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CAN ENERGY-EFFICIENT ELECTRICAL APPLIANCES BE CONSIDERED "ENVIRONMENTAL GOODS"?

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Abstract

Public policies in a large number of OECD and non-OECD countries seek to steer producers and consumers towards relatively more energy-efficient goods. This chapter considers electrical appliances for home and office, which are produced and consumed in large and increasing numbers in industrialised and, increasingly, in developing economies. Since most relatively energy-efficient appliances achieve high performance levels through combinations of features that would be difficult to characterise succinctly under the product descriptions normally used for customs purposes, it may be necessary and desirable to distinguish them according to a single criterion: their energy performance in use. While international standards for defining and testing for energy performance exist, they differ for each appliance and in practice are not universally applied. This chapter notes progress made at the regional and international levels to harmonise these standards. But for products exhibiting large regional variation, differentiating more from less efficient models at the multilateral level — a necessary condition for co-ordinated tariff reductions in the WTO — is more difficult. However, work towards harmonising test procedures for measuring the energy performance of household and office electrical appliances would in itself help to lower non-tariff barriers affecting energy-efficient goods, which may be more important than lowering tariffs.

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The report is available on the OECD website in English and French at the following URL addresses: http://www.oecd.org/trade and http://www.oecd.org/environment.

LIST OF ACRONYMS AND ABBREVIATIONS

ANSI	American National Standards Institute (www.ansi.org)
APEC	Asia-Pacific Economic Co-operation (www.apecsec.org.sg)
ARI	Air-conditioning and Refrigerating Institute (www.ari.org)
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers (www.ashrae.org)
CEN	European Committee for Standardization (www.cenorm.be)
CENELEC	European Committee for Electrotechnical Standardization (www.cenelec.org)
CFL	compact fluorescent lamp
EER	energy-efficiency ratio
ESIS	Energy Standards Information System
EU	European Union
GHG	greenhouse gas
IEC	International Electrotechnical Commission (www.iec.ch)
IESNA	Illuminating Engineering Society of North America (www.iesna.org)
ISO	International Organization for Standardization (www.iso.org)
IEA	International Energy Agency (www.iea.org)
ITC	International Trade Centre (www.intracen.org)
JIS	Japan Industrial Standards Association (www.jsa.or.jp)
kWh	kilowatt-hour
MEPS	minimum energy-performance standards
NAEWG	North American Energy Working Group
NAFTA	North American Free Trade Agreement
TBT	technical barrier to trade, or the WTO Agreement on Technical Barriers to Trade
TEPS	target energy-performance standard
USD	U.S. dollar
WTO	World Trade Organization (www.wto.org)

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Executive Summary

Public policies in a large number of OECD and non-OECD countries seek to steer producers and consumers towards goods that are relatively more energy efficient. Could goods with better-than-average energy efficiency therefore be considered to be environmentally preferable, or even "environmental goods" in the sense implied in the World Trade Organization (WTO) mandate to negotiators (paragraph 31(iii) of the Doha Ministerial declaration) to liberalise trade in environmental goods?

Some relatively energy-efficient appliances employ technologies that are readily distinguishable from those used in their less-efficient counterparts. But most achieve their high performance levels through combinations of features that would be difficult to characterise succinctly in the types of product descriptions normally used for customs purposes. This suggests that, were relatively energy-efficient goods to be defined as "environmental" for the purposes of a market-access negotiation, it might be necessary and desirable to distinguish them according to a single criterion: their energy performance in use.

This paper considers the case of household and office electrical appliances, which are produced and consumed in large and increasing numbers, both in industrialised and, increasingly, in developing countries. Currently, technical regulations and standards relating to energy performance vary widely from country to country. Some 51 countries currently regulate a minimum energy performance standard (MEPS) for one or more classes of electrical appliances. Most of these are developed or rapidly industrialising countries although there are a fast-growing number of less developed countries that are establishing similar regulations. An additional 26 countries are in the process of developing MEPS. Of the countries that have established MEPS, major differences exist in how they classify and describe the products for which energy performance is regulated. Countries also specify the standards differently, and at different levels, and many require test procedures to measure energy performance that are not substantially identical to those set out in internationally established test standards.

A similar situation applies for energy labels, where some 57 countries have currently implemented labels on one or more class of household appliance and some 28 additional countries are in the process of developing them. A much larger percentage of the world's population live in countries that have developed or are developing appliance energy standards and labels than those that do not; however, there are still a large number of mostly smaller, or less developed countries that have not yet instigated standards and labelling programmes. Furthermore, the number of product types covered by standards and labels varies considerably from country to country and many have currently only developed requirements for a small number of products.

The paper explores several possible ways that preferential tariff margins could be created for relatively energy-efficient goods and reflects upon the practical and economic issues that trade negotiators would need to carefully consider before employing such a blunt, yet powerful, trade-policy instrument. It concludes that the feasibility of distinguishing goods for the purpose of selective tariff liberalisation depends on the nature of the technology and the degree of difference in testing procedures and regulations

among countries. Some products, such as compact fluorescent lamps and LCD computer monitors, could theoretically be differentiated easily on the sole basis of visually-verifiable physical characteristics. For most products visual inspection is inadequate because their relative energy performance can only be established by testing. Among these there are some products whose energy test procedures, product categorisation, efficiency metrics and required efficiency thresholds are sufficiently similar that it would be feasible to devise a common set of requirements determining their entitlement to a liberalised tariff. There are other products for which many aspects of the test procedure, product categorisation and efficiency metrics are similar, or could be expressed in a comparable manner across regions, but for which the efficiency thresholds currently applied are very different from one market to another. These differences in efficiency requirements often reflect significant differences in the price of energy and the way the product is used from one region to another that determine the efficiency-level at which the product is most cost-effective for the consumer. In this case it may be inappropriate to aim at a harmonised efficiency requirement for entitlement to a reduced tariff; however, agreement on a common approach to devising economy-specific efficiency thresholds above which liberalised tariffs would be applied might be a way forward for this category of goods. The same approach could be adopted for those goods for which there are large differences in test procedures, categories, metrics and efficiency thresholds.

The study also concludes that work is required to either standardise or harmonise product descriptions and energy-performance metrics or to develop algorithms that would allow simple conversion from one set of requirements to another without necessitating retesting. For products exhibiting large regional variation in design features, use patterns, testing procedures and energy-performance standards, differentiating more from less efficient models at the multilateral level would be less feasible, at least over the short or medium term. In support of that longer-term goal, however, work towards harmonising test procedures for measuring the energy performance of household and office electrical appliances would in itself help to lower *non-tariff* barriers affecting energy-efficient goods and thereby help to achieve one of the goals of the Doha Development Agenda.

International co-operation involving energy-efficiency programmes and labels has been progressing on several fronts, especially within regional bodies, such as the Asia-Pacific Economic Co-operation (APEC) Energy Working Group, the North American Energy Working Group and the European Economic Area. The question is raised whether progress on this front is reason enough for WTO members to consider using energy performance as a basis for defining certain goods as “environmental” for the purpose of improving market-access. Trade negotiations incur high transaction costs: any multilateral decision to work towards reducing non-tariff and tariff barriers to relatively energy-efficient goods would therefore presumably have to be justified by an expectation that the net benefits of liberalising trade in the goods would be sufficiently large.

This paper attempts to scope the range of magnitudes of such benefits and examines potential mechanisms which could be implemented to realise them. Despite this, while relatively high energy performance may be a necessary condition to distinguish an energy-using good as environmentally preferable, in some cases it may not be a sufficient one. This paper does not attempt to analyse these additional product environmental characteristics, but simply notes that they exist and are often alluded to in eco-labelling requirements.

I. Introduction

Public policy in a large number of OECD and non-OECD countries clearly reflects a preference for goods that are more efficient in their use of energy over versions of the same goods that are less energy-efficient. Such preferences are manifested through regulations that require a minimum energy performance from household electrical appliances and office equipment, requirements to display labels indicating the relative energy performance of the good for sale, and voluntary labelling schemes that indicate certain goods as exhibiting a superior energy performance to competing products on the market. Some 57, countries with a combined population of 4.4 billion, currently have energy performance standards or labels for one or more energy using products, and many more countries are in the process of developing such schemes, while the scope of most existing schemes is being enlarged. In the majority of cases the energy performance in use of energy-using equipment, such as refrigerators and clothes-washers, is the dominant component of their environmental impact[1], and there is generally a large potential to reduce the energy consumption in use of such goods.[2]

Could goods with better-than-average energy efficiency therefore be considered as environmentally preferable, or even "environmental goods"? More than about ten years ago, such a question might have seemed odd. But since the mid-1990s various governments and inter-governmental organisations have been trying to decide what constitutes an "environmental good" — initially for the purposes of estimating the size and growth of the environmental goods and services industry. Whether energy-efficient goods could be defined as environmental products has become even more apposite since World Trade Organization (WTO) Ministers, in paragraph 31(iii) of the November 2001 Doha Ministerial Declaration, called for "negotiations, without prejudging their outcome", on "the reduction or, as appropriate, elimination of tariff and non-tariff barriers to environmental goods and services." A particular challenge in the on-going discussions is how to identify modalities for discussing environmental goods and services in a way that is useful to the WTO in pursuit of its liberalisation objective, and that also contributes to higher levels of environmental protection.

Currently, discussions in the WTO on environmental goods have been focussed largely on products that are used in the provision of environmental services, such as equipment for monitoring noise levels or cleaning up oil spills. Nevertheless, several of the product lists that have been submitted to the WTO's Committee on Trade and Environment in Special Session contain goods that are deemed by the sponsoring countries to be environmentally preferable because of their intrinsic performance characteristics. Qatar, for example, has proposed electric power turbines and fuel-cell technologies designed to run on natural gas, which burns more cleanly than other fossil fuels. Japan has proposed that certain innovative designs for household appliances — such as inverter-type air conditioners and refrigerator-freezers, ultrasonic dish-washing and clothes-washing machines, and induction-heating electric stoves — be included in a list of environmental goods. In its submission, Japan noted that "Cleaner/Resource Efficient Technology and Products and Resources Management as a product group … are worth reflecting on in the course of the Market Access Negotiations." And the Commission of the European Communities has suggested that environmental performance, including energy efficiency, be one of the objective parameters used in identifying environmental goods. As an example they mention fluorescent lighting. Other WTO Members have remarked on the significant feasibility questions raised by including relatively energy-efficient goods (indeed, of any goods defined by their relative performance that changes over time) on a list of environmental goods — questions that this paper attempts to address.

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1 See, for example, the life cycle impact analyses conducted for the European eco-labels applied to energy using goods.

2 *Cool Appliances: Policy Strategies for Energy Efficient Homes*, International Energy Agency, Paris, 2003

Although some relatively energy-efficient electrical appliances, like those on Japan's list, employ technologies that are readily distinguishable from those used in their less-efficient counterparts, many achieve their high performance levels through combinations of features that would be difficult to characterise succinctly in the types of product descriptions normally used for customs purposes. Should there ever be an interest in defining a wider range of relatively energy-efficient goods as "environmental" for the purposes of a market-access negotiation, therefore, it might be necessary and desirable to distinguish products by a single criterion: their energy performance in use. Distinguishing goods on the basis of energy-performance criteria presents no insurmountable problem for customs clearance in as much as conformity with product performance standards can, if need be, be physically verified.

Yet energy performance is not a universally defined quotient, like acceleration or density, and each class of appliance requires its own method for measuring it. Across countries, these methods ("test procedures") and the performance requirements vary in ways that are not trivial. These differences pertain to:

- *How countries classify and describe the products for which minimum energy performance standards (MEPS) or energy labels are regulated*. Owing to a wide range of cultural, commercial and historical factors, the features available on, and the configurations, of basic household appliances — particularly refrigerator-freezers and washing machines — may exhibit wide regional differences. This variability is typically reflected in the categories within a product group for which individual standards or labels are developed but may also be manifested in differences in product categories applied in energy performance test procedures.

- *The test procedures used to measure energy performance*. International standards for testing energy performance exist for most household appliances and office equipment types, but there are sometimes significant departures from these test procedures at the national level in ways that make their results hard to compare. Tests in some large OECD countries can predate the international ones, and are favoured. The degree of departure from international test procedures depends on the product being considered.

- *The ways in which the standards are specified*. Most MEPS, energy labels and energy performance targets require the energy efficiency of the product to be calculated, where the efficiency is expressed in terms of the energy used to perform a given service, or function. Even when countries apply identical test procedures to measure energy consumption they do not necessarily apply identical energy efficiency metrics. For example, the formulas for calculating the energy performance of an appliance may differ in how they adjust for particular functionality variables such as storage volume, or cleaning performance. This leads to issues of comparability.

- *The stringency of energy performance thresholds required of products*. Even where formulas for specifying efficiency requirements are similar, there are often differences in the stringency of efficiency thresholds specified for MEPS, labels or targets. This may reflect a diversity in the efficiency of product markets, varying levels of policy ambition, variations in energy prices or simple differences in the timing at which regulations were introduced.

- *The scheduling of reviews of regulations and test procedures.* In the case of household electrical appliances and electrical office equipment, the pace of innovation is often higher than for household goods in general, especially with the incorporation of digital technology into many appliances.[3] Clearly, for energy-efficiency standards to be relevant, they must keep pace with

3 While most performance advances involve technology-related advances, product design changes are also very important in improving energy efficiency levels. For example, many European refrigerator-freezer

technological changes that affect design and performance. This necessity is reflected in government regulations, which often mandate reviews of MEPS and labels every three to five years. However, different starting dates for programmes have meant that review cycles are not in sequence.

Reconciling these differences across a large number of countries would be a major undertaking. Any multilateral decision to start developing internationally agreed criteria for relatively energy-efficient goods, based on comparable test procedures, would therefore presumably have to be justified by an expectation that the net benefits of liberalising trade in the goods would be correspondingly large. Those benefits would depend on: the potential size of each product's international market; the contribution that the product makes to world energy consumption and the spread of energy performance among the different models on offer within the same product class; and the degree to which tariff and non-tariff barriers are currently restricting trade.

This paper concentrates on household and office electrical appliances, which are produced and consumed both in industrialised and, increasingly, in developing countries. (Cars and trucks are also major consumers of energy, and vehicle fuel-economy regulations and targets have been established by several countries, but they are not examined here.) Section II provides contextual information on trends in the consumption of this category of goods, differences in the energy performance of the least and most energy-efficient models, and the tariffs that are currently being applied to them. That is followed, in Section III, by an overview of the types of regulatory and voluntary measures being used in different countries to shift consumption towards more energy-efficient products. Section IV turns to obstacles to aligning energy-performance standards and test procedures, which could be one goal of a trade-liberalisation initiative. The first part of the Section highlights differences in national regulations and standards pertaining to energy performance, based on an analysis of existing requirements. In particular the paper examines the treatment of four representative product groups — refrigerator-freezers, air conditioners, fluorescent lighting and personal computers — under various national and private energy-performance standards. Details of the regulations applying to these products are reported in Annexes 1 to 4. This section also explores several ways that countries could agree to differentiate relatively less energy-efficient from relatively more energy-efficient goods for the purpose of applying a lower or zero tariff to the latter class of goods. In exploring the various options the paper also discusses some of the arguments for and against creating preferential tariff margins. Some regional and bilateral groups of countries are currently trying to harmonise their energy-performance requirements and test procedures. Section V reviews international alignment efforts to date. A few final observations conclude the paper.

