Minimum Energy Performance Standards

How does New Zealand compare with other countries?

A comparative explorative study to gain insights into the number and stringency of current implemented MEPS in New Zealand

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Summary

The average number of mandated Minimum Energy Performance Standards (MEPS) in the ten countries with the strongest MEPS portfolios (excluding New Zealand) is 27. New Zealand has implemented MEPS in 17 product classes in the NZ regulations[1] or 18 classes based on CLASP[2] categories. The number of implemented MEPS in New Zealand is significantly less than countries such as the U.S. (46), Canada (44) and China (41). Compared with other countries with active MEPS programmes, New Zealand is in eighth-equal position with Israel. It has significantly more implemented MEPS than the European Union, which has 14, although 29 are currently under consideration.

Most New Zealand MEPS are closely aligned with those of Australia, but there are significant differences: Australia has implemented MEPS for televisions, incandescent lamps and transformers for extra-low-voltage lights, not yet adopted by New Zealand. On the other hand, New Zealand has MEPS for gas water heaters, a standard not yet implemented in Australia. While Australia has generally been quicker than New Zealand in implementing its standards over time, the MEPS regulations are not the same in all Australian states and two (WA, NT) have no MEPS regulations.

The existing MEPS in New Zealand include products in categories that contribute to 24.5% of all national energy consumption, and 71.8% of electricity consumption[3]. The products most commonly represented in the MEPS of other countries, but not presently implemented in New Zealand, are: clothes washers, compact fluorescent lamps, boilers (oil and gas), dishwashers, incandescent lamps, televisions and vending machines. Other products that merit consideration for new MEPS in New Zealand include: clothes dryers, domestic dehumidifiers, solar water heaters and heat pump water heaters.

The stringency of New Zealand's MEPS is compared with the standards of eight other countries/economies in Table 1 (below). For these appliances New Zealand MEPS are more stringent than 14 countries and less for 16. Compared with other countries with active MEPS programmes, New Zealand's MEPS are both more and less stringent; there are no outstanding anomalies.

In relation to particular regulations, the E.U, U.S, Korea, China and Canada have more stringent MEPS standards for refrigerator/freezer group 5B and chest freezer 6C compared to New Zealand. New Zealand's MEPS for refrigerator/freezer 5T are more stringent compared to the European Union, U.S and Canada. However, current standards implemented in Korea and China are more stringent than New Zealand's for refrigerator/freezer group 5T.

MEPS implemented for linear fluorescent lamps are at present more stringent in Korea, Canada and Japan than in New Zealand. New Zealand's MEPS are more stringent than those applied in Hong Kong. Although not implemented yet, CFL standards for New Zealand are likely to be aligned with Australian standards. Currently Australian CFL-bare MEPS are more stringent than China, Thailand and Mexico. Compared with the other countries, Australian MEPS for CFL-covered are more stringent than Mexico. The remaining countries/economies considered for comparison (E.U, U.S, Korea, China, Canada, Brazil and Thailand) have all implemented MEPS for covered CFLs that are more stringent than Australia.

Compared with New Zealand, energy performance standards for storage water heaters were found to be less stringent in Australia, the European Union, U.S, Taiwan and Canada.

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[1] [NZ] Energy Efficiency (Energy Using Products) Amendment Regulations 2011. Schedule 1.

[2] http://www.clasponline.org/clasp.online.worldwide.php. The clasponline data incorrectly listed TVs as having MEPS in NZ. Accessed 22-08-2011

[3] Based on the EECA end-use data base. http://enduse.eeca.govt.nz/ Accessed 20/6/2011

Currently New Zealand/Australian standards for RAC-split and RAC-window are more stringent than those implemented in Korea and China. Canada has the most stringent MEPS for RACs and is only surpassed by Japan with its Top Runner programme, which should be seen as targets not standards.

Table 1. Summary table of MEPS for household appliances comparing the standards of different countries with New Zealand

	EU	U.S.	KOR	CHN	CAN	JAP	HK	TWN
Refrigerator/Freezer 5B	+	+	+	+	+			
Refrigerator/Freezer 5T	-	-	+	+	-			
Freezer 6C	+	+	+	+/-[4]	+			
Linear fluorescent lamp			+		+	+	-	
Storage water heater	-	-			-			-
RAC-split		+/-[5]	-	-	+	T		
RAC-window		-	-	-	+	T		

T= Japan Top Runner target MEPS programme

+
-

MEPS are less stringent (-) or more stringent (+) compared with New Zealand's current MEPS

[4] Proposed Chinese MEPS (2012) are more stringent than New Zealand's standards. Chinese current MEPS of 2008 are less stringent.

[5] U.S. MEPS are more stringent for RAC-split with a capacity >11 kWh

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1.1 MEPS Introduction

Interest in improving the energy efficiency of household appliances is widespread and growing globally. Examples of methods for reducing energy consumption include energy labelling, energy efficiency standards and market conditioning. Energy standards were implemented for the first time in the industrial sector and subsequently adopted in domestic appliances. Initially implemented by individual countries as an attempt to reduce energy consumption, energy efficiency standards have now become a global issue with a number of international agencies, such as IEA and APEC, involved. In addition, some countries have formed sub-groups to harmonize their testing and energy efficiency standards (e.g. Australia/New Zealand and Canada/Mexico/USA) (Turiel, 1997). Energy-efficiency labels and standards can be applied to any product that consumes energy, directly or indirectly, as it provides its services. Energy efficiency standards can be either mandatory or voluntary; they can be in the form of minimum allowable energy efficiency or a maximum allowable energy use (Turiel, 1997; Wiel and McMahon, 2005). Minimum Energy Performance Standards (MEPS) establish limits for the energy efficiency that products must meet or exceed before they can be sold. Some MEPS are implemented by industry organisations[6], but this report considers only those mandated by government regulation[7]. Over time MEPS are usually reviewed, in consultation with the industries concerned, and updated in line with technological advances. Along with energy rating labelling, MEPS should ideally give the industry the motivation to constantly improve the energy efficiency of products on the market (APEC, 2009).

1.2 History

Poland was the first country to introduce mandatory Minimum Energy Performance Standards (MEPS) for a range of industrial products. The first MEPS for domestic appliances were implemented by the French government for refrigerators in 1966 and freezers in 1978. Between the 1960s and 1970s France was followed by other European governments and Russia in the adoption and implementation of energy efficiency standards. Early MEPS legislation in the European Union was weak, poorly implemented and had little impact on appliance energy consumption. It was eventually repealed under the pressure to harmonize European trading conditions between the late 1970s and early 1980s (Waide, 1997; Wiel and McMahon, 2005). The first energy efficiency standards to dramatically affect manufacturers, and significantly reduce energy consumption, were those established by the state of California in 1976 (and implemented in 1977). The U.S. implemented national standards in 1988 under the US National Appliance Energy Conservation Act (NAECA) of 1987. To avoid the need to produce different models for different states, manufacturers decided it would be easier to observe one national standard for refrigerators, freezers, water heaters and room air conditioners (Turiel, 1997). Other countries followed rapidly in adopting mandatory MEPS for different appliances; Taiwan (1991 - Room Air Conditioning), Australia (1987), Philippines (1993 - Room Air Conditioning) and Malaysia (1999 - Fans & Lightning) (Mahlia and Saidur, 2010).

1.3 Test Standards

The development of a test procedure for rating and testing is the first step in the development of energy efficiency standards. An energy test procedure is the technical foundation for energy efficiency standards, energy labels and other related programmes (Mahlia and Saidur, 2010). Countries usually

[6] For example, gas appliance MEPS in Australia: http://igs.nigc.ir/IGS/BOOK/Energy-Labeling-Standard.PDF Accessed 21-08-2011.

[7] Some countries have no MEPS programme. In this report the Top Runner programme of Japan is treated as a MEPS scheme de facto.

implement their own testing standards (not compatible with other countries), but some countries work together in establishing joint test standards (e.g. Australia and New Zealand).

1.4 European Union

The 27 member states of the European Union (EU) are required to implement harmonized regulations including MEPS and labelling. Before the EU embarked on its MEPS scheme, some individual countries had already implemented their own labelling and/or standards programmes. In 1990 Denmark announced its decision to introduce Mandatory Energy Labelling Programmes, but the European Commission (EC) asked Denmark not to go ahead as the MEPS were seen as a trade barrier and an obstacle to free trade. However, because of growing interest in member states, the EC then developed the "Directive For Mandatory Energy Labelling Of Household Appliances" (92/75/EEC) to make comparative labelling compulsory. In the same year, the Netherlands notified the EC of its wish to introduce MEPS for refrigerators. It took another six years until the first EU mandatory efficiency standards were accepted (in 1996) and implemented in September 1999. However, because the standards apply to refrigerator/freezers only, all new MEPS candidates must be presented separately to the Council of Ministers. As a result the EU has implemented only 14 MEPS, much fewer than the US (46) or China (41). However it has 29 standards under consideration for implementation (see Table 2), more than any other country/economy.

