FINAL

Electrical Appliance Energy Labelling and Minimum Energy Performance Standards for Pacific Island Nations:

Baseline Study

Report to the

FORUM SECRETARIAT ENERGY DIVISION

by

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and

Energy Efficient Strategies

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Executive Summary

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 34 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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Abbreviations

AC	Air Conditioner
AGA	Australian Gas Association
AHAM	Association of Home Appliance Manufacturers (USA)
ANZ	Australian and New Zealand (as in description of an ANZ common appliance market)
DSM	Demand Side Management
EC	European Community
EECA	Energy Efficiency and Conservation Authority (New Zealand)
EPA	Environmental Protection Agency (US)
F&P	Fisher and Paykel (New Zealand-based appliance manufacturer)
FDOE	Fiji Department of Energy
FEA	Fiji Electricity Authority
FSED	Forum Secretariat Energy Division
FTC	Federal Trade Commission (US)
FTSE	Full time staff equivalent
GWA	George Wilkenfeld and Associates
ISO	International Standards Organisation
MEPS	Minimum energy performance standards
NAEECC	National Appliance Energy Efficiency Coordinating Committee (Australia)
NAEEAP	National Appliance Energy Efficiency Advisory Panel (Australia)
NAFTA	North American Free Trade Association
PICs	Pacific Island Countries
PNG	Papau New Guinea
SEDA	Sustainable Energy Development Authority (New South Wales)
SRCI	SRC International (author of Demand Side Management Potential Study reports)
TRC	Total Resource Cost
UNDP	United Nations Development Program
USDOE	United State Department of Energy
WH	Water heater

1 Introduction

1.1 Background to the Study

For most types of electrical equipment, there is a wide range in the energy-efficiency of the products on the market. For some products the market is clustered into different types of technology, each with its own energy and cost characteristics. An example is the lamp market, with fluorescent, compact fluorescent and incandescent types. In other cases all models use the same basic technology, but there are more energy efficient products, distinguished by better quality components, thicker insulation or simply by more careful design and manufacture. This is true of the refrigerator and air conditioner markets.

The average level of energy-efficiency for each product type in a particular market (local or national) is determined in a complex way through the decisions of both suppliers and buyers. However, it is possible for agents such as 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 (PICs): energy labelling and Minimum Energy Performance Standards (MEPS).

1.1.1 Aims of Labelling and MEPS

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. an indicator of the energy efficiency of each model in relation to the other comparable models on the market at the same time (eg by visually indicating its position along a line from “most” to “least” energy efficient, as in the United States appliance labelling program);

3. an indicator of the energy efficiency of each model in relation to a mathematical algorithm such as litres of refrigerated space per kWh of annual electricity consumption (eg by means of a star rating, as in the Australian appliance labelling program);

4. a “pass” 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 in the USA).

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 guide or a register, 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 greater 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). 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 will be distributed to many PIC markets with different currencies and energy tariffs, so it is impossible to ensure that the running cost data on a 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.

For these reasons it is not practical to include a single running cost value on the energy label. The US appliance energy label has a cost matrix to help buyers calculate the running cost for a range of tariffs, but consumer research in Australia has shown this to be more confusing than helpful. A more practical approach is to list the running cost for each model in guidebooks or brochures produced for each specific market. These brochures are valid only for a limited period, because the range of models on the market is always changing.

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, and could add to costs if the products have not already been energy tested. This could lead less scrupulous suppliers to:

- under-state the energy consumption of the products;
- produce entirely fictitious labels for products that have never been energy tested;
- reduce other aspects of product performance in order to get a good energy rating: for example, by producing refrigerators that do not keep food as cold, or washing machines that do not wash clothes as clean.

The incentive to mis-label will be much reduced if there is an effective compliance and checking regime, backed with appropriate legislation. The incentive to degrade product performance can be removed by tying the energy aspects of labelling to performance standards. For example, major appliances in Australia cannot be energy labelled unless they meet the performance requirements of the relevant Australian Standard, and they cannot legally be sold without a label.

Energy labelling works best within technology types and fuel types. It is difficult to set up a labelling system that encompasses both gas and electric heaters, for example, or that covers all types of electric water heater technology: instantaneous, storage, heat pump or solar with electric boost. This is not a problem, since those buyers who have a choice usually select their energy form (gas, electric or solar) before deciding on the specific appliance. Where some technology types cost much less to run than others (eg solar water heaters) this can be communicated through general energy information channels in a much simpler way than through an energy label.

Energy labelling also 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.

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 increases 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.

Minimum Energy Performance Standards (MEPS), on the other hand, sets a legally enforceable minimum level of energy efficiency. There are two approaches to setting MEPS levels:

- "low-level" MEPS are set so that most existing models pass, and only the least efficient are removed from the market. This creates an energy efficiency "floor" which protects consumers (and also responsible suppliers) from products of low energy efficiency;

- "high-level" MEPS can actively drive the market towards greater energy efficiency, by setting levels which few current models can meet. In extreme cases, no models at the time the MEPS levels are set can meet them.

The MEPS levels recently adopted for refrigerators and freezers in Australia are "low-level", since they would affect less than a quarter of the models on the market at present, and in any case suppliers have until September 1999 to withdraw or redesign any models that do not comply with the requirements. The MEPS levels adopted for electric storage water heaters in Australia are "high-level", at least for the Australian market. At present no products manufactured in Australia can meet them, but again, manufacturers have until September 1999 to comply. Furthermore, the Australian water heater MEPS levels are not particularly stringent by international standards: models meeting the 1999 Australian MEPS levels have been available in New Zealand and the USA since the late 1980s.

The most striking examples of "high-level" MEPS have been in the USA. In late 1989, when MEPS levels for refrigerators and freezers take effect in January 1993 were first announced, only 7 of 2114 models then on the US market would have complied. Yet by January 1993, there were even more models on the market than in 1989 and they all complied with the new rule.

The USA is the largest single appliance market in the world, and it supplied mostly by domestic manufactures with comparatively small levels of imports and exports. Manufacturers (and importers) had no choice but to meet the US MEPS levels if they wanted to retain market share in the world's largest market. By contrast, the Pacific Island Countries are small markets supplied almost entirely by imports. If they were to set more stringent MEPS levels than other countries, many importers may well withdraw from PIC markets altogether.

Interaction of Labelling and MEPS

Labelling and MEPS programs can and do work together. The USA and Australia, for example, have both programs operating in parallel, but with different emphases. Since the National Appliance Energy Conservation Act of 1987, the USA has used high level MEPS to drive energy efficiency for a wide range of products. Energy labelling is also mandatory for a range of products, but has not been well supported and has been relatively ineffective.

Australia, on the other hand, has had mandatory labelling for a range of appliances since 1986. A review of the program in 1991 found that it had been moderately effective in raising the efficiency of the most efficient on the market and in shifting consumer preference towards more efficient products, but that it had not been effective in eliminating poor energy performers (GWA et al 1991). There was still a large potential for cost-effective energy efficiency improvements which labelling was not able to capture, both in labelled products and in products not labelled. A MEPS program was the most promising way to capture this potential.

A study in 1993 found that it would be cost-effective to introduce MEPS for refrigerators, freezers, clothes dryers and electric water heaters (GWA et al 1993). Australian governments decided in 1995 to introduce MEPS for refrigerators and freezers, which are energy labelled, and for some electric water heaters, which are not labelled (clothes dryers were not included because the energy savings were small in comparison with the other products and the industry argued that there were difficulties with the energy test).

However, MEPS is seen as complementary to energy labelling, not a replacement for it. Australian governments are still committed to labelling, and are in fact considering enhancing the program and extending it to products not presently labelled. It is also possible for different types of labelling to coexist. The Victorian government gives a special "Galaxy Award" to products in the highest category of energy efficiency. Award winning models can carry the special Galaxy label, if their suppliers wish, but they must still carry the normal energy label as well.

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.

1.1.2 Current Labelling and MEPS Programs

Household Appliances

The USA has the world's most wide-ranging MEPS program for household appliances. Table 1 presents the products covered by the National Appliance Energy Conservation Act of 1987, and the years at which progressively more stringent MEPS levels are due to take effect. The levels are set by the US Department of Energy after a process of research and public consultation, and must be announced at least 3 years in advance of the date they are to take effect. Labelling is also required for some of these products.

Table 1 Scope of Labelling and MEPS Programs for Household Appliances, Selected Countries

Product		USA	Australia (b)		New Zealand		European Community	
		MEPS (a)	Labels	MEPS	Labels	MEPS	Labels	MEPS
Refrigerator	M	1990,1993	M, 1986	M, 1999	V	R	M, 1995	M, 1999
Freezer	M	1990,1993	M, 1986	M, 1999	V	R	M, 1995	M, 1999
Dishwasher	M	1988,1994	M, 1988	R	V		M (f)	
Clothes washer	M	1988,1994	M, 1990	R	V		M, 1996	
Clothes dryer		1988,1994	M, 1990	R	V		M, 1996	
Room AC	M	1990	M, 1987	R	V			
Central AC	M	1992						
Water heater	M	1990	UC,V(c)	M,1999	V(d)	M(e)		
Cooker		1990						
Furnace	M	1992	V(c)					
Direct heater		1990	V(c)					
Pool heater		1998						
Lamp ballast		1990		UC		M(e)		
8' fluoro tube		1994				M(e)		
4' fluoro tube		1995				M(e)		
Reflector lamp		1995						
Television		UC						

UC Under Consideration M Mandatory V Voluntary R Has been considered, but rejected for time being

(a) Year of first effect of Federally mandated MEPS, and year of latest update. MEPS levels are revised at predetermined interval. MEPS and labelling programs also cover gas- and oil-fired appliances where applicable.

(b) Labelling for some or all the electrical products indicated is mandatory in most States: year in which labelling first became mandatory in at least one state is given..

(c) Labelling of these gas appliances not required by law, but Australian Gas Association ensures high degree of compliance.

(d) Labelling of electric storage water heaters not required by law, but NZ Electricity Development Association ensures high degree of compliance.

(e) NZ Government announced intention in July 1996 to legislate for MEPS for these appliances.

(f) Not yet confirmed, but expected in 1997/98.

Given that most PICs source import nearly all their appliances from Australia and New Zealand (ANZ) rather than from the USA, developments in those countries are more relevant. The energy labelling of refrigerators and freezers first became mandatory in New South Wales in 1986, and in Victoria in 1987. Since then the labelling program has been extended to dishwashers, air conditioners, clothes dryers and clothes washers. It is now effectively a national program. Even though not all of the States and Territories have mandatory labelling requirements for all of the product types, few products in the categories covered by the program are now displayed for sale without an energy label, anywhere in Australia.

Australian energy labels are also seen on many ANZ-made electrical appliances displayed for sale in New Zealand and in Pacific Island Countries, even though this is not a legal requirement in those countries. The major regional manufacturers, Fisher & Paykel (F&P) and Email, do not attach energy labels to units which they know are destined for the PICs, but some smaller ANZ manufacturers and distributors cannot distinguish by final destination, and label all units. Also, some small retailers in the PICs purchase products not from F&P and Email direct, but from wholesalers or agents in other countries, and many Australian energy labels get through in this way.

It is understood that the NZ Energy Efficiency and Conservation Authority (EECA) is negotiating with appliance suppliers in New Zealand to increase the use of labels, although there are still no firm plans to make it mandatory there. New Zealand does have its own voluntary energy labelling program for electric storage water heaters, called the "WaterMark". This was developed in 1991 by the NZ Electricity Development Association, which administers the program.

Australia also has an energy labelling program covering gas water heaters, room heaters and central heaters. While not mandatory in the legal sense, gas appliance labelling is now required in the product approval codes enforced by the Australian Gas Association (AGA), which makes it mandatory in effect. There is no single electricity industry body in Australia which matches the AGA in universal coverage of both energy suppliers and equipment suppliers, so to the extent that universal electrical appliance labelling is a public policy objective, it must be (and has been) pursued by regulatory means.

Australia is implementing mandatory MEPS for refrigerators, freezers and electric water heaters, to take effect in 1999. New Zealand has also considered MEPS for refrigerators, freezers, electric and gas water heaters and gas and solid fuel space heaters (Energetics and GWA 1994b). Under the NZ building code, water heaters which meet the heat loss requirements of the New Zealand water heater standard NZS4606.1 (effectively WaterMark Grade A) will be required in all *new* installations from 1997. However, this is only a small proportion of the water heater market, which is dominated by replacement sales. NZ has announced that it will adopt MEPS for *all* electric storage water heaters, as

well as for fluorescent lamp ballasts and fluorescent lamps (*NZ Minister for Energy*, July 1996).

Another labelling program which may be of interest to PICs is that of the European Union (EC), since some products are imported from Europe (although no EC labels were seen during our visits and this is unlikely to ever occur - because EC energy labels can come in 10 languages, they are generally fitted in the country of sale). Mandatory energy labelling took effect in the EC in January 1995 for refrigerators and freezers, and in April 1996 for clothes washers and clothes dryers. In 1991 the EC made a commitment in principle to introduce MEPS as well, but the program has been much delayed because of disagreements between EC countries. The only EC-wide MEPS so far is for new hot water boilers using gas or liquid fuels with a rated output in the range 4 kW to 400 kW (adopted 21 May 1992 - Directive 92/42/EEC). There has been considerable discussion on MEPS levels for refrigerators and freezers, but no agreement as yet.

Other Products

As is evident from Table 1, labelling and MEPS programs for household appliances have been in operation for well over a decade in some countries. More recently, programs of this type have been extended to some of the equipment used in industry and commerce. Again, the USA has the most comprehensive set of programs. They now come within the scope of the Federal Energy Policy Act of 1992, although some program elements date from earlier legislation.

The Energy Policy Act expanded the role of the US Department of Energy (USDOE) in setting MEPS, and of the Federal Trade Commission, which administers appliance energy labelling (The US Environmental Protection Agency (EPA), not the FTC, administers the "Energy Star" program for office equipment). Table 2 indicates the current status of US MEPS and labelling programs for non-domestic equipment.
The US MEPS levels are progressively being adopted in Canada and in Mexico as well, through the influence of the North American Free Trade Alliance (NAFTA). The impact on other countries is not as great.

There has also been considerable work on the scope for such programs in Australia and New Zealand. A 1994 feasibility study for Australia (Energetics and GWA 1994a) found that the MEPS and labelling approaches listed in Table 2 appeared to warrant further study. Detailed research is currently under way on the costs and benefits of MEPS and/or labelling for electric motors, fluorescent lamp ballasts and packaged air conditioners, and firm recommendations concerning motors, ballasts and office equipment should be available by the end of February 1997. The Commonwealth and State governments will then be in a position to decide on implementation.

New Zealand has considered programs for the same range of products as Australia (Energetics and GWA 1994b). In July 1996 the NZ Government announced an intention to adopt MEPS for fluorescent lamps and lamp ballasts, but the details are still being worked out.

Table 2 Scope of Labelling and MEPS Programs for Industrial and Commercial Equipment, Selected Countries

Product	USA		Australia		New Zealand	
	Labelling	MEPS (a)	Labelling	MEPS	Labelling	MEPS
Motors, 0.75-150 kW	++	+	UC	UC	UC	UC
Motors, < 0.75 kW	UC					
Fluorescent lamps	++	+				UC
Fluoro lamp ballasts	++			UC		UC
Incandescent lamps	+	+				
Incand reflector lamps	++					
HI discharge lamps	UC	+				
Luminaires		+				
Packaged ACs	++	+	UC	UC		
Warm air furnaces	++	+				
Packaged boilers	++	+				
Plumbing fixtures	++	+				
Window systems		+				
Distribution transform	UC					
Computers	V		UC		UC	
VDUs	V		UC		UC	
Printers	V		UC		UC	
Fax machines	V		UC		UC	
Photocopiers	V		UC		UC	

UC Under consideration V Voluntary ++ Mandatory standards or labelling requirements established, although not necessarily in force yet. + Legislation in place, but standards or labelling requirements not yet established

Draft recommendations concerning an Australian national information program for office equipment, based on the US Energy Star label, have recently been made to the Commonwealth and State governments (GWA et al 1996). Information programs based on Energy Star have already been launched in New Zealand (by EECA, in September 1996) and in NSW (by SEDA, in November 1996). The Energy Star is rapidly becoming a de-facto global label for office equipment because of the highly integrated nature of the global computer and office equipment market.

1.1.3 Application to Pacific Island Countries

Most of the products listed in Tables 1 and 2 contribute to the demand for energy, and electricity in particular, in Pacific Island Countries (PICs). There may well be scope for labelling and MEPS programs to influence the markets for these products.

Existing Impacts

To some extent, energy labelling and MEPS programs in other countries already have some impact on PIC markets. Many of the large appliances sold in the PICs carry Australian energy labels. An inspection of two large department stores in Suva, Fiji in July 1995 revealed that about 8% of the refrigerators, 13% of the freezers and 38% of the washing machines on display carried the Australian energy label (Goldberg 1995). During the course of this study, several Australian energy labels were also observed in stores in Port Moresby, Papua New Guinea, in Nuku'alofa, Tonga, in Raratonga, Cook Islands, and in Kiribati.

For those countries importing appliances from Australia and New Zealand, the proportion of units with energy labels could quickly be increased. The major manufacturers could readily attach the same energy labels they put on units destined for the Australian market to units destined for the PICs. Some models shipped to the PICs from Fisher and Paykel (F&P) in New Zealand are not sold under the same brand elsewhere, but are technically identical to products made for the ANZ market. The energy test data are available and labels could be printed and attached for the PIC markets as well.

The same applies to products sourced from wholesalers or regional distribution centres in Australia or New Zealand, even if those products are manufactured in some other country. In many cases the same models are shipped to the PICs as are sold in Australia. Again, the energy test data are available and labels could easily be attached for the PIC markets as well.

The appliances for which labelling would be more difficult are:

- products shipped direct to PICs from countries other than Australia or New Zealand, even if those models are currently covered by the Australian energy labelling program. It would be necessary to make special arrangements to label these in the country of origin or the country of destination;

- models, or whole product families not currently covered by the Australian energy labelling program (ie products other than refrigerators, freezers, air conditioners up to 7.5 kW cooling, dishwashers, clothes washers, clothes dryers, gas water heaters and gas space heaters).

(The authors of this study did not see any energy labels other than Australian ones during their visits to PNG, Fiji and Tonga. However, it is possible that US labels might be present on some of the appliances sold in the Marshall Islands and Palau, which have strong historic and economic links with the USA; also their electricity systems operate at 110 V and 60 Hz, which would favour US products).

Flow-On from Developments in Australia and New Zealand

As we have seen, some energy labels have already found their way to many PICs through the import of products. There have been other flow-ons as well. Energy labelling in Australia led to a significant increase in the energy efficiency of appliances in the ANZ market. There is evidence that manufacturers did indeed respond to the program as anticipated, by speeding up the rate of removal of less energy efficient models and the rate of introduction of more efficient ones (GWA et al 1991).

Since many of the large appliances sold in PICs originate in New Zealand or Australia, PICs have benefited indirectly from the product development prompted by labelling. They may also benefit from the Australian and New Zealand MEPS programs. The least energy-efficient models now made in Australia will have to be improved or removed from the Australian market. The PIC market is a relatively small one for ANZ manufacturers, and it is not likely that they will maintain production of different, less efficient models solely for export. So the benefits of MEPS in the ANZ market are likely to flow on to the PICs in the longer term.

On the other hand, there is some risk that the way MEPS are being introduced in Australia and New Zealand might have negative consequences for PICs, particularly for refrigerators and freezers. After MEPS takes effect in Australia (in September 1999 for refrigerators and freezers) ANZ manufacturers might seek to sell their remaining stocks of products which do not meet the MEPS levels to nearby countries without MEPS, such as the PICs.

The likelihood of this occurring may well be greater now that New Zealand has decided not to follow Australia in implementing MEPS for refrigerators and freezers for the time being (NZIER 1996). If New Zealand were closed off as a market for sub-MEPS refrigerators and freezers after 1999, there would be little value in continuing to manufacture such products or import them to the region, and any dumping in the PICs would be temporary until stocks ran out. However, now that New Zealand will provide a continuing market for sub-MEPS products they are likely to persist in the region for longer.

The problem may be even greater for products not manufactured in Australia or New Zealand. Less energy efficient models from other countries, which could no longer be sold in Australia, might be permanently redirected to New Zealand and the PICs. As regional trade increases it is possible that more appliances from manufacturers not currently

represented in the PIC markets will begin to appear, and these products will be of unknown energy efficiency levels.

The risk that these regional developments will lead to a decline in the energy-efficiency of appliances sold in the PICs can be minimised by adopting "defensive" MEPS, harmonised to whichever MEPS level applies in Australia or New Zealand (if there are different levels, the higher one should be adopted) and coming into force at the same time.

DSM studies

The Demand Side Management Potential studies 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 1995b).

Table 3 indicates the energy savings projected by SRCI in the year 2000, from a refrigerator program and an air conditioner program in each PIC studied. In each case, SRCI assumes that the program - a combination of labelling and MEPS - can reduce the energy consumption of new refrigerators, freezers and air conditioners by 10% below what it would otherwise be.