II. Background and context

Household and office appliance markets

After transportation, household and office electrical appliances represent the world's fastest-growing segment of total energy consumption. World purchases of major appliances and equipment — refrigerators, clothes washers, lighting, water heaters, air conditioners, computers, fax and photocopying machines increased by roughly 3.7% a year in the decade from 1992 to 2002 and are projected to grow at about 3.8% a year from 2002 to 2005. Estimates of production, consumption and trade in household and

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models have improved energy efficiency by using more efficient compressors, optimisation of the sizing and thermal heat transfer properties of heat exchangers, improved control and better quality insulation. In some cases low-conductivity evacuated panels have been installed, which allows for higher efficiency levels with thin walls.

electrical appliances are difficult to obtain at the aggregate level. According to the *2003-2008 World Outlook for Household Refrigerators*, global sales of refrigerator-freezers and room air conditioners were each worth around USD 12 billion in 2001. Other sources suggest that global sales of refrigerators and freezers were approximately 90 million units in 2002, compared with ~14 million clothes-dryers, ~17 million dishwashers, ~60 million clothes-washers and ~120 million cooking appliances.

There are important differences among countries in their demand patterns, however. In the richer countries of the OECD, growth in sales of large household electrical appliances is driven mainly by product replacements. Demand is nonetheless large in these mature markets. In the former European Union (EU)-15 countries, roughly 19 million refrigerator and freezer units were sold in 1999 (Waide *et al.*, 2000). A major exception may be air conditioners, sales of which are rapidly expanding across Europe, but especially in the south. And there is still much potential for growth in sales of household appliances in the new Member States of the EU, and in Central and Eastern Europe and the former Soviet Union.

Generally, rates of growth in appliance ownership in rapidly industrialising developing countries are much higher than in mature markets. For example, nowadays most first-time buyers of microwave ovens live in developing countries.[4] The Asia-Pacific region accounts for roughly 35% of appliance demand compared with 23% respectively for Western Europe and North America and 19% for the rest of the world. The shift in consumption toward the Asia-Pacific region is exemplified by the growth in demand in China. For example, consumption of room air conditioners in China increased from a total annual production of roughly 0.22 million units in 1990, to 33 million in 2002. Growth rates have been near 20% a year, while domestic production now represents one-third of the world market.[5]

New demand in several developing countries — notably China and neighbouring Asian countries — and the shift in regional production to countries like Korea and Mexico, is signalling potentially important longer-term changes in patterns of trade. According to the ITC (Table 1), there were several developing countries among the world's top 16 producers of household refrigerators, freezers and refrigerator-freezers in 2002, and even more among the world's top producers of room air conditioners. Rates of annual growth in exports from these countries have been in the double digits for some countries.

4 MindBranch, *World Major Household Appliances* (www.mindbranch.com).

5 FriedNet, Air Conditioning Industry Report (www.friednet.com).

Table 1. Exports of household refrigerators, freezers and refrigerator-freezers (HS 8418.10 through 8418.30), and air conditioners (HS 8415.10) in 2002

Freezers and refrigerator-freezers				Air conditioners			
Exporting country	Value USD millions	Growth, 98-02 (%)	Share of world exports	Exporting country	Value USD millions	Growth, 98-02 (%)	Share of world exports
Italy	1 160	-2	16%	Korea	1,173	25	32%
Korea	806	12	11%	China	954	51	27%
Mexico	646	~50	9%	Thailand	307	12	8%
USA	585	-1	8%	Malaysia	249	-1	6%
China	471	~40	7%	Belgium	197	176	5%
Germany	419		6%	Singapore	93	-2	2%
Sweden	282		4%	USA	84	-7	2%
Turkey	274		4%	Saudi Arabia	72	-2	2%
Spain	255		4%	Italy	67	4	1%
Thailand	251		3%	Mexico	42	50	1%
Singapore	185		3%	United Arab Emirates	38	21	1%
Belarus	176		2%	Chinese Taipei	28	-16	0%
Slovenia	167		2%	Brazil	22	-4	0%
Canada	75		1%	Indonesia	20	154	0%
Netherlands	75		1%	Philippines	18	59	0%
Brazil	72		1%	Bahrain	18	36	0%
Subtotal	5 899		82%				

1. Shading indicates developing-country exporter.

Source: International Trade Centre, TradeMap database.

Much of this shift in regional production is linked to the opening up to foreign investment of formerly restricted national markets, such as in China, and a trend toward globalisation in appliance manufacturing. For example, Electrolux have developed an appliance joint venture in China, while Whirlpool have established manufacturing in India. In the lighting sector Osram (Osram Foshan Lighting Co., Ltd.), Philips (Philips & Yaming Lighting Co., Ltd) and General Electric (GE Lighting Co. Ltd.) have all established joint-ventures, or fully owned production facilities, in China. There are many other examples of the globalisation of appliance production over the last decade.

The environmental rationale for energy-efficiency standards and labels

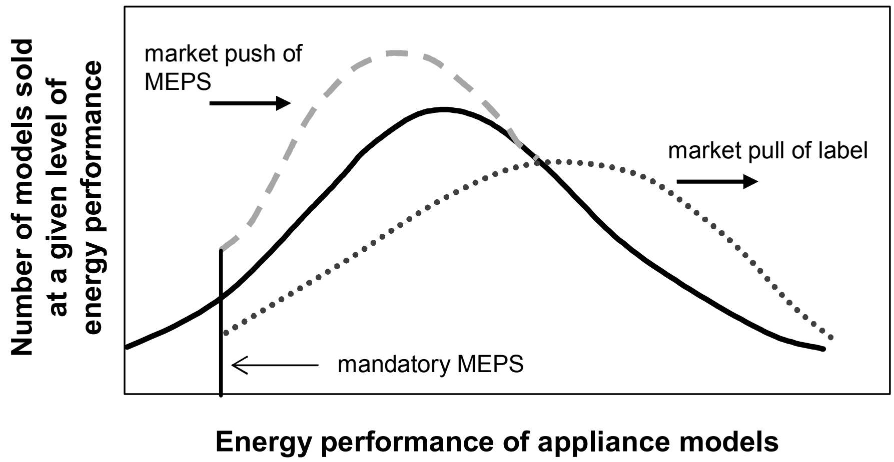
Residential electricity consumption in the OECD was 2612 TWh in 2002 which amounted to 31% of total electricity consumption in the region. Of this space heating and cooling accounted for about 22%, water heating and lighting 14% respectively and other appliances such as white goods, home entertainment, miscellaneous cooking appliances and office equipment for 51%. Because of differences in such variables as climate conditions, building codes, and disposable income levels, the share of national final energy consumption accounted for by household and office products varies considerably.

Energy-efficiency standards, targets and labels are intended to lower the energy requirements of new appliances in delivering a given appliance service, through either forcing inefficient appliances from the market or making the choices more transparent to consumers, who will presumably respond by buying relatively more of the efficient models. These effects are sometimes referred to, respectively, as "market push" and "market pull" (Figure 1). It has long been recognised that labels can be effective market-based instruments to promote energy-efficiency goals. For example, Australia's Greenhouse Office reasons that:

> Labelling of appliances empowers consumers through the provision of the information they need to take energy efficiency into account when purchasing a new appliance. The provision of energy efficiency information ensures a healthy, competitive appliance market, where purchasers are able to consider whole-of-life costs for the appliance, not just the purchase price.[6]

Similarly, in its enabling legislation for electrical appliances (Directive 92/75/EEC), the European Commission states that its mandatory labels are intended to promote the "reduction of environmental damage or risks related to the use of energy (global warming, acidification, depletion of non-renewable energy sources) by reducing energy consumption" (European Commission, 2000).

Figure 1. How mandatory minimum energy performance standards (MEPS) and labels affect the market for an electrical appliance



Source: Adapted from NAEWG (2002), Figure 1.

Differences in the energy performance of similar appliances can be large. In the European Union, the least-energy-efficient refrigerators on sale consume up to three times the electricity of the most efficient despite MEPS being in place since 1999. The influence of the EU's energy label on the efficiency of the refrigerator market can be seen clearly in Figure 2, which shows the evolution of the share of refrigerator models as a function of the energy efficiency index, where a low index indicates a high efficiency. By 1999 almost all models on the market were designed to attain a specific energy label class and most had efficiency indices that were very close to the thresholds separating the label classes.[7]

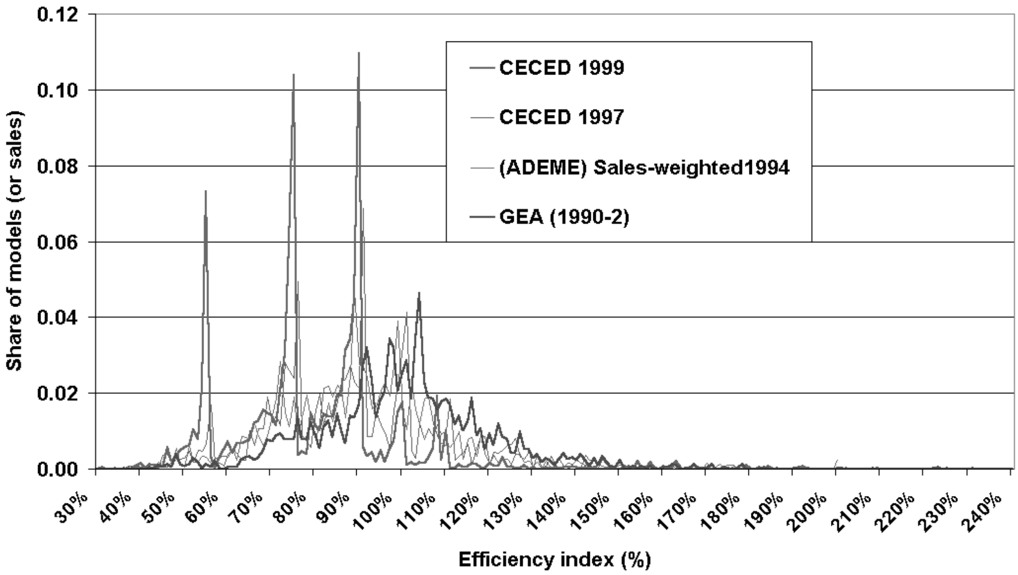
Even among compact fluorescent lamps (CFLs), which are by design up to five times more energy efficient than the more common incandescent light bulbs, the most efficient lamps have an efficacy (i.e., produce more lumens per Watt) that is at least 20% better than the least efficient CFLs. The reductions in Mexico's electricity consumption following the introduction of MEPS for several categories of goods in

6 Commonwealth Government of Australia: The Australian Greenhouse Office (www.greenhouse.gov.au).

7 Waide et al. (2000), *Cold II: The revision of energy labelling and minimum energy efficiency standards for domestic refrigeration appliances*, IEA, Paris.

that country during the mid-1990s were expected to be of the same magnitude, with the biggest percentage savings associated with refrigerators, air conditioners and water pumps (Table 2).

Figure 2. The distribution of refrigerator and freezer sales as a function of their energy efficiency index in the European Union



Source: Waide et al. (2000), Cold II: The revision of energy labelling and minimum energy efficiency standards for domestic refrigeration appliances..

Table 2. Expected electric energy savings from Mexico's MEPS

Regulated appliance or piece of equipment	Sales of units per year	Expected reduction in electricity consumption, in %	First year estimated savings in giga-Watt hours
Residential refrigerators	1 050 000	41	579.0
Room air conditioners	182 108	20	323.*
Central air conditioners	4 000	3	18.5
3-phase AC induction electric motors	171 396	7	669.*
Clothes washers	1 000 000	10	7.9
Vertical pumps	2 500	13	18.0
Centrifugal residential water pumps	300 000	18	6.0
Electromechanical efficiency of deep-well pumps	4 500	30	578.0
Submersible pumps	1 100	3	11.4

*Savings are after year three.

Source: Energy Efficient Strategies, Australia (1999a), Review of Energy Efficiency Test Standards And Regulations in APEC Member Economies: Main Report, APEC Secretariat, Singapore.

In the United States and Canada, energy-efficiency programmes are credited with helping to reduce the amount of energy used to power new models of refrigerator-freezers by over two-thirds between 1973 and 1998.[8] This improvement contributed to a net decrease in annual residential electricity consumption from refrigerator-freezers, even though over the same period the number of units in use increased. As explained in Box 1, claims regarding the benefits of energy labelling and standards programmes are not always simple to substantiate. Moreover, the net environmental benefits depend also on how the electricity that powers the appliance is generated. If the avoided electricity would have come from a coal-fired power plant, less carbon dioxide will be produced — all else being equal. If most of the electricity would have come from hydropower stations — such as would be the case in Norway — emissions would be less, but other environmental impacts related to the building of new dams and electricity distribution lines would also be reduced.[9]

Box 1. Quantifying the benefits of energy standards and labels for household appliances and office equipment

Many claims are made about the benefits for the environment — mainly in terms of emissions of air pollutants and greenhouse gases avoided through reduced electricity consumption — resulting from the implementation of MEPS and labelling. Estimating the counterfactual situation — that is, what energy consumption and emissions would have been in the absence of such measures — is difficult, however, because of the need to take into account changes in technologies and consumer preferences that would have occurred even in the absence of government intervention. Nonetheless there is a growing body of evidence, such as that illustrated for the EU refrigerator market in Figure 2, that appears to demonstrate a clear influence of such programmes and render the hypothesis that such transformations would have occurred without the introduction of energy efficiency policy measures highly improbable.

The voluntary ENERGY STAR programme estimates that it saved 80 billion kilowatt hours and 10 000 megawatts of peak power in 2002, thereby avoiding emissions of 38 million metric tonnes of carbon equivalent, and 140 000 tonnes of nitrogen oxides.[†] One study estimates that energy-efficiency programmes for the residential sector (including building codes as well as MEPRs) avoided the equivalent of 4% of total GHG emissions in the United States (Koony *et al.*, 1998). The Government of Japan expects that its Top Runner programme will achieve energy savings of 13% to 72% (depending on the appliance) by the target year set for each appliance, compared with current energy use patterns (IEA, 2003, p. 73). The IEA has estimated that appliance efficiency policies put in place in OECD countries between 1990 and 2002 were on course to save 292 TWh of residential electricity demand in 2010 and 393 TWh in 2020 (some 13.5% of the forecast total residential electricity consumption). The same study estimates that were all appliances sold from 2005 onwards to have an efficiency level that resulted in the lowest product life cycle costs for the consumer (the combination of purchase price and discounted life-time operating costs) that total residential electricity consumption in OECD countries could be 35% lower in 2020 than with the current policies. Were this to happen it would result in about 524 Mt of annual CO2 savings and reduce total annual consumer costs by 24.7 billion US$ in OECD-North America and 30.9 billion Euro in OECD-Europe (IEA, 2003).

Estimating the environmental benefits world-wide from current programmes would be a highly data-intensive and imprecise exercise, owing to differences in regulations in standards and in patterns of use and is beyond the scope of the current paper.

[†]Environmental Protection Agency (2002), "Consumers and the Environment Score Big with ENERGY STAR Products" (www.epa.gov).

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8 A new refrigerator-freezer in one year consumes typically less than 500 kWh, compared with over 1 800 kWh for an average model sold in 1973.

9 Displacement of electricity use in interconnected systems can provide a benefit also. In North America, for example, hydroelectricity produced in Québec but not used in the province can be sold to other markets, displacing coal-generated electricity. The same is true for Norwegian electricity which can be sold into the Scandinavian Nordpool.

Tariffs on household appliances and office equipment

In the OECD countries with the highest GDP per capita, applied most-favoured-nation (MFN) tariffs on household appliances and office equipment are already low (Table 3). The main exception is Mexico, which applies a tariff of 20% on several categories of goods. However, as the majority of Mexico's trade in these products now takes place within the context of regional and bilateral trade agreements with OECD countries, tariffs on most of its imports are much lower than indicated here.

