program. There are published ANZ energy test standards for all of these products, and labelling standards for the product indicated.

Other Standards and labels

For products which might be significant energy users in Fiji, but are not covered by ANZ standards, there may be other sources of standards. For example, there are test standards for ceiling fans in China, India and the USA (Energy Star), among others.[4]

[4] http://www.clasponline.org/en/Resources/Resources/PublicationLibrary/2013/SEAD-Highlights-the-Global-Benefits-of-Improved-Energy-Efficiency-in-Ceiling-Fans.aspx

Table 7 Products covered by Australian and New Zealand Standards

Product or product group	Measures (in place and projected)(a)	Residential	Other (b)
Household refrigerators & freezers	Energy labelling 1986 Label enhancements 2000, 2008 MEPS 1999, 2005, 2017	✓	
Electric storage water heaters (large)	MEPS 1999, 2016	✓	
Electric storage water heaters (small)	MEPS 2005, 2016	✓	
Hot water storage tanks	MEPS 2016	✓	
Heat pump water heaters	MEPS & labelling, 2016	✓	
Solar water heaters	MEPS & labelling 2016	✓	
Gas water heaters	MEPS 2013, 2018	✓	
Clothes washers, dishwashers, clothes dryers	Energy Labelling 1987, 1990 Label enhancements 2000	✓	
Household air conditioners	Energy labelling 1987 Label enhancements 2000, 2010 MEPS 2004-2011, 2016	✓	
Packaged air conditioners	MEPS 2001, 2010, 2011, 2016		✓
Air conditioner liquid chillers	MEPS 2009, 2016		✓
Close control air conditioners	MEPS 2009, 2016		✓
Televisions	Energy Labelling 2009, Label enhancements 2013 MEPS 2010, 2013	✓	
Set top boxes	MEPS 2009	✓	
External power supplies (EPS)	MEPS 2009	✓	✓
Commercial refrigeration products	MEPS 2006, 2009, 2017		✓
Fluorescent lamp ballasts	MEPS 2003, 2017	✓	✓
Linear fluorescent lamps (tri-phosphor)	MEPS 2005, 2017	✓	✓
Incandescent lamps, ELV transformers	MEPS 2009	✓	✓
Compact fluorescent lamps	MEPS 2009	✓	✓
Electric motors (3 phase)	MEPS 2001, 2006, 2016		✓
Power supply transformers	MEPS 2004, 2016		✓
Standby energy (range of products)	MEPS 2016	✓	✓
Swimming pool pump-units (single phase)	MEPS & Labelling 2017	✓	
Personal computers & monitors	MEPS 2013	✓	✓
Battery chargers	MEPS 2018	✓	
Gas space heaters (d)	MEPS 2017	✓	
Clothes washers, dishwashers, showers, taps	Water Efficiency Labelling and Standards 2006	✓	✓

Source: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/General/Equipment_Energy_Efficiency_Program_(E3)/Impacts-of-the-E3-Program.pdf

In many cases the energy test standards are linked to the energy labelling programs of those countries. Now that the AS/NZS star rating labels for refrigerators and freezers are well established in Fiji, it would be cost-effective to use the same label formats for other appliances, because consumers already have a high level of familiarity with the labels.

Introducing different label types would require higher expenditure on public information programs and would complicate the present messages "look for the most stars" and "compare the running costs using the energy calculator".

However, for products where energy labelling is not used it may be possible to adopt non-AS/NZS test standards and MEPS levels. For example, it may be feasible to permit the import of CFL lamps that meet one of a number of designated standards. However, the more compliance options there are, the greater the administrative burden of ensuring compliance, and the higher the probability of non-compliance.

Level of existing compliance

As was the case with refrigerators and freezers prior to 2012, many products sold in Fiji already carry energy labels even though they are not required to. Table 8 summarises the results of informal retail store visits in Nadi (3 stores) and Suva (one store) in May 2014:

- Nearly all refrigerators and freezers had energy labels;
- Nearly 70% of the clothes washers and all of the (very few) dishwashers on display carried labels;
- Most of the labels on whitegoods were ANZ energy labels, but there were also some Singapore, European and hybrid labels (where the suppliers had made up their own label, combining design elements from other labels); and
- More than half the televisions on display had ANZ energy labels;

This suggests that for televisions, clothes washers and dishwashers there is already a solid base of labelling to build on. Of course, it would be necessary to ensure that only permitted labels are used, and that they give correct data for the model they are fixed to.

Table 8 Labelling Survey, Nadi and Suva, May 2014

	Large retail 1		Large retail 2		Large retail 3		Small retail 1		Combined		
	Label	No label	Label	No label	Label	No label	Label	No label	Label	No label	Labelled
Refrigerator	34	1	30	1	47	0	15	0	126	2	98%
Freezer	8	0	6	0	NA	NA	3	0	17	0	100%
Television	12	8	20	2	5	15	1	8	38	33	54%
Clothes washer	11	6	9	1	13	1	3	8	36	16	69%
Dishwasher	3	0	2	0	NA	NA	0	0	5	0	100%
All of above	68	15	67	4	65	16	22	16	222	51	81%
This store		82%		94%		80%		58%			

Administrative Complexity

Scale of effort required

The scale of administrative effort required to implement MEPSL for a particular product depends partly on the number of units imported and sold each year. Table 9 summarises the customs import data for the product groups under consideration, and also for refrigerators and freezers. FDOE has already successfully implemented MEPSL for refrigerators and freezers, through the stages of consultation, training, setting up the administration and registering products, so comparing other product markets with refrigerators and freezers gives a first indication of whether the existing resources are sufficient.

There were about 19,500 household refrigerators, freezers and related items imported to Fiji in 2012 and 28,200 in 2013. Some of these may have been re-exported, but the great majority were sold in Fiji. The number and total value of air conditioners and related items was similar – 18,300 in 2012 and 19,700 in 2013.

Imports of commercial refrigerated display equipment (e.g. glass-front drinks cabinets and open-well supermarket refrigerators) are roughly one fifth the numbers of domestic refrigeration equipment. This does not include other classes of equipment such as ice-makers. However, the average commercial refrigeration unit consumes much more energy than the average household unit, so even though there are far fewer units, commercial refrigeration energy use is still equivalent to about 55% (40.0/72.2) of household refrigeration energy (Table 5).

About 17,000 televisions are imported annually. For clothes washers, about 8,400 were imported in 2012 but over 13,000 in 2013. By contrast, dishwasher imports were only a few hundred each year, and many of these were commercial rather than residential models.

On average, about a million lamps are imported each year for separate sale (ie not counting lamps imported as part of fixtures).

Table 9 Refrigeration and air conditioning product imports to Fiji, 2012 and 2013

		Number of items		Million FJD (b)		FJD/item	
Customs Code	Products (a)	2012	2013	2012	2013	2012	2013
8418.1000-4000	Domestic refrigerators and freezers	19,523	28,230	11.7	13.6	597	480
8415.1000-8300	Air conditioners	18,336	19,738	11.0	13.5	601	683
8418.5010-5090	Commercial refrigeration units	5,210	4,893	3.8	5.0	733	1017
8539.2000	Lamps	1,139,344	878,168	1.9	2.3	1.6	2.7
8528 7200	Televisions	17,653	16,786	5.9	7.6	332	451
8450 1900	Clothes washers	8,382	13,073	2.4	3.8	278	290
8422 1100	Dishwashers	393	224	0.4	0.2	1,118	1,041
	Sum of above			39.1	46.0		

Source: extracted by GWA from Customs data IMPORT_HS 8415-8418_2012-2013.xls (a) Some categories include components and a small number of used products as well as complete new units. (b) Declared customs value – retail value would be higher.

Supply chain complexity

The number of stakeholders involved in product import and distribution is also an indicator of the administrative effort required. The number of air conditioner and television importers in 2012 was slightly less than the number of refrigerator and freezer importers (Table 10). There were far more importers of lamps than any other of the products under consideration. By contrast, there were very few importers of clothes washer and dishwashers.

The top 10 individual companies accounted for the great majority of imports in all categories other than lamps, where they accounted for just over half. Many of the same companies dominated several sectors. The large electrical appliance retailers accounted for about 69% of refrigerators and freezer imports by value, 39% of air conditioners, 89% of televisions, 99% of clothes washers and 71% of dishwashers.[5] The only products where the large retailers did not dominate were lamps, air conditioners (where specialist contractors accounted for nearly half of imports) and dishwashers (where there was significant direct import by hospitality and accommodation operators). The air conditioning sales and installation industry is fairly fragmented – one estimate was that over 500 companies are involved in the sector. However, nearly all of these would obtain their products from the major importers.

On these indicators, the majority of the market for the products under consideration is supplied by companies that already participate in refrigerator and freezer MEPSL, and so are already familiar with the concepts and administrative arrangements.

The supply chain for commercial refrigeration differs in that most units are imported directly by the beverage companies that are the end users, and made to their specifications (including branding and signage). Therefore end users have more control over the energy efficiency of commercial refrigeration than for other products.

Table 10 Import and distribution channels, 2012

	Refrigerat-or & freezer	Air cond-itioners	Lamps	Televisions	Clothes washers	Dish-washers
Number of registered importers (a)	82	61	187	63	16	9
Market share of 5 largest (by value)	74%	64%	49%	92%	97%	87%
Market share of 10 largest (by value)	93%	84%	57%	94%	99%	NA
Market share of general appliance suppliers	69%	39%	20%	89%	99%	71%
Market share of air conditioner specialists	NA	47%	NA	NA	NA	NA
Market share of resorts	1%	3%	NA	NA	1%	28%

Source: extracted by GWA from Customs data (a) Excludes importers where value is less than FJD 500 or the product is recorded as "used."

[5] Brijlal, Courts, Morris Hedstrom, Narhari, Tappoo, Vinod Patel.

Regional Support

Australia and New Zealand

If a product group is covered by the MEPSL program in Australia and New Zealand (i.e. if it is included in Table 7) there are several advantages for Fiji:

- There are published AS/NZS testing, labelling and MEPS standards that can be adopted without further work;
- The label format is the same as the label already used for refrigerator and freezers in Fiji, so it can build on existing public awareness;
- There are data on the energy efficiency ranges of those products; and
- Many of the products imported to Fiji are likely to already be registered for sale in Australia or New Zealand. In fact, many product registrations already include an indication of whether the product is available in Fiji.[6]

Coverage in Australia or New Zealand also means that there are check testing facilities in those countries, which could be used in the event that a product needs to be tested. Australian officials have indicated in the past that they would look favourably on requests for assistance with testing to ANZ standard, including financial support.[7]

ANZ labs could probably set up for non-ANZ standard energy tests, but the set-up costs would be very high, especially if certification were required. For smaller products, it may be feasible to send them to already qualified labs in other countries.

Other Regional Programs

The regional programs that could have most impact on Fiji are PALS and the UNEP en.lighten program. If a product is also being considered for coverage by other PICTs (Table 2) this creates opportunities to adopt common rules for that product. This would assist companies that operate throughout the Pacific, and is likely to increase their level of compliance. It could also reduce administrative costs, since Fiji would be able to share information about models and suppliers, and possibly set up a shared regional register.

There is also a defensive value in covering the same products with the same rules as other PICTs. If there were no requirements in Fiji, there would be a risk that inefficient products that could no longer be exported to other PICTs would be diverted to Fiji.

[6] See www.energyrating.gov.au

[7] The cost of air freighting a 50kg refrigerator from Suva to Sydney is of the order of A$900-1,000. This covers packing, documentation, handling and customs clearance at both ends, airfreight at FJD3 per kg, and special permit to import refrigerant gases, as required under ODP substances legislation in Australia.

Strategic Value

There are potential benefits from inclusion of particular products that go beyond the immediate value of increasing the energy efficiency of those products.

Consumer Awareness

Some products are natural "billboards" for the energy label, and so can increase consumer awareness of labels on other products which use the same labelling format. Two examples are clothes washers and dishwashers.

Neither appliance contributes much to energy use in Fiji. Most of the labelled energy difference between clothes washer models depends on the differences in the volume of water used. The label energy calculation is based on the assumption that some of the water is heated, so this accounts for a large part of the difference in star ratings. Spin drying performance also account for some of the energy calculation, on the assumption that some loads will be spin dried, so the less water in the finished load, the less energy will be used subsequently by the dryer. In Fiji however it is likely that the great majority of clothes washing is done with cold water and dried on the line rather than in a tumble dryer, in which case the real energy differences of clothes washers largely disappear.

For dishwashers, the potential for contribution to Fiji's energy use is limited by the fact that so few units are sold. Furthermore, the water-efficiency of all dishwashers has increased to such an extent over the past 10-15 years that the energy differences between models are now very small.

