FINAL

The Costs and Benefits of Energy Labelling and Minimum Energy Performance Standards for Refrigerators and Freezers in Fiji

Prepared for the

Australian Greenhouse Office

by

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February 2006

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Summary

Background

Energy labelling provides buyers with consistent, reliable information that consumers can take into account when they purchase a new appliance. From this perspective, it can increase the efficiency of market operation through better information.

However, energy labelling does not directly force suppliers to introduce more energy efficient products or to remove the less efficient ones from the market, so if appliance buyers are not sensitive to labels the program has little effect. Minimum Energy Performance Standards (MEPS), on the other hand, set a legally enforceable minimum level of energy efficiency, so the energy savings are achieved provided that suppliers comply with the regulations.

Most of the large electrical appliances sold in Fiji and many other Pacific Island Countries (PICs) are imported from Australia or New Zealand (ANZ). Many of these arrive with their ANZ energy labels, so these have been familiar in Fiji since the early 1990s. In 1996 the South Pacific Forum Secretariat commissioned a study of the scope for the systematic application of energy labelling and MEPS to increase energy efficiency in Fiji and other PICs. The study recommended the implementation of mandatory energy labelling and MEPS programs, based on the ANZ program, initially in Fiji, Papua New Guinea and Tonga, and eventually other PICs.

By 2002 the incidence of labelling in Fiji had increased well beyond the level of the mid 1990s, but many products were still displayed without labels. Between 2002 and 2003 the Fiji Department of Energy (FDOE) worked with several retailers and with appliance buyers to (a) further increase the incidence of refrigerator and freezer energy labelling, and (b) encourage buyers to pay more attention to running costs when purchasing a refrigerator. The project appears to have had some success with the objective (a) but less so with the (b). The project report recommended that 'the Department of Energy pursue energy labelling of refrigerators and freezers on a mandatory basis with the inclusion of minimum energy performance standards for these appliances.'

This study

This study was commissioned by the Australian Greenhouse Office (AGO), which is part of the Australian Department of the Environment and Heritage (DEH), in co-operation with the Fiji Department of Energy.

Its purpose is to:

- Assess the costs and benefits of implementing a mandatory energy labelling and MEPS regime for refrigerators, freezers and other appliances in Fiji; and

- Review and update where necessary the data and assumptions in *Electrical Appliance Energy Labelling and Minimum Energy Performance Standards for Pacific Island Nations: Baseline Study* (1996)

Whether a mandatory energy labelling and MEPS regime could be established under existing legislation or whether new legislation may be required is beyond the scope of the study. It is understood that investigation of that issue is proceeding separately.

Projected Energy Impacts

Australian and New Zealand manufacturers intend to export ANZ MEPS-compliant models to Fiji once their current stocks of non-compliant models run out, so in due course Fiji consumers will gain the benefits of greater efficiency if they continue to buy ANZ-made products. This is not necessarily altruism on the part of the ANZ suppliers – the costs of making different models for different markets are high for ANZ manufacturers, who have smaller production runs than manufacturers in other countries.

However, if there is no mandatory MEPS regime in place, a commensurate increase in the energy efficiency of products imported from other countries is not likely. Although the non-ANZ manufacturers supplying Fiji sell MEPS-complying models in Australia, there is no incentive for them to supply those products to Fiji. Because of their higher global sales volumes and wider sourcing options, they are better able to segment their markets by continuing to supply higher-efficiency models for ANZ, and lower efficiency models to Fiji and the PICs. In fact, the market share of less efficient models may increase slightly since they may become cheaper in comparison with the more efficient ones, and the evidence is that Fiji consumers are very price-sensitive.

Therefore failure to adopt ANZ MEPS levels in Fiji would mean losing some or all of the potential energy benefits that could be gained under a harmonised regime. Adoption of MEPS would not bias the market toward ANZ-made products, since the evidence from the Australian labelling and MEPS register is that other suppliers can also provide complying models if forced to.

The adoption of ANZ MEPS would have a special impact on the market for Group 4 refrigerators, which still have a large share of the Fiji market but are no longer sold in Australia. For this Group, MEPS would either:

- force their removal from the market, in favour of more energy-efficient but more expensive Group 5 frost –free types; or

- force the suppliers of Group 4 products to invest in bringing those models up to meet the MEPS standards (at least for selected models).

The magnitude of projected energy reductions will depend on the following factors:

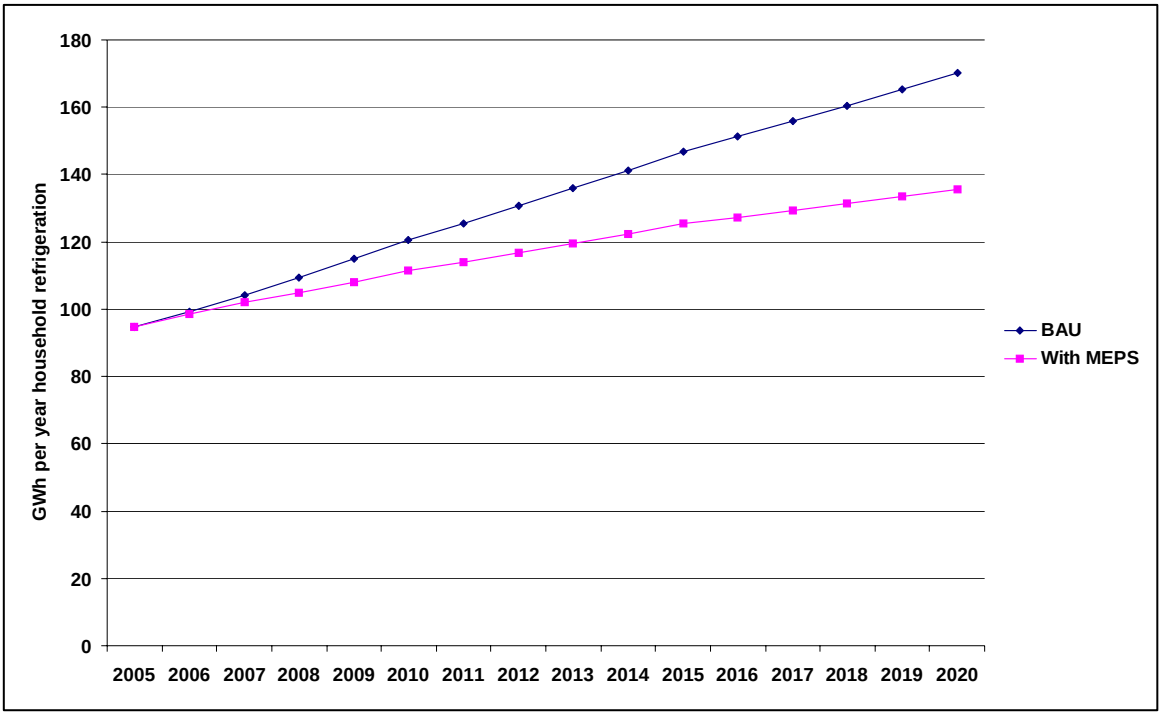
- The number of products that will be sold in the coming years;

- The market share of each Group, and within each Group, the share of products that will comply with MEPS in any case, and those which will not comply unless Fiji mandates MEPS; and

- Average annual energy use within in each Group, with and without MEPS.

On this basis, it is projected that the implementation of MEPS in 2008 would reduce total electricity use by household refrigerators and freezers by about 9 GWh/yr (8% below BAU) by 2010, 21 GWh/yr (15% below BAU) by 2015, and 35 GWh/yr (20% below BAU) by 2020 (Figure S1).

Figure S1 Projected total annual energy use of all domestic refrigerators and freezers, Fiji 2005-2020



Costs and Benefits – Consumer Perspective

Average product prices may increase somewhat to cover the higher production costs for more efficient products, and testing costs for the few models not already tested for sale in Australia or New Zealand. The *maximum* overall increase in average product prices is estimated at about 10%, but could be much lower.

It is projected that in the BAU scenario Fijians will spend a total of FJD 205 million purchasing refrigerators in the period 2006-2020 (inclusive). If the implementation of MEPS increases average prices by 10% Fijians will spend a total of about FJD 226 million purchasing refrigerators over the same period, an increase of about FJD 19.5 million.

The value of the electricity saved by Fiji households as a result of purchasing more efficient refrigerators due to MEPS is estimated at FJD 163.4 million.

This means that from the perspective of the householder the benefits (energy savings) are about 8.4 times the costs (higher refrigerator prices), even assuming the maximum price rises. If the future purchase costs and energy savings are both discounted at a rate of 10% (the discount rate generally used to evaluate energy efficiency programs in Australia) then the Benefit/Cost (B/C) ratio is about 4.2. This is an extraordinarily high

ratio by international standards: the comparable ratio for Australia's National Appliance and Equipment Energy Efficiency Program (NAEEEP) is 1.7.

Costs and Benefits – Societal Perspective

Domestic electricity tariffs in Fiji are not fully cost-reflective, and the cost to the Fiji economy of supplying an additional kWh at the margin (which will be generated by diesel) is significantly higher than the tariff received by the Fiji Electricity Authority (FEA).

At the same time, the cost to the Fiji economy of importing a more expensive refrigerator is not the retail price but the wholesale value. From a societal perspective, then, the value of energy savings are *higher* than from the end user perspective, and the costs of MEPS are *lower* than from an end user perspective.

There are also cost associated with setting up and administering a mandatory labelling and MEPS program. There may also be additional benefits available for Fiji from designating MEPS as a Clean Development Mechanism (CDM) program, and so creating a stream of saleable carbon credits.

Societal costs and benefits have been calculated at four levels of benefit: valuing electricity saved at the domestic tariff, and valuing electricity saved at 3, 6, and 9 c/kWh higher than the tariff. Given that the domestic tariff appears to fall well short of cost recovery in many parts of Fiji, the higher savings values are more likely. Table S1 shows that if energy is valued at the cost of supply rather than at the tariff paid by consumers, the benefit/cost ratio of the MEPS program can be as high as 9.4, compared with 4.2 from the consumer perspective (at the same 10% discount rate).

Table S12 Summary of projected costs and benefits of refrigerator MEPS, societal perspective

	Consumer perspective	Societal perspective			
Basis of energy savings valuation	Domestic Tariff (a)	Domestic Tariff	Tariff + 3c/kWh	tariff + 6c/kWh	tariff + 9c/kWh
NPV of projected savings	37.2	$37.2	$42.1	$47.0	$52.0
NPV projected CO2 savings	NA	$1.4	$1.4	$1.4	$1.4
NPV Projected appliance costs	8.9	$4.5	$4.5	$4.5	$4.5
NPV projected program costs	NA	$1.3	$1.3	$1.3	$1.3
Total benefits	37.2	$38.6	$43.5	$48.4	$53.4
Total costs	8.9	$5.7	$5.7	$5.7	$5.7
Net benefits	28.3	$32.9	$37.8	$42.7	$47.7
B/C ratio	4.2	6.8	7.6	8.5	9.4

All values millions FJD Net Present Value at 10% discount rate. Appliance costs at custom declared value. (a) From Table S1

Conclusions

Energy labelling does not appear to be very effective at present in encouraging refrigerator buyers in Fiji to prefer more energy-efficient refrigerators. The fact that labelling is not mandatory is only part of the reason – in fact labelling rates are

relatively high for a voluntary program, because so many models are imported from New Zealand or Australia with their labels already attached.

The more significant reasons for the limited impact of energy labelling are:

- Fiji appliance buyers appear to be very motivated by first cost, so lower running costs have less impact on their purchase decision even if they are aware of the label;

- The electricity tariffs faced by many domestic consumers are well below the costs of supply, so consumers under-value running costs in the purchase decisions;

- The range of models on the market is smaller than in Australia or New Zealand, so there are fewer opportunities to make a decision among 2 or 3 equally acceptable models on the basis of energy efficiency.

These barriers will not be overcome by mandatory energy labelling alone. However, they can be addressed through mandatory Minimum Energy Performance Standards (MEPS). The regulatory and administrative infrastructure for implementing MEPS is almost identical to that for mandatory energy labelling, so both could be implemented at the same time, especially as the information and infrastructure to support the Fiji program is already in place in Australia and New Zealand. Mandatory labelling would be an important and highly cost-effective means of encouraging suppliers to comply with MEPS, since tracing product suppliers and verifying performance claims would be far easier if there are labels on the products.

A share of ANZ-made refrigerators on the Fiji market will probably meet the ANZ MEPS levels adopted in January 2005 within a few years. However, this will not necessarily apply to models made in other countries, or to the large part of the market that still purchases Group 4 (cyclic defrost) models, which are no longer sold in ANZ.

To bring these up to the ANZ MEPS levels it will be necessary for Fiji to implement the same mandatory MEPS as Australia and New Zealand. There may be some variation to this, in that the Group 4 models that are still widely sold in Fiji are no longer sold in ANZ, so slightly modified Group 4 product standard (eg not requiring internal temperature criteria to be met at 10°C, which is lower than would be encountered in Fiji) may be considered, if that provided a more cost-effective route for supplies to meet the MEPS level.

The projected economic benefits of MEPS greatly exceed the projected costs, both for refrigerator buyers and for the Fiji economy as a whole. In effect, it is far less costly for the Fiji economy to import more efficient refrigerators (and other electrical appliances) than to import diesel fuel.

MEPS would still be cost-effective for almost all householders, even at current tariff levels and even if refrigerator prices rise. The upper bound of price rise is estimated at about 10%, although it will probably be much less than that. If the Government wishes to avoid any possibility of price rises, there would be scope for reducing the cost burden by transferring some of the economic benefit to refrigerator buyers. For example, it would be cost-effective for the FEA to directly subsidise the import price of MEPS-

complying refrigerators. The resulting reduction in diesel fuel costs would be greater than the costs of subsidy.

At the societal level, the administrative cost of MEPS are estimated at about 20% of the total costs – the other 80% is increased refrigerator purchase costs. However, the administrative costs could be offset in full if the MEPS program could be accredited to produce carbon credits under the Clean Development Mechanism. Alternatively, some or all of the administrative costs could be recouped from development funding, since the MEPS program would have a unique combination of economic, environmental and consumer benefits.

This report has concentrated on domestic refrigeration only, since at the time of writing there were not enough data available to carry out an equally rigorous analysis for other products. Domestic refrigeration is particularly important in Fiji, accounting for over half of domestic electricity use.

There are at least two other product groups which account for significant shares of electricity use in Fiji, and which are covered by MEPS in Australia and New Zealand:

- air conditioners, which account for about 8% of household electricity and 39% of commercial sector electricity use; and

- commercial refrigeration and icemaking equipment, which accounts for about 11% of commercial sector electricity use.

These should also be considered for MEPS, once the regulatory and administrative infrastructure is in place. However, it may be advisable to commence with refrigerators, since most suppliers are familiar with both labelling and MEPS and compliance should be achievable at relatively low cost.

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Contents

1. Introduction

MEPS and Energy Labelling

Energy Labelling

Energy labelling is a system which allows buyers to compare the energy efficiency of the products they are considering purchasing. The following types of information might be made available to buyers:

1. the energy consumption (say in kWh per year for electrical appliances) for each specific model, when tested according to a given technical standard and assuming a certain pattern of usage;

2. a visual indicator of the energy efficiency of each model, eg by means of a star rating;

3. an indicator that a product exceeds a specified level of energy efficiency, or that it possesses a certain capability, eg the 'Energy Star' label used for computer equipment (originated un the USA, but now used around the world).

The form in which the information is made available might also vary. It may be on a tag or sticker attached to the product itself, so that buyers can see it when they go to a store or showroom where the product is displayed. The same information could also be included in product brochures and advertisements, so that buyers can become aware of it even before they visit a showroom, and on packaging, so that customers buying from warehouses can be aware of it.

If the energy information on all models is collected into a printed guide or a register accessible on the internet, it is easier for buyers to get an idea of how the energy efficiency of a model they are interested in compares with others, even if the others are not displayed in the same showroom. It can also create demand for the more efficient models, since buyers interested in energy can identify and seek them out more easily.

Governments might be interested in promoting energy efficiency for a range of strategic reasons, but energy labelling will only work if product suppliers and buyers consider it in *their* interest to prefer more energy-efficient products. For buyers, the incentive is largely financial: the expectation that a more energy-efficient product will be cheaper to run. It might cost a little more to buy than a less efficient product (although this is not always the case) but this is still worthwhile if the running costs are low enough.

To work out the running cost of any energy labelled product, the buyer needs to multiply the energy consumption information on the label (which might be in kWh per year) by the appropriate energy tariff (eg cents per kWh).[1]

[1] It would be more direct to have the actual annual running cost on the label (eg in dollars per year) but this is difficult in practice. The same model with the same label may be distributed in many markets with different currencies and energy tariffs, so it is impossible to ensure that the running cost data on a

If energy labelling has the intended effect on appliance buyers, product suppliers should respond by introducing and promoting more efficient models, and removing their less efficient ones from the market. However, the extent to which different manufacturers, importers, suppliers and retailers can respond will vary.

Importers who have access to a range of brands and products may be able to obtain more efficient products to meet a market demand. Importers tied to a single supplier of products which are not very energy efficient may have to discount them heavily to obtain sales in a more energy-conscious market, or in the extreme case withdraw from the market altogether.

Labelling will increase the commercial value of a good energy rating, create a commercial penalty for a poor rating and could add to supplier costs if the products have not already been energy tested. This could lead less scrupulous suppliers to:

- under-state the energy consumption of their products; or
- produce entirely fictitious labels for products that have never been energy tested.