Table 2 Overview of the year of implementation of mandatory product standards for the European Union[8]

MEPS Product Description	Year implemented
MEPS implemented already	
Refrigerators-Freezers (household)	1994
Boilers hot water (gas)	1998
Freezers	1999
Ballasts (magnetic)	2004
Ballasts for fluorescents lamps	2004
External power supplies	2009
Lamps	2009
Lighting (tertiary sector)	2009
Motors (3-phase)	2009
Set-top-boxes	2009
Standby power	2009
Televisions	2009
Dishwashers	2011
Fans	2011
MEPS under consideration, not yet implemented	
Building circulators	U
Boilers hot water (oil)	U
Central Air conditioning	U
Central heating systems	U
CFL	U
Clothes dryers	U
Clotheswashers	U
Coffee makers	U
Computers	U

[8] Source: http://www.clasponline.org/clasp.online.worldwide.php Accessed 23-08-2011

Cook tops and ranges/ovens	U
Cooking Appliances	U
Dish dryers	U
Dryers commercial	U
Household router standby losses	U
Imaging equipment (copiers, printers)	U
Incandescent Lamps	U
Industrial ovens	U
Lamps (halogen)	U
Lighting (directional)	U
Local room heating products	U
Machine tools	U
Power transformers	U
Pumps	U
Refrigerator-Freezers (commercial)	U
Refrigerators (commercial)	U
Room air conditioning (split)	U
Sound and imaging equipment	U
Storage water heaters	U
Vacuum cleaners	U

1.4.1 Germany

As a member of the European Union, Germany must comply with EU MEPS regulations. However voluntary labelling schemes are encouraged as options to inform consumers about energy efficiency of household appliances and to encourage industry to produce more energy efficient products. The government of Germany created its own labelling programme (Blue Angel) in 1978. Currently 11,500 products in 90 product classes are Blue Angel eco-labelled, with 961 suppliers (21% foreign) having contracts to use Blue Angel. Amongst the German consumers, 76% know the Blue Angel label and 39% make purchases based on the Blue Angel label[9].

1.5 New Zealand's Alignment with Australia

New Zealand aligns its energy-related product standards (technically, commercially and administratively) with Australia through the Equipment Energy Efficiency (E3) programme, under an agreed policy framework and funding mechanism (APEC, 2009). The E3 programme develops energy efficiency measures for a range of residential, commercial and industrial products including MEPS and labelling. Through the E3 programme New Zealand meets its obligations under the Australia-New Zealand Closer Economic Treaty Agreement (ANZCERTA) and the Trans-Tasman Mutual Recognition Arrangement (TTRMA). The aligned programmes target the adoption of 'best regulatory practice' among trading partners to minimize trade problems while ensuring alignment with best international practice in standards for energy efficiency testing, performance standards and labelling. For most products, the same manufacturers and importers supply the same model range into both markets (ICF, 2011).

[9] http://www.blauer-engel.de/en/index.php accessed 07-03-2011

1.6 New Zealand MEPS

The New Zealand Energy Efficiency and Conservation Act (2000) provided the foundation for energy efficiency promotion in New Zealand. It allowed the government to make labelling mandatory and to set MEPS for a range of products such as air conditioners, lamps, freezer, refrigerators and motors, that became mandatory in 2002. The Act established the Energy Efficiency and Conservation Authority (EECA) to promote energy efficiency across all sectors in the economy (IEA, 2009). EECA also promotes Energy Star®, a voluntary, international endorsement programme, awarded to the top 25% most energy efficient equipment in each product category. Recently it has been argued that most of the residential MEPS of New Zealand and Australia are focused on lower and middle income homes. It was argued that higher income homes with more energy consuming appliances are given limited consideration (APEC, 2009). The report does recognize, however, that a good monitoring system has been set up by EECA to track the penetration of inefficient appliances, based on reporting of appliances sales data (APEC, 2009).

2. MEPS Comparisons

2.1 Comparing MEPS in New Zealand with Australia

The MEPS scheme for electrical appliances and equipment in Australia is a national one[10], but is implemented by regulation in the states, rather than through federal regulation[11]. As a result there are variations in the MEPS regulations between the states and there are none in Western Australia and the Northern Territories. In New South Wales, Victoria and South Australia the regulations do not yet include transformers/voltage-convertors for extra low voltage halogen lamps.

Table 3. Overview year of implementation of Minimum Energy Performance Standards for New Zealand and Australia. This list is based on the product classifications used in the Australian and New Zealand regulations [12] [13] [14] [15] [16] and clasponline[17].

Product classification	New Zealand	Australia
Storage water heaters (electrically heated)	1989	1999
Household refrigerators	2002	1999
Household freezers	2002	1999
Household refrigerator-freezers	2002	1999
Refrigerated display cabinets	2002	1999
Air conditioners & heat pumps (three phase, up to 65 kW cooling))	2002	2001
Three-phase cage induction motors (0.73 to <185 kW)	2002	2001
Ballasts (electric)	2003	2003
Ballasts (magnetic)	2003	2003
Linear fluorescent lamps	2002	2004
Air conditioners & heat pumps (single phase, ducted)	2005	2004
Air conditioners & heat pumps (single phase, non-ducted)	2005	2004
Distribution transformers	2004	2004
External power supplies (low voltage)	2011	2008
Digital set-top boxes	2011	2008
Liquid chillers for commercial buildings	2011	2009
Computer room (close control) air conditioners	2011	2009
Televisions	-	2009
Incandescent lamps	-	2009
Compact fluorescent lamps	-	2009
Transformers/voltage-convertors for extra low voltage halogen lamps	-	2010
Gas water heaters	2011	-

[10] http://www.energyrating.gov.au/man1.html Accessed 21-08-2011
[11] http://www.freehills.com/1634.aspx Accessed 21-08-2011.
[12] [NZ] Energy Efficiency (Energy Using Products) Amendment Regulations 2011. Schedule 1. As at August 2011.
[13] [NSW] Energy and Utilities Administration Regulation 2006. As at August 2011.
[14] [VIC] Electricity Safety (Equipment Efficiency) Regulations 2009. As at August 2011.
[15] http://www.sa.gov.au/subject/Water,+energy+and+environment/Energy/Electricity+and+gas+safety/Electricity+and+gas+safety+and+technical+regulation/Manufacturers+and+importers/Approval+of+electrical+products/Electrical+product+approval Accessed 21-08-2011
[16] [QLD] Electricity Regulations 2006. Schedule 4. Reprint No. 4G 1 July 2011.
[17] http://www.clasponline.org/clasp.online.worldwide.php Accessed 23-08-2011

Currently Australia nationally has MEPS for four product groups that have not been implemented in New Zealand: televisions, compact fluorescent lamps, incandescent lamps, and transformers/voltage-convertors for extra low voltage halogen lamps (see Table 3). New Zealand has recently implemented MEPS for gas water heaters. Australia has had an industry-run MEPS scheme for gas water heaters, space heaters and cookers since 1983[18], but this appears not to have a basis in regulation yet[19].

MEPS for electric storage heaters were implemented in New Zealand in 1989, prior to Australia in 1999. Most of the other product groups have been set simultaneously with Australia or later. In 1995 Australian energy ministers agreed to implement energy performance standards for refrigerators, freezers and electric storage water heaters to take effect in 1999, while New Zealand waited until 2002 for the implementation of major MEPS (Turiel, 1997). Fluorescent lighting ballasts were originally set more stringent MEPS in New Zealand compared with Australia but have been adjusted to be comparable (Harrington, 2004). For domestic storage electric water heaters the MEPS in Australia cover different products from those in New Zealand. Even where the products are similar, the MEPS are different, those in New Zealand being more stringent[20].

2.2 New Zealand Products MEPS Compared Worldwide

In total New Zealand has 18 products currently with implemented MEPS (see Table 3), based on clasponline categories[21]. For comparison with other countries, Figure 1 shows the number of product MEPS implemented by 16 different countries/economies. The majority of countries also have a number of pending standards awaiting regulatory approval. For the ten countries – other than New Zealand – with the most implemented MEPS (Figure 1: USA, Canada, PR China, Japan, Korea, Mexico, Australia, Israel, China Taipei and the European Union) the average number of implemented MEPS is 27.

Figure 1 shows that the U.S. and Canada have the highest number of approved standards (46 and 44 respectively) followed by China (41), Japan (27), Korea (25), Mexico (23) and Australia (21). New Zealand (18) is currently at eighth-equal position with Israel. It has four more implemented MEPS than the European Union, although the latter has many (29) under consideration.