Nevertheless, both clothes washers and dishwashers are energy labelled in Australia and New Zealand, and frequently labelled in Fiji as well (Table 8). Therefore they could be incorporated in the Fiji MEPSL program at low cost, and would act as label billboards, making customers more aware of the label and preparing them to look for labels in more energy-significant future purchases, such as refrigerators, freezers and air conditioners.

Support for Other Policies and Programs

Fiji is inserting new energy efficiency provision into the Fiji National Building Code. A review of priorities and options (NBI 2014) recommended that MEPS be implemented for a number of products commonly used in new construction, citing the AS/NZS standards. From the point of view of capturing the energy efficiency potential of new buildings, the report considered the highest priorities for MEPS were:

1. Air Conditioners, using AS/NZS 3823.2-2011;
2. Chillers, using AS/NZS 4776;
3. Close-control air conditioners, using AS/NZS 4965-2008, provided these have significant use in Fiji. As these are generally used in computer rooms and server warehouses, this may not be the case;

Although the study did not model the energy use of commercial refrigeration, it concluded that MEPS should be considered, "given the high ambient temperatures, heat release associated with inefficient equipment, and potential savings".

Regarding lighting, the report concluded:

> "Lighting efficiencies can be addressed through both the building code and MEPS. The proposed draft building code language will include requirement for electronic ballasts, efficacy of residential lighting, lighting power densities (watts/m^2), and lighting controls. However, having MEPS for lighting would also be beneficial and compliment the code requirements."

There is a strategic case for pursuing MEPS for lighting and air conditioning at the same time, because:

- A large proportion of the energy that must be removed from air conditioned commercial buildings is due to the heat load of the lights, so the more efficient the lights the less energy required for cooling;

- The UNEP en.lighten project offers an opportunity to co-ordinate regional adoption of lighting MEPS; and

- While building codes are very valuable for ensuring that lighting in new buildings is energy-efficient, they cannot increase the lighting efficiency in existing buildings.

Product Testing Capability

Unfortunately none of the products under consideration can be energy tested in Fiji. Test facilities for products such as refrigerators and air conditioners are expensive to build and operate. For example, air conditioners require two climate controlled chambers, to maintain the separate indoor and outdoor temperature and humidity conditions specified in the test standard. Such facilities are not likely to be able to attract enough business to be economic without significant on-going subsidies.

However, setting up a lamp test facility with reasonable capabilities would be considerably simpler and cheaper. FDOE is already funding the development of a test facility for biofuels at the University of the South Pacific (USP), where some lamp testing is already carried out as part of USP courses. There are staff members who could help establish a properly accredited facility, and these is potential for some scale economies in terms of sharing premises and administration. If such a facility could be cost-effectively set up, it would also be a strategic support for the UNEP en.lighten program, in which several PICTS are taking part.

Higher Energy Service Standards

There are generally two ways in which the benefits of greater energy-efficiency can be realised: reduced energy consumption for the same level of energy service or greater output of energy services for the same consumption. In markets such as Fiji, where the underlying demand for energy services is not fully satisfied, it is likely that a significant share of the benefit of greater product energy efficiency will be taken as greater consumption of energy services.

For example, if better designed buildings or more efficient HVAC equipment reduces the costs of cooling then people may choose to run their air conditioners longer or at colder settings, rather than maintain their present levels of comfort and save money. In practice, the benefits of more efficient HVAC are usually split between energy/money savings and greater comfort. This is a perfectly valid outcome, since the economic benefits are much the same irrespective of how the benefits are taken.

A recent study of the scope for energy-efficiency in the Fiji National Building Code (FNBC) found that the level of lighting in many public buildings in Fiji was well below international standards (NBI 2014). Therefore if the introduction of higher efficacy lamps, which deliver more lumens per Watt, leads to higher levels of lighting rather than lower lighting energy use, that will still be a welcome benefit.

However, caution is required so that policies do not lock in energy use when the same energy services can be obtained through good design. For example, it is nearly always more energy-efficient to design buildings to make full use of natural light and ventilation (possibly fan-assisted), rather than install air conditioners and more lamps, however energy-efficient they may be.

Some products lend themselves more to realising the benefits of energy-efficiency as lower energy use. For example, people cannot plug their refrigerator in for longer hours simply because it is more efficient, so greater efficiency translates directly to lower energy use. On the other hand, if an energy-efficient lamp is only available in a form that gives out more light rather than a form that uses less energy, the user has no choice: the savings can only be taken in the form of higher energy services.

One example of this came out of the phaseout of incandescent lamps (IL) in Australia. Lamp suppliers responded to the regulations by introducing a new type of lamp – mains voltage halogen (MVH) – which have 30% higher efficacy (lumens per Watt) are dimmable (unlike CFLs), and so are ideal drop-in replacements for ILs. The MVH lamps were however offered in two formats:

- Equivalent output, e.g. a 42W MVH bulb which has the same light output as a 60 W IL (and said so on the packaging); and
- Equal wattage, eg a 60 W MVH, which has the same light output as a 78 W IL. The packaging indicated that the bulb was 30% more energy-efficient than an IL, and while this was true it did not help the buyer either save energy or identify the correct bulb for their needs – which was the one that gave the same light output as the IL they were replacing.

Buyers were confused by these two formats, and many purchased the equal wattage versions, which gave them more light than they expected (and usually more than they wanted) and did not save any energy. The E3 Program had to work with the industry to ensure that the equal wattage lamp sizes were either eliminated from the market or at least more clearly marked on the packaging.

Conclusions Regarding Decision Criteria

The conclusions about energy use are tempered by the lack of recent household energy use or appliance ownership surveys in Fiji, and the absence of detailed information on non-residential energy use. Even so, it is likely that lighting and air conditioning (across all sectors) account for an even greater share of electricity use in Fiji than domestic refrigeration.

The next largest segment of energy use is likely to be commercial refrigeration, followed by domestic televisions and fans. A wide range of appliances and equipment accounts for the remainder of electricity use, but none of them appear to be large energy users in their own right. These estimates exclude industrial energy which, at 25% of Fiji electricity use, is a potentially fertile ground for energy-efficiency opportunities. However, only some of this opportunity can be addressed through MEPSL, and these could be considered in the future, after MEPSL for the priority products are in place.

All of the products under consideration are covered by the E3 program in Australia and New Zealand, so there are well-established AS/NZS standards for these product categories. Tests to AS/NZS standards are routinely carried out in the countries of manufacture before the products are exported to Australia or New Zealand. Adopting the same standards would simplify administration in Fiji, and also build on the existing consumer awareness of the ANZ energy label.

The level of existing voluntary compliance is one indicator of the extent of effort needed if MEPSL for a product is made mandatory. The appearance of a label generally means that the product also complies with the MEPS level associated with that labelling system (provided that the label is genuine, of course). For example, products can only carry an ANZ label if they also meet the MEPS level for that product.

The existing level of voluntary compliance with AS/NZS labelling on clothes washers and dishwashers appears to be fairly high, and more than half of televisions are labelled. There are no systematic surveys of labelling compliance for air conditioners. Customers may not see air conditioner labels often, since about half of the market is supplied by specialist contractors rather than general appliance retailers or department stores (Table 10). Therefore the greatest boost to the visibility of energy labels would be to make them mandatory for TVs and air conditioners.

However, the Fiji clothes washer market is dominated by twin-tub models, of which only three are still registered in Australia. Therefore most models on sale in Fiji would need to be tested to the relevant standard (AS/NZS 2040) before they could be properly labelled. Many twin tubs in Fiji carry a non-standard ‘hybrid’ label with a star rating band at the top and a European rating below. The retailer who imported the models in question indicated that the labels were applied in the factory in China, but was not able to explain how the ratings were obtained.

Adding more products to the MEPSL program would obviously increase the number of imports covered and the number of commercial stakeholders involved. However there are already FDOE staff administering the existing MEPSL scheme, and many of the products are supplied by stakeholders already involved in the present scheme. Therefore

the addition of other products would certainly increase the workload, but how much more is difficult to assess at this preliminary stage.

The best way to manage this uncertainty is to phase in the introduction of MEPSL for additional products over a reasonable period – say five years. In this way, FDOE resources can be maintained at a fairly even level, rather than having to be quickly ramped up and then down again. It will also allow different products to come within the scheme in different years, so any settling-in issues can be handled progressively rather than all at once.

There would also be costs imposed on stakeholders, especially those without previous exposure to refrigerator and freezer MEPSL. Many of the large retailers are already familiar with MEPSL, and could probably take the coverage of televisions, clothes washers and dishwashers in their stride, provided there was sufficient advance notice.

Air conditioners would involve both existing retailers and a new group of specialist contractors. Lighting products have the widest distribution, but if only MEPS were involved for lamps, and point of sale labelling were not required (as would be the case if ANZ rules were adopted) then it would only be necessary to ensure compliance at the point of import. Checking for labels at the point of sale would not be necessary.

Non-residential products such as commercial refrigeration would involve entirely new groups of stakeholders. However, there are relatively few of these, so the burden should not be excessive. The products with the highest level of regional support are air conditioners and lighting. At least five other PICTs are planning to implement MEPSL for those products (Table 2). They are also covered in Australia and New Zealand. The next group are those covered by the E3 program but not necessarily in other PICTs – this includes televisions, commercial refrigeration and industrial motors.

Summary

Table 11 summarises the assessment of the product groups which FDOE requested for consideration, under the criteria discussed in the previous section.

Table 11 Conclusions regarding Decision Criteria

Product group	Energy use	Standard	Label presence	Admin difficulty	Regional support	Strategic value
Domestic refrigerators and freezers (in place)	High	ANZ	High	Medium	PALS, ANZ	High
Air conditioners	High	ANZ	Low	Medium	PALS, ANZ	High
Lighting products (AC and MV)	High	ANZ (some types)	NA	Medium	PALS, ANZ UNEP	High
Commercial refrigeration	High	ANZ	NA	High	ANZ, Kiribati	Med
Televisions	Medium	ANZ	Medium	Low	ANZ	High
Clothes washers	Low	ANZ	High	Low	ANZ, Cook Is	Med
Dishwashers	V. low	ANZ	Medium	High	ANZ	Med

Product Segmentation and Standards

The previous section established the main product groups suitable for inclusion in the Fiji MEPSL program. However, each product group consists of a number of distinct segments, covered by different standards in different ways. This section examines those segments and options in more detail and proposes priorities which could form the basis of a five-year work plan for FDOE.

The standards relevant to the product under consideration are summarised in Table 15. All AS/NZS product energy efficiency standards (apart from commercial refrigeration) follow a similar structure:

- Part 1 contains the methods for determining product capacity (eg kW output), energy consumption (eg kWh/cycle) and other performance criteria (eg the maximum temperatures to be maintained inside a refrigerator). There may be sub-parts to cover different product segments (as with air conditioners); and

- Part 2 contains the formulae for calculating energy efficiency using the test results in Part 1 (eg the star rating), the MEPS levels (eg minimum level of efficiency star rating that is acceptable for a product that complies with the standard) and the energy labelling requirements (ie the layout of the label and how the information is to be presented.

Air Conditioning

Single phase split units are used in domestic, accommodation and smaller commercial buildings. The two main technology groups are inverter-driven compressors and fixed-speed compressors. Inverter units are more energy efficient but tend to be more expensive, although the cost differential has been declining. The running cost savings usually repay any additional capital costs in less than a year.

The air conditioner suppliers interviewed indicated that they had made efforts to inform consumers about the running costs advantages of inverter-driven units. While professional and business buyers had been responsive, household customers were still highly sensitive to first cost – even cost differentials of less than FJD 100 were enough to deter them from buying inverters.

The running cost advantages of more efficient models would be reinforced if there were energy labels on the products. If the Fiji MEPS regulations required compliance with the air conditioner standards listed in Table 15, then all single-phase models would need to carry a star rating energy label, and would need to meet MEPS levels that that would remove the least efficient models from the market.

Nearly all of the brand names currently available in Fiji appear on the AS/NZS product register. The Fiji house brands (e.g. Modyl) are supplied by global manufacturers which also supply products to ANZ under different brand names, so there is a high probability that the suppliers will be able to provide test results for Fiji models.

Three-phase air conditioners, with electrical inputs greater than 2.4 kW and cooling outputs greater than about 7-8 kW are generally used for medium sized commercial buildings, often with ducting. They are subject to MEPS under the AS/NZS standards but not labelling, since they are rarely purchased in showrooms.