Suppliers may also be tempted to reduce other aspects of product performance in order to get a good energy rating (eg by producing refrigerators that do not keep food as cold, or washing machines that do not wash clothes as clean), but in Australia and New Zealand this is prevented by setting minimum performance levels. It is not possible to legitimately claim an energy rating or prove compliance with MEPS unless the product also meets those performance levels. Of course, unscrupulous suppliers could as easily make false claims about a product's performance as about its energy efficiency, so it is important to have some means of checking claims. The incentive to mis-label will be much reduced if there is an effective compliance and checking regime, backed with appropriate legislation.

Energy labelling works best where there is a reasonable choice of models on the market, and they have different levels of energy efficiency. If there are only a few models and they are all at similar levels of efficiency (eg all have 3 or 4 stars on the label) then labelling will not have much scope to influence consumer choice.

Energy labelling is a common means of promoting appliance energy efficiency. In 2004, 51 countries had laws requiring the labelling of at least one product (CLASP 2005).

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standard label are accurate for each market. Even in the same market, tariffs change over time and different customer classes may be subject to different tariffs.

MEPS

Energy labelling provides buyers with information that is consistent and reliable and enables consumers to take into account the energy costs of an appliance at the time of purchase. From this perspective, it can increase the efficiency of market operation through better information. However, energy labelling does not directly force suppliers to introduce more energy efficient products or to remove the less efficient ones from the market, so if appliance buyers are not sensitive to labels the program will have little effect.[2] Minimum Energy Performance Standards (MEPS), on the other hand, set a legally enforceable minimum level of energy efficiency, so the energy savings are achieved provided that suppliers comply with the regulations.

Labelling and MEPS programs can and do work together. Australia and New Zealand, for example, have both programs operating in parallel. Mandatory energy labelling for refrigerators and freezers was first introduced in some States of Australia in 1986. Labelling became mandatory throughout Australia in the early 1990s, although it remained voluntary in New Zealand for a further 10 years or so. MEPS was first introduced in Australia in 1999, for refrigerators, freezers and electric storage water heaters. The labelling and MEPS programs of Australia and New Zealand are now largely unified, and cover the products listed in Table 1.

Table 1 Products covered by mandatory energy labelling and MEPS in Australia and New Zealand

Product	Energy labelling introduced	MEPS first introduced	MEPS revised
Refrigerator	1986	1 Oct 1999	1 Jan 2005
Freezer	1986	1 Oct1999	1 Jan 2005
Dishwasher	1988	NA	None planned
Clothes dryer	1989	NA	None planned
Clothes washer	1990	NA	None planned
Air conditioner (single phase)	1987	1 Oct 2004	2006, 2007, 2008
Air conditioners (3 phase)	Optional	1 Oct 2001	1 Oct 2007
Electric storage water heater (>= 80 l)	Optional	1 Oct 1999	None planned
Electric storage water heater < 80 l)	Optional	1 Oct 1999	1 Oct 2005
Electric motors (3 phase)	Optional	1 Oct 2001	1 Oct 2006
Ballasts for linear fluorescent lamps	2003 (marking)	1 Mar 2003	None planned
Linear fluorescent lamps (550-1500mm)	Optional	1 Oct 2004	None planned
Distribution transformers	Optional	1 Oct 2004	None planned
Commercial refrigeration	Optional	1 Oct 2004	None planned

Energy labelling and MEPS are complementary in their impacts. MEPS removes the least efficient models from the market, while labelling enables buyers who wish to do so to select the most efficient of the models remaining. The most effective combination of measures depends on how the market for a particular product operates. Labelling has limited effect for products not purchased in showrooms, or which are purchased by builders or plumbers rather than the person paying the energy bills, so MEPS is the more effective strategy.

[2] It can still have some initial effect if suppliers expect buyers to respond and introduce some high-efficieny models accordingly, but this effect will diminish once it become apparent that customers do not prefer the more efficient models.

Even so, suppliers can choose to label if they wish, as some do if their products are particularly energy efficient (eg if they meet designated 'High Efficiency' criteria). The products for which labelling is 'optional' are indicated in Table 1. Note that this is not the same as 'voluntary' labelling. A supplier who opts to label must use the label specified in law and must comply with all requirements, and face penalties in the event of proven non-compliance.

Energy labelling and MEPS are complementary in their administrative basis, as well in their impacts. They rely on the same energy tests and the same information base on products. Once a labelling program is in place, the cost of implementing MEPS is marginal, and once MEPS are in place, the cost of implementing labelling is relatively small - providing, of course, that both programs are based on the same tests and protocols. It would not be workable for the one country to have a labelling program based on the Australian system, for example, and a MEPS program based on the USA.

Neither MEPS nor labelling will be effective unless the rules are clear and applied equally to all product suppliers. Otherwise suppliers, retailers and customers will quickly lose confidence in the scheme.

Mandatory labelling can be a powerful element in reinforcing compliance with a MEPS program. Without a label, product retailers or officials responsible for checking compliance will find it far more difficult to verify the model number, the supplier or the claimed energy performance of a given product. Rather than reading this off the label, they will have to find the model number on the compliance plate, check it against a register and track down the importer or manufacturer. If the trail of documentation is incomplete this increases the chance that breaches will not be followed up. This will be known to unscrupulous suppliers, who will be much more prepared to take the risk of supplying products that fail MEPS.

If there is a requirement to label as well as meet MEPS, there can be a presumption that any product that lacks a label also fails MEPS, so checking and compliance efforts can be concentrated more efficiently.

Appliance Energy Programs in Fiji

Studies in the Mid 1990s

Most of the large electrical appliances sold in Fiji and many other Pacific Island Countries (PICs) are imported from Australia or New Zealand (ANZ). Many of these arrive with their ANZ energy labels, so these have been familiar in Fiji since the early 1990s. However, because there was no requirement to label in Fiji, only a minority of products carried labels, and very few appliance buyers understood the labels or used them in purchase decisions.

The possibility of building a Fiji energy labelling program on the ANZ label was first considered over 10 years ago. A Demand Side Management Potential study funded by the United Nations Development Programme (UNDP) in 1995 recommended energy

labelling and MEPS for refrigerators, freezers and air conditioners in the 10 PICs studied (SRCI 1995).

In 1996 the South Pacific Forum Secretariat commissioned a study of the scope for the systematic application of energy labelling and MEPS to increase energy efficiency in Fiji and other PICs (GWA and EES 1996). The study recommended the implementation of mandatory energy labelling and MEPS programs, based on the ANZ program, initially in Fiji, Papua New Guinea and Tonga, and eventually other PICs.

The appliances recommended for labelling were refrigerators, freezers and air conditioners. MEPS was recommended for refrigerators, freezers and electric storage water heaters (keeping in mind that Australian governments had just agreed to implement MEPS for these products, although MEPS was not to take effect until 1999). MEPS and labelling were not recommended for other products, because they were not significant energy user in the PICs, there was no ANZ MEPS regime for them, or both. The report's full Executive Summary is at Appendix 1.

FDOE Appliance Labelling Programme

The Fiji Department of the Environment (FDOE) commenced work on a voluntary labelling system as early as 1998, and funds were obtained from SOPAC in 1999. Progress was delayed, first by the Australian decision to introduce a new label design in 2000, and then by political disruptions in Fiji in 2000.

During 2001 the FDOE, with the assistance of major retailers, compiled a list of the most widely available refrigerators and freezers models (Fisher & Paykel, Westinghouse, Samsung, Shacklock and Kelvinator brands) with their Australian energy label details, including kWh/yr and star rating.

In early 2002 FDOE printed 40,000 brochures and distributed 90,000 flyers promoting the energy label as inserts mailed out with Fiji Electricity Authority (FEA) bills. The energy label was also promoted by national TV advertising over a period of two weeks, in two cinemas in Suva for 26 week, through the newsletter of the Consumer Council of Fiji and via press releases.

FDOE also worked with a number of large retailers to:

- Encourage the stores to increase the proportion of floor stock carrying the 'new' energy label (ie the version introduced in Australia in 2000);
- Distribute the brochures listing the labelled refrigerators;
- Train sales staff to promote and explain the label to customers; and
- Compile a list of refrigerator buyers whom FDOE could survey about awareness of the label and priority given to energy efficiency. Two groups were surveyed, one at the beginning and one at the end of the promotion campaign.

In the 3 stores with which FDOE had direct contact, the proportion of the floor stock labelled increased from an already high 74% in early 2002 to 84% in early 2003 (Table 2). The labelled proportion in other stores was somewhat lower (66%), even in early 2003, after the promotion campaign.

Even at 66% (and more so at 84%), the proportion of the refrigerators and freezers on display in Fiji stores is *remarkably high*, given that:

- in 1995 the ratio of refrigerators and freezer labelled had been only 8% and 13% respectively[3]:
- a significant number of the models on display do not appear on the Australian energy label register, so could not have been labelled anyway; and
- For those models that are imported with a label, it is not mandatory to leave the label stuck on.

Another notable finding is that the old style labels, which still represented nearly a quarter of the labels in Fiji in early 2002, had declined to 6% a year later. It appears that the older labels phased out of Fiji showrooms as stock turned over, although this process lagged the changeover in Australia by about 2 years.

Table 2 Share of display refrigerators and freezers with energy labels, Fiji (2002-2003) and Australia (2000).

	Units displayed	New label		Old label		No label	
		Number	%	Number	%	Number	%
3 stores (before campaign)	77	44	57%	13	17%	20	26%
Same 3 stores (after)	58	48	83%	1	1%	9	16%
18 stores (after campaign)	256	159	62%	11	4%	86	34%
Australia (Dec 2000)(a)			76%		17%		7%

Source: FDOE (2004) (a) from *Label Update* 2001; towards end of label changeover period.

FDOE carried interviews with retail staff in the three participating stores, and in-store surveys with appliance shoppers before and after the promotional campaign. Table 3 summarises the purchase criteria nominated as 'most important'. As expected, purchase price is the factor most commonly nominated as most important. However, energy efficiency was nominated as most important by some (although not necessarily volunteered, since it was on the questioner's prompt list) and may have been ranked reasonably high by others. [4]

The results of the surveys are summarised in Table 3. These results on their own are inconclusive There appears to have been an increase in the proportion nominating

[3] Goldberg (1995) surveyed two large department stores in Suva in 1995 and found that about 8% of the refrigerators, 13% of the freezers and 38% of the washing machines on display carried the Australian energy label.

[4] The survey form asked the respondent to rank a list of criteria nominated by the questioner from most important to least important. The actual ranking matrices are not known – for example, a large number many have nominated energy efficiency as second most important. It is not known whether the prompt order was changed from survey to survey to randomise the ranking effect.

energy efficiency as most important after the campaign, but there were also increases for all the other non-price factors.

Table 3 Findings of in-store shopper surveys and staff interviews

Survey group	Number	% Nominating factor as 'most important' in their purchase					
		Price	Energy effic-iency	Product features	Model	After sales service	Other
Retail staff views on customer preference	7	86	14	0	0	0	0
Appliance shoppers (pre-campaign)	24	80	4	8	4	0	0
Appliance shoppers (post-campaign)	150	35	13	7	25	5	15

Source: FDOE (2004)

However, a follow-up phone survey of 20 people who purchased refrigerators or freezers from the three stores participating in the awareness campaign suggested that the impact of labelling was limited:

> Of the 20 persons interviewed, only 4 persons were aware of the new energy rating labels and of these, only 2 showed they had an appreciation of what information was contained in the labels, while the other 2 were more concerned about the price of the appliance. The rest of the people interviewed (16) had no knowledge of the energy rating labels. Some customers who purchased appliances (chest freezers) mentioned that there were no energy labels on the appliances they purchased and they did not receive any advice or information on the energy rating labels from the sales staff when making the purchase (FDOE 2004).

The main conclusion and recommendation of the FDOE study is as follows (the complete findings and conclusions are at Appendix 2):

> The pilot program has indicated the willingness of the relevant stakeholders to participate in the program. However for the energy labelling program to be effective there needs to be some mechanism to ensure that manufacturers, distributors and retailers comply. **It is recommended that the Department of Energy pursue energy labelling of refrigerators and freezers on a mandatory basis with the inclusion of minimum energy performance standards for these appliances** (FDOE 2004; original emphasis).

The FDOE study also concluded that:

> Energy efficiency and conservation is not an easy concept to understand, therefore the awareness programme ought to be focused and ongoing rather then being a one-off event. Efforts must be directed at ensuring the continuity of the awareness programme to ensure that the message reaches out to the wider community.

This Study

This study was commissioned by the Australian Greenhouse Office (AGO), which is part of the Australian Department of the Environment and Heritage (DEH), in co-operation with the Fiji Department of Energy.

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- Review and update where necessary the data and assumptions in *Electrical Appliance Energy Labelling and Minimum Energy Performance Standards for Pacific Island Nations: Baseline Study* (1996)

Whether a mandatory energy labelling and MEPS regime could be established under existing legislation or whether new legislation may be required is beyond the scope of the study. It is understood that investigation of that issue is proceeding separately.

This study does propose how a scheme might operate, including the administrative and compliance arrangements, because it is necessary to have concrete proposals in order to judge likely costs and effectiveness.

The author gratefully acknowledges the help of the following individuals, who assisted with data collection:

- Mr Intiyaz Khan, of FDOE;

- Mr David Brunoro, on secondment to FDOE;

- Mr Felix Gooneratne, of the International Institute of Environment and Development.

Additional data was obtained from the published materials listed in the references and in the footnotes to tables and diagrams.

All analyses and conclusions are the responsibility of the author.

2. Electricity Production and Use in Fiji

Access to Electricity Supply

The Fiji Electricity Authority (FEA), a wholly Government-owned commercial statutory authority, is responsible for the generation, transmission and distribution of electricity in Fiji.

The FEA maintains electricity distribution grids on Viti Levu (the FEA's Central/Eastern and Western regions), Vanua Levu (the Northern region), and Ovalau. The FEA also maintains a number of small off-grid systems. About 90% of the Fiji households with access to electricity are supplied by the FEA. Population, estimated rates of household electricity connection and number of household electricity users are shown in Table 4, Table 5 and Table 6 respectively. It is estimated that about 69% of Fiji households had access to electricity in 2002: 90% in urban areas and 49% in rural.

Table 4 Estimated population and household numbers by region, Fiji 2002

		Urban	Rural	Total	Pop share
Viti Levu	Persons	350141	285378	635519	77%
	HH	73875	60211	134086	
	Pers/HH	4.74	4.74	4.74	
Vanua Levu	Persons	38885	109678	148563	18%
	HH	8768	24731	33499	
	Pers/HH	4.43	4.43	4.43	
Ovalau & East	Persons	4839	36428	41267	5%
	HH	1000	7528	8528	
	Pers/HH	4.84	4.84	4.84	
Total	Persons	393865	431484	825349	100%
	HH	83643	92470	176113	
	Pers/HH	4.71	4.67	4.69	

Source: Fiji Islands Bureau of Statistics website

Table 5 Estimated % of households with electricity supply, by region, Fiji 2002

	FEA urban	FEA rural	Other rural	Total rural	Total
Viti Levu	90%	40%	10%	50%	72%
Vanua Levu	90%	30%	20%	50%	60%
Ovalau & East	90%	20%	20%	40%	46%
Total	90%			49%	69%

Source: author estimates, based on FEA (2003) and UNDESA (2003)

Table 6 Estimated number of households with electricity supply, by region, Fiji 2002

	FEA urban	FEA rural	FEA rural	Other rural	Total rural	Total
Viti Levu	66,500	24,100	90,600	6,000	30,100	96,600
Vanua Levu	7,900	7,400	15,300	5,000	12,400	20,300
Ovalau & East	900	1,500	2,400	1,500	3,000	3,900
Total	75,300	3,300	108,300	12,500	45,500	120,800

Source: author estimates, based on FEA (2003) and UNDESA (2003)

Generation Fuels

Most of Viti Levu's energy comes from the FEA's 83 MW Wailoa hydro power station on the Monasavu dam, near the centre of the island, and the 7 MW Wainikasou hydro power station. The FEA generates additional energy in a number of its own diesel power stations (totalling about 73 MW), and also purchases some energy from independent power producers (IPPS; mainly diesel-generated, with some generated from bagasse at sugar mills).

The FEA system on Vanua Levu has 15 MW of diesel and the 1 MW Wainikeu hydro station. The Ovalau system has 2 MW of diesel. Virtually all of the non-FEA electricity supplied on Vaua Levu and Ovalau is also diesel, apart from a small amount of photovoltaic and wind generation.

Figure 1 illustrates total energy sent out on the FEA networks by energy source. Hydro accounted for 77% of energy sent out in 2000 but this fell to 54% by 2004. This was partly due to drought, which took the water level in the Monasavu dam to below the safe minimum operating level in 2003. Even if water storages return to the long term average, future growth in electricity demand will have to be met by other means. There are plans for expanding renewable energy, and in July 2005 the FEA entered a contract with a New Caledonia company to install 2.75 MW on wind turbines on the west coast of Viti Levu.[5] When completed this will produce about 11.5 GWh per year – less than half the amount now purchased annually from IPPs.

For the foreseeable future, the marginal generation fuel in Fiji will be diesel. The hydro potential is already close to fully utilised, and as wind and other renewable generation is built it will also be fully utilised, but the difference between renewable output and demand will by made up by diesel. This fact is important for the economic evaluation of electricity efficiency programs, because **the value of a kWh saved at the margin is the avoided cost of diesel generation.**

Fiji's long term dependence on diesel has been acknowledged by the FEA, which in 2003 signed a 20-year agreement with a private company, Telesource, to operate its two largest diesel power stations, Vuda (24 MW) and Kinoya (36 MW).

Use by Customer Class

Electricity consumption by consumer class on the FEA system is illustrated in Figure 2.[6] Total consumption grew at an average of 6.5% per annum between 2000 and 2004. Domestic and commercial electricity use grew at about 5.5% per annum. Although population increased at an average of 1% over the period, and the share of Fiji households connected to electricity also increased, much of the growth in residential electricity use was due to greater consumption per connected household.

