International Comparisons of Product Policy

FINAL REPORT

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for a cool planet

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For a stronger, faster Ecodesign Directive to help save the climate & money.

The Coolproducts for a coolplanet coalition is a group of NGOs from all across Europe who are working to ensure the EU Ecodesign Directive and related Energy Labelling policies are as ambitious as possible.

The full report was commissioned by Coolproducts member the European Environmental Bureau and ECOS and written by Paul Waide, Waide Strategic Efficiency Ltd.

FEBRUARY 2013

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EXECUTIVE SUMMARY

Equipment energy efficiency policy measures are one of the key elements underpinning international policy measures for energy efficiency. Since the early 1990s equipment energy efficiency standards and labelling programmes have become a mainstay of international energy and industrial policy. The number of countries implementing such schemes has risen to over 70, including all the world's major economies, and this policy instrument is applied in economies comprising over 80% of the world's population and a larger percentage of its GDP. In the EU it is estimated that full exploitation of the regulatory potential of the Ecodesign Directive could produce net annual cost benefits of €90 billion and savings in annual CO2 emissions of 400 MT, equivalent to the expected benefit from the EU Emissions Trading Scheme (ETS).

Over the last 20 years considerable international experience has been gained regarding best practice in the design and implementation of equipment energy efficiency programmes. This experience addresses all aspects of programme design and implementation including:

- the legal foundation, administrative processes and program resources
- development of mandatory (or voluntary) energy efficiency standards or requirements (also called minimum energy performance or MEP's)
- energy performance test procedure design and maintenance
- communications
- regulatory compliance
- monitoring and evaluation
- impact assessment

This report presents a summary of this experience and compares the EU's programme to those operated in the peer economies of Australia, China, Japan and the USA to ascertain where the EU programme is most successful and in what ways it could be improved by adopting international best practice. In particular it focuses on:

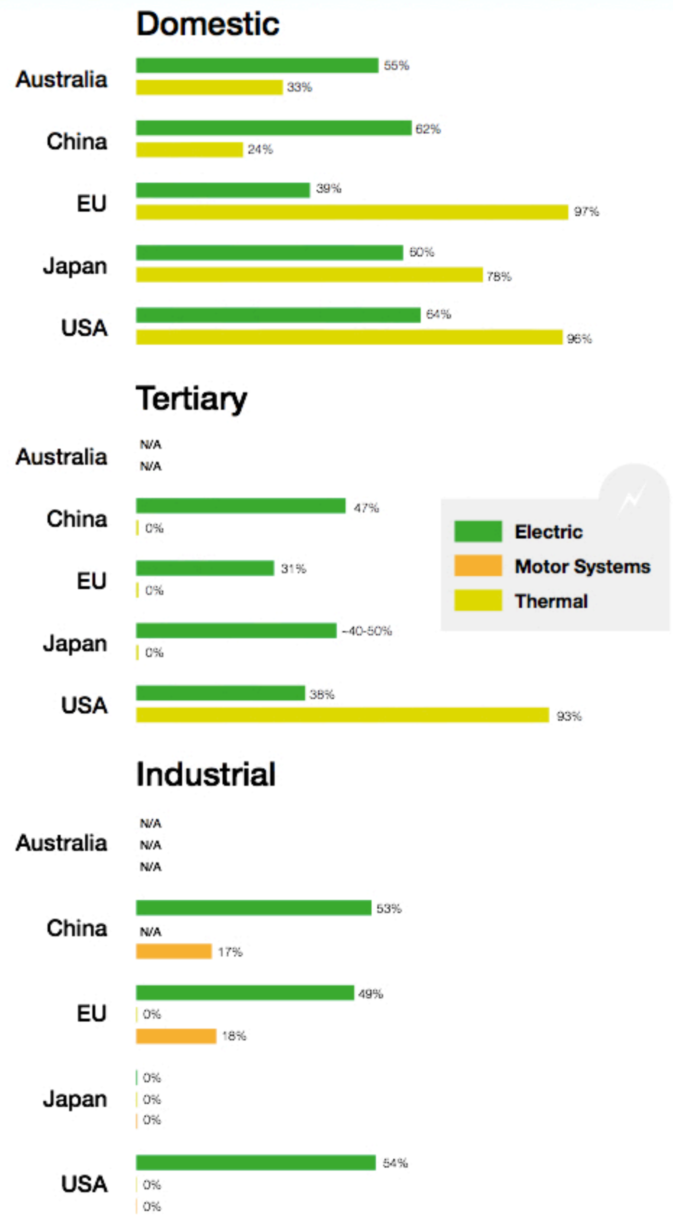
- administrative processes, capacity and throughput
- policy coverage
- stringency
- compliance and rigour
- monitoring and evaluation of impacts

Principal findings

Policy coverage

Although the EU's energy labelling programme dates back to the mid 1990s and has had a significant positive impact on most of the products it has been applied, the EU was relatively late in implementing minimum energy performance standards (MEPS) (through the Ecodesign Directive) compared with the peer economies. The other economies established legal frameworks to impose product energy performance requirements considerably earlier than the EU and hence have made more progress in issuing regulations. This is reflected in the disparity in the relative shares of equipment energy consumption which is subject to MEPS in the peer economies. Taking mid-2010 as a benchmark year the EU had the lowest proportion of it's total electricity consumption covered by MEPS in the domestic and tertiary (service) sectors, Table E1.

Table E1 Estimated shares of energy consumption subject to MEPS in 2010 for the peer economies



Nonetheless in some ways the EU's programme is a leader among the peer economies. It is the only one designed to address all environmental impacts of energy using and energy-related products. It also has the widest mandate regarding the factors which may be addressed in the regulations in that Ecodesign and energy labelling measures can be set for all types of non-transport energy-using or energy-related products; however, in practice there is considerable scope in the other economies to address similar equipment types while the other economies have been more productive in setting regulatory measures than the EU has to date.

Regulatory throughput

The pace at which regulations and other policy measures are developed and adopted (the throughput) is one of the key parameters of a programme's effectiveness. In this regard the EU seems to be behind most of the other peer economies although some of these have also had to overcome difficulties in the past. Australia has managed to set 2.5 regulations per year since the programme began in 1999 and 5.7 per year over the last 3 years. The pace at which China has been adopting MEPS and labelling has been increasing in recent years, averaging 3.8 regulations per year since 2000 but increasing to 6 per year for the last few years. Japan has set 2.9 regulations per year since 1995 but was expecting to accelerate from 2012 onwards. The USA has been setting approximately five regulations per year over the last six years and is expected to continue at this rate over the next few years. By contrast the EU had adopted by the end of 2011 just 17 MEP's and labelling regulations. Following the passage of the Ecodesign Directive the average rate of adoption has been 2.8 regulations per year. With 6 implementing measures and a voluntary agreement in 2012 and a promised record year in 2013, the average annual adoption rate in the EU may soon improve.

The comparative tardiness of the EU process is a major handicap to its overall effectiveness and puts in question the ability of the EU's product policy to make the desired contribution to the EU's broader 2020 policy target for energy efficiency. In general the most significant delays have occurred in the consultation phases after the preparatory studies have been completed. The cause of delay is thought to principally be due to combinations of the following factors:

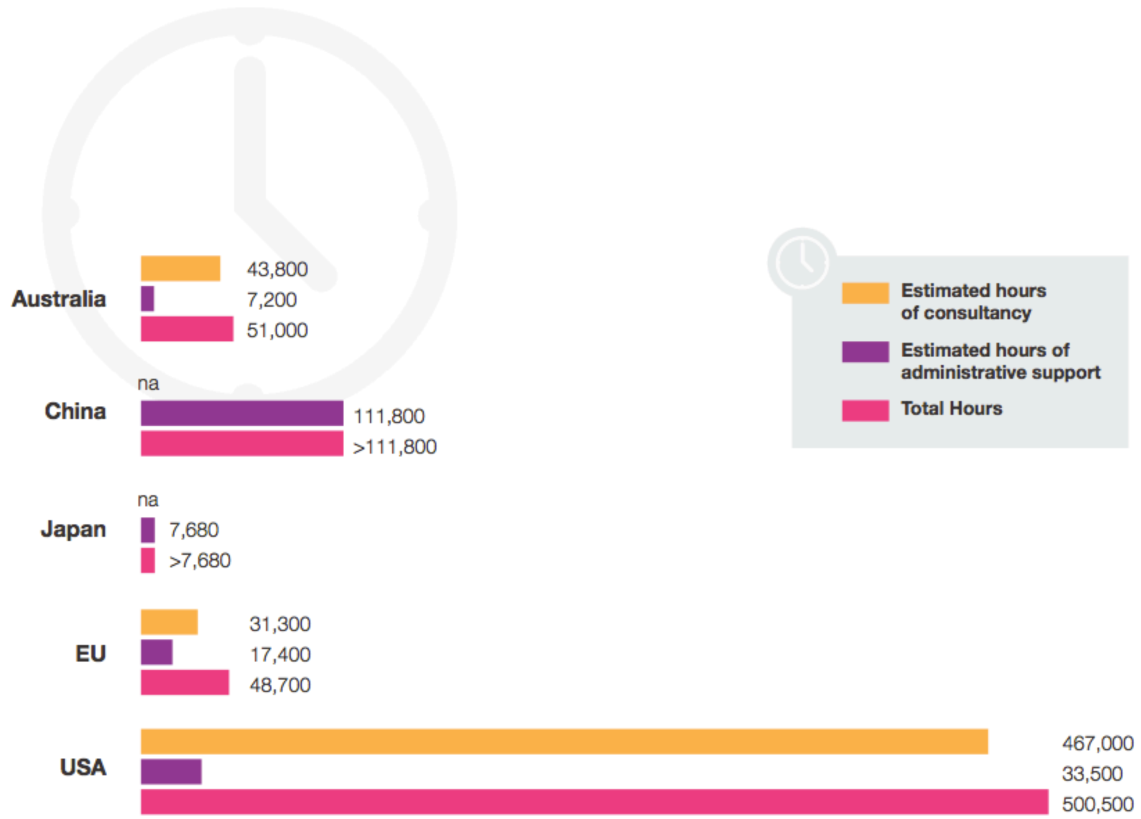
- lack of consensus over the preparatory study results, sometimes caused by inadequacies in the studies or lack of sufficient data, partially stemming from inadequate market monitoring
- lack of administrative capacity within the Commission, sometimes worsened by staff rotations and personnel changes, combined with burdensome regulatory procedures
- lack of readily available and adequate product performance measurement methods
- lack of robust deadlines in consultation and decision making processes and a need for more streamlined procedures to accelerate the different stages of the regulatory development process (consultations, negotiations with stakeholders, finalisation, mandating of measurement standards, etc.)

Administrative and technical capacity

Limited administrative capacity and inadequate budgets to hire consulting support are the key factors that limit the rate of policy measure development in the EU compared with the peer economies. Based on what is known about each of the peer programmes their estimated human resources, expressed in terms of annual person-hours of administrative and technical (consulting) support are shown in Table E2. Additional resources would be allocated for labelling. For the size of its economy the EU commits substantially less resources to support its programme than any of the peer economies.

While these values are estimates it is interesting to note that the US figure is roughly 10 times that of the EU despite both having similar sized economies and similar magnitudes of benefits to achievable from optimising their equipment energy efficiency programmes. The estimated person-hours per year for development of the Chinese programme are over twice those of the EU's. The Japanese and Australian programmes have the lowest person hours committed for administration but the total Australian effort when consultants are added is roughly equivalent to that in the EU despite having a population of only one 25^{th} of the EU's and a much smaller economy. These figures suggest that the EU and possibly Japan are lagging behind the other peer economies when it comes to human resource allocations to the development and administration of their equipment energy efficiency programmes.

Table E2 Administrative and technical support for the development and administration of equipment energy efficiency regulations by peer economy– estimated hours per year



Note, the Australian, Chinese and European values include estimates of all time spent at the economy-wide level for the development of all equipment energy efficiency regulations, including MEPS and labelling. By contrast the US figures are just the estimated time spent on the development of MEPS.

Stringency

Comparison of the stringency of the energy efficiency regulations in place in the peer economies is often complicated by differences in how energy efficiency is measured and defined. Nonetheless in many cases it is possible to either directly compare policy settings or make adjustments for the differences to allow comparison. To date efforts to make such comparisons have usually been piecemeal and so the information is only available for some product types. These have tended to show that the regulatory measures in place in one of the EU, Japan or the USA are likely to be the most stringent for any given product type. However Australia's policy of setting the stringency of their regulations at the same level as the most stringent of those in place among their leading trading partners is likely to mean their regulations are as stringent as anyone's across the set of products which they regulate. In some cases, such as for room air conditioners in Japan, there is a very significant difference between the most stringent policy settings and those applied elsewhere. By contrast, the EU has often led the field in the breadth of applicability of their policy settings e.g. being the first of the peer economies to adopt a horizontal standby power limit and extending it to Network standby power limit in 2013.

Compliance and enforcement

Australia has had the most proactive approach to compliance and enforcement among the peer economies and has carried out relatively extensive and systematic product energy performance verification testing and retailer labelling compliance surveys over many years. The Australian authorities and more recently their US counterparts have been willing to prosecute non-compliance and publicise the findings to maximise the deterrent effect. Although a small number of EU countries and jurisdictions have done likewise, proactive enforcement of the energy labelling and Ecodesign Directives is still rare among the EU Member States and the willingness to take legal action against non-compliant suppliers is rarer still. Enforcement of compliance remains an area of weakness in the implementation of the EU's policy and one where there is scope to learn from international experience.

Monitoring, evaluation and impact projection

The level of efforts to monitor trends in regulated product markets and evaluate programme impacts varies across the peer economies, although the efforts in Australia would appear to be the most consistent and systematic. Apart from tracking sales of regulated products by their efficiency, features and energy consumption as measured under standard test conditions, the Australian authorities have regularly conducted detailed end-use metering studies to confirm that the theoretical savings are being realised in practice and to inform the development of their energy performance test procedures. Such studies have also been conducted within the EU but have tended to be piecemeal in nature and there is no consistent and systematic effort to gather such primary data for use in regulatory evaluation and design processes. It should be noted the same data will also support efforts to forecast programme impacts and in this regard Australia and the USA have developed the more comprehensive regulatory impact forecasting tools. While some EU countries have elaborated similar tools, e.g. within the UK's Market Transformation Programme, they are not as complete or as well elaborated at the EU scale.

Recommendations

The EU needs to invest in the design and implementation of the Ecodesign and energy labelling Directives if it is to realise their impressive potential for cost-effective energy and carbon savings. The most urgent need is to bolster administrative and technical resources by increasing the number of desk officers administering the development of energy labelling and Ecodesign measures and by raising the budget available to sustain technical support for preparatory studies, data collection, standardisation development, forecasting, monitoring and evaluation. It may also be possible to address part of the administrative capacity shortfall by farming out some functions to other agencies or partners.

The Commission and Member States should consider adoption of a binding administrative schedule that fully clarifies well in advance all the regulatory design, standardisation and consultative procedures and indicates to stakeholders when they will have an opportunity to engage in or comment on the regulatory development process and when the process will conclude.

An associated regulatory development plan should be developed (and frequently revised) that clearly indicates the regulatory development resource requirements, provisional estimated outcomes in terms of energy savings, environmental impacts and economic effects and the impact on the share of total product energy use subject to energy labelling and Ecodesign measures.

The strength of monitoring and compliance activities needs to be substantially enhanced. Most critically efforts should be intensified to ensure adequate resources are committed to compliance at the Member State level and that synergies are explored that would facilitate greater cooperation among national market surveillance authorities. Given the low level of compliance activity seen to date in the EU it may be appropriate for the Commission to be given a coordination role and for legal obligations on the scale of compliance activity to be established.

Other recommendations are:

The Ecodesign preparatory studies should consider the more systematic application of learning curves to estimate and account for the expected rate of technological and production cost progress associated with higher efficiency design options and the use of this in the techno-economic and least life-cycle cost determinations. Application of a shadow price for carbon emissions should also be considered in the life cycle cost determinations.

The Commission should explore options to strengthen the technical foundations of the preparatory studies by: organising the development and maintenance of product energy and cost simulation tools to be used to examine proposed design changes; conducting product tear -down analyses to establish the bill of materials and associated production costs, establishing longitudinal market and field data collection; farming out the impact assessments to a dedicated consultancy that applies the same approach across all product types; developing a long-term bottom up energy consumption forecasting tool for products in the EU based on stock modelling approach.

Efforts should be taken independently of the preparatory studies to benchmark EU product regulatory energy efficiency settings against those applied in peer economies and clarify reasons for the differences observed

The Commission should ensure that lack of adequate energy performance measurement standards is not a cause of delay in the regulatory schedule. Efforts should be made to work with the standardisation processes in the peer economies to share the developmental burden, enhance international harmonisation and facilitate policy benchmarking and trade.

Stronger efforts should be made to integrate the energy labelling specifications into green public procurement plans potentially including clear targets or obligations across the EU and similarly, to leverage other economic instruments to accelerate the adoption of advanced and innovative technologies.

The EU should consider options to share regulatory development efforts for demanding or green-field (new) product categories with administrations in peer economies.

CONTENTS

Glossary 13

1. Introduction 15
2. Structure 16
3. Programme summaries 16

Australia 16

China 17

The EU 17

Japan 18

The USA 18

4. Legal and administrative basis and requirements 19

Australia 20

China 21

The EU 22

Japan 24

The USA 26

Analysis of Policy objectives 28

Range and nature of products which are treated 28

Mandates and administrative control over the types of policy instruments 29

Mandates and administrative control over test procedures 30

Mandates and administrative control over enforcement 30

Voluntary agreements 31

Monitoring and evaluation 32

Ability to raise programmatic resources 32

5. Scope and policy coverage 33

Australia 33

Current coverage 33

Future plans 35

China 35

Current coverage 35

Future plans 36

The EU 37

Current coverage 37

Future plans 38

Japan 39

Current coverage 39

Future plans 40

USA 41

Current coverage ... 41
Future plans ... 42
Summary – MEPS coverage across the economies ... 42
6. Administration, regulatory processes, capacity and throughput ... 43
Programme administration ... 44
Australia ... 44
China ... 46
EU ... 48
Japan ... 49
USA ... 51
Regulatory development process ... 51
Consultations and stakeholder input ... 54
Programmatic resources ... 55
Budget ... 56
Throughput ... 57
Regulatory development process - findings ... 58
7. Regulatory design methodology ... 60
Regulatory design methodology ... 60
Nature of regulatory minimums ... 60
Nature of energy labels ... 60
Analytical methods used to determine efficiency thresholds ... 61
EU Methodology ... 62
Japanese Methodology ... 66
US Methodology ... 68
Learning curves ... 72
Reach standards ... 73
Summary ... 73
8. Stringency ... 73
Australia ... 74
China ... 74
The EU ... 74
Japan ... 75
The USA ... 78
9. Review and revision ... 78
Japan ... 78
USA ... 78
10. Compliance and rigour ... 79
Australia ... 80
Japan ... 81

China and the USA 82
Summary 82
11. Monitoring and impacts 82
Australia 83
EU 84
USA 85
12. Conclusions and recommendations 86
Recommendations 88
References 90
Contact information 91

Glossary

ACEEE	American Council for an Energy-Efficient Economy (USA)
ANRE	Agency of Natural Resources and Energy (Japan)
AQSIQ	State Administration for Quality, Supervision Inspection and Quarantine (China)
ASAP	Appliance Standards Awareness Project (USA)
BAT	Best Available Technology
BNAT	Best Not Available Technology
CEN	Committee Europeen de Normalisation
CENELEC	Committee Europeen de Normalisation d'Electricité
CLASP	Collaborative Labeling and Appliance Standards Program
CNCA	Certification and Accreditation Administration of China
CNIS	China National Institute of Standardisation
COAG	Council of Australian Governments
Commission	European Commission
CQC	China Quality Certification Centre
DOE	US Department of Energy
E2WG	Energy Efficiency Working Group (Australia)
E3	Equipment Energy Efficiency Program (Australia/New Zealand)
ECCJ	Energy Conservation Center of Japan
ECL	Energy Conservation Law (China and Japan)
EEA	European Economic Area
EEB	European Environmental Bureau
EISA	Energy Independence and Security Act (USA)
EPA	US Environmental Protection Agency
EPAct	Energy Policy Conservation Act (USA)
EU	European Union
FTC	US Federal Trade Commission
FTE	Full time equivalent
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
GW	GigaWatt
HVAC	Heating Ventilation and Air Conditioning
ICT	Information and Communication Technology

IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
LCC	Life cycle cost
LLCC	Least life cycle cost
MCE	Ministerial Council on Energy (Australia)
MEPS	Minimum Energy Performance Standard
METI	Ministry of Economics, Trade and Environment (Japan)
MS	Member State (of the European Union)
NFEE	National Framework for Energy Efficiency (Australia)
NDRC	National Development and Reform Commission (China)
NRDC	Natural Resources Defence Council (USA)
NPV	Net present value
PBP	Pay-back period
SAC	Standardization Administration of China
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
US(A)	United States (of America)

1. Introduction

Equipment energy efficiency policy measures are one of the key elements underpinning international policy measures for energy efficiency. Since the early 1990s equipment energy efficiency standards and labelling programmes have become a mainstay of international energy and industrial policy. The number of countries implementing such schemes has risen to over 70, including all the world's major economies, and this policy instrument is applied in economies comprising over 80% of the world's population and a larger percentage of its GDP.