In non-OECD developing countries, by contrast, one can observe a wide variation in tariffs, both among countries and across products imported into the same country. The Philippines and Chinese Taipei already apply low tariffs to most manufactured goods, whereas Egypt, Malaysia, Nigeria and India apply tariffs of 25% or more on refrigerators, air conditioners and lamps. Tariffs levied on personal computers are zero in many developing countries, but remain at 15% or higher in Brazil and India.

Table 3. Average applied MFN tariffs on selected household appliances and office equipment in OECD and selected non-OECD countries (% ad valorem)

Country	Year of data	Refrigerator-Freezers HS 8418.10	Air Conditioners HS 8415.10	Heat Pumps HS 8415.81	Incandescent Lamps HS 8539.22	Fluorescent Light bulbs HS 8539.31	Portable computers HS 8471.30	Desktop computers HS 8471.41
Australia	2004	5.00	5.00	5.00	5.00	5.00	—	—
Canada	2003	4.00	—	3.00	4.00	7.00	—	—
EU	2003	1.27	4.00	1.35	2.70	2.70	3.50	1.75
Iceland	2003	6.25	10.00	10.00	7.50	7.50	—	—
Japan	2004	—	—	—	—	—	—	—
Korea	2002	8.00	8.00	8.00	8.00	8.00	—	—
Mexico	2004	23.00	23.00	23.00	12.00	25.00	—	3.60
New Zealand	2004	7.00	7.00	7.00	7.00	7.00	—	—
Norway	2003	—	—	—	—	—	—	—
Switzerland	2004	1.92	1.50	0.83	specific-rate	specific-rate	—	—
United States	2004	—	—	1.00	4.20	2.40	—	—
Turkey	2003	1.27	2.20	1.35	2.70	2.70	—	—
Brazil	2004	21.50	18.33	16.75	19.50	19.50	18.25	20.00
China	2004	14.43	15.00	17.50	7.75	8.00	—	—
Egypt	2002	38.00	40.00	40.00	30.00	25.00	5.00	5.00
India	2004	25.00	30.00	30.00	30.00	30.00	15.00	15.00
Indonesia	2003	15.00	10.00	10.00	10.00	8.33	—	—
Malaysia	2003	30.00	30.00	10.00	26.25	30.00	—	—
Nigeria	2002	55.00	55.00	55.00	25.00	40.00	2.50	5.00
Philippines	2003	5.00	7.00	7.00	6.50	6.50	—	—
South Africa	2004	25.00	17.00	17.00	20.00	20.00	—	—
Taipei, Chinese	2003	4.00	11.00	11.00	4.67	5.00	—	—
Thailand	2003	30.00	30.00	30.00	20.00	20.00	—	—

— = no tariff is applied.
Source: OECD Secretariat, based on various national and international databases.

III. Standards, regulations and labels: general considerations

Analyses of energy-efficiency standards and labelling programmes distinguish four types of measures: mandatory minimum energy-performance standards (MEPS), energy performance targets, comparative energy labels and seal-of-approval energy labels (also sometimes called “endorsement labels”). MEPS are, by definition, mandatory and seal-of-approval labels voluntary, but comparative labels may be mandatory or voluntary. The majority of labelling schemes are administered by governments, but some, mostly seal-of-approval labels, are administered by not-for-profit organisations or even industry associations.

From the perspective of trade policy, a mandatory technical requirement is more significant than a voluntary one. Both MEPS and mandatory labelling requirements impose an obligation on suppliers, including foreign suppliers, to engage in conformity assessment. This involves subjecting samples of the product to an approved test procedure, which is itself issued in the form of a standard. Often manufacturers themselves are allowed to carry out the testing, and to certify the results, but depending on the conformity requirements they may need to be accredited to do so. In other cases a third-party certifier or the importing government carries out the test.

A seal-of-approval energy label indicates that a product meets or exceeds a predetermined set of eligibility criteria. Some seal-of-approval labelling schemes require only conformity with a (voluntary) minimum energy performance standard. So-called “eco-labels” set additional environmental criteria — such as those relating to chemical content or recyclability — that must be met. Other than the fact that participation in a seal-of-approval labelling programme is voluntary, the same conformity assessment procedures may be followed as for mandatory labels. However, since voluntary seal-of-approval energy labelling programmes sometimes set their standards at a more demanding but related level to those applied in local mandatory MEPS, or sometimes on a standard applied by a voluntary labelling scheme in another (usually larger) country, a manufacturer can sometimes use the test results it obtained for demonstrating conformity with the MEPS when applying for a voluntary label. The same is usually true for mandatory labels when MEPS are in place.

As of April 2005, at least 51 economies countries, including the EU and its 25 Member States, had established MEPS for household appliances or office equipment, and 57 had established either mandatory or voluntary labelling schemes to encourage consumers to purchase the most energy efficient of these goods. A growing number of developing countries — particularly in Asia, South America, Africa and the Middle East — have established energy labelling schemes in the past decade, often building upon the experience of OECD countries.

A brief summary of the different approaches to regulating and labelling the energy performance of household appliances and office equipment follows. In order to appreciate the technical underpinning of MEPS and labels, the discussion begins with an overview of test procedures for appliances which, as Meier and Hill (1997) have underscored, serve as “the foundation for energy-efficiency standards, energy labels, and other related programs.”

Test procedures

An energy test procedure is a standardised method for measuring the energy performance of an appliance or piece of equipment (Meier, 2001). Depending on what is being tested, the result of an energy test procedure may be expressed in terms of the product’s annual energy use, energy consumption over a specified cycle, efficiency or efficacy (in the case of lighting products). Generally, if an appliance — such as a refrigerator — needs to be available all the time, the test procedure is likely to stress annual energy use; if it is used seasonally or intermittently, the stress will be on energy efficiency or efficacy (Table 4).

Table 4. Generic descriptions of energy test procedures for selected household appliances

Appliance	Description of energy test procedure
Domestic refrigerator *(annual energy use)*	The refrigerator is placed in an environmental chamber with the door(s) of the refrigerator (and freezer, if applicable) closed. The ambient temperature of the chamber is maintained at a level slightly higher than would be normal for room temperature, to account for door openings and food loading. In Japan, the refrigerator's doors are opened at specified intervals. Depending on the test procedure the appliance has to be able to maintain different pre-determined internal temperatures during testing. The choice of ambient test temperature may also vary from one test procedure to another.
Room air conditioner	The air conditioner is placed in a calorimeter chamber. Heat removal rate is measured under steady-state conditions and at only one level of humidity.
Furnace or boiler	The furnace or boiler is operated under steady-state conditions. Heat output is determined indirectly by measuring temperature and the concentrations of combustion products. The energy required to operate any fan or pump is sometimes added to the input energy.
Lamp (light bulb)	Light *output* is measured in an integrating sphere. Light *input* is measured differently for each component, depending on type of light, ballast (in the case of fluorescent lamps), and other features. Combining these elements yields a measurement of *efficacy*.

Source: Adapted from Meier, Alan (2001), "Energy testing for appliances", in Stephen Wiel and James E. McMahon (eds.), Energy-Efficiency Labels and Standards: A Guidebook for Appliances, Equipment, and Lighting, Collaborative Labeling and Appliance Standards Program, Washington, D.C., pp. 55-70.

International energy-test procedures exist for all major household appliances. Test procedures typically originate with manufacturers' associations, government agencies, or professional societies, and are eventually adopted by a national or international standard-setting body. The leading international standard-setting bodies for energy tests are the International Organization for Standardization (ISO) which mainly focuses on mechanical performance, and its sister organization, the International Electrotechnical Commission (IEC), which mainly focuses on electrical performance. Implementation and refinement of international standards is left to national and regional counterparts of ISO and IEC. Thus the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC) have assumed responsibility for developing EU-wide test procedures, respectively for mechanical and electrical performance. The Japan Industrial Standards Association (JIS) is responsible for developing all appliance test procedures in that country. And in the United States several organisations are involved in developing test procedures. Chief among these are the American National Standards Institute (ANSI), the Air-conditioning and Refrigerating Institute (ARI), and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), although final responsibility for the appliance energy test procedures used in MEPS regulations resides with the Department of Energy.

Ideally, a well-designed test procedure will be inexpensive, accurate, and closely reflect actual operating conditions. In reality, compromises have to be made. Meier (2001), using the example of air conditioners, provides an excellent illustration of the illusiveness of the ideal test procedure:

> A test that tries to accurately duplicate actual usage will probably be expensive and not easily replicated. For example, most energy test procedures for room air conditioners measure efficiency while a unit is operating at steady-state at a specified outdoor temperature. This is a relatively easy mode to test after the test chamber has been created; efficiencies can be measured quickly and reliably. In practice, however, air conditioners operate mostly at part load or at a higher outdoor temperature, where the efficiency will typically be lower. Part-load performance is much more complicated to measure, and results are more difficult to duplicate reliably. Likewise, most energy test procedures measure energy efficiency at a single

specified ambient air temperature. Testing at different ambient temperatures requires costly retesting and still fails to capture all the differences in ambient conditions. Testing to country-specific ambient temperatures makes it difficult to compare product performance across borders.

Geographic, climatic and cultural differences among countries further complicate efforts to develop internationally standardised test procedures that are sufficiently flexible to reflect local conditions while still allowing results from different countries to be compared. In North America, for example, clothes are washed in warm or hot water drawn from hot-water pipes — i.e., the energy to heat the water comes from another appliance. Most European clothes washers connect only to ambient-temperature pipes and so must heat the water themselves. In Japan, the greater part of which is blessed with naturally soft water, people tend to wash their clothes in un-heated water. Beyond these basic differences, appliances often vary greatly in their configurations (e.g., top-loading or front-loading clothes washers) and the range of options (e.g., through-the-door ice dispensers in refrigerators) on offer. This variety in configurations and options, because it can affect energy efficiency, often necessitates the creation of separate standards.

Interest in making test procedures better reflect local conditions and available appliance models has therefore led many countries to adapt the international standards in non-trivial ways. Many newly industrialising countries, such as Thailand, on the other hand, tend to align their national test standards with those of ISO, with usually only minor differences.[10] In general European, African and most Asian countries including China and Russia align their test procedures with ISO/IEC test procedures. Japan and Korea are often aligned with ISO/IEC but some significant differences exist for certain products. India, the Philippines, and Sri Lanka base most of their test procedures on ISO/IEC procedures but sometimes there are important differences. Chinese Taipei often uses similar test methods to ISO/IEC but frequently introduces significant variations. In the Americas, the United States uses its own test procedures which occasionally align to ISO/IEC tests. Canada and Mexico are essentially aligned with the United States. Most South American countries including Brazil use ISO/IEC test procedures but some (e.g. Venezuela) use variants or US test procedures. Australia and New Zealand use harmonised test procedures, which despite being loosely based on ISO/IEC test procedures often exhibit significant differences.

Minimum energy-performance requirements

Today virtually all OECD country governments regulate the minimum energy performance of at least one, and usually several, household energy-using appliances and types of office equipment. The most common approach is to impose mandatory MEPS, which remove the least efficient appliances from sale; however, some countries (most notably, the EU, Switzerland, Japan and Korea) have also used energy performance targets, under which manufacturers are instructed, or voluntarily agree, to attain some prescribed energy performance thresholds for their products. The prescribed energy efficiency thresholds may either be a minimum level that all products must meet or a sales- or production-weighted target level that products must attain on average. Among non-OECD countries, China, Chinese Taipei, India, Iran, Israel, Jamaica, Malaysia, the Philippines, Russia, Saudi Arabia, Singapore, Sri Lanka, Thailand and Tunisia regulate the energy performance of at least one household appliance. Many other countries, particularly in South America and south-east Asia, but also in parts of non-OECD Europe, Africa and the Middle-East are in the process of developing appliance energy performance regulations. Sources of information on MEPS are listed in Box 2.

National and supra-national MEPS generally pertain to one or more *product groups*. A product group may include several *product classes* (generic models). Thus, in the product group “refrigerators, freezers and combinations thereof”, Australia, Canada, the EU and New Zealand specify separate MEPS for 10

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10 See, for example, http://www.apec-esis.org/economy.asp?id=19 .

primary product classes, and the United States specifies separate MEPS for 18 product classes — each set of MEPS reflecting typical combinations of refrigerators, freezers, and features such as automatic defrosting, sold in the countries' or regions' respective markets. Separate product classes are used because the energy efficiency of refrigerators is defined in terms of their consumption relative to other products on the market providing an identical service.

Yet the nature of the service provided has a fundamental impact on energy consumption. For example, chest freezers and upright freezers will both provide the same cooling and storage service if they have the same volume and freezing capacity, but in general a chest freezer is likely to use less energy to do so. This is because chest freezers are liable to have fewer constraints on the thickness of insulation as they do not have to fit into a predetermined square space in a kitchen. Also, cool air in chest freezers sinks to the bottom of the chest away from the gasket, whereas gasket losses are liable to be higher in upright freezers. The type of evaporator used is also different. As upright freezers provide a slightly different functionality or service compared with chest freezers it is therefore appropriate to treat them as a separate product category.

In some federal systems of government, sub-national MEPS operate along-side the federal ones. Five of *Canada's* provinces have established their own MEPS, for example. For the most part, these are harmonized with the Federal MEPS. In a few cases, however, provinces are regulating products for energy efficiency that are not covered federally. Canada's Federal regulations do not take precedence over provincial regulations for locally manufactured and sold products (Harrington and Damnics, 2001). During the mid-1970s, several individual states in the *United States* had begun promulgating their own MEPS. With the passage of the National Energy Policy and Conservation Act of 1978, Federal law in this area was given precedence over state laws — unless the Federal government determines that no standards are warranted for a particular product, in which case states are then free to establish local MEPS. The US DOE currently imposes MEPS for 25 products including 15 used in the residential sector; however, some states such as California have imposed additional requirements. In *Australia* the Federal (Commonwealth) government has no constitutional powers to regulate the energy performance of appliances, hence MEPS are mandated by the States and Territories. However, with the adoption of uniform regulations by all the States and Territories in 1999, the regulatory system operates largely as if it were a national one. Australia now has MEPS for 12 products but is the process of developing more.

The *Korean* government sets both MEPS and a more stringent "target energy performance standard", or TEPS. The MEPS establish the bottom (a rating of 5) of Korea's mandatory comparative energy labels, and the TEPS value (a rating of 1) the top. When MEPS are revised upwards — typically every three to five years — so too are the TEPS. Often, the former TEPS value for a particular appliance becomes its new MEPS value.

Technically, *Japan* does not have MEPS. Rather, it has requirements for fleet-average energy-efficiency levels for products, which manufacturers and importers must meet by a given (target) year — usually four to ten years after the target has been announced. Those companies not achieving the target, which determination is calculated on the weighted-average of their sales of different models, risk being singled out in public announcements, and possibly fined (Harrington and Damnics, 2001). Japan announced its first target average energy-efficiency standards in 1979, for refrigerators, refrigerator-freezers, and household air conditioners. In 1998 the country revised its Energy Conservation Law and in the following year issued new energy-efficiency targets for products delivered to the domestic market during the years starting 1 April 2003 (for televisions and video cassette recorders), 1 April 2004 (for refrigerators and freezers), 1 April 2005 (for fluorescent lamps, computers and computer disk drives), 1 October 2006 (for air conditioners and copying machines), and 1 April 2010 (for gasoline-fuelled passenger cars and motor trucks). These targets were set to the level of the most energy-efficient model in each product category on the market as of 1999 — hence the name "Top Runner". In April 2003, the coverage of the programme was expanded to include stoves, gas cookers, gas or oil water systems, electric-heated toilet seats, vending machines and transformers.