[5] http://www.sidsnet.org/latestarc/energy-newswire/msg00032.html

[6] 'Other' includes Street Lighting and Institutional sales. Loss includes transmission and distribution loss and theft.

Figure 1 Electricity sent out by source, all FEA systems 2000-2004

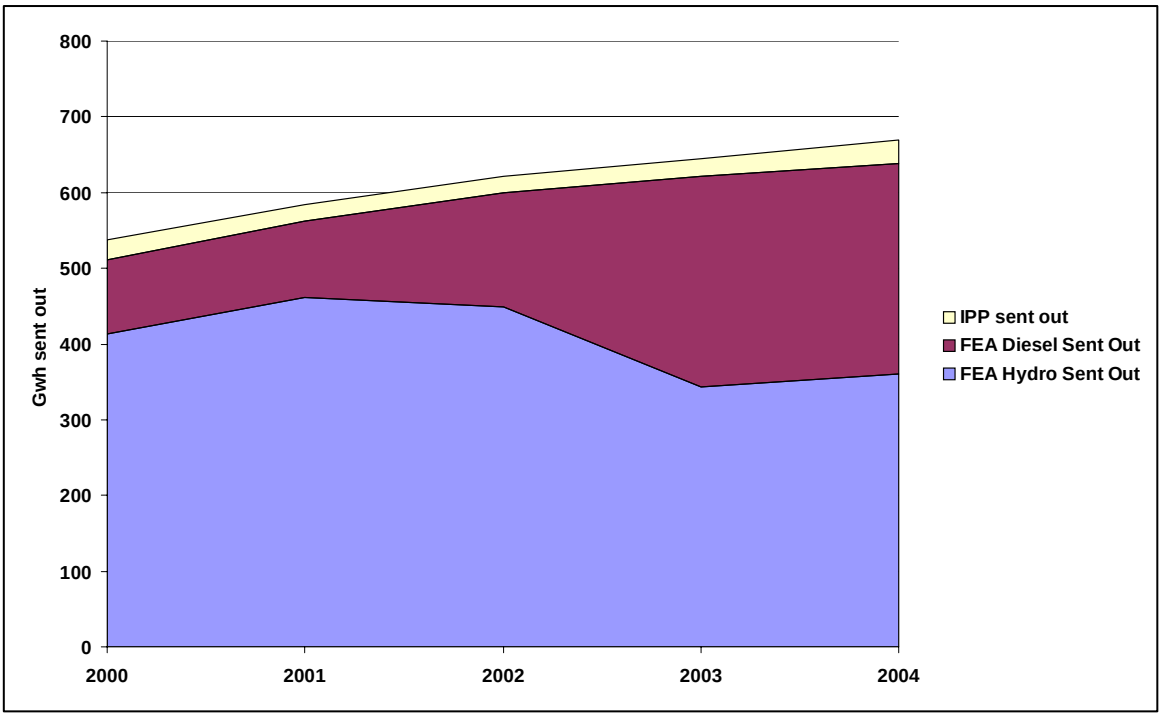
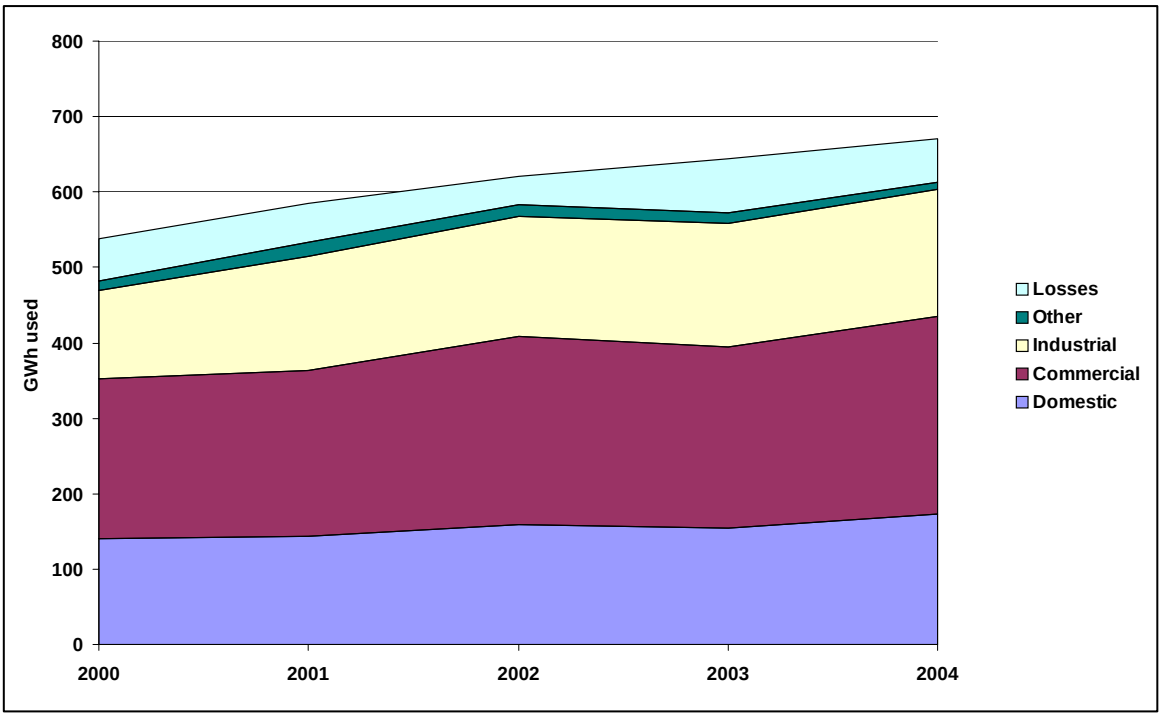


Figure 2 Electricity used by sector, all FEA systems 2000-2004



Tariffs and Generation Costs

It is government policy to apply a uniform tariff to domestic users throughout Fiji, irrespective of cost of supply. In 2004 the FEA announced that tariffs would increase over the coming years for commercial and industrial users, and for domestic users with an average consumption of more than 250 kWh/month (Table 7). However, as average domestic customer use is less than 1500 kWh per year (125 kWh per month) only a small minority of domestic customers will face tariff increases.

Table 7 FEA Tariffs, 2004-07

Tariffs	Monthly threshold	Annual threshold	FJD cents/kWh 2004	2005	2006	2007
Domestic lifeline tariff	<250	3000	20.59	20.59	20.59	20.59
Domestic other tariff	>250	3000	20.59	21.27	21.95	22.63
Commercial & industrial	<14999	180000	20.71	22.14	23.57	24.91
	>14999	180000	20.00	21.38	22.76	24.06

Source : FEA Public Notice. Maximum Demand tariff also available

According to the *Pacific Islands Renewable Energy Project* (PIREP 2004) the average cost of supply significantly exceeds the tariff:

> FEA has a single national tariff structure throughout all supply areas, with charges varying by consumer classification. …However, the cost of supply varies greatly by delivery area [Table 8]. In 2001, for example, the cost to supply urban consumers in Viti Levu was about half the cost of urban customers in Vanua Levu or Ovalau. If the cost for urban Viti Levu is set at a baseline of 1.0, rural supply costs in 2001 were 2.68 in Viti Levu, 6.42 in Vanua Levu and 9.89 in rural Ovalau. It has long been argued at the political level in Fiji that a tariff varying by geographical area according to supply cost is unpalatable. Although this may be true, the policy of a single national tariff has reduced the incentives for FEA to extend its supply to other islands – and more remote parts of current supply areas – where costs per kWh may well exceed ten times Suva/Nadi/Lautoka supply costs. The current policy, whatever its merits, also requires a considerable level of subsidy from urban Viti Levu users to the rest of FEA's customers. It has also hindered past efforts to develop grid-based renewable energy systems, which could be less expensive than diesel alternatives but nonetheless financially unattractive under a national power tariff.

Combining the PIREP supply cost estimates for 2001 with estimates of the number of domestic customers in each region suggests an average domestic supply cost of 37c/kWh, well above the current average tariff of about 21 c/kWh (Table 8). Rural users appear to be cross-subsidised by urban ones and by the government, which requires that FEA profits that would otherwise by received as dividends be applied to the cross-subsidy (FEA 2003). While this a political decision for the government to make, it means that value of increasing the efficiency of electricity use is far higher than the tariff indicates.

The extent of subsidy to domestic electricity users is likely to have increased considerably since 2001, because hydro availability has fallen (see Figure 1). The FEA reported FJD 16 million in unbudgeted extraordinary expenses in 2003:

- $ 13 million from increased fuel costs and leased diesel generators because of low hydro generation at Monasavu;
- $ 2 million in cyclone repairs; and
- $ 1 million in additional insurance premium costs (FEA 2003). .

This amounted to 3c for every kWh sold. While some of these expenses were caused by the temporary factors of cyclones and unusually low hydro output, high oil prices, and hence high diesel prices, may well be a permanent feature.

Table 8 Indicative costs of supply to domestic users by region, 2001

Region	Class	FJD c/kWh supply cost (a)	FEA domestic customers (b)	
			Number	%
Viti Levu	Urban	0.19	66,500	61.4%
Viti Levu	Rural	0.51	24,100	22.2%
Vanua Levu	Urban	0.40	7,900	7.3%
Vanua Levu	Rural	1.22	7,400	6.9%
Ovalau	Urban	0.38	900	0.8%
Ovalau	Rural	1.88	1,500	1.4%
All	Wtd Avg	0.37	108,300	100.0%

(a) From PIREP (2004) (b) From Table 6

The future marginal costs of diesel generation will depend on a range of factors, as indicated in Table 10. The most critical, and most likely to fluctuate, are the crude oil price and the FJD/USD exchange rate. Table 9 and Figure 3 illustrate the effects of changes in these factors on fuel costs in Fiji and in the total supply charges (as FJD/kWh delivered). Only under combination of factors that may now appear to be optimistic (<USD 40/bbl and >0.55 FJD/USD) does the average domestic tariff meet the supply charges. Therefore, there is a high probability that future marginal generation costs alone will be well above the current domestic tariff (not even considering marginal transmission, distribution and other costs). This means that every additional kWh of domestic electricity use will represent a loss to the FEA.

Table 9 Estimated supply charge variation with oil price and exchange rate

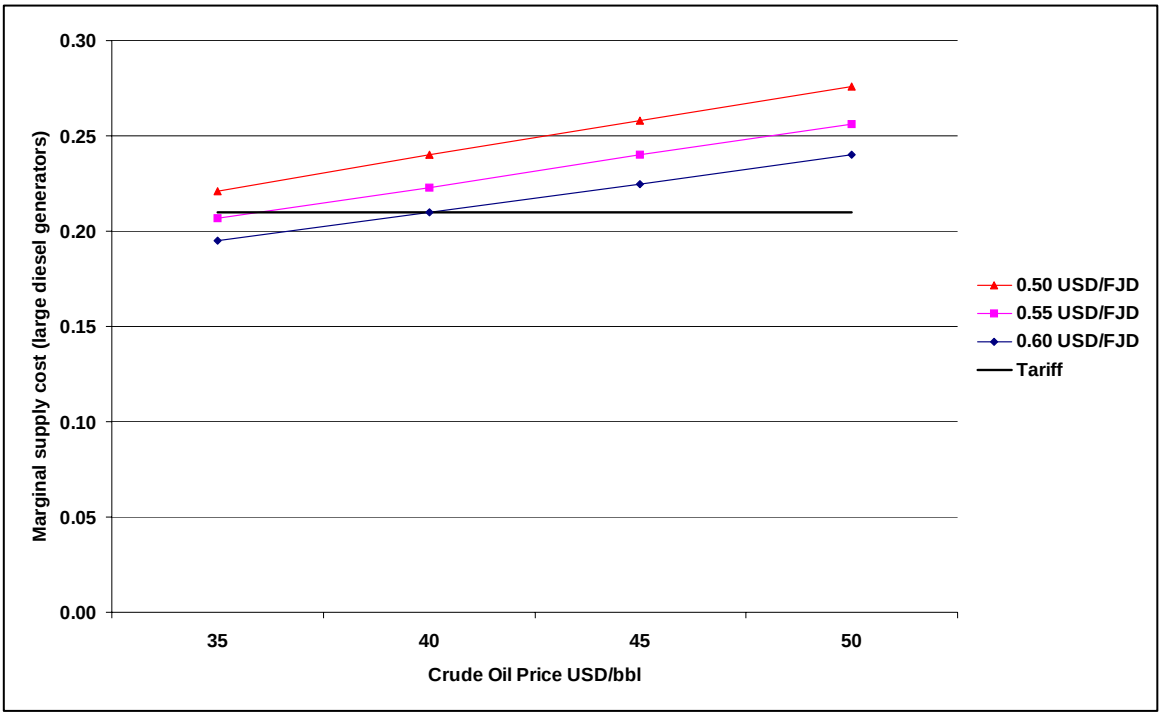
Exchange rate USD/FJD		USD/bbl Crude oil			
		35	40	45	50
0.60	FJD/tonne fuel	536	597	658	719
	FJD/kWh delivered	0.20	0.21	0.23	0.24
0.55	FJD/tonne	585	651	718	784
	FJD/kWh	0.21	0.22	0.24	0.26
0.50	FJD/tonne	643	716	789	863
	FJD/kWh	0.22	0.24	0.26	0.28

Table 10 Factors determining the marginal cost of diesel generation

	Units	Est. Value
Crude oil (a)	USD/bbl	45
Refining margin (a)	USD/bbl	5
Transport & handling (a)	USD/bbl	4
Total cost	USD/bbl	54
	bbl/tonne	7.31
Total diesel fuel cost	USD/tonne	395
Exchange rate	USD/FJD	0.60
	Euro/FJD	0.50
Total diesel fuel cost	FJD/tonne	658
	FJD/GJ	14.7
Generation	Thermal efficiency (a)	36%
	GJ fuel/GJ sent out	2.78
	GJ fuel/kWh sent out	0.010
	FJD/kWh sent out	0.147
System losses		10%
Fuel charges	**FJD/kWh delivered**	**0.163**
Maintenance costs (b)	Euro/kWh	0.003
	FJD/kWh sent out	0.006
Maintenance charges	**FJD/kWh delivered**	**0.007**
Total variable charges	**FJD/kWh delivered**	**0.169**
Capital charges (b)	Euro/kWh	0.025
	FJD/kWh	0.050
Total fixed charges	**FJD/kWh delivered**	**0.056**
Total charges	**FJD/kWh delivered**	**0.225**

(a) Author estimates for indicative purposes (b) Klimstra (2004)

Figure 3 Estimated supply charge variation with oil price and exchange rate



End use by Appliances

There is very little up to date information on appliance ownership and energy use in Fiji. For the present study it has been necessary to rely partly on data from previous studies which are now over a decade old. However, because refrigeration and air conditioning still dominate electricity use in the residential and commercial sectors respectively, the conclusions in the present study are still fairly robust.

The percentage of electricity-connected households owning a refrigerator was already high in 1993, and is estimated to have reached 95% in 2005 (Table 11). This would indicate nearly 122,000 refrigerators in use. Freezer ownership is much lower, and it is estimated that about 14,000 units are in use in homes. Air conditioner ownership is the least reliable estimate: if a significant share of air conditioner imports are purchased by households rather than by businesses, it could well be much higher.

Table 11 Estimated domestic refrigeration and air conditioner ownership, Fiji 2005

	Ownership			2005		
	1981(a)	1993(a)	2005(b)	Number	KWh/yr(d)	MWh/yr(c)
Refrigerators	90%	93%	95%	121745	702	85510
Freezers	NA%	9%	11%	14097	645	9097
Air conditioners	4%	5%	15%	19223	710	13645
Total domestic customers				128152		

(a) GWA & EES (1996) (b) Author estimates (c) From Table 13 (d) Derived values

The estimated energy consumption associated with each major end use in 1995 and in 2005 is summarised in Table 12 and Table 13 respectively. Refrigeration, air conditioning and lighting each account for about a quarter of the electricity use of the domestic and commercial sectors combined. Air conditioning contributed more to the growth in national electricity use than did refrigeration (Figure 4).