Over the last 20 years considerable international experience has been gained regarding best practice in the design and implementation of equipment energy efficiency programmes. This experience addresses all aspects of programme design and implementation from:

- Development of mandatory (or voluntary) energy efficiency standards/requirements (also called MEP's, for minimum energy performance)
- Test procedure design and maintenance
- Regulatory compliance
- Communications
- Monitoring and evaluation
- Impact assessment
- Legal basis, administrative processes and program resources

This report presents a summary of this experience and compares the EU's programme to those operated in peer economies to ascertain where the programme is successful and in what ways it could be improved by adopting international best practice. Explicitly, of the many international programmes that could be considered this report focuses on those in operation in Australia, China, Japan, the USA and the EU itself. Within these the primary areas of focus are:

- Administrative processes, capacity and throughput
- Policy coverage
- Stringency
- Compliance and rigour
- Impacts

The intention is to examine the most important areas which determine programme effectiveness and thereby elucidate the key opportunities which exist to strengthen product policy setting in the EU. While sustainable product policy covers many domains including energy in use, material flows, carbon intensity of production and use, chemical and biological risks, safety, industrial policy, consumer rights etc. the principal focus of the current report are the policies and programmes to address energy and CO_2/GHG savings. There is considerable relevant international experience that can be examined to assess the effective implementation of policies designed to reduce the energy and CO_2 footprints of products during the use phase.

2. Structure

The successful implementation of equipment energy efficiency standards and labelling schemes is dependent upon a number of factors which is reflected in the structure of this report. All energy efficiency standards and labelling programmes are designed to accelerate the rate at which energy using (or influencing) product markets migrate to higher energy efficiency levels. **Thus the ultimate measure of their effectiveness is the degree of market transformation**, energy savings and GHG emissions abatement that they produce. The cost-efficiency of these savings is another important factor as is the impact the programmes have upon industrial competitiveness, employment and wealth production and associated co-benefits such as comfort, productivity, technological learning rates and innovation, etc. Experience indicates that many factors concerning how a programme is designed and implemented have an important impact on influencing its overall effectiveness. Accordingly, the details of the various peer programmes are reported on and assessed under each of the following headings:

- Programme summaries
- Legal and administrative basis and requirements
- Scope and policy coverage
- Regulatory processes, capacity and throughput
- Regulatory design methodology - analytical factors used to determine efficiency thresholds, factors considered, consultations and stakeholder input
- Stringency
- Review and revision
- Compliance and rigour
- Monitoring and Impacts
- Conclusions and recommendations

3. Programme summaries

Australia

Energy consumed by appliances and equipment is a major source of greenhouse gas emissions in Australia and improving their energy efficiency is a key objective for Australian government at the federal and state level. Australia has one of the world's more mature equipment energy efficiency standards and labelling schemes with mandatory energy labelling being initiated in the late 1980s and mandatory minimum energy efficiency standards (MEPS) beginning in the 1990s. The labelling programme has its origins in state level programmes managed within Victoria and New South Wales but subsequently evolved into a federally managed nationwide initiative with input and implementation support from state level government. The national body created to administer this effort is known as the Equipment Energy Efficiency Program (E3). The E3 programme is administered by Department of Climate Change and Energy Efficiency, State and Territory Governments and New Zealand's Energy Efficiency Conservation Authority. It reports to the Energy Efficiency Working Group (E2WG) under the National Framework for Energy Efficiency (NFEE), and ultimately to the Ministerial Council on Energy.

Products are considered for inclusion within the program on the basis of whether the community will benefit from their regulation and include consumer appliances, commercial and industrial-sector equipment. The individual product energy efficiency target is either the equivalent of world-best regulatory target or a more stringent level developed specifically for Australia. Evaluations have shown that the programme has proved to be an extremely cost effective mechanism for reducing energy demand and greenhouse gases.

As it has evolved the programme has increased its coverage and rigour and in many ways is an exemplar of how to successfully manage and implement a national equipment energy efficiency standards and labelling effort – especially with respect to test procedure development and maintenance, monitoring, evaluation and enforcement. The programme is anticipated to bring net economic benefits worth over AUS$22 billion from 2009 to 2024 and some AUS$5.2 in 2010 alone and cumulative emissions reductions of around 220 Mt CO_2-equivalent from 2000 to 2020 (E3 2011).

China

China's overall energy policy goal is to reduce the energy intensity of the economy by 40-45 percentage points by 2020 from 2005 levels. As the world's largest manufacturer and market of household appliances, lighting, and other residential and commercial equipment, China has made the development and adoption of clean efficient energy technologies a core part of its 12th Five Year Plan for Economic and Social Development.

Its equipment energy efficiency programme is one of the most comprehensive programmes in the world and one of the most dynamic. China first implemented minimum energy performance standards (MEPS) for energy using equipment in 1989 and now has some 46 standards in place. Mandatory energy labelling was first implemented in 2005 and currently applies to 25 products. In addition a voluntary endorsement labelling scheme is applied to over 40 products. The programme is comparatively well resourced and has an impressive throughput in the design and revision of efficiency standards.

The EU

In December 2008 European Heads of State and governments formally adopted energy sector and climate change policy objectives which call for the following targets to be met by 2020:

- 20% increase in energy efficiency
- 20% reduction in greenhouse gas (GHG) emissions compared to 1990 levels
- 20% share of renewables in overall EU energy consumption
- 10% renewable energy component in transport fuel

The GHG and RE targets are mandatory legally enshrined requirements but the energy saving target is indicative. Despite this it is considered to be the cheapest means of reaching the GHG target. The Commission has estimated meeting it would save the EU some € 100 billion and cut emissions by almost 800 million tonnes a year.

Equipment energy efficiency policy operates within this framework and is considered to be one of its key elements. Individual EU countries were global pioneers in developing equipment energy efficiency requirements in the 1960s and 70s but these lapsed and European regulatory measures for equipment energy efficiency were not reinvigorated until the launch of the European single market in the early 1990s. In 1992 a framework directive for energy labelling was adopted and the first EU-wide mandatory energy labels were implemented from 1995 onwards. Individual MEPS were issued for domestic refrigerators, ballasts and boilers and a number of voluntary agreements were negotiated with industry associations; however, it wasn't until the adoption of the Ecodesign[1] Directive in 2005 that the community had an overarching policy instrument that allowed it to set minimum energy and ecological performance requirements for energy using equipment. The recast of the

[1] DIRECTIVE 2005/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council

Ecodesign[2] and Energy Labelling[3] Directives extended the scope of both Directives to all products having an influence on energy consumption in use. The potential economic, social and environmental benefits of these policies have been assessed in a recent study (Ecofys, 2012) and are estimated to have the potential to provide annual net cost savings worth €90 billion for the EU economy, lead to the creation of 1 million jobs and provide GHG savings of the same order of magnitude of those attributed to the EU Emission Trading Scheme (ETS) i.e. of ~400 Mt / year. In addition EU energy imports could be reduced by 37% for coal and by 23% for gas.

Minimum energy performance requirements have now been adopted for 16 product groups (+ the endorsement of two voluntary agreements) and new labelling regulations for 7 product groups, triggering estimated electricity savings of around 400TWh/year by 2020. Many more measures are under development; however, due to the slow development of an overarching legal framework, the European Community still lags someway behind other peer economies in adopting such measures and runs the risks of setting sub-optimised and insufficiently dynamic requirements. These risks have been highlighted in a report issued by an NGO coalition active in the policy area (Coolproducts 2011) and also in the official evaluation study of the Ecodesign Directive (CSES 2012).

Japan

Japan is recognised as being one of the most energy efficient economies in the world and an international leader in efficient technology and products. Japan has negligible fossil fuel reserves and hence has historically been dependent on imported energy. The impact of this on balance of payments and energy prices, which are among the highest in the world, has given both public and private sector actors a strong and sustained incentive to strengthen energy efficiency. Japan's equipment energy efficiency programme dates back to 1979 but the most meaningful policy actions began in 1998 with the adoption of the *Top Runner* programme for energy using equipment. Since then mandatory energy performance specifications have been adopted for a wide variety of energy using equipment and vehicles. Energy labelling is also applied to many energy using products.

The USA

The USA has the world's oldest continuous equipment energy efficiency standards and labelling programme and in some ways the most comprehensive. MEPS are set by US Department of Energy (DOE) and cover some 55 product groups. Two types of energy labels are used and apply to a wide variety of products. The pace of adoption and ambition of US MEPS have fluctuated over the years but with the advent of the Obama administration equipment energy efficiency has received a much stronger focus and the ambition and throughput of the programme has increased commensurately.

An analysis by the Appliance Standards Awareness Project and ACEEE (ASAP 2012) reports that existing appliance efficiency standards reduced US electricity consumption by about 280 terawatt-hours (TWh) in 2010, that is a 7% reduction. The electricity savings are projected to grow to about 680 TWh in 2025 and 720 TWh in 2035, reducing U.S. electricity consumption by about 14% in each of those years. It goes on to estimate that in 2035 the existing standards will further produce:

[2] Directive 2009/125/EC of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products

[3] Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products

- Annual natural gas savings of about 950 trillion British thermal units (TBtu), or enough to heat 32% of all natural-gas-heated US homes
- Peak demand savings of about 240 GW, saving about 18% of what the total generating capacity projected for 2035 would have been without standards
- Annual emissions reductions of around 470 Mt CO_2, an amount equal to the emissions of 118 coal-fired power plants

The cumulative net economic benefit of these standards to consumers and businesses is estimated to be worth more than US$1.1 trillion. By 2035, the cumulative energy savings are projected to reach more than 200 quads, an amount equal to about two years of total US energy consumption.

4. Legal and administrative basis and requirements

All of the peer economies considered in this assessment have established their standards and labelling programmes on a sound legal basis; however, the paths they have taken in doing so vary significantly and there are important on-going practical implications determined by the manner in which the programmes are legally constituted.

In the case of China and Japan national energy conservation laws provide the legal underpinning to the programmes. These laws empower centralised government officials (from NDRC and METI respectively) to administer the standards and labelling programmes and provide them all the authority they need to both design and implement the programmes.

In the case of Australia, the EU and the USA the authority to develop and implement product standards and labelling programmes has evolved through a complex pathway involving central and regional authorities. In Australia individual states and territories agreed to work with federal authorities to create a centrally managed national scheme from one which had its origins in state level programmes (noting that under the Australian constitution the states have authority over energy and resource management policy making).

In the USA federal acts such as the National Appliance Energy Conservation Act of 1987, the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007, have given authority to the Federal agencies of the Department of Energy, the Environmental Protection Agency and the Federal Trade Commission to design and manage various elements of a national equipment energy efficiency standards and labelling programme and these measures take precedence over any equivalent state level measures; however, individual states have the right to introduce their own requirements whenever the Federal agencies have issued no rulings of their own. In the past this has led to legal challenges over programme authority and the pace of implementation.

The manner in which these laws and regulations are passed has important implications for the following elements which influence the effectiveness of product standards and labelling schemes:

- The overarching policy objectives
- The range and nature of the products which can be treated
- Mandates and administrative control over the types of policy instruments which can be deployed e.g. mandatory labels, voluntary labels, MEPS, other types of regulations and voluntary agreements.
- Mandates and administrative control over energy performance test procedure design and maintenance
- Mandates and administrative control over enforcement
- Monitoring and evaluation
- Ability to raise programmatic resources

These are discussed below following the country summaries or in subsequent sections.

Australia

The Equipment Energy Efficiency Program (E3 program) has its origins in the National Appliance and Equipment Energy Efficiency Program (NAEEEP) which began in 1992 with an agreement to implement a mandatory energy label for a few domestic appliances on a national basis (Figure 4.1). Prior to that, the energy label had been used exclusively in the states of New South Wales and Victoria. The E3 Program is now one of the principal delivery mechanisms of Australia's National Framework for Energy Efficiency (NFEE) and National Strategy on Energy Efficiency (NSSEE) and the New Zealand Energy Efficiency and Conservation Strategy (NZEECS).

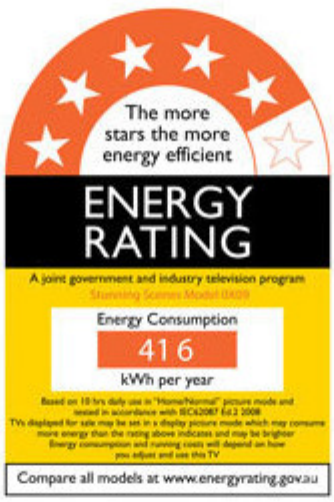
The Program is co-funded by the Australian Government, State and Territory governments and the New Zealand Government and embraces a range of measures aimed at improving the energy efficiency of equipment and appliances used in the residential, commercial and manufacturing sectors in Australia and New Zealand. Its core objectives are to deliver cost-effective greenhouse gas abatement by addressing market failures and to lower the cost to consumers of operating energy using appliances and equipment.

A range of policy mechanisms are used by the Program to maximise the energy saving outcomes including the following:

- Mandatory minimum energy performance standards (MEPS)
- Mandatory energy labels
- Voluntary measures – which include high-energy performance standards, voluntary use of the Energy Rating Label and endorsement labelling such as the voluntary Energy Star label.
- Training and support to promote use of the most energy efficient products.

The MEPS and energy labelling requirements for each product are set out in national standards documents which include test procedure specifications and regulatory requirements.

Figure 4.1 The Australian Energy label



China

As an important technical support for achieving energy conservation and emission reduction goals, energy conservation standardisation has provided a strong guarantee for meeting the target of reducing energy consumption per unit of GDP by 20% during China's 11th Five-Year Plan period (2006-11), and successfully fulfilling the binding targets to reduce energy consumption per unit of GDP by 16% and carbon dioxide emissions by 17% during the 12th Five-Year Plan period (2011-2015).

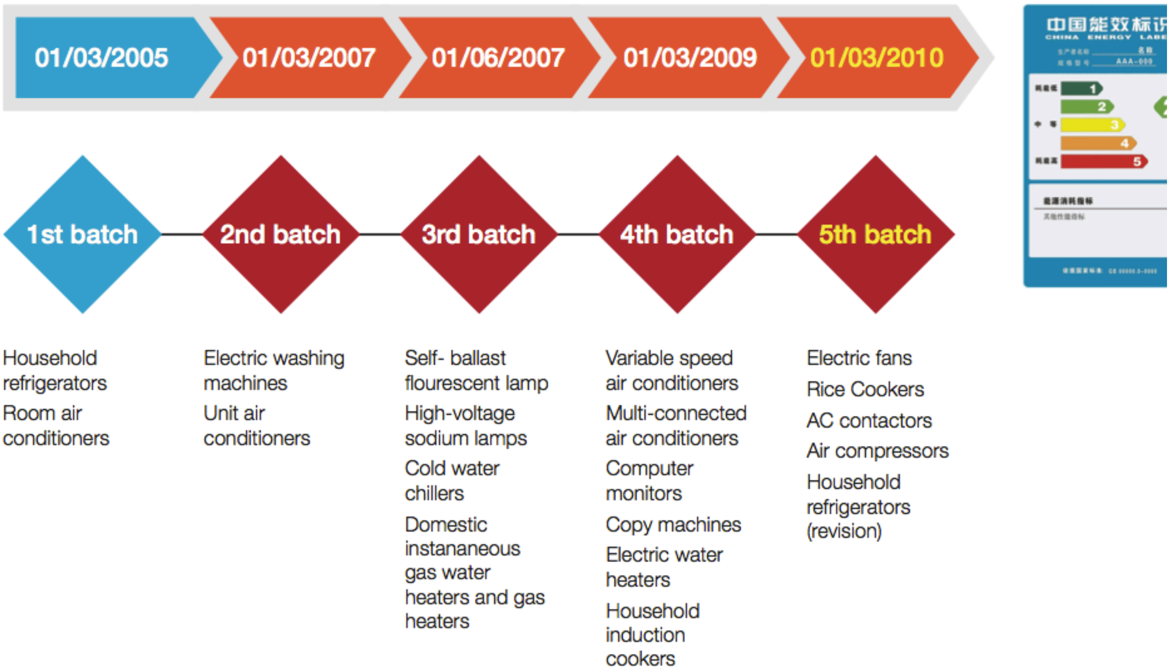
The legal framework for China's equipment energy efficiency programme is the national Energy Conservation Law (ECL), which was first established in 1997 and has been revised several times since.

The main policy instruments used to improve the energy efficiency of equipment are:

- MEPS
- Mandatory energy labelling
- Mandatory energy efficiency grades
- Voluntary endorsement labelling
- Public procurement rules for efficient equipment
- Subsidies
- Industrial policy
- Benchmarking

MEPS in China were first introduced for 8 product groups in 1989 but were set in a rather simplified manner that didn't apply proper efficiency metrics and were easy to satisfy. Since the 1997 ECL was adopted and international technical expertise was made available a much more rigorous approach has been taken to the setting of MEPS and the number and ambition of MEPS has increased significantly. The approach adopted is for the MEPS thresholds to work in tandem with mandatory energy labelling or efficiency grades, the details of which are specified in the same regulations as the MEPS. As happens in the EU, China applies efficiency thresholds in its labelling requirements and hence the mandatory label is a “categorical” design. The labels have either five, or three efficiency classes depending on the product group; with class 1 being the highest efficiency level and the class with the highest number (3 or 5) corresponding to the lowest efficiency level permitted for sale on the Chinese market.

Figure 4.2 Development of mandatory energy labelling in China



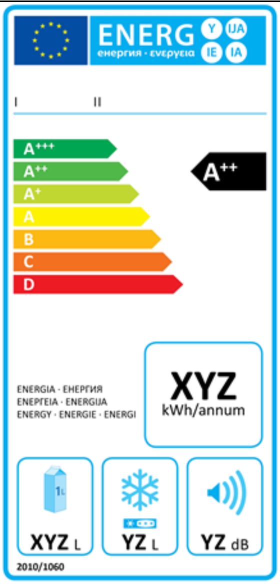
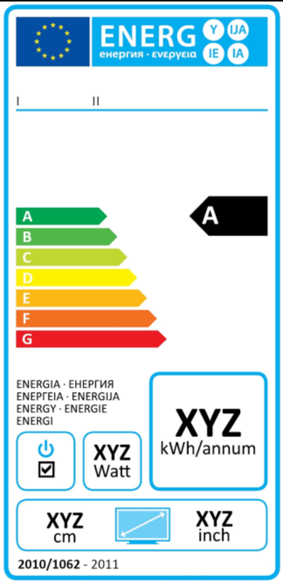
China's *Procurement Policy for Energy Efficient Products* scheme requires Chinese government agencies at all levels to give priority to energy-efficient certified products in their procurement processes. For products to be considered eligible under this programme they must be awarded the CQC's endorsement label. This is arguably the most comprehensive energy-efficient equipment public procurement programme in existence as it applies to over 40 types of energy using products.

The EU

In the EU and its predecessor the EC, a long (17 year) debate regarding the merits of implementing a community-wide energy labelling scheme was eventually resolved following the creation of the European single market and led to the adoption of the initial energy labelling framework legislation in 1992. This was subsequently complemented by individual laws to implement MEPS for refrigerators and freezers, boilers and fluorescent ballasts; however, the passage of laws for individual product type was administratively burdensome and impractical. It wasn't until the passage of the 2005 Directive on Eco-design for energy-using products that framework legislation was adopted which empowered the European Commission to issue regulations or to accept voluntary measures for all energy using products, excluding those in the transportation sector. In 2009 & 10 the Ecodesign and Energy Labelling Directives were recast to permit the scope of products to be extended from energy using products to also included energy-related products such as insulation, windows, taps and shower heads, etc.