Larger, multi-storey commercial buildings are served by central air conditioning plant, which usually include one or more refrigerated water chillers. The chilled water is then circulated to air-handling units throughout the building – distributing chilled water through pipes is more space-efficient than distributing cold air through ducts. Small differences in chillier operating efficiency can be very important, given that annual energy costs for such buildings can be in the hundreds of thousands of FJD.

The ANZ MEPSL website www.energyrating.gov.au lists about 480 chiller models that meet the ANZ MEPS levels. Over 370 models (from 8 brands) are indicated as available in Fiji. Therefore it is highly likely that most chiller imports to Fiji will already have been tested for the ANZ market.

As the air conditioning installations of large buildings tend to be designed by building services engineers for clients who are well aware of the significance of running costs, there are some pressures to select the more energy-efficient chillers. However, if MEPS were implemented as a protective measure this would prevent the possibility that low-cost, low-efficiency models could enter the Fiji market in future, as has happened with other product categories. Therefore implementing MEPS for chillers may be less urgent than for single-phase and three-phase air conditioners.

Lighting

The customs data give a good indication of the number of lamps imported, but not their type. The estimated breakdown of general lamp sales in Table 12 is based on interviews with retailers.

About 30% of lamp sales are single-cap and 70% are linear fluorescent lamps (LFLs). Single-cap lamp sales are further divided into compact fluorescent lamps (CFLs) incandescent lamps and light emitting diodes (LEDs), which have a surprisingly high share of the single-cap market (15%) given how recently they were introduced. However, the LED market is dominated by no-brand, low-quality products with rapid fall-off in lumen output, much shorter service life than promised on the package, and in some cases a risk of becoming electrically unsafe. The share of medium and higher quality products in other lamp types is higher, largely because the price premiums are far lower than for LEDs (see next section).

Adoption of the AS/NZS MEPS levels for single-cap lamps would have the following impacts:

- Low-quality CFLs would be excluded, because they could not meet the minimum service life, lumen maintenance or maximum mercury content levels in AS/NZS 4847.

- All conventional tungsten filament incandescent lamps would be excluded, because they could not meet the minimum efficacy (lumens/watt) levels in AS/NZS 4934. However, mains voltage halogen (MVH) lamps, which are also incandescent but 30% more efficient, would pass the MEPS levels. At present there are no MVHs on the Fiji market, but when AS/NZS 4934 was made mandatory in Australia MVH market share increased rapidly.

Table 12 Estimated market share of lamps by type and quality

Type	Share total lamp sales	Sub-type	Share of type sales	Low quality(a)	Medium quality(b)	High Quality(c)
Single-cap	30%	CFL	55%	60%	30%	10%
		LED	15%	80%	15%	5%
		Incandescent	40%	40%	50%	10%
		MV Halogen	0%	60%	30%	10%
Linear	70%	LFL	100%	10%	50%	40%
Ballasts				70%	20%	10%

Source: GWA estimate based on retailer interviews in Fiji. (a) No-brand generic types. (b) Retailer's house brand. (c) Global brands, eg Osram, Crompton, Phillips, Sylvania.

There are no minimum energy or other performance standards for LED lamps at present (either AS/NZS or any other), although they are under development. It is likely that in the next few years, international and AS/NZS standards will be adopted for LEDs, similar to those for CFLs. In the meantime it may be necessary to use means other than MEPSL to encourage the purchase of better quality LEDs.

If the policy objective is to eliminate incandescent lamps, it would be simpler to directly regulate their exclusion, since the technology can be identified by appearance, without needing efficacy testing. However, it may be necessary to maintain exclusions for specialised shapes and applications (eg explosion-proof lamps) which are not available in MVH alternatives.

The most common type of LFL on the Fiji market is the T8 (18 W for 2ft tubes and 36W for 4ft tubes, plus ballast consumption). T5 tubes are also available. The old style T12 tubes (20W/40W) are no longer sold. Adoption of AS/NZS 4782 for LFLs would mean that low-quality LFLs would be excluded, because they could not meet the minimum service life, lumen maintenance or maximum mercury content levels. There may also be an increase in efficacy, but this is likely to result in more light for the same energy use rather than energy savings.

Adoption of AS/NZ 4783 for fluorescent lamp ballasts would eliminate low-quality ferro-magnetic ballasts, but would not force a switch to electronic ballasts. This would still be a significant energy saving.

Nearly 30% of Fiji households still do not have access to mains voltage electricity. Their highest priority energy needs are lighting, then communications and entertainment (televisions, DVDs and – where there is a signal – mobile phone charging).

Using fuels such as kerosene for lighting is usually expensive, inefficient and unhealthy, given the fumes and fire risk. Off-grid electric technologies give superior lighting, and

can also supply the small amounts of power needed for essential communications and entertainment devices.

Solar lanterns have highly LED lamps, usually mounted in a casing with a small solar photovoltaic (PV) panel and a battery. Alternatively, the solar lantern may be charged from a separate module, which may also be capable of charging mobile phones and other low-power devices.

Although the cost of electricity is not a factor in off-grid solar lighting, the performance of products with regard to key parameters such as light output and distribution, durability and battery life determine the quality of the energy service and the overall cost of ownership.

The IEC Technical Specification TS62257 *Recommendations for small renewable energy and hybrid systems for rural electrification, Part 9-5 Integrated system – selection of stand-alone lighting kits for rural electrification* presents a quality assurance framework that includes product specifications, test methods, a framework for interpreting test results and standardized specifications sheets and templates for communicating test results. TS62257 does not specify actual minimum performance levels that products must meet - only the means for measuring performance.

The Fiji Government could set its own minimum parameters for solar lighting products, referring to IEC TS62257. Alternatively, the Government could require that solar lighting products sold in Fiji have to comply with the quality requirements of respected organisations such as Lighting Global (an innovation of the World Bank), which publishes lists of quality-approved products.[8]

Commercial Refrigeration

There are many types of commercial refrigeration, but the ones most significant for energy use in Fiji are glass-door and open-front beverage display refrigerators, perishable food refrigerators and freezers (which look similar to beverage units but maintain different temperature conditions) and glass-top cabinets (sometimes with the top removed) of the type that is common in supermarkets.

It is estimated that there are between 9,000 and 10,000 beverage refrigerators in use throughout Fiji, accounting for about half of all commercial refrigeration energy use. Nearly half of these units are owned by the Coca-Cola Company and over a quarter by other beverage and dairy companies. Coca-Cola Fiji refrigerators must meet the global energy and performance specifications developed by the company headquarters in Atlanta, Georgia, USA. The Australian office maintains a list of approved models made by well-known brands such as Skope, Sanden, Haier and Frigoglass. All of these exceed AS/NZS MEPS levels by a wide margin (most qualify for the 'High Efficiency' designation in AS/NZS 1731).

[8] See for example http://www.lightingglobal.org/products/

Coca-Cola Fiji purchases refrigerators exclusively from this list, imports the units directly, maintains them at the customers' premises and collects and disposes of them at the end of their service life (after recovering the refrigerant).

The other major beverage and food companies also purchase good quality units, often from the same manufacturers, but some units are purchased locally rather than directly imported. Cabinet display refrigerators and freezers (both vertical and chest) are also sold by the major appliance retailers (eg Narhari, Brijlal) supplying brands such as Husky, Haier, Modyl and Akira. The typical purchasers are smaller store owners, hotels, bars and restaurants, who may be more sensitive to capital costs and less aware of running cost differences between units.

Apparently some of the lower-cost units are not suitable for tropical duty, so the compressors run almost continuously and use up to twice as much energy as the most efficient units of the same size. Apart from the climate rating, the compressor efficiency and the insulation performance, the sophistication of the control strategy also has a major bearing on energy use, by monitoring door openings, minimising defrost cycles and turning off cabinet lighting at the end of the trading day.

The built-in and custom-made segment of the commercial refrigeration market is supplied by the major air conditioning companies: Mechanical Services Ltd, Lincoln Refrigeration and Trade Air Engineering. Larger units tend to be purchased by major supermarket chains, which employ energy services engineers and so have an appreciation of running costs. Some of them have refrigeration units that are remote from the display cabinets, and so require different methods of test.

AS 1731 provides for refrigeration units to be rated according to their product category and climate class, and for determining their energy consumption (in kWh/24hrs/m^2 shelving area). It also sets a MEPS level (as a maximum kWh/24hrs/m^2 value) for each product category, and a lower value that would qualify a model to be designated as 'High Efficiency'. AS 1731 does not provide for on-product energy labelling, because the units are rarely displayed for sale.

Making compliance with AS1731 mandatory for the most common types of commercial refrigeration - display cabinets with integral compressors - would have the following impacts:

- The regulations could specify that only units rated for operation in tropical climates could be imported;

- Some models would be excluded from the market because they are not tropical rated and/or because they fail to meet the MEPS levels in AS1731; and

- Consumers could identify and prefer 'high efficiency' products.

Table 13 illustrates the potential energy savings from adopting MEPS for beverage display refrigerators. Even through there would be no benefit to the segment of the market that is already high-efficiency units, the elimination of sub-MEPS units and greater preference for energy–efficient units could reduce the energy use of this segment

by about 15%. Of course this would not happen overnight, but at the rate at which existing units are replaced at the end of their service life.

Table 13 Estimated energy saving potential, beverage display refrigerators

	Number of units	kWh/day	GWh/yr	Reduced kWh/day	GWh/yr	Energy saving
High-Efficiency	4000	5	7.3	5	7.3	0%
Meets MEPS	2000	8	5.8	6	4.4	25%
Sub-MEPS	3000	10	11.0	8	8.8	20%
	9000	7.3	24.1	6.2	20.4	15%

The performance metrics in AS 1731 have not been changed since 2004, and there is concern that these standards no longer represent a suitable minimum requirement for manufacturers. Energy intensity in the refrigeration sector has trended down since 2004 and revisiting the standards could lead to cost effective outcomes for consumers.

A recent review of AS 1731 raised the suggestion that if AS 1731 is updated, it could be aligned with ISO 23953 *Refrigerated Display Cabinets*, which is currently being revised, and expected for publication in 2015 (E3 2013). This revised standard would set MEPS for refrigerated display cabinets using the classes analogous to the current AS 1731. Therefore adoption of AS 1731 would give a smooth transition path to later adoption of ISO 23593.

About 350 of the 2300 commercial refrigerator models listed as complying with AS 1731 on www.energyrating.gov.au are shown as available in Fiji, as well in Australia and/or New Zealand. Experience with the domestic refrigeration register shows that this does not mean that they are indeed on the Fiji market, and inquiries with Fiji distributors found several models not on the ANZ register. Nevertheless, it is likely chance that most models on the Fiji market will already have been tested to AS 1731.

Televisions

Televisions are subject to both energy labelling and MEPS in Australia and New Zealand, under AS/NZS 62087. Models just meeting the MEPS level rate 1 star. The star rating scale extends up to 10: six on the normal arch and up to four extra stars for 'super-efficient' models.

Table 14 summarises the average screen size, star rating index[9] and kWh/yr for models on the ANZ register, by technology types:

- CRT - Cathode Ray Tube. This is now obsolete technology (as indicated by how few models there are on the market) but Fiji suppliers are still importing some;
- LCD - Liquid crystal display;
- LCD (LED) – LCD with Light Emitting Diode Backlighting;

[9] The Star Rating Index (SRI) is the number actually calculated using the method in Part 2 of the standard. The labelling rules mean that, for example, a model with an SRI of between 4.5 and 4.9 will display a coloured band that runs through 4 whole stars and a half star, It cannot display 5 whole stars unless the SRI is 5.0 to 5.4, and so on.

- OLED - Organic Light Emitting Diode;
- Plasma.

All but CRT are flat screen technologies, distinguished by factors such as available screen sizes (plasma tend to be the largest), brightness, picture definition and persistence (eg some types are better for fast-moving sports), cost and energy efficiency. Table 14 indicates the relative efficiencies of different technologies by the average Wh/yr per cm^2 of screen viewing area, on the assumption that the TV is viewed for 10 hrs/day. Larger screen units have a natural energy advantage, since the fixed energy overheads of the set (eg powering the tuner when on, standby when off) are divided by a larger viewing area. Nevertheless, TVs fall into three distinct energy efficiency groups:

- CRTs are the least efficient (average 2.9 stars)
- LCDs use about 40% less energy than CRTs per cm^2 (average 4.3 stars); and
- LCD (LED), OLED and plasma as a group average 6-7 stars, and use about 60% less energy than CRTs.

There is also a wide range within each technology type, so customers who have decided on a particular technology type could still use the labels to find more efficient models if they wish.

As indicated in Table 8, about half of the TVs on display in Fiji showrooms already have ANZ energy labels. About 1,030 of the 4,351 models registrations in ANZ indicate that the models are available in Fiji, so the majority of the unlabelled models have probably been tested already, but shipped without labels.