Table 3 Energy Savings in 2000, as Projected by SRCI

Programs	PNG	Fiji	Solo-mon Is	Mars-hall Is	Palau	West Samoa	Tonga	Cook Is	Kiri-bati	Tuvalu	10 PICs
Refrigerators	1750	2551	227	399	541	663	257	307	93	22	6810
Air conds	8244	2608	1156	1319	1562	746	194	301	93	39	16262
Others	24044	13189	4515	7305	6090	5071	3285	2644	708	311	67162
Total impacts	34038	18348	5898	9023	8193	6480	3736	3252	894	372	90234
Ref + AC %	29.4%	28.1%	23.4%	19.0%	25.7%	21.7%	12.1%	18.7%	20.8%	16.4%	25.6%

Source: SRCI 1995b; all impact values in MWh

The energy savings projected does of course vary for each country, as does the contribution of the refrigerator and air conditioner programs to the total energy savings expected from DSM programs. In countries with high refrigerator ownership and air conditioner use (eg PNG and Fiji) the projected savings are higher, whereas for other countries they are lower.

Table 4 shows the corresponding estimates of peak demand reductions from the refrigerator and air conditioner programs in each PIC. These programs would contribute somewhat less to peak demand savings than to energy savings, since they are not time-targeted, as are some of the other DSM programs such as interruptible rates.

Table 4 Maximum Demand Savings in 2000, as Projected by SRCI

Programs	PNG	Fiji	Solo-mon Is	Mars-hall Is	Palau	West Samoa	Tonga	Cook Is	Kiri-bati	Tuvalu	10 PICs
Refrigerators	0.37	0.71	0.05	0.07	0.10	0.15	0.06	0.06	0.02	0.00	1.59
Air conds	1.49	0.59	0.21	0.21	0.22	0.13	0.09	0.03	0.02	0.00	2.99
Others	6.74	4.36	1.03	1.59	1.07	0.68	1.11	0.47	0.07	0.10	17.22
Total impacts	8.60	5.66	1.29	1.87	1.39	0.96	1.26	0.56	0.11	0.10	21.80
Ref + AC %	21.6%	23.0%	20.2%	15.0%	23.0%	29.2%	11.9%	16.1%	36%	0%	21.0%

Source: SRCI 1995b; all impact values in MW

SRCI also estimated the costs and benefits for each PIC of the DSM programs it recommended. For the refrigerator and air conditioner labelling/MEPS programs, the following costs were taken into account:

- additional "technology costs", ie a higher average purchase price for appliances;
- initial setup costs (several electricity utility staff members for the first year);
- annual program costs (typically a utility staff member half-time, plus a budget for printing publicity materials).

These were offset against the value of the projected electricity savings. The results of the calculations for PNG, Fiji and Tonga are given in Tables 5 and 6. The explanation of Participant, Utility and Total Resource Cost (TRC) tests in given in SRCI (1995b). Where monetary values are positive and the benefit/cost ratio is greater than 1, that group is better off financially under that set of assumptions.

Table 5 Refrigerator Program Cost-Effectiveness, as Projected by SRCI

	PNG		Fiji		Tonga	
	NPV ('000 K)	Benefit/ cost	NPV ('000 F$)	Benefit/ cost	NPV ('000 T$)	Benefit/ cost
Participant test	3285	5.3	4495	2.8	669	3.9
Utility test	-1320	0.5	-1981	-0.6	338	0.6
TRC test	1153	2.1	3378	2.2	541	2.4
Rate impacts	t/kWh	0.04	c/kWh	0.06	c/kWh	0.03
TRC levellised cost	t/kWh	4.2	c/kWh	8.2	c/kWh	8.0

All values in local currency, as at 1994

The SRCI analysis assumes that all program costs are borne by the electricity utility. The life cycle rate impact measure (LCRIM) is defined as the one-time change in customer rates necessary for the utility to recover the entire cost of the DSM program. The TRC levelised life cycle cost represents the average cost of the program per kWh of energy saved. In general it should be lower than the avoided cost of energy if the program is cost-effective from the TRC perspective.

Table 6 Air Conditioner Program Cost-Effectiveness, as Projected by SRCI

	PNG		Fiji		Tonga	
	NPV ('000 K)	Benefit/ cost	NPV ('000 F$)	Benefit/ cost	NPV ('000 T$)	Benefit/ cost
Participant test	29414	12.1	8287	9.9	701	17.6
Utility test	-4088	0.6	-2234	0.6	-173	0.7
TRC test	9091	7.2	4850	5.4	656	7.9
Rate impacts	t/kWh	0.09	c/kWh	0.05	c/kWh	0.02
TRC levellised cost	t/kWh	1.43	c/kWh	3.2	c/kWh	3.02

All values in local currency, as at 1994

SRCI estimates that both programs are cost-effective from the viewpoints of participants (ie appliance buyers) and society as a whole, but not for utilities. This may be because SRCI assumed that the utilities bear all administrative costs, whereas in Australia most of these are borne directly by governments. Also, SRCI assumed separate setup costs for the refrigerator and the air conditioner programs, whereas in practice the costs of including additional appliances are very low once the administrative structure is established. Thus the SRCI costs need to be reviewed.

1.2 This Study

1.2.1 Aims

The present study was initiated by the Energy Division of the Forum Secretariat, following the positive findings on labelling and MEPS in SRCI's DSM Potential Studies.

Aims

In most PICs, the demand for electricity in the 1980s grew at 6% per year or more, and future growth is expected to average 7.5% per year in the 1990s. Considering this high load growth, most utilities in the region re likely to face serious problems in meeting the demand for electricity. Some of these problems could be addressed by encouraging customers to adopt energy efficient products, equipment and technologies that would eventually benefit the utilities, electricity consumers and society as a whole.

This project aims to examine the desirability and feasibility of introducing:

1. energy labelling on a range of electrical appliances, enabling customers to differentiate appliances on the basis of their energy consumption,

2. minimum energy performance standards for imported appliances.

The overall objective is to establish a labelling or standards program on a regional basis, if feasible, based on the findings and recommendations of this project.

This study represents the first of two stages toward this objective. It involves gathering the information needed to make decisions on the establishment of a labelling program on a regional (or sub-regional) basis. It also provides an assessment of the most efficient way to develop a uniform labelling scheme and of the appropriate stringency of the minimum performance standards for the selected appliances.

In the event that the findings of the present study are favourable, the Forum Secretariat envisages a second stage in due course: the drafting of regulations for standards and labelling programs, and conducting pilot programs in selected countries.

Scope

The range of appliances to be considered for labelling or MEPS was not necessarily restricted to the ones identified in the SRCI studies. However, based on our analysis of the SRCI studies, we envisaged that the *primary* scope of the present study would be:

- household size refrigerators (up to say 600 litre capacity);
- household size freezers (up to say 700 litre capacity);
- household size air conditioners (unitary and split system, up to 7.5 kW cooling capacity, which is the boundary of the existing Australian labelling program);
- commercial size packaged air conditioners (7.5 to about 50 kW cooling capacity), as used in offices, hotels and resorts etc.

These products account for about half of all household and commercial sector electricity consumption in Pacific Island Countries, and we are confident that they should remain the main focus.

We also proposed a list of *secondary* products, to be investigated in less detail than the primary group:

- electric water heaters
- solar water heaters
- LPG (liquefied petroleum gas) water heaters
- clothes washers ("washing machines")
- dishwashers.

During the course of the study we sought PIC views on whether the secondary group was important in their markets, and whether they considered that additional products should also be included in the study.

Although lighting is outside the scope of this study, there may be considerable benefit to extending some aspects of labelling and MEPS to the lighting sector, given that:

- New Zealand is adopting, and Australia is considering, MEPS for fluorescent lamp ballasts (which could lead to the dumping of low-efficiency stock in the PICs);
- New Zealand is adopting MEPS for tubular fluorescent lamps;
- the communications formats and media used in appliance labelling (eg star ratings, special identifiers for high-efficiency models and product guidebooks) may be equally applicable to lamps and/or light fittings.

1.2.2 Methodology

Work Plan

The workplan agreed with the Forum Secretariat Energy Division consisted of the following stages:

1. discussions with the Project Manager (Forum Secretariat) on the overall project objectives, information requirements, project schedule and other relevant issues.

This took place in Suva in early March 1996.

2. review all relevant reports and activities relating to appliance labelling and standards in the Asia-Pacific region to ensure that the project methodology and findings are consistent with the overall regional objectives.

The main documents used in the preparation of this report are listed in the references.

3. discussions with the representatives from the Energy Offices of selected PICs on the overall information requirements, data collection procedures and other relevant issues.

These discussions took place during visits to Fiji (early March 1996), Tonga (mid March 1996) and PNG (late April 1996).

4. prepare a detailed checklist of information required for the study, including guidelines and data collection procedures for relevant appliance segments. They should include, but not necessarily be limited to, the following:

    - annual sales by appliances type and country, annual sales by manufacturer and country of origin
    - rates of appliance turnover
    - patterns and projections of energy supply costs
    - extent of labels currently in use
    - test standards in use for appliances currently labelled
    - availability of test data for imported models in the region and availability of labels for these models in the country of origin.

An initial questionnaire (copy at Appendix 1) was sent to the Forum in early April, for circulation to the PICs not visited during the course of the study. For PICs visited, the information was collected largely during face to face discussions and interviews.

5. review all data collated from the participating PICs and provide advice on assumptions for any missing information.

The initial questionnaire was revised and simplified in July 1996 and sent to the PICs not visited. Some information was received from Vanuatu, and the Forum Secretariat supplied some appliance market information for the Cook Islands and Kiribati. The information from the PICs, combined with data gathered from other sources, gives us confidence that the findings of this report are soundly based and have general application throughout the Forum.

6. Analyse information and prepare draft report on the study. The report should provide estimates of the potential energy and energy cost savings associated with the introduction of labelling and standards in the selected PICs on the basis of information provided through questionnaires and other sources. It should also provide estimates of any increases in appliance purchase costs associated with the introduction of particular standards. The report should include recommendations and guidelines for establishing a labelling program and energy performance standards in the region.

A draft report addressing the descriptive and qualitative aspects of energy labelling and MEPS, including draft conclusions and recommendations but without cost-benefit analyses, was submitted to the Forum Secretariat in June 1996.

7. Finalise reports after review and comments from FSED and participating countries.

We received some comments on the draft report from Fiji, Tonga and the Forum Secretariat. This final report reflects those comments, takes account of significant developments since the draft report, and includes program cost-benefit analyses for Fiji, PNG, Tonga and the region as a whole.

PIC Visits and Other Discussions

The PIC visits proved to be very valuable opportunities to gather information, and to observe first hand the range of appliance models available. We are especially grateful to the officers from the energy agencies of PNG, Fiji and Tonga who organised the meetings and accompanied us on the visits. Discussions were arranged with the following types of businesses and agencies:

- electricity utilities
- household appliance retailers
- electrical wholesalers

- air conditioner suppliers and installers
- consumer departments and agencies
- technical standards and agencies
- manufacturers, both in PICs and in countries exporting to PICs.

1.2.3 Organisation of This Report

Chapter 1 introduces the Study and presents a general background to labelling and MEPS in the region.

Chapter 2 reviews the appliance market in the PICs, and identifies those factors which are important in the design of energy labelling and MEPS programs, including the projected costs of electricity.

Chapter 3 details the key elements in energy labelling and MEPS programs, and discusses how these might be handled separately or jointly in the participating PICs. It also discusses additional "add-on" elements which might be suitable for some countries.

Chapter 4 presents the main costs and benefits associated with labelling and MEPS programs, and quantifies the costs and benefits under a number of scenarios.

Chapter 5 presents conclusions and recommendations.

Appendix 1 has a copy of the questionnaire sent to PICs not visited, and used as the basis of inquiries in participating PICs. Appendix 2 lists the people with whom meetings and discussions were held. Appendices 3 to 5 contain details of the appliance markets in Fiji, PNG and Tonga respectively, including lists of models for which energy consumption data has been retrieved. Appendix 6 describes the cost-benefit modelling approach. Appendices 7 to 9 contain projections of program costs and benefits for Fiji, PNG and Tonga respectively. Appendix 10 scales these up for the region as a whole.

2 Appliance Energy Use in Pacific Island Countries

2.1 The Appliance Market

2.1.1 Product Origins

Virtually all the major electrical appliances sold in the PICs are imported. The only local manufacture we encountered in the PICs visited was a solar water heater manufacturer in Port Moresby (Barlow Industries).

Refrigerators, Freezers and Other Household Appliances

PNG, Fiji and Tonga make up about 90% of the regional refrigerator and freezer market. The New Zealand-based manufacturer Fisher and Paykel (F&P) accounts for the majority of the refrigerator market in these three countries, and also holds large market shares in a number of the other PICs. F&P products are sold under the Shacklock, Fisher and Paykel, Frigidaire, Leonard and Kelvinator brands. Many F&P models are badged under more than brand, so in fact the range of technologically different products on the market is narrower than might appear. All the F&P refrigerators and freezers supplied to PICs are manufactured in New Zealand. F&P also supplies small numbers of clothes washers, clothes dryers and dishwashers to the PICs.

The Australian-based manufacturer Email also has a large share of the PIC market. Its refrigerators and freezers are mainly sold under the Westinghouse brand, although Kelvinator, Simpson and Malleys are also used. (These are different models from the F&P-made Kelvinators: Email has exclusive rights to use the Kelvinator and Frigidaire brand names within Australia, but not in the Pacific). Email also uses the Simpson and Malleys brand names for its clothes washers, clothes dryers and dishwashers. All of the products it currently sells in PICs are manufactured in Australia, although Email may soon be re-exporting some imported refrigerators to selected PICs.

Of the other refrigerator and freezer brands and models distributed in PICs, most are also sold in Australia and New Zealand:

- Gorenje Pacific, made in Slovenia (probably distributed via Australia; now sold as Frigidaire brand in Australia by Email);

- National, Sharp and Sanyo: these are Japanese brands, but most models are now made in Thailand, Malaysia, Singapore and Taiwan;

- Goldstar and Samsung, made in Korea;

- Hoover, made in Australia;

- Whirpool and Amana: these are made in the USA, and tend to be larger models sold in very low numbers.

We also came across, or were informed about, some brands and models not seen in the ANZ domestic appliance market:

- MBf, made in Malaysia - generally smaller models (about 50 litres);

- Yangtse, and other Chinese brands: these come on the market in small quantities from time to time but have not gained a permanent foothold in PNG, Fiji or Tonga;

- special LPG-powered or dual LPG/electric refrigerators, for use in remote areas: made in Brazil (Norder brand) or Sweden. These tend to be very expensive;

- small commercial variants of ANZ-made domestic freezers, with glass tops or fronts.

The range of dishwashers, clothes dryers, top-loading and front-loading clothes washers is similar to the ANZ range. F&P and Email products are well represented, as are many of the other Japanese and Korean brands. There are small numbers of US and European-made appliances (eg Philips Whirlpool and Eurotech), some of which are rebadged versions of models available in Australia.

Some PIC clothes washer markets show a strong preference for twin tub machines rather than top loaders. These are supplied from Australia (Hoover) Japan (Hitachi and other brands) Integrity (Korea) and some from China (eg Eternal, Everota).

Air Conditioners

The air conditioner market is less concentrated than the refrigerator market, in that there are more brands and models available, and the market share of each is smaller. There appear to be no brands or models which approach the sales volumes of the largest-selling F&P refrigerators, for example.

Again, many of the brands and models are identical to those sold (with energy labels) in Australia:

- specialist air conditioner brands such as Daikin, Carrier, Fujitsu; typically, these companies manufacture in several countries, and depending on the model the units may be produced in Japan, Korea, Taiwan, Thailand, Malaysia or Singapore;

- general appliance brands such as National, Sanyo, Toshiba, Hitachi, NEC (all Japan-based, but could be made in a number of countries); Samsung, Goldstar (both Korean-based); Amana, GEC (both US-based);

- regionally, rather than globally significant brands such as TECO (Taiwan), Email, Westinghouse, APAC (Australia) Acson, Uni-air, OYL, Acma, Pan Electra (Malaysia).

Other Products

Electric water heaters are sold in many PICs, although in some countries the utilities discourage their use because of their potentially high contribution to peak demand. ANZ-made Rheem electric storage water heaters are sold in several countries: the full size range from 25 litres to 160 litres storage was seen. Some instantaneous water heaters are also available (Fiji customs data record a shipment from Italy).

Rheem also supplies some Australian-manufactured LPG water heaters (one of these was seen in a builder's supply showroom with the AGA energy label still attached).

Solar water heaters are becoming more popular, and in some countries are actively encouraged by the electricity utility, in preference to conventional electric water heaters. Many are installed as pure solar units, without the electric element boosters common in Australia. Australian-made Solahart and Rheem models are available, as well as a number of Malaysian and European and even US brands. In PNG, the locally made Barlow has a large share of the market.

Smaller electrical appliances such as microwave ovens and rice cookers are supplied by international brands such as Whirlpool, Samsung, NEC, Panasonic etc. Electric fans, which are common, are supplied from Malaysia and China

Although we did not actively research the origins of computers and office equipment, we observed that the international brands such as Compaq, Apple, Brother, Sharp etc are widely available.

We were not able to gather much information on more specialised, industrial scale equipment such as electric motors. Most of these appear to be imported as needed for specific projects and factories, rather than kept in stock. In countries where large motors are used, there are businesses which provide rewinding and repair services.

Some electric thermal cooking equipment (ie hotplates plus ovens) is imported from Australia and other countries. Many of these are probably used in commercial applications, since there still a widespread preference for open-flame cooking in the household, even in grid-connected dwellings. There is some local manufacture of small LPG, kerosene and light oil burner cooktops, especially in Fiji. Many products of this type come from Brazil, Malaysia and China.

2.1.2 Distribution, Sales and Service

Major Trading Houses

Many PIC appliance markets are dominated by the major trading houses such as Carpenters and Burns Philp. These operate in all the major cities of many PICs and have interests in many areas of the economy, including shipping. The trading houses tend to make direct arrangements with their major suppliers, and obtain other supplies from intermediaries, in some cases other trading houses. Apart from retailing most of the new appliances sold, they also wholesale to smaller retailers, and meet large appliance orders from commercial or resource development projects.

All the major trading houses appear to sell F&P products, but their mix of other brands varies:

- the Carpenters group; which it is understood is Malaysian-based. It has recently acquired Morris Hedstrom in Fiji. It sells mainly F&P appliances, as well as its Malaysian-manufactured house brand, MBf, and other brands.

- the Burns Philp group also sells F&P products, as well as Email and other brands

- Brian Bell, the largest distributor in PNG, sells F&P, Email and most other brands

- Courts appears to have a wide range of brands and models, some of which must sell in very small quantities.

- Steamships (PNG) sell F&P products.

Many of the trading houses offer financing, or "hire purchase" as an alternative to outright sale. Typically, this involves 2 years of weekly payments, totalling about 1.5 times the sale price. This seems to be especially popular in Fiji; the major PNG retailer, Brian Bell, does not offer financing.

Some of the trading house have their own appliance repair staff to carry out warranty and post-warranty servicing.

Other Distributors

The trading houses supply nearly all of the market for major appliances. They also sell a limited range of air conditioners, but most of this market is supplied by specialist companies. Builders' and electricians' supply stores do not sell whitegoods, but carry some air conditioners, water heaters, and fans (both fixed and free-standing).

The largest air conditioner distributors are wholly owned subsidiaries of international companies (eg Carrier PNG) or, more commonly, independents with exclusive national distribution rights for one or more major brands.

These companies can design installations all the way from large commercial to household, supply the equipment, install it and service it. As with refrigerators, the demarcation between commercial and household equipment is less clear than in, say, Australia. Commercial installations often consist of multiple smaller units rather than one or a few large units. (Even for large multi-storey buildings, designs based on central, water-cooled plant tend to be avoided, partly because of water quality and corrosion problems and partly because repair times are long, so failures of central plant can affect the entire building for an unacceptable period).

There are also smaller air conditioning contractors. These tend to be less tied to specific brands, and have non-exclusive arrangements with a range of suppliers, or import small quantities of air conditioners direct on an opportunity basis. Because of this, they are often not in a position to carry parts for all the models they might have sold in the past, and are not able to offer the same degree of after-sales service as the major contractors. Some of these companies also offer low cost appliance repairs for clothes washers and refrigerators and other household appliances.

We understand that a lack of effective product warranty is a widespread consumer issue in the PICs. The problem is likely to be greatest with the less established brands, and with the smaller distributors, especially those that are general traders and sell odd shipments of appliances on an opportunity basis.

Differences in PIC markets

The brand names and model types we observed were relatively consistent for PNG, Fiji and Tonga. Information provided by the Forum Secretariat confirms that the Cook Islands and Kiribati are also supplied almost exclusively by F&P and Email, and that the range of models is similar to those in the countries we visited.

Tonga is unusual in that nearly as many second hand refrigerators are imported as new refrigerators. For clothes washers, some 85% of total imports are second hand. The great majority of refrigerators and clothes washers, whether new or second hand, is from Australia and New Zealand.

A feature of the PNG market is the tendency for the developers of large commercial and resource projects to bring in all the building materials, equipment and appliances needed for large projects in remote areas. Some of these projects involve the construction of housing and accommodation units, to be supplied with electricity by on-site generators. The main source of these pre-packaged "construction kits" is Malaysia. The appliances imported in this way often bypass the usual customs and electrical safety approvals processes.

2.1.3 Buyer Preference and Energy Awareness

Product and Usage Characteristics

This section reviews some aspects of the type of products which PIC buyers prefer, and the way they use them, which might impact on energy labelling and MEPS.

The average size of refrigerators sold in the PICs visited is somewhat smaller than in Australia, where the sales-weighted average volume for all refrigerator-freezers sold is about 330 litres. According to some retailers, the most popular size range for refrigerator-freezers in the PICs is 250 to 330 litres, but according to the manufacturers the biggest selling models are in the 170 to 220 litre range.