Under the Ecodesign Directive, binding requirements may be set through implementing measures which are either specific to each product group or horizontal (applying to a wide sector). The Ecodesign Directive sets out conditions and criteria for the adoption of these implementing measures. These criteria include: a significant environmental impact e.g. through their energy consumption; a high volume of sales and trade within the EU internal market and a clear potential for improvement without entailing excessive costs. Triennial working plans list the product groups to be subject to preparatory studies and potential regulatory measures. Industry may suggest a self-regulatory initiative in place of a mandatory regulation, in which case the Directive specifies the criteria that have to be fulfilled for such a voluntary agreement to be endorsed. Thus far 16 Ecodesign implementing measures (+ the endorsement of two voluntary agreements) have been issued. All of these are in the form of mandatory regulations including in particular minimum energy performance requirements and other types of generic and information requirements.

Figure 4.3 EU Energy labels

	
New refrigerator label	TV energy label

The EU energy label (Figure 4.3) is designed to inform consumers about the energy consumption and efficiency of the products they buy and currently applies to 10 domestic product groups and tyres. The original format determined efficiency on an A to G ranking scale and was applied exclusively to household energy using products. Revised labels have now been issued for seven product groups which introduce new higher efficiency classes by adding up to three + (plusses) to the A class. Ecodesign and Energy Labelling implementing measures are now prepared simultaneously and both contain definitions of metrics underpinning the minimum requirements and labelling classes. These in turn rely on measurements made according to agreed test standards. The European Commission mandates the European Standardisation Organisations CEN and CENELEC to elaborate harmonised test standards for each product group. The Commission may subsequently decide to publish, to publish with restrictions or not to publish the references to the harmonised standards concerned in the Official Journal of the European Union.

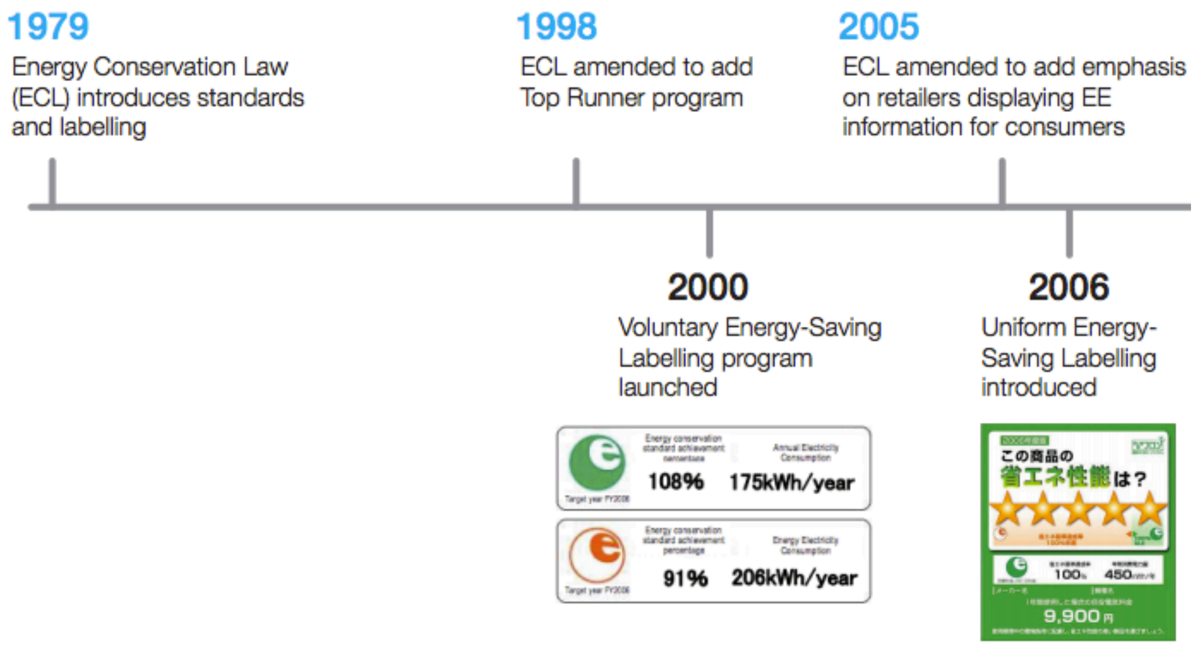
In addition to this the EU and USA have an agreement to jointly operate the Energy Star label for consumer electronics and ICT equipment. Given the global nature of product markets for these equipment types and rapid rates of technological development an internationally harmonised endorsement labelling scheme was considered to be beneficial by both administrations.

Aside from measures which are conceived at the overall European level EU MS have plenty of scope to implement complementary measures that may build upon the wider EU labelling and Ecodesign efforts. These can take the form of rebates, feebates, green public procurement schemes, utility administered incentive schemes, awareness raising and promotional campaigns and voluntary retailer initiatives.

Japan

The 1947 Energy Conservation Law (ECL) provides the legislative basis for Japan's energy efficiency policy. Much of this and its subsequent amendments have concerned energy management measures in industry and commercial buildings; however, in 1979 provisions were added addressing "Energy management guidance for buildings and appliances" which were aimed at encouraging industry to produce more efficient appliances. The 1998 amendment established the "Top Runner Program" for automobiles and household electrical appliances, discussed in the next section.

Figure 4.4 Timeline of Japanese Standards and Labelling Policy and Programmes



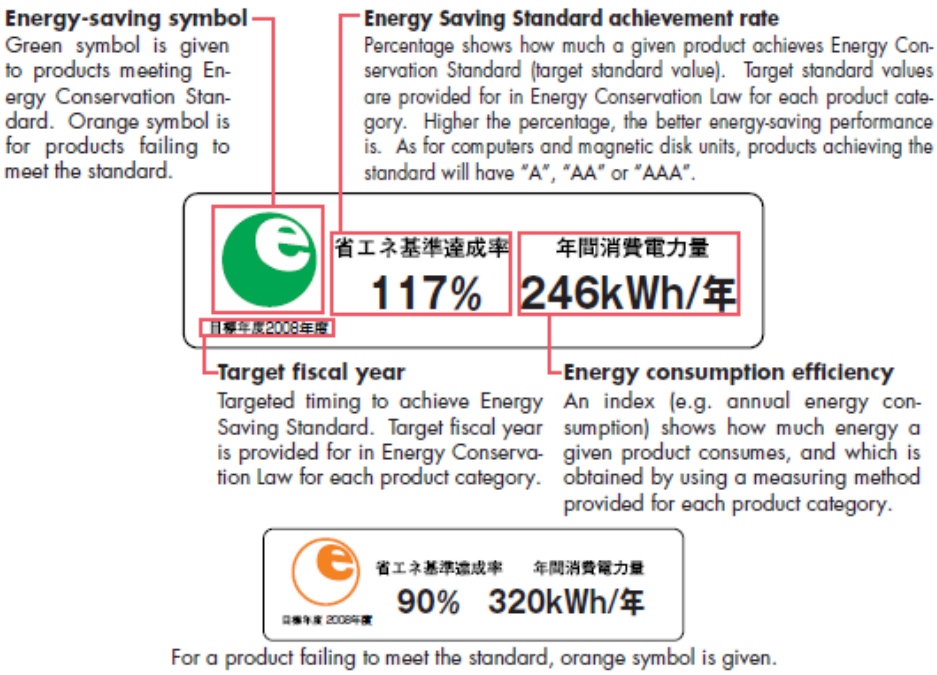
In 2012 the ECL was amended again to introduce provisions concerning demand-side management at peak demand hours and to extend the scope of the Top Runner programme to include energy related products such as building materials. This last amendment is a response to the crisis caused by the great earthquake and the resulting shut down of the countries entire nuclear power generating capacity (over 20% of all generating capacity), which has continued ever since and is set to continue. In consequence Japan is confronted by severe power shortages. This has led the government to amend the ECL to include a "request of electricity savings for consumers by various tools" which provides a stronger legal basis to insist on demand management measures in the future. The power demand savings measures include requirements for medium and large power users to prepare power saving (load shedding) plans, the authority to order large power users to shed loads in peak periods, educational programmes and media awareness building campaigns. At the same time the power shortages have increased even further the interest in energy efficiency and there are indications that energy efficient product policy is also being given a stronger focus.

Strictly speaking Japan does not operate MEPS in the way the other economies do but rather it imposes mandatory minimum fleet-average efficiency requirements that producers or importers have to satisfy for regulated products under an initiative called the Top Runner programme. Thus, instead of each product having to meet a minimum energy-efficiency threshold, the sales-weighted sum of all the products that a producer sells have to meet the specified Top Runner minimum energy efficiency threshold (ANRE 2010).

Japan also operates a rather novel form of mandatory energy label known as the *Energy Saving Label*, Figure 4.5. Under this labelling scheme products which have met the Top Runner efficiency threshold have a green E logo while those that are below the efficiency threshold have a red E logo. The label also indicates the energy efficiency threshold such that 100% is the Top Runner threshold, above 100% is more efficient and below 100% is less efficient than the Top Runner threshold. Typical annual energy consumption is also indicated.

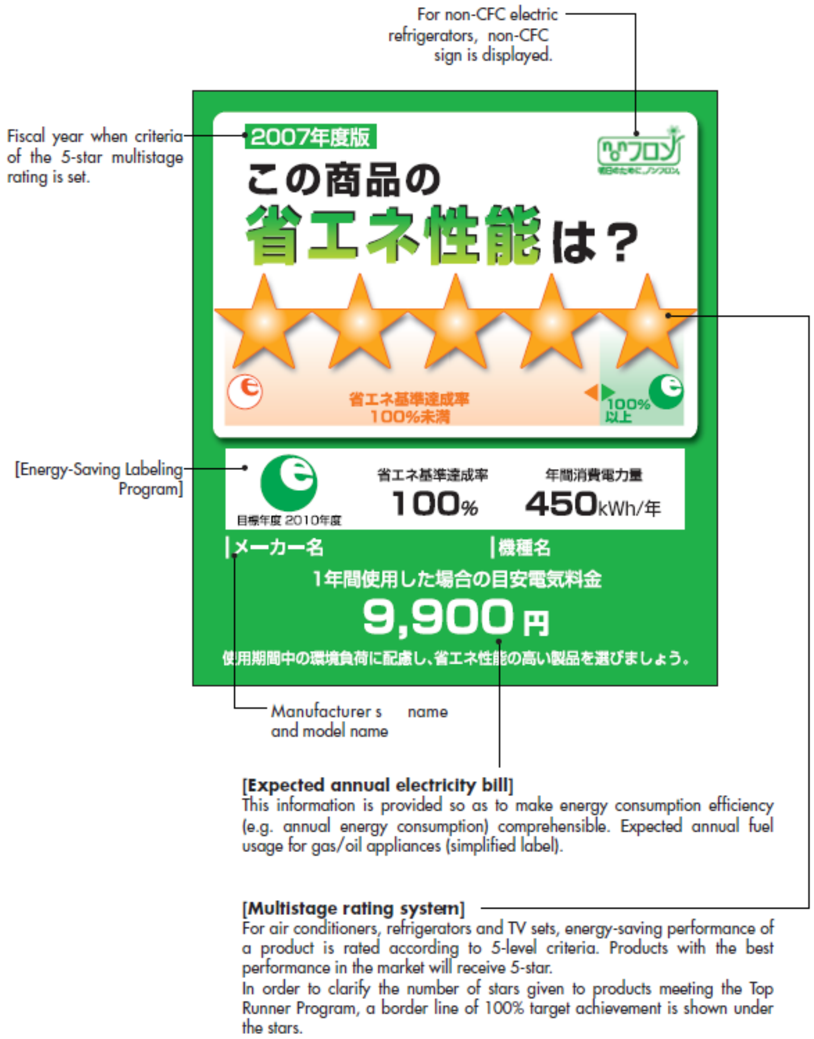
The label requirements state that the labels may be displayed on the packaging, the product itself, the price tags as well as the catalogues.

Figure 4.5 Japan's "Energy Saving Label"



In 2006 the Energy Savings labelling programme was complemented by a new mandatory categorical information label for selected product types, known as the "Uniform Energy-Saving Label". This ranks efficiency from 1 to 5 stars (where 1 star is the lowest, given to products that don't meet the Top Runner fleet average efficiency threshold and 5 stars is the highest. It also indicates the average expected electricity bill amongst other information, Figure 4.6.

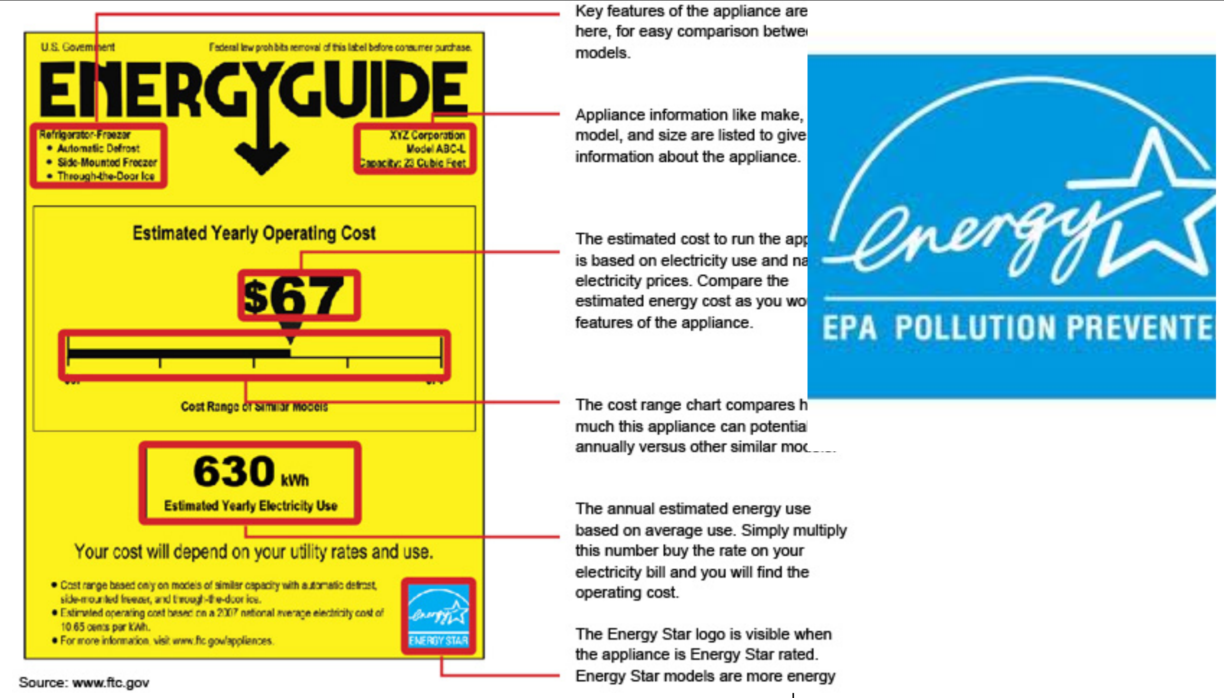
Figure 4.6 Japan's "Uniform Energy-Saving Label"



The USA

The US product energy efficiency programme is built upon a mixture of mandatory minimum efficiency standards (MEPS), mandatory energy labelling (EnergyGuide) and voluntary endorsement energy labelling (Energy Star) (Figure 4.7). Of these, the MEPS programme has had by far the largest impact, followed by Energy Star. The minimum energy efficiency standards program dates back to the 1975 Energy Policy and Conservation Act (EPCA) which established energy performance test procedures for a variety of equipment types and specified energy conservation targets that the equipment should meet. In the event that the targets were not satisfied it set out a process by which mandatory efficiency standards would be set. The same act empowered the Federal Trade Commission to issue requirements for mandatory energy consumption labelling rules for specified products, which led to the creation of the mandatory EnergyGuide information label. The EPCA also gave authority for federal regulations on equipment energy efficiency to supersede state regulations.

Figure 4.7 US Energy labels



Mandatory EnerGuide label	Voluntary Energy Star label

The 1978 National Energy Policy Conservation Act (NEPCA) directed the Secretary of Energy to establish mandatory MEPS for certain equipment types. These were to be set at levels that result in the maximum improvement in energy efficiency which is technologically feasible and economically justified for specified appliances and industrial equipment. This was followed by the 1987 National Appliance Energy Conservation Act (NAECA), which set out specific standards for certain product types and deadlines for the Department of Energy to issue the standards. In 1992 the Energy Star voluntary labelling programme was launched as a joint program of the US Environmental Protection Agency (EPA) and US Department of Energy (DOE), with an initial focus on information and communication technology equipment. The scope of Energy Star has since been extended to cover almost all equipment types. In the same year the 1992 Energy Policy Act increased the variety of products covered by MEPS to include certain additional commercial and industrial equipment types. The 2005 Energy Policy Act further extended the scope to include an extra 15 product standards and the adoption of 11 new test procedures.

In 2005, a coalition of 14 States and environmental NGOs successfully sued the DOE for failing to comply with deadlines and other requirements specified in the EPCA. Following the legal ruling the DOE entered into a consent decree under which they agreed to publish final rules regarding 22 product categories by specific deadlines, the latest of which was June 30, 2011. The consent decree included target dates for the rulemaking processes and deadlines for the issuance of final rules for each product category. The 2007 Energy Independence and Security Act (EISA) added 18 new MEPS, including those for 10 new product types and eight revisions of existing MEPS, and included provisions for 16 new or revised test procedures. It also mandated regular rulemaking reviews to occur every six years for MEPS and every seven years for test procedures. At the time the Obama administration came into office the DOE remained subject to outstanding deadlines with respect to 15 of the 22 product categories covered by the consent decree, as well as statutory deadlines for a number of additional product categories. The new administration therefore prioritised the equipment energy efficiency programme and greatly increased the resources available to

DOE to develop MEPS. This focus has continued to drive the programme as the DOE works to complete all the mandated rulemakings and bring the programme back into compliance with the legislative requirements.

Table 4.1 Congressional Acts mandating the US Energy Conservation Standards programme

Congressional Legislation	References
Energy Policy and Conservation Act (EPCA) of 1975	Public Law 94-163
National Energy Conservation Policy Act of 1978	Public Law 95-619
National Appliance Energy Conservation Act of 1987	Public Law 100-12
National Appliance Energy Conservation Amendments of 1988	Public Law 100-357
Energy Policy Act of 1992	Public Law 102-486
Energy Policy Act of 2005	Public Law 109-58
Energy Independence and Security Act of 2007	Public Law 110-140

Analysis of Policy objectives

While there is a broad similarity there are some important differences of emphasis in the overall objectives of the peer economy product policies. The EU's programme is the only one which clearly states its principal purpose is to reduce the environmental impact of energy related products. China's product policy is intended to support the national energy intensity target, which is a 20% reduction from 2015 to 2020. In the case of the USA the principal rationale of the NAECA and EPAct legislation is to improve economic efficiency and provide value for money to end-users. More recent legislation has established a shadow value for GHG emissions abatement and this is now included in the economic viability determinations. The 2007 EISA also places emphasis on energy security benefits. In the Japanese and Australian legislation the emphasis is divided between economic efficiency and environmental objectives.

The principle impact of these variations in emphasis is expressed through differences in scope, the manner in which requirements are specified, the justification of adopted levels and the approaches taken to stringency in product rulemakings.

Range and nature of products which are treated

As the programmes have matured there has been a tendency for their scope to increase and become more comprehensive. The EU's energy labelling legislation was amended in 2010 to include energy-related products (such as insulation and windows) and products used in all end-use sectors except transport, whereas the original mandate just concerned energy-using products. The 2005 Ecodesign Directive was similarly modified in 2009 to address energy-related products except those in the transportation sector[4]. The Directive included an initial list of a dozen priority products to regulate first. The following lists of product candidates are specified in triennial working plans. The 2009-2011 plan included 10 large product categories, into which specific product groups were mentioned. The 2012-2014 plan (now adopted) should focus on clearing the backlog of delayed measures and introducing a few new energy-related products such as windows. However, the priority for the European Commission in the coming years is to finalise and adopt about 20 measures that are pending and revise 11 of those that have already been adopted. The Ecodesign Directive is distinct from the equivalent measures in place in the peer economies in that it potentially addresses

[4] EU transportation policy is administered by DG MOVE (Mobility and Transport) which has developed different policy instruments to address vehicle GHG emission efficiency, for example.

all environmental aspects of products across the various life-cycle stages and not just the energy in use.

Japan's Energy Conservation Law has recently been revised to permit METI to issue energy labelling and Top Runner (efficiency regulatory) requirements for both energy using and energy-related products. This mandate extends to all energy using equipment including road vehicles.