The European Union has used a mixture of MEPS and negotiated agreements with industry. MEPS are currently in place for refrigerators, freezers and their combinations, boilers and ballasts. Voluntary agreements with industry wherein industry has committed to either phase out equipment with less than a prescribed efficiency level, or reach a production-weighted efficiency threshold or a mixture of both, have been developed for: domestic electric water heaters; dishwashers; clothes-washers; external power supplies; TVs/VCRs, set-top boxes and audio equipment in standby mode. The EU is currently poised to implement a new Directive which will give the European Commission the authority to impose MEPS or negotiate voluntary agreements for a very wide range of energy-using equipment without needing to pass primary legislation as at present.

Brazil has developed two types of voluntary energy label, one which is a comparative energy label and grades the efficiency of appliances from A to G as in the EU, the other which is an endorsement energy label. Labels are currently in place for room air conditioners, freezers, refrigerators and refrigerator-freezers, ballasts, clothes-washers and lamps. The Brazilian government also recently passed legislation allowing the imposition of mandatory MEPS for a broad range of equipment and these are currently under development.

China first introduced MEPS in 1989 and has since been extending their coverage and increasing their ambition. In 2004 China had MEPS for refrigerators and freezers, room air conditioners (windows and split types), TVs, fans, rice cookers, radios and audio receivers, fluorescent lamp ballasts, clothes washers, motors and irons. Requirements for external power supplies were under development. China's energy performance test procedures are mostly harmonised with ISO/IEC procedures.

Russia first implemented MEPS in 1983 and between then and 1991 introduced regulations for room and other types of air conditioners, audio signal amplifiers, computers, dishwashers, refrigerators, refrigerator-freezers, freezers, graphical input devices, monitors, printers, ranges & ovens, TVs and electric water heaters. Most of these standards have not been updated and hence have since become largely obsolete; however, in 2001 Russia passed a general law allowing the issuing of MEPS and labels for a large range of appliance types. Since then energy labels and voluntary MEPS have been developed for refrigerators.

Box 2. Sources of information on energy-efficiency standards and labels

At the national level, government-administered programmes issue public notices as required for regulatory changes in general. For example, in Mexico, any proposed new or revised MEPS are preceded by the publication of proposed standards in the *Diario Oficial de la Federación* followed by a 60-day period for public comments, and an additional 45 days for additional consultation within the Committee. Proposed changes to Canadian and US standards are notified in the *Canada Gazette* and *Federal Register* respectively, followed by mandated periods to allow for public comments. In Europe, revisions or the introduction of new laws are published in the *Official Journal of the European Commission*. Most countries also make available copies of their energy-efficiency regulations and any criteria for voluntary labels on dedicated Internet web sites.

At the international level, all WTO member countries are obliged — under the Agreement on Technical Barriers to Trade (TBT) — to notify the organisation of any new regulations, including MEPS. Indeed, energy-efficiency related notifications appear to be one of the largest single categories of all TBT notifications, providing a useful insight not only into the degree of their transparency but also the pervasiveness of these programmes.

Several organizations have established web sites on the Internet that provide information on energy-efficiency standards and labels. Asia-Pacific Economic Co-operation (APEC) is funding an Energy Standards Information System (ESIS) which provides comprehensive information on test standards, MEPS, and labelling requirements for countries in the Asia-Pacific region. Its web site (http://www.apec-esis.org/home.asp) allows searching by country, type of equipment, or test standard. The Collaborative Labelling and Appliance Standard Programme (CLASP), provides similar information on energy-efficiency standards and labelling schemes, for more countries, at (http://www.clasponline.org/), but its information is sometimes less up-to-date than that reported by the ESIS.

Details of particular countries' MEPS and energy labelling requirements are usually posted on the Internet:

Australia: www.energyrating.gov.au.

Canadian: www.oee.nrcan.gc (MEPS) and www.energuide.nrcan.gc.ca (labelling requirements)

EU: http://europa.eu.int/scadplus/leg/en/lvb/l32004.htm. and energyefficiency.jrc.cec.eu.int.

Japan: www.eecj.or.jp

Korea: www.kemco.or.kr

New Zealand: www.eeca.govt.nz

United States: www.eren.doe.gov (MEPS and energy test procedures) and www.energyguide.com (labelling requirements)

Information on other countries' standards and labelling programmes can be found at www.clasponline.org

Mandatory energy-information labels

Most countries that regulate MEPS also require energy-information labels to be displayed on the same products. The exceptions are Chinese Taipei, Ghana and Saudia Arabia all of which regulate MEPS but do not yet require energy information labels.[11]

France was the first country to mandate the display of energy labels on household appliances in 1976 rapidly followed by Canada and the USA. Today, mandatory energy-information labels are required by all OECD and EU Member countries, and by a growing number (at least 14) of non-OECD/EU countries, for at least one product, and more often for several. Canada and the United States each require energy labels on 15 or more product groups, from air conditioners to water heaters. The EU introduced a harmonised labelling programme for household appliances in the early 1990s and now has mandatory comparative energy labels for 9 domestic appliance types. There is an on-going discussion in the EU about whether to change the primary labelling legislation to allow non-domestic energy-using products to be labelled. EU member countries also have the right to impose mandatory energy labelling for cars and many have recently implemented car-labelling requirements.

Typically, the main piece of information provided by a mandatory energy-information label is the appliance's estimated energy consumption in kWh/year, or per operating cycle (or EER for room air conditioners), which is derived from standard tests. Usually the label also shows the product group type and size category (cooling capacity category in the case of air conditioners) within which the model should be compared, as well as the energy consumption (or EER) of the most and least energy efficient models within the product group that are currently on the market. In some cases the energy labels will also provide information on typical operating costs or on non-energy performance, such as the cleaning performance of clothes-washers, but this practice depends on the labelling scheme.

11 Chinese Taipei is currently investigating information labelling but already has seal-of-approval energy labelling. Ghana is considering energy labelling and has already conducted related research into an appropriate label design.

Increasingly popular are the use of visual aids, such as dials or bars, to facilitate quick comparison between different appliances and identification of the most-efficient models. The *EU's* energy-labelling framework Directive (Council Directive 92/75/EEC), for example, expresses relative energy performance on a scale from G (lowest efficiency) to A (highest efficiency). Colour-coding of the bars, with red representing G, and green representing A, adds to its ease of use. The label has been standardised, except for differences in language, across all EU Member States. It appears also on products sold in Iceland, Lichtenstein, and Norway, where it is mandatory, and in Switzerland, where it is not. The EU energy label has recently been adopted in Russia and in Turkey, and is poised for adoption in Bulgaria, Croatia, Romania and South Africa. Other countries, including Argentina, Brazil, China, Columbia, Iran and Tunisia have utilised some aspects of the EU energy label in their own labelling schemes.

Seal-of-approval and other voluntary labels

Seal-of-approval labels are voluntary and selective, and are awarded only to products that meet relatively strict environmental requirements, including requirements related to energy performance. Many of these labels are administered by governments and are closely co-ordinated with their corresponding mandatory energy labelling programmes. Examples include the EU's Eco-label award scheme, China's Great Wall energy certification label, India's Ecomark scheme, Korea's "Energy Boy" label, Singapore's Green Labelling Scheme, Chinese Taipei's Greenmark, and the USA's ENERGY STAR programme. In addition there are several voluntary labelling schemes administered by non-profit organisations, such as Japan's Eco Mark scheme, Korea's "Energy winner", the USA's Green Seal, and Thailand's Green Labelling Scheme. Canada's third-party, multi-criteria[12] Environmental Choice[M] Programme is owned by the Federal Government and licensed to a "for profit" organisation to administer. Several schemes — notably the Nordic Swan label and Germany's Blue Angel label — are administered jointly by representatives of governmental and non-governmental organisations. In Australia and Thailand, associations of, respectively, gas and electric utilities sponsor their own voluntary energy-labelling schemes. Some web sites providing information on voluntary schemes are given in Box 3.

ENERGY STAR has proved to be among the most internationally successful of the government-administered seal-of-approval programmes (Meier, 2003). In the United States it covers a wide range of products including clothes washers, different models of air conditioners, dehumidifiers, dishwashers, fluorescent lamps and ballasts, compact fluorescent lamps, computers and peripheries (monitors, printers, scanners), ceiling fans and ventilation fans, fax machines, freezers, furnaces, heat pumps, refrigerator-freezers, cordless telephones and answering machines, televisions, traffic signals, vending machines andwater coolers. In Canada, the ENERGY STAR programme covers a slightly smaller number of product categories, while in most other participating countries it covers only one or two categories, namely office equipment (EU, Japan, Taiwan) and home electronics (Australia and NZ).

Where a mandatory MEPS already exists for a given product, the minimum energy performance level that the same product must meet to be eligible to display the voluntary label will be set, in the case of government-run schemes, typically at a value representing anywhere from a 10% to a 55% improvement over its corresponding MEPS value. Similarly, most private schemes either reference a MEPS and set a percentage target improvement that is similar to these labels, or refer to target values set out in one of the major government-administrated schemes. For example, the Nordic Environmental Label for Refrigerators and Freezers (037/3.0) uses an energy performance target value for refrigerator-freezers that is identical to

12 Many of these criteria reference other programmes, such as the USA's ENERGY STAR.

that of the EC Eco-label, which is also identical to the requirement for the second-highest label class (the A+ class) on the EU mandatory energy label.[13]

Ecological or environmental labelling schemes ("eco-labels") often augment energy-efficiency criteria with other product performance criteria, such as for noise, water use or product durability, specifications relating to the composition of the product, or the product's re-use, recycling and disposal characteristics.[14] The criteria set by the EU Eco-label for portable computers, for example, include restrictions on the use of harmful substances, such as flame retardants, heavy metals and plastics; criteria for durability; and end-of-life criteria. Most private third-party voluntary labelling schemes contain similar criteria unrelated to the product's energy performance.

Box 3. Box 3. Sources of information on voluntary energy-efficiency standards and labels

Australian energy-star programme: www.energystar.gov.au

Brazilian voluntary comparative and endorsement energy labels can be seen at www.inmetro.gov.br and http://www.eletrobras.gov.br/procel/site/home/index.asp,

EU Eco-label requirements: europa.eu.int/comm/environment/ecolabel/

Switzerland's voluntary energy labelling requirements: www.energielabel.ch

US Energy Star label: www.energystar.gov

IV. Creating preferential tariff margins for relatively energy-efficient electrical appliances

Multilateral and plurilateral sectoral liberalisation initiatives normally lead to the removal of, or at least substantial reduction in, tariffs applied to goods covered by the initiative. The mandate for the WTO negotiations on environmental goods and services is no exception, calling for "the reduction or, as appropriate, elimination of tariff and non-tariff barriers" to environmental goods.

Normally, when a sector, or group of similar products, is the subject of a negotiated reduction in tariffs, the demarcation of the sectoral coverage is clear, or differences among countries are of secondary importance. Were countries to consider creating preferential tariff margins for relatively energy-efficient electrical appliances, however, they would be starting from a situation in which some of the products concerned are not described by separate commodity descriptions and codes. Either new, internationally standardised descriptions and codes would have to be agreed upon (perhaps at the national, 8- or 10-digit level), or an alternative approach would need to be adopted wherein common rules regarding energy performance thresholds would be established and tied to existing national MEPS or labelling categories.

This section sets out some of the practical obstacles to defining relatively energy-efficient electrical appliances as environmental goods for the purposes of such a tariff-reduction initiative.

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13 The index requires an efficiency level that is akin to using just 42% of the energy of an average equivalent refrigerator or freezer on the EU market in 1992 (Nordic Ecolabelling, 2001).

14 Rules covering the use of the EU label pertain to various design and use criteria, such as the manner in which it is displayed on the appliance at the point of sale, and content involving information about its average energy performance, including its annual average energy consumption (in kWh per year), the storage volume of its compartments (in litres), and its comparative ranking according to the seven efficiency classes set out by the Commission.

The starting point: differences in MEPS, voluntary standards and test procedures

The starting point for any discussion is the great variety of approaches to regulating and labelling the energy-efficiency of electrical appliances that currently exists. Annexes 1 through 4 of this document explore these differences for four representative products: refrigerator-freezers, room air conditioners, compact fluorescent lamps and personal computers. Refrigerators and freezers were the first consumer goods for which efficiency standards were established and labels issued and hence, of all appliance categories, they are subject to the greatest number of MEPS and mandatory labelling programmes. Most OECD countries, along with many developing countries, have established MEPS or labelling schemes for air conditioners and compact fluorescent lamps also. Personal computers are included in the list as an example of an office product that is traded widely and for which differences among energy-consumption standards are small.

From the evidence provided in Annexes 1-4, and the recent work of other investigators (Energy Efficient Strategies, 1999a and b; Meier, 2001), it is clear that there is a significant difference in the relative ease of establishing international standards for some appliance types compared with others. White goods such as refrigerators, clothes-washers and dishwashers tend to exhibit the largest differences in test procedures, product categorisation and energy performance requirements applied from one region to another. Office equipment, such as PCs, monitors and printers exhibit the least differences, especially when measuring standby mode, and other appliance types such as lamps, ballasts, room air conditioners, water heaters and home entertainment devices an intermediate degree of variation. Personal computers, especially portable computers, have become a globalised commodity: variation is mainly found in combinations of features among models, not in the models available across countries. Given that the United States, as the largest importer of personal computers in the world, was one of the first countries to establish a test standard and voluntary energy label[15] for standby power, it was relatively easy for the test standard and efficiency threshold to be adopted and recognised by other countries.

By contrast, in establishing labelling schemes and MEPS for electrical appliances like refrigerators and air conditioners individual countries have typically taken into consideration country-specific variables such as domestic energy prices and climatic conditions, as well as the features and configurations that most aptly describe the appliances sold in their markets. These differences are also reflected in the standards relating to test procedures, many of which were first developed nationally and may have been established more than two decades ago. Judged by current differences in product descriptions, standards and test procedures, prospects for developing and implementing common international energy performance standards for white goods appear to be poor in many cases.[16] The major obstacles include:

- *Differences in the test procedures used to measure energy performance*. There are significant variations in the test procedures used for the purposes of energy-related regulations and labelling programmes currently in use around the world. Differences among test procedures for refrigerators are substantial, while those for compact fluorescent bulbs, PCs and room air conditioners are probably close enough to be harmonised, at least partially, if there is a will to do so.

- *Differences in how countries classify and describe the products for which energy performance standards are regulated*. Permutations of features and configurations for refrigerators and freezers lead to inconsistent descriptions and varying numbers of product categories. International standards for the terms used to describe air conditioners exist, but are not

15 The ENERGY STAR label

16 The same is not necessarily true of other residential and commercial appliances such as Information and Communication Technology, entertainment appliances, lighting products, water heaters etc.

universally used. The USA and Canada, for example, categorise single-package split air conditioners as "central air conditioners" and apply a more complex test procedure for their energy performance rating than they do for single-packaged window air conditioners. Other countries test these air conditioner types in the same way, but may apply different categorisations depending on the maximum cooling capacity.