Smaller refrigerators would use less energy in the same operating circumstances. For example, the labelled energy consumption of the 170 litre F&P two-door cyclic defrost refrigerator-freezer is 500 kWh per year, whereas the labelled energy consumption of the 390 litre F&P model of similar configuration is 780 kWh per year. On the other hand, refrigerators in the PICs generally have to cope with hotter conditions than in Australia, so energy consumption, and the running cost advantage of a more energy efficient unit, may be somewhat higher than suggested by the label.

A more serious disadvantage of smaller refrigerators is that the Australian "star rating" algorithm favours larger models. Given two refrigerators of comparable configuration, compressor technology, insulation thickness and build quality, the larger will rate more stars than the smaller because it has a more favourable surface to volume ratio. For the refrigerator sizes preferred in the PICs, nearly all models will have star ratings of either 2 or 3 (with a few rating at 1) , whereas the range for larger units will be 3 to 5. Also, there are fewer distinct smaller models on the market than larger models: much of the apparent choice is between rebadged F&P models.

This may give the impression that smaller units are less energy-efficient than larger ones (even though the label will still show that the larger ones use more kWh per year) and that there is less point in seeking out a better star-rated unit, since both the star range and the model range are narrower.

The issue of algorithm bias was identified in a 1991 study of the Australian energy labelling program (GWA et al 1991) and is being considered by the Commonwealth and State governments as part of a general review of the labelling program. Some changes to the star rating scale may result from this review, and it is possible that the changes may make labelling more effective for smaller refrigerators. If the changes were imminent, PIC governments might consider waiting for them before formally introducing labelling in their countries. However, it is likely to be several years before any changes are made.

There are three main types of refrigerator:

- units with a single external door, with internal compartments accessible only when the main door is open. In the Australian/New Zealand refrigerator standard, AS2572, these are termed Class 1 if they have no icemaker, Class 2 if they have an icemaker, or Class 3 if they have a freezer compartment capable of short-term storage of frozen food;

- units with separate external doors to the fresh-food compartment, which is defrosted "cyclically", and the freezer compartment, which requires manual defrost. These are termed Class 4 in the ANZ standard (they are also sometimes called "refrigerator-freezers"). The more common arrangement is for the freezer to be located above the fresh-food compartment, but models with bottom-mounted freezers are also made;

- units with separate external doors to the fresh-food compartment and the freezer compartment, but with "frost free" or "no frost" operation in both compartments (using forced circulation of cold air) are termed Class 5 in the ANZ standard. As with Class 4 the more common arrangement is for the freezer to be located above the fresh-food compartment, but models with bottom-mounted freezers are also made. The largest models (of 600 litres or more) have the compartments mounted side by side.

The single best selling model, accounting for up to half of all refrigerator sales in some PICs, is the 170 litre F&P cyclic defrost (Class 3) model, with a 114 litre fresh food compartment and a 55 litres freezer.

Frost free units are estimated to account for about 20 to 30% of the PIC market, compared with about 50% in Australia and over 90% in some Asian markets with very high humidity. The frost-free share is higher among the larger sizes sold in PICs. Frost free units use more energy than cyclic defrost units in energy tests. They have internal fans and defrost mechanisms which operate continuously, whereas the energy tests for cyclic (and manual) defrost units do not included defrost energy. For example, the F&P C335T has a labelled

energy consumption of 710 kWh/yr, whereas its frost-free counterpart, the N325T, with similar refrigerator and freezer volumes, has a labelled consumption of 880 kWh/yr. The energy difference in actual operation may not be as great.

In air conditioners, there are two major configurations: the "unitary" or "window-wall" unit, where all operating components are in the one cabinet, and the "split system", with a separate external condenser unit and one (or more) internal air handling unit, which may be floor-standing, or mounted on a wall or ceiling. Air conditioners can be designed to heat as well as cool ("reverse cycle"), but the demand for such models in the PICs is negligible.

For the same cooling capacity, a unitary system tends to be cheaper, but its disadvantages are noise and, it is claimed by some PIC contractors, lower security against intruders. Unitary systems are only available up to about 7 kW cooling (most are between 2.5 and 3.5 kW). Split systems can go up to 60 kW cooling capacity and more, although the great majority sold are less than 12 kW.

For domestic use in the PICs, unitary types are still more popular than split, because they are cheaper. A popular size, suitable for a small bedroom, is 2.5 kW. Split systems dominate the commercial sector, and are also becoming more popular in the domestic. All models have thermostats and nearly all models are now sold with timers, but according to contractors, people tend not to use them - they just "switch on and turn up to maximum". If this is the case, then the advantages of buying a more efficient model in the first place are magnified.

The intensive use of air conditioning, where installed, is borne out by the findings of the DSM survey for PNG (SRCI 1995a/PNG). Of the 80 commercial sites surveyed, 77 (96%) had some form of air conditioning (in Fiji, two thirds of commercial sector respondents use air conditioning, but in Tonga only 10%). Of the PNG respondents who gave information about patterns of use, 90% said they used air conditioning all through the year, 5% for between 6 and 12 months, and 5% for less than 6 months. The average usage rate was 5.7 days each week, for a period of 8 to 12 hours per day.

By contrast, PIC users appear to be relatively frugal with their use of hot water. According to FDOE (1993) 50% of Fiji households with electric water heaters turn the unit on between 5am and 8am and turn it off between 6pm and 9pm, and a further 10% switch on their heaters only in the evening. Only 6% of respondents said they leave their water heater on at all times.

According to our discussions, most clothes washing in PICs is done with cold water and dried on the line (few PIC households have electric clothes dryers). The Australian energy label test for washing machines measures three elements of energy use:

1. the energy required to heat the water for a warm wash. This is proportional to the amount of warm water used per wash, and is usually the largest component of labelled energy use;

2. the energy required to remove the water remaining in the clothes after spin drying; in effect, this is only consumed as electricity if the clothes are dried in an electrical clothes dryer after washing (this component is not included in the label energy consumption, but does influence the appliance star rating); and

3. the energy required to operate motors, pumps and controls. This is usually the smallest component of labelled energy use, and the one whether there is least difference between different models.

Given that the great majority of clothes washing in PICs is done in cold water and then hung out to dry, only the third, and smallest component of energy use applies to most people. This means that energy labelling of washing machines is unlikely to lead to significant savings in the PICs.

Washing machines were included in the Australian energy labelling program in the late 1980s because hot and warm washes were more common then, and because of the relatively high use of clothes dryers in Australia. However, because of the increasing use of cold washing in Australia, the energy comparisons between different models of clothes washer have become less clear. For these reasons, washing machines were the only class of appliances covered by the 1993 study of MEPS in Australia for which it was recommended that MEPS *not* be introduced (GWA et al 1993a).

The pattern of use for solar water heaters in the PICs also complicates the case for labelling and MEPS. Where a solar water heater is installed with a booster element, its overall efficiency will affect the proportion of water heating energy that is obtained from solar input, and the proportion obtained from the electric booster. In Australia, where nearly all solar water heaters are installed with electric boost, the solar component can be as high as 80% (in north Queensland) to as low as 50% (in Tasmania). For a given location, the more efficient the design, the less boost electricity is required.

In PICs the majority of solar water heaters are initially installed without any form of boosting. In this case there is no monetary advantage to a more efficient system. However, the more efficient the unboosted system, the more hot water it will provide and the less often it will run out (although it has been found that householders will adjust their usage patterns to the solar water heater characteristics, to some extent). The higher the efficiency of the system, the more the chance that the solar-only performance will be satisfactory and that an electric booster will not be fitted at a later date.

Awareness of Energy Costs of Appliances

The energy departments, utilities and consumer groups in some PICs distribute some information about appliance choice and energy use (some of it taken from material produced by the FSED). Thus there is likely to be some awareness that energy is a significant cost in appliance operation, and this is would be reinforced by the appearance of labels on a number of products.

From our discussions with retailers and contractors in the PICs visited, it appears that a very small proportion of buyers makes inquiries about the energy costs of operating an appliance, sometimes prompted by the presence of an Australian energy label. A few of the sales assistants and air conditioner contractors we spoke to were familiar with the label and able to correctly explain its elements, while most were not.

This situation is not so different from Australia, where awareness of energy costs and of labelling were low when labelling was introduced in 1985. The latest Australian survey of recent and intending appliance buyers, in August 1993, indicated that nearly 90% were aware of the energy label, and 45% said they used it to compare appliances prior to purchase, when prompted, ie mentioned by the interviewer (GWA et al 1993).

The only survey of consumer awareness and attitudes on appliance energy we were able to obtain was that carried out for the Fiji Department of Energy (FDOE 1993). The household sector was covered by some 2700 face-to-face interviews and 500 postal questionnaires. When asked "when you purchased your refrigerator, what factor affected your choice most?", and given four options, 46% said "price", 35% said "brand name", 5% said "energy consumption/efficiency" and 15% nominated "other" (FDOE 1993,p44).

In fact, appliance purchases are determined by many factors, and a better indication of the actual importance of energy is to get an unprompted listing of the factors and then a relative ranking. Even in Australia, where labelling is well established and effective, energy consumption (or related factors such as energy efficiency and cost of operation) is rarely ranked first, but has gradually increased in average ranking from about eighth to fourth.

From this limited evidence, there is reason to suppose that, if an energy labelling program were introduced, many householders in the PICs would be receptive to it. However, this does not necessarily apply to other groups of appliance buyers and users. The FDOE study concludes:

> "The commercial sector is one of the most complacent sectors of the economy when it comes to energy efficiency - and this runs from the top to the bottom - from the Government itself to the small business owner. This is not entirely the fault of the commercial sector since there is very little information available on efficiency

standards and potential costs of running certain equipment and appliances" (FDOE 1993,p63).

From the viewpoint of the likely effectiveness of labelling and/or MEPS, it appears that appliance buyers in the PICs divide into the following groups:

1. Lower to middle income householders: these may be urban or rural, and have relatively few large appliances - most likely a small refrigerator and possibly a twin-tub washing machine (they may also have lights, TVs etc but these are outside the scope of this study). They pay their own electricity costs, which are a significant part of the household income, and when they purchase appliances (possibly second-hand, or on hire purchase if new), they are very sensitive to first cost. They probably cook with wood or kerosene, and are unlikely to have any form of water heating. This group is likely to have a reasonably strong motivation to respond to energy labelling, but may have limited ability to do so if it involves spending more on buying appliances.

2. Higher income householders: these are very likely to have a larger refrigerator-freezer, an automatic washing machine and a water heater (solar, LPG or electric), and perhaps a clothes dryer and air conditioning for some rooms. Cooking is likely to be by LPG or perhaps electricity. When purchasing appliances, suitability and value for money may be a higher purchase criterion rather than first cost. This group may be a good target for energy labelling.

3. Higher income temporary residents: some PICs have significant numbers of temporary residents working for large commercial enterprises, resource projects or regional institutions. These workers often receive housing for their families as part of their contract. The housing may be fully furnished and equipped, or the workers may receive allowances to buy furniture and appliances. The cost of electricity is often borne by the employer. The type and number of appliances is similar to what would be found in an Australian or New Zealand household (including some form of water heating, a clothes dryer and possibly a dishwasher), and there will probably be air conditioning. Those temporary residents who are in a position to buy appliances may be a good target for energy labelling, even if they do not meet the running costs. They may well be familiar with labelling in their home countries and may have the discretion to purchase more efficient appliances.

4. Small business: typically small enterprises with air conditioning and a refrigerator, and, in the case of shops or restaurants, a cooker and perhaps a freezer. The owner purchases the appliances and meets the electricity costs, which may be a significant proportion of total business expenses. This group may be a good target for energy labelling.

5. Larger commercial, hospitality and industrial enterprises: typically several air conditioners and refrigerators at each establishment (apart from specialised industrial process equipment). Hotels are likely to have air conditioners in each guest room as well as in the

public areas, multiple water heaters, coolrooms or large domestic type refrigerators and freezers in the kitchen, and perhaps small refrigerators in the guest rooms. They may purchase their own appliances, or take over the stock of appliances in leased premises. Electricity costs are either a low proportion of total business expenses, or if a higher proportion (eg in hospitality industry) can be recovered indirectly through charges to customers. Some parts of this group may be responsive to energy labelling.

6. Builders and project developers: these build housing, offices or hotels for on-sale to the ultimate owner, who may be a hotel operator or, in the case of an apartment building, a large company which lets out the apartments to its temporary resident contracted employees. The developer's concern is usually to minimise first cost while meeting the required standards of quality and appearance. This group is unlikely to be responsive to energy labelling.

7. Government and other public agencies: these includes all uses where government buys appliances and/or pays electricity bills: eg departments, health services, schools, public housing and defence force housing. This is a large part of the energy market: PNG Elcom, for example, estimates that up to a third of its electricity sales are to government in one way or another. In small countries like Tuvalu, some 75% of electricity sales are to government. However, the agencies and budgetary processes which pay the electricity bills are often unrelated to those which purchase appliances, and purchases are in many cases constrained by first cost. Therefore this group is not likely to be responsive to energy labelling, unless governments and public agencies deliberately decide to make energy-efficiency a high priority in their purchase policies.

From this it is apparent that some appliance buyers might be influenced by energy labelling, but some important groups are not likely to respond. Therefore the introduction of MEPS, which impacts on appliance efficiency irrespective of customer choice, also requires consideration.

2.2 Ownership and Energy Use

2.2.1 Appliance Ownership

Household

Table 7 summarises the penetration of major household appliances as determined by the surveys carried out for the 10 DSM studies (SRCI 1995a: note that "penetration" is the proportion of households in which the appliance is present. "Ownership" is the total number of appliances divided by the number of households in which the appliance is present. The terms are used interchangeably and incorrectly in some documents). After lighting, which would be present in every electrified household, the appliance with the highest penetration is the refrigerator, which is present in nearly 90% of PIC households. The lowest refrigerator penetration, in Kiribati, Western Samoa and Tonga, is 57%.

Table 7 Household Appliance Penetration in Selected PICs, 1994

	Fiji	PNG	Solo-mon Is	Palau	Kiribati	West Samoa	Tuvalu	Tonga	Marsh-all Is	Cook Is
Refrigerator	88%	90%	85%	99%	57%	57%	70%	57%	80%	94%
Air conditioner	4%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Electric HW	21%	15%	40%	37%	14%	4%	1%	8%	13%	47%
Solar HW	13%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Electric cooking	12%	30%	33%	45%	5%	13%	0%	3%	41%	24%

Source: SRCI 1995a

Table 8 Appliance Penetrations, Fiji, 1982 and 1993

Appliance	% ownership 1982	% ownership 1993
Refrigerator	90 %	93 %
Air conditioner	4 %	5 %
Electric water heater	23 %	17 % (a)
Solar/electric water heater	3 %	5 %
Electric stove	9 %	12 %
Washing machine	20 %	47 %
Clothes dryer	n/a	17 %
TV/video	23 %	86 %
Fan	46 %	66 %
Electric kettle	26 %	30 %
Electric Iron	97 %	94 %
Electric rice cooker	12 %	43 %

Source: FDOE (1993) (a) 7% instantaneous, 10% storage

The SRCI DSM studies only surveyed the penetration of selected major appliances, and only at a single point in time. For Fiji, there is some additional data on other appliances and on trends over time (see Table 8).

Considering the different survey forms and methods used, the 1993 values for Fiji in Table 8 are reasonably consistent with the corresponding values in Table 7, except for water heaters. Because of this it is difficult to make conclusions about trends relating to water heating, except that the use of solar water heaters appears to be increasing.

The penetration of refrigerators was already high in 1982, and has advanced little since then, so it is obviously close to "saturation", ie the maximum level it is likely to reach. The penetration of domestic air conditioners has remained virtually unchanged, so that it too may be close to saturation, if at a very low level. It is likely that most household demand for ventilation and cooling is being met by fans, the penetration of which has grown considerably. A similar pattern of preference for small, specialised devices appears to be occurring with cooking as well: while there has been little growth in the use of electric stoves, an increasing number of households use electric rice cookers.

The other appliances in which there was significant growth over the period was in washing machines (from 20% to 47% penetration), possibly clothes dryers (no data for 1982, suggesting they were not common enough to survey, to 17%) and TVs and/or videos (23% in 1982 to 86% in 1993).

There is no survey data on the penetration of freezers. Discussions with retailers suggests that most are sold to small businesses, and few to householders. For most households, the freezer compartment of the refrigerator appears to be adequate.

Based on this analysis, the appliances for which there is *potential* for greater household electricity demand because of increased ownership appear to be:

- electric water heaters (whether electric only or solar-electric)
- air conditioners
- washing machines
- clothes dryers
- electric stoves

The rate at which this potential for greater appliance ownership is realised will depend on factors such as the rate of change in household incomes, in appliance costs and electricity costs. Of course, even if there were no change appliance ownership rates at all, new

appliances will still enter the stock as old ones need replacement, and energy labelling and/or MEPS can help increase their average energy efficiency. This can offset the additional energy and maximum demand requirements that will come from the connection of additional households and from the increasing ownership of appliances in connected households.

Commercial/Institutional

The Commercial/Institutional sector comprises locations such as offices, shops, restaurants, hotels and hospitals. It can also include light manufacturing (eg small bakeries) and the office parts sections of industrial sites. Energy is used in ways very similar to the household sector: to light and cool buildings, preserve and prepare food, heat water (all if which can be energy intensive) as well as perform many other tasks, such as operate computers or lifts, which may not be very energy intensive individually, although in total can consume significant amounts of energy.

The appliances used in many parts of the commercial sector are also similar to those used in the household sector. The main difference is that commercial sites tend to have many refrigerators and air conditioners rather than just one, and each one may be somewhat larger than the typical household size - although in the PICs many are still "household" models rather than the larger "commercial" products used in countries like Australia or the USA.

Tables 9 and 10 summarise selected results of a 1994 survey of 80 commercial customers in Port Moresby, carried out for SRCI (1995a/PNG). Table 9 indicates that 56 of the 80 sites had refrigerators, and 55 of these had "medium" or "small" types, which are assumed to be of the household variety. Similarly, 20 of the 21 sites with freezers had "medium" or "small" types, also assumed to be of the household variety. This reinforces the conclusion that a labelling or MEPS program for household style refrigerators and freezers could have considerable impact on the commercial sector as well, especially given the number of units per commercial site: an average of 8.6 for refrigerators and 2.9 for freezers.

Table 9 Refrigerators and Freezers in Commercial Use, PNG 1994

Product type	Sites having	Number of units	Units per site	Sites with "large"	Sites with "medium"	Sites with "small"	Sites with "glass door" type	Average age (yrs)
Refrigerators	56	481	8.6	6	25	30	11	4.8
Freezers	21	60	2.9	8	12	5	0	6.1
Cool rooms	14	30	2.1	8	5	4	0	10.4
One or more of above	67	571	8.5					

Source: Extracted by authors from SRCI 1995a/PNG

Table 10 indicates that 77 out of 80, or 95% of the commercial sites surveyed had some form of air conditioning (higher than Fiji, 67%, and far higher than Tonga, 10%). The average number of units per site was 11.2. The average number of "packaged" (assumed to be window/wall) units per site was greater than the average number of "split" systems. This may well be because of the tendency to use small window/wall systems in hotel guest rooms. The 4 hotels surveyed had an average of 27.5 air conditioners, compared with just over 10 for the other sites.

Table 10 Air Conditioners in Commercial Use, PNG 1994

Product type	Sites having	Number of units	Units per site	Average age (yrs)
"Packaged" AC	50	614	12.3	6.6
"Split" AC	29	208	7.2	4.9
"Other" AC	3	43	14.3	4.3
Some form of AC	77	865	11.2	
Hotels, etc	4	110	27.5	
Other	73	755	10.3	

Source: Extracted by authors from SRCI 1995a/PNG

Multiple air conditioner installations are also common in Fiji. Of the 141 commercial sector respondents who provided information on their air conditioning systems for the 1993 survey (FDOE 1993):

- 19% used "centrally controlled" systems
- 56% had 1 to 5 "individually located" units
- 13% had 6 to 10 "individually located" units

It is assumed that the remaining 12% had more than 10 "individually located" units.

Again, this reinforces the conclusion that a labelling or MEPS program for household style air conditioners could have considerable impact on the commercial sector as well.

Industrial

The largest industries in PICs tend to be food and agricultural product processing, mining and minerals. SRCI 1995b estimated the industrial sector share of grid-supplied electrical energy as 5% in PNG, 18% in Fiji, 26% in the Solomon Islands and 4% in Tonga. No industrial electricity demand was estimated for the other PICs. The relatively low proportion for PNG is due to the fact that the most energy-intensive resource developments are in remote areas, and are supplied with electricity not from the grid but from their own generators.

Most industrial sites use specialised and often purpose-built equipment, rather than the mass-produced appliances common in the residential and commercial/institutional sectors. This limits the potential for energy labelling and MEPS programs, except perhaps for electric motors, which are used in nearly every type of plant. It is questionable that a general labelling scheme for such equipment would have much impact anyway, since most industrial plant is designed or selected by engineers who are already able to seek out the information necessary for the most cost-effective designs.

2.2.2 Energy Use

One of the main criteria for determining priorities for labelling and MEPS is the contribution of each end use and appliance type to total electricity use. Table 11 summarises the information for the 10 PICs studied by SRCI (1995a).

Refrigeration (including freezers) is clearly the largest residential end use, accounting for over 38% of household electricity use in the 10 PICs, and over 49% of non-lighting use (the more appropriate measure, given that lighting is excluded from the present study). In countries with high refrigerator ownership and/or lower ownership of other appliances, refrigeration can account for even higher shares of non-lighting electricity: nearly 96% in Tonga, nearly 80% in Kiribati, and nearly 66% in Fiji. In absolute terms, Fiji has by far the highest household refrigeration load.