It is important not to place too much weight on these numbers because the results depend on how the product categories are defined. Some countries include several related products in one regulation, whereas others have separate regulations for the same related products. It is also important to bear in mind that products may have an appropriate role in the MEPS portfolio of one country, but may be quite irrelevant in another.

[18] http://igs.nigc.ir/IGS/BOOK/Energy-Labeling-Standard.PDF Accessed 21-08-2011

[19] See http://www.energyrating.gov.au/library/pubs/200922-ris-gwh.pdf Accessed 21-08-2011

[20] AS/NZS 4692.2: 2005 Electric water heaters Part 2: Minimum Energy Performance Standard (MEPS) requirements and energy labelling.

[21] http://www.clasponline.org/clasp.online.worldwide.php Accessed 22-08-2011

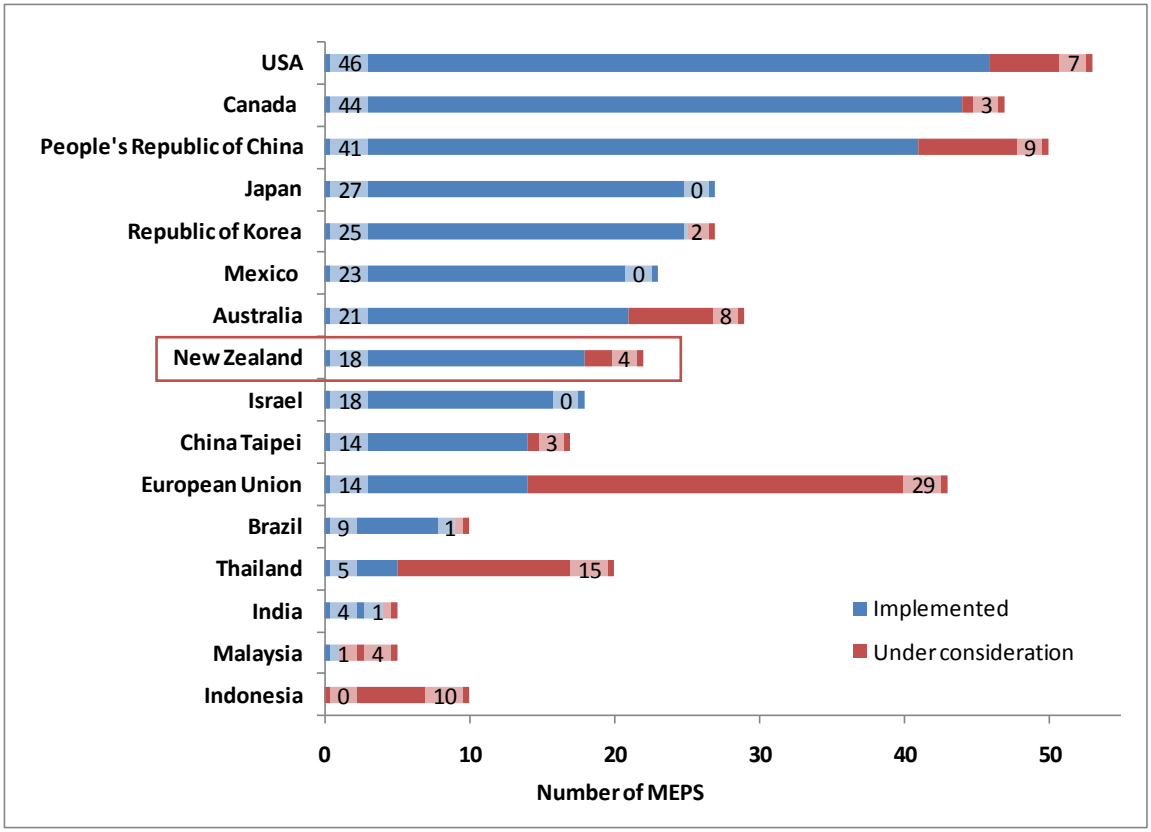

Figure 2. Overview of the number of mandatory MEPS implemented (blue) and under-consideration (red) for 16 countries including New Zealand[22].

2.3 End-use Groups Covered by Other Countries (excluding New Zealand)

This part of the report examines product groups not covered by New Zealand's MEPS which are in the MEPS portfolios of other countries. Figure 2 below shows how these groups are distributed, focussing on household appliances (grouped by end-use category) currently implemented by other countries but not New Zealand. Household appliances were grouped in product end-use group: bathroom, climate control, clothes, cooking, entertainment, ICT, hot water, kitchen, large miscellaneous, lighting, refrigerators, water and other using the same categorisation as the OECD/IEA.

[22] Sources: http://www.clasponline.org/clasp.online.worldwide.php together with data for individual countries. Site accessed 22-08-2011. The categories are those defined by clasponline, but include others shown in Table 3 for consistency. Some corrections have been made: NZ does not have an implemented MEPS for televisions, contrary to the data in clasponline.

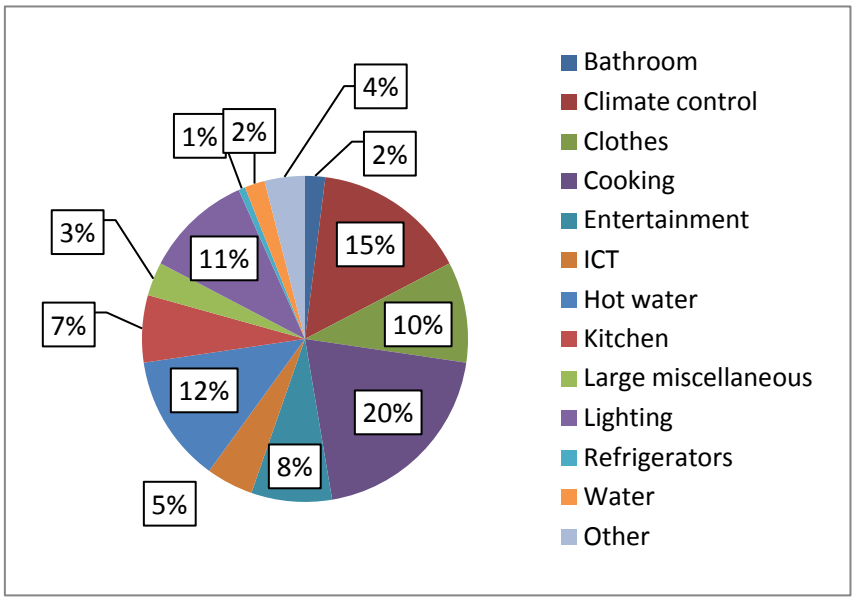

Figure 3 General overview of end-user groups for MEPS not implemented or pending in New Zealand but implemented in other countries considered in this report.

Cooking (2%) is a significant end-use group where other countries have implemented or pending MEPS not adopted in New Zealand e.g. furnaces, cook tops, ranges, ovens and range hoods. The second group is climate control (15%) where New Zealand has no implemented or pending MEPS: space heaters (fan, electric and gas), fans, dehumidifiers, water chillers and direct heating equipment. Hot water (12%) is an important end-use group where other countries have implemented MEPS not found in New Zealand: solar water heaters, boilers (gas, oil and electric), water heaters (oil).

Only some of these products are sufficiently important in the New Zealand context to merit further consideration. More generally, each country has its own priorities for implemented and pending MEPS within the different end-use household appliances groups. Countries such as China and Taiwan have a relatively larger number of their MEPS devoted to climate control. Canada, Japan, Taiwan and the U.S. place a greater emphasis on MEPS targeted at the cooking appliance group. Hot water is the third household appliance group that the U.S. Canada and Taiwan focus on. Entertainment makes up of a relatively large portion of Canadian and Japanese MEPS compared with other countries. This discussion is taken further in section 3.7.

3 MEPS Product Comparison

3.1 Refrigerators

Refrigeration forms an important energy use in New Zealand houses and is estimated to consume 1.119 ± 72 kWh per household per year which equals 15% of household electricity and 10% of total household energy use. In this category freezers are the highest consumers of household energy (663±39 kWh per household per year) followed by refrigerator-freezers (621±30) and refrigerators (367±62) (Isaacs *et al.*, 2010). Recognizing the importance of energy consumption by refrigerators, seventeen countries have

adopted mandatory standards for household refrigerators, refrigerator-freezers and freezers; Australia, Bahrain, Brazil, Canada, Chinese Taipei, Costa Rica, Equador, EU member countries, Hungary, Iran, Israel, Mexico, New Zealand, China, Korea, Thailand and the USA. Six countries are still pending in their adoption of MEPS; Algeria, Chile, El Salvador, Indonesia, Nicaragua and Vietnam.