- *Differences in how energy performance or efficiency is defined.* The energy performance or efficiency metric is often specified in regulations separate from the test procedure (depending on the product and country concerned) and can differ considerably from one jurisdiction to another. For example, most countries define refrigerator energy performance in terms of energy consumption per unit of adjusted volume[17] compared to a reference level that has been defined relative to the historic performance of refrigerators on the local market. Sometimes a country will harmonise these relative levels to those already in use elsewhere, as China has recently done with respect to the EU regulations, but mostly these efficiency metrics are not directly comparable outside the jurisdiction in question. For other products the efficiency metric applied might be a pure and hence universally transferable efficiency measure, as is the case of the energy efficiency ratio (EER) of room air conditioners, or the luminous efficacy measure of lamps. In this case there may be differences in the units applied (e.g. W/W or Btu/kcal for EER measurements) but the values can still be directly compared across programmes.

- *Differences in the ways in which the standards are specified*. Most countries specify the annual energy use of refrigerator-freezers using a fixed and a variable factor, but the adjustment factors, and the way they are included in the calculations, differ widely. In respect of compact fluorescent lamps, some countries specify evenly spaced increments for efficacy (usually in 5-lumen steps), while the EU uses a non-linear formula. Some eco-labelling schemes specify only two categories of input wattage for CFLs (e.g., less than and greater than 15 W), while others specify as many as five.

- *Differences in the energy performance required of products.* Given the aforementioned problems, MEPS levels for refrigerator-freezers cannot be directly compared; but the levels seem to vary more widely than for air conditioners. For a typical 15 W CFL, the minimum efficacy requirements needed to qualify for various voluntary seal-of-approval labels range from 50 to 65 lumens/watt (and only can be as low as 33 lumens/watt for a CFL equipped with a reflector). These differences reflect significant variations in energy prices, appliance use profiles, usage environments and appliance characteristics from one jurisdiction to another; however, they also reflect important differences in the ability of local market actors to supply products of a designated efficiency level and in the political mandate, or ambition of the programmes concerned.

- *Differences in the scheduling of reviews of the regulations*. Generally appliance standards and labelling programmes do not follow a fixed schedule for considering the revision of performance criteria. Many programmes are vague about the periodicity of their revisions, saying only that they update their efficiency standards "regularly" or "periodically." Based on historical evidence, most programmes appear to work on a 2-4 year review and revision cycle for endorsement labels and a 2-8 year revision cycle for mandatory labels. Some are extended and some appear to have never been revised. But the timing of these revisions are not co-ordinated internationally. Similar observations can be made for MEPS and energy performance targets.

17 Adjusted volume is the storage volume normalised to be equivalent in energy usage terms to a compartment having a given internal temperature e.g. 5°C in the case of a fresh food compartment.

Identifying energy-efficient goods via simple physical inspection

From a trade negotiation perspective it is simpler to countenance the liberalisation of trade in energy-efficient goods that can be distinguished simply through simple inspection. However, as already mentioned, this is usually insufficient to identify an energy efficient appliance, because the relative energy performance of the appliance is generally not apparent from its appearance.

Lamps are an exception. The luminous efficacy (light output per unit power input) of fluorescent lamps is 3 to 4 times higher than that of incandescent lamps and hence despite significant differences in efficacies and other performance characteristics of fluorescent lamps they are always appreciably more efficient than incandescent lamps and will remain so regardless of any foreseeable future technological developments. Currently there is very little variation in the import duties applied to incandescent and fluorescent lamps (Table 5), so there could be an argument to differentially lower duties applied on fluorescent lamps. For other products it is rarely possible to to determine their relative efficiency based on a simple assessment of their physical characteristics, although there are a small number of appliances where it may be possible. Such appliances include:

- water-cooled air conditioners or heat pumps, which are almost invariably more efficient than their air-cooled counterparts;

- liquid crystal display (LCD) computer monitors, which almost invariably use less energy in the on-mode than equivalently sized cathode ray tube (CRT) monitors;

- solar water heaters, which are inherently less polluting than those that heat via electricity, gas or oil although they are not necessarily more efficient in a narrow engineering sense;

- electric clothes-dryers using a heat pump, which are typically twice as efficient as conventional electric clothes-dryers;

- electric space- or water-heaters using a heat-pump, which are typically two to three times as efficient as their electric counterparts using electric-resistance heating elements.

There are two other groups of appliances that makes use of a technology which could be deemed to be inherently more energy-efficient than the conventional alternative and hence could arguably be given favourable treatment: air conditioners, heat pumps, fans or refrigerators using a variable or rated-speed drive system and refrigerators, freezers and refrigerated cabinets using vacuum insulation panels.

The difficulty with this approach is that it is often possible to produce an efficient appliance which does not use these technologies and in some cases an equivalent energy-efficiency improvement might be attained more cheaply. Thus the deployment of these technologies may be helpful to raise efficiency but is neither a necessary nor sufficient condition to do so. A more compelling case can be made for reduced duties on energy-efficient components that could include: variable or rated speed drive units and vacuum insulation panels.

Lastly, there is another group of products that either does not use energy directly, or do so to a minimal degree, but which through their inherent properties are instrumental in conserving energy. These products are beyond the scope of this paper because they are not household electrical appliances that are listed below for the sake of completeness:

- insulation (this comes in very wide range of types and qualities);

- insulated or energy-controlling glazing (double or triple-glazing, argon filled double glazing, glazing with infra-red reflecting coatings, special types of solar control glazing, etc.);
- devices to minimise summertime solar overheating while maximising daylight and winter time solar gains; these include daylight collection and guidance devices, daylight optimisation blinds and photosensitive glazing;
- heat recovery systems for buildings, such as certain types of heat exchangers;
- building thermal energy storage systems including phase change materials purposely designed for this task;
- Electronic building energy management systems (BEMS).

Establishing common reference energy-performance standards

If, as is true for the majority of cases, energy-efficient goods cannot be distinguished simply via their appearance, selective liberalisation of tariffs would require their performance to be determinable via testing. It would also require a common set of rules to be established regarding the efficiency threshold to be attained in order to qualify for the reduced tariff. The most immediately obvious approach would be to require a common efficiency threshold to be attained regardless of where the good is to be sold. This would require agreement on:

1. the use of either common, or mutually convertible energy performance test procedures;
2. either common, or mutually convertible energy-efficiency metrics and product categories;
3. common energy-efficiency thresholds .

In order to illustrate the modalities to be addressed for each of these steps they are now discussed in relation to the products examined here: refrigerator-freezers, air conditioners, compact fluorescent lamps and computers.

Test procedures

Common or near common test procedures appear to be applied in most countries having energy labels and or MEPS for computers with almost all countries using the US EPA’s Energy Star test procedure. Exceptions include Russia and China although the latter’s test procedure is thought to be very similar to the EPA’s. The vast majority of countries use the same international test procedures for CFLs, namely IEC 60901 and IEC 60969; however, the USA and Canada use their own aligned procedures (IES LM 66). Japan and Korea use aligned procedures that are not identical to IEC procedures, but produce equivalent results for efficacy.

Almost all countries test room air conditioners (be they single-packaged window, wall or split units) according to the ISO 5151 T1 test condition and hence it is possible to make direct comparisons between air conditioner energy efficiency ratios (EER). In several countries, including Canada, Japan, Korea, Chinese Taipei and, the United States, there are sometimes minor deviations from this test condition — usually deviations of up to 0.5°C in one of the design temperatures — which have only a small impact on the rated EER. In the case of the Philippines there is a more significant deviation for the outdoor wet bulb temperature. Despite these deviations, an accurate test procedure conversion algorithm has been developed and tested under the auspices of APEC to enable conversions to be made between room air conditioner energy and cooling capacity test results when all but the most accurate comparisons are required.

The situation is less favourable for refrigerator-freezers, where not only do the different regional or national test procedures in use require different internal temperatures to be maintained under different steady-state ambient test temperatures, they also specify different ways of measuring the internal temperatures that are consequently not easily comparable.[18] Making matters worse, the fact that appliances are designed with the satisfaction of specific test procedures in mind means that their performance is usually optimised to that test procedure. A refrigerator-freezer that is optimised to perform well under the Japanese test procedure, which includes door-openings during the test, might place relatively greater design emphasis on an efficient refrigeration system compared with one that is optimised for other test procedures where the door is not opened and the quality of the insulation plays a relatively greater role.

Product categories and efficiency metrics

The product categories and efficiency metrics applied are directly equivalent between countries for computers and CFLs. For room air conditioners the efficiency metric applied is identical across all countries (the Energy Efficiency Ratio) although there are often different units used in the numerator and denominator (this is a trivial matter to re-calculate on a common footing). There are more profound differences in product categorisation but even here it would be relatively straightforward to make an adjustment onto a common basis for tariff application purposes.

There is much commonality in the basic methodology used to define refrigerator-freezer energy efficiency metrics across countries, as efficiency is usually specified in terms of the energy consumption of the appliance compared with a comparably sized and featured reference appliance, the energy consumption of which is determined from a linear equation relating energy use to adjusted storage volume. However, the significant differences in product categories, which in turn reflects the different demands of the energy test procedures applied in different countries, results in a basic problem of comparability even once differences in units are adjusted for. Furthermore, the reference appliance equations used in the older programmes invariably have their origins in regressions to the efficiency of products on the market concerned at some point in the past. That is to say, they allow the energy consumption of a specific appliance type to be measured against an equivalently featured appliance with average energy performance at some point in the past. The differences in the evolution of national markets means that these are not easily comparable, although in recent years there has been a tendency for countries developing new metrics to harmonise them with existing ones —as have Argentina, China, Russia, South Africa, Tunisia and Turkey with the EU's efficiency metric for refrigerators and freezers. Despite the considerable difficulties, conversion between refrigerator-freezer test procedures and efficiency metrics is possible providing that accuracy is not paramount and only indicative results are required. Such a simplified conversion algorithm has been developed and applied to help establish Australian MEPS requirements as explained below.

18 For example, ISO test procedures require the freezer compartment to be fully loaded with test packs and specify that the temperature of any of the test packs must not exceed a maximum level, whereas the NAFTA and Australia-New Zealand test procedures simply require that the average air temperature of an empty freezer compartment must not exceed a prescribed level. These two means of prescribing the compartment temperatures are not easily comparable in energetic terms.

Common energy-efficiency thresholds

For reasons that have already been outlined, internationally applied MEPS or energy labelling efficiency thresholds are rarely common or harmonised beyond programme boarders. Computers are rarely subject to MEPS, and only Japan and Russia (with an obsolete requirement) currently specify MEPS levels. Voluntary endorsement labels are far more common for computers than are mandatory requirements, be they labels or MEPS, largely because of the rapid pace at which the technology is evolving. The majority of countries that have requirements have harmonised them with the international Energy Star, which has become a kind of international standard for this product.[19] This includes Australia, Canada, the EU, Japan and Korea, as well as the United States.

CFLs are also rarely subject to MEPS, with just six countries (Canada, Colombia, Korea, Mexico, Thailand and the United States) having imposed mandatory minimum energy performance requirements. China, the EU, the Philippines and South Korea impose mandatory energy labels on CFLs (as well as for all household lamps in the case of the EU). At least eight countries apply voluntary energy labelling to CFLs and at least another thirty apply voluntary eco-labels for CFLs. As discussed below, the international ELI programme has developed common quality criteria for CFLs, which relate to their energy performance (efficacy and power factor) and lifetime. These criteria have been adopted by eight countries.

Room air conditioners and refrigerator-freezers are the products which are most commonly subject to MEPS and mandatory energy labels and in both cases a wide diversity of thresholds are applied. In the case of room air conditioners there has been almost no attempt to harmonise efficiency thresholds for MEPS or labelling beyond national or regional programme boundaries (e.g., NAFTA, EU, China, Japan, Korea, Australia/New Zealand). A sole exception is the matching of the Australian/New Zealand MEPS requirements with Korea's, as described below. The situation is similar for refrigerator-freezers except that several countries have harmonised their labelling efficiency thresholds with the EU's (Argentina, Iceland, Lichenstein, Norway, Russia, South Africa, Tunisia and Turkey) and Australia/New Zealand have roughly aligned their MEPS with those applying in the USA.

Necessary steps

If, for the purposes of selective tariff liberalisation, a common energy performance standard were to be developed for all or some of these products it would be necessary to establish common, or alternatively, convertible test standards, product descriptions, efficiency metrics, efficiency thresholds and revision schedules across countries. In an ideal situation the same common test procedures, product classes and efficiency thresholds would also be used for national energy labels and MEPS; however, for the reasons which have already been discussed a major international alignment effort would be required to bring this about and for some product types this would present a formidable challenge. For other products there have already been efforts to align efficiency requirements and so the route toward fully aligned liberalised tariff efficiency requirements would be much smoother. These efforts are discussed in the next section.

It is worth considering the interaction between such a common energy performance standard applied for tariff liberalisation and existing national or regional efficiency requirements. In theory, differences in the MEPS across countries could be allowed to continue. But under those conditions, and assuming that many of those MEPS would co-exist with mandatory or voluntary schemes for labelling appliances with

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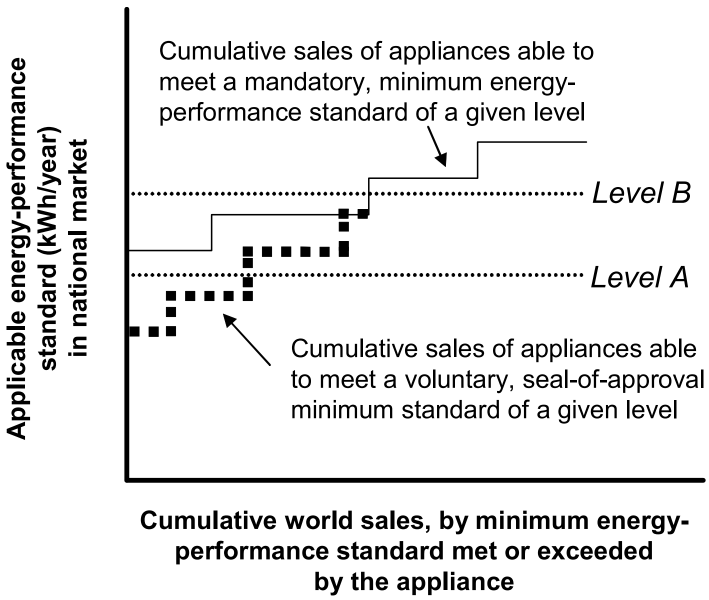
19 The same is broadly true of all office equipment including, to a lesser extent than for computers, monitors, printers, photocopiers and fax machines. Consequently the vast majority of computers now comply with Energy Star requirements.

higher levels of energy performance, reaching a collective decision on where to set a commonly used dividing line would, for many products, present a formidable challenge.

The situation that would confront negotiators can be described by Figure 3. The vertical axis represents energy performance (improving as one moves closer to the origin), and the horizontal axis cumulative world-wide sales of the product in question, according to the energy performance that it must achieve at a minimum. The upper, solid, stepped line relates to mandatory MEPS; the lower, dashed, stepped line to a higher (in the sense of more difficult to achieve) voluntary standard. Both stepped lines are illustrative only: they are not based on the market for any particular appliance.