Cooking is the next highest contributor to non-lighting electricity use in households (nearly 14%) followed by air conditioning (nearly 11%) and water heating (over 10%). All other uses - including clothes washing, clothes drying, dishwashing, irons, kettles, TVs, VCRs and everything else - account for 16% of household electricity, so it is apparent that none of these end uses on its own accounts for anywhere near as much energy as, say, air conditioning.

Table 11 Residential Sector Electricity Consumption by End Use, PICs, 1995

	Fiji	PNG	Solo-mon Is	Palau	Kiri-bati	West Samoa	Tuvalu	Tonga	Marsh-all Is	Cook Is	Total	Share of total	Non-light
Refrigeration	40870	16881	2210	3390	795	6989	187	4163	3723	2487	81694	38.4%	49.3%
Air conditioning	3406	4604	737	4188	122	1223	0	0	2978	485	17743	8.3%	10.7%
Hot Water	5960	3581	1289	3390	61	874	30	124	745	1092	17145	8.1%	10.4%
Cooking	4257	8185	1289	3988	20	1922	10	62	2382	364	22480	10.6%	13.6%
Lighting	22989	7673	3131	2393	1039	5067	226	1864	1787	849	47020	22.1%	
Other	7663	10231	553	2592	0	1398	39	0	3276	789	26540	12.5%	16.0%
Total	85145	51154	9210	19942	2038	17473	492	6213	14890	6066	212623	100%	100%
Share of total	40.0%	24.1%	4.3%	9.4%	1.0%	8.2%	0.2%	2.9%	7.0%	2.9%	100%		

Source: Extracted by authors from SRCI 1995a. All values MWh per annum

Table 12 summarises end use electricity consumption in the commercial sector. Air conditioning accounts for nearly 60% of non-lighting energy for the 10 PICs combined. Refrigeration accounts for over 16% of non-lighting energy, and all other end uses - electric cooking, water heating, lifts, pumps, office equipment and many others - for 24%.

Table 12 Commercial Sector Electricity Consumption by End Use, PICs, 1995

	Fiji	PNG	Solo-mon Is	Palau	Kiri-bati	West Samoa	Tuvalu	Tonga	Marsh-all Is	Cook Is	Total	Share of total	Non-light
Refrigeration	17244	15800	2574	3254	576	2977	121	1046	2302	1675	47571	10.6%	16.3%
Air conditioning	50296	73731	9127	13666	1633	10827	344	1814	10399	2681	174517	38.9%	59.8%
Lighting	53170	57932	8425	10738	1921	9473	405	3069	8457	3016	156605	34.9%	
Other	22992	28088	3276	4881	672	3789	142	1046	3983	1005	69876	15.6%	23.9%
Total	143703	175550	23402	32538	4803	27067	1012	6976	25141	8377	448569	100%	100%
Share of total	32.0%	39.1%	5.2%	7.3%	1.1%	6.0%	0.2%	1.6%	5.6%	1.9%	100%		

Source: Extracted by authors from SRCI 1995a. All values MWh per annum

Table 13 summarises energy consumption for the residential and commercial sectors combined, for end uses that occur in each sector. The two dominant end uses are air conditioning, which accounts for 42% of combined non-lighting energy in the 10 PICs, and refrigeration, which accounts for over 28%. As Table 14 indicates, the pattern is consistent across the 10 PICs.

Table 13 Commercial plus Residential Electricity Consumption by End Use, PICs, 1995

	Fiji	PNG	Solo-mon Is	Palau	Kiri-bati	West Samoa	Tuvalu	Tonga	Marsh-all Is	Cook Is	Total	Share of total	Non-light
Refrigeration	58114	32680	4785	6644	1371	9967	308	5209	6025	4162	129265	19.6%	28.3%
Air conditioning	53702	78335	9864	17854	1755	12050	344	1814	13377	3166	192260	29.1%	42.0%
Res Hot Water	5960	3581	1289	3390	61	874	30	124	745	1092	17145	2.6%	3.7%
Res Cooking	4257	8185	1289	3988	20	1922	10	62	2382	364	22480	3.4%	4.9%
Lighting	76159	65605	11556	13131	2961	14541	631	4933	10243	3865	203625	30.8%	
Other	30656	38319	3829	7473	672	5187	181	1046	7259	1794	96416	14.6%	21.1%
Total	228848	226704	32612	52480	6841	44540	1504	13189	40031	14443	661192	100%	100%
	34.6%	34.3%	4.9%	7.9%	1.0%	6.7%	0.2%	2.0%	6.1%	2.2%	100%	0.0%	

Source: Extracted by authors from SRCI 1995a. All values MWh per annum

Although the dominance of air conditioning and refrigeration is clear, the relative importance of other end uses is less so. The total share of water heating is somewhat higher than the 3.7% contributed by residential water heating alone (see Table 13): there is also a significant amount of commercial water heating included in "Other". Similarly, the total cooking share is somewhat higher than the 4.9% contributed by residential cooking alone: there is also a significant amount of commercial cooking included in "Other".

Table 14 Refrigeration and Air Conditioning Share of Non-Lighting Electricity in PICs

	Fiji	PNG	Solo-mon Is	Palau	Kiri-bati	West Samoa	Tuvalu	Tonga	Marsh-all Is	Cook Is	Total
Residential											
Refrigeration	65.8%	38.8%	36.4%	19.3%	79.6%	56.3%	70.4%	95.7%	28.4%	47.7%	49.3%
Air conditioning	5.5%	10.6%	12.1%	23.9%	12.2%	9.9%	0.0%	0.0%	22.7%	9.3%	10.7%
Both	71.2%	49.4%	48.5%	43.2%	91.8%	66.2%	70.4%	95.7%	51.1%	57.0%	60.0%
Commercial											
Refrigeration	19.0%	13.4%	17.2%	14.9%	20.0%	16.9%	20.0%	26.8%	13.8%	31.3%	16.3%
Air conditioning	55.6%	62.7%	60.9%	62.7%	56.7%	61.5%	56.7%	46.4%	62.3%	50.0%	59.8%
Both	74.6%	76.1%	78.1%	77.6%	76.7%	78.5%	76.7%	73.2%	76.1%	81.3%	76.1%
Res+Comm											
Refrigeration	38.1%	20.3%	22.7%	16.9%	35.3%	33.2%	35.3%	63.1%	20.2%	39.4%	28.3%
Air conditioning	35.2%	48.6%	46.8%	45.4%	45.2%	40.2%	39.4%	22.0%	44.9%	29.9%	42.0%
Both	73.2%	68.9%	69.6%	62.3%	80.6%	73.4%	74.8%	85.1%	65.1%	69.3%	70.3%

Finally, it is necessary to estimate the share of energy contributed by different classes of equipment, since labelling and MEPS are specific to equipment types not to end uses. Table 15 gives our estimate of the share of end use by type of equipment in each sector, for the 10 PICs as a group, based on the following simple assumptions:

- 100% of residential sector household refrigeration, air conditioning, water heating and cooking is supplied by household type appliances;
- 9% of residential non-lighting energy (about 55% of "other residential") is used by the major household type appliances: clothes washers, clothes dryers and dishwashers;
- 80% of commercial sector refrigeration and air conditioning is supplied by household type appliances;
- water heating accounts for 5% of Commercial sector energy (about a quarter of "other commercial"), and household type appliances supply 95% of water heating energy
- cooking accounts for 7% of Commercial sector energy (about a third of "other commercial"), and household type appliances supply 80% of water heating energy
- 4% of commercial non-lighting energy (about 20% of "other commercial") is used by the major household type appliances: clothes washers, clothes dryers and dishwashers.

On these assumptions, nearly 82% of all residential plus commercial sector electricity in the PICs is used in household type appliances (lighting excluded). Of the commercial appliance types, the most significant energy users are air conditioners. Energy use by commercial type cookers and water heaters is likely to be very low.

This suggests that restricting energy labelling or MEPS to household type appliances alone would capture nearly all of the energy saving potential. Indeed, restricting the program to just household refrigerators, freezers and air conditioners to 7.5 kW cooling would impact on about 60% of non-lighting energy use in the PIC residential and commercial sectors.

Table 15 Share of Residential and Commercial End Use by Equipment Class, 10 PICs (Lighting Excluded)

	Resid MWh	Comm MWh	Total MWh	% of Total	Share of Com end use
Household type refrigerators, freezers	81694	38057	119751	26.2%	80%
Commercial type refrigerators, freezers, coolrooms	0	9514	9514	2.1%	20%
Household type air conditioners (to 7.5 kW)	17743	139614	157357	34.4%	80%
Commercial type air conditioners (> 7.5 kW)	0	34903	34903	7.6%	20%
Household type water heaters (inc solar/electric)	17145	13868	31014	6.8%	95%
Commercial type water heaters (> 400 litre delivery)	0	730	730	0.2%	5%
Household type cooking equipment	22480	16350	38830	8.5%	80%
Commercial type cooking equipment	0	4087	4087	0.9%	20%
Household type clothes washers, clothes dryers, dishwashers	14904	11679	26583	5.8%	34%
All other equipment	11636	23162	34798	7.6%	66%
Total	165604	291964	457567	100.0%	
Household type appliance share of total	153968	219567	373535	81.6%	75.2%
Water heating share of Commercial energy	5%	14598			
Cooking share of Commercial energy	7%	20437			
Other household type appliance share of Commercial energy	4%	11679			
“Other” share of Commercial energy	11.9%	23162			

2.3 Equipment for Inclusion in Program

The appliances suitable for further consideration for a PIC labelling and/or MEPS program are those which meet the following criteria:

1. they already account for a significant share of PIC energy consumption or peak demand in the household and/or commercial sectors;

2. they are likely to account for a significant share of PIC energy consumption or peak demand in the household and/or commercial sectors in the future;

3. they are sold in reasonably large quantities in most PICs;

4. they are covered by existing energy labelling or MEPS regimes in their countries of manufacture, or in their countries of trans-shipment (eg Australia);

5. the energy test in such energy labelling or MEPS regimes corresponds to the way the appliance is used in the PICs.

Table 16 indicates how well the products selected for this study meet these criteria. (It is emphasised that this is a preliminary assessment only: if a product meets some but not all criteria, it can still be further considered).

It appears that the following appliances are high priorities for labelling and/or MEPS:

- household refrigerators;

- household air conditioners (unitary and split, up to 7.5 kW cooling).

These account for over 60% of non-lighting energy consumption in the residential and commercial sectors.

The following appliances are of medium priority for labelling/MEPS:

- household freezers: significant energy use and sales, though somewhat lower than for the high priority group; relatively simple to include with refrigerators;

- commercial air conditioners: no dominant program in countries of origin (as yet) and lower sales per model, but large energy use per unit. Labelling and/or MEPS under investigation in Australia;

- electric storage water heaters: data on ownership is inconclusive, but large energy use per unit and need to guard against diversion of less efficient product from Australian and NZ markets;

- clothes dryers: low ownership base, but increasing in some PICs.

The following appliances are of lower priority for labelling/MEPS:

- solar water heaters: no energy labelling program in countries of origin; many not connected to electricity so energy efficiency has no direct monetary impact;

- clothes washers: ANZ program well established, but usage in PICs is significantly different from Australia, where washing in warm water and drying of clothes in electric dryer are more common;

- dishwashers: ANZ program well established, but negligible ownership, low sales in PICs

- LPG water heaters: ANZ program well established, and may merit further investigation in some PICs, but will not have benefits for electricity supply

- electric cookers: no ANZ program yet, and difficult to establish a representative energy test, but may merit investigation if ANZ program introduced (this is unlikely in the short term).

Other equipment which will merit further investigation in PICs once labelling and/or MEPS programs are established in Australia are electric motors and office equipment.

Table 16 Preliminary Screening Criteria for Labelling and MEPS in PICs

	Present energy use		Projected energy use		Annual Sales	Origin	Home country program	Usage Similar to PICs
	HH	Comm	HH	Comm				
Household refrigerators	V High	High	V High	High	High	ANZ, others	Yes	Yes
Household freezers	Medium	Medium	Medium	Medium	Medium to high	ANZ, others	Yes	Yes
Household air conditioners <7.5kW	Medium to low	V High	Medium	V High	High	Many	Yes	Yes
Commercial air conditioners >7.5 kW	-	High	-	High	Low	Many	No(a)	Yes
Electric storage WH	Medium	Medium	Medium	Medium	Low	ANZ	Yes	Yes
Solar WH	V Low	Low	Medium	Low	Low	ANZ, other	No	No
LPG WH	Low?	Low?	Low	Low?	Low	ANZ	Yes	Yes
Clothes washers	Low	?	Low	?	High	ANZ, other	Yes	No
Clothes dryers	Low	?	Medium	?	Low	ANZ	Yes	Yes
Dishwashers	V Low	?	Low	?	V Low	ANZ	Yes	Yes
Cookers	Medium	Medium	Medium	Medium	Medium	ANZ, other	No	Yes

(a) Energy efficiency data to common test (to ISO 5151) is available for models.

3 Program Elements

This chapter examines the various elements needed to make an energy labelling and/or MEPS program work in the PICs, keeping in mind the appliance priorities determined in the previous chapter, the origins of the priority products and the structure of the appliance market.

3.1 Appliance Energy Data

3.1.1 Testing and Registration

Energy Consumption Tests

In order to energy label an appliance, or to ensure that it meets whatever MEPS level might be adopted, it is necessary to carry out an energy test on one or more samples of that appliance. Each country which has an energy labelling or MEPS program specifies the energy tests which must be used. These may be spelt out in detail in legislation or in standards referenced by legislation.

The tests used in the USA, Australia, Japan or the EC are all different. In some cases the differences are relatively minor, eg slightly different temperature setting for air conditioner tests. In other cases they are major. Most countries test refrigerators empty and with the door closed, and at a high ambient temperature to simulate the additional heat load from door openings and from the introduction of uncooled food whereas the Japanese Industrial Standard specifies an actual door opening schedule.

It is difficult to translate the results of tests done to one set of standards to another. Where attempts have been made to develop a mathematical formula for this purpose, it has been found that "the formula correctly predicted the trends across all models of a given type but for individual models it could be quite seriously wrong" (Waide 1995).

Since it is fundamental to labelling and MEPS that the energy consumption data be as accurate as possible for each individual model, there is as yet no substitute for physical testing using the designated standard. (Computer simulation for some test points is being considered for commercial size air conditioners in Australia, but it is likely that at least one physical test will still be necessary. At present household size air conditioners are labelled on the basis of a physical test only).

The physical testing of refrigerators and freezers must be carried out in climate-controlled test chambers, where both the ambient temperature and the internal cabinet temperature can be regulated and monitored. For air conditioners, a split climate-controlled chamber is

required. The "outdoor" side is regulated to the conditions specified in the relevant standard, and the unit set to produce the required "indoor" conditions, which are usually cooler and less humid than the "outdoor conditions" - although when testing reverse cycle heat pumps, the indoor condition is warmer.

There are no laboratories in the PICs with the capability to perform climate-controlled energy consumption tests. It may be technically feasible to set up such a laboratory, say attached to the University of the South Pacific, but it would be expensive (of the order of A$250,000, plus annual running costs). These costs would have to be recovered somehow: from governments, or from appliance suppliers - who would have to pass the cost of testing on to consumers through the appliance price.

It is not necessary for the PICs to go to the expense of setting up a laboratory, since there is adequate testing capacity elsewhere in the region. The larger manufacturers supplying the PICs have their own laboratories, which they use in product development and to supply energy data where required by law (eg for the Australian energy labelling program). There are also several university, electricity utility, consumer association and commercial laboratories, in Australia, New Zealand, the USA, Malaysia, Japan and elsewhere, where smaller manufacturers without their own laboratories can have products tested. These laboratories are also available to governments who wish to check test results supplied by manufacturers.

Performance and Capacity Tests

When the energy consumption of a product is tested, it is relatively easy to test or verify other aspects of its capacity or performance. In fact. most energy test standards include minimum product performance standards. In the Australian program for example, refrigerators which cannot achieve an internal temperature of 3ºC in an ambient of 32ºC cannot receive an energy rating at all, and neither can air conditioners which cannot achieve an "internal" condition of 27ºC dry bulb/19ºC wet bulb when the "external" condition is 35ºC dry bulb/24ºC wet bulb.

The same principle applies to dishwashers and clothes washers, which have to wash to specified levels of cleanliness, and clothes dryers, which have to dry to specified moisture content. These tests also verify the capacity claimed by the supplier. It sometimes happens that clothes washers or dishwashers will not achieve the required wash standard with the weight of clothes or dishes claimed by the suppliers, but only with a smaller load. Where this has occurred in Australia, the supplier has been forced to change the product description on the label, in advertising and brochures. For example, it has happened that a washing machine originally claimed to have a 6 kg capacity has had to be relabelled as a 5 kg machine.

Perhaps the most important area where energy labelling can affect product description is with air conditioners. Our discussions with contractors in the PICs suggest that some air conditioner suppliers claim a higher cooling capacity than is really the case. They have been able to do this because capacity can be expressed in many different ways (eg motor wattage, motor horsepower, dry bulb output, wet bulb output, compressor cooling capacity, whole system cooling capacity). When coefficient of performance is defined for labelling or MEPS purposes, however, it must be done in relation to a standard definition of output capacity. The introduction of air conditioner energy labelling in Australia eliminated misleading statements about capacity, which were common before then.

It will be seen that the standardised energy testing associated with labelling or MEPS also has other benefits for the consumer:

- an assurance that the product meets the performance criteria incorporated in the energy test; and

- an assurance that the product has the load or output capacity measured in the energy test.

Of course, this means that some product suppliers might have more reason to fear an energy test. Not only might it show that a product is not energy efficient, but it may also show that it does not meet the performance criteria, or that it does not have the capacity which the supplier wants to claim for it.

Registration

A register of the energy and other attributes of each appliance is an essential regulatory and administrative element of any labelling or MEPS program. The labelling legislation in each Australian State provides for the establishment of a register, and requires that only products with a registered energy label can be sold. There is also reciprocal recognition between States, so that a product energy label registered in, say, New South Wales is also deemed to be registered in other States. Thus the complete Australian register is in fact the sum of the registers in each of the States.

The register has many uses:

1. as a point of checking and verification: the officers who process applications for labels or monitor products claimed to meet MEPS can review the test results attached to the applications before they register a label for the product - many errors, omissions or inconsistencies have been picked up at this point;

2. as a reference for checking whether labels which appear on products in the field have in fact been registered - it has happened that suppliers have invented wholly fictitious labels to avoid the cost of testing or to claim a higher energy efficiency;

3. as a means of monitoring the average energy efficiency of labelled products over time, and hence evaluating the impact of the labelling program and deciding whether other measures would be cost-effective. This can be done by estimating the annual sales of each product on the register, and deriving trends in "sales-weighted" energy efficiency;

4. as a means of producing printed guides to assist customers to choose the most efficient appliance;

5. as a basis for an inquiry service. Prospective appliance buyers could ask (by letter, telephone or even via the Internet) questions such as "what are the most energy-efficient refrigerators in the capacity range 200 to 330 litres?".

The establishment and maintenance of such a register is not a trivial exercise. Experienced officers are required to process applications from product suppliers, maintain the register (in paper and electronic form) and deal with inquiries from other jurisdictions, field inspection officers and the public. Attention must also be paid to de-registration of appliance once they are removed from the market, otherwise listings will be out of date and will bias analyses based on the register.

In the State of NSW, where most Australian appliance suppliers choose to register their products, administration and registration requires the equivalent of one full time officer (NSW 1995). It is about the same in Victoria, which also has a high rate of registration, but much less in the other States and Territories (perhaps a third of a full-time equivalent officer in each).

3.1.2 Options

Technical Basis

The PICs need to make a fundamental decision which energy tests should be used as the basis of labelling or MEPS. It is important that only one test be accepted for each appliance type: allowing a range of different labels, each based on different tests, will most likely be more confusing to buyers than having no labels at all.

In practice, the options are limited to:

- adopt the technical basis of the Australian energy labelling and MEPS program (ie the Australian standard energy tests, which cover the products listed in Table 1);

- adopt a different set of tests: eg the International Standards Organisation (ISO) tests used in Europe, or the Association of Home Appliance Manufacturers (AHAM) or National Institute of Standards and Testing (NIST) tests used in the USA; or

- develop a new set of tests for the priority appliances.

The criteria for deciding between these options are:

- how costly is it to get the necessary data for the appliance models sold in the PICs?

- how costly is it to check the data?

- do the tests correspond reasonably well to the way the appliances actually operate in the PICs?

The adoption of the Australian tests best meets each of these criteria. It is a low-cost option, both for PIC governments and most product suppliers, since the test standards are well established and widely available, and the cost of maintaining and revising them is borne by industry and government in Australia and New Zealand, as part of the normal standards development process.

It would also make it relatively cheap for manufacturers to supply the test data for the models sold in the PICs. Our analysis of the product range sold in PNG, Fiji and Tonga (see Appendices 3 to 5) suggests that the following proportion of the models sold would already have energy consumption test results registered in Australia (or, in the case of electric water heaters, conform to Australian product standards):

- refrigerators: 80-90%
- freezers: close to 100%
- clothes dryers: 90%+
- clothes washers: 50-70% (there are several twin tub models not seen in Australia)
- dishwashers: 90%+
- air conditioners (to 7.5 kW cooling): 40-60%
- electric storage water hearers: close to 100%
- LPG storage water heaters: close to 100%.