Test standards

AS/NZS 4474.1-2007 is the test standard followed in New Zealand and Australia. This was issued as a Joint Standard under the terms of the Memorandum of Understanding between the Standards Association of Australia and the Standards Association of New Zealand, with the objective of reducing technical barriers to trade between the two countries (Mahlia and Saidur, 2010). Energy consumption is measured at specified internal compartment target temperatures while operating at an ambient temperature of 32°C. During the energy consumption test, the freezer compartment does not contain test packages and any automatic defrost mechanism is allowed to operate. Energy consumption is measured over a whole number of defrost cycles and there are separate procedures for adaptive defrost systems (where the time between defrosts exceeds 24 hours). There are no door openings in the test procedure. All tests are undertaken with a power supply at 230 Volts and 50 Hz (Energyrating, 2010).

The energy consumption for refrigerator-freezers depends on the appliance volume and on the temperature difference between the surroundings and the inside of the refrigerator-freezers. The adjusted volume is a measure of the refrigerator-freezers volume adjusted to reflect the various operating temperatures of different compartments (Harrington and Wilkenfeld, 1997; Mahlia and Saidur, 2010). The MEPS for refrigerator/freezers is expressed as the maximum allowable energy consumption (kWh/year) following the equation below:

$$MEPS = F + Vadj. \times A$$

Where:

MEPS	=	maximum allowable comparative energy consumption - kWh/year to AS2575.2
F	=	MEPS intercept (fixed allowance) for its Group, shown in Table 4 - kWh
A	=	MEPS slope (variable allowance) for its Group, shown in Table 4 - kWh per litre of adjusted volume
Vadj.	=	Adjusted Volume of the cabinet in accordance with AS2575.2 - litres
	=	Vff + Vfz * FAF where: Vff = volume of fresh food compartment Vfz = volume of the freezer compartment

MEPS for refrigerators

Australia has had energy labelling for refrigerators and freezers since 1986 (with a revision of the energy label algorithm in 2000). MEPS for refrigerators and freezers were implemented in 1999 and revised to be more stringent in 2005. New Zealand followed in 2002 by implementing a mandatory MEPS scheme under the Energy Efficiency and Conservation Act and mandatory labelling scheme in 2003. Although MEPS and labelling are not directly linked they do influence each other; the 2005 MEPS (for Australia) levels have resulted in a market where most products with lower star ratings under the 2000 algorithm have been eliminated, leaving star ratings bunched for refrigerators and freezers, predominantly with a rating of 3.5 and 5 stars (sales weighted average star rating was nearly 4 stars in 2006) (E3, 2008b).

3.1.1 Comparing MEPS for Refrigerators

The energy efficiency standards for refrigerators-freezers both for New Zealand and Australia (AS/NZS 4474.2-2009) were compared to MEPS standards of; EU-27 (2003), US (2001), Korea (2004), China (2008) and China (2012). These are revised standards and subject to further revision over time. The first MEPS on refrigerators for the different countries were: US implemented MEPS for refrigerators in 1990, Canada in 1995, California in 1988, Korea 1992 and China 1989, Australia in 1999 and New Zealand in 2002. Canada and California currently have the same standards as the US and will therefore not be mentioned separately.

Three types of refrigerators were chosen to represent New Zealand's biggest market share (E3, 2008b);

-5B: Refrigerator/freezer, automatic defrost, bottom mounted freezer (43% of all refrigerator/freezers purchased)
-5T: Refrigerator/freezer, automatic defrost, top mounted freezer (29% of all refrigerator/freezers purchased)
-6C: Chest freezer (72% of all freezers purchased)

Refrigerator/freezer, automatic defrost, bottom mounted freezer (5B)

New Zealand allows – by a small margin – the highest maximum energy consumption per year (E_{max} in kWh/year) for the average size of 441 litres (adjusted volume) of a 5B Refrigerator/freezer combination with bottom mounted freezer (see Figure 3A). New Zealand has more stringent MEPS standards for smaller refrigerators/freezers compared to China with an adjusted volume smaller than 130 litres. For larger size refrigerators (>530 l) New Zealand has more stringent MEPS standards than the European Union. China's proposed MEPS for 2012 are the most stringent compared to the other countries standards, except for sizes less than 180 litres adjusted volume.

Refrigerator/freezer, automatic defrost, top mounted freezer (5T)

For average-sized refrigerator/freezers with top mounted freezer (412 litres, adjusted volume) New Zealand's MEPS standards are the third most stringent after China and Korea (see Figure 3B). For smaller sized refrigerators (less than 190 litres adjusted volume) New Zealand has the second most stringent MEPS standards after the European Union. For larger refrigerator/freezers, China's proposed MEPS for 2012 are most stringent.

Chest freezers (6C)

New Zealand allows for the 2nd highest maximum allowable energy consumption (E_{max} in kWh/year) for chest freezers (after China's MEPS of 2008). The most stringent MEPS standards – by a significant margin – are implemented by the US (see Figure 3C).

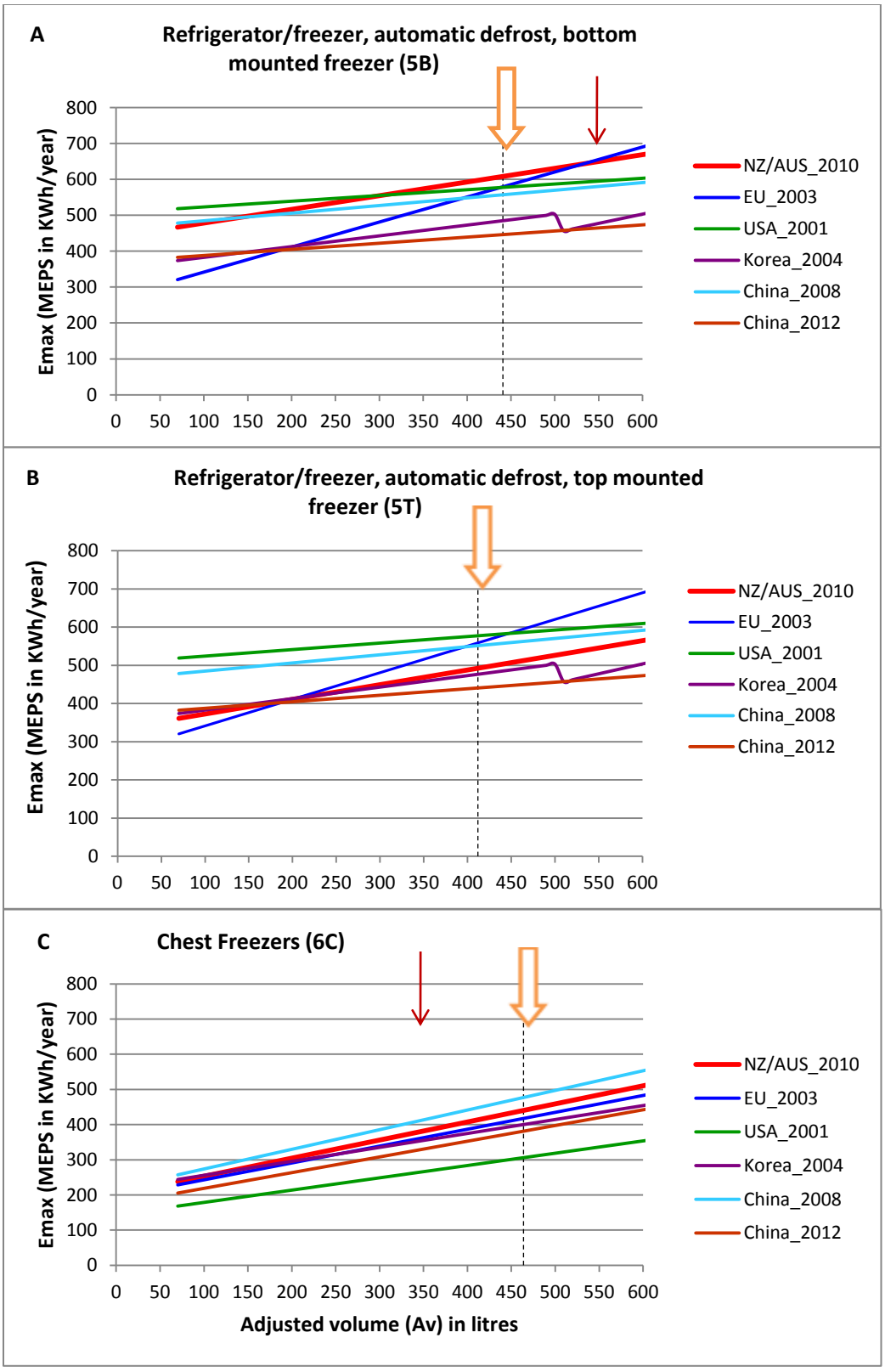

Figure 3. Maximum allowable energy consumption (E_{max} in kWh/year) for two different types of refrigerator-freezers (5B and 5T) and chest freezers (6C) for five countries (NZ/AUS, EU, US, Korea and China). Orange arrows indicate average size of the most often purchased models in New Zealand; red arrows indicate the same for Australia.