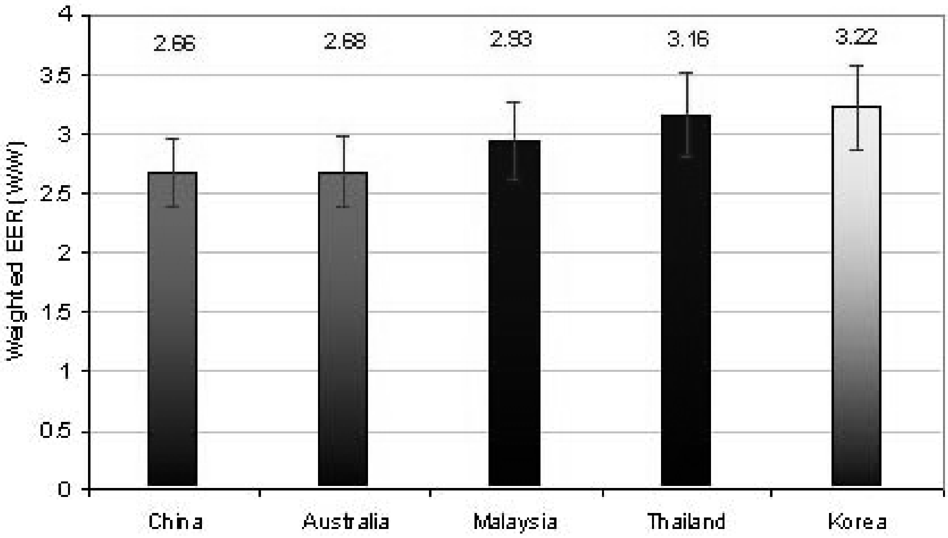
Negotiators might look to find an energy-efficiency criterion — a dividing line between two descriptions of an electrical appliance — that was equal to or exceeded the most-stringent MEPS applied by any participating country (Level A in Figure 3). Were the level set to be less ambitious than the most-stringent MEPS (Level B), the country applying that MEPS might subsequently find itself being accused of excessive strictness, given that the international community had ruled that a lower standard could already be considered adequately "environmental". On the other hand, there may exist cases wherein a voluntary standard in one country, established for the purposes of a voluntary seal-of-approval label, has been set at a level lower (i.e., less stringent) than the MEPS set by another country. In that situation, setting an international reference standard at Level A in Figure 3 could call into question the adequacy of any standards linked to seal-of-approval labels that were set below that level. The affected regulations and schemes could, of course, revise their energy-performance criteria. But that is usually difficult in the short term, since manufacturers will have designed their models around satisfying those criteria. These observations reflect the fact that national product markets are often not at similar efficiency levels and hence the ambition of their MEPS and labelling requirements is always likely to vary.

Figure 3. Choosing an international energy-performance reference standard



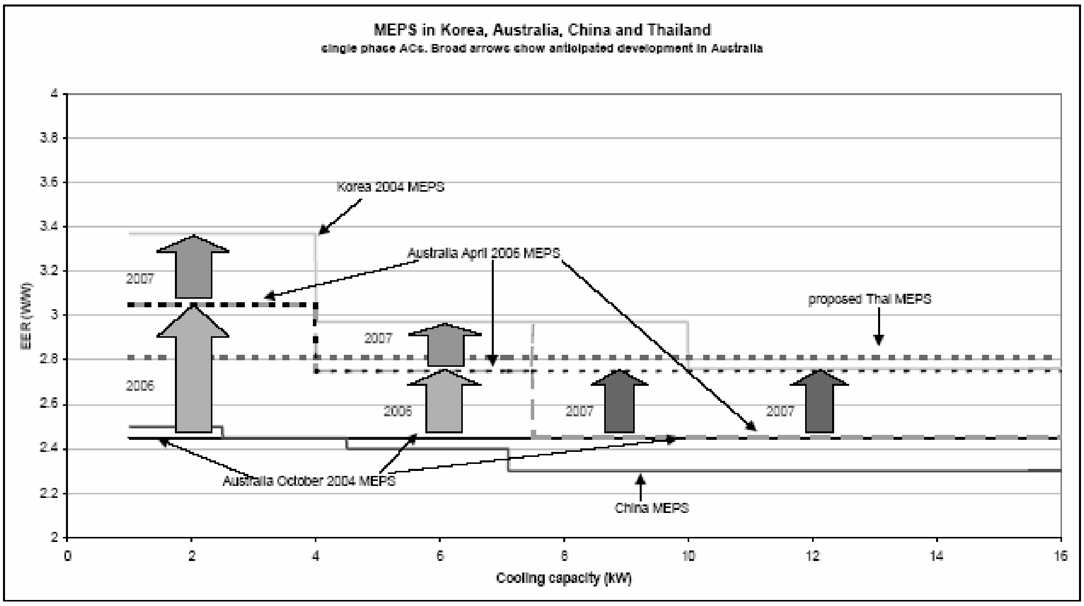
A concrete example of this is illustrated in Figure 4, which shows a recent analysis of the spread in energy efficiency levels of room air conditioners sold in four Asian countries and Australia.

Figure 4. The average energy efficiency ratio (EER) upper and lower values of room air conditioners sold in five national markets (DEM 2004)



The existing and proposed MEPS for room air conditioners in the same countries are shown in Figure 5.

Figure 5. Air conditioner MEPS in five national markets (DEM 2004)



The process would not end once an international reference standard was established, however. The standard would likely be a moving target, requiring updating as technology evolved. Some institutional mechanism for reviewing and revising the standard would be required. As described in Steenblik (2005, p. 22), countries could agree to assign the task of reviewing the technical criteria to a WTO Committee or technical working group. Such a body would presumably meet at regular intervals to consider the suitability of the current criteria (much as national standard-setting bodies responsible for updating specifications for energy-performance standards already do). Alternatively, countries could for some products decide, rather than duplicate work undertaken elsewhere, to agree simply to reference an established, recognised international standard, either private or public. They could even agree that the product specifications will automatically change as the standard is updated, thus obviating the need to create an entirely new international body of technical experts.

However, there are several potential drawbacks to such an approach. First, changes in the standard would have to be communicated to customs agents, and time allowed for their translation into local languages and procedural manuals. Second, relinquishing control of the key technical criteria of a product description to another body — particularly a private standardising body — could raise difficult issues. Not the least of these would be the question of what to do if some WTO members were to declare that they were not in agreement with a decision taken by the standardising body.

A "MEPS plus" approach

Because of all the problems related to differences among countries in the ways that they have specified their MEPS and labels — the efficiency levels which have been set, the associated standards for test procedures ("testing standards"), and the frequency with which MEPS, labels and testing standards are revised — the simplest way to introduce preferential tariff margins would be to make the threshold for lower tariff treatment a function of each country's national MEPS or labelling requirements and to implement it at the national (i.e., 8- or 10-digit) level. In the case of refrigerators, for example, countries could all agree to establish a standard that reflected, say, a 15% improvement over the minimum performance required by their own MEPS or upper efficiency thresholds applied in their energy labels. For countries that have already established MEPS or labels, or both, this approach would avoid the necessity of having to wait until national differences in MEPS and testing standards had been resolved.[20] The element of subsidiarity allows rapid agreement over the presumed common objective, to selectively favour efficient goods, while avoiding the difficulty of defining common efficiency thresholds.

A major problem with such a "MEPS plus" approach is that not all countries have established MEPS or labelling requirements for electrical appliances. While the number of countries with regulations or standards, or both, relating to the minimum energy performance of one or more electrical appliances is significant, and growing[21], many countries, particularly less-developed countries, have not yet developed such regulations or standards, and therefore may not have the means for verifying compliance with them. According separate tariff treatment to two versions of a product that would be distinguished by characteristics that could not be readily verified without testing facilities would oblige an importing country either: *(i)* to accept the claims of the manufacturer, or a testing facility used by the manufacturer, regarding the energy-performance of the good; *(ii)* establish its own means for testing the energy performance of the product in question; *(iii)* send goods for testing to a third-party laboratory outside the country; or *(iv)* ignore energy-performance differences and apply the preferential tariff to *all* versions of the good.

Benefits from liberalising tariffs on energy efficient goods

All of the foregoing presumes a certain logic. That logic maintains that creating tariff preferences favouring relatively energy-efficient appliances would reduce final consumer prices for the affected goods,

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20 Individual countries always have the option of creating 8- or 10-digit national customs codes for relatively energy-efficient products, at some level above their corresponding MEPS values.

21 About 80% of the world's population live in countries that have defined or are in the process of defining such requirements at least for some product types.

thereby encouraging a shift in consumption patterns away from products that are relatively wasteful in their energy use. In addition, manufacturers would be expected to respond to the price changes by shifting that part of their output that is exported towards the more-efficient models. The higher the current applied tariff in its export markets, the greater would be the magnitude of the "market pull" effect following liberalisation of trade in the more energy-efficient good. Partially offsetting these two effects would be the consequence of lowering life-cycle costs for operating any given appliance, which, all else equal and depending on the circumstances, could encourage some consumers to purchase more and larger-capacity appliances than they might have purchased prior to the reductions in tariffs.[22] While this effect is not likely to be large it also implies rising standards of living and hence is not inconsistent with economic development goals.

Accelerating tariff elimination for essentially nuisance tariffs would not substantially change relative prices between efficient and inefficient models in the developed world, however: tariff levels for household and office appliances are already low in most OECD countries (Table 5). That could still make a difference for some products for which demand is sensitive to even small changes in relative prices (e.g., through substitution effects). It could be argued also that differential tariffs — however small the differential — would still have symbolic value, and be seen to be contributing to fulfilment of the Doha mandate. Moreover, tariff levels in developing countries for several major household appliance products are significantly higher than those of OECD countries, by as much as 20% or 30%. Given the robust demand forecasts for household and office appliances in many developing countries, differential tariffs between efficient and inefficient products would yield significant environmental benefits, via displaced pollution emissions from reduced energy consumption.

As it appears that the selective liberalisation of tariffs for energy efficient goods is likely to have a much more significant impact on the market in less developed and middle income countries than in the OECD countries it is worth considering what the consequences of such a measure might be in terms of total imports into these countries. Tariffs for computers are quite low in most less-developed countries and average about 9.7%, but for other appliances the duties can be much higher. For example average tariffs are 24.5% for refrigerator-freezers, 24.9% for room air conditioners, 26.2% for fluorescent lamps and 17.7% for incandescent lamps.

In theory selectively reducing tariffs for relatively energy-efficient products would encourage a greater share of imports to be efficient and perhaps also a greater share of products to be imported. This latter factor could increase total imports. However, appliances also use energy to operate and this is often imported. In the case of electricity the electricity powering the appliances may be directly imported from another country, but more typically it is generated locally. In the latter case it is highly probable that a significant proportion of the generation, transmission and distribution equipment will be imported, as will the components used to maintain and repair the generation and distribution system. Fuel to power the plants is also often imported. For a typical developing country, importing 90% of the capital equipment needed for generating and distributing electricity and 70% of the fuel used to power the plants, average marginal imports would amount to roughly USD 0.05 per kWh of electricity consumed. If a typical refrigerator-freezer uses 525 kWh/year and lasts for 15 years it would require additional capital and fuel

[22] This notion is known as the *rebound effect* and has been much discussed in the literature. An in-depth literature review by Lorna Greening, David Greene, and Carmen Difiglio examined econometric studies and direct measurements of the rebound effect for different sectors and major end uses. They found that the effect is very small (less than 10%) for residential appliances, residential lighting, and commercial lighting, and less than 20% for industrial process uses. For residential space heating, water heating, and automotive transport, they find the rebound effect is small to moderate (<10-40%). And for residential space cooling, they find the rebound effect is in the range of 0-50%. They conclude that, overall, the rebound effect ranges from very low to moderate (Greening, Greene and Difiglio, 2000).

imports valued at USD 405 over its lifetime. The appliance itself may only cost USD 200 to import, thus the energy-related imports would be more than twice the direct import costs for the product concerned. If, for the sake of argument, the same product had an efficiency equivalent to the EU class A label rating, which now account for more than 50% of sales in Europe, it is likely to consume just 278 kWh/year, but would be slightly more expensive to import, say USD 277. This appliance would require energy-related imports over its lifetime of USD 214 and hence its total imports (direct plus energy related) would be USD 491, compared with USD 605 for the traditional, less-efficient appliance. If the lower price encouraged 1.1 more-efficient appliances to be imported for each substituted appliance that was previously imported, the net import cost would be USD 540 per less-efficient appliance that was no longer imported — i.e. a net import saving of USD 65 per appliance.

Table 5. Tariffs of product imports, values of product imports and product energy-related imports for selected household appliances

Product and economy grouping	Weighted average import tariff[1] (% ad valorem)	Value of product imports[2] (USD 1000)	Estimated energy related imports[3] (USD 1000)	Estimated total imports[4] (USD 1000)	Ratio of energy to product imports (%)
Refrigerator-freezers					
Least developed	24.5%	54 128	58 029	112 157	107%
Middle income	22.3%	328 757	632 137	960 895	192%
Transitional	12.2%	125 976	158 811	284 787	126%
High income, non-OECD	3.8%	126 587	118 627	245 214	94%
OECD and EU	2.1%	2 352 811	1 015 124	3 367 935	43%
World weighted average	*4.9%*	*2 934 132*	*1 924 700*	*4 858 832*	*76%*
Room Air Conditioners					
Least developed	24.9%	177 671	231 508	409 180	130%
Middle income	17.5%	647 704	801 537	1 449 240	124%
Transitional	10.4%	119 047	120 735	239 781	101%
High income, non-OECD	2.5%	560 664	780 232	1 340 896	139%
OECD and EU	1.9%	1 618 881	526 845	2 145 726	33%
World weighted average	*5.8%*	*2 946 295*	*2 229 349*	*5 175 644*	*87%*
Fluorescent lamps					
Least developed	26.2%	28 397	54 748	83 145	193%
Middle income	14.4%	281 740	515 884	797 623	183%
Transitional	11.3%	23 650	28 391	52 041	120%
High income, non-OECD	2.4%	118 665	163 827	282 492	138%
OECD and EU	3.4%	1 107 236	938 376	2 045 612	85%
World weighted average	*5.4%*	*1 531 291*	*1 646 478*	*3 177 769*	*108%*
Incandescent lamps					
Least developed	17.7%	11 568	124 898	136 466	1080%
Middle income	15.6%	170 651	1 749 848	1 920 499	1025%

Product and economy grouping	Weighted average import tariff[1]	Value of product imports[2]	Estimated energy related imports[3]	Estimated total imports[4]	Ratio of energy to product imports
	(% ad valorem)	(USD 1000)	(USD 1000)	(USD 1000)	(%)
Transitional	14.7%	26 733	179 722	206 455	672%
High income, non-OECD	1.0%	39 696	306 901	346 597	773%
OECD and EU	3.8%	693 966	3 293 541	3 987 507	475%
World weighted average	*6.1%*	*931 047*	*5 530 011*	*6 461 058*	*594%*
PCs					
Least developed	9.7%	120 006	25 080	145 085	21%
Middle income	1.3%	896 483	177 934	1 074 417	20%
Transitional	3.5%	119 033	10 915	129 948	9%
High income, non-OECD	0.1%	132 869	10 008	142 877	8%
OECD and EU	0.3%	2 446 784	94 281	2 541 066	4%
World weighted average	*0.6%*	*3 595 169*	*293 139*	*3 888 308*	*8%*
Laptops					
LDCs	9.6%	160 530	7 681	168 212	5%
Middle income	1.2%	1 966 524	89 365	2 055 889	5%
Transitional	1.6%	104 870	1 875	106 745	2%
High income, non-OECD	0.1%	726 880	14 943	741 823	2%
OECD and EU	0.0%	27 262 508	286 705	27 549 213	1%
World weighted average	*0.1%*	*30 060 782*	*392 887*	*30 453 669*	*1%*

[1] The tariffs applied to product imports weighted by their sales value.
[2] The value of imports into the countries concerned in the year 2003 in USD 1000.
[3] The estimated value of the imports related to the energy use of the product over its useful lifetime in USD 1000.
[4] The sum of columns 3 and 4 in USD 1000.