The lowest coverage rate is for air conditioners. However, the air conditioner test conditions used in Australia are identical to the ISO test conditions used through the world, so test information should be readily available even for models not registered for sale in Australia at present.

The Australian standard energy and performance tests are also reasonable reflections of the operating conditions in the PICs. For refrigerators and freezers in particular, they are far more stringent than the European tests (although the ISO allows for a "tropical" test condition, such tests are not routinely carried out for refrigerators designed for the European market).

It has been found in actual operation in Sydney, refrigerators consume about 90% of the energy indicated on their energy label (GWA et al 1993a). Given the higher year-round average temperatures in most PICs, actual energy consumption is likely to be similar to, or slightly exceed, the label value.

With air conditioners, it is necessary to consider not only energy efficiency but also dehumidifying capability, especially in the humid climates of the PICs. At the ISO test conditions, a typical air conditioner produces about 80% of its cooling effect as sensible (ie through lower air temperature) and about 20% as latent (ie through lower humidity). However, there is considerable variation in this ratio. Air conditioner buyers in PICs might wish to seek out models with a high latent cooling ratio, and avoid models with low latent cooling ratio.

As it happens, this information is measured and recorded during the energy test, and is used to calculate the energy efficiency reported on the label. However, dehumidification itself is not reported on the energy label (some manufacturers report it in their brochures, sometimes in terms of "litres of water removed per hour"). Therefore the PICs may wish to investigate how to collect and convey this information within the structure of a labelling program.

Labelling Options

The labelling options may be somewhat wider than the technical options. In theory, it may be possible for PICs to accept energy test results based on the Australian standards, but require that the information be conveyed in a form different from the Australian energy label. If this were the case, suppliers would have to either identify the units to be shipped to PICs and put on the correct label in the factory (which ANZ manufacturers are able to do for products sold in bulk to the trading houses, but not the products reaching the PICs through wholesalers) or arrange for the correct label to be affixed further along the distribution chain, by the wholesaler or even the retailer.

The option of having labels added by retailers was considered before the Australian labelling program was launched, but rejected by the industry itself because of the high risk of leaving labels off or putting the wrong labels on. Wholesalers of appliances imported to Australia from other countries fix the labels on in the warehouse, or sometimes arrange for labels to be fixed in the home country before shipping to Australia.

If the Australian energy tests are accepted as the technical basis for labelling in the PICs, the most cost-effective and reliable option would be to accept the Australian energy label as well. However, this would not necessarily rule out other means of conveying *additional* information in the PICs, either on supplementary labels or in separate guides. For example:

- the Australian energy label for air conditioners gives an annual electricity consumption based on 500 hours of cooling at full load. This is probably a gross underestimate for PICs - based on survey information in PNG, commercial use (which accounts for the vast majority of air conditioner energy in the PICs) can run to 2000 or even 2500 hours per year, and even allowing for the fact that some of the operation is at part load conditions, full-load equivalent operation could be well over 1,000 hours per year. This magnifies the importance of choosing a more energy-efficient air conditioner. It would be possible to publish a guide to labelled air conditioners, with annual consumption based on more hours of operation, together with an estimated cost based on local electricity tariffs;

- the dehumidification performance of air conditioners could be indicated on a supplementary label, or (perhaps a safer option) be incorporated in the separate guide (see above);

- there could be an optional, additional label to identify "most energy efficient" products. For example, the Victorian government has a "galaxy award" sticker which all products which score 5 or 6 stars on the 6-star energy label scale are entitled to carry, if their suppliers choose to put them on (those products are still required by law to carry the normal energy label). The "galaxy award" sticker becomes a quick way of identifying the most efficient products. However, the label scale for some products means that even the most efficient on the market does not rate more than 4 or even 3 stars (eg clothes dryers, top-loading washing machines and small refrigerators). A label to indicate the most efficient locally available models in these categories would be useful to PIC customers, but it would have to be added in the country of sale, and may be misused by unscrupulous retailers.

All in all, the most reliable route for actual product labelling is to have the Australian label on its own, and convey any additional information via other means such as guides. In order to avoid confusion, some PICs may wish to require that any labels referring to energy consumption or energy efficiency which are *not* in the specified or approved format must be removed. This would avoid the confusing situation where a product might have several different energy labels on it, or the supplier's own sticker claiming "this is the most energy efficient refrigerator you can buy". The Australian energy labelling regulations prohibit the use of non-authorised energy labels, and also specify the actual location of the label on the product, so it is displayed prominently.

3.2 Regulatory Instruments

3.2.1 Need for Regulation

Another basic issue for the PICs is whether to have a "mandatory" program, whereby all products have to be labelled or conform to specified MEPS levels by law, or whether to have a "voluntary" program.

Labelling

It must be said that the only instances of successful implementation of energy labelling in the Pacific region have been mandatory. Labelling is mandatory in the USA. In Australia, the Commonwealth and State governments tried to negotiate voluntary energy labelling with the appliance industry for nearly 3 years, but in the end the program was only implemented once the NSW and Victorian governments decided to make it mandatory. In New Zealand, where appliance labelling is not mandatory, the level of labelling is very low.

There is an intermediate option between voluntary and mandatory. If there is a strong industry association, it can agree with government to enforce labelling among its members, without the necessity for actual regulation. For this to work the association must have near-complete coverage of the appliance suppliers in its area, and have the means to enforce compliance among its members. The best example is the Australian Gas Association (AGA), which covers all gas utilities and gas appliance manufacturers and importers in Australia. The AGA has managed its own energy labelling program since the mid 1980s, but did not achieve universal compliance until the mid 1990s, when it wrote the labelling requirements into the gas product codes. Since the utilities will not connect products that do not comply with the codes, this ensure compliance.

There are no appliance industry associations in the PICs which have anywhere near this level of coverage or influence. On the other hand, the trading houses are extremely influential. It may be open to PIC governments who want a "voluntary" labelling program to negotiate it with key elements of the appliance industry: manufacturers, wholesalers and retailers. If Morris Hedstrom, Burns Philp, Brian Bell and other major trading houses were to agree to label all appliances in the target groups (say refrigerators, freezers and air conditioners) using the Australian energy label, then the rate of labelling might be high, at least for a while.

However, it would be necessary for the trading houses to make detailed arrangements with their suppliers, and to monitor compliance. In effect, the administrative responsibilities and costs would be borne by the trading houses, not the PIC governments. This may suit the governments but not the trading houses, who may well argue that administration of the program is properly the business of government.

Another weakness of voluntary arrangements is the likelihood that some suppliers and/or retailers will decline to volunteer. In all probability, it will be the less efficient products that will go unlabelled, and the less scrupulous suppliers that refuse to participate or who misuse the label. If so, consumers would be deprived of information and protection when they most need it. Furthermore, the responsible suppliers may wonder why they should bear the costs of labelling when others do not, and might in time also withdraw. Australian experience has shown that industry itself generally prefers a program which places equal responsibility on all parties. If this cannot be done through a strong industry association, then the only option is government regulation.

MEPS

The arguments for a mandatory approach are even stronger for MEPS than for labelling. A mandatory energy labelling program obliges product suppliers to have an energy test done and to present the results on the labels, but it does not oblige them to remove products that are not efficient. The supplier can take the risk that customers will not take much notice of the label, or that inefficient models will continue to sell in certain markets because they have special features which customers value, because competing products are equally inefficient, or simply because they are cheaper.

MEPS goes further, in that poor energy performers must be withdrawn from the market and cannot be sold at all. It is highly improbable that any supplier will do this voluntarily.

3.2.2 Options

The most appropriate regulatory vehicle for mandatory labelling and/or MEPS will vary from country to country. The following observations are made specifically in relation to PNG, Fiji and Tonga. The range of options in other PICs may be different

Consumer Regulation

Some PICs have consumer protection legislation which empowers them to make regulations or standards relating to product safety, the information to be supplied on or with products, product quality and performance. Fiji, for example, has the *Trade Standards and Quality Control Decree 1992*.

Mandatory energy labelling could be introduced through a regulation requiring a removable energy label to be displayed on all (new) products of specified types offered or displayed for sale. The regulation would also need to specify:

- the form, size and colour of the label, its location and method of fixing
- the information to be on the label (eg model number, capacity, kWh/yr)

- the technical tests on which the information on the label is to be based (eg the number of the relevant Australian Standards)

- the need for the label to be registered with a designated authority, and what information is required when applying for registration (eg copy of laboratory test results)

- whether labels registered in other countries are deemed to be registered, and if so what proof of registration is required

- procedures to be followed in the event that the information on the label is suspected to be inaccurate or misleading.

Consumer legislation could also be used to enforce MEPS. Since energy efficiency is clearly an aspect of product quality, it should be possible to make regulations specifying minimum acceptable levels of energy efficiency for all (new) products of specified types offered or displayed for sale. These levels could refer to published Standards (eg "water heaters to have a standing heat loss no higher than required under Australian Standard 1056") or set out as mathematical formulae in the regulation itself.

Electrical Safety and Approvals Regulation

Another possible avenue for enforcing labelling or MEPS is electrical safety and approvals legislation. The PNG Electricity Commission Act, for example, enables the Commission to "make laws, not inconsistent with this Act, for carrying into effect the purpose of this Act, and in particular-...

(l) for regulating the lamps, meter appliances and electricity-consuming devices that a consumer may connect to an electricity supply"...

(o) generally for fixing and regulating standards of safety in the construction, operation, maintenance and use of...electrical apparatus and appliances".

While clause (l) appears to be wide enough to cover MEPS, and perhaps even a requirement for labelling, clause (o) limits the focus to matters of safety rather than energy efficiency or other standards of performance. Similarly, the current by-laws under the Act enable the Commission to prescribe articles, register them and control their sale, but also contains reference to "minimum safety standards" and defines "labelled" as "marked with a securely affixed label or sticker of a permanent nature. Electrical safety, after all, was the primary motivation for framing legislation of this type, and some amendments or new by-laws may be necessary to extend the scope to cover energy efficiency. This is the way energy labelling was first introduced in NSW.

Product Standards

Whether consumer or electrical legislation is used as the vehicle for labelling and MEPS, a large amount of detailed and highly technical information needs to be incorporated. It is possible to spell out how to conduct an energy test or include a diagram of the label in the regulations - as was done in the early stages of labelling in Australia - but it is much more efficient to reference an external standard.

The advantages of reference to published (eg an Australian or New Zealand) standards are:

- completeness: the selected standards should contain all the necessary information (eg via reference to other standards on measurement, instrumentation etc), whereas the regulations may well miss out some crucial point;

- consistency: even where different jurisdictions intend to frame identical regulations, inconsistencies inevitably creep in because of differences in the legislation. This has happened between the Australian states. If all jurisdictions reference the same set of standards, then the technical basis of labelling or MEPS will be the same in all;

- ease of amendment: if the tests need to be updated, this can be done through issue of a new edition of the standard, rather than through extensive revision of regulations. amendment: even if the regulation call up a specific edition by year, rather than the series, it is relatively simple to change the edition year in the regulation.

The disadvantage of calling up a standard is lack of direct control. It is possible that the standards bodies might make a change which does not suit the requirements of PIC governments. In that event, however, governments could retain the reference to the previous edition, or de-couple the labelling regulations from the standard altogether and include whatever details they want in the regulations.

After some years of separate, not always consistent State-specific regulations, the Australian States are now simplifying their regulations and referring to a new set of standards to be published by Standards Australia for this purpose. These will contain the details of the energy tests, labelling requirements and MEPS levels for the relevant products. Although industry and other interests will also be represented on the Standards committees, Governments will retain veto control.

If PIC governments decide to adopt the Australian program, they may wish to call up the relevant standards in their own regulations (perhaps after designating them as national standards for their own countries). If so, they might also seek representation on the relevant Standards committee - perhaps via the FSED - so that their needs can be taken into account in future revisions.

3.3 Registration, Check Testing and Compliance

3.3.1 Energy Consumption Testing

There are two distinct approaches to the initial energy testing of products for approval under labelling or MEPS: asking for samples to be submitted for testing by the responsible authority, or accepting test results submitted by the applicant.

In the US MEPS program for air conditioners, manufacturers or importers submit samples of all models to a central laboratory contracted by the Department of Energy (Underwriters Laboratory). The applicant pays the test fees. The Australian labelling program works on the other model: applicants can submit test results from their own laboratory or any other laboratory of their choosing.

The main control on the accuracy of the results is a random check testing program. The Commonwealth and State governments spend about $ 250,000 per year on purchasing appliances in showrooms and paying for energy tests in independent laboratories. If the results exceed the labelled consumption by more than the variability range permitted under the regulations, the supplier is contacted and further tests are carried out. If the variation is still too great, the label is cancelled and a new application must be made. Under extreme circumstances, the mis-labelled product must be withdrawn from sale.

Given that there are no laboratories capable of testing appliances in the PICs, the only practical option for PIC governments is to follow the Australian system, and allow applicants to submit test results. A further refinement might be to accept only tests carried out in approved laboratories. There are international accreditation agencies which could provide a list of suitable laboratories.

The PICs may also wish to set up a random check testing program. If so, it should concentrate on products not registered for labelling in Australia. The products selected for random testing would have to be sent to approved independent laboratories in the region. The closest are likely to be in New Zealand or Australia. The costs would need to be met, in the first place, by governments (or perhaps electricity utilities, if they are made responsible for labelling). They could then be recovered from utility customers (via the tariff) or through the product registration fees.

Alternatively, the Australian government could be approached to undertake some tests for PICs within its own labelling program, perhaps as part of regional aid and assistance.

3.3.2 Registration

Each PIC which decides to implement a labelling or MEPS program will need to establish, or have access to, a register containing energy and other key data for all models covered by the program. The options for this include:

- each larger PIC could establish its own national product energy register; in some cases (eg PNG) the existing electrical safety registration process could serve as a base;

- smaller PICs could contract product registration to the larger PICs (although they may sometimes need to initiate the registration process, for smaller importers who only operate in that country);

- if several PICs decide to implement the program, they could set up a collective register in one PIC, or at a regional centre (eg the FSED);

- PICs individually, or collectively, could approach one of the registration authorities in Australia (say the NSW Department of Energy or the Victorian Office of the Chief Electrical Inspector) to carry out the registration on a contract basis. This would be efficient in that most of the models sold in the PICs are already registered in Australia;

- PICs individually, or collectively, could approach a private organisation or a standards accreditation body (eg Quality Assurance Australia) to carry out the registration on a contract basis.

The optimum arrangement would depend on how many, and which PICs wished to proceed. A single register would mean that expertise in processing applications, answering inquiries and maintaining the database could be quickly and cost-effectively developed. A single central point of registration, whether in a PIC or elsewhere in the region, would also be more convenient for the larger product suppliers, who operate throughout the region, but less so for the smaller ones. However, with the right communications technology all PIC government agencies and all other interested parties should be able to access the register without difficulty.

There will be opportunities to improve and streamline the PIC registration process compared to Australia: for example, photographs of products should be submitted with applications and filed, to assist later field identification.

3.3.3 Compliance

Inspection

Nominal compliance with MEPS can be assessed at the time of product registration, and actual compliance can be determined though later check testing. The options for check testing have already been discussed. Some aspects of compliance, especially for labelling, will have to be monitored in the field:

- are there products which should be labelled but are not? This is easy enough to tell, simply by visiting showrooms;

- is the label deliberately hidden, or are there other non-complying energy labels as well? Again, this can be ascertained easily enough;

- does the product carry the correct label for the product? A field officer will require some experience and familiarity to make a judgement. Alternatively a photograph can be taken of the label and the product, and sent to the registration authority;

- if a product is of a type covered by MEPS but not labelling, the field officer will need to establish that it has been registered as complying with MEPS. It will be necessary to check the model number information on its compliance plate, and perhaps take a photograph to send to the registration officer.

Some PICs (eg Fiji) already have inspectors attached to their Fair Trading or Consumer agencies. These could perform some of the above functions at little additional cost. They could also assist the program by explaining it to retailers, and keeping point-of sale leaflet dispensers stocked. The State of Victoria has the equivalent of 1.5 full time "retail liaison" officers attached to the energy labelling program for this purpose.

Alternatively, consumer groups, community groups and even schools could be asked to assist with informal monitoring, and advise the registration agency if they suspect non-compliance. This has occurred in Australia. Competing suppliers also check each other's products, and are usually keen to inform the registration authorities if they suspect non-compliance.

Prosecution and Penalties

Experience with labelling in Australia shows that if there is non-compliance, it will be detected or reported one way or other. The onus will then be on the authority responsible for the program to take action. If no action is taken, all suppliers will quickly become aware of it. This will seriously undermine the program and could lead to its collapse.

It is important for PICs who implement labelling or MEPS to have some effective means of enforcing compliance, to have the determination to use those means and to communicate this intention to all interested parties. The following might be considered for inclusion in regulations:

- the right of the responsible authority to order unlabelled or mis-labelled products to be withdrawn from sale;

- the right of the responsible authority to order products known or suspected not to comply with MEPS to be withdrawn from sale;

- fines for offenders who do not comply with orders.

In addition, there may be effective non-legal ways of encouraging compliance, such as the publication of the pictures and descriptions of non-complying products, and the exclusion of suppliers of non-complying products from government tenders.

Another important aspect of the compliance regime is where responsibility lies. In Australia, it is the retailers who are legally obliged to have the correct labels on products they display for sale, even though it is the manufacturers who test the products and put the labels on. This decision was taken in order to streamline the compliance process and allow the rapid withdrawal of non-complying models. It is relatively simple to issue an order to a retailer not to display or sell a specific model, but more difficult to order a manufacturer or wholesaler not to ship it to the next part of the distribution chain. The end of the chain - the point of transfer to the customer - is the most clearly identifiable point.

3.4 Consultation, Promotion and Extension

3.4.1 Governments and Business

Those involved in the supply and distribution of appliances in the PICs should be consulted before governments take final decisions about labelling or MEPS. Once a decision is taken, they will need to be informed about the details of the program.

Product Suppliers

The major manufacturers of products sold in the PICs, such as Fisher & Paykel, Email, Carrier and Daikin will all be familiar with the operation of labelling and MEPS in Australia. They can be contacted via their regional head offices. They will mainly be concerned that the PIC programs are compatible with the Australian, so their costs of compliance will be moderate.

The many smaller importers, and those manufacturers in countries such as Malaysia or Korea with no experience of energy labelling, may require more effort to contact. It will be especially important to engage them in consultations early in the process, since this is where difficulties may well arise.

Retailers

The large regional trading house should be involved early in the process. Experience in Australia shows that retailers form a crucial link in the communication chain. Early in the program, customers often rely on sales assistants to explain the label to them. Some of those we spoke to are already well informed about labelling, but many are not. The trading houses are likely to have good internal training and communications systems for their staff, so if the senior management supports the program this will diffuse through the organisation. PIC governments can assist by providing leaflets and training kits designed especially for retailers.

Smaller appliance retailers and air conditioning contractors will also need to be contacted, but they will probably not be able to attend meetings. Notices in the press, letters explaining what is intended, and perhaps visits from energy agency or utility personnel, may be necessary.

Others

In the larger PICs there may be several departments or agencies interested in the program - the energy departments, consumer and fair trading departments, the electricity utilities, and possibly trade and customs.

Consumer groups (whether statutory bodies such as the Consumer Council of Fiji, or non-government organisations) are potentially strong supporters of the program, and should be consulted and informed at an early stage.

3.4.2 Appliance Buyers and General Public

In the case of MEPS the public information requirements are relatively simple. The public would need to be prepared beforehand if a significant reduction in the range of models on the market were expected, but the effectiveness of MEPS would depend largely on the effectiveness of the administrative structure and the cooperation of suppliers. Labelling relies on these factors *plus* a high level of public awareness, information and motivation.

Ideally, consumers should understand the label in sufficient detail to be able to work out the purchase price plus running costs of two alternatives, and compare them (as in the example in the FSED booklet *Energy Efficiency for the Domestic Householder in the Pacific*). However, the program should be effective even if people only absorb the message: "the more stars on the label, the more energy efficient". In Australia, this is how the label tends to be used, not for detailed lifetime cost calculations. However, people need to have some idea of what lifetime cost means in order consider anything other than purchase price when they but an appliance.

Launching the Program

It will be necessary to inform the public about what the energy label is, how to use it to compare products, and how it can save people money. One of the most important messages to get across is that the energy cost of owning an appliance is as great, or greater than the purchase cost. (The theme could be "you still keep paying after the hire purchase finishes").

The best media and messages to use will be different in each PIC. When labelling was launched in Australia, there was a large advertising campaign using television, radio, newspapers, magazines, outdoor billboards and point-of-sale posters and leaflets in appliance showrooms. The electricity utilities also distributed information with their bills, and the labelling agencies sent out press kits which prompted more publicity.

On-going Publicity and Information

Some information will need to be continued after the initial launch. While the initial publicity campaign should be general, the on-going information should be targeted at people who are actually considering buying appliances. The label itself is a good reminder to take energy into account when choosing a product, especially if it appears on every single model in the showroom. Leaflets which explain how to use the label, and listings of all products labelled, should be made available at the point of sale.

Another cost-effective form of on-going publicity would for retailers to include the energy rating of labelled appliances in press advertisements and in their brochures. This has not been done with any consistency in Australia. The governments of PICs which implement labelling could consider negotiating an agreement with retailers to this effect, or perhaps consider including it as a requirement in regulations.