Lighting

Several countries have pursued policies for increasing energy efficiency in the lighting sector. The International Energy Agency (IEA), an autonomous body, was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme. The IEA has identified phasing out conventional incandescent lamps as a first priority for an energy-efficient lighting policy. Currently only two IEA countries (New Zealand and Turkey) do not have policies in place to phase out conventional incandescent lamps (IEA, 2009). New Zealand and Turkey do not have MEPS for incandescent lighting[23].

3.2. Incandescent Lamps

Incandescent lamps have been used worldwide for many years but are currently under consideration for replacement with CFLs or other efficient lamps in the market. Incandescent lamps include the following product categories; incandescent tungsten lamps, incandescent reflector lamps and tungsten halogen lamps. Four economies have adopted mandatory standards for incandescent lamps; Australia, Canada, Korea and the USA. In addition another three countries have pending standards for incandescent lamps: Chile, Chinese Taipei and the EU.

Test standards

Australia uses the test procedures in AS/NZS 4934.1 for measuring the energy performance of incandescent lamps. This standard specifies methods for determining the energy performance of tungsten filament and tungsten halogen lamps used in general lighting services. It applies to both non-reflector and reflector lamps of all voltages.

MEPS Incandescent Lamps

Since November 2009, general purpose incandescent lamps manufactured in or imported into Australia are required to comply with the MEPS set out in AS/NZS 4934.2:2008. Since February 2009, Australia has implemented an import restriction for general lighting service (GLS) incandescent lamps through Commonwealth Regulation. Like Compact Fluorescent Lamps (CFLs) and Fluorescent Lamps (FLs), the energy efficiency, in lumens/watt (lm/W), of incandescent lamps is a key performance characteristic. MEPS for incandescent lamps are aimed at eliminating lower-efficiency lamps from the market. The required minimum initial lamp efficiency in Australia (in lm/W) is $2.8\ln(L) - 4.0$, where $\ln(L)$ is the natural logarithm of the initial measured luminous flux, L, (in lumens)

3.3 Fluorescent Lamps

Several countries have adopted MEPS for residential linear fluorescent lamps. Some of those have developed standards for specific lamp types (e.g. linear FLs, double-capped FLs, single-capped FLs, circular FLs etc.) whereas others have developed only one standard for fluorescent lamps in general. Eight economies currently have adopted MEPS for fluorescent lamps: Australia, Canada, Chinese Taipei, Japan, Israel, New Zealand, Korea and the USA, while others have pending standards; Algeria, the EU, Indonesia and Vietnam.

Test standards

The test methods for measurement luminous efficacy are set out in AS/NZS 4782.1 and AS/NZS 4782.3.

MEPS Linear fluorescent lamps

Since 1 October 2004, linear fluorescent lamps manufactured in or imported into Australia and New Zealand must comply with the Minimum Energy Performance (MEPS) requirements as set out in AS/NZS 4782.2-2004. The scope of the MEPS for linear fluorescent lamps covers FD and FDH lamps

[23] http://www.clasponline.org/clasp.online.worldwide.php. Accessed 25-08-2011

ranging from 550mm to 1500mm in length (inclusive) and with a nominal lamp power of 16 Watts or more. The intention of the MEPS is to improve end-use energy efficiency by eliminating lower-efficiency fluorescent lamps from the market and encouraging the sale of higher-efficiency products instead. When measured in accordance with AS/NZS 4782.1 the initial efficacy (at 100 hours) and the maintained efficacy (at 5000 hours) should exceed the values specified in lm/W. The maximum quantity of mercury present in fluorescent lamps should not exceed 15 mg. The quantity of mercury present is determined in accordance with the relevant Clauses of AS/NZS 4782.3.

3.3.1 Comparing MEPS for Fluorescent Lamps Internationally

The most stringent linear fluorescent efficiency requirements (lm/W) have been implemented by Korea and Japan for different size classes (see Figure 4). The least stringent MEPS requirements have been adopted by Hong Kong. Australian/New Zealand's efficiency standards compare closely with Canadian/US standards.

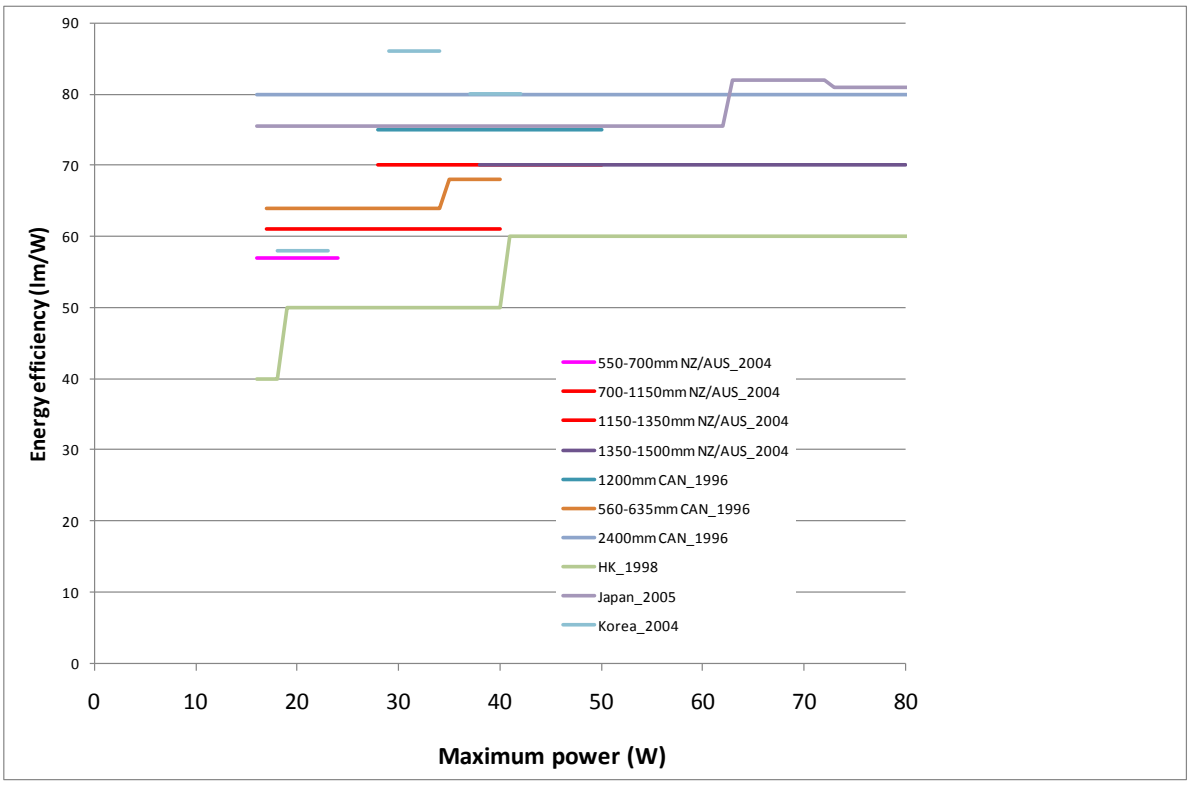

Figure 4. Minimum required energy efficiency (lm/W) for linear fluorescent lamps for 5 different countries (Korea, Japan, Hong Kong, Canada/US and NZ/AUS)

3.4 CFLs

Compact Fluorescent lamps (CFLs) have been widely considered and accepted as energy-efficient substitutes for incandescent lamps. Many countries have established and adopted mandatory energy efficiency standards and label programmes for CFLs. Thirteen economies currently have MEPS for CFLs; Australia, Brazil, Chinese Taipei, Colombia, Ghana, India, Mexico, Pakistan, China, Korea, Thailand, the Philippines and the USA. Standards for CFLs in New Zealand are currently pending as they are also in Chile, Ecuador, the EU, Nicaragua and Vietnam.

Test Standards

Test procedures for CFLs are set out in AS/NZS 4847.1:2010. This applies to self-ballasted CFLs with integrated means for controlling starting and stable operation, intended for domestic and similar general lighting purposes. It applies to CFLs of all voltages and wattages irrespective of the type of lamp cap. The CFL energy-efficiency is specified in lm/W.

MEPS for CFLs

Australia has adopted energy efficiency standards for self-ballasted compact fluorescent lamps (CFLs). Since 1 November 2009, CFLs have to comply with MEPS set out in AS/NZS 4847.2-2010. Although New Zealand has not adopted and implemented MEPS standards on Compact Fluorescent Lamps it is expected that they will be aligned with Australia's standards once adopted.

3.4.1 Comparing MEPS for CFLs Internationally

The minimum energy efficiency standards for CFLs (in lm/W) are often divided into bare and covered CFL's. For the purpose of comparing New Zealand/Australian standards internationally, the same division has been applied (see Figure 5A for covered CFLs and Figure 5B for bare CFLs).