China's Energy Conservation Law essentially focuses on energy using equipment as does the Australian and US legislation. Successive amendments to the Australian legislation have broadened the scope to enable regulatory measures to be set for residential, commercial and industrial equipment but not for transport or energy-related products. The scope of US regulations is similar, however different acts apply to different groups of equipment and prescribed lists of equipment types to be treated are mentioned in much of the primary legislation. As with China and the EU, vehicle fuel economy (or emissions efficiency in the case of the EU) requirements are set through separate mandates in the USA to those set for other energy using equipment types. The degree of prescription in the regulations can have important impacts on the potential for the implementing measures to achieve energy and GHG emissions savings and the adherence to general principles is an important strength of the EU's product policy in particular. Programme managers in Australia, China, and Japan also have considerable freedom in how they categorise products and thus in how they set policy measures. US administrators have tended to be more constrained as the primary legislation often limits regulatory mandates to the specification of measures for specific and narrowly defined product types, thus US regulators are often unable to set requirements that cut across broad service offerings e.g. household lamps or standby power use, but rather have to set requirements for each individual product type that provides these services.

Mandates and administrative control over the types of policy instruments

In most of the peer economies the responsibility for administering the minimum energy efficiency regulations, mandatory energy labelling and voluntary energy labelling is all held by a single administrative agency. In Australia it is the Department of Climate Change and Energy Efficiency, in China it is NDRC, in Japan it is METI. In the EU, DG Energy is responsible for developing and administering the mandatory energy labelling scheme and the voluntary Energy Star labelling scheme; whereas administration of the Ecodesign Directive is shared jointly by DG Energy and DG Enterprise with a consultative role for DG Environment. This division of responsibilities carries the risk of differences in implementation approaches by product category, depending on which Directorate within the Commission is charged with the principal administrative responsibility. Nonetheless the inclusion of Energy Labelling and part of the Ecodesign Directive roles within the same Directorate does at least increase the probability that the two instruments will be set and revised in a complementary manner and thereby raises the combined market transformational effect. The same is not necessarily the case in the USA as the mandatory energy labelling programme (Energy Guide) is administered by the Federal Trade Commission, MEPS are administered by the Department of Energy and the Energy Star programme is administered jointly by the DOE and the Environmental Protection Agency. This division of labour and responsibility inherently makes it harder to effectively coordinate the three policy instruments to produce a complementary market transformation effect although some measure of coordination does occur.

Mandates and administrative control over test procedures

Test procedures are a critical issue for any product energy efficiency programme as they determine how energy performance is measured and defined as well as the tolerances which are to be permitted when testing for compliance.

In the USA the DOE has a full mandate to set the test procedures used in all its MEPS rulemakings, whereas test procedures used for Energy Star labelling are jointly administered by the DOE and EPA. In Australia the E3 programme managers have a large degree of influence over the test procedures used in the energy labelling and MEPS programmes via the consultants that they hire to represent their interests in the test procedure development process and via direct liaison with Standards Australia (the body directly responsible for establishing test procedures used in Australia). A similar situation exists in Japan where METI have a close working relationship with the national standardisation body JIS and in China where agencies designated by NDRC have direct input into the national test procedure standardisation process.

In Europe, the Commission is in the process of establishing a similar approach to test procedures. When the Ecodesign Directive was adopted in 2005, the original intention (in the spirit of the EU 'New approach' agenda to simplify legislation) was to fully delegate the development of technical measurement procedures to industry-led standardisation bodies CEN and CENELEC and let them achieve the work independently. These were supposed to work as much as possible on the basis of international ISO/IEC standards. However, this first approach has triggered some difficulties (delays or inconsistent work schedules, insufficiently clear instructions, overlaps between some provisions in regulations and standards, lack of alignment in scopes and methodologies, etc.). Some steps have recently been taken to improve the situation: earlier association of those involved in standardisation in the regulatory process, the development of a horizontal standardisation mandate that clarifies the overall needs for measurement methods to support Ecodesign and Energy Labelling measures, a detailed technical annex to this mandate that can be updated frequently, and the participation of experts appointed by the European Commission to the standard development process. CEN and CENELEC have also established an Ecodesign coordination group to better streamline their responses to policy needs. CEN and CENELEC may receive funding from the EU to carry out this work. Once a measurement procedure is completed, the Commission evaluates it and has the option to publish it, or not, as the harmonised standard reference that manufacturers are invited to use to benefit from a presumption of conformity. A more constant dialogue between the Commission and standardisation organisations is planned in order to anticipate and solve potential cases of rejection that could hamper the implementation of regulations.

It is critical that regulatory authorities should be able to exercise large and clear control over the test procedures developed and used in their energy efficiency regulations if the integrity of those regulations is to be maintained. The other concern is that a lack of control over the test procedure development and maintenance process and schedule can lead to significant delays in the development and issuance of regulations which may lead to lost savings and an effective weakening of intent.

Mandates and administrative control over enforcement

In most of the peer economies the agency which sets the regulatory requirements is also responsible for their enforcement. This is the case in China, Japan and the USA. In Australia and Europe enforcement is the responsibility of the individual states or EU Member States and thus the potential for inconsistent implementation of enforcement measures is increased. In practice a large part of Australian enforcement practice has been voluntarily delegated by the states to the federal administration, which manages a national product registration database, conducts compliance surveys, and arranges product energy performance check testing.

In the EU/EEA there is much less coordination on this issue and compliance activity varies greatly from one jurisdiction to another. In consequence Europe arguably has the least coherent compliance regime among all the major international energy efficiency standards and labelling schemes. This has been documented in detail in several studies e.g. CSES 2012. The EU is currently trying to improve the situation, through the reinforcement of an Administrative Coordination group consisting of national market surveillance authority representatives and several pan-European projects funded by the Intelligent Energy Europe Program, such as the ECOPLIANT project (http://eaci-projects.eu/iee/page/Page.jsp?op=project_detail&prid=2497)

Voluntary agreements

Among the peer economies the EU is really the only one that has shown any significant enthusiasm for the notion of voluntary agreements. Prior to the adoption of the Ecodesign Directive a number of voluntary agreements were established for household appliances but this was partly motivated by the difficulty in passing primary legislation for each new product efficiency requirement. The Ecodesign Directive keeps the door open to future voluntary agreements according to the following clauses:

(18) Priority should be given to alternative courses of action such as self-regulation by the industry where such action is likely to deliver the policy objectives faster or in a less costly manner than mandatory requirements. Legislative measures may be needed where market forces fail to evolve in the right direction or at an acceptable speed.

(19) Self-regulation, including voluntary agreements offered as unilateral commitments by industry, can enable quick progress due to rapid and cost-effective implementation, and allows for flexible and appropriate adaptations to technological options and market sensitivities.

(20) For the assessment of voluntary agreements or other self-regulation measures presented as alternatives to implementing measures, information on at least the following issues should be available: openness of participation, added value, representativeness, quantified and staged objectives, involvement of civil society, monitoring and reporting, cost-effectiveness of administering a self-regulatory initiative and sustainability.

(21) The Commission's Communication of 17 February 2002, entitled 'Environmental Agreements at Community level within the Framework of the Action Plan on the Simplification and Improvement of the Regulatory Environment', could provide useful guidance when assessing self-regulation by industry in the context of this Directive.

In practice, the EU will probably favour voluntary initiatives in areas where regulation may be difficult to pass, for instance when some important market players cannot be covered by regulatory requirements e.g. service providers in the case of complex set top boxes, in cases of complicated modular products (such as machine tools) and in peculiar market situations e.g. game consoles with only a small number of manufacturers and a very limited number of products on the market.

In practice other economies have eschewed voluntary agreements because of the difficulty of finding a group of industrial partners to negotiate with that account for a large enough proportion of the products sold on the market, the problems of monitoring compliance with the agreement, the protracted and time consuming nature of such negotiations and the lack of legal recourse in the event on a breach of the agreements terms. Many industry associations acknowledge these difficulties and many prefer the clarity of a legally binding standard that is sure to apply to all producers in a common way over the potentially lopsided nature of a voluntary agreement.

Monitoring and evaluation

Responsibility for monitoring and evaluation of the MEPS and labelling programmes is also usually conducted by the same agency that administers the programme albeit sometimes a third agency will be tasked with verifying the associated impact assessments. In Australia the Department of Climate Change and Energy Efficiency has the responsibility to monitor and evaluate the standards and labelling programmes and to produce regulatory impact assessments. These are then verified through an inter-ministry scrutiny process. In China and Japan, NDRC and METI respectively are charged with monitoring and evaluating their product energy efficiency programmes. In the USA the DOE evaluates programme impacts and periodically reports them to Congress. These impact assessments are verified by the Office of Management and Budget. In Europe responsibility for monitoring and evaluation falls on the Commission for the community as a whole, but individual Member States also sometimes monitor impacts and produce regulatory impact assessments within their national jurisdictions. The degree of statutory obligation that applies to the conduct of these evaluations and associated monitoring activities varies significantly across the international programmes.

Ability to raise programmatic resources

Most legislation has nothing to say about the level of programmatic resources that an administration must commit to develop and administer the product energy efficiency regulations; however, in practice the legislation does influence programmatic resources if it creates a legally binding obligation on an administration to develop and issue standards in a prescribed way. The nature of these prescriptions often varies and may include obligations:

- to issue standards or labels for certain product groups within a certain period
- to set a certain number of requirements within a given time frame
- to review and revise requirements in a certain period
- to set regulations according to a certain methodology which may entail conducting certain specified analyses and determining requirements according to a prescribed set of principles

If these obligations are legally binding and imply a certain minimum level of resources to be implemented the agency responsible for their implementation is usually able to secure the necessary resources. If the obligations imply certain scale of programmatic funding to comply with, their legal enshrinement will usually facilitate internal government negotiations over funding.

Occasionally, the legislation itself specifies a budgetary allocation as occurred for the US EPCA of 2005.

Among the peer economies the US legislation seems to place the greatest onus on resource allocations because implementation of the legislative requirements is a legally binding requirement and failure to meet them can lead to law suits against the Federal government. The desire to avoid this outcome gives extra impetus to resource allocations. In addition the legislation is relatively specific about both the nature of the evidence base required to set efficiency standards and the timing of their development and implementation; thus the DOE would put itself at legal risk were it to fail to satisfy any of the legislative provisions.

5. Scope and policy coverage

Australia

Current coverage

The coverage of the E3 programme has expanded since its initiation and now extends into all energy using sectors except transport.

Some 21 product groups are subject to MEPS in Australia, 7 product groups to mandatory energy labelling, 2 to voluntary energy labelling and 1 to a mandatory performance mark (Table 5.1).

Table 5.1 Products regulated under the Australian equipment energy efficiency (E3) programme (as of October 2011, (E3 2011b))

		MEASURE Year implemented/revised		
PRODUCT	**SECTOR**	**MEPS**	**LABELLING**	**HEPS**
Air Conditioners				
Chiller towers	C	2009		
Close Control Units (CCUs)	C	2009		
Single-phase air conditioners	R,C	2004, 2006, 2010, (2011)	ML: 1992, 2000, 2010	
Three-phase air conditioners	C	2001, 2010 (2011)	VL: 2001, 2010	
Commercial and industrial				
Refrigerator Display Cabinets	C	2004		
Distribution Transformers	I	2004		2004
Electric Motors (Three-phase)	C,I	2001, 2006		2001, 2006
Residential Recreation				
Swimming pool pumps	R	2010 (voluntary)	VL:2010	
Water Heating				
Electric Water Heaters	R,C	1999, 2005		
Gas Water Heaters	R	2011		
Home Entertainment and ICT				
External Power Supplies	R,C	2008	PM: 2009	
Complex and Simple Set Top Box	R,C	2009		
Complex Set Top Box CoC R	R	2009 (voluntary)		
Televisions	R	2009 (2012)	ML: 2009 (2012)	
Lighting				
Linear fluorescent ballasts	C,I	2003		
Linear fluorescent lamps	C,I	2004		
Self-ballasted CFLs	R,C	2009		
Incandescent lamps	R,C	2009		
Convertors for ELV Lamps	R,C	2010		
White goods				
Clothes dryers	R		ML: 1992, 2000	
Clothes washers	R		ML: 1992, 2000	
Dishwashers	R		ML: 1992, 2000	
Refrigerators	R	1999, 2005,2010	ML: 1992, 2000, 2010	
Freezers		1999, 2005, 2010	ML: 1992, 2000, 2010	

Measures MEPS – minimum energy performance standards; ML- Mandatory Labelling; PM – Performance Marking; VL- Voluntary Labelling, HEPS – high efficiency performance standards[1] R = residential, C = Commercial, I = Industrial

*Labelling. Some states had mandatory energy regulations prior to 1992 for a range of products. For example, refrigerators were first labelled in late 1986 in NSW and VIC. Algorithm changes occurred in 2000 for all products. Algorithm changes for refrigerators, freezers and air conditioners occurred in 2010.

Codes AS/NZS Australian/New Zealand standard;

NZHB-New Zealand handbook (a regulatory standard prepared by the NZ Government and published by standards NZ) labelling.

In common with other national standards and labelling programmes the Australian programme has greatest policy coverage for electricity consumption in the residential sector, for which about 55% of all electrical energy is used in end-uses which are subject to MEPS. Logically the end-uses which are covered are predominantly those with the largest technical savings potentials so the share of policy coverage of the total savings potential is likely to be somewhat higher.

About a third of residential gas use is consumed in water heaters which are subject to MEPS but the remaining gas consumption is used in unregulated appliances and thus overall about 39% of all residential energy use is subject to MEPS.

In the other sectors the shares of total energy use subject to MEPS is less certain but is probably about 50% of industrial electricity consumption (through electric motor MEPS) and between 50 to 65% of commercial electricity consumptions through MEPS applied to lighting, air conditioning, motors, refrigeration, ICT and water heating[5]. Overall about 53% of all Australian electricity consumption is thought to be subject to MEPS.

Future plans

The E3 programme is currently believed to be working on MEPS for a variety of products but details are not publically disclosed until the regulatory determination is made.

China

In principle China's MEPS and labelling programme applies to all types of energy using products be they in the residential, commercial or industrial sectors. They are not applied to vehicles nor yet to energy-related products although there is no reason why these could not also be treated in principle. NDRC is also interested in water conservation and it is possible that in the future measures will be set to limit product water use too.

Current coverage

China's MEPS programme is one of the most comprehensive currently in place. Thus far China has implemented MEPS for 46 products, mandatory energy labels for 25 products and established voluntary energy endorsement labelling criteria for over 40 products.

MEPS are in place for: refrigerators, freezers, room air conditioners clothes washers, irons, rice cookers, TVS, electric motors (both small and medium sized types), CFLs, fluorescent lamps, air compressors, air conditioning ventilation fans, high pressure sodium lamps and ballasts, metal halide lamps and ballasts, chillers, small fans, pumps, commercial packaged air conditioners, external power supplies, instantaneous gas water heaters, electric storage water heaters, variable speed and multi-connected air conditioners and heat pumps, induction cook tops, computer monitors, copiers, printers, computers, servers, heat pump water heaters, range hoods, set-top boxes, fax machines amongst other end-uses. China has also announced that it will phase out incandescent lamps from 2014 to 2016.

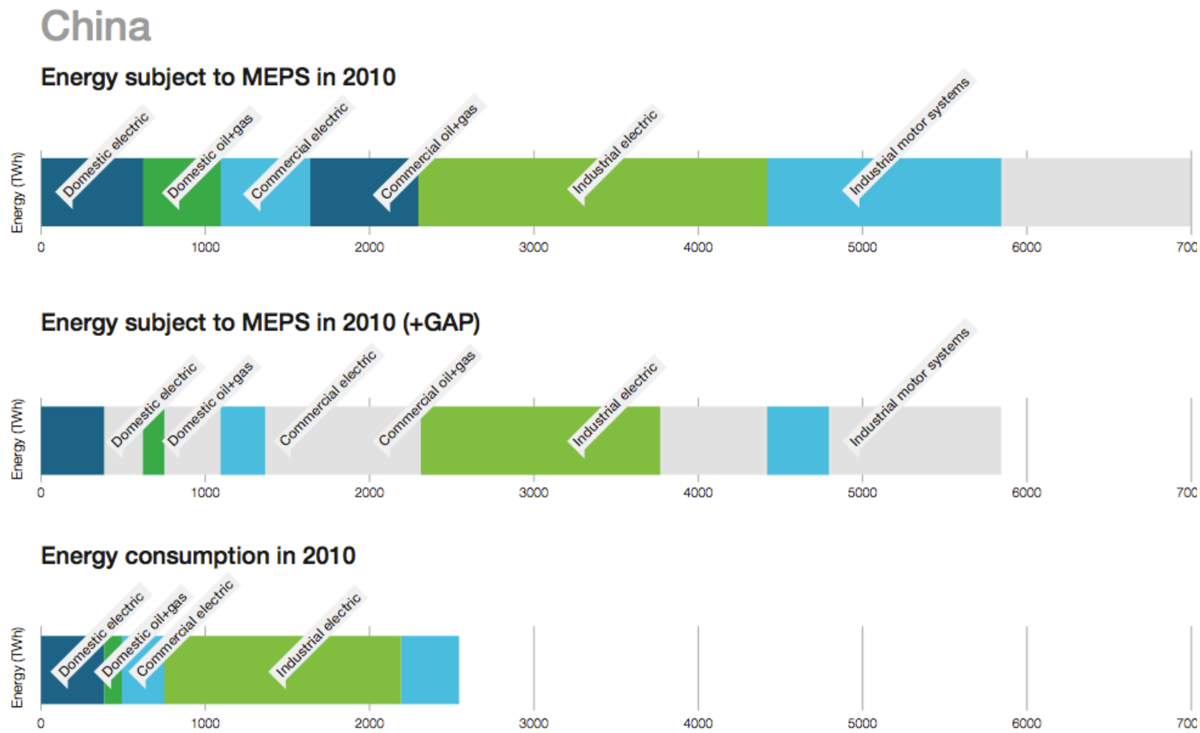
Mandatory energy labels currently apply to: refrigerators, freezers, room air conditioners, clothes washers, chillers, fluorescent lamps, high pressure sodium lamps, instantaneous gas water heaters, gas heaters, variable speed air conditioners, monitors, copiers, electric water

[5] Estimates made for this report

heaters, induction cookers, electric fans, rice cookers, air compressors, three phase induction motors, set-top boxes, printers and fax machines and five other products.

If MEPS coverage is considered for all residential and commercial energy using equipment and for industrial electric motor driven applications China's MEPS programme was estimated to cover 64% of all electricity use and 10% of residential and commercial sector oil and gas use in 2010, Figure 5.1 (CLASP 2011).

Figure 5.1 Energy consumption and energy subject to MEPS in 2010 for China (CLASP 2011)



Specifically current regulations in place in the China cover about:

- 62% of domestic electricity consumption and 24% of domestic oil and gas consumption
- 47% of commercial electricity consumption and 0% of commercial oil and gas consumption
- 75% of industrial electric motor consumption and 24% of industrial electric motor system consumption

Overall as of 2010 the regulations addressed about 64% of the electricity consumption in the domestic, commercial and industrial sectors and 10% of the oil and gas consumption in the domestic and commercial sectors.

Future plans

CNIS is currently in the process of developing MEPS for flat-screen televisions, gas cooktops, and copiers with regulations expected to be adopted in 2013. CNIS has also recently launched initial MEPS development processes for commercial cookers and LED lamps, as well as revisions to increase the stringency of existing MEPS for computer displays, domestic electromagnetic stoves, and variable frequency air conditioners. CNIS has work underway to develop energy labelling implementation rules for three new products:

ventilating fans, gas cook-tops, and heat pump water heaters. The MEPS for external power supplies are also undergoing revision.

The EU

Current coverage

To date the EU has implemented MEPS for 16 products groups (+ endorsement of two voluntary agreements), mandatory energy labels for 10 products and has implemented Energy Star voluntary labelling on a number of ICT products.