Market research

It would be useful to carry out some surveys of recent and intending appliance buyers in the larger PICs before energy labelling commences. This will have two purposes:

- to see what proportion are aware of and understand the energy label, and how much emphasis they place on running costs: asking the same questions at regular intervals (say annually) will give an indication of the effectiveness of labelling;

- to get some idea of what is important to appliance buyers, so that the most effective messages can be used in the initial publicity campaign.

3.4.3 Possible Extension and Reinforcement

Financial Incentives

It is possible that the most energy-efficient products might cost a little more than others, although we do not have enough data to draw a definite conclusion. It is more likely that the very least efficient products will be cheapest, since such products tend to be of lower quality in all aspects of performance, including energy efficiency.

Financial incentives could make it easier for customers to meet any extra costs involved in buying more efficient appliances. One possibility may be for electricity utility to offer a cash rebate for the purchase of specified, energy efficient products. The customer can then repay

the rebate through their electricity bills, but the bills would be lower than otherwise because the product is more efficient.

In effect, the utility makes a loan to the customer which is repaid from the energy savings. This could overcome the reluctance (or inability) of some customers to pay more for an efficient product.

Let us take the refrigerator example in the FSED booklet *Energy Efficiency for the Domestic Householder in the Pacific*. Refrigerator Model "A" uses 810 kWh per year, costing $ 129.60 per year at a notional tariff of 16 c/kWh. Model "B" uses 1370 kWh per year, costing $ 219.20. The difference in running cost is about $ 90 per year. Let us say that Model A costs $1000, and Model B costs $ 900. The customer could get a voucher for $ 100 toward the purchase of Model A from the energy utility, and repay the utility $ 130 over 2 years (to allow for interest and administration). This would mean a payment of $ 1.25 a week. However, the customer would be saving $ 1.73 in electricity each week (compared with Model B), so they will still be $ 50 better off after 2 years. After that, they keep the benefit of all the savings.

Given the smaller refrigerators preferred by most customers in the PICs, the difference in annual running cost between alternative models is likely to be no more than about 100 kWh ($ 16 per annum at the notional tariff). However, the cost differences are also likely to be smaller.

While such an arrangement could work with other loan providers, the utility would be ideal because:

- it is in a strong position to credibly advertise and promote a program based on energy efficiency

- it stands to gain considerable long term benefits through the slower, more predictable load growth brought about by more energy efficient end use devices;

- it has regular transactions with the customer through the bill anyway, so the marginal administration costs are low. It is noted that the nature of the transaction will be changed by the introduction of prepayment meters, such as is occurring in PNG. It needs to be investigated whether the system is capable of "repayments" - eg by subtracting the repayment from the amount tendered at the payment point.

A simpler incentive scheme would be for the utility to make the incentive payment for the purchase of the more efficient appliance, without repayment. This occurs in some US utility areas, where the marginal cost of supply exceeds the tariff that can be charged (at least to some customers), so the utility is better off by ensuring that those customers have the most efficient appliances.

With any incentive scheme, it is necessary to take care that the value of the incentive is not captured by the appliance suppliers and retailers, who increase the price of the products attracting the incentive. It would be necessary to monitor the prices of the products before the program, and gain agreement from the retailers not to raise the price (or perhaps even add a discount of their own) in return for greater sales.

Government Purchase

Large buyers of appliances could use their purchase power to influence the market towards energy efficiency. Once there is a labelling program to indicate the energy efficiency of every model, it becomes possible for large buyers of appliances, both government and private, to take this information into account when issuing tenders. Further, the government could set minimum energy performance standards for the refrigerators or air conditioners it buys for its own offices and housing. These could be set higher than any general MEPS level.

Intermediary Training Programs

For air conditioners, it is common for the contractor to advise the buyer on selection and installation. There should be special training programs for air conditioner contractors on how to interpret and explain the energy labels.

The design energy efficiency of a new appliance is not the only thing that determines its operating efficiency and energy consumption. Maintenance is also important. A poorly maintained refrigerator or air conditioner will use far more energy than a properly maintained one. (For an equal level of maintenance, the one that started off more efficient will most likely remain more efficient).

SRCI proposed a "commercial refrigeration maintenance program" and an "air conditioner equipment maintenance program" among their recommended DSM programs. Since the people who maintain this equipment will from time to time select or advise on new equipment (often multiple purchases of domestic style products) it would be efficient to introduce and explain labelling in the training materials and sessions.

3.5 Scope for Common Action

3.5.1 Between Pacific Island Countries

Implementation Options

It would be impractical for any of the PICs we visited (or those for which we obtained detailed market information from the FSED) to implement MEPS or labelling regimes which differ in their core elements from the Australian regime. For reasons of cost and administrative efficiency, the core elements - the energy tests, MEPS levels and the energy label design - need to be the same as for the Australian program. It is possible that the appliance markets in some of the smaller countries, from which we have not yet received information, are sufficiently different to make other labelling options possible in those countries, but this would still not alter the situation in PNG, Fiji and Tonga, the Cook Islands or Kiribati.

If the Australian program were adopted as the "core" for a Pacific program, each PIC would still have the following options:

1. not to participate at all;

2. adopt labelling for some or all of the products for which core elements have been developed in Australia, and where according to our analysis significant energy savings can be made in most PICs: ie refrigerators, freezers, air conditioners;

3. adopt labelling for some or all of the products for which core elements have been developed in Australia, and where lower energy savings can be made in most PICs: ie clothes washers (lower saving potential because of cold wash), clothes dryers, dishwashers, electric water heaters and LPG water heaters (lower saving potential because of low ownership);

4. adopt the Australian MEPS levels for some or all of the products for which MEPS is to be introduced in Australia: refrigerators, freezers and electric water heaters;

5. adopt MEPS for products where MEPS have been considered in Australia, but no decision has been made to proceed (especially air conditioners). The balance of costs and benefits may well be different in PICs.

Apart from option 1, none of the others are mutually exclusive.

Also, the PICs should monitor the situation for products where labelling and MEPS are still being considered in Australia and/or New Zealand. These are (for Australia): electric motors, fluorescent lamp ballasts, larger air conditioners (above 7.5 kW cooling) and office equipment, and for New Zealand, electric motors, fluorescent lamp ballasts and fluorescent tubes. It would be premature for the PICs to take decisions regarding these appliances until the situation in Australia and New Zealand is clarified.

Joint Administrative Structure

Those PICs which decide to participate could share some of the costs of a common administrative structure. Participating PICs could establish a central database for data on every appliance registered for MEPS or labelling in any of the participating PICs, and share the costs according to share of appliance sales or some other formula. It would be up to participating PICs whether they wish direct all supplier applications to the same central point, or retain an independent registration capability in their own country. A single point of registration would have the advantages of efficiency and expertise.

It is possible that some countries' labelling regulations might require that there be an official national register available for public inspection within the country. If so, this could be a regularly updated copy of the central database.

Other areas where costs could be shared are:

- check testing of models sold in several countries: check testing of models sold in one country only may have to be the responsibility of that country:

- the production of labels and guides: if the range of models sold in participating PICs is reasonably similar, then the same guide could be used in all. Even if not, it might still be cost-effective for the central registration agency to produce separate guides for each country;

- liaison with the major appliance manufacturers and with the trading houses, most of whom operate regionally.

- occasional program evaluations.

When energy labelling began in Australia in 1985, there was no coordination framework other than informal consultations between the two original labelling States, New South Wales and Victoria. The 1991 review of the program found that a lack of a coordinating structure had become a major difficulty, and shortly after that, two separate bodies were established:

- the National Appliance Energy Efficiency Coordinating Committee (NAEECC), consisting of officials from all States and Territories, New Zealand and the Commonwealth. This coordinates the regulatory and administrative basis of the labelling and MEPS programs, including check testing; and

- the National Appliance Energy Efficiency Advisory Panel (NAEEAP), consisting of representatives of appliance manufacturers, importers, retailers, standards bodies, the utilities and consumer groups, as well as some NAEECC officials. This considers the wider issues of maintaining and extending the program, and provides a means for conveying the views of other interested parties to the governments.

Depending on the number of PICs which choose to participate, there may be need for a coordinating bodies along the lines of NAEECC and NAEEAP, perhaps attached to the FSED.

There are some local functions which each participating PIC will need to do for itself. These include:

- field monitoring of local compliance with MEPS and/or labelling requirements: some PICs will already have fair trading inspectors who can take on this function, while others will need to rely on informal monitoring or make other arrangements;

- general publicity support for the program: some PICs have higher levels of appliance penetration and use, and may wish to spend more on promoting labelling than others. Also, the most effective media and messages will differ in each PIC;

- liaison with local retailers and product suppliers.

3.5.2 With Australia and New Zealand

If PICs adopt a labelling and MEPS program based on the Australian system, there would be considerable scope for coordination and joint working arrangements. Because of high level of overlap in the models registered, it may well be cost-effective for the PIC appliance database to be maintained by one of the Australian State registration bodies, a standards body or other private organisation. The cost of this could be met by the participating PICs on a commercial basis, or the Australian government could be approached for support as an aid project.

The PICs would also benefit from involvement in:

- the Australian and New Zealand standards bodies: while full participation for the many appliances covered may be expensive, PIC standards bodies with ANZ links (eg the PNG National Institute of Standards & Industrial Technology), or the FSED, could monitor developments and alert PICs to relevant issues;

- the National Appliance Energy Efficiency Coordinating Committee (NAEECC): New Zealand is a member despite the fact that it does not have mandatory labelling, and if the PICs adopt the Australian program, they should also consider applying for membership. NAEECC manages a joint check testing program.

4 Program Costs and Benefits

The costs and benefits of MEPS and labelling for PNG, Fiji, Tonga and for all PICs as a group have been estimated using the computer modelling detailed in Appendix 6.

4.1 Labelling, MEPS or Both?

4.1.1 Criteria

The core technical elements for energy labelling and MEPS are identical. Each model needs to undergo the prescribed energy test, and the results need to be registered. The energy consumption might then be made public (via an energy label, guides etc), checked to ensure that it meets the MEPS levels, or both.

In Section 2.3, we identified those appliances for which efforts to increase energy efficiency in the PICs via labelling and/or MEPS would be justified on energy grounds, and which met certain other market-related and administrative criteria. We now review which approach might be preferable: MEPS only, or both labelling and MEPS.

Labelling should be considered for products where:

- an Australian energy label already exists;
- there is already some use of the label in the PICs;
- the products are purchased largely by the end users responsible for paying the electricity bills, so that there is a direct benefit to them from using the label to purchase more efficient appliances;
- there is a reasonably wide range in the energy efficiency of products on the market in the PICs: labelling has less impact if all models appear to be of similar efficiency;
- the great majority of the market is supplied by new rather than second hand imports.

MEPS should be considered for products where:

- MEPS levels exist, or will be introduced in Australia or New Zealand. If so, then (a) the same levels can be adopted without carrying out time-consuming analyses of preferred levels in the PICs, and (b) defensive adoption of the same levels at the same time will guard against the diversion of sub-MEPS stock to the PICs;

- the products are purchased not by the end users but by intermediaries such as builders who are interested only in first cost rather than operating cost and lifetime cost. Such users are not responsive to labelling;

- product test results can be compared with the MEPS levels with a high degree of confidence. If not, MEPS compliance is more difficult to determine, and can lead to higher administrative and check testing costs, and possibly to legal challenge.

In practice, the last of the above conditions can be more easily met if there are discrete levels of efficiency on the market, rather than a continuous range. For example, virtually all ballasts for 50 mm (36W or 40W) fluorescent lamps fall into three classes: the most common "code" ballast which consumes about 9w, the "low-loss" type which uses about 5.5W, and the "super low loss" which uses around 3W. Setting a nominal MEPS level of 6w would eliminate the "code" ballast from the market. Since these models are easy enough to identify from markings and numbers, checking compliance would be relatively simple (Energetics and GWA 1994a).

Refrigerator and air conditioner models, on the other hand, can fall anywhere along a continuous efficiency spectrum from the most to the least efficient. If a MEPS cutoff level is set somewhere along this range, then careful attention will need to be paid to those near the MEPS level. Those that appear to be just above it may in fact not pass when check tested, and vice versa. The greater the natural variability of the energy test, the more scope there is for uncertainty and dispute.

This was one of the major reasons why the 1993 study of MEPS for Australia did not recommend MEPS for air conditioners for the time being. However, it also recommended that "...the situation should be reviewed after the energy test is revised" (GWA et al 193a).

Some of these compliance difficulties will be present in the PICs, and perhaps more so during the early phases of any program. On the other hand, the benefits of increasing air conditioner energy efficiency are significantly greater in the PICs, because of far higher annual use and higher energy costs. Therefore air conditioner MEPS should not be ruled out, although an intermediate data gathering stage would be advisable before full MEPS and/or labelling were implemented.

4.1.2 Considerations for Each Product

Refrigerators

Household refrigerators meet most of the criteria for both energy labelling and MEPS. Many purchasers could be motivated to use the label, but some important groups are not likely to, so there is a case for MEPS. There are also reasons for "defensive" MEPS: the

planned adoption of MEPS in Australia (in September 1999) and the occasional shipments of low quality, and in all probably low-efficiency product from outside the region.

Table 17 summarises the two door refrigerator-freezer models available in the best selling size range (210 to 350 litres). All models in this range seen on our visits to PNG, Fiji or Tonga are listed. Not all models listed are seen in every country at all times, and it is possible that other brands and models appear from time to time, but the table represents the widest range of choice usually available to PIC buyers in this size range.

Table 17 Models Available: Class 4 Refrigerators, 210 to 350 litres

Manufacturer	Brands	Fresh food ltrs	Freezer ltrs	Total ltrs	Labelled kWh/yr	Dial (a) rating	Star rating
Gorenje Pacific	GP, Frigidaire	191	16	217	493	3.46	3
Email	Malleys	165	51	216	650	2.84	2
Email	Westinghouse	166	51	217	720	2.33	2
Fisher & Paykel	Shacklock, F&P, Kelvinator	191	57	248	560	4.01	4
Gorenje Pacific	GP, Frigidaire	188	68	256	628	3.77	3
Hoover	Hoover	226	60	286	730	3.50	3
Email	Westinghouse	227	79	306	700	4.00	4
Fisher & Paykel	Shacklock, F&P, Kelvinator	227	94	321	710	4.19	4
Fisher & Paykel	Kelvinator	227	94	321	740	4.00	4
Gorenje Pacific	GP, Frigidaire	260	68	328	693	4.21	4

Source: Appendix 3. (a) Energy efficiency rating, as indicated by dial scale behind stars on label

If all the information on Table 17 as well as purchase price were available to buyers, they could make an informed choice about energy efficiency. It would be difficult for any single buyer to assemble this information, even if they went to many showrooms and all the units in each showroom were labelled. This emphasises the value of leaflets and guides listing all models.

Buyers looking at units around 220 litres, for example, would be in a position to compare the 217 litre Westinghouse, using 720 kWh per year, with the 217 litre Gorenje Pacific, using 493 kWh per year (noting that the former has a much larger freezer). The differences are not always as great. All models in the size range 286 to 328 litres consume between 693 and 740 kWh per year, and are all 4 stars (except one 3 star) so labelling may not have as great an impact on choice. Even so, labelling would enable the informed buyer to ask for the version of the F&P 321 litre model which uses 710 kWh rather than the one which uses 740 kWh (probably because it has a different compressor).

Of the models listed in Table 17, the only one which would fail to pass the Australian MEPS levels to come into effect in 1999 is the 217 litre Email. The maximum allowable annual energy consumption for each class of refrigerator is based on a formula derived from the

fresh food volume and the freezer volume. For a Class 4 cabinet of 166 litres fresh food and 51 litres freezer compartment, the allowable energy consumption is 677 kWh, or 6% less than the labelled consumption 720 kWh per year.

It is possible that non-complying models would be removed from the PIC markets by 1999 even if PIC countries did not formally adopt MEPS. On the other hand, it is possible that old stocks of the units no longer saleable in Australia would be shipped to the PICs. There is clearly a case for defensive adoption of MEPS for refrigerators.

Air Conditioners

Household air conditioners meet most of the criteria for energy labelling. Buyers typically have a reasonably wide choice of both window/wall and split system models around the cooling capacity they require. Tables 18 and 19 list some of the models available in the three PICs, as close to 3.5 kW cooling as possible. There are other models as well, but unlike refrigerators not all are known in Australia, so it was more difficult to get a complete listing.

Even with the selected models shown, there is a significant range in energy efficiency, as indicated by the dial rating. This is derived from coefficient of performance (COP) at the standard cooling test condition. Models with a COP of less than 2.1 rate 1 star, and each COP increment of 0.2 rates a further star up to a maximum of 6 stars for models with a COP of 2.9 or greater. For the window/wall systems shown, dial rating range from 2.4 to 4.0, and for the split systems, 3.3 to 6.15.

Table 18 Selected Models: Window/Wall Air Conditioners, 3.13 to 3.52 kW

Manufacturer	Cooling kW	Labelled kWh/yr	Dial (a) rating	Star Rating	3 x Label kWh/yr
Daikin	3.13	717	2.40	2	2150
Samsung	3.18	673	3.30	3	2020
Daikin	3.33	695	3.45	3	2085
Carrier	3.52	705	4.00	4	2115

Source: Appendix 3. (a) Energy efficiency rating, as indicated by dial scale behind stars on label

Table 19 Selected Models: Split System Air Conditioners, 3.49 to 3.52 kW

Manufacturer	Cooling kW	Labelled kWh/yr	Dial (a) rating	Star Rating	3 x Label kWh/yr
Toshiba	3.49	675	4.45	4	2025
Daikin	3.49	683	4.20	4	2050
Daikin	3.50	740	3.30	3	2220
Carrier	3.52	600	6.15	6	1800

Source: Appendix 3. (a) Energy efficiency rating, as indicated by dial scale behind stars on label

As with refrigerators, buyers can use the label either for a quick "efficiency check" or for a more informed comparison. In many capacity classes, there is a wide range of models on the market in the PICs: we identified some 1 star products (see Appendix 3) and, as Table 19 shows, 6 star products can also be obtained. A first objective of promoting labelling would be to make customers aware that this range exists, and that they should make a quick efficiency check to ensure that the model they are considering has a rating of, say, 4 stars or more.

For the informed purchaser who uses the label to systematically take energy efficiency into account, the full decision process will be:

1. determine acceptable capacity range (say plus or minus 10% of the target capacity) and compile short list of likely models based on what is available, the maximum money available for the purchase, brand reliability, after-sales service etc;

2. identify the most energy efficient models on the short list (ie the ones with the most stars and/or highest dial rating);

3. estimate the annual operating costs by multiplying the annual energy consumption on the label by the local electricity tariff;

4. estimate the lifetime costs for the short-listed alternatives as the sum of capital cost (purchase plus installation) and annual energy cost;

5. compare lifetime costs and make selection.

The annual energy cost can be calculated from the kWh per year on the label and the local energy tariff. The annual energy consumption indicated on the Australian label is calculated as the capacity, divided by the COP (*not* the dial rating) multiplied by 500 (the average annual hours of operation estimated in Australia). However, the annual hours of use in the PICs it can be 3 to 5 as great. The last column in tables 17 and 18 give three times the labelled consumption for each model. The difference between the highest and lowest labelled consumption values Tables 18 and 19 is 140 kWh per year, which would cost about $ 22 at a tariff of 16c/kWh, or $ 112 over 5 years of operation. Given the higher air conditioner use in PICs it is more likely to be about three times this: 420 kWh per year, or $ 340 over 5 years.

This higher the value of projected energy savings, the more likely it is to influence the purchase in favour of the more efficient model. The options to communicate this are:

- require a version of the energy label which states energy consumption over more operating hours (say 1500); and/or

- publicise the need to take more operating hours into consideration in leaflets and in the guides which list the energy efficiency of what is on the market.

Only the second option is practical. If the Australian labelling program is adopted, suppliers will not wish to use different labels for the PICs. Also, use of a different label would create a risk that some air conditioner labels appearing in PICs would be based on 500 hours of operation, and some on the higher value.

Air conditioners certainly meet one of the criteria for MEPS - many are purchased not by the end users but by intermediaries such as builders who are interested only in first cost rather than operating cost and lifetime cost. As we have discussed, no MEPS levels were adopted for air conditioners in Australia because of the variability of the energy test, but the greater energy benefits of air conditioner MEPS for the PICs may outweigh this consideration.

Technically, the PICs could adopt labelling *and* set MEPS levels for air conditioners, based on the Australian energy test. However, the most cost-effective MEPS level cannot be determined until these is much more information on the actual models sold in the PICs. The most cost-effective means of getting this information is from the energy labelling register, once labelling is in operation. Had the energy labelling database not been available in Australia, the 1993 study of MEPS would not have been possible.

Furthermore, so long as there is no MEPS for air conditioners in Australia, the Australian energy testing program will not make air conditioner testing as great as priority as, say, refrigerator testing. Therefore it will be entirely the responsibility of the PICs to identify and exclude non-complying products. It would be advisable to set up air conditioner labelling first and get the administrative framework for it operating smoothly before going to MEPS.

Medium Priority Appliances

In Section 2.3, the following appliances were identified as medium priorities for efforts to increase energy efficiency in the PICs via labelling and/or MEPS. They consume moderate amounts of energy and meet certain other market-related and administrative criteria.

- household freezers: these have somewhat lower energy use and sales than the high priority group, but are relatively simple to include with refrigerators. In fact, the Australian labelling and MEPS programs treat freezers as simply another class of refrigerators, and the same approach should be adopted in the PICs.