Table 14 Television models registered in Australia and New Zealand

Type	Number of Models	Average screen size (a)	Star rating index			kWh/yr			Average Wh/yr/ cm^2
			Avg	Min	Max	Avg	Min	Max	
CRT	9	49	2.9	1.1	4.5	238	133	409	190
LCD	1575	80	4.3	1.0	8.1	345	38	1297	113
LCD (LED)	2386	97	6.8	1.0	10.4	250	26	1531	55
OLED	11	123	7.3	3.1	9.3	411	103	640	60
Plasma	370	146	5.6	5.0	6.0	637	504	813	70
Total, avg(b)	4351	95							78

(a) cm, measured diagonally. Screen area can vary for the same diagonal, because aspect ratios vary.
(b) Model-weighted averages, not sales-weighted

Making compliance with AS/NZS 62087 mandatory, would have the following impacts:

- All models displayed for sale in Fiji would have to meet MEPS and carry an energy label. It is likely that the ones currently without labels are the lower rated models, so if these are also labelled it will enable more consumers to be better informed and avoid less-efficient models. It may also increase the awareness of the relative energy costs of different flat screen technologies;

- CRT TVs would probably be excluded from the Fiji market. Although it is possible for CRTs to meet the MEPS levels, and there are still 9 CRT models registered in Australia, those currently being supplied to Fiji are from low-cost manufacturers

and have probably not been tested to AS/NZS 62087. Making MEPS and labelling mandatory will probably result in their withdrawal from the market, but CRTs will disappear sooner or later anyway. LCD and LED televisions are coming down in price, so consumers will not have to pay much more for a TV of the same size, and will enjoy the benefits of better screen quality as well as lower running costs.

Clothes Washers

About 70% of the clothes washers in Fiji showrooms carry ANZ energy labels (Table 8). Nearly all the front loaders and most top loaders are labelled. However, twin tub clothes washers, which are the most popular type, tend to be either unlabelled or carry a hybrid label with ratings determined by the supplier, without reference to any known standards.

The actual differences in energy operating costs between clothes washer models in Fiji are less than star rating differences would indicate, because most clothes in Fiji are washed in cold water, and dried on the line rather than in a clothes dryer. This means that the only energy used in clothes washing is the motor energy, which tends to be similar for all washer types and models.

To get an ANZ energy label, a clothes washer must be tested to AS/NZS 2040.1, using a standard wash load and a cycle which involves some warm water fills and rinses (although there are provisions for labelling energy use on cold wash alone). The water consumption measured during the same test is used to calculate water efficiency (WELS) rating label.[10] There are no MEPS for clothes washers.

Making compliance with AS/NZS 2040 mandatory in Fiji would have the following impacts:

- Most top loader and front loader models could comply without additional testing. About a third of the 661 models currently on the ANZ register indicate that they are available in Fiji as well.

- It is likely that some twin tub models would need to be tested to AS/NZS 2040 for the first time. There are only 11 twin tub models on the ANZ register, and only one of these (ARDA brand) is indicated as available in Fiji, although some may be sold under different brand names in Fiji (eg Modyl).

Therefore making labelling mandatory could impose large testing costs on importers, for minimal energy benefits to individual consumers or to Fiji. A possible intermediate step is to make energy labelling optional, but regulate that:

[10] The way in which the raw water consumption is converted to a WELS star rating is set out in AS/NZS 6400:2005*Water efficiency rating and labelling*. The Commonwealth Water Efficiency Labelling and Standards (WELS) Act requires all clothes washers, combined washer-dryers and dishwashers (as well as toilets, shower heads and taps) offered for sale in Australia to carry a WELS rating label, has a similar layout to the energy label but is coloured blue and white. Clothes washers, but not dishwashers, also have to meet minimum water efficiency standards.

- If an energy label is fixed to the product, it must be the ANZ label as defined by AS/NZS 2040 Part 2. No other labels would be permitted.

- If an energy label is affixed then the model must be registered, as it would be if labelling were mandatory. This means that any non-compliance could be pursued under the regulations. Otherwise a supplier whose product is found to be non-compliant (e.g. the star rating is over-stated) could simply choose to stop labelling without penalty, so there would be no deterrent to non-compliance.

The practical impacts of such a measure would be that consumers would see only properly applied AS/NZS energy labels on most clothes washers and no labels at all on the rest. They would not see labels such as the questionable and potentially misleading hybrid labels, which are currently common.

This would give suppliers an incentive to have their models tested to AS/NZS 2040, since consumers would otherwise suspect that un-labelled models are deficient in some way. However, suppliers could choose to do so in their own time. FDOE could review the situation some years later to determine whether labelling should then be made mandatory.

Dishwashers

Nearly all domestic dishwashers offered for sale in Fiji appear to have an ANZ energy label, in accordance with AS/NZS 2007. Like clothes washers, they also have a WELS label. There are no MEPS or minimum water efficiency standards for dishwashers.

The efficiency differences indicated by dishwasher energy labels are more likely to translate into real differences in energy costs than that for clothes washers, because all dishwashers heat the wash water – unlike clothes washers, there is no option for cold wash. However, use of the label by consumers will not lead to significant energy savings in Fiji, because:

- The number of household dishwashers in use, and the number of annual sales, are so low; and

- All dishwasher manufacturers place an emphasis on reducing water consumption, and the average litres per wash have been falling for decades. Therefore the running cost differences between models is small.

However, given the high rate of voluntary compliance with AS/NZS labelling, it should cause very little market disruption to make labelling mandatory. This would have the advantage of extending the reach of the MEPSL program at little cost - but also for little benefit. Over 300 of the more and 1,000 models currently on the ANZ register are marked as being available in Fiji.

Table 15 Product segmentation and relevant standards

Product group	Subgroup	Measure	Relevant Standards	Comments	Priority
Air conditioning	Single-phase	MEPS & labelling	AS/NZS 3823AS/NZS3823.1:2012 Performance of household electrical appliances – room air conditioners Part 1.1: Non ducted air conditioners and heat pumps – Testing and rating for performance Part 1.2: Test Methods – Ducted air conditioners and air-to-air heat pumps – Testing and rating for performance Part 1.4: Test Methods – Multi split-system airconditioners and air-to-air heat pumps – Testing and rating for performance AS/NZS3823.2:2013 Performance of electrical appliances – air conditioners and heat pumps Part 2: Energy labelling and minimum energy performance standard (MEPS) requirements	Feasible	1
	Other packaged	MEPS only		Feasible	2
	Chillers	MEPS	AS/NZS 4776.1.1:2008: Liquid-chilling packages using the vapour compression cycle—Method of rating and testing for performance—Rating. AS/NZS 4776.1.2:2008: Liquid-chilling packages using the vapour compression cycle—Method of rating and testing for performance—Testing. AS/NZS 4776.2:2008: Liquid-chilling packages using the vapour compression cycle—Minimum energy performance standard (MEPS) and compliance requirements.	Feasible but limited impact	3
Lighting	Single cap GLS incandescent lamps	MEPS - efficacy	AS/NZS 4934.1: 2014 Incandescent lamps for general lighting service Part 1: Test methods – Energy performance AS 4934.2-2011 Incandescent lamps for general lighting services Part 2: Minimum Energy Performance Standards (MEPS) requirements	Feasible – but simpler to ban	1
	CFLs	MEPS & quality	AS/NZS 4847.1:2010 Self-ballasted lamps for general lighting services Part 1: Test Methods – Energy performance AS/NZS 4847.2:2010 Self ballasted lamps for general lighting services Part 2: Minimum Energy Performance Standards (MEPS) requirements AS/NZS 4782.3(Int):2006 Double-capped fluorescent lamps – Performance specifications Part 3: Procedure for quantitative analysis of mercury present in fluorescent lamps [also covers mercury content of CFLs]	Feasible – will improve quality	1
	LEDs		No AS/NZS or other standards at present	Wait for standards	2
	LFLs	MEPS & quality	AS/NZS 4782.1:2004 Double-capped fluorescent lamps – Performance specifications Part 1: General (IEC 60081:2000 MOD) AS/NZS 4782.2:2004 Double-capped fluorescent lamps – Performance specifications Part 2: Minimum Energy Performance Standards (MEPS) AS/NZS 4782.3(Int):2006 Double-capped fluorescent lamps – Performance specifications Part 3: Procedure for quantitative analysis of mercury present in fluorescent lamps	Feasible	2

Product group	Subgroup	Measure	Relevant Standards	Comments	Priority
	Ballasts	MEPS ferro-magnetic	AS/NZ 4783.1:2001 Performance of electrical equipment – ballasts for fluorescent lamps – Part 1: Method of measurement to determine energy consumption and performance of ballasts-lamp circuits AS/NZ 4783.2.2002 Performance of electrical lighting equipment – ballasts for fluorescent lamps – Part 2: energy labelling and minimum energy performance standards	Feasible	1
	Off-grid lights		No AS/NZS or other standards at present	Wait for standards	3
Commercial refrigeration	Beverage display	MEPS	AS 1731.1-2003 Refrigerated display cabinets. Part 1: Terms and definitions Part 2: General mechanical and physical requirements Part 3: Linear dimensions, areas and volumes Part 4: General test conditions Part 5: Temperature test Part 6: Classification according to features Part 9: Electrical energy consumption test Part 13: Test Report Part 14: Minimum energy performance Standard (MEPS) requirements	Feasible – most products comply	1
	Perishables display vertical	MEPS		Feasible	2
	Open-top units	MEPS		Not enough information yet	3
Clothes washers		Optional labelling	AS/NZS 2040.1:2005: Performance of household electrical appliances—Clothes washing machines—Part 1: Methods for measuring performance, energy and water consumption. AS/NZS 2040.2:2005: Performance of household electrical appliances—Clothes washing machines—Part 2: Energy efficiency labelling requirements.	Feasible - little energy benefit	1
Televisions		MEPS & labelling	AS/NZS 62087.2.2:2011: Power consumption of audio, video and related equipment—Part 2.2: Minimum energy performance standards (MEPS) and energy rating label requirements for television sets. AS/NZS 62087.1:2010: Power consumption of audio, video and related equipment—Methods of measurement.	Feasible	1
Dishwashers		Optional labelling	AS/NZS 2007.1:2005: Performance of household electrical appliances—Dishwashers— Part 1: Methods for measuring performance, energy and water consumption. AS/NZS 2007.2:2005: Performance of household electrical appliances—Dishwashers— Part 2: Energy efficiency labelling requirements.	Feasible - little energy benefit	2

Costs and Benefits

Benefits

The benefit of introducing MEPS and labelling for particular products is the expected value of the electricity that will be saved compared with the "Business as Usual" (BAU) case. It should be noted that in some product areas there will be efficiency improvements in Fiji even without MEPSL, because manufacturers are already making their products more efficient in response to other market forces, including the MEPSL policies of other countries such as China and Australia.

Nevertheless, even against a background of general improvement, many products imported to Fiji do not meet the MEPS levels in the relevant AS/NZS standards, and of those that do, some will still be more energy- efficient than other, so labels would enable consumers to choose the more efficient of the range.

It requires some judgement to estimate the combined effects of these changes. The following estimates are based on those observed in Australia and New Zealand, the efficiency potentials indicted in Table 12, Table 13 and Table 14 and the lighting energy modelling for Fiji in the recent report *Regional status report on efficient lighting in the Pacific Island Countries and Territories* (GWA 2014). The Fiji population and household projections underlying the estimates are summarised in Table 16 (all of these can be changed if there are other projections considered by FDOE to be more reliable).

Table 16 summarises the main modelling assumptions for population, household numbers and lighting energy use. It is assumed that the share of Fiji homes connected to the grid (or with access to sufficient locally generated electricity to operate major appliances) will increase from about 70% in 2012 to 80% by 2030. Combined with population growth and a trend towards fewer person per household, this would mean a 2.7% per annum increase in the number of electrified households with a demand for appliances and lighting services and the electricity they consume.[11]

The share of electrified household owning major appliances is also projected to increase, as an expected by-product of economic growth – for example television ownership is projected to increase from an already high 0.90 to 0.95 (see Table 17). Household air conditioner ownership is projected to increase from 0.05 to 0.20 in 2030, but as the starting base is so low, it is possible that growth could be even higher.

It is assumed that the underlying demand for *non-residential* air conditioning and refrigeration services increases at 2.5% per annum. For the end uses not affected by MEPSL, the following overall annual growth rates demand are assumed: 1.5% per annum for the balance of household electricity use, 2.0% per annum for the balance of commercial and government energy use and 1.0% per annum for industrial energy use.