The effect on competing domestically produced products of reducing tariffs on relatively energy-efficient goods will vary, depending on several factors. Generally, local manufacturers would see domestic prices fall for models of the electrical appliance they produced that met or exceeded the international reference standard, but continue to benefit from the price-supporting effects of the tariff that remained on less-efficient models, which are often less-costly to produce. If most domestic consumers who purchase the good in question, say an air conditioner, use it sparingly, and are therefore more influenced by capital costs than the discounted life-time costs of the electricity needed to run it, they may not be persuaded to switch to more-efficient models. Under such circumstances, it is therefore possible that the reduction in price, induced by the lower tariff, might not be great enough to induce a corresponding shift in the domestic manufacturer's production mix. However, if the domestically produced goods are considerably less efficient than goods that would qualify for a lower tariff, and the tariffs on both efficient and inefficient goods were previously high (e.g., 15% or more), there could be a significant shift to imports unless local producers improve the energy efficiency of their products or reduce their prices, or both.

V. Aligning energy-performance standards and test procedures

Differences in technical regulations and standards can create barriers to trade in electrical appliances. Some countries are now working together to iron out those differences. These efforts differ in scope and approach. Many countries already allow labels issued by another country to appear on appliances sold within their borders. Some are working to harmonise or align standards, including mandatory MEPS. A few have agreed to adopt another country's (usually voluntary) standard. This usually involves, at the same time, adoption or alignment of related test procedures and review schedules. Other efforts are aimed at better understanding differences in test procedures, as the first step to aligning these bilaterally or within a region. A consequence is that international co-operation is increasing in several important areas, resulting in the emergence of *de-facto* international standards in several large, regional markets. This section describes some of the on-going bilateral and international efforts in this area.

Bilateral and regional agreements involving energy-efficiency

The ENERGY STAR programme forms the basis for several bilateral agreements, notably between the United States and, respectively, Australia, Canada, the European Union, Japan, New Zealand and Chinese Taipei. Under the general terms of these agreements, the ENERGY STAR label can appear on various products marketed in those countries. For example, in 2001, Canada agreed to promote the marketing of ENERGY STAR labels for a broad range of products, including office equipment, consumer electronics, heating and cooling equipment, home appliances, lighting and signage, distribution transformers, commercial solid-door refrigerators and freezers, and windows. Already, Australia refers to ENERGY STAR as an international standard for standby power[23], though it uses its own Energy Rating Label for labelling energy-efficient major domestic appliances. The ENERGY STAR programme itself notes that international "partnerships are intended to unify voluntary energy-efficiency labelling programmes in major global markets."

In December 2000 the United States and the European Communities signed an administrative agreement on the co-ordination of labelling programmes for energy-efficient office products. Under the Agreement — which remains in force during the initial period until 2006 — the ENERGY STAR programme is the recognised reference standard within the European Union for computers, monitors, printers, fax machines, copiers, scanners and multifunctional electrical office equipment. The European Union also shares responsibility with the US EPA for establishing and maintaining the efficiency metrics and thresholds applicable to ENERGY STAR eligible office equipment. Among the goals of the agreement is to stimulate international trade in (energy-efficient) office equipment, by adopting a single reference standard. Following the agreement, various national voluntary labelling programmes, such as Germany's Blue Angel, have adopted ENERGY STAR energy-efficiency criteria for computers and other appliances. In August 2004, three of the members of the European Free Trade Association (EFTA), Norway, Iceland and Liechtenstein, signed onto the ENERGY STAR programme for office equipment; they rely on the European Commission for programme implementation. In effect, the ENERGY STAR programme has emerged as the most prevalent international standard for office products in the two largest regional markets in the world.

In late 2002, the North American Energy Working Group (NAEWG) — comprised of representatives of the governments of Canada, Mexico and the United States — announced the "North American Energy Efficiency Standards and Labelling" initiative (NAEWG, 2002). One of the objectives of the initiative is to enhance co-operation of voluntary endorsement labels such as ENERGY STAR. Although the 2002 Energy Efficiency Report of the North American Energy Working Group does not explicitly identify the ENERGY STAR programme as the basis of harmonisation or a continent-wide energy-efficiency labelling programme, the ENERGY STAR programme is the only example cited in the context of harmonisation of standards.

23 The Australian Greenhouse Office (www.energystar.gov.au) refers to ENERGY STAR as "an international standard for [stand-by power in] energy-efficient office equipment like computers, printers, photocopiers, and home electronics like TVs, VCRs, audio products and DVD players." See also Australian Greenhouse Office, "Appliance Labelling" (http://www.greenhouse.gov.au/appliances/index.html).

Other notable regional harmonisation efforts include:

- In Europe, the EU-25 countries are working with new accession states (Bulgaria, Croatia, Romania and Turkey) to assist them in introducing EU appliance energy performance regulations. This mirrors the process which previously took place in the 10 new EU member states prior to their becoming EU members.

- Australia and New Zealand have a formal arrangement to develop common energy efficiency requirements for energy using products and apply harmonised test procedures.

- ASEAN countries are working together to develop a common regional endorsement energy label for energy-using products.

- Six countries in and around the Indian sub-continent have been co-operating through the auspices of the South Asian Regional Initiative programme to share experiences and possibly co-operate in the development of regional appliance efficiency requirements.

- Members of the ANDEAN pact countries are co-operating in a regional initiative to develop energy efficiency labels and standards for energy using appliances.

- A May 2003 workshop[24] sponsored by the International Energy Agency examined the rapidly rising energy consumption of television set-top boxes. The digital adapter (needed to convert digital video signals to analogue signals for existing televisions) was identified as an internationally-traded energy-using product that exhibited large variation in energy efficiency. A group of countries agreed to study the same efficiency specification. Since then four governments have adopted a nearly identical specification for use in their mandatory and voluntary efficiency programmes.

Informal bilateral agreements

In addition to the formal agreements between the EU and Accession states many other countries have voluntarily adopted some or all EU appliance efficiency regulations, including Norway, Switzerland, Russia, South Africa and Turkey. There are many other countries which have harmonised some parts of their appliance efficiency regulations to EU regulations including: Tunisia, Algeria, Egypt, Iran, China (for refrigerators), Australia (for ballasts), Columbia, Argentina and Brazil. In a similar manner Venezuela adopted US EnergyGuide requirements for refrigerators and room air conditioners.

The Australian MEPS programme is a particularly interesting example of how appliance efficiency requirements can be applied internationally and across different test procedures and product categorisation. The Australian Greenhouse Gas Office and National Appliance Energy Efficiency Committee have a policy of adopting the most stringent MEPS in place amongst their major international trading partners. The implementation of this policy usually requires addressing all the obstacles recounted above, namely converting international MEPS requirements into a common test procedure, product categorisation and efficiency metric. In this case all international requirements are converted into corresponding requirements under the Australia/NZ test procedure to enable a common comparison of stringency. The methodology applied is not always as accurate as would be expected were all products to be tested under the same test procedure, but is sufficiently robust for Australian MEPS policy to be established with some confidence of product conformity to all relevant international MEPS requirements. In other words, once the most

24 http://www.iea.org/Textbase/work/workshopdetail.asp?textfield=box&Submit2=Submit&id=103

stringent MEPS have been adopted from among Australia's trading partners the regulatory authorities are confident that conforming products would meet the MEPS requirements of any of them. Reports which describe the conversion analyses applied are available on the website: www.energyrating.gov.au.

The Energy Efficient Lighting initiative

The Efficient Lighting Initiative (ELI) was established in the mid 1990s and is implemented by the International Finance Corporation with funding from the Global Environment Facility (GEF). ELI works with lighting manufacturers, lighting wholesalers and retailers, electric utilities, the public sector, NGOs, and educational institutions to accelerate the growth of lighting markets through efficient, high quality lighting technologies. ELI aims to reduce greenhouse gas emissions by increasing the use of energy-efficient lighting technologies. ELI operated through country-based programmes from 2000 to 2003 in seven countries: Argentina, the Czech Republic, Hungary, Latvia, Peru, the Philippines, and South Africa.[25] A part of this work involved the development of energy and quality performance specifications for energy-efficient lamps. Lamps that are certified as meeting these criteria are entitled to display the ELI logo on their packaging and promotions. Building upon the value created during programme implementation for the ELI product quality certification process and quality mark, the next generation of ELI is due to begin shortly and aims to expand the reach of the quality mark globally across the emerging markets.[26]

The IEA's initiative on standby power

The International Energy Agency (IEA) has proposed a 1-watt target for standby power. Standby power for electrical equipment is the electricity consumed by appliances when they are nominally switched off (but still plugged in to an electrical socket) or not performing their primary function. Standby power consumption accounts for an increasing fraction of the world's energy use, and already represents 5–15% of residential electricity use in IEA member countries.

The IEA's open, co-ordinated international initiative has helped to transform the entire electronics market by stimulating manufacturers of products and components to use low-loss components and designs. Its proposed 1-watt target gained legitimacy when Australia formally endorsed the concept and, more recently, in July 2001, when the U.S. President issued an Executive Order requiring the Federal Government to purchase products with low standby-power consumption, and preferably below 1 watt. Japan encourages its manufacturers, on a voluntary basis, to reduce the standby power consumption of major household electrical appliances they produce. It recommends that appliances with equipment such as timers should be designed to consume less than 1 watt during standby mode, and that electricity consumption should be minimised to as close to zero as possible for all other products. In Europe, several codes-of-conduct have been proposed by the European Commission to the electronic industry to bring to the market only the equipment with a standby power lower than 1 watt.[27] China recently has imposed a 1-watt target for the standby power of TV sets sold in the country.

[25] www.efficientlighting.net

[26] http://www.cecp.org.cn/englishhtml/showpage.asp?newsid=31

[27] http://www.iea.org/Textbase/work/workshopdetail.asp?textfield=standby&Submit2=Submit&id=202

Testing and standards

Several efforts are underway at the regional level to reduce trade barriers caused by unnecessary differences in test methods. In North America, for example, Canada, Mexico and the United States are co-operating to verify the test procedures for refrigerator-freezers and freezers, room air conditioners, and electric motors. The North American Energy Working Group reports near-identical definitions, testing conditions, and testing equipment in several product categories, though there are minor differences in test procedures for refrigerators, notably in product definitions, testing calculations and test standards.[28]

Because of the economic dominance of the U.S. market in NAFTA, it is not surprising that test procedures used in Canada and Mexico are substantially similar to those used in the United States. Across more diverse regions, however, variations in test procedures can be large.

In the late 1990s, therefore, the APEC Steering Group on Energy Standards (SGES), one of ten such task groups reporting to the APEC Energy Working Group, was asked by APEC Energy Ministers to develop firm proposals for establishing a base on which mutual acceptance of accreditation of energy-efficiency testing facilities and the results of tests performed at these facilities, could be achieved, and to work towards the establishment of bases of comparison of the outcomes of testing to different standards so that the need to test to multiple standards could be reduced or eliminated. Several major studies were commissioned, and workshops held, to address this request. These efforts produced a detailed list of specific issues and recommended strategies.

One of the recommended strategies, to develop conversion algorithms, holds some promise for avoiding the need for full alignment of test methods. As described by EESA (1999a, p. 231):

> In its simplest form, a conversion algorithm is a simple "fudge" factor which will allow the measure of energy and/or performance under one test procedure to be converted to an equivalent and comparative value under a different test procedure without the need for additional retesting. In its most complex form, an algorithm could consist of a computer model which is used to simulate the performance and energy consumption under a range of conditions, including different test procedures, or conditions of actual use (say in a factory or household).

The potential benefits of developing acceptable algorithms would be large. Where feasible, a conversion algorithm would normally be much less expensive for manufacturers than laboratory testing, which in turn would reduce the costs of trade. A well-specified conversion algorithm could also provide a more accurate estimate of the impact of local usage patterns, produce a better ranking of products under conditions of actual use, and in some cases allow the retention of local or traditional test conditions. The latter alone would make comparing and aligning energy performance standards much, much easier.

It is easier to create conversion algorithms for some electrical appliances than for others, and some may never be feasible at all. Table 6 summarises the findings of the 1999 study for APEC Steering Group in respect of conversion algorithms for the four appliances discussed above. Although a conversion algorithm would be highly useful for refrigerators and freezers, its successful development remains elusive. Algorithms for florescent lamp ballasts (the test for light output is straightforward enough not to need a conversion algorithm) and standby power for personal computers are not necessary. But both the prospects for, and the utility of, conversion algorithms for air conditioners appear to be good.

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28 Examples of differences in testing include minor differences in the temperate baseline used to distinguish refrigerator and freezer compartments. Mexico does not include chest or upright freezers in its adjustment factors. In testing procedures, the United States requires greater temperature measurement accuracy, while Mexico requires greater accuracy in measuring power consumption (NAEWG, 2002).

Table 6. Prospects for developing conversion algorithms for translating the results of energy performance testing

Appliance	*Comments in the EEAS (1999a) study*
Refrigerators and freezers	"Ultimately, a conversion algorithm (most likely a rather complex computer model with extensive calibration through physical tests) is the only medium-term prospect to avoid (at least in part) the myriad of test methods that currently exist. However, this is a complex and significant task and would require substantial resources merely to establish feasibility, let alone get it to an acceptable level of performance for regulatory purposes." (p. 250)
Air conditioners	"There are a number of computer models for air conditioners that are used to simulate energy and performance and there is also extensive testing of air conditioners. What appears to be missing is the linking of the two aspects to provide a much more flexible and accurate tool for both energy regulations, modelling and analysis."
Fluorescent lamp ballasts	"If a suitable IEC [International Electrotechnical Commission] standard can be successfully developed, this test method would be already suitable for a range of purposes and conditions and would "characterise" the product to the extent that is required in the market place. Therefore, the development of a conversion algorithm is probably not necessary or recommended for this product (if the new IEC test method is deemed to be acceptable)."
Personal computers	"There is probably no need for a conversion algorithm given the largely uniform approach for testing these products to date. The other issue is that much of the measurement required for these products relates to standby or sleep mode energy consumption, rather than the energy consumed during normal operation (therefore measurement of performance is not required)." (p. 251)

A growing number of experts have called for a major rethinking of current test procedures in the area of energy performance — not only because of non-comparability between national testing standards but also because many of the tests are not keeping up with changes in technology, particularly the incorporation of microcontrollers (IEA, 2003). A microcontroller can be used to sense when an appliance is about to be tested and thus boost its performance during the test, while leaving actual energy use in common situations unchanged. According to Meier (1998), "unscrupulous manufacturers can, under certain conditions, lower the tested energy use by over 30% without a parallel drop in field use." In his opinion, "nearly all energy test procedures are obsolete and cause serious misrepresentations of energy consumption." Developing new, national and international test standards — which would probably need to combine tests of both hardware and software — if co-ordinated with work on developing conversion algorithms, could, Meier concludes, create "an excellent opportunity for all countries to harmonize their energy test procedures while addressing a serious technical shortcoming."

VI. Concluding observations

This paper considers the feasibility of using energy efficiency as a basis for defining groups of household and electrical appliances as "environmental goods". The results of this initial study suggest that feasibility depends on several factors, including the characteristics of the technology or the appliance itself, and its susceptibility to categorization on the basis of relevant energy performance, the characteristics of relevant testing procedures, and those of applicable regulations. While harmonisation of standards would simplify the task in some respects, the process of standards harmonisation itself introduces other issues. This paper does not address the feasibility or appropriateness of various approaches to improving and harmonising energy performance or other matters of general trade and energy policy

Some energy-efficient products, such as LCD monitors and CFLs, could be differentiated easily on the basis of their physical characteristics alone. For the others it is necessary to apply an energy-efficiency threshold that is gauged according to an energy-efficiency metric determined through energy performance formulae and verified by testing. Among these there are some products whose energy test procedures, product categorisation, efficiency metrics and required efficiency thresholds are sufficiently similar that it would be feasible to devise a common set of requirements determining their entitlement to a liberalised tariff. There are other products for which many aspects of the test procedure, product categorisation and efficiency metrics are similar, or could be expressed in a comparable manner across regions, but for which the efficiency thresholds currently applied are very different from one market to another. These differences in efficiency requirements often reflect significant differences in the price of energy and the way the product is used from one region to another that determine the efficiency-level at which the product is most cost-effective for the consumer.