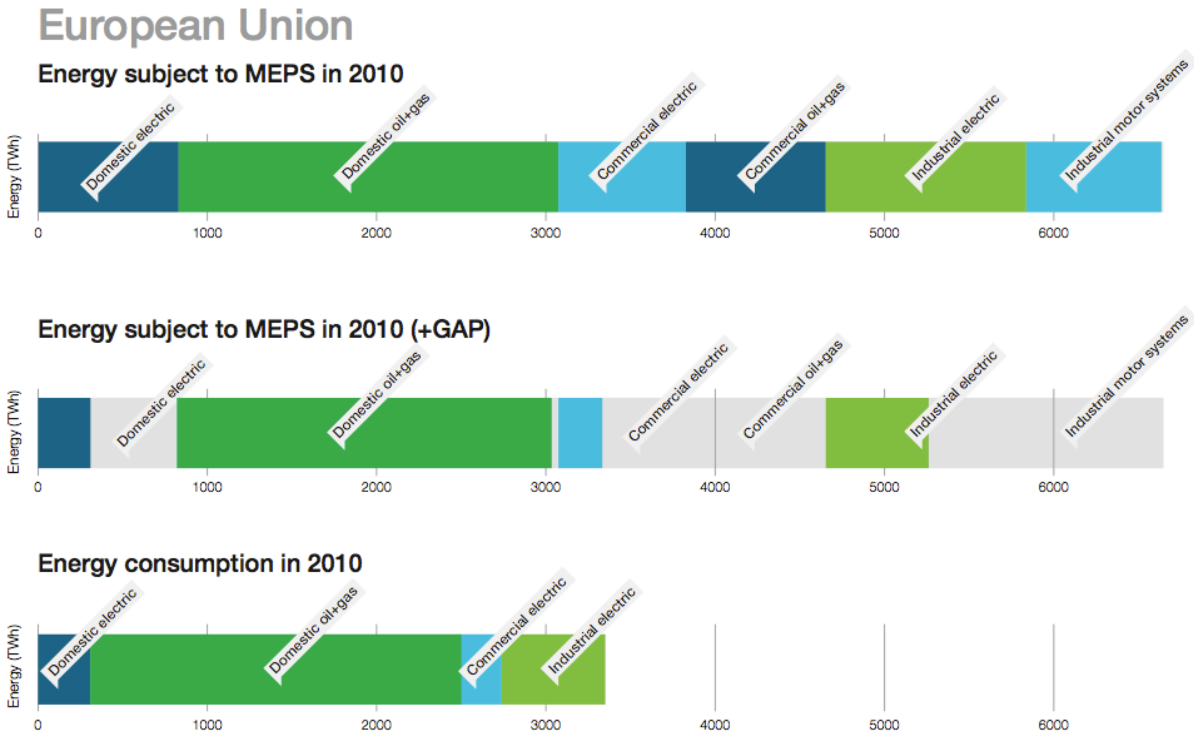
MEPS are in place for: household refrigeration appliances, household dishwashers, household washing machines, circulators, domestic air conditioners, TVs, standard electric motors, household lamps, tertiary and directional lighting products, simple standby and off-mode power consumption of household and office equipment, external power supplies, simple set-top boxes, non-residential fans, standard water pumps and household tumble driers. A voluntary agreement has been endorsed on Complex set top boxes (CSTB) and a second one on Imaging equipment.

Mandatory energy labels currently apply to: refrigerators and freezers, domestic air conditioners, domestic washing machines, domestic tumble driers, household lamps, TVs, household dishwashers, domestic ovens, washer-driers and tyres.

The EU also operates the Energy Star program for office equipment following an agreement between the US government and the European Community. This includes computers, imaging equipment and monitors and specifically: desktop computers, notebook computers, integrated desktop computers, thin clients, small-scale servers, workstations, game consoles, displays, printers, digital duplicators, copiers, scanners, multi-functional devices, fax machines and mailing machines.

Despite substantial increase in activity since the initiation of the Ecodesign Directive in 2005 the current regulatory coverage of energy usage in the EU is among the lowest of all the peer economies considered here. If MEPS coverage is considered for all residential and commercial energy using equipment and for industrial electric motor driven applications the EU's MEPS programme covered about 42% of all potential electricity use and 71% of residential and commercial sector oil and gas use in 2010, Figure 5.2 (CLASP 2011). It is to be noted that the oil and gas coverage is essentially due to the old MEP's on boilers, set before the Ecodesign was adopted, in 1992.

Figure 5.2 Energy consumption and energy subject to MEPS in 2010 for the EU (CLASP 2011)



Specifically current regulations in place in the EU cover about:

- 39% of domestic electricity consumption and 97% of domestic oil and gas consumption
- 31% of commercial electricity consumption and 0% of commercial oil and gas consumption
- 75% of industrial electric motor consumption but 0% of industrial electric motor system consumption

Overall regulations address 42% of the electricity consumption in the domestic, commercial and industrial sectors and 71% of the oil and gas consumption in the domestic and commercial sectors.

Future plans for 2013 and beyond

The Commission currently has regulatory processes or product studies underway for 29 product groups including: uninterruptible power supplies, large pumps and pumps for pools, fountains, aquariums; special motors; compressors; industrial ovens; machine tools; tertiary air conditioning; central heating products (other than CHP); professional wet appliances and dryers; distribution and power transformers; sound and imaging equipment; residential ventilation and kitchen hoods; solid fuel small combustion installations; vacuum cleaners; complex set-top boxes; local room heating products; domestic and commercial ovens; domestic and commercial hobs and grills; non-tertiary coffee machines, networked standby losses; professional and commercial refrigerating and freezing equipment; boilers; water heaters; PCs and servers; Imaging equipment; electric pumps; directional lighting.

Furthermore a draft product prioritisation study was completed in 2011 to help guide the decision regarding the choice of future products to be addressed and which included proposals concerning both energy-using and energy-related products. A new 2012-2104

Ecodesign Working Plan has now been released, including some energy related products such as windows and tap & shower heads. (VHK 2012).

Japan

Current coverage

Including transportation some 23 energy-using product categories are subject to Top Runner requirements. The products covered are: passenger vehicles, freight vehicles (HDVs), air conditioners, electric refrigerators, electric freezers, electric rice cookers, microwave ovens, lighting equipment (essentially fluorescent lighting including CFLs and associated ballasts), electric toilet seats, TV sets, video cassette recorders, DVD recorders, computers, magnetic disk units, copying machines, space heaters, gas cooking appliances, gas water heaters, oil water heaters, vending machines, transformers, routers, switching units.

Japan was the first economy in the world to regulate the efficiency of heavy duty vehicles although the USA has recently followed suit. Toilet seats may appear to be a curiosity but they are a significant electricity consuming appliance in Japan where whole house heating is uncommon.

METI and IEEJ estimate that about 55% of residential electricity use and about 70% of household energy use is currently covered by Top Runner standards, Figure 5.4 a) and b) (ANRE 2012).

Figure 5.3 Average electricity consumption by end-use in Japanese households in 2009 and the proportion of electricity use covered by Top Runner requirements (ANRE 2012)

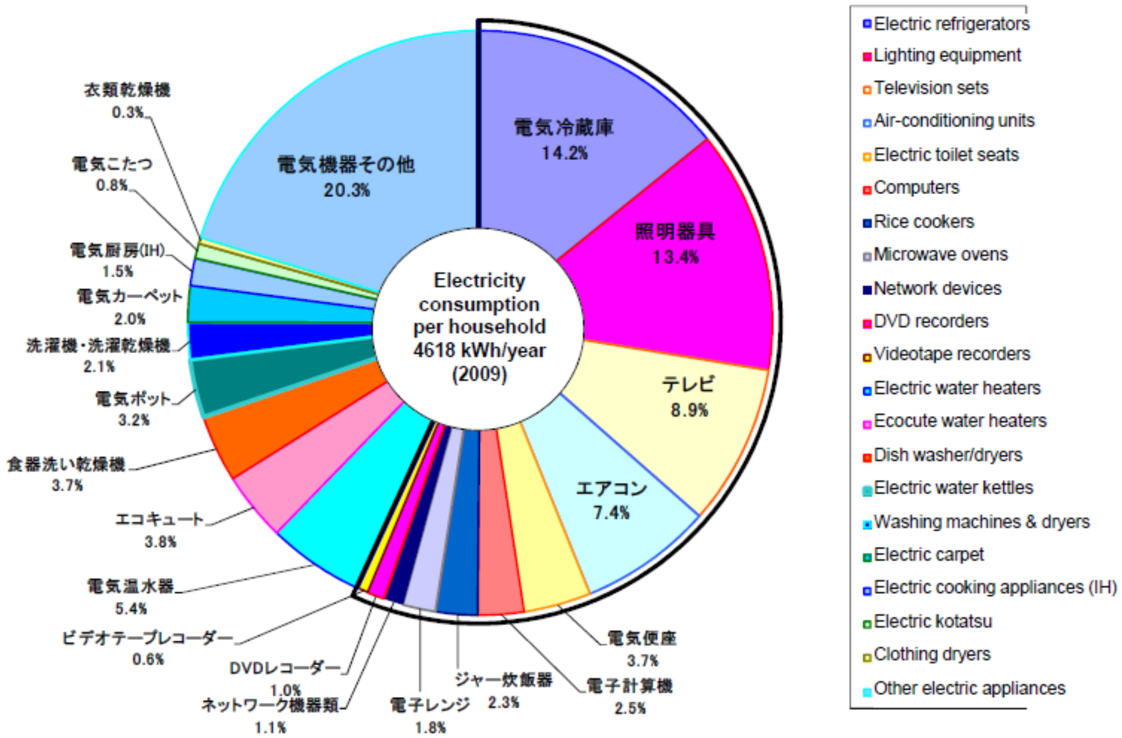
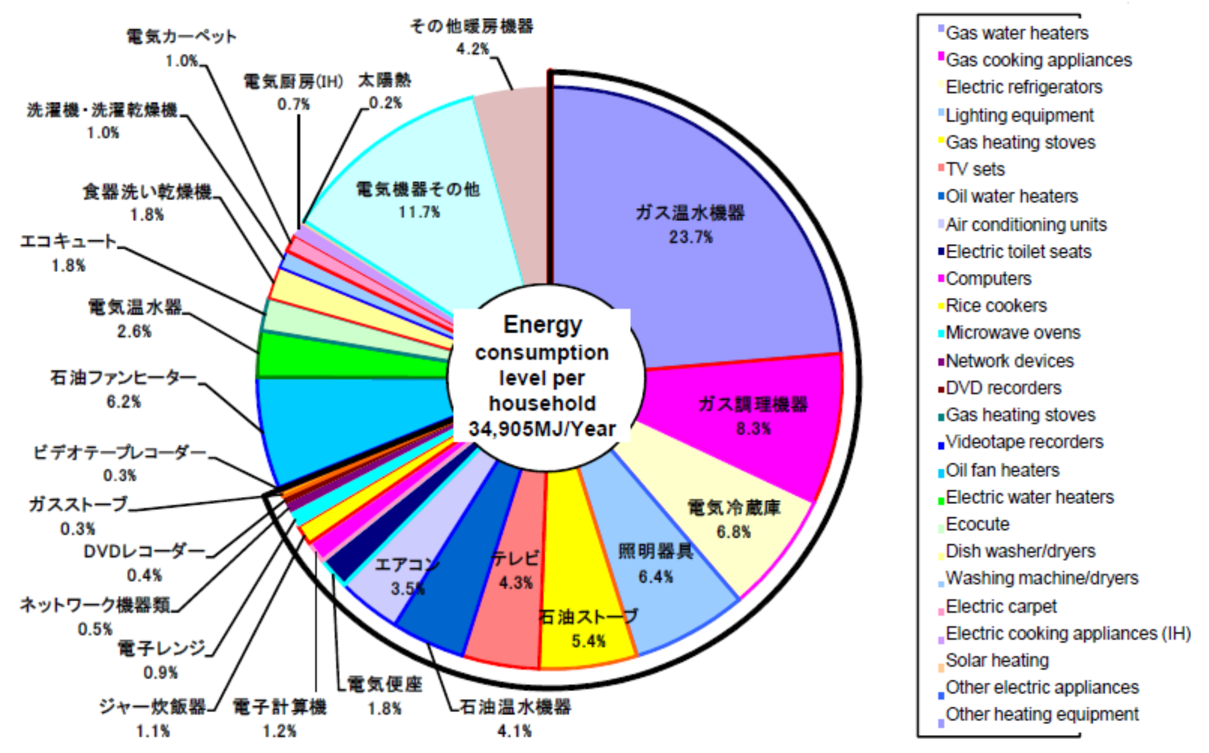


Figure 5.4 Average energy consumption by end-use in Japanese households in 2009 and the proportion of energy use covered by Top Runner requirements



Of those products not yet covered the largest energy users are gas heating stoves and electric water heaters. The breakdown is not available for the services or industry sector. No industrial end-uses are yet subject to Top Runner requirements except for transformers and there are gaps in the coverage of the service sector.

Future plans

Top Runner targets have recently been adopted for distribution transformers and light duty vehicles (LDVs) with the regulations due to take effect later in 2012. Top Runner requirements are also in the enactment procedural phase for copying machines and commercial refrigeration equipment. The LDV regulations gave considerable attention to how to treat hybrid electric vehicles and petrol vehicles.

Revision work is also underway for room air conditioners and new Top Runner regulations are being considered for windows, insulating materials and bathroom & kitchen facilities in response to the 2012 ECL amendment which extended the scope of Top Runner to include energy-related products.

Among direct energy using products new Top Runner measures are planned for:

- industrial electric motors
- LEDs
- transformers – small local distribution type

LEDs present a special case as Top Runner requirements are normally aimed at efficiency; however, it is thought the LED requirements may focus on quality parameters e.g. correlated colour temperature etc. Note national LED safety standards are already about to come into effect but these may also cover some quality parameters such as lifetime.

New uniform labels are under development for freezers, gas cooking appliances, gas water heaters, oil water heaters, rice cookers, microwave ovens, VCRs and DVD players. Energy saving labels have also been completed for routers and switching units.

USA

Current coverage

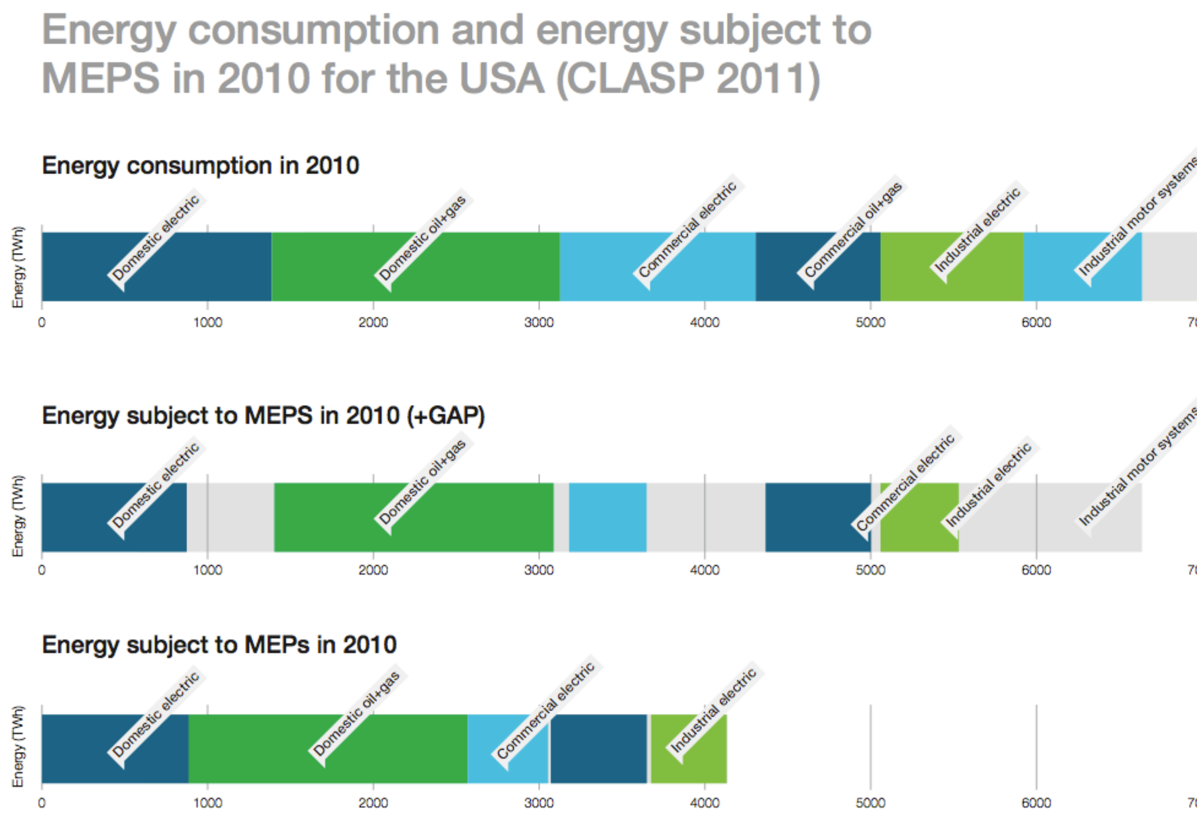
Some 55 energy-using product categories are subject to MEPS in the USA including: water heaters, residential, direct heating equipment, pool heaters, furnace fans, small furnaces, mobile home furnaces, residential furnaces, residential boilers, commercial warm air furnaces, commercial packaged boilers, commercial water heaters, hot water supply boilers and unfired hot water storage tanks, unit heaters, small electric motors, electric motors, 1-500 hp, distribution transformers, high-intensity discharge lamps, fluorescent lamp ballasts, metal halide lamp fixtures, general service incandescent lamps, general service fluorescent lamps, compact fluorescent lamps, ER lamps, BR lamps, and small diameter incandescent reflector lamps, ceiling fans and ceiling fan light kits, torchieres, illuminated exit signs, traffic signal modules and pedestrian modules, mercury vapour lamp ballasts, microwave ovens, clothes washers (commercial), clothes dryers (residential), room air conditioners, dishwashers, refrigerators (residential), clothes washers (residential), kitchen ranges and ovens, central air conditioners and heat pumps (residential), commercial air conditioners and heat pumps, dehumidifiers, packaged terminal air-conditioners and heat pumps, commercial refrigeration equipment, refrigerated bottle or canned beverage vending machines, automatic ice makers, walk-in coolers and freezers, external power supplies (non-class A), battery chargers, external power supplies (class A), televisions, digital set top boxes, faucets, showerheads, commercial pre-rinse spray valves

Mandatory energy labels are applied to: ceiling fans, central air conditioners and central air conditioning heat pumps, direct heating equipment, dishwashers, furnace fans, furnaces, mobile home furnace, packaged terminal air conditioners and packaged terminal heat pumps, pool heaters, refrigerators, freezers and refrigerator-freezers, residential boilers, residential clothes washers, residential water heaters, room air conditioners, single package vertical air conditioners and single package vertical heat pumps , small furnaces, storage water heaters, instantaneous water heaters, and unfired hot water storage tanks , unit heaters, lamps, plumbing products, and ceiling fans.

Voluntary Energy Star labelling is applied to at least 59 product types.

As the oldest continuous international MEPS programme the coverage in the USA is among the highest. If MEPS coverage is considered viable for all residential and commercial energy using equipment and for industrial electric motor driven applications US's MEPs programme covered 52% of all potential electricity use and 95% of residential and commercial sector oil and gas use in 2010, Figure 5.5 (CLASP 2011).

Figure 5.5 Energy consumption and energy subject to MEPS in 2010 for the USA (CLASP 2011)



Specifically current regulations in place in the USA cover about:

- 64% of domestic electricity consumption and 96% of domestic oil and gas consumption
- 38% of commercial electricity consumption and 93% of commercial oil and gas consumption
- 77% of industrial electric motor consumption

Overall regulations address about 52% of the electricity consumption in the domestic, commercial and industrial sectors and 95% of the oil and gas consumption in the domestic and commercial sectors

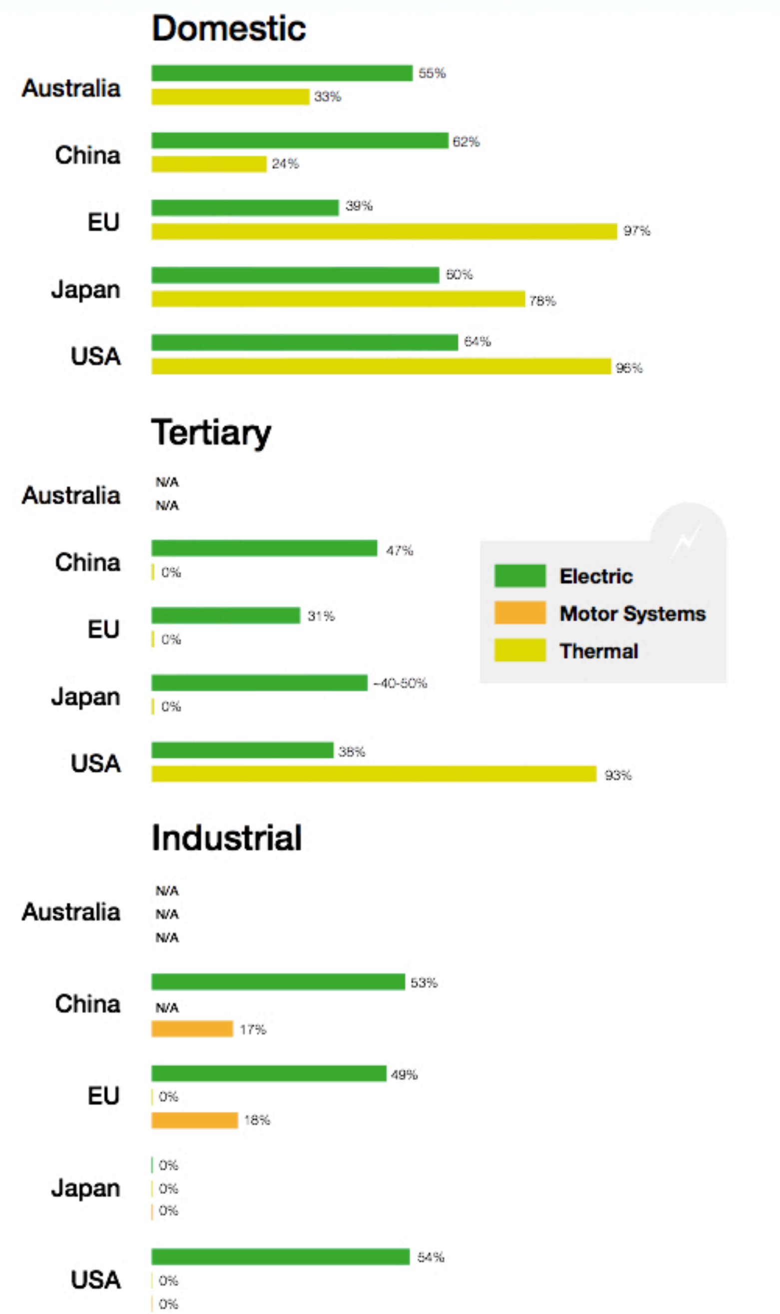
Future plans

The US DOE currently has rulemaking processes planned for 15 product group MEPS between the end of 2012 and 2017. Some of these are newly regulated product groups but most are revisions to existing MEPS. The new product groups include LEDs and OLEDs.