Bare CFLs

Australia has adopted minimum energy efficiency standards comparable to EU legislation for bare CFLs. Compared with other countries with MEPS for CFLs, Australian standards are found in the upper middle ranging between the most stringent (Canada-until 35 Watts) and the least stringent (China and Mexico).

Covered CFLs

Mexico has the least stringent MEPS requirements on covered CFL efficiency (lm/W) followed by Brazil and Australia. The most stringent MEPS efficiency levels have been implemented by Canada with the EU pending MEPS the second most demanding. European standards for CFLs have not yet been fully implemented.

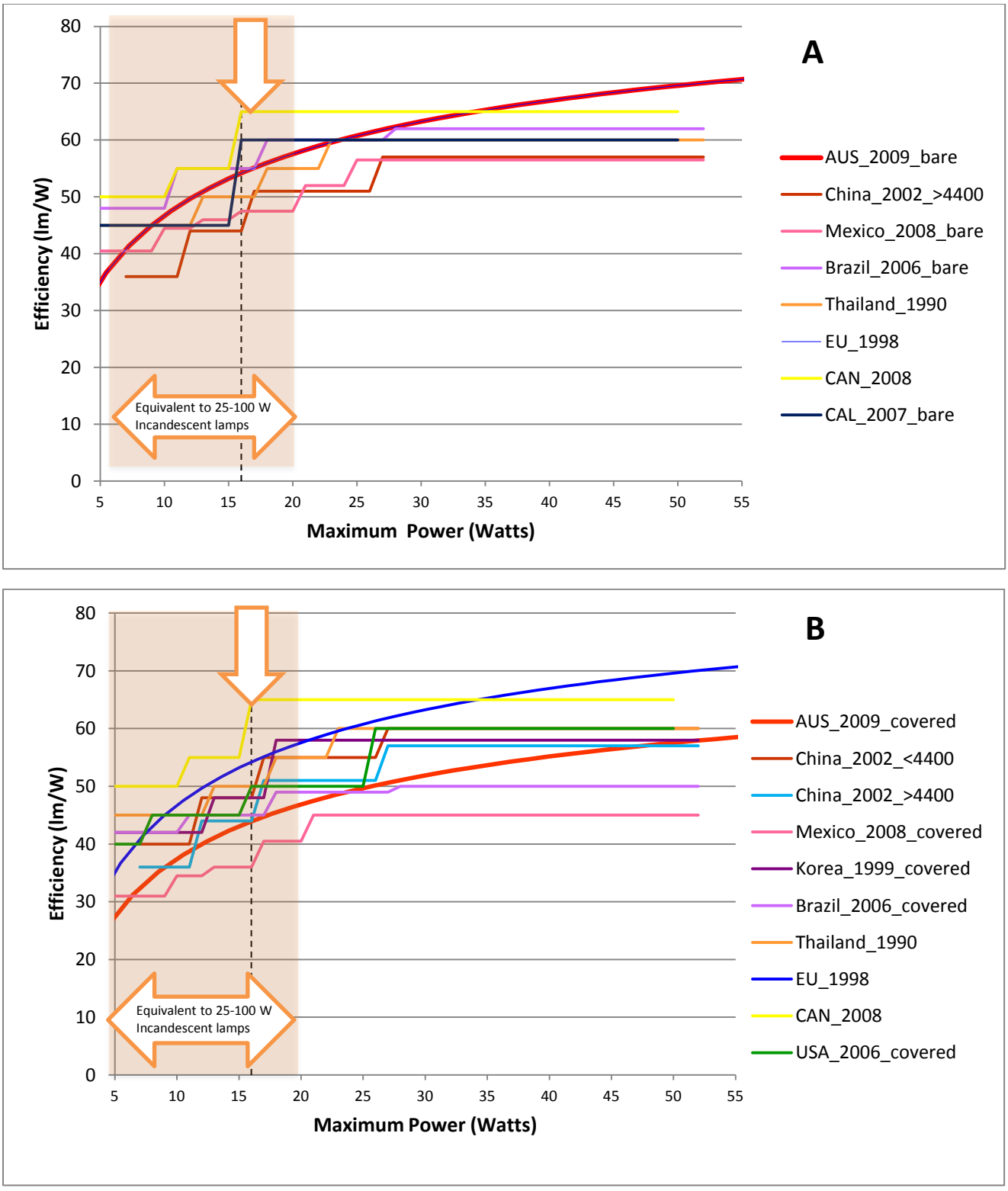

Figure 5. Minimum energy efficiency standards (in lm/W) for covered (A) and bare (B) compact fluorescent lamps for eight different countries (Australia, China, Mexico, Brazil, Thailand, EU, Canada and California). The arrows indicate the most purchased CFLs in Australia (16 W) and the most important product range (equivalent to 25-100W incandescent lamps).

3.5 Electric Water Heating

New Zealand has mandatory MEPS for electric water heaters together with seven other countries/economies (Australia, Canada, Chinese Taipei, Costa Rica, Israel, China and USA). Indonesian standards are still pending. Mandatory labels have been implemented in Costa Rica, Iran, Israel, China and the USA and are still pending in Russia, Argentina and Chile. In Australia, an agreement has been reached to phase-out electric water heaters in residential homes[24].

Test Procedures

For New Zealand and Australia, electric water heaters are tested for their standard heat loss at a nominal 20°C ambient air temperature and a water storage temperature of 75°C (for most tanks), giving a ambient air/hot water temperature difference of 55°C . The test measures the energy consumed over a number of complete thermostat cycles, and this is normalized to a heat loss per 24 hour period[25].

MEPS standard:

Minimum Energy Performance Standards (MEPS) have been set at a maximum standing heat loss rate (kWh per day) for hot water storage tanks. Electric water heaters manufactured or imported into Australia and New Zealand must comply with the MEPS set out in AS/NZS 4692.1.2005. Although New Zealand and Australia share the same standard, the MEPS requirements are different and the products to which they apply are also different[26].

3.5.1 Comparing MEPS for Electric Water Storage Heaters Internationally

Up to 250 litres storage capacity, the standards that apply to Australia allow for the highest maximum standing heat loss (in kWh/day) for electric water storage heaters compared to U.S, Canada, New Zealand and the European Union (see Figure 6). On the other hand, over the range 50 – 500 litres New Zealand has the most stringent standards (requires the lowest rate of heat loss) for vented storage water heaters. Canada has the next most stringent MEPS with a capacity up until 300 litres. Most hot water storage heaters purchased in New Zealand have a capacity ranging from 135-180 litres (70% market share - HEEP, 2010).

[24] www.climatechange.gov.au accessed at 07-03-2011

[25] AS/NZS 4692.1:2005 Electric water heaters - Energy consumption, performance and general requirements

[26] AS/NZS 4692.2:2005 Electric water heaters Minimum Energy Performance Standard (MEPS) requirements and energy labelling