Clothes washer and dishwasher energy use is included in the "balance of household electricity use" that is unaffected by MEPSL. Although there may be minor reductions

[11] The number of FEA Residential consumers increased at an average rate of 2.8% per annum between 2009 and 2013, so the projections match the recent historical trend.

in energy use due to the adoption of optional labelling for clothes washers and mandatory labelling for dishwashers, as recommended in the previous section, they would be negligible for energy modelling purposes.

As the electricity consumption of 'industrial' customers is likely to include a significant amount of lighting, air conditioning and refrigeration using the products that would be impacted by MEPSL, the fact that these savings are not included in the total impacts builds a conservative bias into the modelling.

Figure 2 illustrates Fiji's projected BAU electricity use by sectors and end uses. The sectors shown shaded would be covered by MEPSL (or in the case of domestic refrigeration, are already covered). The red line at the top illustrates the projected trend in total Fiji electricity use if MEPSL were implemented.

Table 16 Projections of population, household numbers and lighting electricity use, Fiji 20112-2030

Fiji - Current (Default lamp count)	**2012**	**2030**
Population	944720	1294142
Pop growth rate	2.0%	1.5%
Persons/HH	4.93	4.8
Households	191589	269613
Electrification rate	70%	80%
Electrified HH	134112	215690
Non-electrified HH	57477	53923
Lighting kWh/elec HH - BAU	301	429
Lighting kWh/elec HH - Reduced	243	348
Lighting kWh/HH saved	57	82
Household lighting MWh saved	7658	17591
Public lights per capita	0.03	0.04
Total public lights	28342	51766
Public lighting W/lamp - BAU	80	70
Public lighting W/lamp - Reduced	30	30
Public lighting kWh/elec HH - Reduced	50	40
Hrs/night	6	8
Public lighting MWh/yr - BAU	4965	10581
Public lighting MWh/yr - Reduced	1862	4535
Public lighting GWh saved	3103	6046
Comml/Govt lighting kWh/cap - BAU	120	100
Comml/Govt lighting MWh - BAU	113366.4	129414
Reduction potential	40%	10%
Comml/Govt lighting kWh/cap - Reduced	72	90
Comml/Govt lighting MWh - Reduced	68020	116473
Comm/Govt lighting GWh saved	45347	12941
HH lighting MWh/yr BAU	40305	92581
Public area lighting MWh/yr BAU	4965	10581
Comml/Govt lighting MWh/yr - BAU	113366.4	129414
Total lighting MWh/yr - Reduced	158637	195997

Source: GWA (2040)

Table 17 Projections of ownership, energy use and energy savings for products covered and proposed for MEPSL,

Product group		2012	2030
Domestic refrigerators and freezers (already subject to MEPSL)	kWh/owning HH	659	600
	Ownership	0.80	0.90
	HH owning	107290	194121
	BAU GWh	70.7(a)	116.5
	With-MEPSL efficiency factor	1.00	0.80
	GWh (with measures)	70.7	93.2
	GWh saved	0.0	23.3
	% BAU saved	0%	20%
Air Conditioners - Domestic	kWh/owning HH	1500	1300
	Ownership	0.05	0.20
	HH owning	6706	43138
	BAU GWh	10.1(a)	56.1
	With-MEPSL efficiency factor	1.00	0.80
	GWh (with measures)	10.1	44.9
	GWh saved	0.0	11.2
	% BAU saved	0%	20%
Televisions – Domestic	kWh/owning HH	240	250
	Ownership	0.90	0.95
	HH owning	120701	204906
	BAU GWh	29.0(a)	51.2
	With-MEPSL efficiency factor	1.00	0.80
	GWh (with measures)	29.0	41.0
	GWh saved	0.0	10.2
	% BAU saved	0%	20%
Air Conditioners - Other	Base GWh	140.0	140.0
	Demand factor	1.00	1.56
	Efficiency factor (BAU)	1.00	0.90
	GWh (BAU)	140.0(b)	196.5
	MEPSL Impact	1.00	0.85
	With-MEPSL efficiency factor	1.00	0.77
	GWh (with measures)	140.0	167.0
	GWh saved	0.0	29.5
	% BAU saved	0%	15%
Commercial Refrigeration	Base GWh	40.0	40.0
	Demand factor	1.00	1.31
	Efficiency factor (BAU)	1.00	0.90
	GWh (BAU)	40.0(b)	47.1
	MEPSL Impact	1.00	0.85
	With-MEPSL efficiency factor	1.00	0.77
	GWh (with measures)	40.0	40.0
	GWh saved	0.0	7.1
	% BAU saved	0%	15%

(a) See Table 4 (b) See Table 5

Figure 2 Projected electricity consumption, Fiji 2012-2030

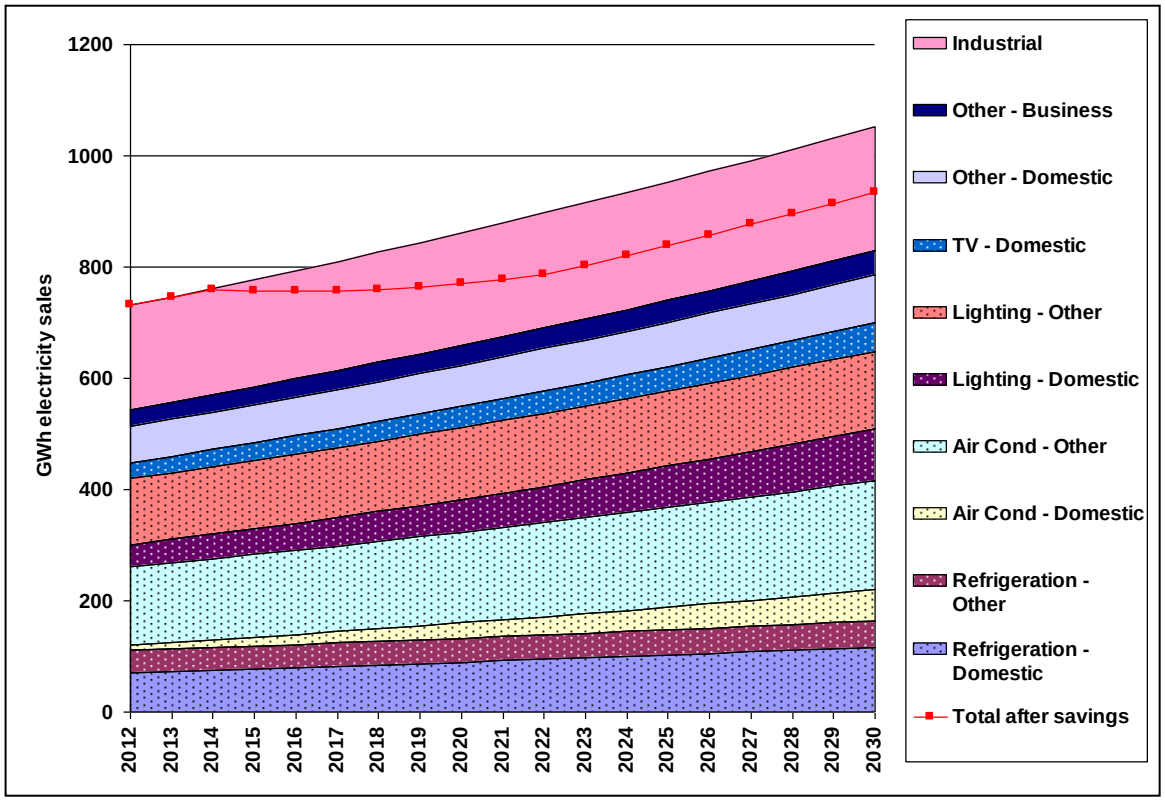


Figure 3 Sectoral efficiency factors

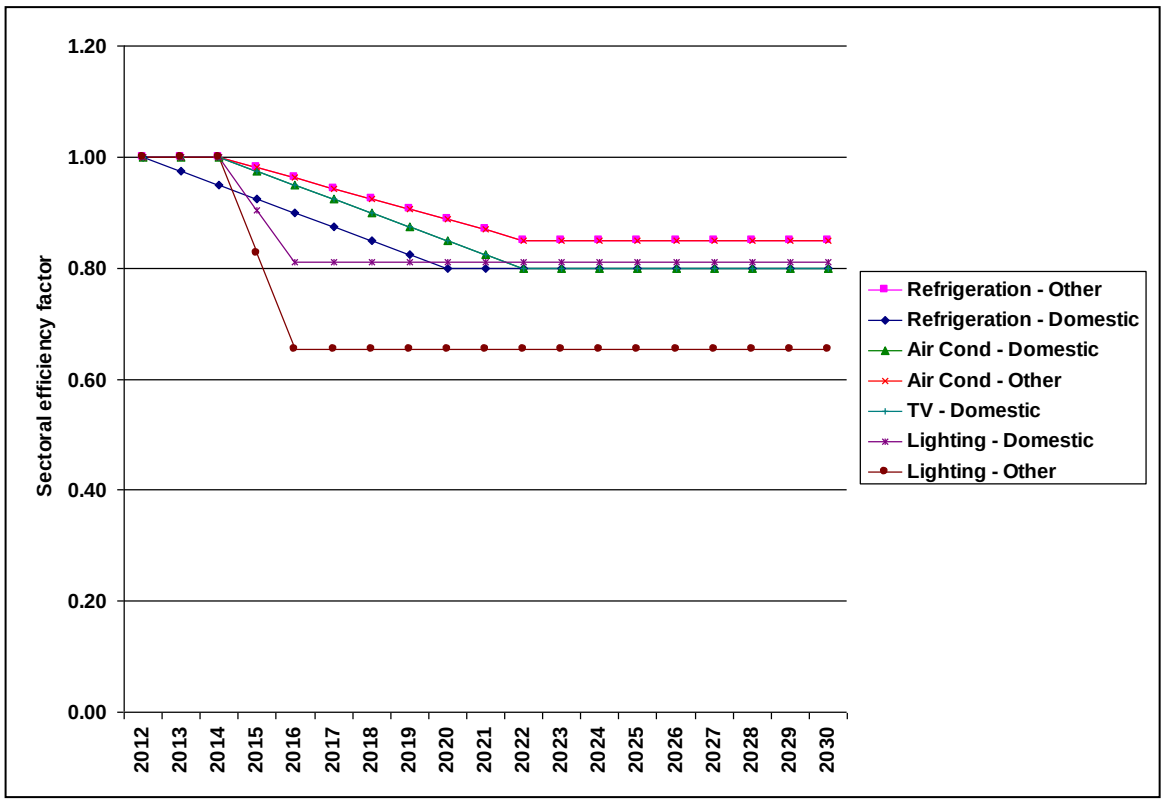


Figure 3 illustrates the change in the energy-efficiency of new products imported to Fiji under the influence of MEPSL regulations. For modelling purposes the BAU efficiency factor is set at 1.0 for every product, even though technical efficiency may be increasing anyway. For example, the average coefficient of performance (COP) of air conditioners sold in Fiji might increase from, say, 2.5 in 2012 to 2.7 in 2020 due to changes in the market that are unrelated to MEPSL in Fiji (these figures are illustrative only – the actual average COP is not currently known).

If however MEPSL were to increase the average COP by 15% by 2020 then the sectoral efficiency factor for new air conditioners would be 0.85 and the actual average COP would be (2.7/0.85) = 3.2. As MEPS for refrigerators and freezers has already been implemented, the efficiency increases trend starts in 2012. For the other products efficiency increases start in 2015, on the assumption that MEPSL can be implemented without delay.[12] The reduction trend for lighting is rapid, because only MEPS are involved. For the other product the trend is more gradual, since some of the change is due to energy labelling, which has a more gradual market impact.

Figure 4 shows the projected energy savings by product. The savings for domestic refrigerators and freezers are also shown for comparison, although these savings should already be locked in due to existing MEPSL, while the other savings depend on MEPS still to be implemented. Over the period 2015-2030, the projected energy savings from new MEPSL measures is about 4.2 times as great as the projected savings from MEPSL already implemented from domestic refrigeration. The relative magnitude of savings is illustrated in Figure 5, which covers only the sectors subject to MEPSL, not the whole of Fiji electricity use. It is projected that by 2030, annual electricity savings will total about 118 GWh/yr, nearly 17% of the BAU electricity use of the impacted sectors.

The value to consumers of the electricity saved has been calculated using the electricity prices in Table 6. It is assumed that the real price of electricity remains constant (ie ignoring inflation, it remains at the 2014 value of 0.33 FJD/kWh to domestic consumers and 0.42 FJD/kWh to commercial and government consumers). This is a conservative assumption, since oil prices could rapidly increase in real terms in the future.