- commercial air conditioners: labelling and/or MEPS for these products (in the capacity range 7.5 to 65 kW cooling) is under investigation in Australia. Among the issues that need to be resolved are the appropriate energy tests. The PICs should await the results

of the Australian study (expected in March 1997) before considering labelling or MEPS for these products.

- electric storage water heaters: MEPS are being adopted in Australia (in 1999) and in New Zealand as well, so it would be advisable for PICs to adopt the same MEPS levels as a defensive measure. However, there may be slight differences between the two MEPS levels. The best course of action for the PICs may be to require suppliers to register the energy consumption (in effect the standing heat loss) for each water heater model, together with a statement that the water heater complies with MEPS levels in its country of manufacture. This will be a safeguard against diversion of lower efficiency models from Australia and NZ. For a unit not manufactured in Australia or NZ, it would be fair to require that it should comply with *either* the Australian *or* the NZ MEPS level, whichever is the less stringent.

- clothes dryers: energy labelling is in operation in Australia and nearly all models in PICs are labelled anyway. They could be included in PIC energy programs at little cost, but given the small level of sales and the limited energy differences between models, the energy savings to PICs would be negligible.

Lower Priority Appliances

In Section 2.3, the following appliances were identified as lower priorities for efforts to increase energy efficiency in the PICs via labelling and/or MEPS.

- solar water heaters: there is no labelling or MEPS for these in Australia or elsewhere in the region. Given the high cost of developing and implementing a program for PICs alone, and the low energy benefits (given that many are not connected to electricity so energy efficiency has no direct monetary impact), PICs should not consider either MEPS or labelling for the time being.

- clothes washers: the Australian energy labelling program is based on the assumption that clothes are washed in warm water and then likely to be dried in a clothes dryer. Neither of these assumptions holds in the PICs. Furthermore, many of the models sold in PICs are twin tubs which are not sold in Australia, so would have to be tested and labelled for PICs only. Given the cost, and the low energy benefits, PICs should not require labelling or MEPS for the time being. Display of the Australian energy label should be permitted as an option, with the proviso that displayed labels should be registered and hence subject to verification. Some consideration is being given in Australia to the development of a cold water wash test, and if this occurs the matter should be reconsidered.

- dishwashers: energy labelling is in operation in Australia and nearly all models in PICs are labelled anyway, so there is little cost in requiring them to be labelled in PICs as well. Including them would extend the scope and visibility of the program.

- LPG water heaters: energy labelling is in operation in Australia and the few models we saw in the PICs were labelled. Display of the Australian energy label should be permitted as an option, with the proviso that displayed labels should be registered and hence subject to verification.

- electric cookers: there is no labelling or MEPS for these in Australia or elsewhere in the region. Given the high cost of developing and implementing a program for PICs alone, PICs should not consider either MEPS or labelling for the time being.

- electric motors: labelling and/or MEPS for 3 phase motors in the capacity range 0.75 to 150 kW is under investigation in Australia. The PICs should await the results of the Australian study (expected by the end of 1996) before considering further.

- office equipment (computers, screens, printers, faxes and copiers): labelling for these is under investigation in Australia. The PICs should await the results of the Australian study (expected by the end of 1996) before considering further.

Lighting

Although this study focuses in non-lighting appliances and equipment, it should be remembered that lighting accounts for nearly 31% residential plus commercial sector electricity consumption in the PICs (see Table 13). According to SRCI (1995b), about two thirds of this energy is due to fluorescent lighting, and a third to incandescent.

This may be a significant overestimate of the incandescent lighting share. During our visits, we observed very little use of incandescent lighting, and our discussions with electrical wholesalers confirmed the popularity of "thin" tubular fluorescents (ie 36w/26mm diameter rather than 40w/38mm) in both commercial and residential use. In PNG we were told that many respondents to the household energy survey had mistakenly counted their fluorescent tubes as "ordinary light bulbs", so greatly over-reporting the apparent number of incandescence (an argument for including diagrams in future survey forms).

The implication of this are:

- there is less scope for shifting from incandescent to fluorescent lighting than might have been thought

- where a shift from incandescent is possible, it may well be acceptable (and certainly far cheaper) to shift to a conventional tubular fluorescent rather than to compact fluorescent

- if tubular fluorescent is the dominant lighting technology and likely to remain so, then programs to increase its efficiency assume high priority

There are two possible lighting-related MEPS developments which could have considerable importance in the PICs:

- fluorescent lamp ballasts: these would account for about 20% of the total fluorescent lighting load - about as much electricity as is used for electric cooking in the PICs. MEPS levels which would exclude the "code" ballasts (ie eliminate the 9w type and permit only 5.5w or less for 36w tubes) are under investigation in both Australia and New Zealand. The PICs should await the results of the Australian study (expected by the end of 1996) before considering further;

- tubular fluorescent lamps: New Zealand is considering MEPS levels which would eliminate all 38 mm tubes (becoming les common in the PICs) and all mono-phosphor 26mm tubes (the most common type in the PICs), and permit only the more efficient tri-phosphor 26mm type. The PICs should await the results of a New Zealand decision in this matter before considering further.

4.1.3 Program Implementation Scenarios

The appliances which use enough energy in the PICs to warrant detailed cost-benefit analyses are refrigerators and freezers, unitary and split system air conditioners and electric storage water heaters. Both household and commercial energy use by these products needs to be taken into account.

For refrigerators, freezers and air conditioners, there are arguments that energy efficiency could be improved through labelling, MEPS or perhaps both. For electric storage water heaters there is no labelling so only MEPS is an option.

In order to clarify the benefits and costs of alternative approaches, the following scenarios have been analysed in detail.

Business as Usual Scenario

The base case, or "business as usual" (BAU) scenario, reflects what we believe is likely to happen if the present low-level appliance information programs are continued but more vigorous actions are not taken. We envisage that the historical trend towards greater average energy efficiency in refrigerators and freezers, which was largely driven by the introduction of labelling in Australia and New Zealand, will be offset by slight increases in average size and greater proportion of frost free sales. The average annual energy consumption of new products will remain at the current level (see Diagram 1). For air conditioners, we envisage a slight deterioration in average efficiencies (as indicated by average COP of new sales) as greater market demand leads to more imports of low-cost, low-efficiency units on an opportunity basis. For water heaters we project a slight increase in average daily heat loss as the average size increases (see Diagram 2).

These trends in the BAU scenarios would result partly from the diversion to the PICs of models which do not meet the Australian MEPS levels to come into force in 1999 and increasing imports of lower purchase price but also lower energy efficiency products from South East Asia and China. This would lower the efficiency at the bottom of the range. The top of the range would remain static, since the lack of energy labelling would mean that manufacturers would have little incentive to introduce more efficient equipment to PIC markets.

Scenario 1: MEPS Only

In this scenario the Australian MEPS levels for refrigerators, freezers and water heaters come into force in the PICs at the same time as in Australia (late 1999). This rapidly increases the energy efficiency of new products between the announcement of the measure (nominally 1997) and 2000. For refrigerators and freezers there is a smaller improvement thereafter (see Diagram 1).

For water heaters, efficiency remains constant at the MEPS level after 2000.
Moderate MEPS levels are also adopted for air conditioners, with the effect of maintaining the present levels of new product energy efficiency (see Diagram 2).

Although there is no general labelling in this scenario, it is assumed that once a register of products is established for MEPS purposes it will be possible for PIC government agencies, who account for a significant share of the PIC appliance markets, to take the information into account in their own product purchases.

Scenario 2: MEPS with Labelling

This is identical to Scenario 1, except that universal labelling is adopted in addition to MEPS. The rates of efficiency improvement are somewhat greater, since even after MEPS removes the least efficient products there will still be some efficiency variation in the range and consumers can use labelling to select the more efficient models. However, the post-MEPS scope for labelling will be greater for air conditioners (see Diagram 2) than for refrigerators and freezers (see Diagram 1).

Scenario 2 is identical to Scenario 1 for electric storage water heaters, since there is no form of energy labelling for them at present.

Scenario 2 envisages the greatest rate of increase in product energy efficiency.

Scenario 3: Labelling Only

In this scenario, universal labelling is adopted without MEPS. For refrigerators, freezers and air conditioners the rate of efficiency improvement is projected to be less than Scenario 2 (MEPS + Labelling) but greater than Scenario 1 (MEPS only). Since labelling has no effect for water heaters, the efficiency trend is as for BAU.

4.2 Costs

The costs of establishing MEPS and/or labelling in each PIC have been estimated on two bases:

- as if all costs are borne by that country alone ("separate costs"); and
- as if costs are shared with other PICs ("shared costs"). For simplicity, it has been assumed that for each PIC shared costs are 50% as great as separate costs, irrespective of the number of PICs participating in the program.

The estimated separate costs for Fiji, PNG and Tonga are given in Appendices 7,8 and 9 respectively. The costs for Fiji are used in the following examples.

Table 20 Estimated Costs of Program Elements: Fiji

Administrative Cost Elements	Units	F$/yr	A$/yr
Policy & coordination	0.5 (a)	31200	28624
Registration, monitoring	1 (a)	30000	27523
Additional product tests needed per yr	15	81750	75000
Check tests needed per yr	10	76300	70000
Additional home-country labels - first year	9420	4709	4320
Additional in-country labels - first year	7350	11026	10116
Labelling promotion cost - first year	Total	60000	55046
Labelling promotion cost - subsequent years	Total	20000	18349
Unit cost assumptions			
Senior management	5200	F$/month	
Middle management	2500	F$/month	
Cost per initial test	5000	A$/test	
Cost per check test	7000	A$/test	
Cost per home-fixed label	0.5	F$/label	
Cost per in-country label	1.5	F$/label	

(a) Full Time Staff Equivalent (FTSE)

4.2.1 Industry/Customer Costs

These costs are borne by product manufacturers or importers in the first instance, but are passed on to appliance buyers through the product price.

Additional Energy Testing

These are the costs to suppliers of obtaining energy consumption data for registration for labelling or MEPS for those models for which such data are not already available. For models already tested for other markets, no additional tests will need to carried out before registration for in the PICs. It is estimated that 15 such models will come on to the Fiji market in an average year, although there may well be greater need for such tests in earlier years and less in later years. The average cost to suppliers of A$ 5,000 per test is based on Australian experience.

Label Fixing

These are the costs of printing and affixing the label itself. For products which already arrive labelled (as many do), there will be no additional costs. For products presently labelled in ANZ but not in the PICs, it is assumed that there will a small additional cost of F$ 0.50 per unit shipped to the PICs. For products for which the label will need to be fixed in the country of sale, it is assumed that the cost per unit will be three times as great, since it will include some administrative overheads on the part of the importers.

4.2.2 Administrative Costs

The following costs are borne by whichever agencies are responsible for labelling and/or MEPS in each country. In some case different agencies - energy departments, consumer departments and electricity utilities may be involved, and each may bear some of the costs. Some part of these costs might be recoverable from appliance suppliers (and, through them, appliance buyers) via product registration fees.

Policy and Coordination

These are the costs associated with the development of the program, the drafting of regulations etc. If the program proceeds on a shared costs basis, then there would still be a need for PICs to participate in the coordinated regional framework. It is assumed that this would require half the time of a senior manager on a continuing basis (perhaps more in the early years, less later). The salary costs and overheads for each country are taken from SRCI 1995a.

Registration and Compliance Monitoring

These are the costs associated with establishing and maintaining a register. They may be offset partly, or completely, through registration charges to suppliers. The other aspect of compliance monitoring is field inspection of whether appliances are labelled. This can be done at low cost through informal arrangements with community and consumer groups, etc. or by adding this to the duties of existing inspectors.

It is estimated that in Fiji this would require the full resources of a middle-level manager on a continuing basis (perhaps more in the early years, less later). Greater resources would be required in PNG, because of the more dispersed pattern of appliance imports and sales. The salary costs and overheads for each country are taken from SRCI 1995a.

Check Testing

These are the costs to the labelling agencies of carrying out random energy tests on products to ensure that they conform to the information stated on their labels, or and/or in the register. It is estimated that about 10 such tests per year would maintain a high level of supplier compliance for Fiji. The estimated cost of A$ 7,000 per test includes purchase in Fiji and shipment to an Australian or New Zealand laboratory.

Publicity and Promotion

These are the costs of

- promoting and advertising the labelling program in the year of inception: this is a comparatively large publicity cost incurred for one year only;
- preparing guides for distribution at regular intervals (since the model range changes from year to year);
- printing and distributing guides;
- holding seminars and training sessions for retailers, air conditioning contractors and other key intermediaries.

Experience has shown that while other classes of administrative costs depend largely on the number of models on the market, their rate of introduction and the sales per model, publicity and promotion costs are highly variable and largely discretionary. PICs can spend very little if they wish, but if so they may find that labelling has relatively little impact on their markets. It is assumed that there are no publicity or promotional costs for MEPS.

4.2.3 Total Costs

Table 21 summarises the estimated total annual costs for MEPS only and for MEPS plus labelling for each of the three PICs visited, on the basis of both separate and shared costs. A total cost for a program covering the 10 PICs studied by SRCI has also been estimated, by summing the "shared" costs for the three countries and scaling up in proportion to the total residential plus commercial electricity consumed (Fiji, PNG plus Tonga account for 71% of the total: see Tables 12 and 13).

It is estimated that the program cost for labelling alone will be 90% of the cost for "MEPS + Labelling" shown in Table 20. The same program elements will be present, including publicity, but the policy and coordination costs may be somewhat lower.

Table 21. Estimated Total Annual Program Costs, AU$

Program	Cost elements	Fiji (a)		PNG (b)		Tonga (c)		All PICs
		Separate	Shared	Separate	Shared	Separate	Shared	Shared
MEPS only	Government	126,000	63,000	123,000	61,500	70,500	35,250	225,000
	Industry	75,000	37,500	75,000	37,500	25,000	12,500	123,000
	Total	201,000	100,500	198,000	99,000	95,500	47,750	348,000
MEPS + labelling	Government - first yr	181,000	90,500	200,000	100,000	92,000	46,000	333,000
	Government - later yrs	144,500	72,250	161,500	80,750	81,500	40,750	273,000
	Industry - first yr	89,500	44,750	92,000	46,000	26,000	13,000	146,000
	Total - first yr	270,500	135,250	292,000	146,000	118,000	59,000	479,000

(a) See Table 20 (b) See Appendix 8 (c) See Appendix 9

For comparison, Table 22 summarises a recent estimate of annual costs to the governments of New South Wales and Victoria of their participation in the Australian MEPS + labelling program. These are considerably higher than the corresponding "shared costs" to PIC government (eg A$ 273,000/yr for NSW compared with an estimate of A$ 72,250/yr for Fiji). The difference is due to a larger model range and higher salary costs in Australia, and the fact that costs in the PICs will be contained by making use of the registration data already available in Australia.

Table 22 Estimated Labelling Administration Cost, Victoria and New South Wales, 1995

Function	**Victoria**				**New South Wales**			
	FTSE (a)	Salary costs $	Other costs $	Total costs $	FTSE (a)	Salary costs $	Other costs $	Total costs $
Policy and Coordination	0.2	20,000		20,000	0.2	20,000		20,000
Registration	0.5	30,000		30,000	0.8	50,000		50,000
Field monitoring, promotion (b)	1.5	90,000	70,000	160,000	1.0	60,000	40,000	100,000
Contribution to check testing (c)	0.2	20,000	30,000	50,000	0.2	20,000	40,000	60,000
Total	2.4	160,000	100,000	260,000	2.2	150,000	80,000	230,000

Source: NSW (1995) and personal communication. (a) Full Time Staff Equivalent. (b) Cost of retail liaison field officers who carry out both in-store promotions and monitoring. (c) Commonwealth government meets half of check testing costs; States share other half according to population.

4.2.4 Market Impact Costs

Appliance Prices

Previous studies have shown that there the relationship between appliance price and energy efficiency it is a complex one and varies for different products (GWA et al 1993a). It is rarely the case that two comparable models differ only in their energy efficiency (except in water heaters): in general the more expensive model is also likely to have other extra features which complicate comparisons.

Nevertheless, it is assumed that MEPS will drive up average appliance prices slightly because the least efficient models excluded from the market are also likely to be the cheapest. Labelling will also drive up average prices slightly, because many customers will be prepared to pay more for models which the label shows will be cheaper to run.
The projected trends in appliance prices under BAU assumptions and in the three scenarios are shown in Diagrams 3 and 4.

Competition and Consumer Choice

It is possible that some brands, or some retailers, will have a disproportionate number of less efficient appliances. If so, they could face serious business difficulties, and may be forced out of the appliance market if they cannot supply, or obtain, more efficient products. This would be a disproportionate burden for any suppliers in this position, and if they left the market, it may reduce general price competition and the range of product choice available to consumers.

It is likely that very few appliance retailers will be affected in this way. Most models would pass the proposed MEPS levels, and if there greater customer preference for more efficient models because of labelling this could be met from the existing model range or by drawing on other models from the same suppliers. The group most likely to be affected are those who import appliances direct and in small quantities: small general retailers who may import the occasional consignment of air conditioners, say, or builders who import appliances in containers of materials and components for particular projects.

These groups may well be tempted to ignore the requirements of MEPS or labelling, since the testing costs per unit for models imported to PICs in small quantities will be high (unless those models happen to also be tested for the ANZ market). By the same token, it is likely that the major retailers will be very sensitive to how closely the authorities monitor these groups. If apparent breaches by any suppliers are seen to be tolerated, those suppliers who comply will lose confidence in the program.

4.3 Benefits

4.3.1 Energy Cost Savings

The value of energy savings have been calculated using a computer model described in Appendix 6. It incorporates the following inputs for each PIC:

- For each product type (refrigerators, freezer, air conditioner, electric storage water heater): numbers purchased in each of the 16 years 1997 to 2012 (inclusive), based on existing penetration rates, projected penetration and population rates and service lifetimes;

- Sales-weighted average kWh/annum trends for all new products sold between 1997 and 2012, under BAU and each of the three scenarios. The mix of new appliances sold in each year is assumed to be the same in each PIC, but the energy consumption is modified for each PIC on the basis of local climate and, for air conditioning, reported annual hours of operation;

- Sales-weighted average purchase price trends for all new products sold between 1997 and 2012, under BAU and each of the three scenarios;

- Average electricity tariffs in 1997, and tariff projections based on data in SRCI (1995b) and in utility planning studies supplied by the PICs visited.

The model projects total electricity consumption of the appliance stock under four scenarios: "business as usual" (BAU), Scenario 1 (MEPS only), Scenario 2 (MEPS + Labelling) and Scenario 3 (Labelling only). The stock energy consumption is affected by the rate of removal of older, less efficient models (which would occur irrespective) as well as by the average efficiency of new models (which varies according to Scenario). For new appliances entering the stock, the entire energy consumption over the service life is taken into account.

The monetary benefit of each scenario is calculated by:

- comparing the stock energy consumption in that scenario with the stock energy consumption in the BAU case to calculate amount of electricity saved in each year from 1997 to 2012;

- multiplying the amount of electricity saved in each year by the projected tariff in that year;

- bringing the value of electricity saved to a "Net Present Value" (NPV) using an appropriate discount rate, as explained in Section 4.5.

4.3.2 Other Benefits

Environmental

The generation of electricity in the PICs, as in other places, involves some cost the environment. Hydro-electric developments can involve land and water use conflicts, although once a hydro development has been built each unit of electricity production is relatively "clean". In any case, hydro development is limited. Utility projections for PNG envisage that the hydro share of total generation will decline from about 74% in 1995 to 62% by 2010 (PNGEC 1995). Utility projections for PNG envisage that the hydro share of total generation will decline from about 89% in 1995 to 64% by 2005 (FEA 1995).

This means that diesel and other petroleum fuels will significantly increase their share of generation in Fiji and PNG. In Tonga and most other PICs these fuels already account for nearly 100% of electricity supply. The environmental costs of fuel combustion include local air and noise pollution, and greenhouse gas emissions. The import of petroleum fuels also represents a major economic cost to the PICs, which may not be fully reflected in the tariffs charged for electricity.

Given the projected generation fuel mix (diesel and hydro), the computer model calculates the carbon dioxide emissions associated with each scenario. This allows the greenhouse gas reduction benefits of the different scenarios to be calculated.

Product Performance

To score an energy rating on the tests and so qualify for energy labelling, products will need to meet certain task performance standards. The elimination of poorly performing product, of any, from PIC markets would represent another benefit to consumers.

Consumer Awareness

According to our discussions in the PICs visited, many appliance buyers in the PICs (as in other countries) are guided primarily by purchase price. This applies to government as well as private buyers. The cheapest appliance to buy will in many cases not be the cheapest over its operating life, since the increases in energy costs will often exceed any savings in purchase price - even taking into account the time value discount factor applied to future savings.

Energy labelling can encourage consumers to include factors other than purchase price. Although the immediate emphasis is on energy, once consumer awareness is raised the approach can be extended to durability, after-sales service and other aspects of life cycle cost.

Public Policy

At present the PICs have relatively little control over or awareness of appliances imported (apart from numbers and declared monetary values, which are used as the basis of levying customs duty). The establishment of a register of products for energy labelling purposes would give PIC governments a useful tool for better understanding the trade in appliances, which makes up a significant share of PIC imports of manufactured products.