Summary – MEPS coverage across the economies

Table 5.2 summarises the estimated share of energy use subject to MEPS in each of the peer economies by fuel type and by sector circa 2010. From this we see that the EU has the lowest share of domestic electricity consumption subject to MEPS but the highest share of thermal energy use (mostly due to the pre-existing boiler MEPS). In the tertiary sector the EU has the lowest proportion of electricity subject to MEPS and only the USA has a large proportion of thermal energy use subject to MEPS. For the Industrial sector China has the highest share of electricity subject to MEPS and Japan the least. From this it can be concluded that all the economies have substantial potential to increase the proportion of equipment energy use subject to MEPS, especially in the industrial and tertiary sectors and for thermal energy powered equipment. It is also apparent that the EU has one of the lower shares of equipment energy subject to MEPS. This is partly due to starting later with its programme but is also caused by delays in agreeing and issuing regulations.

Table 5.2 Estimated shares of energy consumption subject to MEPS in 2010 for the peer economies



6. Ac es, capacity an

The effectiveness of equipment energy efficiency standards and labelling programmes is strongly influenced by their ability to issue policy measures which stimulate meaningful energy savings and this in turn is driven by the administrative structure and regulatory processes used in designing and issuing the policy measures, the administrative capacity and the overall throughput i.e. the rate at which measures covering the most important potential energy savings are issued.

Programme administration

The administrative structure that governs equipment energy efficiency programmes is a key aspect of their productivity. This section summarises the structures in place in each economy.

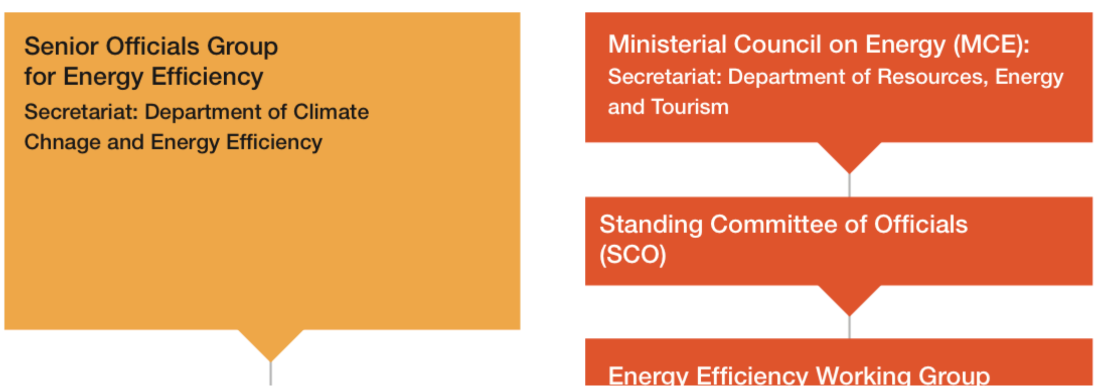
Australia

The Equipment Energy Efficiency Program (E3 program) is co-funded by the Australian Government, State and Territory governments and the New Zealand Government and embraces a range of measures aimed at improving the energy efficiency of equipment and appliances used in the residential, commercial and manufacturing sectors in Australia and New Zealand. The programme is one of the key delivery mechanisms of Australia's National Framework for Energy Efficiency (NFFEE) and National Strategy on Energy Efficiency (NSEE) and the New Zealand Energy Efficiency and Conservation Strategy and is managed through, the overall NFEE/NSEE structure (E3 2011a), Figure 6.1.

Administration of the E3 Program is the responsibility of the E3 Committee, which consists of officials from Commonwealth, State and Territory government agencies, as well as representatives of the New Zealand Government. The E3 Committee is accountable to the Ministerial Council on Energy (MCE), which was established by the Council of Australian Governments (COAG) in 2001 to deliver the economic and environmental benefits to Australia from implementation of the COAG national energy policy framework. The MCE is comprised of the Federal Energy Minister, each jurisdiction's Minister responsible for energy, and observers from New Zealand, Papua New Guinea and Norfolk Island. The New Zealand Minister for Energy has full membership and voting rights in regards to issues that fall under the Trans-Tasman Mutual Recognition Arrangement (TTMRA), a trigger which applies whenever any proposals for mandatory performance standards or labelling for end-use products are being considered. Measures approved by the MCE are subject to additional approval by the New Zealand Cabinet before they are adopted in New Zealand. In addition to clearance from the Office of Best Practice Regulation (OBPR), proposals with trans-Tasman implications are also subject to review by the New Zealand Government's Regulatory Impact Assessment Team.

The E3 Committee is responsible for advising the MCE on implementation measures to address the efficiency needs of all types of energy using equipment. MCE has given the E3 Committee a mandate to assess any energy-using product for possible regulation, subject to community consultation and the completion of a Regulation Impact Statement (RIS) as required by COAG and approved by OBPR. In 2006, the MCE agreed for the first time to consider regulating products even in circumstances where a cost is imposed upon the community, providing such action will offset even more expensive mitigation action sometime in the future.

Figure 6.1 Governance structure of Australia's E3 programme



In practice the national standards and labelling programme is largely administered by a team of from four to six staff working in the Department of Climate Change and Energy Efficiency ministry based in Canberra. These Federal officials are supported by a large team of experienced consultants who are hired to help:

- Investigate technical and market factors needed to develop energy performance test procedures and as inputs into product studies needed to develop energy labelling and MEPS regulations
- Support and/or manage the development of national and international product energy performance test procedures
- Support and/or manage the conduct of product technical studies and associated stakeholder working groups
- Conduct market monitoring and surveillance activities and support the product registration and compliance process
- Conduct product compliance check-testing
- Assist in strategy development studies
- Carry out end-use metering studies
- Perform impact evaluation assessments and support regulatory impact assessments

There is considerable continuity in the choice of consultants used, many of whom have been working almost continuously for the programme since its inception, and hence this enables institutional memory and quality of practice to be established.

China

Product energy efficiency policy is set by the National Development and Reform Commission (NDRC) and specifically the Department for Environment and Resource Conservation within NDRC.

Specifically, the Department of Resource Conservation and Environmental Protection is responsible for “comprehensively analysing important and strategic issues related with the coordinated development of economy, society, environment and resources; organising formulation and implementation of plans, policies and measures concerning the conservation and comprehensive utilisation of energy and resources, and the development of circular economy; participating in the formulation of environmental protection plans; coordinating work related to environmental protection industry and clean production; organising and coordinating key pilot programs of energy conservation and emission reduction, and promotion and application of new products, technologies and equipment; undertaking concrete work assigned by the National Leading Group Dealing with Climate Change, Energy Conservation and Emission Reductions”.

Implementation of the energy efficiency standards and labelling programmes is carried out by the China National Institute of Standardisation (CNIS) that operates under the control of the Standardization Administration of China (SAC) which is within the State Administration for Quality, Supervision Inspection and Quarantine (AQSIQ), Figure 6.2. These organisations and some of the programmes they administer are discussed below.

Figure 6.2 Chinese Standards and Labelling Organisations

In practice the work-plan on new and revised efficiency standards is set jointly by NDRC and SAC and is implemented by CNIS. CNIS has roughly 60 staff working on MEPS and labelling, while the managing department within NDRC has five staff addressing this and many other topics. They have often been assisted in conducting their work through external technical and financial contributions which may come through grants issued by development orientated third parties such as UNDP, UNEP, GEF, NGOs (Energy Foundation and CLASP) and bi-lateral assistance efforts from Australian, European, Japanese and US government agencies.

Other relevant bodies are the Certification and Accreditation Administration of China (CNCA) and the China Quality Certification Centre (CQC).

CNCA was established under AQSIQ as an independent entity to promote the unification of separate inspection regimes for domestic and foreign products. AQSIQ is also responsible for reporting on standardisation requirements to the WTO (to conform with the Technical

Barriers to Trade (TBT) agreement) and to foreign and domestic companies. The organisation submits to the WTO current PRC technical regulations, standards, quality evaluation procedures, labelling requirements, and other issues that may affect trade with WTO members. Membership of the CNCA is comprised of 20 regional test labs and institutes.

The China Quality Certification Centre is the largest professional certification body in China. It operates under the auspices of the China Certification & Inspection Group (CCIC), approved by the State General Administration for Quality Supervision and Inspection and Quarantine and Certification and Accreditation Administration of the People's Republic of China. The centre was set up to promote advanced energy efficient and energy conserving products. CQC develops and administers the voluntary endorsement energy labelling programme in China including overseeing the certification of products that apply to receive the label.

EU

The development and adoption of Ecodesign and Energy Labelling regulations is led by the European Commission and governed by the process of 'comitology' (renamed 'delegated acts' after entry into force of the Lisbon Treaty in December 2009). Currently, the Energy Labelling policy is fully in line with the Lisbon Treaty procedure, while the Ecodesign policy is still following the old way until it is streamlined. The main difference in the two processes is that in the new one the vote of each regulation by a committee of Member State representatives has been supressed. This should help to simplify and accelerate the regulatory adoption process, although it does pose some concerns about the transparency and legitimacy of potential last minute modifications brought to draft regulations under the pressure of some stakeholders.

The preparatory work and development of product MEPS and energy labels is divided among units of the Commission's DG Energy and DG Enterprise. Following the publication of the original Ecodesign Directive in 2005, the European Commission has contracted 44 preparatory studies, each of which is charged with carrying out technical assessments of the product group in question according to a prescribed procedure, which is explained in Section 7 below. During the conduct of the preparatory studies, interested stakeholders have the possibility to comment on draft reports and to give input at stakeholder consultation meetings organised by the contractors.

When a study is completed, the Commission prepares draft Ecodesign and/or energy labelling rules that are presented and discussed at a consultation forum composed of appointees from each EU Member State's administration, industry representatives and civil society organisations. Based on comments expressed, the Commission refines its draft, gathers any internal reactions from all its DGs (in so-called 'inter-service consultations'), performs an economic and social impact assessment study of the policy options, notifies the measures to the WTO and submits the draft Ecodesign rules for a vote by a Regulatory Committee of Member State representatives. This committee can request modifications to the texts. The resulting Ecodesign and Energy Labelling proposals are formally adopted by the Commission and passed to the European Council and European Parliament, who can exert a right of scrutiny (i.e. accept or reject the proposals but not amend it).

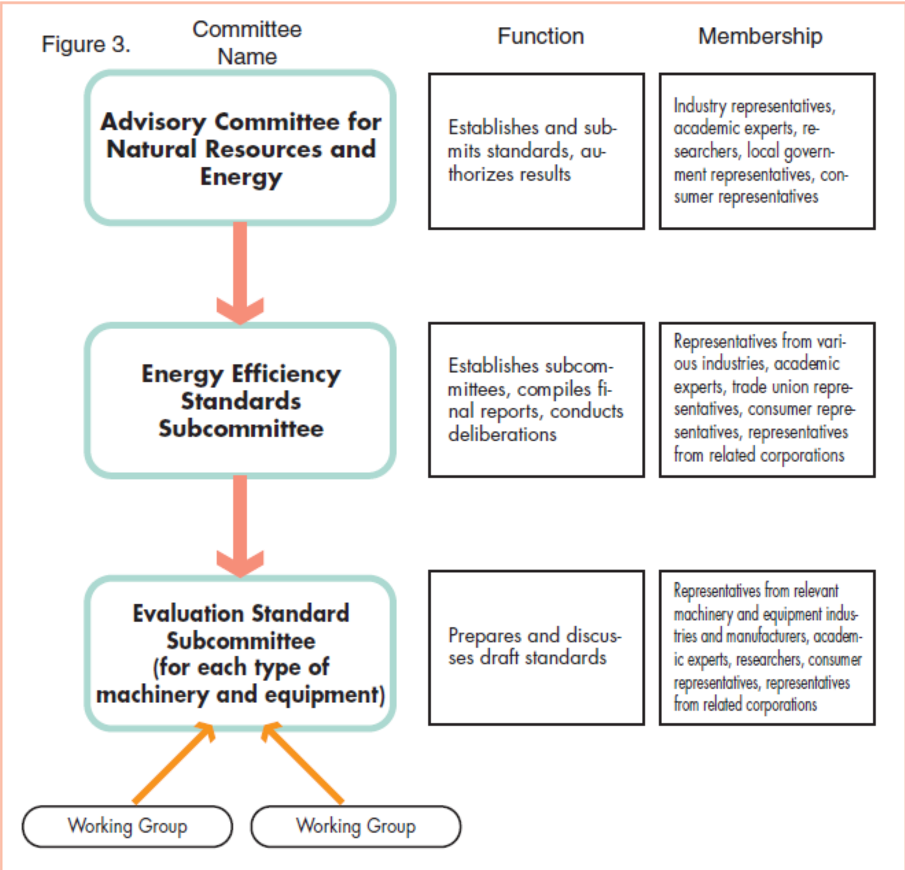
To administer this effort DG Energy employs 8 to 9 full time desk officers who are responsible for about 30 products categories while DG Enterprise and Industry have an equivalent of 3 FTE desk officers supporting the Ecodesign programme (6 product categories). Since its inception the Ecodesign Directive's administrative expenditure is estimated to have averaged €4.1m per annum in staff costs and (very approximately) €2m per annum for consultancy costs. The Ecodesign evaluation study calculated that the resources spent on developing the first Working Plan and 37 Preparatory Studies (of which 22 were completed and 15 on-going) so far amount to €11.1 million or an average of €300,000 per study (CSES 2012).

The limited staff and financial resources deployed in the EU process have been widely accredited with contributing to delays in the regulatory development process. However, procedural factors are also likely to be partially responsible. For example, the European Commission is believed to favour first reaching agreement in the Consultation forum on the details of a product labelling scheme before holding a vote among EU MS on the related Ecodesign implementing measures. If an aspect of the labelling regulation is then contested during the Commission's internal consultation, the vote on the Ecodesign implementing measure is then delayed, as is understood to have recently occurred for the proposed Ecodesign boiler implementing measures.

Japan

Japan's policies for energy conservation are deliberated by the Minister of Economy, Trade and Industry "Advisory Committee for Natural Resources and Energy". The "Standard Values" are set by the "Energy Efficiency Standards Subcommittee" which is set-up by the "Advisory Committee for Natural Resources and Energy". The "Energy Efficiency Standards Subcommittee" has an "Evaluation Standard Subcommittee" for every product which supports the details of the standard for each product under evaluation. The role of the "Evaluation Standard Subcommittee" is to define the technical details for each of the products and then to present its outcomes to the "Energy Efficiency Standards Subcommittee" who finalise the product details. This collection of committees and supporting subcommittees are supported by the office responsible for the Agency for Natural Resources and Energy. It is often the case that before setting up the subcommittees that working groups are created to conduct studies evaluating the machinery and equipment being considered for the Top Runner Programme inclusion as well as studies which evaluate the energy efficiency consumption measurement methods. Figure 6.3 illustrates the set-up of the committees and provides a high-level overview of their roles and membership.

Figure 6.3 Committee structures in determining Top Runner requirements



Energy Efficiency and Conservation Division within the ANRE is responsible for preparing and delivering the studies selecting the potential types of machinery and equipment eligible for the Top Runner Programme inclusion. Any machinery or equipment which is deemed to meet the set requirements is put forward to the Energy Efficiency Standard Subcommittee. The requirements which the machinery and equipment must meet include large scale use in Japan, high energy use during the in-use phase, and scope for energy efficiency improvement. The products selected for regulation are founded upon several other factors along with the "set requirements" and anticipated market trends for the products in question.

Once the Energy Efficiency Standards Subcommittee has received recommendations and the studies on suitable candidate products; then the "Evaluation Standard Subcommittee" is created to provide a more rigorous evaluation of the standard values. Where candidate products are complex and there are no well-established methodologies for measuring energy consumption efficiency studies are commissioned prior to the hand over to the Evaluation Standard Subcommittee discussions. Such studies are conducted by all relevant stakeholders with working groups established within relevant corporations and organisations seeking to develop a confirmation for the methodology used to evaluate the energy conservation performance, ultimately culminating in a proposed draft standard.

The Evaluation Standard Subcommittee has a defined agenda which dictates the discussions for setting the product standards. The agenda for setting the standards includes a discussion on the, equipment target scope as well as definition of the measurement methods of energy consumption efficiency. This is followed by measuring the energy consumption efficiency of all active market products yielding the maximum energy efficiency value on the market. The next step is to set the efficiency levels for target years by factoring the anticipated product technical development and manufacturer capacity amongst the key factors. This allows the Top Runner Standard values to be determined with target years defined.

Despite this Evaluation Standard Subcommittee being closed to public scrutiny in order to maintain industry data confidentiality, an interim report is made public on the web to allow for public commentary. The public input is then evaluated and where appropriate addressed and the final report is delivered. Upon the Energy Efficiency Standards Subcommittee approval, the draft standards are established.

Finally, the Draft Top Runner Standard Values are reported to the WTO/TBT in order to ensure trade barriers on imported products are avoided. Upon completion of the above defined procedures the government seeks to amend their regulation to add the draft Top Runner Standard Values to the target products. Naturally, the time lapse between the proposed target machinery and enforcing the legislation varies depending on the machinery and equipment type but such previous amendments have demonstrated that this can take from as little as a year up to two and a half years.

As is the case with the EU, shortage of administrative capacity is a major bottleneck for the Top Runner programme. There are currently four full time equivalent staff working on the programme and this constrained capacity limits the rate at which new requirements can be issued and existing ones revised.

USA

The US Department of Energy (DOE) is responsible for the development and issuance of MEPS in the USA and of the related energy performance test procedures and efficiency metrics. The regulations it issues are available in the Code of Federal Regulations (Title 10, Chapter II, Part 430—Energy Conservation Program for Consumer Products and Title 10, Chapter II, Part 431—Energy Efficiency Program for Certain Commercial and Industrial Equipment).

The US Environmental Protection Agency (EPA) shares responsibility for the design and implementation of the Energy Star label with the DOE. In some cases this also includes the development of energy efficiency test procedures and efficiency metrics if these are not already developed for products covered by the MEPS programme.

The US Federal Trade Commission (FTC) is responsible for the development and issuance of the mandatory Energy Guide Label. The DOE and the FTC share responsibility for mandatory energy labelling of commercial equipment.

In addition to the Federal standards individual states have the right to set their own equipment energy efficiency standards whenever there is no competing Federal level legislation. Historically many of them have done exactly this, especially when the Federal standards setting process has progressed slowly. These proactive States also tend to be among the key stakeholders engaged in the regulatory hearings.

Within this administrative framework the bulk of the effort is carried by the DOE for the development of equipment energy standards. The programme is operated within the DOE's Building Technologies Program within the Energy Efficiency and Renewable Energy Division. The unit working on appliance and equipment standards responsible has 14 full time staff working on MEPs development and administration and 4 attorneys to address compliance related issues.

Regulatory development process

The principal distinctions between the regulatory processes followed in the peer economies are in the manner in which regulatory measures are designed, the consultation and stakeholder engagement process and the review and revision process. Each of these factors is considered below.