Figure 6 illustrates projected average annual household electricity bills, with and without MEPSL. Without MEPSL, it is projected that average bills will increase from FJD 532 in 2012 to FJD 615 in 2030, due to rising ownership of household appliances and greater use of lighting. MEPSL for refrigerators and freezers will reduce bills by FJD 35 per year, and MEPSL for air conditioners, television and lighting by a further FJD 60. By 2030 the total savings will reach by FJD 95 per household per year, or 16%.[13] Figure 7 illustrates the total value of energy saved in both the residential and non-residential sectors

[12] The effects of phased introduction are not taken into account. While delaying MEPSL introduction for some products beyond 2015 would slightly reduce the total energy savings achieved by 2030, the impact on the net present value of benefits would be minimal, Although the cost savings would accrue later in time, so would the implementation costs.

[13] This projected 16% savings in household energy bills should not be confused with the projected 17% savings in the combined electricity use of the household, commercial and government sectors.

Figure 4 Projected energy savings by product, 2012-2030

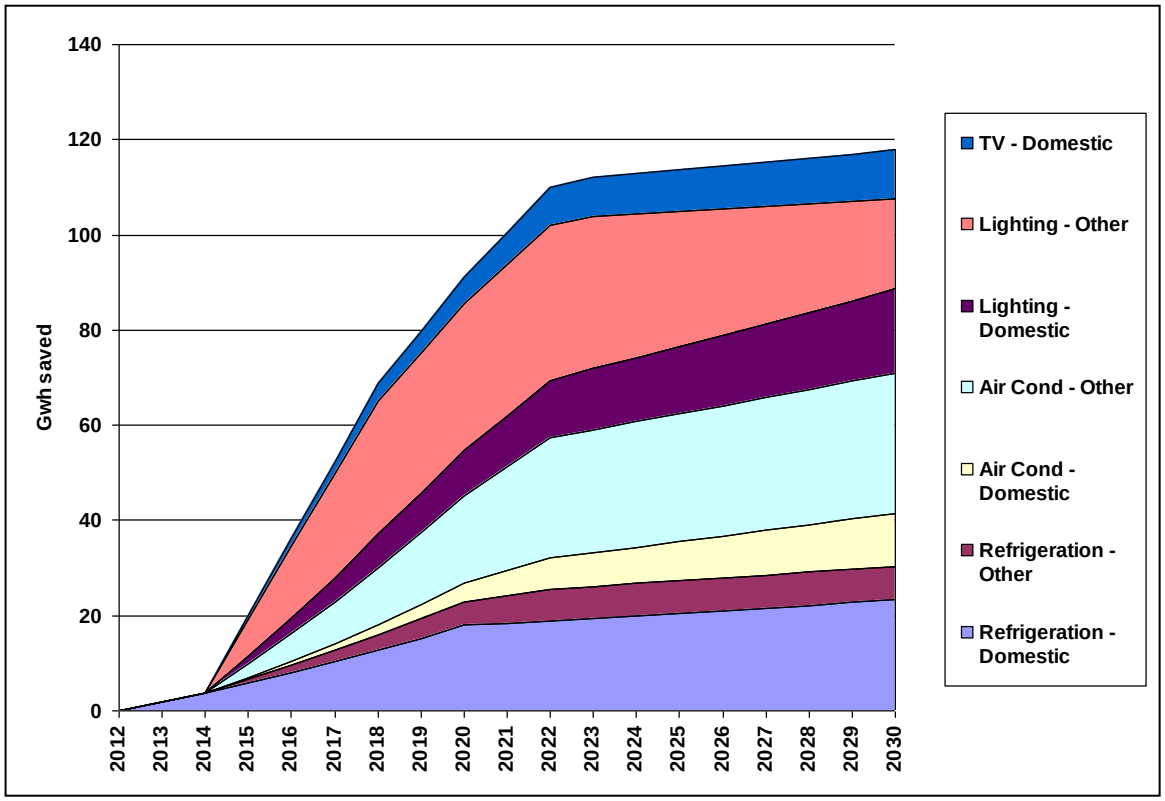


Figure 5 Energy savings by impacted sectors, 2012-2030

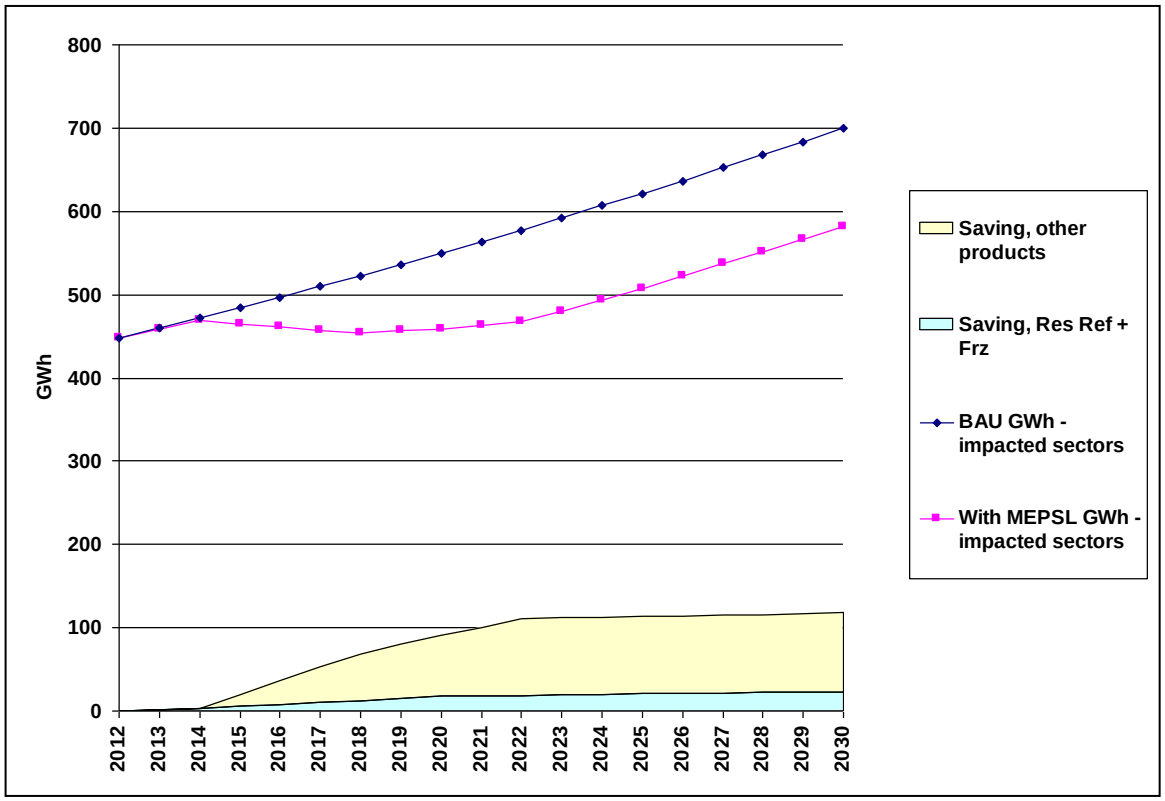


Figure 6 Projected savings in average household electricity bills

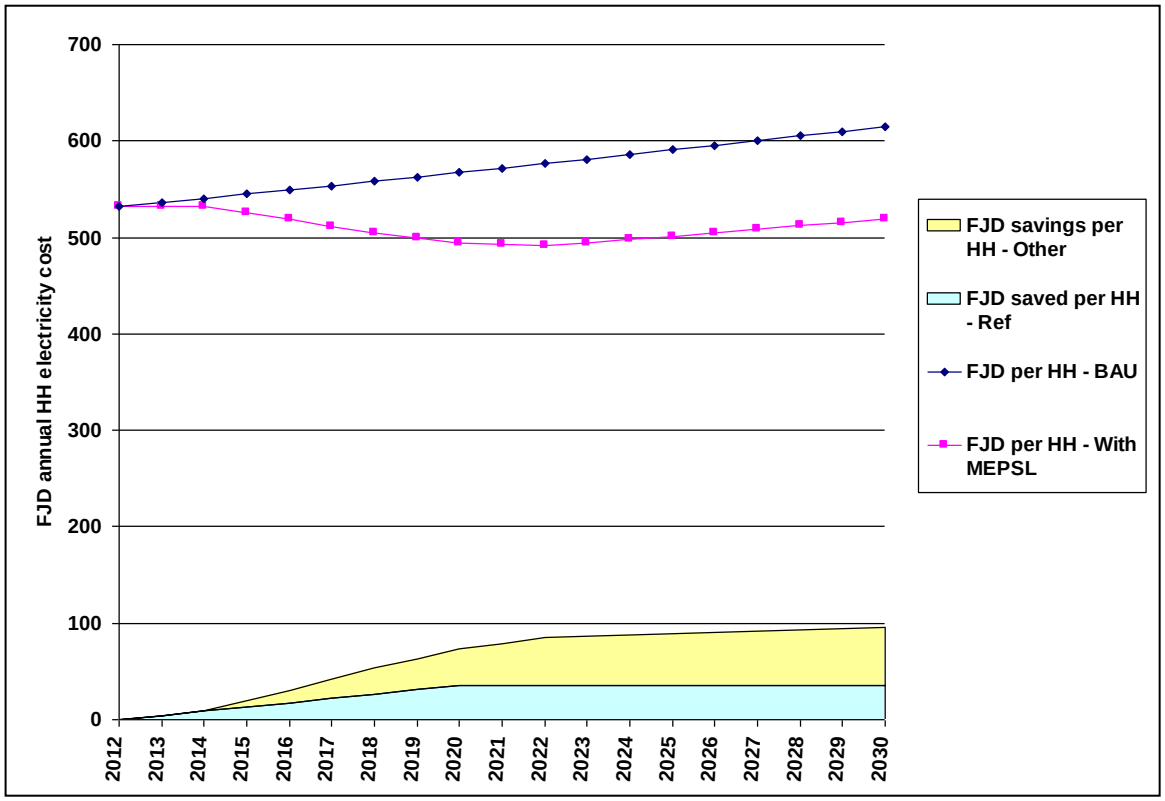
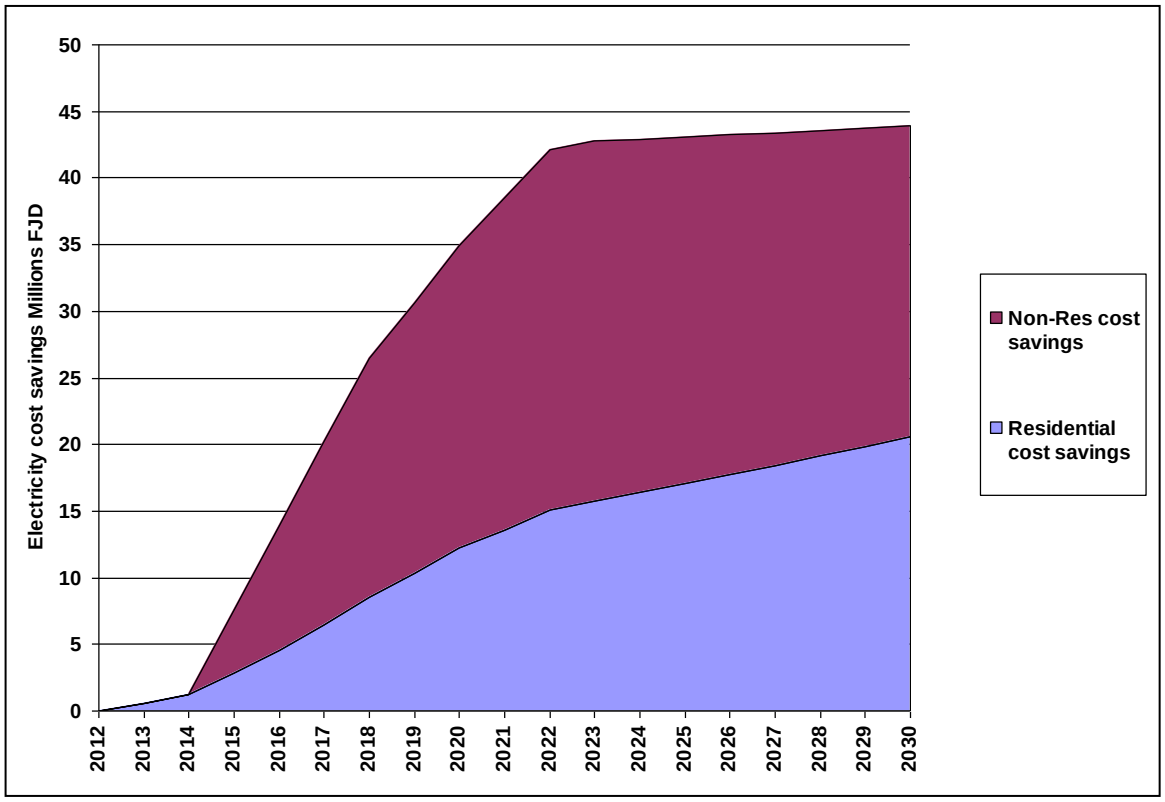


Figure 7 Projected savings in total electricity costs



Costs

The introduction of MEPSL is likely to lead to some increase in the cost of products affected, because the least efficient products are often the cheapest to buy (although this is not always the case). The potential impact on product prices is estimated using the following assumptions:

- The retail prices of products which consumers pay is twice the declared customs values (which are summarised in Table 9). This level of mark-up is typical for electrical appliances.
- As average efficiency increases due to MEPSL, the price of products goes up as defined by the Price/Energy (P/E). A P/E of 1.0 means that a 10% increase in average efficiency leads to a 10% increases in product price. A P/E ratio of 0.2 means that a 10% increase in efficiency leads to a price increase of 2%.