4.4 Cost/Benefit Analysis

4.4.1 Main Findings

Calculation of Costs and Benefits

In each scenario, the monetary "cost of ownership" for each type of appliance is the sum of:

- the total value of appliances to be purchased new in the period 1997 to 2012: eg for refrigerators in Fiji , this is estimated at A$ 243 M in the base case, A$ 255 M in the MEPS case, A$ 259 M in the MEPS + Labelling case, and A$ 253 M in the Labelling case (at 0% discount rate - see discussion in next section);

- the total value of the electricity to be consumed during the entire service life by all appliances to be purchased new in the period 1997 to 2012: eg for refrigerators in Fiji , this is estimated at A$ 460 M in the base case, A$ 439 M in the MEPS case, A$ 418 M in the MEPS + Labelling case, and A$ 428 M in the Labelling case.

Thus the total costs of ownership for new refrigerators in Fiji is projected as A$ 703 M in the base case, A$ 694 M in the MEPS case, A$ 677 M in the MEPS + Labelling case, and A$ 681 M in the Labelling case. Although each scenario has higher purchase costs than the base case, this is outweighed in nearly every case by lower energy costs.

All else being equal, the lower the total ownership costs, the better off the appliance owners. In the above examples the most favourable outcomes are, in declining order, MEPS + Labelling, Labelling only, MEPS only, and the base case (ie "business as usual" produces the least favourable outcome). Table 23 illustrates the total ownership costs for Fiji, and compares scenarios for each product.

Table 23. Projected New Appliance Ownership Costs, Fiji 1997-2012

	Refrigs	Freezer	Air Cond	Water H	Total A$M	Total GWh
Business as Usual	703	76	587	127	1493	4240
1. MEPS only	694	74	578	111	1457	3948
2. MEPS + Labelling	677	72	551	111	1411	3688
3. Labelling only	681	74	544	127	1426	3853
Savings cf BAU:						
1. MEPS only - AU$M	9.4	2.0	8.7	15.6	35.8	292
% of BAU saved	1.3%	2.7%	1.5%	12.3%	2.4%	6.9%
2. MEPS + Labelling	25.8	4.5	35.7	15.6	81.7	552
% of BAU saved	3.7%	5.9%	6.1%	12.3%	5.5%	13.0%
3. Labelling only	22.0	2.7	42.4	0.0	67.1	387
% of BAU saved	3.1%	3.5%	7.2%	0.0%	4.5%	9.1%

Source: Appendix 7 (0% discount); All values are in A$ Millions, unless stated otherwise.

It can be seen that the least cost scenarios differ for product types: Scenario 2 for refrigerators and freezers, Scenario 3 for air conditioners and Scenarios 1 and 2 equally for water heaters. Overall, Scenario 2 is the least cost (5.5% less than the base case), closely followed by Scenario 3 (4.5% less than the base case). Scenario 1 (2.4% less than the base case) is significantly less favourable. Scenario 2 is also the lowest energy (13.0% less than the base case), followed by Scenario 3 (9.1% less than the base case) and Scenario 1 (6.9% less than the base case).

However, the costs associated with program administration - those summarised for Fiji in Table 20 - also need to be included. These are difficult to assign to any one product group, so are better assessed for all products together. Table 24 adds these costs to the appliance ownership costs. It also compares the value of benefits (ie the savings in energy costs) with the total costs (ie greater purchase price plus administration costs) for each scenario, and calculates a benefit/cost ratio. If this is greater than 1, the scenario appears to be cost-effective from a public policy viewpoint, assuming of course that the costs and benefits have been estimated with reasonable accuracy. The higher the ratio, the more likely that it will prove cost effective in fact.

Table 24. Projected Program Costs and Benefits, Fiji

	O'ship AU$ M	Admin - Separate	Benefit cf BAU	Cost cf BAU	Benefit/ cost ratio	Admin - Shared(b)	Cost cf BAU(c)	Benefit/ cost ratio
Business as Usual	1493	0.0				0.0		
1. MEPS only	1457	3.0	72	39	**1.8**	1.5	37	**1.9**
2. MEPS + Labelling	1411	3.6	136	58	**2.4**	1.8	56	**2.4**
3. Labelling only (a)	1426	3.2	95	32	**3.0**	1.6	30	**3.2**

Source: Appendix 7 (0% discount). All values are in A$ Millions, except for ratios in bold. (a) Admin costs assumed to be 10% less than for Scenario 2. (b) Shared costs assumed to be 50% of separate admin costs. (c) Value of benefits to each PIC is identical, whether costs shared or separate.

Table 24 indicates that Scenario 3 (labelling alone) has the highest benefit/cost ratio, even though Scenario 2 (MEPS + Labelling) has the highest overall benefit. This is because the projected increase in appliance costs is much greater. Sharing administrative costs has little impact on overall benefit/cost ratios seen from the customer's perspective, because the administrative costs (borne by the customer via the product price or taxation) are small in comparison with the costs of higher appliance prices.

Discount Rates

The discount rate adopted for valuing future costs and benefits has an important effect on the benefit/cost ratio. The examples in Tables 23 and 24 are "undiscounted," ie calculated at 0% discount rate. In general, policy makers value future benefits less than current benefits, so higher rates are appropriate. SRCI (1995a) used 6% and 10% in their examples. The

present analysis uses 5% and 10%, as well as 0%. Inflation has not been taken into account, since it would have equal effects on costs and benefits: all price and tariff increases projected are "real".

Discount rate has an unequal effect on costs and benefits. Increases in average appliance prices are incurred at the time of purchase, but the benefits of lower running costs are incurred progressively over the service life. Thus as discount rate increases, both purchase prices and energy costs decline in value, but the former declines more slowly. At very high discount rates, future benefits are given such a low net present value (NPV) that even small increase in costs, because they occur earlier, come to dominate.

Table 25 summarises the projected benefit/cost ratios for under the three discount rates. Both separate and shared cost arrangements are shown although they have little impact on the ratios. As expected, benefit/cost ratios decline with discount rate, but at 10% discount, all scenarios still return a ratio greater than 1. The benefit/cost ratios are similar for each country, although those for PNG are somewhat higher for the labelling only scenarios, and those for Tonga are somewhat higher in the scenarios which include MEPS.

Table 25. Projected Program Benefit/Cost Ratios, Various Discount Rates

Scenarios	Discount	Separate Admin Costs				Shared Admin Costs			
	Rate	Fiji	PNG	Tonga	All PICs	Fiji	PNG	Tonga	All PICs
1. MEPS only	0%	1.8	1.9	2.3	1.9	1.9	2.0	2.7	2.0
2. MEPS + Labelling	0%	2.4	2.9	3.1	2.7	2.4	2.9	3.6	2.8
3. Labelling only	0%	3.0	4.4	3.3	3.9	3.2	4.5	4.1	4.1
1. MEPS only	5%	1.4	1.5	1.7	1.5	1.5	1.6	2.1	1.6
2. MEPS + Labelling	5%	1.8	2.2	2.3	2.1	1.9	2.3	2.7	2.2
3. Labelling only	5%	2.4	3.4	2.4	3.0	2.5	3.5	3.1	3.2
1. MEPS only	10%	1.2	1.2	1.3	1.2	1.2	1.3	1.7	1.3
2. MEPS + Labelling	10%	1.5	1.8	1.8	1.7	1.5	1.8	2.2	1.7
3. Labelling only	10%	1.9	2.7	1.9	2.4	2.0	2.9	2.4	2.6

Source: Appendices 7,8,9,10

Major Sources of Uncertainty

All assumptions used in modelling, whether in this analysis or elsewhere, are subject to uncertainty. In our view the major sources of uncertainty here are:

- the impact of labelling and/or MEPS on average appliance energy efficiency: if the programs are not enforced then compliance may be low and the impacts much less than assumed;

- the impact of labelling and/or MEPS on average appliance prices: this may well be less than we have projected, which would increase the cost-effectiveness of the programs;

- the relationship between electricity tariffs and costs of electricity production: if costs exceed tariffs (ie tariffs are not fully cost-recovering) then the actual cost-effectiveness of these programs would be greater than indicated.

4.4.2 Findings by Country

Fiji

Refrigerators and freezers account for about half the energy consumption of the appliances recommended for labelling and/or MEPS, although in absolute terms most of the potential for energy savings lies with air conditioners. 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 17% lower, and under Scenario 3 (labelling only) it would be about 12% lower. (Note that Table 26 gives the *annual* electricity consumption in selected years, whereas Table 23 and Appendices 7 to 10 give *cumulative* electricity consumption over the entire service life for appliances purchased new between 1997 and 2012).

MEPS only, MEPS + labelling and labelling only program are all cost-effective for Fiji, at all the discount rates analysed. However, at a discount rate of 10% the projected value of energy saved by MEPS for air conditioners is slightly exceeded by the projected value of the purchase price increases, suggesting that the outcome for air conditioners is neutral at high discount rates.

PNG

Air conditioners account for about two thirds of the energy consumption of the appliances recommended for labelling and/or MEPS, and for the great majority of the potential for energy savings. 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 17% lower.

MEPS only, MEPS + labelling and labelling only program are all cost-effective for PNG, at all the discount rates analysed. However, at a discount rate of 10% the projected value of energy saved by MEPS for refrigerators is slightly exceeded by the projected value of the purchase price increases, suggesting that the outcome for refrigerators is neutral at high discount rates.

Table 26 Fiji - Projected Appliance Electricity Consumption

Scenario	Year	Refs	Frzs	ACs	WHs	Total	cf BAU
BAU	1997	63.8	6.6	56.6	14.2	141.1	
	2002	72.5	7.9	66.8	17.1	164.2	
	2007	87.0	9.7	80.8	21.4	198.9	
	2012	106.8	12.2	92.9	26.5	238.5	
1. MEPS only	1997	63.8	6.6	56.6	14.2	141.1	
	2002	71.0	7.7	64.0	15.3	158.1	-3.8%
	2007	83.1	9.2	74.5	17.0	183.8	-7.6%
	2012	100.1	11.4	84.5	20.3	216.3	-9.3%
2. MEPS +	1997	63.8	6.6	56.6	14.2	141.1	
Labelling	2002	69.4	7.5	60.6	15.3	152.7	-7.0%
	2007	79.0	8.6	66.1	17.0	170.7	-14.2%
	2012	93.7	10.4	72.6	20.3	196.9	-17.4%
3. Labelling only	1997	63.8	6.6	56.6	14.2	141.1	
	2002	70.5	7.6	61.6	17.1	156.9	-4.5%
	2007	81.4	9.0	68.2	21.4	179.9	-9.5%
	2012	96.6	11.0	75.1	26.5	209.2	-12.3%

Source: Detailed computer modelling outputs. All Values GWh

Table 27 Fiji - Projected Appliance Energy Costs

Scenario	Year	Refs	Frzs	ACs	WHs	Total	cf BAU
BAU	1997	$14.6	$1.5	$13.0	$3.3	$32.4	
	2002	$17.1	$1.9	$15.7	$4.0	$38.7	
	2007	$21.0	$2.3	$19.5	$5.2	$48.0	
	2012	$26.4	$3.0	$23.0	$6.6	$59.0	
1. MEPS only	1997	$14.6	$1.5	$13.0	$3.3	$32.4	
	2002	$16.7	$1.8	$15.1	$3.6	$37.2	-3.8%
	2007	$20.1	$2.2	$18.0	$4.1	$44.4	-7.6%
	2012	$24.8	$2.8	$20.9	$5.0	$53.5	-9.3%
2. MEPS +	1997	$14.6	$1.5	$13.0	$3.3	$32.4	
Labelling	2002	$16.3	$1.8	$14.3	$3.6	$36.0	-7.0%
	2007	$19.1	$2.1	$15.9	$4.1	$41.2	-14.2%
	2012	$23.2	$2.6	$18.0	$5.0	$48.7	-17.4%
3. Labelling only	1997	$14.6	$1.5	$13.0	$3.3	$32.4	
	2002	$16.6	$1.8	$14.5	$4.0	$36.9	-4.5%
	2007	$19.6	$2.2	$16.5	$5.2	$43.4	-9.5%
	2012	$23.9	$2.7	$18.6	$6.6	$51.8	-12.3%

Source: Detailed computer modelling outputs. All Values current A$ M (undiscounted)

Table 28 PNG - Projected Appliance Electricity Consumption

Scenario	Year	Refs	Frzs	ACs	WHs	Total	cf BAU
BAU	1997	38.9	4.2	96.6	3.3	143.0	
	2002	54.8	6.1	175.9	4.4	241.2	
	2007	83.7	9.5	317.1	6.3	416.7	
	2012	132.4	15.3	552.1	8.9	708.7	
1. MEPS only	1997	38.9	4.2	96.6	3.3	143.0	
	2002	53.6	6.0	167.3	4.0	230.8	-4.3%
	2007	79.8	9.0	290.7	5.0	384.6	-7.7%
	2012	124.0	14.2	501.8	6.8	646.7	-8.7%
2. MEPS +	1997	38.9	4.2	96.6	3.3	143.0	
Labelling	2002	52.2	5.8	156.4	4.0	218.4	-9.5%
	2007	75.7	8.4	255.9	5.0	345.0	-17.2%
	2012	115.9	13.0	429.7	6.8	565.3	-20.2%
3. Labelling only	1997	38.9	4.2	96.6	3.3	143.0	
	2002	53.2	5.9	159.7	4.4	223.2	-7.5%
	2007	78.1	8.8	264.5	6.3	357.6	-14.2%
	2012	119.4	13.7	444.8	8.9	586.8	-17.2%

Source: Detailed computer modelling outputs. All Values GWh

Table 29 PNG - Projected Appliance Energy Costs

Scenario	Year	Refs	Frzs	ACs	WHs	Total	cf BAU
BAU	1997	$7.0	$0.8	$17.4	$0.6	$25.8	
	2002	$10.1	$1.1	$32.5	$0.8	$44.6	
	2007	$15.9	$1.8	$60.2	$1.2	$79.0	
	2012	$25.8	$3.0	$107.4	$1.7	$137.8	
1. MEPS only	1997	$7.0	$0.8	$17.4	$0.6	$25.8	
	2002	$9.9	$1.1	$31.0	$0.7	$42.7	-4.3%
	2007	$15.1	$1.7	$55.2	$0.9	$73.0	-7.7%
	2012	$24.1	$2.8	$97.6	$1.3	$125.8	-8.7%
2. MEPS +	1997	$7.0	$0.8	$17.4	$0.6	$25.8	
Labelling	2002	$9.7	$1.1	$28.9	$0.7	$40.4	-9.5%
	2007	$14.4	$1.6	$48.5	$0.9	$65.4	-17.2%
	2012	$22.5	$2.5	$83.6	$1.3	$110.0	-20.2%
3. Labelling only	1997	$7.0	$0.8	$17.4	$0.6	$25.8	
	2002	$9.8	$1.1	$29.6	$0.8	$41.3	-7.5%
	2007	$14.8	$1.7	$50.2	$1.2	$67.8	-14.2%
	2012	$23.2	$2.7	$86.5	$1.7	$114.1	-17.2%

Source: Detailed computer modelling outputs. All Values current A$ M (undiscounted)

Table 30 Tonga - Projected Appliance Electricity Consumption

Scenario	Year	Refs	Frzs	ACs	WHs	Total	cf BAU
BAU	1997	5.6	0.9	2.1	1.0	9.5	
	2002	6.7	1.2	3.0	1.3	12.1	
	2007	8.3	1.5	4.2	1.6	15.7	
	2012	10.6	2.0	5.7	2.2	20.5	
1. MEPS only	1997	5.6	0.9	2.1	1.0	9.5	
	2002	6.5	1.1	2.9	1.1	11.7	-3.6%
	2007	8.0	1.4	3.9	1.3	14.6	-7.2%
	2012	9.9	1.9	5.1	1.7	18.6	-9.0%
2. MEPS +	1997	5.6	0.9	2.1	1.0	9.5	
Labelling	2002	6.4	1.1	2.7	1.1	11.3	-6.6%
	2007	7.6	1.4	3.4	1.3	13.6	-13.2%
	2012	9.3	1.7	4.4	1.7	17.1	-16.5%
3. Labelling only	1997	5.6	0.9	2.1	1.0	9.5	
	2002	6.5	1.1	2.7	1.3	11.6	-3.9%
	2007	7.8	1.4	3.5	1.6	14.4	-8.4%
	2012	9.6	1.8	4.6	2.2	18.2	-11.3%

Source: Detailed computer modelling outputs. All Values GWh

Table 31 Tonga - Projected Appliance Energy Costs

Scenario	Year	Refs	Frzs	ACs	WHs	Total	cf BAU
BAU	1997	$2.2	$0.4	$0.8	$0.4	$3.8	
	2002	$2.7	$0.5	$1.2	$0.5	$4.9	
	2007	$3.5	$0.6	$1.7	$0.7	$6.5	
	2012	$4.5	$0.9	$2.4	$0.9	$8.7	
1. MEPS only	1997	$2.2	$0.4	$0.8	$0.4	$3.8	
	2002	$2.6	$0.5	$1.2	$0.5	$4.7	-3.6%
	2007	$3.3	$0.6	$1.6	$0.5	$6.0	-7.2%
	2012	$4.2	$0.8	$2.2	$0.7	$7.9	-9.0%
2. MEPS +	1997	$2.2	$0.4	$0.8	$0.4	$3.8	
Labelling	2002	$2.6	$0.4	$1.1	$0.5	$4.6	-6.6%
	2007	$3.1	$0.6	$1.4	$0.5	$5.7	-13.2%
	2012	$4.0	$0.7	$1.9	$0.7	$7.3	-16.5%
3. Labelling only	1997	$2.2	$0.4	$0.8	$0.4	$3.8	
	2002	$2.6	$0.5	$1.1	$0.5	$4.7	-3.9%
	2007	$3.2	$0.6	$1.5	$0.7	$6.0	-8.4%
	2012	$4.1	$0.8	$1.9	$0.9	$7.7	-11.3%

Source: Detailed computer modelling outputs. All Values current A$ M (undiscounted)

Table 32 All PICs - Projected Appliance Electricity Consumption

Scenario	Year	Refs	Frzs	ACs	WHs	Total	cf BAU
BAU	1997	153	16	219	26	414	
	2002	189	21	347	32	589	
	2007	253	29	567	41	890	
	2012	352	42	918	53	1365	
1. MEPS only	1997	153	16	219	26	414	
	2002	185	21	330	29	565	-4.1%
	2007	241	28	521	33	822	-7.7%
	2012	330	39	834	41	1244	-8.9%
2. MEPS +	1997	153	16	219	26	414	
Labelling	2002	180	20	310	29	539	-8.4%
	2007	229	26	459	33	747	-16.2%
	2012	309	35	715	41	1099	-19.5%
3. Labelling only	1997	153	16	219	26	414	
	2002	184	21	316	32	553	-6.2%
	2007	236	27	474	41	779	-12.6%
	2012	318	37	740	53	1148	-15.9%

Source: Detailed computer modelling outputs. All Values GWh

Table 33 All PICs - Projected Appliance Energy Costs

Scenario	Year	Refs	Frzs	ACs	WHs	Total	cf BAU
BAU	1997	$33.7	$3.7	$44.1	$6.0	$87.4	
	2002	$42.2	$4.9	$69.8	$7.6	$124.4	
	2007	$56.9	$6.8	$114.8	$9.9	$188.4	
	2012	$80.0	$9.7	$187.3	$13.0	$290.0	
1. MEPS only	1997	$33.7	$3.7	$44.1	$6.0	$87.4	
	2002	$41.3	$4.8	$66.6	$6.8	$119.4	-4.0%
	2007	$54.3	$6.4	$105.4	$7.9	$174.0	-7.6%
	2012	$74.9	$9.0	$170.3	$9.9	$264.1	-8.9%
2. MEPS +	1997	$33.7	$3.7	$44.1	$6.0	$87.4	
Labelling	2002	$40.3	$4.6	$62.5	$6.8	$114.2	-8.2%
	2007	$51.6	$6.0	$93.0	$7.9	$158.4	-15.9%
	2012	$70.1	$8.2	$145.9	$9.9	$234.1	-19.3%
3. Labelling only	1997	$33.7	$3.7	$44.1	$6.0	$87.4	
	2002	$41.0	$4.7	$63.7	$7.6	$117.0	-5.9%
	2007	$53.2	$6.3	$96.1	$9.9	$165.4	-12.2%
	2012	$72.2	$8.7	$151.0	$13.0	$244.9	-15.5%

Source: Detailed computer modelling outputs. All Values current A$ M (undiscounted)

Tonga

Refrigerators and freezers account for about two thirds of the energy consumption of the appliances recommended for labelling and/or MEPS, and for most of the potential for

energy savings. 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 17% lower, and under Scenario 3 (labelling only) it would be about 11% lower. MEPS only, MEPS + labelling and labelling only program are all cost-effective for Tonga, at all the discount rates analysed.

All PICs

The "All PICs" case is derived from the combined results for Fiji, PNG and Tonga, which together account for 71% of the combined commercial plus residential electricity consumption of Fiji, PNG, Tonga, Solomon Islands, Palau, Kiribati, Western Samoa, Tuvalu, Marshall Islands and Cook Islands. As such, it is broadly representative of those 10 countries as a group but cannot be taken as accurate for any of the 7 PICs not visited.

Air conditioners currently account for about 53% of the energy consumption of the appliances recommended for labelling and/or MEPS, refrigerators and freezers for about 41% and water heaters for about 6%. Most of the potential for energy savings lies with air conditioners, largely because of the very high projected growth in air conditioning energy in PNG which we have adopted from SRCI(1995a).

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. Diagram 5 (overleaf) illustrates the projected trends on total energy consumption for the appliances under consideration, in the PICs as a group.

MEPS only, MEPS + labelling and labelling only program are all cost-effective for the PICs as a group, at all the discount rates analysed.

5 Conclusions and Recommendations

5.1 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.

5.2 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 34 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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