Of course, even if product descriptions were to be harmonised, and every country were to adopt the same international standards for test procedures, differences in the levels at which mandatory and voluntary standards for minimum energy performance are set would likely remain. Assuming that countries agreed to proceed along these lines on relatively energy-efficient electrical appliances and that these products could be differentiated for tariff purposes from less-efficient appliances on the basis of their compliance with a country's MEPS or labelling requirements, or on the basis of their compliance with an internationally agreed minimum energy performance standard, doing so would nonetheless require a number of specific issues to be addressed.

For refrigerators, clothes-washers and a few other products exhibiting large regional variation in design features, use patterns, testing procedures and MEPS or labelling requirements, differentiating more from less efficient models at the multilateral level is achievable only over the longer term. Even for this category of electrical appliances, however, opportunities for trade would be improved if international efforts to align test procedures (or develop conversion algorithms), and perhaps product descriptions, if not the actual levels at which mandatory energy-performance standards are set, were continued or even strengthened. To date, only a few bilateral and regional efforts to encourage alignment of national test procedures, and even the energy-performance standards themselves have been successful.

It is important to keep the trade policy options in perspective. Trade policy, to the extent that it may be enlisted to support trade in energy-efficient goods, can only play a secondary role in promoting energy efficiency. The current multiplicity of national efficiency standards and labelling schemes may itself be acting in a similar manner to non-tariff barriers, and be more important. Non-uniform standards create diseconomies of scale, especially for small and mid-sized enterprises in developing countries seeking to access foreign markets. Further progress in international co-operation would be welcome, and could help to address one piece of the Doha mandate on environmental goods — namely, the objective of reducing or eliminating non-tariff barriers to environmental goods and services. Needless to say, for such an exercise to effectively address market-access concerns, developing countries would need to be partners and active participants from the outset.

GLOSSARY

Appliance category	A group of appliance models that have similar technical characteristics from the perspective of their user utility.
Categorical energy label	An energy label where product efficiency is classified into one of several classes. Examples of categorical labels include the EU's energy labels where efficiency is ranked from A to G and Australia's energy label where efficiency is ranked from 1 to 6 stars. Brazil, China, India, Iran, Korea, Thailand and Tunisia amongst others have all developed categorical energy labels.
Endorsement energy label	A voluntary energy label where the supplier of an appliance which meets some minimum energy performance requirement is entitled to apply the label to their products.
Energy Efficiency Ratio (EER)	A measure of the relative efficiency of a heating or cooling appliance, such as an air conditioner, that is equal to the unit's thermal output divided by its consumption of energy. The units used to measure the thermal output and energy input may vary from one economy to another although international test standards measure both in watts.
MEPS	Minimum energy performance standards (some times known as minimum energy efficiency standards).
Test standard	A standard that sets out a test method, but that does not indicate what result is required when performing that test.

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ANNEX 1. REGULATIONS AND STANDARDS FOR COLD APPLIANCES: REFRIGERATORS, FREEZERS AND COMBINATIONS THEREOF[29]

Summary of current regulations

Table A1. Economies that have established, or are considering establishing MEPS and/or labelling schemes for household refrigeration appliances

Economy	Refrigerators and Refrigerator-Freezers			Freezers		
	MEPS[1]	Labels		MEPS[1]	Labels	
		Compare	Approve		Compare	Approve
Algeria	**M**[1]	**M**[1]		**M**[1]	**M**[1]	
Argentina	UC	**M**[1,2]		UC	**M**[1,2]	
Australia	**M**[5]	**M**[5]	V	**M**[5]	**M**[5]	V
Bolivia	UC	UC		UC	UC	
Brazil	UC	V[3]	V	UC	V[3]	V
Bulgaria	UC[2]	UC[2]	UC[2]	UC[2]	UC[2]	UC[2]
Canada	**M**[4]	**M**[4]	V[4]	**M**[4]	**M**[4]	V[4]
Chile	UC	UC	UC	UC	UC	UC
China	**M**[3]	**M**[3]	V	**M**[3]	**M**[3]	V
Columbia	**M**[1]	**M**[3]		**M**[1]	**M**[3]	
Costa Rica	V	**M**		V	**M**	
Croatia	UC[2]	UC[2]	UC[2]	UC[2]	UC[2]	UC[2]
Ecuador	UC	UC		UC	UC	
Egypt	UC	UC[3]		UC	UC[3]	
EU-25	**M**	**M**	V	**M**	**M**	V
Ghana	UC	UC[2]		UC	UC[2]	
Hong Kong, China	UC	V	V	UC		V
Iceland	**M**[2]	**M**[2]	V[2]	**M**[2]	**M**[2]	V[2]
India	**M**	(V)	V			

29. The following four annexes will be filled out in a separate working paper, available on the web, in the OECD Trade and Environment Working Paper series. In addition to what is included here in Annexes 1 to 4, the following elements for each product considered will also be covered:

- Lists of the main energy performance test procedures applied in the various economies with energy performance requirements
- When relevant; descriptions of key differences in the energy test procedures
- Descriptions of the product category definitions and energy efficiency metrics applied in the main economies (China, EU, Japan and NAFTA)
- Descriptions and/or formulae defining the efficiency thresholds applied in the main economies (China, EU, Japan and NAFTA)

Economy	**Refrigerators and Refrigerator-Freezers**			**Freezers**		
	MEPS[1]	**Labels**		**MEPS**[1]	**Labels**	
		Compare	**Approve**		**Compare**	**Approve**
Indonesia	UC	V	V			
Iran	**M**	**M**[3]				
Israel	**M**	**M**[3]		**M**	**M**[3]	
Jamaica		**M**			**M**	
Japan	**M**[6]	**M**		**M**[6]	**M**	
Korea	**M**	**M**		**M**	**M**	
Lichtenstein	**M**[2]	**M**[2]	V[2]	**M**[2]	**M**[2]	V[2]
Malaysia		(M)			(M)	
Mexico	**M**[4]	**M**[4]	V	**M**[4]	**M**[4]	V
New Zealand	**M**[5]	**M**[5]		**M**[5]	**M**[5]	
Norway	**M**[2]	**M**[2]	V	**M**[2]	**M**[2]	V
Peru	UC	UC		UC	UC	
Philippines	UC	**M**		UC	**M**	
Romania	UC[2]	UC[2]	UC[2]	UC[2]	UC[2]	UC[2]
Russia	**M**	M[2]		**M**	M[2]	
Singapore			V			V
South Africa	UC	M[2]		UC	M[2]	
Switzerland		V[2]	V		V[2]	V
Chinese Taipei	**M**		V			V
Thailand	M	M	V			
Tunisia	**M**[3]	**M**[3]		**M**[3]	**M**[3]	
Turkey	UC[2]	**M**[2]	UC[2]	UC[2]	**M**[2]	UC[2]
United States	**M**	**M**	V	**M**	**M**	V
Uruguay	UC	UC		UC	UC	
Venezuela	V[4]	**M**[4]		V[4]	**M**[4]	
Vietnam	UC	UC		UC	UC	

Source: IEA and OECD Secretariats, based on various sources. M = Mandatory, V = voluntary, UC = under consideration

[1] Framework legislation is passed but the implementing legislation is believed to still be under consideration. [2] Harmonised with EU, [3] partially harmonised with EU, [4] partially or fully harmonised with USA, [5] harmonised between Australia and New Zealand, 6 Japan requires the sales-weighted average efficiency of any suppliers' appliances to exceed a prescribed efficiency threshold - these requirements are mandatory but fines for non-compliance are very low and therefore they are sometimes described as voluntary targets; nonetheless, being named and shamed for non-compliance is likely to have severe consequences in the Japanese marketplace and hence is thought to be an adequate deterrent by Japanese regulators.

ANNEX 2. REGULATIONS AND STANDARDS FOR AIR CONDITIONERS

Summary of current regulations

Table A.2. Economies that have established, or are considering establishing MEPS and/or labelling schemes for room air conditioners

Economy	Type of air-conditioner					
	Single packaged (window)			Split or multi-split		
	MEPS	Label		MEPS	Label	
		Compare	Approve		Compar	Approve
Algeria	**M**[1]	**M**[1]		**M**[1]	**M**[1]	
Argentina	UC	**M**[1,2]		UC	**M**[1,2]	
Australia	**M**[5]	**M**[5]	V	**M**[5]	**M**[5]	V
Bolivia	UC	UC		UC	UC	
Brazil		V	V		V	V
Bulgaria		UC[2]	UC[2]		UC[2]	UC[2]
Canada	**M**[4]	**M**[4]	V[4]	**M**[4]	**M**[4]	V[4]
China	**M**	**M**	V	**M**	**M**	V
Columbia	**M**[1]	**M**[3]		**M**[1]	**M**[3]	
Costa Rica	V	**M**				
Croatia		UC[2]	UC[2]		UC[2]	UC[2]
Ecuador	UC	UC		UC	UC	
Egypt	UC	UC[3]		UC	UC[3]	
EU-25	UC	**M**	UC	UC	**M**	UC
Ghana	**M**			**M**		
Hong Kong, China		V			V	
Iceland		**M**[2]	UC[2]		**M**[2]	UC[2]
India	UC	UC		UC	UC	
Indonesia	UC	V		UC	V	
Iran	**M**[7]	**M**[7]				
Israel	**M**	**M**[3]		**M**	**M**[3]	
Japan	**M**[6]	**M**		**M**[6]	**M**	
Korea	**M**	**M**		**M**	**M**	
Lichtenstein		**M**[2]	UC[2]		**M**[2]	UC[2]
Malaysia	UC	UC		UC	UC	
Mexico	**M**[4]	**M**[4]	V	**M**[4]	**M**[4]	
New Zealand	**M**[5]	**M**[5]		**M**[5]	**M**[5]	
Norway		**M**[2]	UC[2]		**M**[2]	UC[2]
Peru	UC	UC		UC	UC	

Economy	**Type of air-conditioner**					
	Single packaged (window)			**Split or multi-split**		
	MEPS	**Label**		**MEPS**	**Label**	
		Compare	**Approve**		**Compar**	**Approve**
Philippines	**M**	**M**		**M**	**M**	
Russia	**M**	UC[1,2]		**M**	UC[1,2]	
Saudi Arabia	**M**			**M**		
Singapore	**M**		V			V
South Africa		UC[2]			UC[2]	
Switzerland		V[2]			V[2]	
Chinese Taipei	**M**		V	**M**		V
Thailand	UC	V	V	UC	V	V
Tunisia	UC	UC		UC	UC	
Turkey		UC[2]	UC[2]		UC[2]	UC[2]
United States	**M**	**M**	V	**M**	**M**	V
Venezuela	V[4]	V[4]		V[4]	V[4]	
Vietnam	UC	UC		UC	UC	

Source: IEA and OECD Secretariats, based on various sources. M = Mandatory, V = voluntary, UC = under consideration

[1] Framework legislation is passed but the implementing legislation is believed to still be under consideration. [2] Harmonised with EU, [3] partially harmonised with EU, [4] partially or fully harmonised with USA, [5] harmonised between Australia and New Zealand, 6 Japan requires the sales-weighted average efficiency of any suppliers' appliances to exceed a prescribed efficiency threshold - these requirements are mandatory but fines for non-compliance are very low and therefore they are sometimes described as voluntary targets; nonetheless, being named and shamed for non-compliance is likely to have severe consequences in the Japanese marketplace and hence is thought to be an adequate deterrent by Japanese regulators, [7] Iran has specifications for evaporative coolers not air conditioners as such.

ANNEX 3. REGULATIONS AND STANDARDS FOR COMPACT FLUORESCENT LIGHTING

Summary of current regulations

Table A.3. Economies that have established, or are considering establishing MEPS and/or labelling schemes for CFLs

Economy	MEPS	Label	
		Compare	Approve
Argentina		**M**[1,2]	V
Australia	**M**[5]		V
Brazil			V
Bulgaria		UC[2]	UC[2]
Canada	**M**[4]		V[4]
China	**M**	UC	V
Columbia	**M**[1]	**M**[3]	
Costa Rica	V	**M**	
Croatia		UC[2]	UC[2]
EU-25		**M**	V
Ghana	UC		
Hong Kong, China			V
Iceland		**M**[2]	V[2]
Indonesia	UC		
Israel	**M**	V	
Japan	**M**[6]	**M**	
Korea	**M**	**M**	V
Lichtenstein		**M**[2]	V[2]
Malaysia	M[7]	UC	
Mexico	**M**[4]		V
New Zealand	**M**[5]		V
Norway		**M**[2]	V[2]
Peru		UC	V
Philippines		**M**	V
Russia		UC[1,2]	
Singapore			V
South Africa		UC[2]	V
Sri Lanka		V	
Switzerland		V[2]	
Chinese Taipei	**M**		V
Thailand	UC	V	V
Tunisia	UC	UC	
United States	**M**		V
Vietnam	UC	UC	

Source: IEA and OECD Secretariats, based on various sources. M = Mandatory, V = voluntary, UC = under consideration

[1] Framework legislation is passed but the implementing legislation is believed to still be under consideration. [2] Harmonised with EU, [3] partially harmonised with EU, [4] partially or fully harmonised with USA, [5] harmonised between Australia and New Zealand, 6 Japan requires the sales-weighted average efficiency of any suppliers' appliances to exceed a prescribed efficiency threshold - these requirements are mandatory but fines for non-compliance are very low and therefore they are sometimes described as voluntary targets; nonetheless, being named and shamed for non-compliance is likely to have severe consequences in the Japanese marketplace and hence is thought to be an adequate deterrent by Japanese regulators, [7] For ballasts used with fluorescent lamps only.

ANNEX 4. REGULATIONS AND STANDARDS FOR PERSONAL COMPUTERS

Summary of current regulations

Table A.4. Economies that have established, or are considering establishing MEPS and/or labelling schemes for personal computers

Economy	MEPS	Label	
		Compare	Approve
Australia			V[2]
Bulgaria			UC[1,2]
Canada			V[2]
China			V
Croatia			UC[1, 2]
EU-25			V[2]
Hong Kong, China			V
Iceland			V[1, 2]
Japan	**M**[3]		V[2]
Korea	**M**		V[2]
Lichtenstein			V[1, 2]
New Zealand			V[2]
Norway			V[1, 2]
Russia	**M**		
Singapore			V
Switzerland	**V**		V
Chinese Taipei			V
Thailand			V
United States			V
Vietnam			UC

Source: IEA and OECD Secretariats, based on various sources. M = Mandatory, V = voluntary, UC = under consideration

[1] Harmonised with EU, [2] partially or fully harmonised with USA, [3] Japan requires the sales-weighted average efficiency of any suppliers' appliances to exceed a prescribed efficiency threshold - these requirements are mandatory but fines for non-compliance are very low and therefore they are sometimes described as voluntary targets; nonetheless, being named and shamed for non-compliance is likely to have severe consequences in the Japanese marketplace and hence is thought to be an adequate deterrent by Japanese regulators.