Table 12 Estimated electricity consumption by main end use, Fiji 1995

	Domestic		Commercial		Domestic + Commercial	
	MWh	%	MWh	%	MWh	%
Refrigerators	37464	44.0%	17244	12.0%	54708	23.9%
Freezers	3406	4.0%	1437	1.0%	4843	2.1%
Air conditioning	3406	4.0%	50296	35.0%	53702	23.5%
Hot Water	5960	7.0%	1437	1.0%	7397	3.2%
Cooking	4257	5.0%	1437	1.0%	5694	2.5%
Lighting	22989	27.0%	53170	37.0%	76159	33.3%
Other	7663	9.0%	22992	16.0%	30655	13.4%
Total	85145	100.0%	143702	101.0%	228847	100.0%

Source: GWA & EES (1996)

Over the decade, refrigeration increased its share from about 48% to 52% of household use, and air conditioning from 4% to about 7.5%. It is possible that the energy use of refrigerators in the residential sector is over-estimated somewhat, but in that case the energy use in the commercial sector has probably been underestimated to the same

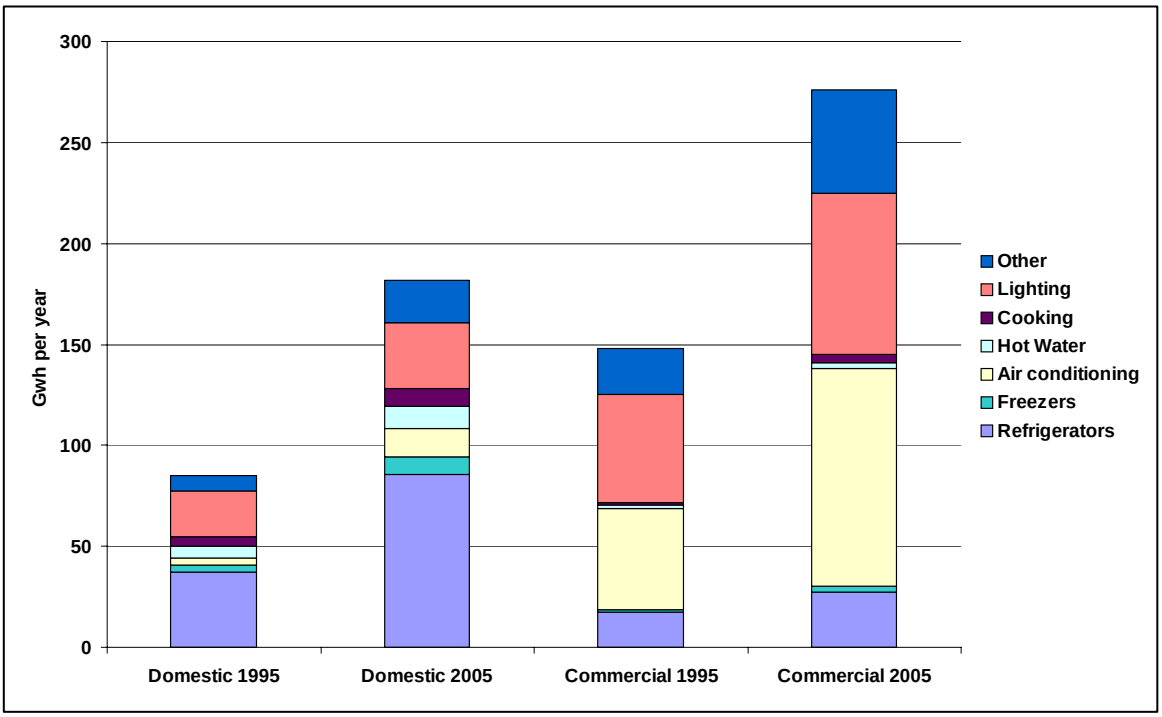
degree. This is because many household style refrigerators are used in commercial applications (eg catering, restaurants and accommodation).

Table 13 Estimated electricity consumption by main end use, Fiji 2005

	Domestic		Commercial		Domestic + Commercial		Annual
	MWh	%	MWh	%	MWh	%	growth rate
Refrigerators	85510	47.0%	27609	10.0%	113120	24.7%	7.5%
Freezers	9097	5.0%	2761	1.0%	11858	2.6%	9.4%
Air conditioning	13645	7.5%	107677	39.0%	121322	26.5%	8.5%
Hot Water	10916	6.0%	2761	1.0%	13677	3.0%	6.3%
Cooking	9097	5.0%	4141	1.5%	13238	2.9%	8.8%
Lighting	32749	18.0%	80067	29.0%	112816	24.6%	4.0%
Other	20923	11.5%	51078	18.5%	72000	15.7%	8.9%
Total	181937	100.0%	276095	100.0%	458032	100.0%	7.2%

Author estimates

Figure 4 Estimated electricity consumption by main end use, Fiji 1995 and 2005



The appliance market

Equipment imports

Virtually all the electrical appliances sold in Fiji are imported. The total value of household refrigerators, freezers, dishwashers and clothes washers in 2004 declared to customs totalled FJD 10.4 million.[7] The value of fans and air conditioners (not differentiated by commercial or household type) totalled FJD 9.3 million, and the value of commercial refrigeration and icemaking equipment was FJD 4.4 million.

Table 14 indicates the countries of origin by value, and Table 15 the share of each product market supplied from each country.[8] For the products of concern in this study:

- New Zealand products accounts for nearly half of household refrigerators and nearly 60% of freezer imports by value
- Australian products account for a quarter of household freezers and nearly 40% of freezer imports by value
- The other significant refrigerator suppliers are China, Singapore, Turkey and Thailand; virtually all freezers come from ANZ;
- The air conditioner equipment market is more diverse, with imports from Japan having nearly a quarter of the market, followed by Australia, China, New Zealand, Malaysia and Thailand.

The number of items actually imported is not reported, but it is possible to roughly estimate this from typical Fiji retail prices, and on the assumption that declared customs values are about half the retail prices – the difference is made by taxes (3% import duty and 12.5% Value Added Tax) and retail markups. On these assumptions the estimated household refrigerator market in Fiji is 12,000 to 13,000 units per year. This corresponds well with the size of the total installed stock and with the estimates of the suppliers themselves.

The household freezer market is estimated at about 2,000 units per year. The household clothes washer market is about 10,000 units per year, and the dishwasher market is fairly small, at between 500 and 600 units.

Air conditioner sales are estimated at about 9,000 units per year, but this is approximate only, because the wide range of configurations and values make it hard to judge average price. Window-wall types make up nearly 60% of the total value, and as these tend to be of lower cost than split systems, they may account for up to 70-75% of sales.

[7] At the time of preparing this report the exchange rate was 1 FJD = 0.80 AUD = 0.84 NZD = 0.59 USD.
[8] It is not clear whether the country of origin indicated in the customs returns is country of manufacture or country of origin of the freight shipment. If the latter, this could over-state the apparent market share of New Zealand, Australia and Singapore, since some product would be shipped by importers based in those countries.

Table 14 Source of Appliance Imports by Value, Fiji 2004

Product	Australia	New Zealand	China & HK	Japan	Singapore	All Other Asia	Europe	North America	All other	Total	Avg $ (Retail)(b)	Avg $ (W'sale)(c)	Number(d)
Fans	1045	444	565	44	118	187	99	70	14	2585	110	55	47000
Air Conditioning Machines (a)	1453	865	909	1592	778	1089	48	20	1	6755	1500	750	9000
Household Refrigerators	1433	2646	285	0	604	239	322	95	72	5695	920	460	12400
Household Freezers	258	385	3	0	11	0	0	1	0	659	750	375	1760
Commercial Refrigeration	1201	1901	717	4	16	268	136	38	144	4425			
Dishwashers	122	252	0	0	0	0	0	2	0	376	1400	700	540
Household Clothes Washers	1322	605	426	0	788	295	0	3	183	3620	700	350	10300
Total	6833	7098	2904	1640	2315	2078	605	228	413	24114			

Source: Author analysis of Fiji Customs Data for 2004 All values '000 FJD customs declared value. (a) Household and commercial not differentiated (b) Author estimates based on Courts catalogue advertised prices (c) Author estimates based on estimated retail multiplier of 2. (d) Total declared value divided by average wholesale price.

Table 15 National share of Appliance Imports by Value, Fiji 2004

Share of product import value	Australia	New Zealand	China & HK	Japan	Singapore	All Other Asia	Europe	North America	All other	Total	Share of total value
Fans	40.4%	17.2%	21.8%	1.7%	4.6%	7.3%	3.8%	2.7%	0.5%	100.0%	10.7%
Air Conditioning Machines (a)	21.5%	12.8%	13.5%	23.6%	11.5%	16.1%	0.7%	0.3%	0.0%	100.0%	28.0%
Household Refrigerators	25.2%	46.5%	5.0%	0.0%	10.6%	4.2%	5.6%	1.7%	1.3%	100.0%	23.6%
Household Freezers	39.2%	58.5%	0.4%	0.0%	1.7%	0.0%	0.0%	0.2%	0.0%	100.0%	2.7%
Commercial Refrigeration	27.1%	43.0%	16.2%	0.1%	0.4%	6.1%	3.1%	0.9%	3.2%	100.0%	18.3%
Dishwashers	32.5%	67.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	100.0%	1.6%
Household Clothes Washers	36.5%	16.7%	11.8%	0.0%	21.8%	8.1%	0.0%	0.1%	5.1%	100.0%	15.0%
Total	28.3%	29.4%	12.0%	6.8%	9.6%	8.6%	2.5%	0.9%	1.7%	100.0%	100.0%

Source: Author analysis of Fiji Customs Data for 2004. (a) Household and commercial not differentiated

Refrigerator and Freezers

Brands

The New Zealand-based manufacturer Fisher and Paykel (F&P) accounts for the majority of the Fiji refrigerator and freezer market in terms of both value and sales. All of its products are now sold under the F&P brand. The company discontinued its Shacklock brand, which was well known in Fiji for many years, in August 2004.

Most of the models sold in Fiji are manufactured in New Zealand, although the larger models are manufactured in Australia: ie F&P products account for some of the reported refrigerator imports from Australia as well as all of the imports from New Zealand. All of the F&P refrigerator and freezer models sold in Fiji are identical with the models sold in Australian and New Zealand, with one exception – which happens to be the largest selling single model in Fiji.

The Australian-based manufacturer Electrolux (formerly Email) also has a large share of the Fiji refrigerator and freezer markets under its Westinghouse and Kelvinator brands.

Other brands on the market include:

- Panasonic and Toshiba: these are Japanese brands, but most models are now made in Thailand, Malaysia, Singapore and Taiwan;
- LG and Samsung, made in Korea;
- Haier and Akita, made in China;
- Whirlpool and Amana: these are made in the USA, and tend to be larger models sold in very low numbers.
- MABE, made by Controladora Mabe S.A in Mexico (48% owned by GE).

Market Characteristics

Although most of the products sold are manufactured in Australia and New Zealand, the Fiji refrigerator market is significantly different from those markets. The characteristics of the Fiji market have been estimated on the basis of store surveys, retailer catalogues and in-store surveys carried out by FDOE between March 2002 and April 2003 (Table 16). The characteristics of the Australian market have been tracked since 1993 by annual sales surveys. Table 17 summarises the characteristics for 2002, the year corresponding to the Fiji data, and Table 18 for 2004, the latest data year.

The main differences are:

- The average volume of refrigerators sold is much smaller in Fiji than in Australia. The weighted average for refrigerators is about 270 litres compared with about 330 litres in Australia (the exception is Group 2 single door refrigerators, which tend to

be used as second or bar refrigerators in Australia but as main household refrigerators in Fiji);

- Average freezer volumes appear to be higher in Fiji than in Australia;

- The market share of Group 4 units (cyclic defrost in the fresh food compartment, but manual defrost of the freezers compartment) is still high in Fiji. As Figure 5 shows, this configuration was almost absent from the Australian market by 2004, and has since disappeared entirely due to the increase in ANZ MEPS levels in 2005 (see discussion, next section).

For the smaller refrigerators favoured by Fiji customers, retail prices appear to be about the same as in Australia after adjusting for the exchange rate, eg a model selling for AUD 480 in Australia sells for about FJD 600 in Fiji. For larger units, however, the price differential appears to be in favour of Fiji: a unit selling for AUD 1800 in Australia would sell for FJD 1800 in Fiji, which is in fact cheaper given the exchange rate. This may indicate heavier discounting at the more expensive end of the market, where larger $ margins allow it, and where sales volumes are low.

Table 16 Estimated characteristics of Fiji refrigerator market, 2002

	Avg FF vol litres	Avg FZ vol litres	Avg Total vol litres	Avg kWh/yr	Avg star rating	Annual sales	% of Ref market	Number of models
Group 1 single dr	306	0	306	526	1.8	1250	10.0%	4
Group 2 single dr	113	0	130	333	2.0	1875	15.0%	5
Group 4 cyclic	133	77	210	544	2.3	4375	35.0%	4
Group 5 f/free(a)	267	100	368	627	2.8	5000	40.0%	24
Group 6 chest Frz	0	370	370	471	2.4	2000		11

Author estimates based on store surveys and catalogues. (a) Excludes Side by Side

Table 17 Reported characteristics of Australian refrigerator market, 2002

	FF vol litres	FZ vol litres	Total vol litres	kWh/yr	Average star rating	Annual sales	% of Ref market	Star rating compared with Fiji
Group 1 single dr	375	0	375	482	3.5	19680	4.9%	1.7
Group 2 single dr	99	0	99	331	2.1	77183	19.2%	0.1
Group 4 cyclic	308	108	416	660	3.0	17147	4.3%	0.7
Group 5 f/free(a)	275	113	388	685	2.8	286956	71.6%	0.0
Group 6 chest Frz	0	185	185	404	1.5	40344		-0.9

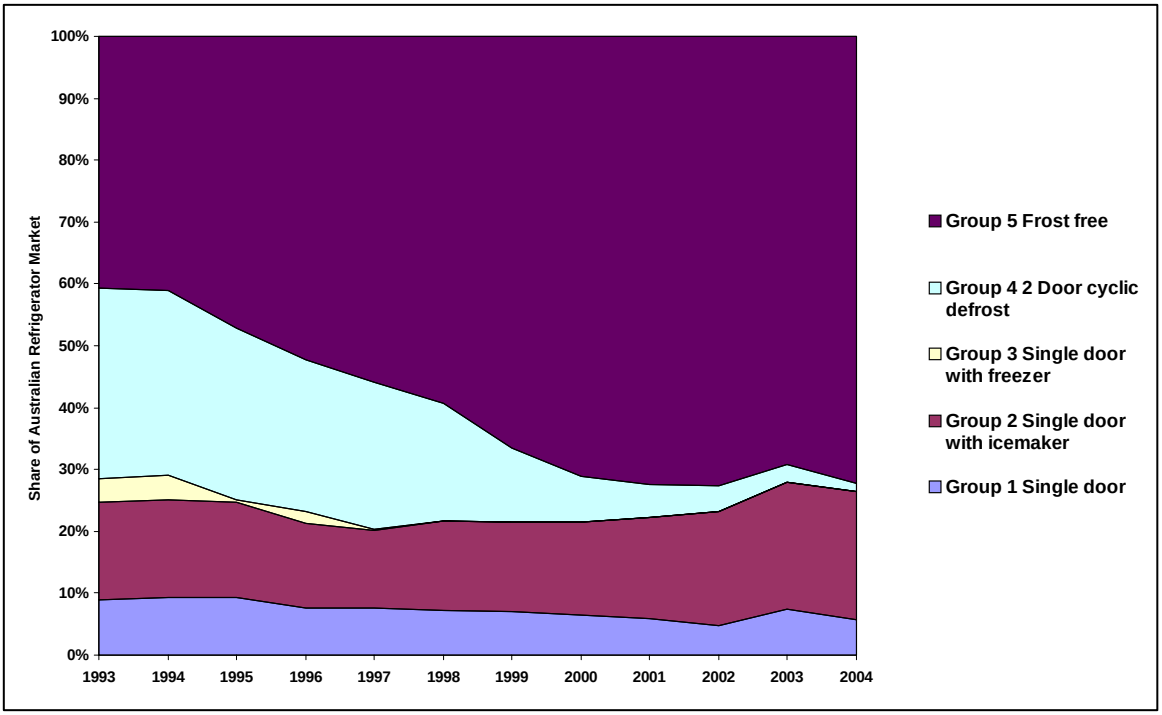
Source: GfK sales data analysed by EES (a) Excludes Side by Side

Table 18 Reported characteristics of Australian refrigerator market, 2004

	FF vol litres	FZ volume litres	Total vol litres	kWh/yr	Average star rating	Annual sales	% of Ref market	Star rating cimpared with Fiji
Group 1 single dr	363	0	363	514	3.0	30630	6.1%	1.2
Group 2 single dr	92	0	92	322	2.2	113228	22.6%	0.2
Group 4 cyclic	290	97	387	611	3.1	7396	1.5%	0.8
Group 5 f/free(a)	276	105	381	586	3.4	349672	69.8%	0.6
Group 6 chest Frz	0	225	225	428	1.7	58522		-0.7

Source: GfK sales data analysed by EES (a) Excludes Side by Side

Figure 5 Market share of refrigerators by Group, Australia 2003-2004



Energy Efficiency and MEPS

The average energy efficiency of refrigerators sold in Fiji is slightly lower than the average for the corresponding groups sold in Australia:

- For Group 1, the average star rating of models sold in Australia was 1.7 stars higher than in Fiji, but the average Australian rating fell by 0.5 stars in 2004. The difference in terms of annual energy use was 44 kWh/yr in 2002 (the quality of data for Fiji do not allow reliable estimates for 2004);

- For Group 2 there was very little difference in average star ratings or annual energy use;

- For Group 5 there was little difference star rating in 2002, although Australian cabinets used more energy because they were larger on average. By 2004 however, the average ratings in Australia increased by 0.6 stars.

The main driver for the increase in Group 5 ratings in Australia was the fact that MEPS levels increased significantly on 1 January 2005, and suppliers were adjusting their model mix in the preceding year to remove those that did not meet the new MEPS levels and to introduce more efficient versions. According to the ANZ suppliers, they will not continue to make the older, less efficient variants for export, so Fiji should in due course receive the newer, more efficient models once stocks of the older models are sold. Therefore it is assumed that by 2008, the ANZ-made frost free refrigerators available in Fiji will be as efficient as those available in Australia and New Zealand.

However, this does not necessarily apply Group 1,2 or 5 products imported from other countries. Although most of those suppliers manufacture models which meet the new ANZ MEPS levels (Table 19), it is likely that Fiji will continue to receive the models which can no longer be sold in Australia or New Zealand. Indeed, the market share of those products could increase because the suppliers will transfer stocks of non-complying models to Fiji, and the more efficient ANZ-made models may lose market share because their prices may be slightly higher.