Figure 8 illustrates the total cost of the affected products to Fiji consumers, with and without MEPSL. Figure 9 illustrates the cost per electrified household and compares them with the benefits. It shows that the average household will spend an extra FJD 30 per year on lamps and appliances compared with BAU, but will save FJD 95 per year.

However, when an appliance is purchased the extra capital costs are paid up-front, while the energy savings accumulate over the operating life of the product.[14] As they occur later in time, their present value is lower. This time-based discounting is the usual basis for evaluating the costs and benefits of programs such as MEPSL from a national perspective. If the benefit/cost (B/C) ratio is 1.0 or greater, then the measure is cost-effective. Table 18 indicates that, on the assumption used in this analysis (all of which can be reviewed and changed) MEPSL appears to cost-effective for all the products under consideration – although more so for the non-residential products than the residential ones.

[14] There is no evidence that more energy-efficient products have a shorter service life than their less efficient counterparts. On the contrary, they tend to be of better build quality in all respects, so tend to have a longer service life. However, the cost-effectiveness of products such as CFL and LED lamps relies on having a much longer service life than incandescent lamps, to allow enough operating time for lower energy costs to compensate for higher capital costs. Sometimes the actual service life turns out to be much shorter than claimed. The adoption of AS/NZS 4847 for CFLs would require suppliers to declare a mean service life that can be verified by sample testing.

Figure 8 Total costs of products without and with MEPSL

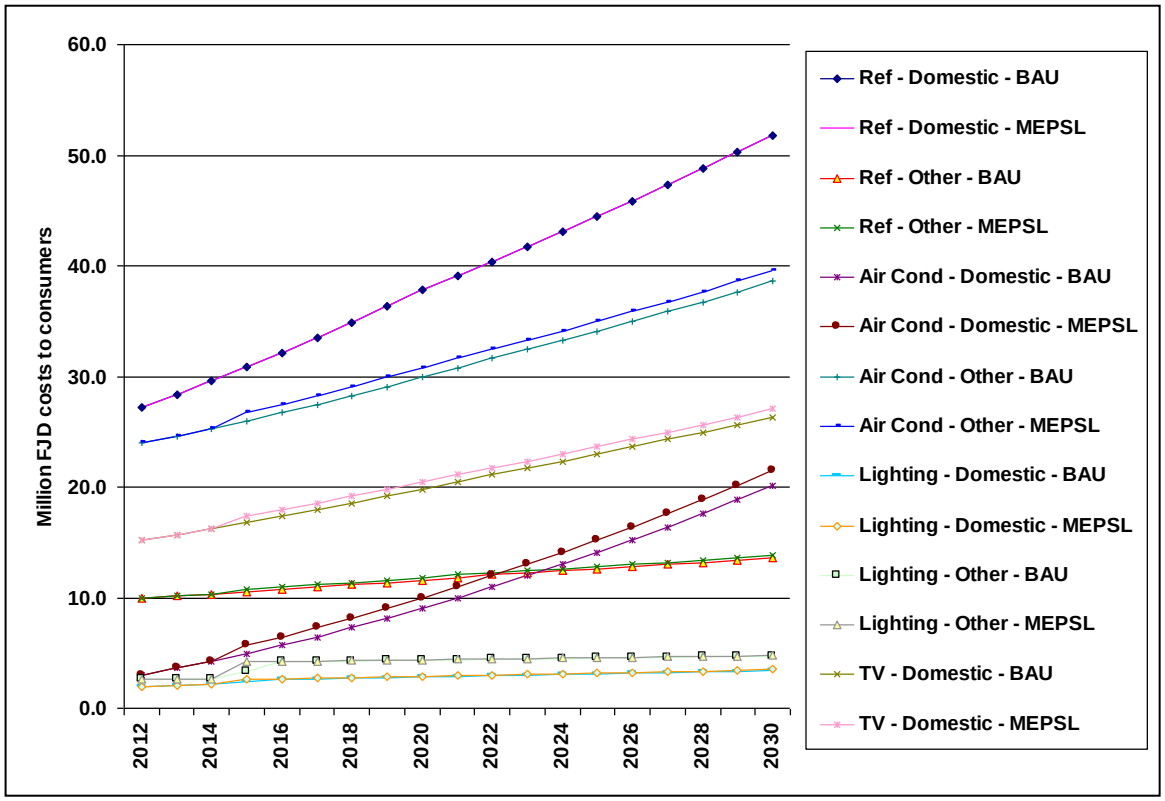


Figure 9 Projected extra appliance costs and electricity cost savings per household

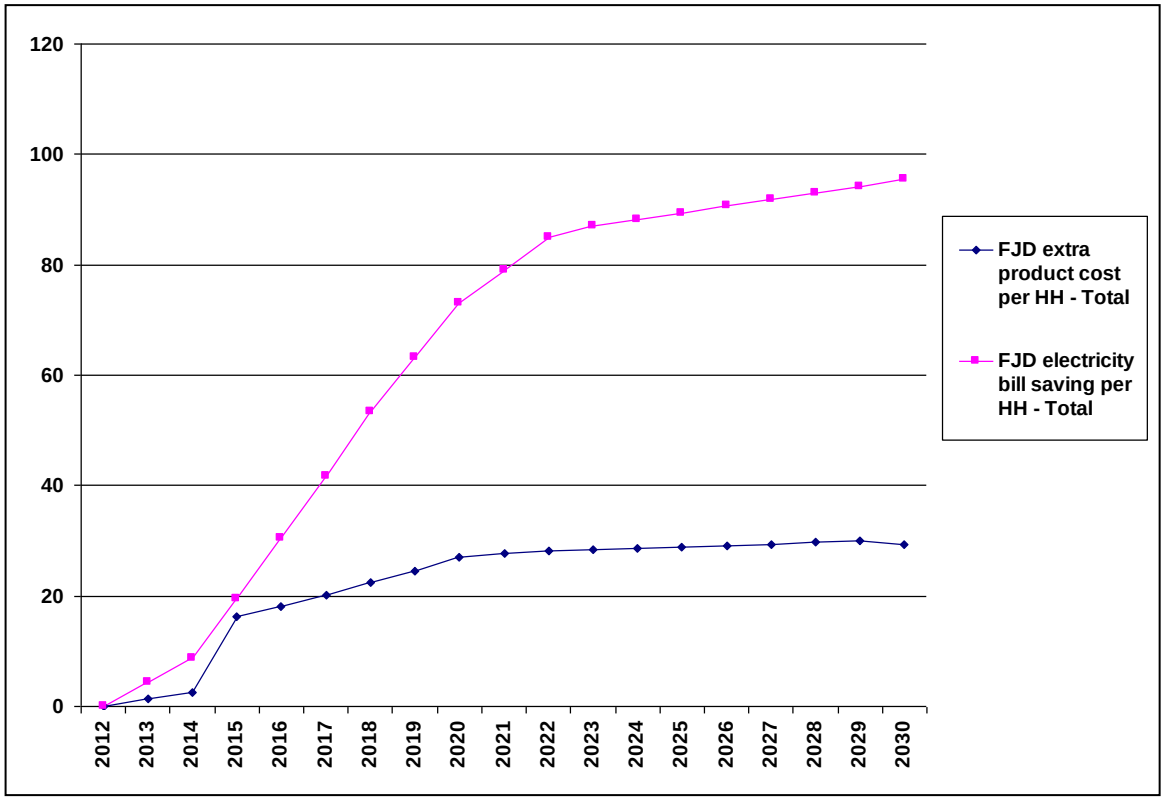


Table 18 Estimated value of benefits and costs and B/C ratios

	Retail 2014 M FJD	P/E ratios	PV(a) Energy saved MFJD	PV(a) Extra cost MFJD	PV(a) Net benefit MFJD	B/C ratio
Refrigeration – Domestic (b)	29.2	0.25	$47.3	$15.2	$32.1	3.1
Refrigeration - Other	10.3	0.25	$17.1	$4.6	$12.4	3.7
Air Cond - Domestic	4.2	0.20	$14.6	$11.6	$3.0	1.3
Air Cond - Other	25.2	0.20	$66.7	$13.3	$53.4	5.0
Lighting - Domestic	2.1	0.75	$28.2	$4.1	$24.1	6.8
Lighting - Other	2.7	1.00	$90.6	$13.8	$76.8	6.6
TV - Domestic	16.2	0.10	$16.9	$8.2	$8.7	2.1
Total	90.0		$281.4	$70.9	$210.5	4.0
Residential	51.8		$107.1	$39.2	$67.9	2.7
Non-residential	38.2		$174.4	$31.8	$142.6	5.5

(a) Present value of streams of future costs and benefits discounted at 7%. (b) Already implemented

Regulatory and Administrative Issues

Regulations

The energy labelling and MEPS for refrigerators and freezers is required under the Fiji Government Trade Standards (Household Electric Refrigerating Appliances) Order 2007 (which was originally published 27 September 2007, but took effect January 2012). The Order adopts AS/NZS 4474.1 as FS/AS/NZS 4474.1 and AS/NZS 4474.2 as FS/AS/NZS 4474.2, and amends 4474.2 to align certain dates, and to add list Fiji along with Australia and New Zealand as an option on the product registration report form.

The regulatory options to extend MEPSL to other products are:

1. Make a separate order under the Trade Standards Act for each product. As Table 15 illustrates, this could require over a dozen orders, depending on how products are grouped

2. Amend the Trade Standards Act to permit the responsible Minister to make a general regulation for the energy efficiency and energy labelling of electrical products, appliances and equipment. The Act would specify the powers of the Minister and the regulator (presumably the FDOE, although if the Minister responsible for the Trade Standards Act is not responsible for the FDOE this could be a problem), and provide for the making of regulations under the Act. As products are added to the program, each could be subject to a new regulation. Alternatively, there could be one regulation under the Act with a schedule to which regulated products can be added by Ministerial order, along with the relevant MEPSL standards; or

3. Develop new legislation that enables the Minister for Energy to make regulations as above. This would have the advantage of ensuring that the Minster responsible for the Act is also responsible for its administration by the FDOE.

The Pacific Island countries that are implementing MEPSL for the first time are all using variants of options 2 and 3 above. For Fiji, option 3 would be the most effective and flexible in the longer term.

The development of a new Act will also allow resolution of a number of problems that have arisen in the administration of MEPSL, such as imports of used products and disposal of non-compliant products.

Exemptions for private use

The current Order does not allow the exemption or different treatment of products that private individuals import for their own use, as part of their personal effects when returning to Fiji from living overseas. This has led to the confiscation of a number of refrigerators and freezers, creating problems for both the owners – who were unaware of

the requirements when consigning their goods – and for FDOE, which is obliged to confiscate them and store them indefinitely.

This serves no practical purpose. The products have already been purchased, so an energy label is pointless. (Of course, they could eventually be on-sold in the second hand market, but so can products purchased new in Fiji). It is possible that the products might be less efficient than the Fiji MEPS level, but the cost of determining this on a case by case basis is high and the national benefit low, given the small number of products involved (as is evident from the customs data).

It is understood that the existing Trade Standards Order does not give FDOE the power to make exemptions, and if this power does not exist in the controlling Act it further strengthens the case for new legislation. However, it is important that no loopholes be created that would allow people to import new products expressly for the purposes of sale, or enable a commercial operator to get individuals to act on their behalf. This could be achieved by requiring a person importing a unit to apply to the regulator, limiting the number of exemptions a person could claim (e.g. only one refrigerator, freezer etc. every 2 or 3 years) and requiring the person to declare that they have no immediate intention of selling the product and are not acting on behalf any other person.