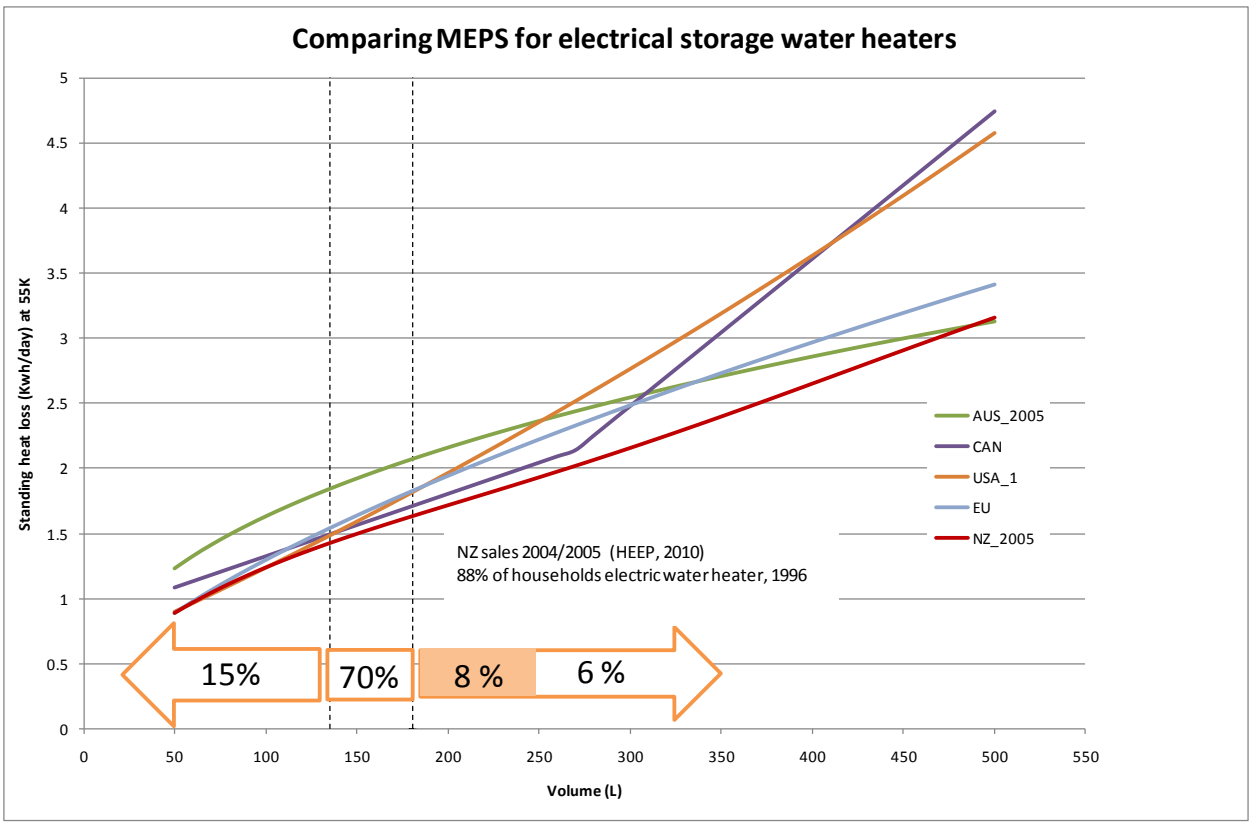

Figure 6. Maximum allowable heat loss rate (kWh/day at 55°C temperature difference) for electric storage water heaters plotted against volume (in litres) for 5 countries/economies (NZ, AUS, Canada, U.S, EU). Arrows indicate the market share of the different sizes of storage water heaters sold in New Zealand. Most prominent are those ranging between 135 and 180 litres (sale data NZ sales 2004/2005 from HEEP, 2010).

3.6 Air conditioners

Air conditioners (AC) can be grouped according to unit: packaged AC, split AC, ductless AC, evaporative coolers and window AC. In addition they can be grouped by condenser types as air-cool and water cool, or by cooling capacity as Room AC and Central AC. The most common energy efficiency standards for energy standards are for Room AC and Central AC. Thirteen countries/economies have adopted MEPS standards for RAC appliances: Australia, Canada, Chinese Taipei, Costa Rica, Egypt, Ghana, India, Israel, Mexico, New Zealand, China, Thailand, the Philippines and USA. Five countries are still deciding on implementation; Algeria, El Salvador, Indonesia, Malaysia and Tunisia.

Test Standards

Since 1 October 2004, all single-phase air conditioners manufactured in or imported into Australia must comply with Minimum Energy Performance Standards requirements, now AS/NZS 3823.2:2009. MEPS covers single-phase non-ducted or ducted room air conditioners of the vapour compression type (commercial or residential) within the scope of AS/NZS 3823.1.1 or AS/NZS 3823.1.2 or AS/NZS 3823.1.3, as applicable. AS/NZS 3823.1.1 and AS/NZS 3823.1.2 and AS/NZS 3823.1.3 cover equipment utilizing one or more refrigeration systems with one outdoor unit and one or more indoor units controlled by a single thermostat/controller. They cover equipment utilizing single, multiple and variable capacity components. Examples of equipment types covered include those with a single indoor control such as

single packaged units, packaged ducted units, double and triple split systems and single split systems and water sourced heat pumps[27].

MEPS standards for RAC

Since 1 April 2010, new MEPS have been put into place for New Zealand and Australia: AS/NZS 3823.2:2009. The new standards require the determination of the power consumption in the non-operative mode. The key performance standards of room air conditioner energy-efficiency are determined by the Energy Efficiency Ratio (EER) for cooling and the Coefficient of Performance (COP) for heating. Commonly a minimum EER or COP is used as the MEPS, except for Japan, which uses a target in their Top Runner programme. Other ways to indicate the energy-efficiency of Air Conditioners adopted by several countries (including the USA and Canada) include Annual Performance Factor (APF) and Seasonal Energy Efficiency Ratio (SEER). It is only possible to convert SEER and APF metrics into EER and COP by estimation and therefore comparison between countries can be difficult. To be able to compare standards, MEPS of Japan, Canada and USA were converted using the same approach as EnergyConsult (2002).

3.6.1 Comparing MEPS for RACs Internationally

Single system Room Air Conditioner (RAC)

The highest energy efficiency requirements (expressed as the heating COP) currently in place for single system RACs are those implemented by Canada followed by New Zealand/Australian MEPS (see Figure 7A). Japan has set target levels under their Top Runner programme. Korea has the least stringent MEPS for RAC-single systems at the moment.

Split system Room Air Conditioner (RAC)

Comparable for RAC-single systems, Canada has the highest energy efficiency requirements followed by New Zealand/Australian standard requirements for <11kWh capacity models (see Figure 7B). The U.S has more stringent MEPS compared with New Zealand for models with a capacity >11kWh, but less stringent compared to Canada. The least demanding energy efficiency standards have been implemented in Korea.

[27] See http://www.energyrating.gov.au/pac1.html

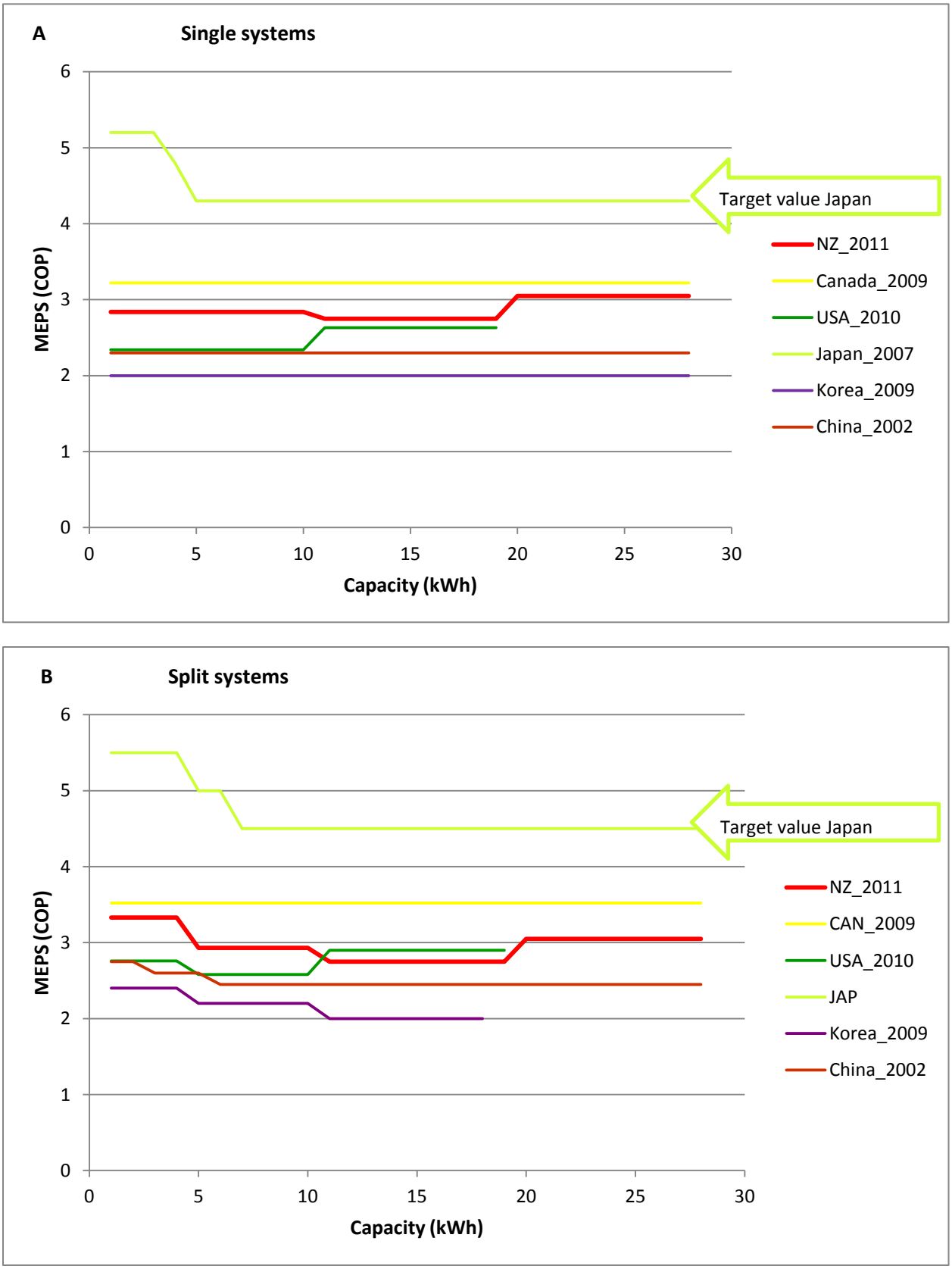

Figure 7: Minimum heating Coefficient of Performance depending on capacity (kWh) for single system heat pumps (A) and split systems heat pumps (B) for seven different countries (NZ/AUS, Canada, U.S, Japan, Korea and China).