Table 19 Brands sold in Fiji with models meeting ANZ 2005 MEPS

Brand	Countries of manufacture	Number of models on ANZ market:		
		Failing 2005 MEPS (b)	Meeting 2005 MEPS	Total on register
Akita (a)	? China	NA	NA	NA
Amana	USA	23	4	27
F&P	New Zealand, Australia	44	37	81
Haier	China	39	45	84
Kelvinator	Australia, Korea	57	7	64
LG	Korea, China, Indonesia, Mexico	45	111	156
Mabe (a)	Mexico	NA	NA	NA
Panasonic	Taiwan	8	0	8
Samsung	Korea, China, Thailand	24	40	64
Toshiba	Thailand	8	8	16
Westinghouse	Australia, Korea, China	81	60	141
Whirlpool	USA, Korea, Japan, India, Brazil, Italy	24	40	64
All above		**353**	**352**	**705 (c)**

(a) This brand does not appear in Australia or New Zealand (b) These models are 'grandfathered' for the ANZ market – they can still be legally sold if imported prior to the date of MEPS increase. (c) This exceeds the number of models sold in Fiji – table is indicative only for the Fiji market.

The flow-on of benefits from ANZ MEPS will not extend to Group 4 cabinets, which were already in sales decline and were effectively eliminated from the Australian market by the increase in MEPS levels. The ANZ manufacturers have no plans to improve those models to meet the new MEPS because there is no longer a market for them in Australia, but will continue to manufacture them for export to Fiji and the other PICs where there is still a demand for cyclic defrost cabinets.

According to the suppliers, this demand is underpinned by the fact that old-technology cyclic defrost models are slightly cheaper than frost-free models of similar size, and the PIC markets are very price sensitive (as evidenced by the results of the FDOE survey). One supplier ventured the opinion that if the cyclic defrost models were not available, some customers could not afford to buy a refrigerator-freezer at all (ie they would have to settle for a Group 1 or 2 model, without a freezer).

It is not possible to directly establish the actual price difference in Fiji between Group 4 models and their direct Group 5 counterparts (ie cabinets of the same dimensions built on the same chassis) because they do not both appear on the Fiji market. Only F&P still produces a pair of direct counterparts, but only sells the Group 4 version outside Australia and the Group 5 version within Australia.[9] However, it is possible to

[9] There are no Group 4 models registered as 2005 MEPS-compliant in Australia. There are three complying Group 4 models registered for sale in NZ: two made by the Danish company Gram, and one by the Italian company SMEG. They are at the high-quality, high-cost end of the market.

indirectly compare the price per adjusted volume for cyclic and frost-free models of comparable size and configuration on sale in Fiji. On this basis the average price for cyclic defrost models was FJD 2.3 per litre and the average price for frost free models of similar size was FJD 3.0 per litre, ie about 25% higher.

The ANZ-made frost free models on the Fiji market will become far more energy-efficient over the coming years due to the effects of the more stringent MEPS levels which took effect in Australia and New Zealand in January 2005. These forced reductions in energy consumption of 47% and 33% respectively for the two frost free models in Table 20. If the suppliers had also decided to keep the cyclic variants on the ANZ markets, they would have had to reduce the energy consumption of those models by 32-33%. Given the negligible sales of cyclic refrigerators in Australia, the suppliers took the commercially rational decision not to modify them, but to keep exporting them to markets with less stringent, or no MEPS.

Table 20 Energy consumption of Cyclic and Frost Free variants

Brand	Model	Group	Volume (litres)			KWh/yr		
			Fresh food	Freezer	Total	Pre-MEPS	MEPS	Reduction
Fisher & Paykel	C170T	4 cyclic	115	57	172	515(a)	345(c)	-33%
	N169T/E169T	5 f/free	115	57	172	635(a)	338(b)	-47%
Westinghouse	RE221SR	4 cyclic	165	50	215	526(a)	358(c)	-32%
	RJ212SR	5 f/free	168	50	218	593(a)	396(b)	-33%

(a) Actual model – may no longer be sold in Australia or New Zealand (after current stocks run out)
(b) Actual replacement model introduced to meet 2005 MEPS (c) Maximum consumption to meet new MEPS – but no plans to manufacture such a model.

If the 2005 ANZ MEPS levels for Group 4 refrigerators were adopted in Fiji. The possible outcomes would include:

- If the suppliers decided to upgrade their cyclic products to meet the MEPS level, the intending purchasers could still buy a cyclic model, but it would probably be more expensive because of the need to recoup the development costs from the relatively small PIC market;

- The intending purchasers could switch their purchase to a frost-free model instead: this would have much lower energy consumption but would be about 25% more expensive.

Either outcome would make the purchaser better off financially. Table 21 compares the lifetime ownership cost for actual cyclic models available in Fiji, a MEPS-compliant cyclic alternative (if one existed) and the actual MEPS-compliant frost free variant (if it were available in Fiji). The purchase price estimates are approximate only, but it appears buying the alternative to the current cyclic defrost model would reduce the lifetime ownership costs by 11% to 21%. If the net present value of future energy savings were discounted at 10%, the lifetime ownership cost would fall by 3 to 14%.

This suggests that MEPS would almost certainly be privately cost-effective for typical refrigerator buyers, even at relatively large purchase price increments and at subsidised electricity tariffs. The economy-wide benefits are estimated in Chapter 3.

Table 21 Lifetime costs of refrigerator variants, undiscounted

	Group	Purchase	15 year running cost (c)	Total ownership cost	Saving	
C170T (as is)	4 cyclic	$650(a)	$1,748	$2,398	NA	NA
C170T (MEPS-compliant)	4 cyclic	$733(b)	$1,171	$1,904	$494	21%
E169T (frost free equivalent)	5 f/free	$815(b)	$1,147	$1,962	$436	18%
RE221SR (as is)	4 cyclic	$730(b)	$1,786	$2,516	NA	NA
RE221SR (MEPS compliant)	4 cyclic	$815(b)	$1,215	$2,030	$486	19%
RJ212SR (frost free equivalent)	5 f/free	$900(b)	$1,344	$2,244	$271	11%

All values FJD (a) Actual selling price (b) Author estimates (c) At 22c/kWh

Table 22 Lifetime costs of refrigerator variants, 10% discount rate

	Group	Purchase	15 year running cost (c)	Total ownership cost	Saving	
C170T (as is)	4 cyclic	$650(a)	$886	$1,536	NA	NA
C170T (MEPS-compliant)	4 cyclic	$733(b)	$594	$1,326	$210	14%
E169T (frost free equivalent)	5 f/free	$815(b)	$582	$1,397	$140	9%
RE221SR (as is)	4 cyclic	$730(b)	$905	$1,635	NA	NA
RE221SR (MEPS compliant)	4 cyclic	$815(b)	$616	$1,431	$204	13%
RJ212SR (frost free equivalent)	5 f/free	$900(b)	$682	$1,582	$54	3%

All values FJD (a) Actual selling price (b) Author estimates (c) At 22c/kWh

3. Determining Costs and Benefits

Private benefits and costs

The private benefits of MEPS and energy labelling for Fiji consumers will come from the value of the electricity saved from the purchase of refrigerators and freezers that are more energy-efficient than would be the case if the programs were not implemented: the 'Business as Usual' (BAU) case. The electricity is valued at the tariff which consumers pay, irrespective of whether that value reflects the real costs of electricity supply.
The private costs of MEPS are the increase in the average price that consumers in Fiji will pay for refrigerators and freezers as a result of MEPS.

Although it is generally assumed that there is a correlation between energy efficiency and price, the correlation has been found to be relatively weak in other markets where MEPS have been introduced. In the USA, for example, average refrigerator prices fell over the 6-year period after MEPS were introduced in the late 1980s (Dale et al 2003).

Error! Reference source not found. illustrates the trend in the average purchase price, in Australia, of the types of refrigerator and freezer popular in Fiji. Prices are adjusted for changes in average volumes and corrected for inflation. The period covers the implementation of MEPS in October 1999, up to the increase in MEPS stringency at the end of 2004. Energy labelling was also in operation over the whole period, and customers were using the labels to purchase models that were even more efficient than the MEPS level. Prices remained constant or fell, while average while energy consumption per unit declined (Figure 7).

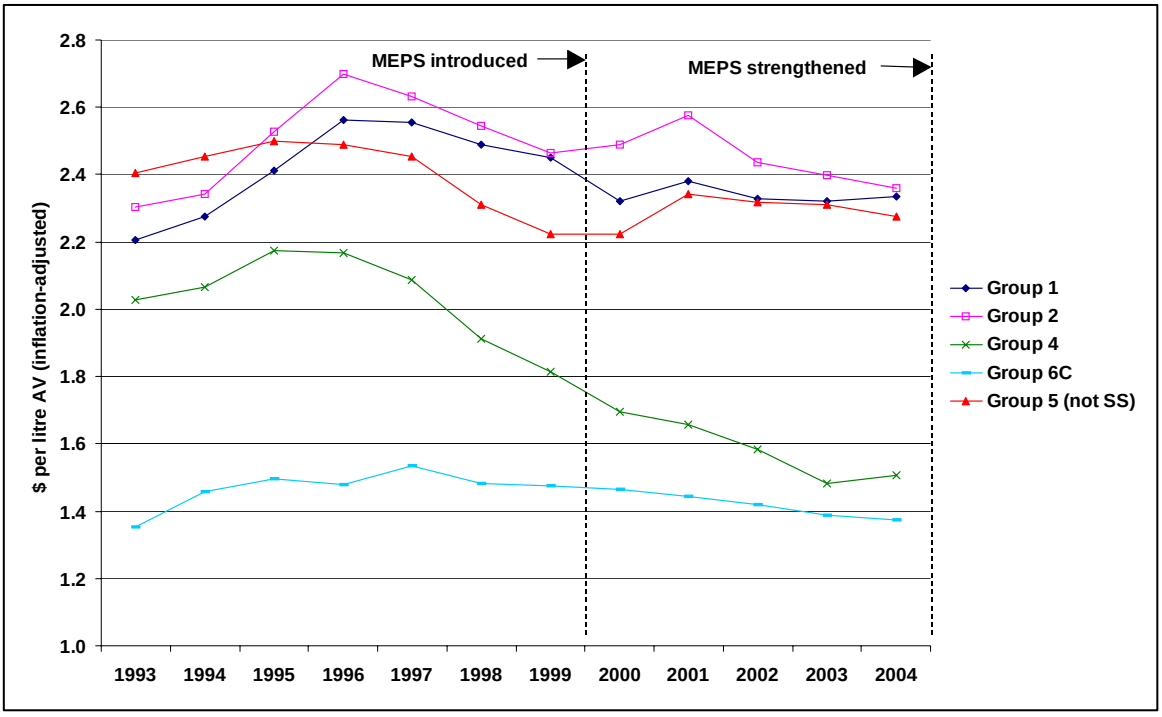
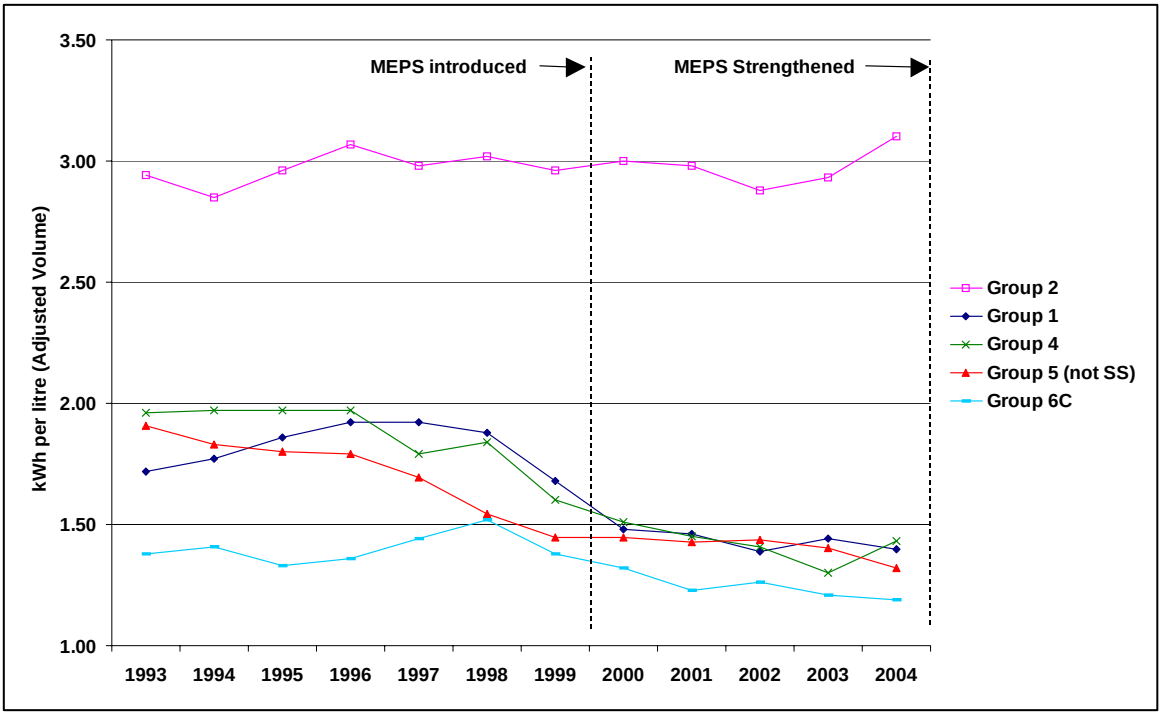


Figure 6 Average price, new refrigerators and freezers sold, Australia 1993-2004

Figure 7 Average annual energy consumption, new refrigerators and freezers, Australia 1993-2004



Energy Impacts

As outlined in the previous chapter, the Australian and New Zealand manufacturers intend to export ANZ MEPS-compliant models to Fiji once current stock run out, so in due course Fiji consumers will gain the running cost benefits and meet any additional costs if they continue to buy the ANZ-made products. This is not necessarily altruism – the costs of further segmenting the market by making more models are too high for ANZ manufacturers, who produce smaller model runs than other brands.

However, if there is no mandatory MEPS regime in place, a corresponding increase in the energy efficiency of products imported from other countries is not likely. Although the non-ANZ manufacturers supplying Fiji sell MEPS-complying models in Australia (Table 19), there is no incentive for them to supply those products to Fiji. Because of their higher global sales volumes and wider sourcing options, they are better able to segment their markets by continuing to supply higher-efficiency models for ANZ, and lower efficiency models to Fiji and the PICs. In fact, the market share of less efficient models may increase slightly since they will not undergo any price increases, and the evidence is that Fiji consumers are very price-sensitive.

Therefore failure to adopt MEPS in Fiji would mean losing some or all of the potential benefits of the flow-on of ANZ MEPS for some classes of products. Adoption of MEPS would not bias the market toward ANZ-made products, since the evidence from the Australian labelling register is that other suppliers can also supply complying product if forced to.

The adoption of ANZ MEPS would have a special impact on the market for Group 4 refrigerators, which still have a large share of the Fiji market but are no longer sold in Australia. For this Group, MEPS would either:

- force their removal from the market, in favour of more energy-efficient but more expensive Group 5 frost –free types; or

- force the suppliers of Group 4 products to invest in bringing those models up to meet the MEPS standards.

As illustrated in Table 21 and Table 22, buyers would still be financially better off, because in nearly all cases the value of electricity savings will more than outweigh any purchase price increases.

Table 23 summarises the impacts of adopting ANZ-level MEPS on each group of refrigerators and freezers imported into Fiji. The adoption of MEPS will lead to a major reduction in the energy consumption of 5 categories of refrigerator, but make little impact for 4 other categories. For freezers, the adoption of MEPS will have almost no impact, because virtually all products sold are ANZ-made, and so will conform to the new ANZ MEPS levels in any case.

Table 23 Likely impacts of adopting MEPS by refrigerator and freezer group

Group	Manufacture	No Fiji MEPS	With Fiji MEPS	Difference
Group 1 single dr	ANZ	Will follow ANZ MEPS	Will follow ANZ MEPS	No effect
	Other	No change from BAU	Will follow ANZ MEPS	Less energy
Group 2 single dr	ANZ	Will follow ANZ MEPS	Will follow ANZ MEPS	No effect
	Other	No change from BAU	Will follow ANZ MEPS	Less energy
Group 4 cyclic	ANZ	No change from BAU	Will follow ANZ MEPS	Less energy
	Other	No change from BAU	Will follow ANZ MEPS	Less energy
Group 5 f/free	ANZ	Will follow ANZ MEPS	Will follow ANZ MEPS	No effect
	Other	No change from BAU	Will follow ANZ MEPS	Less energy
Group 6 chest Frz	ANZ	Will follow ANZ MEPS	Will follow ANZ MEPS	No effect
	Other (a)	No change from BAU	Will follow ANZ MEPS	Less energy

(a) Impact on this category is negligible, since ANZ-made freezers have almost 100% of market

The magnitude of projected energy reductions will depend on the following factors:

- The number of products that will be sold in the coming years (Figure 8); this is projected to increase due to natural population growth, the increases in the proportion of rural households connected to electricity, and the growing need to replace older refrigerators as they wear out. (As almost every electrified home has a refrigerator, increases in ownership rates will no longer drive market growth.)

- The market share of each Group, and within each Group, the share of ANZ-made products that will comply with MEPS in any case, and those made on other countries and ANZ-made Group 4 products, which will not comply unless Fiji mandates its own MEPS (Figure 9);

- The projected average annual energy use of Group, with and without MEPS (Figure 10).

On this basis, it is projected that the implementation of MEPS in 2008 would reduce total electricity use by household refrigerators and freezers by about 9 GWh/yr (8% below BAU) by 2010, 21 GWh/yr (15% below BAU) by 2015, and 35 GWh/yr (20% below BAU) by 2020 (Figure 11).