In Australia the Department of Energy Efficiency and Climate Change produces regular plans of its new areas of focus for MEPS and energy labelling. For each product under regulatory consideration consultants are hired to produce a technical study to assess the elements needed to inform regulatory design. The findings of these studies are discussed with relevant stakeholders including the affected industry and commercial sectors before the Department proposes a draft regulation to the E3 programme committee. A regulatory impact assessment is also conducted as input into the deliberative process. If the proposed regulation is deemed to be satisfactory it is approved and issued as a final regulation. There is no set schedule that has to be followed in this process but typical MEPS or labelling setting processes take about 2 years to complete.

In China NDRC charges CNIS with the development of MEPS and energy labelling. Each year NDRC and CNIS draw up a working plan for the products for which MEPS are to be developed. CNIS are then charged with executing the plan. There is no fixed regulatory schedule that has to be abided by and the process is driven by the time it takes to do the back ground studies and hold consultations used to inform the regulatory design process. The background studies are generally done by CNIS staff but are often supported by experts, sometimes bought in internationally. The process of developing MEPS and labels typically takes from 1 to 3 years for each product group.

The EU process of setting Ecodesign and Energy Labelling requirements is for the Commission to oversee preparatory work to assess the most relevant potential product groups for new Ecodesign measures and then to commission technical studies to look at each of those considered most promising. Once a decision has been made regarding which products to investigate the Commission engages consultants to conduct the technical assessments according to a prescribed timetable, which is typically 1 to 2 years in length. The technical studies follow a set format and are required to follow a standardised methodology, which is described in the next chapter. Draft measures are then submitted to the Ecodesign Consultation Forum comprised of national representatives of EU Member States, NGOs and industry associations. When the Commission considers they are ready the draft implementing measures are subsequently submitted to the formal adoption process described in the previous chapter. The timetable in this process is not fixed and so if the Commission is not persuaded the implementing measure is ready to be advanced they may have further technical work done, or engage in more rounds of consultation and approval. Since the inception of the Ecodesign process, the Commission has initiated 44 product preparatory studies, of which all except 7 are completed. Overall some 16 Ecodesign implementing measures have been adopted, two voluntary agreements endorsed and about 20 are under discussion in draft form. Some of the latter have been under consideration for a very long time. For example, the very first preparatory study (Lot 1) on boilers was completed in 2007 and first presented to the Consultation Forum for consideration in February 2008. Despite numerous meetings and discussions a regulation have still not been issued although a draft implementing measure has been approved by MS and is ready for being voted by the Regulatory Committee since early 2012. **Of all the peer economies considered in this report the EU has the biggest backlog of regulatory measures awaiting final approval and the longest delays in the final consultation stages.**

In Japan, METI works with an advisory committee to develop and issue Top Runner standards. The committee comprises representatives from industry, independent expert institutions and academia. It holds regular meetings to consider the programme of work and the priority products for new or revised Top Runner requirements. Once a decision is made to establish or revise existing Top Runner requirements a product working group is established for the duration of the specific product regulatory development process. These working groups include representatives from industry and their related associations, independent experts and academia as well as a METI representative. The working groups are charged with developing the product specific set of Top Runner regulatory proposals as well as any associated energy labelling requirements. They develop a report and submit this to METI who then act upon the findings as they see fit, to set the Top Runner and energy labelling specifications. The whole process from convening a product working group to setting Top Runner specifications is typically concluded within two years. The relative speed of this process, compared to those in place in the EU or USA (see below), is partly made possible by the nature of the Top Runner methodology, which relies more on statistical analysis than life cycle assessment.

In the USA the process of setting MEPS follows a rigidly defined structure. The DOE issues a regulatory framework document which indicates that it is setting up a regulatory process to make an energy efficiency rulemaking for a particular product group. At this point the DOE engages technical consultants to prepare a Technical Support Document (TSD). The draft TSD, known as the preliminary technical support document, typically takes from 13 to 18 months to prepare. Following a public review and comment period the DOE will potentially request changes to be made to the TSD and will ask for additional analyses to be produced before a notice of proposed rulemaking (NOPR) is issued, which is a draft regulatory proposal. Following another round of public review and comment, which may trigger some final analytical changes, the DOE makes a final determination and issues a final rulemaking. The total process will usually take about three and a half years from the opening of a rulemaking to its final conclusion. Up until the passage of the 2007 Energy Independence and Security Act the DOE was also required to issue an Advance Notice of Proposed Rulemaking (ANOPR) in its energy conservation standards rulemakings. This requirement was removed for residential products under Section 307 of EISA. Nonetheless for certain products where DOE has taken a decision not to issue an ANOPR, it still continues to hold public meetings to receive stakeholder input on DOE's preliminary analyses.

In practice the DOE uses the same pool of consultants for almost all their rulemakings and has done for at least twenty years. As a result the process followed is very consistent and there is a considerable institutional memory among the consultant organisations used. However, there is also a route by which the whole process can be shortened that involves a negotiated rulemaking. This occurs when industry and energy efficiency advocates including NGOs and state level energy agencies set up an independent process to try and reach common agreement on proposed energy efficiency standards. If this happens the DOE will assess the proposed standards and may decide to adopt them if they deem that they satisfy regulatory requirements. In this case some of the secondary analytical steps and public review processes can be omitted, which may shorten the time taken to develop and issue the ruling. This process of fast tracking a negotiated consensual rulemaking was legally empowered through section 308 of the 2007 Energy Independence and Security Act, which gave DOE authority to issue direct final rules in cases where a fairly representative group of stakeholders (including manufacturers, States, and efficiency advocates) jointly submit a recommended standard level. The requirements for using this authority include sufficient notice to allow all stakeholders to have an opportunity to review and comment on the final rule.[6] In the last few years eight out of a total of 18 rulemakings have been developed in this way.

[6] DOE efforts are conducted consistent with the National Technology Transfer and Advancement Act (P.L. 104-113) was signed into law on March 7, 1996, as set forth in OMB Circular A-119 - Federal Register (63 FR 8545) on February 19, 1998.

Consultations and stakeholder input

All of the peer economies have consultative mechanisms to engage stakeholders although the extent of engagement and degree of formality of the process varies considerably.

In Australia stakeholder meetings are convened for each product type subject to a rulemaking. The principal stakeholders comprise the state level governments and their agencies, as well as commercial actors (manufacturers, importers, distributors, and retailers). Civil society can also be represented via consumer associations and environmental groups. The organisation of stakeholder meetings is not formalised and is done on an as needed basis; however, each rulemaking process will typically involve several stakeholder consultation meetings. These meetings serve the purpose of announcing the intention to regulate a product type and to request the supply of relevant information that could help in the design of the regulations, of informing stakeholder of initial analytical findings and seeking feedback and eventually of informing stakeholders of the details of the draft and final regulations as they move through the drafting and adoption process.

In China, there is a similar ad hoc process of informing and engaging stakeholders on regulatory developments. This tends to be less of a two way process than in the OECD peer economies. The purpose is communicate that a regulatory process is underway and to solicit necessary informational inputs. When new regulations are being developed industry stakeholders are informed and then requested to contribute data and information to be used in the development of the regulations. They are often invited to workshops were the details of the pending regulations are disclosed. China has a number of industry associations for lighting, household appliances etc. and these provide one route for industry to present a common view to government.

In Europe, as previously explained, interested stakeholders have the possibility to comment on drafts of the preparatory studies and to give input at stakeholder consultation meetings organised by the contractors. Draft Ecodesign and/or energy labelling rules are presented and discussed at the Consultation Forum and the feedback is used to inform the drafting of final implementing measures (MEPS or voluntary agreements and labelling). Following 'inter-service consultations' with the Commission the draft Ecodesign implementing measures are submitted for a vote by the Regulatory Committee comprised of Member State representatives.

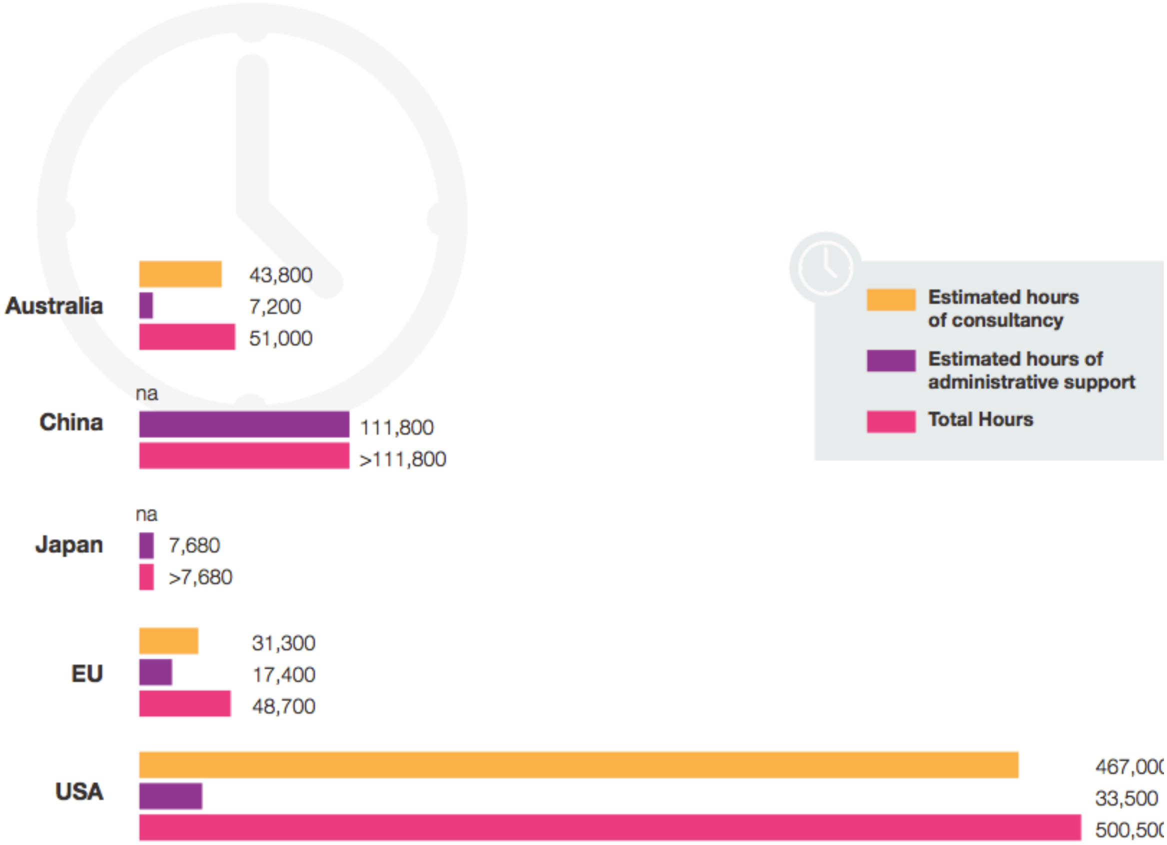
In Japan the Energy Efficiency and Conservation Division within the Agency of Natural Resources and Energy (ANRE) of METI who manage the Top Runner and energy labelling programmes. The only exception is the case of vehicle efficiency requirements, including those specified under the Top Runner programme, where responsibility lies with the Ministry of Land, Infrastructure and Transports (MLIT). METI's work is supported by a number of government funded agencies including: the Japanese Institute for Energy Economics (IEEJ) and the Energy Conservation Centre of Japan (ECCJ). It also sub-contracts some equipment energy efficiency work to an energy-efficiency NGO, the Jyukanko Research Institute. The function of these agencies in helping to support institutional memory and provide technical expertise is considerable, as civil servants within METI will typically only spend three years administering a programme like Top Runner before changing functions. A core group of stakeholders are engaged directly in the legislative development committees operated under the aegis of METI. The members of these committees are fully involved in the design of the regulations. This structure reflects the close ties that exist between industry and government within the country.

The USA has the most formal and legally enshrined consultative process of any of the peer economies. The DOE is legally required to go through a series of formal consultative stages when developing and issuing a regulation. This involves staging open public hearings that any citizen is entitled to attend. Over the years since equipment energy efficiency regulations were first introduced the consultative process of regulatory development has evolved into one where well established stakeholders are formed into informal coalitions that then negotiate the details of the prospective regulations from somewhat opposing perspectives. On the one side are ranged environmental NGOs including groups such as the ACEEE, ASAP, NRDC and the Alliance to Save Energy while on the other are industry associations and representatives. Within these hearings the DOE tends to present the findings of its consultants supplied via the draft technical support document and to hear arguments presented by the stakeholders regarding the accuracy or otherwise of the information contained therein which may result in amendments to the TSD. Once a final TSD has been produced the DOE will draft a NOPR (a draft rulemaking) and organise another hearing to take final stakeholder comments into account before a final rulemaking is issued.

Programmatic resources

Based on what is known about each of the peer programmes their estimated human resources, expressed in terms of annual person-hours of administrative and technical (consulting) support are shown in Table 6.1. Note, the Australian, Chinese and European values include estimates of all time spent at the economy-wide level for the development of all equipment energy efficiency regulations, including MEPS and labelling. By contrast the US figures are just the estimated time spent on the development of MEPS. Additional resources would be allocated for labelling.

Table 6.1 Administrative and technical support for the development and administration of equipment energy efficiency regulations by peer economy– estimated hours per year



While these values are estimates it is interesting to note that the US figure is roughly 10 times that of the EU despite both having similar sized economies and similar magnitudes of potential benefits from optimised equipment energy efficiency programmes. The estimated person-hours per year for development of the Chinese programme are over twice those of the EU's. The Japanese and Australian programmes have the lowest person hours committed for administration but the total Australian effort when consultants are added is roughly equivalent to that in the EU despite having a population of only one 25th of the EU's and a much smaller economy. These figures suggest that the EU and possibly Japan are lagging behind the other peer economies when it comes to human resource allocations to the development and administration of their equipment energy efficiency programmes.

Budget

The budgetary allocations that are dedicated to equipment energy efficiency regulations are harder to come by than information on staffing levels and hence the data is incomplete. In the case of Australia the annual budget for the E3 program has risen from AUD$1.5m/year in 2005/6 to AUD$3.5m in 2010/11 (E3 2011a). In the USA the 2005 Energy Policy Act, which further extended the coverage of equipment energy efficiency standards to include an extra 15 product standards and the adoption of 11 new test procedures, authorized budget appropriations to the DOE of USD $90 million per fiscal year for 2006 to 2010 for standards development and all the other provisions (e.g., industrial, transportation, renewable fuel standards, etc.). The US DOE is currently allocating about US$70m per annum on technical support for consultants and employing 18 full-time staff to manage their equipment MEPS development and administration.

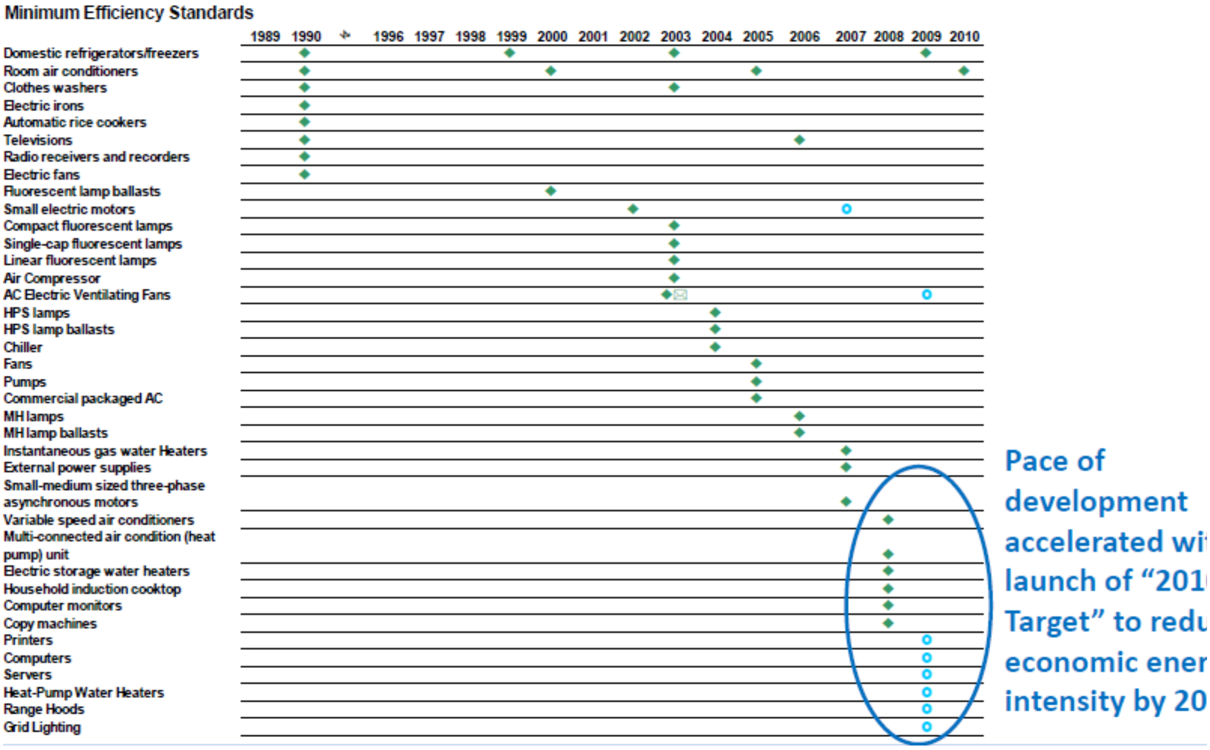
In the EU the Commission has allocated at least €6m to hire consultants for Ecodesign product studies, reviews and general policy assistance over the next 4 years. Whatever the actual budget eventuates to be it is clear that it is a tiny fraction of that allocated in the USA. The typical amount paid to consultants to conduct an Ecodesign study in just €300k whereas the budget allocated to produce a US technical support document is several US$ million. Value for money aside this vast disparity in resources has clear implications regarding the quality and timeliness of the evidence base in the European equipment efficiency process by comparison with its US counterpart.

Budgetary figures are not available for China or Japan; however, in the case of China it is known that not only are a large number of technical staff deployed for efficiency standards development work within CNIS but that the budget for externally supported work has been in the level of multi-millions of US$. Given the disparity in labour costs between China and the other economies investigated here the practical resources available to the Chinese efficiency standards development effort would appear to be considerably above those for the EU.

Throughput

The pace at which regulations and other policy measures are developed and adopted (throughput) is one of the key parameters of a programme's effectiveness. In this regard the EU seems to be some way behind the other peer economies although some of these have also had to overcome difficulties in the past. Australia has managed to set 2.5 regulations per year since the programme began in 1999 and 5.7 per year over the last 3 years. The pace at which China has been adopting MEPS and labelling has been increasing in recent years, as shown in Figure 6.4. China has set about 3.8 regulations per year since 2000 but the pace has increased to 6 per year for the last few years. This is a response to stronger overarching policy direction and to increased administrative resources to develop and implement the national standards and labelling programme. Japan has set 2.9 regulations per year since 1995 but METI is planning to accelerate that rate this year and next. The USA has been setting approximately 5 regulations per year over the last 6 years and is set to continue over the next few years. By contrast by the end of 2011 the EU had adopted just 17 MEP's and labelling regulations. Following the passage of the Ecodesign Directive the average rate of adoption has been 2.8 regulations per year. With 6 implementing measures and a voluntary agreement in 2012 and a promised record year in 2013, the average annual adoption rate in the EU may soon improve.

Figure 6.4 Energy consumption subject to MEPS in 2010 for China by major end-use (Zheng and Zhou 2011)



The comparative tardiness of the EU process is a major handicap to its overall effectiveness and puts in question its ability to make the desired contribution to the EU's 2020 goals for energy efficiency. The principal delays have occurred in the consultation phases after the preparatory studies have been completed. The causes seem to variously comprise elements of the following:

- Lack of consensus over the preparatory study results, sometimes caused by inadequacies in the studies or lack of sufficient market data stemming from inadequate market monitoring
- Lack of administrative capacity within the Commission, sometimes worsened by staff rotations and personnel changes
- Lack of readily available and adequate product performance measurement methods
- Lack of robust deadlines and streamlined procedures to accelerate the different stages of the process (consultations, negotiations with stakeholders, finalisation, mandating of measurement standards, etc.)

The first factor can be less contentious when the evidence base is stronger and the policy guidelines are clearer. The second factor is to be expected in the civil service and can only be addressed by larger teams or by moving some of the assessment and deliberative functions into the hands of a more stable technical support agency. The third factor is something which should be assessed very early on for all prospective products, ideally before full preparatory studies have been launched. In principle strategies to develop adequate test procedures across a swathe of important energy related products could be launched independently and in anticipation of Ecodesign requirements and hence should be anticipated from the regulatory development process.