The regulations also need to cover categories of commercial imports that are not intended for retail. This includes businesses such as resorts, hotels and government agencies importing products for use in their own facilities, or companies loaning or renting out beverage refrigerators for use by other businesses. If these entities are not covered they would be free to import products that do not meet MEPS. This would allow a stock of higher energy using products to remain on the market, some of which could eventually find their way to private users through the second-hand resale market. Furthermore it would disadvantage local retailers, who would have to comply with MEPS, and so undermine their support for the program.

However, in the cases of commercial imports not intended for retail sale but for use in an organisation's own facilities (e.g. air conditioners for a hotel) the regulations should allow FDOE to exempt the products from energy labelling, provided they meet MEPS. This is because the products would already have been purchased by their users and will not be displayed for sale in showrooms in Fiji, so requiring them to have labels attached would have no effect.

Registration

For commercial imports, the Fiji department of Energy (FDOE) maintains an Excel-based registration system. All of the refrigerators and freezers currently registered for sale in Fiji appear on the ANZ register (www.energyrating.gov.au), either under the same brand name as in Fiji ('Registration Category A') or a different brand name ('Registration Category B'). A Category C registration is one where the model has not been previously tested to AS/NZS standards, either under its own or a different brand name, so a complete test report is required. So far no supplier has used Category C Registration, although this may happen in future.

The ANZ register currently lists over 1,100 refrigerator and freezer models as available in Fiji (as well as in Australia and/or NZ), whereas less than 100 are actually on the Fiji market. It is not known why the registrants of the other 1,000 indicated that the product was available in Fiji. Perhaps it was a pre-emptive measure in case the model was ever sold there, but then the Fiji distributor chose not to take it (Fiji consumers generally prefer smaller, cheaper models).

Also, the FDOE's Category B models do not appear on the www.energyrating.gov.au website. For example, FDOE has a model registered as a local house brand (eg "Modyl") whereas energyrating lists the equivalent model under its ANZ brand name.

This makes the website almost useless as a search aid for consumers in Fiji. Even if a filter were developed for the energyrating website so that it presented only products indicated as available in Fiji when accessed by a computer with Fiji locality coding, it would present 1,100 models of which 1,000 are not in fact available, and miss several others which are available but under different brand names.

FDOE and the local energy agencies in the other PICTs are best placed to monitor which products are actually sold there, since they keep track of all imports. It would therefore be useful for FDOE (and in due course other PALS PICTs) to be able to access the register to give a true indication of local market availability.

The following changes would be needed to the software:

1. Enabling access to the register for authorized persons in the PALS PICT energy agencies;

2. For Category A registrations. enabling those authorized persons to either alter the existing 'Sold_in' field or (preferably) tick a box for availability in their local market;

3. For Category B registrations, enabling authorized persons to enter a different brand name against already registered models (either as a separate field or by creating a duplicate registration in the new brand name, taking across all physical data and entering as contact/registrant the local user of the brand name in the PICT);

4. Setting up a search filter so that only locally available products are presented to searches from computers in each locality.

FDOE should work with the Australian Department of Industry to ensure that these capabilities are built into the registration database.

FDOE does not currently require the ability to undertake a complete new registration entry (Category C) , but may do so in future as other product types are added, where there may be more models registered as unique to Fiji or the Pacific (eg lighting products).

In the meantime, FDOE should request that arrangements be put in place so it could call on the Australian manager of the database to enter registration data on its behalf in the

event that a Category C registration is received. This would be tagged as available in Fiji only (or perhaps in other PICTs as well), but would not appear in Australian or New Zealand searches.

Disposal of Non-Compliant Products

Exemption of imports of single items for own use will greatly reduce the need to confiscate and store products. However, it is still possible that commercially imported products will be found to be non-compliant, and will need to be removed from the market. In such cases the regulator should be empowered to either order the re-export of the products from Fiji, or scrap them in Fiji, and charge the cost to the non-compliant party. In the case of refrigerators and air conditioners, safe disposal would mean removing the refrigerant gases first.

Provisions of this type would greatly reinforce compliance, since the costs of export or disposal would be substantial. Of course, sale of confiscated products by FDOE within Fiji should not be an option, since that would defeat the purposes of MEPSL.

Administration, Monitoring and Market Surveillance

Once the necessary regulations are in place, the main administrative tasks for FDOE will be:

- Ensuring that the likely commercial importers and retailers of the relevant products are aware of the regulations;
- Administering the registration process: determining the registration category (A, B or C, and possibly an additional 'optional' category for clothes washers), processing applications and collecting any fees;
- Managing a public register in a form that may be searched by stakeholders, including members of the public (this may be done in conjunction with the ANZ register administrators, using the www.energyrating.gov.au website, subject to their agreement);
- Running information programs and campaigns to inform the public whenever labels appear on new products (e.g. air conditioners) or MEPS results in the exclusion of particular technology types (e.g. incandescent lamps);
- Administering exemptions for private own-use imports: if these are limited to one every two years, for example, a list of persons will have to be retained;
- Working with Fiji Customs to ensure that only registered products are imported;
- Inspecting retail outlets to ensure that products subject to mandatory labelling carry the required label and, if there is optional labelling for clothes washers, that no model carries any other type of label;

- In the event that products are detected without labels or with the wrong labels, taking graduated actions to help the supplier correct the matter. This may begin with a warning, with the option of legal action in the event of repeated non-compliance (the regulator's powers to take these steps should be specified in the regulations);

- For products that are thought to be significantly less efficient than stated in the registration application and/or on the energy label, taking action to determine the actual level of efficiency. None of the products proposed for MEPSL can be tested in Fiji at present. As with domestic refrigerators and freezers, FDOE would have to rely on test laboratories in other countries in cases of suspected non-compliance. In the case of products also registered in ANZ (Categories A and B) FDOE could bring the matter to the attention of the registering regulator, who could undertake the necessary testing if they were convinced of a potential problem.

  It is only with Category C registrations that the check testing responsibility would rest solely with FDOE. The risks could be reduced if FDOE required Category C registrations to be accompanied by tests reports from approved laboratories only. The Australian Department of Industry could provide such a list. It would be prudent for the regulations to provide for recovery of testing costs from the registrant, in the event that the testing confirms non-compliance;

- Collecting and analysing market tracking information. Ideally, this would be the annual import numbers for every model of registered product. Sales numbers would only cover retail, not direct imports by commercial entities for their own use. It is not clear whether the existing data collections can support this. At present, the customs data does not consistently record product brands and models.

The number of staff required to undertake these tasks will need to be determined by FDOE.

A Five-year work plan

A proposed five-year work plan for the expansion of the Fiji MEPSL program is set out in Table 19, in 6-month blocks. The first stage will be the development of a suitable regulatory structure, through either amendment or new legislation, and the establishment of the necessary administrative framework, including a greater registration capability to handle more products and models.

Each product is then implemented in the same stages:

- A period of consultation with stakeholders, to ensure that they are familiar with the standards and so they can plan ahead with ordering. The time periods are coloured yellow;

- The scheduling of the regulations should start a 6-month notice period (shown orange). During this period FDOE staff will need to answer inquiries, accept

registrations and perhaps manage public information campaigns if labelling or technology change is involved;

- Implementation (shown green). The regulations are then in force. FDOE will need to liaise with Customs regarding imports, manage exemptions for private own-use imports and undertake compliance checks for that product (e.g. store visits).

For LED lamps and off-grid lighting the timing will depend on the availability of suitable test standards, and possibly scheduling of the UNEP/SPC Pacific Efficient Lighting Strategy (PELS), in which Fiji is participating. The fifth year of the program should be allocated largely to review activities.

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Table 19 5-year Work Plan

Task		Year 1 2015		Year 2 2016		Year 3 2017		Year 4 2018		Year 5 2019	
		First half	Second half	First half	Second half	First half	Second half	First half	Second half	First half	Second half
Legislation		Draft	Enact					Review	Amend if necessary		
Regulations		Draft	Gazette						Review	Amend if necessary	
Register	Set up electronic registration	Prepare	Activate							Review	Revise if necessary
Priority 1	Air-conditioners: single-phase	Consult	Schedule	Implement							
	Single-cap incandescent lamps	Consult	Schedule	Implement							
	Compact fluorescent lamps	Consult	Schedule	Implement							
	Ferro-magnetic ballasts		Consult	Schedule	Implement						
	Beverage display refrigerators		Consult	Schedule	Implement						
	Clothes washers		Consult	Schedule	Implement						
	Televisions		Consult	Schedule	Implement						
Priority 2	Air-conditioners: other packaged			Consult	Schedule	Implement					
	Linear fluorescent lamps			Consult	Schedule	Implement					
	LEDS	Monitor standard	Monitor standards	Consult	Schedule	Implement					
	Perishables display refrigerators				Consult	Schedule	Implement				
	Dishwashers				Consult	Schedule	Implement				
Priority 3	Chillers					Consult	Schedule	Implement			
	Off-grid lights				Monitor standard	Monitor standard	Consult	Schedule	Implement		
	Open-top and well refrigeration							Consult	Schedule	Implement	
Review	Assess effectiveness, schedule extra products if necessary									Review	Review

References

CLASP (2013) *Potential global benefits of improved ceiling fan energy efficiency*, April 2013

DFAT (2014) *Lighting Vanuatu: Independent Completion* Report, RDSM Consulting and Energy Cultures Group, University of Otago for DFAT, January 2014

E3 (2013) Product Profile: Commercial refrigeration – Refrigerated Display and Storage Cabinets, Equipment Energy Efficiency Committee, Australian Department of Resources, Energy and Tourism 2013.

EES (2014) *Energy Standards and Labelling Programs throughout the World in 2013*, Energy Efficient Strategies and Maia Consulting, for Department of Industry, Australia, and SEAD, May 2014

GWA (2014) *Regional status report on efficient lighting in the Pacific Island Countries and Territories*, George Wilkenfeld and Associates for the UNEP en.lighten project and the Secretariat of the Pacific Community, October 2014

IEA (2013) *Pico Solar PV Systems for Remote Homes*, International Energy Agency Photovoltaic Power Systems Programme, January 2013

IIEC (2014) *Samoa National Survey on household lighting and electrical appliances*. Prepared for Asian Development Bank by IIEC, January 2014

IIEC (2014a) *Promoting Energy Efficiency in the Pacific (Phase 2) - Urban Household Appliance & Energy Use Survey: Port Vila & Luganville, Vanuatu (2013)* Volume 1: Main Report, 19 March 2014

NBI (2014) *Incorporation of energy efficiency into the National Building Code*, New Buildings Institute and Britt/Makela Group, for the Department of Energy, Fiji, April 2014

REEEP (2012) *Technical Analysis of Appliance Markets to Support the Pacific Appliance Labelling and Standards (PALS) Programme*, Prepared for Renewable Energy and Energy Efficiency Partnership (REEEP) by International Institute for Energy Conservation – Asia (IIEC Asia), September 2012 (Fiji volume).

Tonga (2013?) *Analysis of the Tonga national survey of household lighting and electrical appliances* (Draft)

SPC (2011) *The costs and benefits of introducing standards and label for electrical; appliances in Pacific Island Countries*, prepared for SPC, supported by the Department of Climate Change and Energy Efficiency and AusAID, September 2011

SPC (2012) *Fiji Country Energy Security Indicator Profile 2009*, SPC 2012

Appendix 1. Consultations

All meetings took place in Suva, on 28 May 2014 and 24-25 September 2014.

Brijlal & Co Limited

Diren Kapadia

Mechanical Service Limited (Suva)

Shiv Nand Sharma, Managing Director

Sanjeev Kumar, Senior Sales & Marketing Executive

Salendra Pillay, Corporate Sales

Lincoln Refrigeration Limited

Poly Products

Pranit Shusil, Technical Engineer

Sigatoka Electric Limited

Avin Nischal, Wholesale Supervisor

Courts (Fiji) Limited

Jayesh Prasad, Product Trainer

Gihan Kohoban, Inventory Manager

Praveen Sami, Manager Logistics

Coca-Cola Amatil (Fiji)

Pita Moku, Equipment Service Manager

Narhari Electrical Co. Ltd

Chetan Kumar, Manager

Carpenter's Hardware

Rupesh Prasad

Trade Air Engineering

Davendra Sharma

Goodman Fielder (Fiji)

Madhu Lum, Purchasing Manager

Vishal Krishna Naicker, Procurement

Vinod Patel

Amit Maharaj, Business Development Manager

Juluis Ayalon, Electrical Engineer

University of the South Pacific

Dr Anjeela Jokhan, Associate Professor of Biology and Dean

Hamendra Reddy

Shivneel Prasad

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