Figure 8 Projected sales of domestic refrigerators and freezers, Fiji

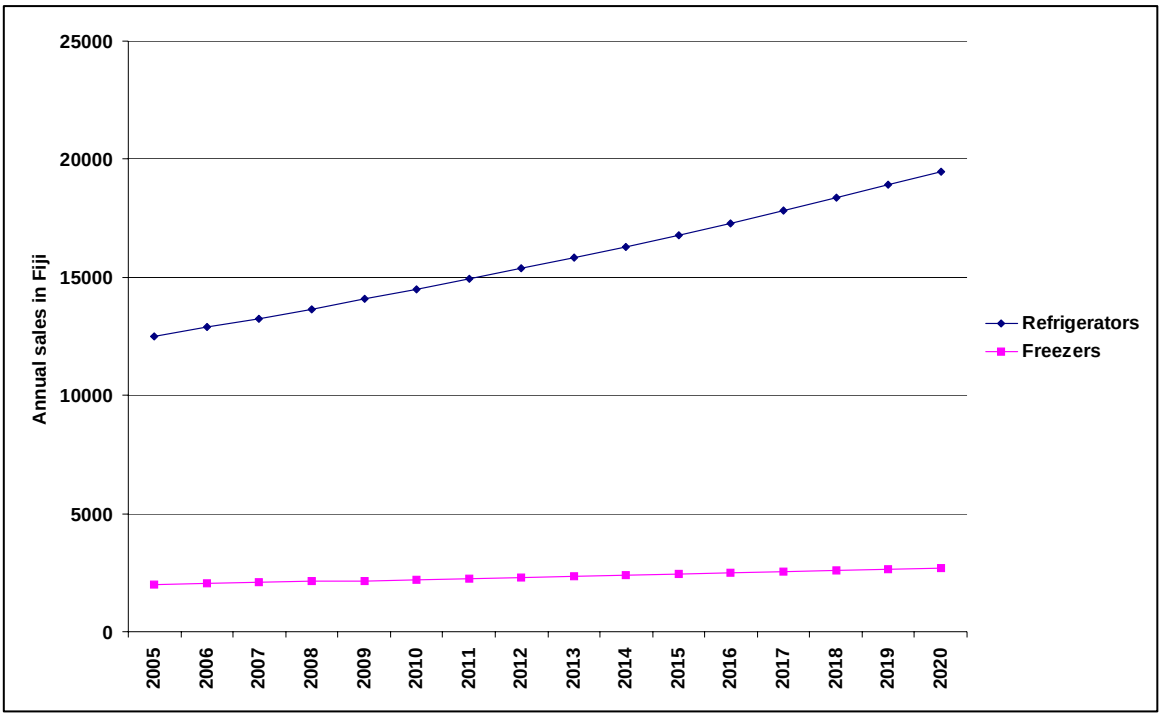


Figure 9 Projected market share by Group and country of manufacture

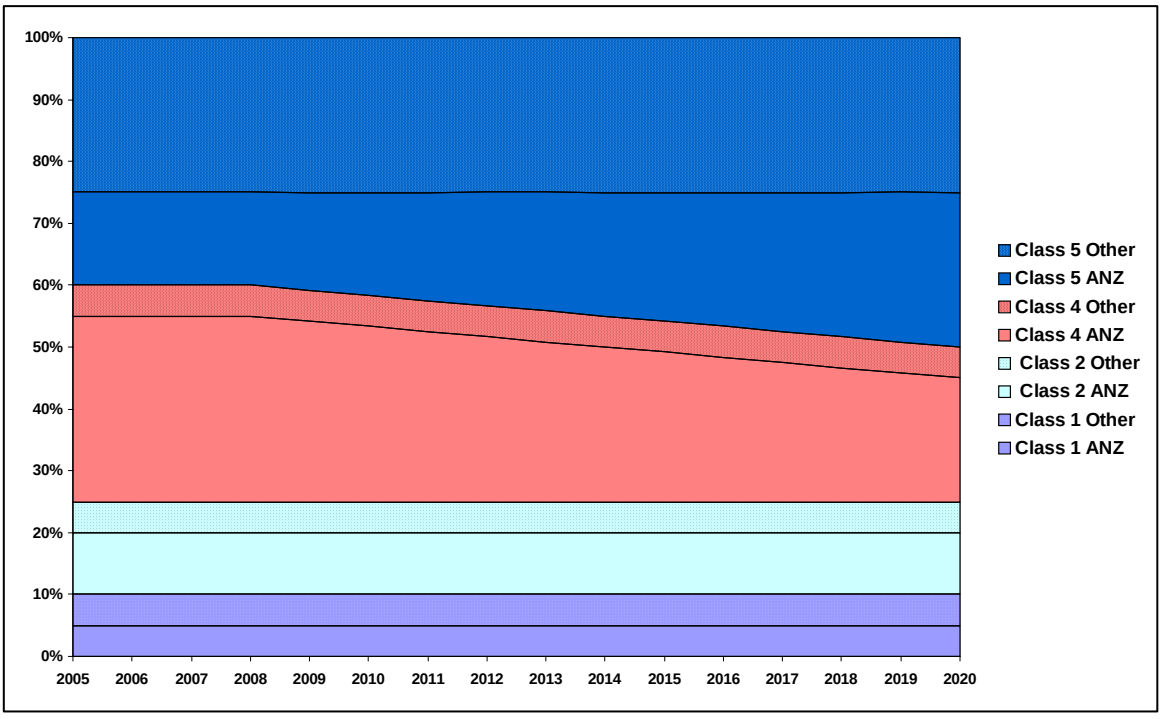


Figure 10 Projected average annual energy use of new refrigerators sold in Fiji

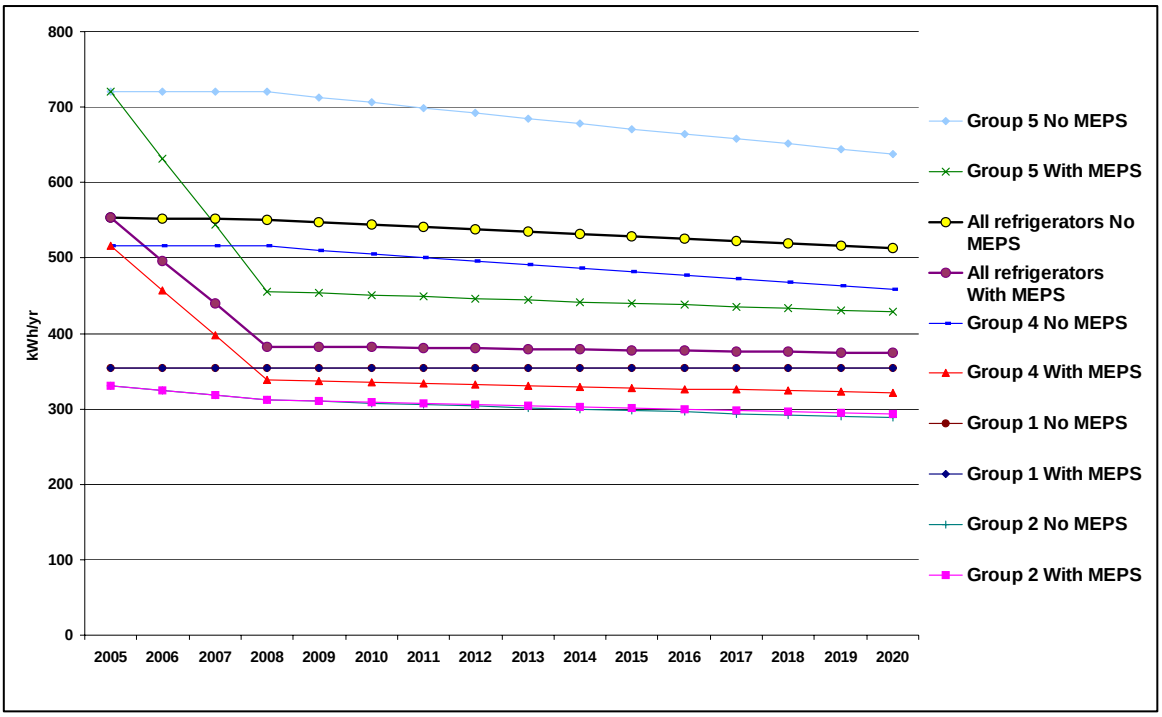
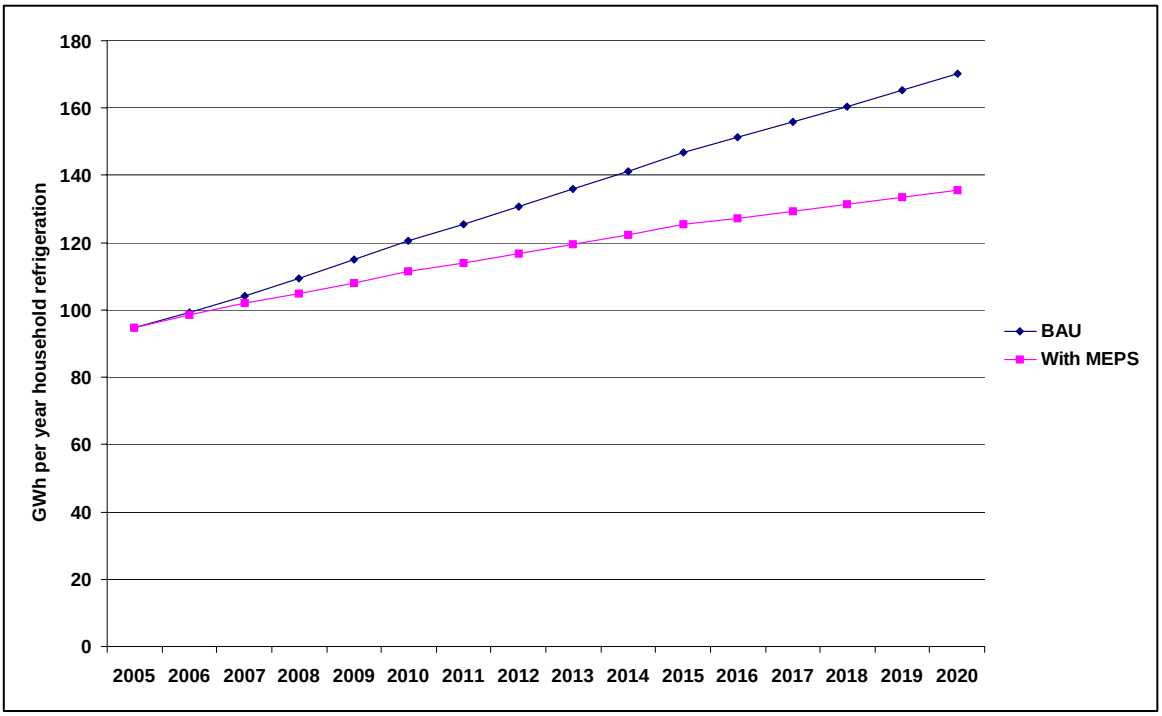


Figure 11 Projected total annual energy use of all domestic refrigerators and freezers, Fiji 2005-2020



Costs and Cost-Benefit Ratios

The maximum likely price increase for any one Group of products was estimated at 25%, on the basis that Group 4 units are withdrawn from the market entirely in favour of Group 5 products (and assuming that the additional quality of service from frost-free operation is given no monetary value). This worst-case outcome would be restricted to the 35% of the market that is now Group 4, so its impact across the market as a whole would be to raise prices by (35% x 25%) = 8.8%. Given the possibility of smaller price rises in the other Groups, the overall price impact might be about 10% (Figure 12).

The price increase would cover the higher production costs for more efficient products, as well as the testing costs for products not already energy tested for sale in other markets (principally Australia or New Zealand). It is assumed that all price increases would be passed on to the customers – although if some suppliers were not in a position to bear the costs and pass them on they would probably withdraw from the Fiji market (eg an importer bringing in only a few units of a model not already tested for sale elsewhere).

It is projected that in the BAU scenario Fijians will spend a total of FJD 205.1 million purchasing refrigerators in the period 2006-2020 (inclusive). If the implementation of MEPS increases average prices by 10% Fijians will spend a total of FJD 225.6 million purchasing refrigerators over the same period (the increase is slightly less than 10% because it is assumed that prices rise gradually over the first 3 years, not in one step). The extra cost is therefore FJD 19.5 million.

The value of the electricity saved by Fiji households from as a result of purchasing more efficient refrigerators due to MEPS is estimated at FJD 163.4 million. This is based on:

- A marginal tariff of 22.63c/kWhin 2007, increasing thereafter at 1% per annum;
- Accumulating the lifetime electricity consumption, over a 17 year service life, of all refrigerators sold between 2006 and 2020 (ie the energy savings for units sold new in 2020 are projected up to the time of their retirement in 2037);
- The assumption that average efficiency (and average price) increase linearly from 2005 to 2008, the year in which MEPS take effect (ie suppliers change products in anticipation, as they have done in the lead-up to MEPS in other markets).

This gives an undiscounted benefit/cost (B/C) ratio of 8.4 from the perspective of end users – ie the benefit to householder is 8.4 times the cost. If the future stream of purchase expenditures and the future stream of energy cost savings are both discounted by 10% (the discount rate generally used to evaluate energy efficiency programs in Australia) then the B/C ratio falls to 4.2 (Table 24). This is an extraordinarily high ratio by international standards: the comparable ratio for Australia's National Appliance and Equipment Energy Efficiency Program (NAEEEP) is 1.7, and new programs with B/C ratios as low as 1.0 are now being implemented.

The robustness of these conclusions can be determined by testing the limits of price increase and discount rates at which the MEPS program would still be cost effective. It would be cost-effective up to a 42% increase in average refrigerator prices (indicated by

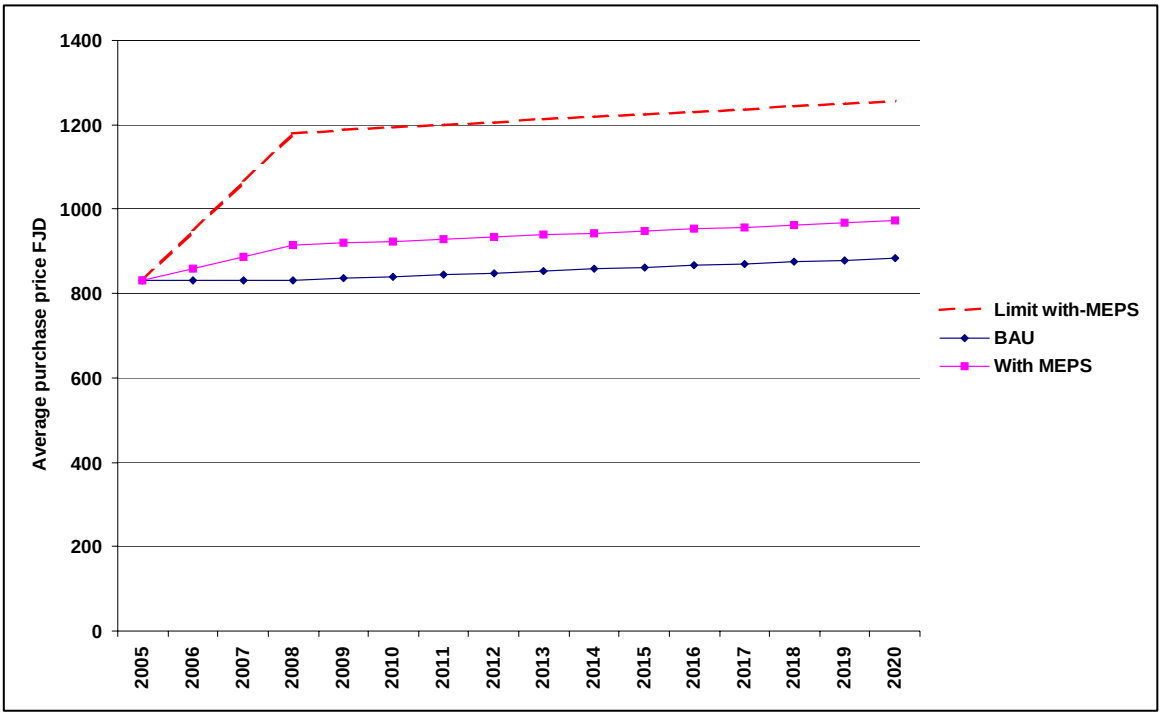
the upper 'limit' line in Figure 12), more than 4 times the likely maximum increase. At a 10% price rise (considered the maximum probable) the program would still be cost-effective at a discount rate of 80% - ie even if buyers (as a group) placed a very low value on future energy savings.

Table 24 Summary of projected costs and benefits of refrigerator MEPS, consumer perspective

Increase in average purchase price	10%	10%	10%	42%(limit)	10%
Discount rate	0	5%	10%	10%	80%(limit)
NPV of projected savings, F$ million	164.3	69.7	$37.2	33.8	0.5
NPV of projected costs, F$ million	19.5	12.2	$8.9	33.8	0.5
Net benefit, F$ million	144.8	57.5	$28.3	0.0	0.0
B/C ratio	8.4	5.7	4.2	1.0	1.0
Comparable B/C ratio, Australia (a)	2.3	2.0	1.7	NA	NA

(a) For whole of National Appliance and Equipment Energy Efficiency Program

Figure 12 Projected BAU, with-MEPS and 'limit' purchase prices for refrigerators in Fiji, 2005-2020



Societal benefits and costs

The preceding section analysed costs and benefits from the perspective of end users, who pay retail prices for refrigerators and retail tariffs for electricity.

However, it has been demonstrated that domestic electricity tariffs are not fully cost-reflective, and the cost to the Fiji economy of supplying an additional kWh, generated by diesel, is significantly higher than the tariff received by the FEA.

At the same time, the cost to the Fiji economy of importing a more expensive refrigerator is not the retail price but the wholesale value declared for customs purposes. The retail price is generally about twice this value, but the difference consists of transfer payments within the Fiji economy, ie:

- Duties and charges (3% import duty and 12.5% Value Added Tax);

- Retail markups – these are transfers from buyers to intermediaries such as retailers, advertisers and suppliers of transport services within Fiji.

From a societal perspective, then, the value of energy savings are *higher* than from the end user perspective, and the costs of MEPS are *lower* than from an end user perspective.