3.7 Gaps in New Zealand's MEPS Portfolio

The products for which New Zealand has implemented MEPS (Table 3) are widely included in the MEPS portfolios of other countries. On average more than six of the ten countries with the most implemented MEPS (see Figure 1: USA, Canada, PR China, Japan, Korea, Mexico, Australia, Israel, China Taipei and the European Union) have implemented or pending MEPS for the same products as New Zealand. Evidently the products in the New Zealand MEPS programme are reasonably in line with current practice internationally.

In order to determine where New Zealand should prioritize further additions to its MEPS portfolio, Tables 4 and 5 show the top energy and electricity end-use categories for New Zealand, indicating whether or not there are presently relevant implemented MEPS that address consumption in these categories. The tables show that 24.5% of all consumer energy use is covered to some extent by one or more MEPS and 71.8% of all consumer electricity use is similarly covered. These tables also show the areas where MEPS are most likely to have an impact on energy use: space heating, water heating, stationary motors, refrigeration and lighting.

In this context it is important to note that the products that offer most promise in a MEPS programme are those for which the energy efficiency is most sensitive to changes in the product design. For example, the energy efficiency of traditional electric heaters cannot be influenced significantly by design or by further investment in the product. On the other hand, the efficiency of products such as refrigerators, air conditioners, chillers, heat pumps, dehumidifiers, dryers, lighting and consumer electronics is comparatively sensitive to design changes. Often there is an increase in cost as the design is changed to improve the energy efficiency. For these products a MEPS scheme can be an effective tool for improving the energy efficiency of the products in the market.

Table 4. New Zealand consumer energy use categories[28] showing the percentage of total consumption and indicating the presence (Y=yes, N=no) of MEPS addressing energy consumer efficiency that category.

Energy use	%	Cum. %	MEPS
Transport, Land	36.1	36.1	N
Intermediate Heat (100-300 °C), Process Requirements	16.3	52.4	N
Low Temperature Heat (<100 °C), Space Heating	6.7	59.1	Y
Low Temperature Heat (<100 °C), Water Heating	5.5	64.6	Y
Motive Power, Stationary	4.6	69.3	Y
High Temperature Heat (>300 °C), Process Requirements	3.8	73	N
Fe3O4 Reduction	3.5	76.6	N
Al2O3 Reduction	3.2	79.8	N
Transport, Air	3.2	83	N
Motive Power, Mobile	3.1	86.1	N
Refrigeration	3.0	89.1	Y
Lighting	2.6	91.8	Y
Electronics and Other Electrical Uses	2.1	93.8	Y
Transport, Sea	1.9	95.8	N
Pumping	1.2	97	N
Intermediate Heat (100-300 °C), Cooking	1.1	98.1	N

[28] EECA end-use data base. http://enduse.eeca.govt.nz/ Accessed 20/6/2011.

Table 5. New Zealand consumer electricity use categories showing the percentage of total consumption and indicating the presence (Y=yes, N=no) of any MEPS addressing consumer energy efficiency in that category.

Electricity Use	%	Cum. %	MEPS
Motive Power, Stationary	16.3	16.3	Y
Low Temperature Heat (<100 °C), Water Heating	14.4	30.7	Y
Al2O3 Reduction	12.7	43.3	N
Refrigeration	11.9	55.3	Y
Lighting	10.4	65.7	Y
Low Temperature Heat (<100 °C), Space Heating	8.9	74.6	Y
Electronics and Other Electrical Uses	8.2	82.9	Y
Pumping	4.9	87.8	N
High Temperature Heat (>300 °C), Process Requirements	3.5	91.3	N
Intermediate Heat (100-300 °C), Cooking	3.0	94.3	N
Space cooling	1.7	96	Y

Table 6. Products for which New Zealand currently has no implemented MEPS that have a significant level of MEPS adoption in the ten countries world-wide with the most active MEPS programmes. The percentage of uptake (either implemented or pending) is in column 2. Column 3 shows the relevant New Zealand energy end-use category. Columns 4 and 5 show (respectively) the percentage of electricity and energy consumption used in that category.

Product	Uptake %	Affected energy use category	Electricity use %	Energy use %
Clothes Washers	70	Water heating (<100 °C)	14.4	5.5
Compact fluorescent lamps	70	Lighting	14.4	5.5
Boilers (oil)	60	Intermed & low temp heat	-	29.6
Dishwashers	60	Water heating (<100 °C)	14.4	5.5
Fans	60	Motive Power, Stationary	16.3	4.6
Incandescent lamps	60	Lighting	10.4	2.6
Televisions	60	Electronics & other uses	8.2	2.1
Boilers (gas)	50	Intermed & low temp heat	-	29.6
Vending Machines	50	Refrigeration	11.9	3.0

Table 6 lists nine products that are not presently part of New Zealand's MEPS portfolio, which are nevertheless widely adopted elsewhere. The column "Uptake %" shows the percentage of the ten countries with the most implemented MEPS (USA, Canada, PR China, Japan, Korea, Mexico, Australia, Israel, China Taipei and the EU) which have a MEPS for the product concerned implemented or pending. The table shows that these products contribute to areas of energy consumption in New Zealand which are significant. These products are appropriate for inclusion in the New Zealand MEPS programme because their energy efficiency is sensitive to the product design.

Other products that have not been widely adopted elsewhere, which could also be important for New Zealand in the future, include: clothes dryers, solar water heaters, heat pump water heaters and domestic dehumidifiers. These are products for which the energy efficiency is sensitive to the product design. Solar and heat pump water heaters are at an early stage in terms of market acceptance, which is

an appropriate time to implement a performance standard for products, such as these, with a service life of 10 – 20 years. Solar and heat pump water heaters are likely to become more important in the Australian market following its decision to phase-out resistive-type electric water heaters in homes[29]. There is therefore a reasonable prospect that these products will become more widely accepted in New Zealand. Clothes dryers and dehumidifiers are also significant because they are established products with significant markets in New Zealand. For example, the stock of dehumidifiers in NZ was 244,000 in 2005 with 45,000 sold annually[30].

4. Concluding Remarks

The average number of MEPS implemented in the ten countries with the strongest portfolios (excluding New Zealand) is 27 (see Figure 1). New Zealand currently has 18, mostly products that are well represented in the portfolios of the top ten countries. While this suggests that New Zealand presently has a well selected set of products with implemented MEPS, there is room to extend the portfolio.

Compared with other countries with active MEPS programmes, New Zealand's MEPS are both more and less stringent and no outstanding anomalies have been identified. New Zealand has aligned its standards with those of Australia, but has not yet adopted MEPS for four products recently implemented in Australia. On the other hand, MEPS for gas water heaters, implemented in New Zealand in 2011, have yet to be adopted in Australia. Of the 18 MEPS implemented in New Zealand, it has been slower than Australia in adopting twelve products, faster for three and the same for three (Table 3).

This analysis has identified nine products for which many other countries have implemented or pending MEPS, that have not yet had MEPS implemented in New Zealand. These are: clothes washers, compact fluorescent lamps, boilers (oil and gas), dishwashers, incandescent lamps, televisions and vending machines. Three of these products (compact fluorescent lamps, incandescent lamps and televisions) are in the MEPS portfolio of Australia. In addition there are reasons for considering clothes dryers, solar water heaters, heat pump water heaters and domestic dehumidifiers as candidates for new MEPS.

Remaining Question

To finish, an unanswered question arose during finalizing of this report: does the alignment of standards and labels between New Zealand and Australia properly reflect differences in the domestic energy consumption of end-use groups and household appliances in each country?

As an example: New Zealand currently has the least stringent MEPS for refrigerator/freezer type 5B at the most often purchased volume (441 liters adjusted volume). For Australia, their most often purchased volume of model lies higher (at 554 liters adjusted volume). At that volume the MEPS for Australia are more stringent than those for European refrigerators. On the other hand, the MEPS for electric storage water heaters is significantly more stringent in New Zealand than Australia, which may be an appropriate reflection of climatic differences. At this point it remains unclear to what extent the differences between the domestic markets of New Zealand and Australia are being considered in setting performance standards. Alternatively, is New Zealand tending to adopting MEPS designed primarily for the Australian market?

[29] www.climatechange.gov.au Accessed 07-03-2011

[30] Energy Consult Ltd., MEPS or labelling for portable dehumidifiers for residential use in Australia and New Zealand: scoping study. http://www.energylibrary.org.nz/documents/EnergyLibraryUpdateJuly06.pdf, 2005.

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