However, there are also cost associated with setting up and administering a mandatory labelling and MEPS program, and these are discussed below.

There may also be additional benefits available for Fiji from designating MEPS as a Clean Development Mechanism (CDM) program, and so creating a stream of saleable carbon credits.

Administrative arrangements and costs

The stages in developing and establishing a MEPS and energy labelling regime for Fiji are set out in *Standards and Labelling Program in Fiji: a Preliminary 5-Year Roadmap* (CLASP 2005a).

The main costs are:

- On-going administrative costs (ie the salaries and on-costs of staff in the FDOE or elsewhere responsible for developing legislation, administering the program, providing a registration service, checking compliance in the field etc). A preliminary estimate for the purposes of this study is FJD 100,000 per annum in the first 3 years, falling to FJD 50,000 per year thereafter.

- The costs of establishing a database of refrigerators and freezers: this cost could be minimised by making use of the existing electronic register which supports energy labelling and MEPS in Australia and New Zealand. The database already distinguishes product availability on a regional basis, and could easily be adapted to

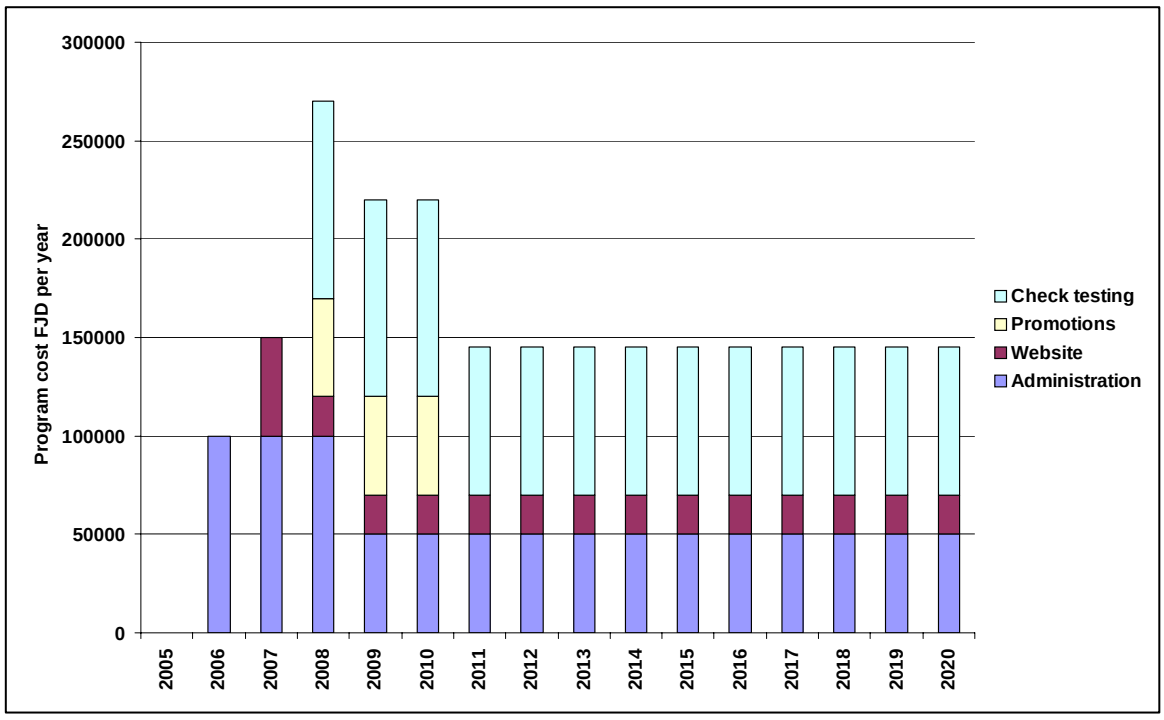
indicate model availability in Fiji. Suppliers, administrators and prospective appliance buyers located in Fiji would access the register (located in Australia) via the internet. The welcome page would be tailored to Fiji, and product searches would give only models available in Fiji. It is estimated that this capability would cost about FJD 50,000 to set up and FJD 20,000 per year to administer. The Australian Greenhouse Office has indicated its willingness to cooperate on this project.

- The cost of publicising the establishment of mandatory energy labelling to retailers and the general public. Energy labelling per se is not expected to drive the energy savings from the program but mandatory labelling would be an important means of ensuring and checking compliance with MEPS. Also, promotion of labelling should increase user responsiveness to other energy efficiency programs over time. Based on the media costs reported in FDOE (2004) it is estimated that this campaign would cost about FJD 50,000 per year for 3 years.

- The costs of carrying out compliance checks on product sold in Fiji. It will be very important, especially in the early years, to have a reasonable level of check testing, otherwise suppliers and the general public will lose confidence in the program. In particular, those responsible suppliers who comply will complain if they become aware that other suppliers are not complying, and the program could collapse. As products will have to be shipped to Australia or New Zealand for testing, there will be shipping costs as well as test laboratory costs. It would be reasonable to budget FJD 100,000 per year for the first 3 years, perhaps falling to FJD 75,000 thereafter.

The total projected total administrative costs are indicated in Figure 13. It is assumed that the Fiji Government makes the decision to implement MEPS in 2006, but MEPS actually take effect in 2008. Although these are significant amounts, they are very small in comparison with the other costs and benefits of MEPS.

Figure 13 Projected program costs by year



Carbon savings

MEPS and labelling would reduce the emission of greenhouse gases by reducing the combustion of diesel fuel in Fiji. The greenhouse gas intensity of diesel generation in Fiji was recently calculated by EcoSecurities (2005) which documented the Vaturu and Wainikasou Hydro developments as Clean Development Mechanism (CDM) projects.

It was estimated that each MWh of generation from hydro would displace diesel, for a net reduction of 0.66 t CO_2. Given that energy efficiency programs avoid transmission and distribution losses as well, each MWh of electricity consumption avoided would save about 10% more, ie about 0.73 t CO_2.

The emissions associated with the energy savings from MEPS and labelling in Figure 11 would be about 6.7 kt CO_2 in 2010, 15.7 kt in 2015 and 25.2 kt in 2020. The future market value of carbon credits in Kyoto signatory countries is difficult to predict, but at a nominal value of 20 FJD/tonne (10 USD/tonne) the income (to the Fiji Government or the FEA) from the carbon credits created by MEPS could reach about FJD 130,000 per year by 2010 and FJD 310,000 per year by 2015: about the same order of magnitude as the program administration costs.

Projected Costs and Benefits

The projected streams of societal costs and benefits is illustrated in Figure 14. Four levels of benefit as shown: valuing electricity supplied at the tariff, and at 3, 6, and 9 c/kWh higher than the tariff. Given that the domestic tariff appears to fall short of recovering supply charges alone by between 3 and 6 c/kWh, the higher savings values are more likely. Figure 14 also indicates how small the projected appliance cost increases and administrate costs are in comparison with the projected benefits.

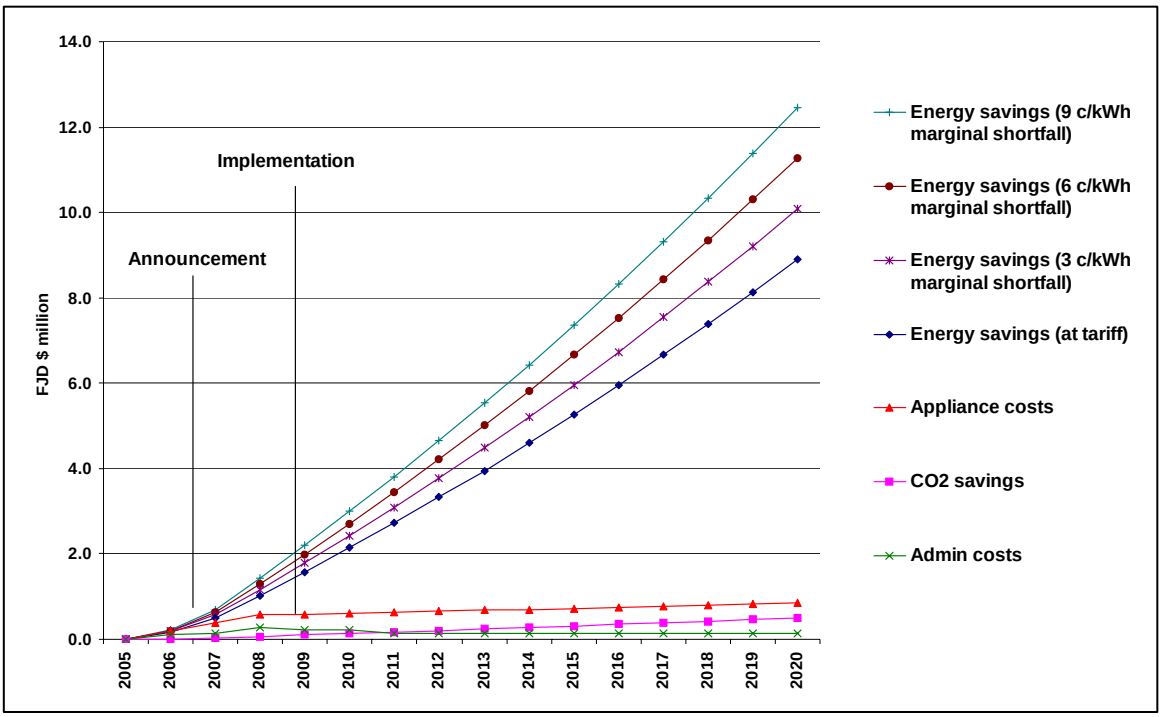
Table 25 summarises the NPV of costs and benefits under the different energy process. If energy is valued at the cost of supply rather than at the tariff paid by consumers, the benefit/cost ratio of the MEPS program is about 9.4, compared with 4.2 from the consumer perspective (at the same 10% discount rate).

Table 25 Summary of projected costs and benefits of refrigerator MEPS, societal perspective

	Consumer perspective	Societal perspective			
Basis of energy savings valuation	Domestic Tariff (a)	Domestic Tariff	Tariff + 3c/kWh	tariff + 6c/kWh	tariff + 9c/kWh
NPV of projected savings	37.2	$37.2	$42.1	$47.0	$52.0
NPV projected CO2 savings	NA	$1.4	$1.4	$1.4	$1.4
NPV Projected appliance costs	8.9	$4.5	$4.5	$4.5	$4.5
NPV projected program costs	NA	$1.3	$1.3	$1.3	$1.3
Total benefits	37.2	$38.6	$43.5	$48.4	$53.4
Total costs	8.9	$5.7	$5.7	$5.7	$5.7
Net benefits	28.3	$32.9	$37.8	$42.7	$47.7
B/C ratio	4.2	6.8	7.6	8.5	9.4

All values millions FJD Net Present Value at 10% discount rate. Appliance costs at custom declared value. (a) From Table 24

Figure 14 Projected societal costs and benefits of refrigerator MEPS, Fiji



Conclusions

Energy labelling does not appear to be very effective at present in encouraging refrigerator buyers in Fiji to prefer more energy-efficient refrigerators. The fact that labelling is not mandatory is only part of the reason – in fact labelling rates are relatively high for a voluntary program, because so many models are imported from New Zealand or Australia with their labels already attached.

The more significant reasons for the limited impact of labelling are:

- Fiji appliance buyers appear to be very motivated by first cost, so lower running costs have less impact on their purchase decision even if they are aware of the label;
- The electricity tariffs faced by many domestic consumers are well below the costs of supply, so consumers under-value running costs in their purchase decisions;
- The range of models on the market is smaller than in Australia or New Zealand, so there are fewer opportunities to make a decision among 2 or 3 equally acceptable models on the basis of energy efficiency.

Consumer (and supplier) information programs will probably increase comprehension and use of the energy label/ However, the main market barriers will not be overcome by mandatory energy labelling alone. Mandatory Minimum Energy Performance Standards (MEPS) would also be required. The regulatory and administrative infrastructure for implementing MEPS is almost identical to that for mandatory energy labelling, so both could be implemented at the same time, particularly as the information and infrastructure to support the programs is already in place in Australia and New Zealand. Mandatory labelling would be an important and highly cost-effective means of encouraging suppliers to comply with MEPS, since tracing product suppliers and verifying performance claims would be far easier.

A share of ANZ-made refrigerators on the Fiji market will probably meet the ANZ MEPS levels adopted in January 2005 within a few years. However, this will probably not apply to models made in other countries, or to the large part of the market that still purchases Group 4 (cyclic defrost) models.

To bring these up to the ANZ MEPS levels it will be necessary for Fiji to implement the same mandatory MEPS as Australia and New Zealand. There may be some variation to this, in that the Group 4 models that are still widely sold in Fiji are no longer sold in ANZ, so slightly modified Group 4 product standard (eg not requiring internal temperature criteria to be met at 10°C, which is lower than would be encountered in Fiji) may be considered, if that provided a more cost-effective route for supplies to meet the MEPS level.

The projected economic benefits of MEPS greatly exceed the projected costs, both for refrigerator buyers and for the Fiji economy as a whole. Indeed, given that the marginal generation fuel is diesel, and that the marginal electricity tariff appears to be well below the cost of supply, each kWh avoided has a higher value to the economy than to the

individual householder. In effect, it is far less costly for the Fiji economy to import more efficient refrigerators (and other electrical appliances) than to import diesel fuel.

MEPS would still be cost-effective for almost all householders, even at current tariff levels and even if refrigerator prices rise. The upper bound of price rise is estimated at about 10%, although it will probably be much less than that. If the Government wishes to avoid any possibility of price rises, there would be scope for reducing the cost burden by transferring some of the economic benefit to refrigerator buyers. For example, it would be cost-effective for the FEA to directly subsidise the import price of MEPS-complying refrigerators so that they cost no more than the non-complying models that would be excluded from the market by MEPS. The resulting reduction in diesel fuel costs would be greater than the costs of subsidy.

At the societal level, the administrative cost of MEPS are estimated at about 20% of the total costs – the other 80% is increased refrigerator purchase costs. However, the administrative costs could be offset in full if the MEPS program could be accredited to produce carbon credits under the Clean Development Mechanism. Alternatively, some or all of the administrative costs could be recouped from development funding, since the MEPS program would have a unique combination of economic, environmental and consumer benefits.

This report has concentrated on domestic refrigeration only, since at the time of writing there were not enough data available to carry out an equally rigorous analysis for other products. Domestic refrigeration is particularly important in Fiji, accounting for over half of domestic electricity use.

There are at least two other product groups which account for significant shares of electricity use in Fiji, and which are covered by MEPS in Australia and New Zealand:

- air conditioners, which account for about 8% of household electricity and 39% of commercial sector electricity use; and

- commercial refrigeration and icemaking equipment, which accounts for about 11% of commercial sector electricity use.

These should also be considered for MEPS, once the regulatory and administrative infrastructure is in place. However, it may be advisable to commence with refrigerators, since most suppliers are familiar with both labelling and MEPS and compliance should be achievable at relatively low cost.

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Appendix 1 Executive Summary of 1996 Baseline Study

Background

For most types of electrical equipment, there is a wide range in the energy-efficiency of the products on the market. It is possible for governments to influence the market so that both product suppliers and buyers favour more energy efficient products. This study describes two of the ways in which this could be done by Pacific Island Countries: energy labelling and Minimum Energy Performance Standards (MEPS).

Energy labelling is a system which allows buyers to compare the energy efficiency of the products they are considering purchasing. Information on how much energy a model uses, and how this compares with other models, can be included in a prominent label or tag attached to the product itself. In this way buyers will see it when they go to a store or showroom where appliances are displayed. The same information could also be included in product brochures and advertisements, so that buyers become aware of it even if they do not visit a showroom.

Buyers will use the label to look for more energy efficient products if they believe that they will be better off. A more efficient product may cost a little more to buy than a less efficient one (although this is not always the case) but this is still worthwhile if the running costs are low enough.

Energy labelling provides buyers with information that is consistent and reliable, but does not force suppliers to introduce more efficient products or to remove less efficient ones from the market. MEPS, on the other hand, sets a legally enforceable minimum level of energy efficiency. Labelling and MEPS programs can and do work together. The USA and Australia, for example, have both programs operating in parallel.

For labelling and MEPS to work efficiently together, they should have the same legal basis and administrative structure, and rely on the same energy tests. Once a labelling program is in place, the cost of implementing MEPS is marginal, and once MEPS are in place, the cost of implementing labelling is relatively.

This study

This study was commissioned by the Forum Secretariat Energy Division, to gather information needed to make decisions on the establishment of a labelling program on a regional (or sub-regional) basis. The study was to provide an assessment of the most efficient way to develop a uniform labelling scheme and of the appropriate stringency of MEPS for the selected appliances.

The Forum Secretariat Energy Division nominated three countries for direct participation in the study: Papua New Guinea, Fiji and Tonga. The authors visited those countries and held extensive discussions with representatives of government departments and agencies, the electricity utilities, and a wide range of appliance retailers and contractors.

In order to gather information on Forum members who are not participating directly in the study, the authors prepared a questionnaire for those countries and reviewed the ten

Demand Side Management Potential Study reports prepared for the Forum Secretariat in 1995 by SRC International, and other documentation.

The results of those questionnaires, and some data requested from the countries visited, was still outstanding at the time of writing this draft report. Consequently the formal cost-benefit analysis is incomplete, and will be included in the final report. This draft report concentrates on the important issues of feasibility and practicality, which do not depend on minor variations in the projections of costs and benefits.

Conclusions

The implementation of energy labelling and/or minimum energy performance standards (MEPS) for selected appliances appears to be feasible for countries in the Pacific region.

Appliances of the type which are subject to labelling and MEPS elsewhere in the region, notably Australia, account for a significant share of both residential and commercial sector electricity use in the Pacific Island Countries (PICs).

Many of the models sold in the PICs have already been tested for energy labelling in Australia, and indeed many are imported with energy labels attached. This provides a solid base for the introduction of energy labelling and/or MEPS.

Apart from encouraging PIC markets towards more energy efficient products, labelling would also bring other benefits to consumers. It would lead to greater consistency in supplier statements about product capacity and size, and establish minimum levels of performance and suitability for the task. It would encourage consumers to consider energy efficiency and other aspects of quality in their purchases and to base their decisions on total costs and not just purchase price.

Given the close connections between the appliance markets in most PICs and those of Australia and New Zealand, the only practical option appears to be the adoption of the Australian energy labelling program. This is the case in Papua New Guinea, Fiji and Tonga and is likely to be the case in most other PICs. However, it may not be the case for some PICs, which have historical links to other appliance-exporting countries.

If the Australian program were adopted, the costs of implementation to both consumers and governments could be kept reasonably low. There would also be opportunity to share administrative costs between participating PICs, and with Australia and New Zealand. The local costs for each country would be sensitive to how many other countries adopt the program and agree to share administrative costs.

Most appliances are used in essentially the same way as in Australia (eg refrigerators, freezers, clothes dryers, water heaters) so the Australian energy tests and labels are appropriate. Air conditioners tend to be used more intensively in the PICs, so additional information emphasising the importance of energy-efficient choice should be made available. Clothes washers are used in less energy-intensive ways in the PICs than assumed for the energy test (eg cold wash is common and clothes are usually line dried) so the energy label is not relevant to most customers.

For products where labelling is introduced, it should be universally required, so that all models carry labels. If labelling were optional it is likely that suppliers would not label the least efficient models. This would greatly reduce the value of the program, since buyers could not identify and avoid the least energy efficient models, and suppliers would have little incentive to remove them from the market.

The objective of universal energy labelling is best achieved through legislation, so that it applies equally to all suppliers, rather than as a "voluntary" program. The PICs we visited could use existing consumer protection legislation or electricity product approvals regulation, with some modification, to achieve this objective.

The key administrative element of energy labelling and MEPS is a comprehensive and up to date register of the tested energy consumption of all current models. Such registers could be set up by each participating PIC, but common arrangements would greatly increase efficiency and reduce costs.

The least costly way to establish the register would be to accept energy tests and other product data submitted by suppliers. The data should be subject to random check testing and verification.

While registration, the production of lists of labelled appliances and other administrative functions can be handled through common arrangements, other tasks such as publicity support, local compliance monitoring and integration with other energy programs can best be handled by each PIC separately. The overall success of labelling in each PIC will depend largely on the degree of local support it receives.

The legal and administrative basis established for energy labelling could also be used for the implementation of Minimum Energy Performance Standards.

The intended adoption of MEPS for some products in Australia and New Zealand means that there is a case for PICs to adopt "defensive" MEPS for the same products, so that the less efficient models are not diverted to PIC markets. This case has been strengthened by the decision of New Zealand not to adopt MEPS for refrigerators and freezers for the time being. This creates a larger regional market for products which fail to meet the Australian MEPS, and increases the likelihood that more will be sold.

It would be costly and impractical for the PICs to develop their own labelling or MEPS regimes for products which are not subject to labelling or MEPS elsewhere in the region. PICs should hold off further consideration of MEPS and/or labelling of those products which are still under consideration in Australia or New Zealand; the situation with those products should be clarified by mid 1997.

Because PIC government and public authorities account for a comparatively large share of their country's electricity consumption, they can strongly influence the appliance market by setting minimum energy performance standards for their own purchases, even without legally binding MEPS.

Three program scenarios have been analysed in detail for each of the three PICs visited. Under the assumptions used in our analysis all three program scenarios (MEPS only,

MEPS plus labelling, and Labelling) appear to be cost-effective in Fiji, PNG and Tonga, even at the highest discount rate analysed (10%).

There is no clear basis for preferring one scenario to another on the basis of cost-benefit analysis. Although the scenarios which include labelling appear to be more cost-effective, those which include MEPS are likely to deliver higher total benefits.

In each scenario, it is projected that the value of energy savings will be offset by a slight increase in the purchase price of appliances. This increase is likely to be the major program cost: administrative costs, though significant to governments, are likely to be smaller in comparison.

For PICs as a group, under Scenario 1 (MEPS only) electricity consumption in 2012 would be about 9% lower than in the base case, under Scenario 2 (MEPS plus labelling) it would be about 20% lower, and under Scenario 3 (labelling only) it would be about 16% lower.

Recommendations

1. Regulatory Framework

It is recommended that Pacific Island Countries review their existing consumer or electrical approvals regulations to establish whether they provide an adequate regulatory framework to require mandatory energy labelling and minimum energy performance standards, as described in this study.

2. Basis of Program

It is recommended that the energy tests and label formats of the Australian energy labelling and MEPS programs be adopted as the technical basis for energy labelling and MEPS in Pacific Island Countries.

3. Phased Implementation

MEPS and labelling would share a common administrative framework. This gives the opportunity to develop programs in phases. The following phases are recommended (in this context "PICs" mean the sub-group of PICs which decide to participate in the program):

1. request all ANZ-based manufacturers and importer of refrigerators, freezers and air conditioners to ship all their products to PIC markets with the correct Australian energy label affixed: this should rapidly increase the visibility of labels (this in fact represents a low-cost, low-benefit program scenario which has not been modelled);

2. establish a mandatory PIC-specific register of appliances, to which appliance suppliers will need to submit energy test results and other product details (alternatively, registration could be non-mandatory, but a requirement for all government agency purchases);

3. after the register is operating effectively, establish mandatory energy labelling and/or MEPS for selected appliances (see following table for recommended strategy for each appliance).

4. Appliance Coverage

It is recommended that the following approach to labelling and/or MEPS be adopted for each specific appliance type:

Table A1 Summary of Recommended Labelling and MEPS Approaches

Product	**Labelling**	**MEPS**
Household size refrigerators and freezers	Adopt labelling as is; consider additional "best of type" labels	Adopt Australian MEPS levels, to take effect at same time (1999)
Household size air conditioners (to 7.5 kW cooling capacity)	Adopt labelling as is; consider publicising greater benefits of energy efficiency in PICs	Consider MEPS after register is established, and there is complete stock data
Commercial size air conditioners (7.5 to 65 kW)	No labelling for time being: reconsider after Australian study complete (early 1997)	No MEPS for time being: reconsider after Australian study complete (early 1997)
Electric storage water heaters	No labelling for time being	Units manufactured in Australia or NZ should meet home country MEPS levels in force at the time. Others should meet whichever is less stringent of Australian and New Zealand MEPS levels
Clothes dryers	Do not enforce labelling; allow optional use of Australian label, subject to registration	No MEPS
Dishwashers	Do not enforce labelling; allow optional use of Australian label, subject to registration	No MEPS
Clothes washers	Do not enforce labelling; allow optional use of Australian label, subject to registration	No MEPS
LPG water heaters	Do not enforce labelling; allow optional use of Australian label, subject to registration	No MEPS
Solar water heaters	No labelling	No MEPS
Electric cookers	No labelling	No MEPS
Electric motors (0.75 to 150 kW)	No labelling for time being: reconsider after Australian study complete (end 1996)	No MEPS for time being: reconsider after Australian study complete (end 1996)
Office equipment (computers, screens, printers, faxes, copiers)	No labelling for time being: reconsider after Australian study complete (end 1996)	No MEPS (rejected as option in Australia)
Fluorescent lamp ballasts	No labelling (rejected as option in Australia)	No MEPS for time being: reconsider after Australian study complete (end 1996)
Tubular fluorescent lamps	No labelling	No MEPS for time being: reconsider after New Zealand makes decision (probably 1996)

5. Consultations

Pacific Island Country governments should consult with each other, and with other stakeholders including suppliers, government and non-government organisations.

The following steps are recommended, once PIC governments have considered this report and formed a view about whether they wish to pursue labelling and/or MEPS:

1. Hold a first meeting of government agencies and electricity utilities from interested PICs, to agree in principle on areas of coordination and harmonisation;

2. Hold a meeting between interested PICs and regionally significant product suppliers, importers, trading houses and retailers, after first distributing an information paper based on this report;

3. Interested PICs should contact smaller, local operators in their own countries by the most effective means (letter, advertisement, personal visit etc) and get feedback on issues;

4. Hold a second meeting of government agencies and electricity utilities from interested PICs, to review feedback, finalise areas of coordination and harmonisation. and develop implementation timetable;

5. PIC governments should consider implementation, and those interested in participating should develop complementary regulations (if regulatory approach adopted).

6. Implementation and Publicity Plan

The following implementation and publicity plan is recommended.

- PICs to jointly agree target implementation dates. For registration and voluntary labelling by ANZ suppliers, this should be about one year (say end of 1997), for mandatory labelling a further year (say end of 1998). For MEPS, implementation should be harmonised with Australia (end of 1999);

- PICs to set up common registration and check testing arrangements;

- Each participating PIC to develop own publicity plan and materials;

- PICs to develop common guide formats;

- Each PIC to print own guides, with energy tariffs and other features appropriate to their home markets (based on common format and model listings produced from register), and distribute as required;

- Each PIC to develop and run own launch publicity campaign;

- Each PIC to set up own monitoring and compliance framework.

7. Public Sector Purchase Policies

PICs should incorporate energy efficiency requirements for government and public authority purchases of air conditioners, refrigerators and freezers. These would involve analysing alternative products in terms of life cycle costs, not just purchase costs, and selecting the most economically favourable option.

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Appendix 2 Conclusions from FDOE 2004 Study

Conclusion

Some important observations as provided below were drawn from this pilot project.

[a] The time to implement a project is critical to the programme's success

The changing environment encountered during the programme implementation affected the programme's completion. The programme suffered some setbacks caused by the political upheavals of May 2000. The political unrest delayed the implementation schedule considerably, resulting in the programme being put on hold until 2001. The enthusiasm shown by retail stores during the initial period on the project dwindled as retail stores concentrated more at trying to keep their operations from closing down as they were experiencing low sales in 2000. The revision of the energy rating labels in the Australian and New Zealand market also affected the commencement of the implementation schedule as most of the appliances sold in the Fiji market are imported from Australia and New Zealand.

[b] Team work and commitment from team members are important ingredients for the programme's success.

The programme required the involvement of retail stores, overseas manufacturers, and the general public with overall co-ordination by the Department of Energy and support from SOPAC. The overseas manufacturers were very supportive and provided the required information on time. However it was found that despite the retail stores commitment on the "Appliance Labeling Programme" one of the participating retail stores, Courts Fiji Ltd, had an extensive promotional campaign on the local TV programme for a non-energy labeled brand of refrigerator called "*Mabe*". Additionally retail Stores continue to display appliances containing the old energy labels and a number of appliances without any energy rating label at all. This category of appliances represented 38% of all appliances surveyed. It followed that 62% of the appliances surveyed were labeled with the new energy rating label.

It was also found that retail stores at times do not provide the required information on time and in some cases do not provide information at all. Some form of incentives for the retail stores for their participation would have assisted in such a situation. However it clearly showed that a stringent measure through mandatory processes is essential to assure compliance to the energy labels.

There are a number of related program measures that increase the effectiveness of an energy label. These include:

- retailer support for the program
- government promotion of the program (e.g., annual efficiency awards);
- publication of lists of current models on the market – (e.g., a brochure and an Internet site that are easily accessible); and

- point-of-sale information and support.

[c] Lack of understanding on energy labels

The survey revealed that customers including sales staff in retail stores were really not aware of the significance of the energy rating label and its impact on their household energy bill. Generally speaking bigger appliances with more features are more energy efficient as compared to smaller ones. The higher capital cost associated with these more energy efficient appliances is often offset by the long run operational cost and generally there appears to be a lack of understanding by customers of this aspect.

It was also noted that a customer's choice of an appliance was based more on its price as compared to other features of the appliance. The initial capital cost as opposed to the long run operational cost of the appliance ranked the highest influential factor for a customer's decision to purchase a particular appliance.

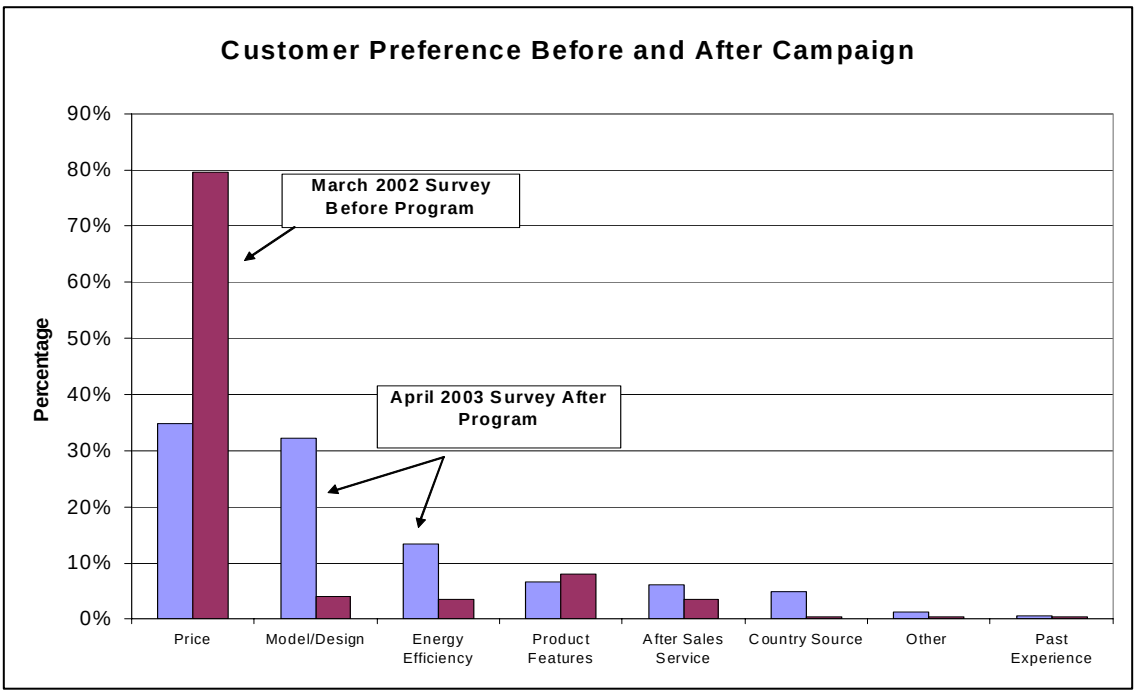
[d] Limited time frame for public awareness and the use of appropriate modes of information dissemination

Clearly the one month time frame for awareness of the energy label was not sufficient. Despite the awareness campaign through advertisements and information dissemination through the retail stores' sales personnel, it was found that customers still lack the basic understanding of the energy rating label and its potential benefits. Customers as evident from the survey result were still being influenced by the price tag.

Disseminating information through TVs, Village 6, and retail stores were limited to people that have access to such medium during the awareness campaign. Providing information in vernacular and using other modes of information dissemination such as radios would have assisted consumers awareness on energy labels.

[e] A change in purchase decision

The price of an appliance during the pre and post-launch was the most influential factor to a customer's purchase. Refer Graph 4 below. Though there is a drop in percentage, this is more-so due to the scale of the two surveys. The results indicate relative preferences do not differ much between the two periods. However it is interesting to note from the survey the change in factors influencing consumers purchase for an appliance. Other factors such as model, energy efficiency, product features, etc. were considered important prior to purchasing. In other words the contributing factors for a purchase has widened after the awareness. However these contributing factors have not had any big impacts due to the limited time frame for awareness on energy labels.



Recommendation

The pilot program has indicated the willingness of the relevant stakeholders to participate in the program. However for the energy labeling program to be effective there needs to be some mechanism to ensure that manufacturers, distributors and retailers comply. **It is recommended that the Department of Energy pursue energy labeling of refrigerators and freezers on a mandatory basis with the inclusion of minimum energy performance standards for these appliances.**

The mandatory process will take a number of years and it is imperative that a ***project document*** be developed to map out the ways and means of achieving this. An important component of the mandatory program is to focus on public awareness. As noted from the pilot project public awareness is crucial to the promotion of energy efficiency and conservation measures to the general public. Research has shown that education and promotion are valuable aids in making the label effective. Promotional marketing is most effective when consumers are subject to numerous consistent messages regarding energy efficiency, not just as part of the energy labeling program but also in other, related energy programs that may be running in parallel. This reinforces a culture of energy efficiency among consumers and industry and helps to create an energy efficiency ethic within the country.

Energy efficiency and conservation is not an easy concept to understand, therefore the awareness programme ought to be focused and ongoing rather then being a one off-event, efforts must be directed at ensuring the continuity of the awareness programme to ensure that the message reaches out to the wider community.

The sales staff at the market place or point of sales have an important role to play in the dissemination of energy efficiency and conservation information to consumers. Thus it

is essential that these sales staff are well versed with the features of the appliances they are selling including their energy efficiency ratings.

As part of the mandatory energy labeling program a firm commitment through Cabinet approval is to be obtained for the mandatory programme to be developed and implemented.

It is also important to consider the monitoring, verification and enforcement process to assess the extent to which labels are not displayed on products and to verify claims made on an energy label (in terms of capacity, performance and energy consumption). Violation of the labeling requirement must be penalized to discourage continued violation and independent testing processes established to verify claims on an energy label.

The pilot programme may be extended to other Pacific Island Countries (PIC), taking into consideration the Fiji experience but it is recommended that any replication to other PICs to focus on the mandatory labeling program and to be implemented bilaterally (ie country with SOPAC/donor). Promoting the use of energy labeling to other PICs offers great opportunity to ensure that only energy efficient appliances are available to consumers.