Regulatory development process - findings

Several lessons can be drawn from this experience. The operation of an effective regulatory regime for equipment energy efficiency or broader Ecodesign requirements necessitates having a clear regulatory development process, operating to set timetables in pursuit of a clearly defined set of policy objectives. Once these are established the procedure becomes one of carefully establishing and assessing the evidence base in a structured way to set the regulations according to prescribed policy objectives. Discussion and consultation when it occurs is then confined to issues surrounding the nature and correctness of the evidence base used to make the determinations and not the relative weighting to be placed on one factor or another.

Ideally the consultation and discussion process needs to occur within a set regulatory window beyond which the development of the evidence base is closed and the determination on the policy instrument is made using the evidence available. The fact that this does not occur in the EU is one of the principle causes of delay in the issuing of Ecodesign measures. The determination of the policy instrument also benefits if it has to be made within a set period as this focuses minds, avoids spending too much time on peripheral issues and ensures that measures are issued. The US process has evolved to ensure this is the case with legal consequences should the regulatory timetable slip.

Programmes such as those implemented in Australia and Japan which set policy settings according to a clear overriding principle - matching the most stringent MEPS applied among the trading partners (for Australia) and matching the level of the most efficient product on the market (for Japan) – find it easier to develop policy settings in a short timeframe and can manage a greater throughput with limited resources. The simplicity and clarity of these policies lowers the number of parameters that need to be assessed, reduces analytical costs and limits the scope for debate around the numbers. Furthermore, there is not discussion about the type of policy instrument, which is already pre-determined. This shortens the period needed for consultation and discussion and accelerates the regulatory time table.

For larger industrial economies of the size of China, the EU or USA it could be argued that the stakes are higher and the needs of the analytical evidence base are increased. The different methodologies used to set regulations are discussed in section 7; however, if good and unambiguous outcomes are to be produced they cannot be skimped on. Thus for programmes that rely on more sophisticated analytical determinations it is essential that the scale of resources for both administrative functions and the analysis that feeds into them are large enough to address the needs and sufficient to avoid regulatory delay. The revised US process manages this by:

- setting definite time limits to each stage of the regulatory development and issuance process
- by properly resourcing the analysis and administrative phases
- by limiting discussion and deliberation to the correct inputs and outputs of each analytical step used to make the final determination

China manages this process by committing large human resources to the analysis and administrative aspects, by limiting consultation and by ensuring the regulatory time table takes precedence over other factors.

The EU by contrast has the most comprehensive analytical and assessment needs (as they are required to assess all cradle-to-grave environmental impacts), has no legally binding prescribed time limits to each step of the regulatory timetable, has an open-ended determination regarding the type of implementing instrument to be adopted and has the smallest amount of human resources committed to the conduct of analysis and administration of the outcomes. Under these circumstances regulatory delay is to be expected and seriously hampers the expected policy delivery.

7. Regulatory design methodology

Regulatory design methodology

There are very important distinctions between the way standards and labelling regulations are derived in the different peer economies.

Nature of regulatory minimums

In Australia, China, Europe and the USA regulations take essentially the form of minimum energy performance requirements (MEPS) which prohibit products which are less efficient than a given level from being sold on the market. In Japan the Top Runner programme specifies a fleet-average minimum energy efficiency requirement wherein an equipment producer or supplier must ensure that the sales-weighted average efficiency of the products they sell exceeds the designated minimum level. In practice this means that some products with an energy efficiency level lower than the specified threshold can be legally sold provided the average of all the products sold by the given supplier exceed the specified minimum. This approach may provide greater flexibility in deciding how to meet the regulatory requirements but it makes compliance much more challenging because it is not possible to know if a product is compliant just by inspecting and testing it.

Nature of energy labels

Australia, China, the EU and Japan all operate mandatory categorical energy labelling schemes where the label has a number of efficiency thresholds and the products are classified into one of the efficiency classes. The US mandatory Energy Guide label uses a continuous scale where the efficiency of any given product is shown via a vertical arrow pointing to the efficiency the given product has on the (horizontal) efficiency scale. Research has shown that this type of label design has less market transformation impact than categorical designs and it's for this reason that all the more recent international energy labels use a categorical design.

In addition to the mandatory labels the US and the EU also operates a voluntary endorsement label, Energy Star. Higher efficiency products (typically in the top 25% of the market) are entitled to use the Energy Star label and specifications have been set for almost all major energy using products on the market including commercial equipment. The Energy Star label is also used for information technology products in Europe, for which it is jointly managed by the EU and the DOE under the international Energy Star programme. Australia and Japan also acknowledge and use the international Energy Star label for IT products but are not involved in designing the specifications. In the EU, another voluntary ecological endorsement label, the 'eco-label' includes energy efficiency requirements when it is applied to energy-using products but also encompasses other environmental parameters.

In addition to a mandatory categorical energy (which is only applied to 6 products) Japan also deploys a mandatory energy efficiency label for a wide variety of products. This label indicates the product's energy efficiency level as a percentage of the Top Runner requirement. In addition it is marked red for products which don't meet the Top Runner efficiency requirement and green for those that meet or exceed the requirement.

In general the best market transformation programmes use the energy label to complement minimum energy efficiency regulations, such that the MEPS prohibit inefficient products and the labels create demand for higher efficiency products. As MEPS are revised upwards over time they are often set at one of the energy label thresholds and thus the label thresholds can also be precursors for future MEPS.

For some of the products for which it has been issued the EU's energy label has done this very well and has a good track record of creating demand for high efficiency products.

Analytical methods used to determine efficiency thresholds

The method and rigour of the analytical approaches used to set efficiency thresholds used in regulatory policy measures is one of the most critical and least understood components of energy efficiency standards and labelling programmes. The approach used has a very strong baring on the stringency of the eventual policy settings and is a key, if not the key, determinant factor of eventual impacts. In practice quite different approaches are adopted in the peer economies although there are superficially strong similarities.

The regulatory processes followed in the US, EU and China all carry out technical analyses to determine the technical options to improve the energy efficiency of products on the market. In the case of the US this is essentially the primary piece of analysis used to inform the decision regarding the stringency of the MEPS set. In Europe and China this is one component along with a statistical analysis of the efficiency of products on the market. The US process is certainly the most thorough when it comes to doing this analysis. For each product under consideration a software tool is developed to analyse the impact of design changes on the energy efficiency of typical products sold on the market and to examine to what level of efficiency it is possible to take the products by the successive application of higher efficiency design changes. This energy engineering analysis is complemented by a techno-economic analysis which analyses the impact of higher efficiency design options on product manufacturing costs and final retail price. The overall results are analysed to determine what design changes produce the most cost effective energy efficiency improvements and thus to determine a theoretically optimised cost versus efficiency cost. This curve enables the energy efficiency level associated with the least life cycle cost (from the consumer's perspective) over the life of the product to beestimated, which is one of the key elements in the US decision making process. Such an engineering approach is very informative, however, it has been demonstrated to lead to overly conservative assessments of cost-benefits from higher efficiency levels unless technology learning effects are also taken into account. Underestimation of innovation and technological deployment trends for the design and manufacture of equipment on the market, leads to sub-optimal MEPS and should be complemented by 'learning curve' approaches, as well as complementary market-based estimates that provide a better estimation of market evolution (PSI & BIOIS, 2011).

In principle the Chinese and EU analytical processes also do this kind of techno-economic energy engineering analysis but in practice the degree to which it is done varies from case to case and the rigour with which it is done is very rarely as high as in the US case. For example in the EU a detailed energy engineering analysis was done for domestic refrigerators and freezers in 1993 (GEA 1993) and again in 2000 (Cold II) but when Ecodesign requirements were set in 2010 the Lot 13 analysis simply applied some design screening factors to the earlier Cold II analysis and omitted to conduct any fresh energy-engineering simulation or techno-economic analysis despite the previous analysis being over 8 years old. Indeed in most cases there appears to be no requirement for the Ecodesign consultants charged with carrying out technical studies to have access to energy engineering software capable of simulating the impact of successive design changes on product efficiency or to have software capable of simulating the impact of higher efficiency design changes on product cost. Rather in most of the Ecodesign studies it appears that simplistic spread sheet analytical tools have been used to estimate the impact of higher efficiency design options on costs, energy savings and GHG emissions. Such techniques can be adequate to derive a provisional estimate but are insufficient when it comes to assessing the real efficiency, cost, economic and environmental impact trade-offs inherent in a potential set of regulatory thresholds.

In China the situation is similar. There is no prescriptive set of analyses that is required to be done to determine the MEPS and labelling thresholds, so the process is somewhat ad hoc. In practice China invariably develops efficiency test procedures and metrics if these are not already in place (often by drawing on internationally developed metrics), conducts a statistical analysis of products on the market and does some benchmarking against international markets. On several occasions these analyses have been complemented by the conduct of some type of techno-economic energy engineering analysis to determine the technical and economic improvement potentials (as is routinely done in the USA and usually in the EU). However, energy engineering design tools only seem to be used for regulatory design purposes when they are provided by external sources. Comparable domestic analytical tools do not appear to have been developed, so the application of such regulatory design techniques is erratic. Based on the findings from these analyses a decision is then made about where the MEPS level should be set and for the efficiency thresholds used in the mandatory labelling scheme. A decision is also made regarding whether to have three or five efficiency classes in the label (where class 1 is always the highest efficiency level).

In recent years MEPS regulations have also often been structured to include “reach standards” which are a second tier of standards, set at a higher efficiency level than the first tier and scheduled to take effect some years later. This approach has the benefit of ensuring that the regulatory requirements have on-going improvement built-in and also give advanced notice to industry of what the future efficiency requirements will be, which enables them to better plan investments.

The analytical approach used to setting regulations in Australia and Japan is quite different again and is partially driven by their specific policy objectives and market circumstances that apply in these countries. In the majority of cases Australia is not a producer of the equipment it regulates but is an importer and generally it imports products from all the main international centres of equipment production. Its market size is not large enough to stimulate foreign producers to develop high efficiency products just for sale in the Australian market so it is not viable for Australia to consider implementing policy measures that are more stringent than are achieved in international markets. Accordingly, the basic policy premise adopted for the last several years has been to survey current international policy settings and to set Australian requirements to match the most stringent requirement currently applied among its principal trading partners. This approach has its complexities as it requires policy settings established under a potentially different set of energy efficiency test procedures and efficiency metrics to be interpreted under Australian test procedures and metrics. In addition, while such analyses are used to provide a starting point for presumptive regulatory settings the final deliberations are always informed by analyses of additional, locally specific factors; however, Australia has a good record of setting MEPS at levels similar to the highest current international levels for many products.

The European, Japanese and US MEPS setting methodologies are now considered in detail.

EU Methodology

Among all the product analysis methodologies applied in the peer economies the one used in the EU is the only one to apply a full cradle-to-grave life cycle assessment. This is because of the emphasis of the original legislation is on minimising all the negative environmental impacts of the product first and on optimising economic factors second. This is laudable in principle but less so in practice, because of the compromises imposed through severely constrained resources to conduct product studies. The analysis in the peer economies is centred much more clearly on opportunities to reduce the energy consumption in use.

Nonetheless the Ecodesign methodological process has certain strengths. First, along with the USA, the EU process is the only one to follow a clearly defined methodology for all products. This was originally developed exclusively for energy using products and has been revised in 2009 to improve some parts and expand the scope to include energy-related products. It is set out in the *Methodology study Ecodesign of Energy-Related Products* (MEErP 2011). The aim is to evaluate whether and to what extent various energy-related products fulfil the criteria that make them eligible for implementing measures under the Ecodesign and Energy Labelling Directives, as well as provide the means to suggest credible and well-informed efficiency metrics and values for the labelling classes and the MEPS levels.

These criteria are specified in Article 15 and Annexes I and II of the Directive. Explicitly, in preparing a draft implementing measure the Commission shall:

a) consider the life cycle of the product and all its significant environmental aspects, inter alia, energy efficiency. The depth of analysis of the environmental aspects and of the feasibility of their improvement shall be proportionate to their significance. The adoption of ecodesign requirements on the significant environmental aspects of a product shall not be unduly delayed by uncertainties regarding the other aspects
b) carry out an assessment, which will consider the impact on environment, consumers and manufacturers, including SMEs, in terms of competitiveness including on markets outside the Community, innovation, market access and costs and benefits
c) take into account existing national environmental legislation that Member States consider relevant
d) carry out appropriate consultation with stakeholders
e) prepare an explanatory memorandum of the draft implementing measure based on the assessment referred to in point (b)
f) set implementing date(s), any staged or transitional measure or periods, taking into account in particular possible impacts on SMEs or on specific product groups manufactured primarily by SMEs.

Implementing measures are required to meet all the following criteria:

a) there shall be no significant negative impact on the functionality of the product, from the perspective of the user
b) health, safety and the environment shall not be adversely affected
c) there shall be no significant negative impact on consumers in particular as regards the affordability and the life-cycle cost of the product
d) there shall be no significant negative impact on industry's competitiveness
e) in principle, the setting of an ecodesign requirement shall not have the consequence of imposing proprietary technology on manufacturers
f) no excessive administrative burden shall be imposed on manufacturers.

The analyses conducted are therefore designed to support the Commission in making these determinations. Regarding these, the directive goes on to stipulate:

- A technical, environmental and economic analysis will select a number of representative models of the product in question on the market and identify the technical options for improving the environmental performance of the product, keeping sight of the economic viability of the options and avoiding any significant loss of performance or of usefulness for consumers.
- The technical, environmental and economic analysis will also identify, for the environmental aspects under consideration, the best-performing products and technology available on the market.

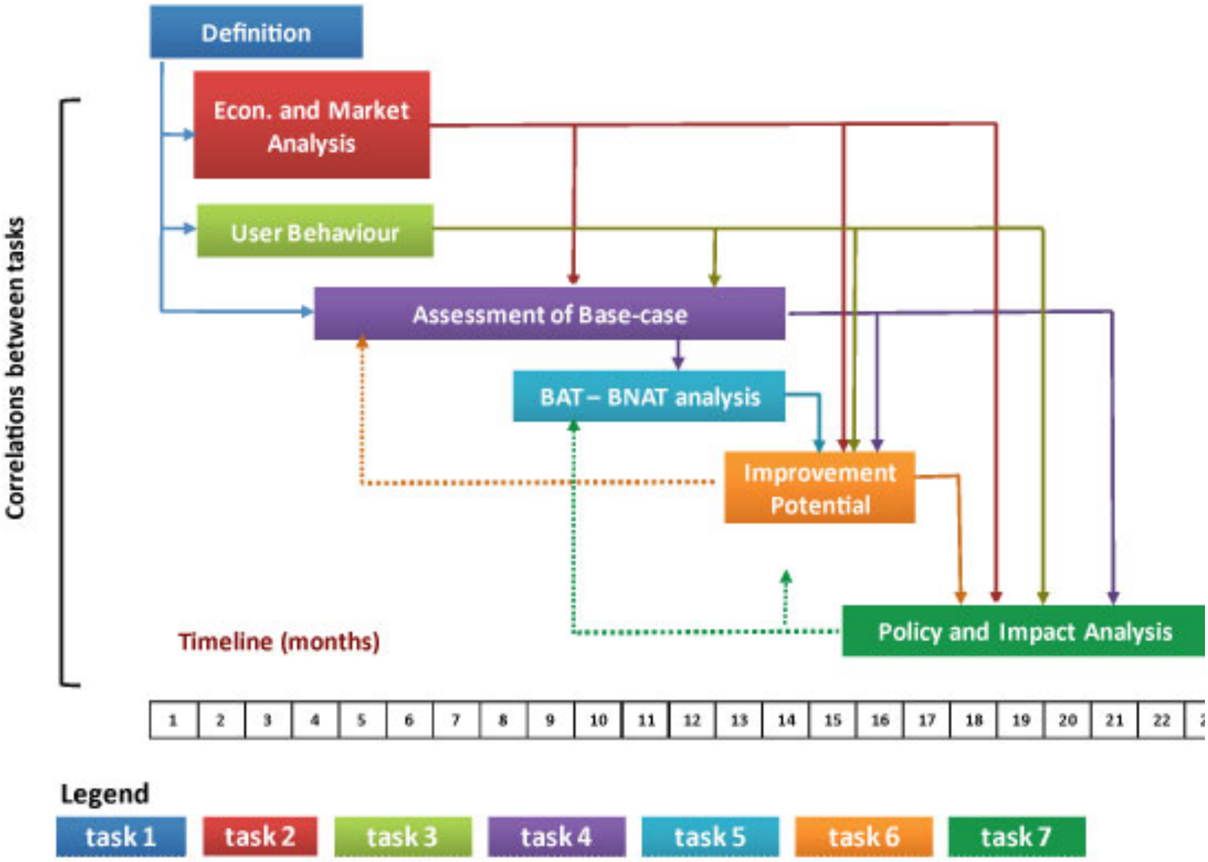
- The performance of products available on international markets and benchmarks set in other countries' legislation should be taken into consideration during the analysis as well as when setting requirements.
- On the basis of this analysis and taking into account economic and technical feasibility as well as potential for improvement, concrete measures are taken with a view to minimising the product's environmental impact.
- Concerning energy consumption in use, the level of energy efficiency or consumption will be set aiming at the life-cycle cost minimum to end-users for representative EuP models, taking into account the consequences on other environmental aspects. The life-cycle cost analysis method uses a real discount rate on the basis of data provided from the European Central Bank and a realistic lifetime for the EuP; it is based on the sum of the variations in purchase price (resulting from the variations in industrial costs) and in operating expenses, which result from the different levels of technical improvement options, discounted over the lifetime of the representative EuP models considered. The operating expenses cover primarily energy consumption and additional expenses in other resources (such as water or detergent).
- A sensitivity analysis covering the relevant factors (such as the price of energy or other resource, the cost of raw materials or production costs, discount rates) and, where appropriate, external environmental costs, including avoided greenhouse gas emissions, will be carried out to check if there are significant changes and if the overall conclusions are reliable. The requirement will be adapted accordingly.
- A similar methodology could be applied to other resources such as water.

To help meet these needs a common product assessment methodology was established that has been used in all product implementing measure preparatory studies over the last seven years. It distinguishes eight product-specific assessments that need to conducted:

1. Product Definition, Standards and Legislation
2. Economic and Market Analysis
3. User Requirements and System Environment
4. Technical Analysis Existing Products
5. Environmental and Economic Assessment of Base-Cases
6. Technical Analysis BAT and BNAT
7. Ecodesign Improvement Potential
8. Policy, Impact and Sensitivity Analysis

Figure 7.1 shows the flow between the various assessments, indicated over a timeline of approximately two years. The analytical teams conducting the actual research on these products may modify the task structure slightly, as is deemed appropriate for products concerned and their respective stakeholder groups.

Figure 7.1 The Ecodesign assessment process



In principle the EU methodology is very comprehensive. It documents and considers standardisation needs and assesses market, economic and consumer behavioural factors. The technical analysis of existing products covers all cradle-to-grave environmental impacts of the products in each of five product phases. Base case products are determined and assessed and the best available technology determined and compared to the base case (theoretically from assessing the best on the EU market and internationally). Improvement potentials are determined and used in assessments of the Best Not Available Technology (i.e. the best technology that could be conceived with existing components and techniques) and of life cycle costs from a consumer perspective. Lastly, impact analyses are determined according to a specified set of scenarios to determine the impact on the environment, consumers, manufacturers and markets from the market meeting given eco-design performance levels.

In practice though some deficiencies in the analyses have been reported which are often actually attributable to limitations in time and resources. The most important of these concern the critical assessments of energy in use and associated economic impacts, which in practice dominate the implementing measure determinations because they dominate the majority of product life cycle impacts and the degree to which any given performance threshold requirement might satisfy the life cycle cost optimisation requirements. Deficiencies can include: rather cursory examinations of international markets and product efficiency levels, limited assessments of actual in situ product performance compared to idealised performance under standard test procedures, insufficient access to credible and recent market data, limited assessments of higher efficiency design options both from a technological (energy savings) and economic (cost of implementation) perspective, and somewhat variable impact assessment scenarios. Inconsistency and variability in the quality of analyses is almost inevitable given the requirements of the procurement process as consultancies that have the necessary specialised knowledge on product standardisation, technical and economic characteristics are not likely to have experience in modelling policy impacts and vice versa. This raises the question of whether some aspects of the analysis might not be better managed in a transversal (cross-cutting across product groups) manner than just through product specific Lots awarded to a single consultancy.

The multi-disciplinary nature of the product assessment work needed in all product energy efficiency regulatory activity is a challenge for all jurisdictions and as their programmes evolve regulators have increasingly appreciated the need to foster a permanent pool of competencies that can bring the relevant skill set to each requirement of the product assessment. Fundamentally, there are difficulties posed by an asymmetry of information between the regulators and their consultants and industry that deals with the design, manufacture and marketing of products on a daily basis. These difficulties are far worse when a product has never been the subject of efficiency regulations in the past (as is increasingly the case for products considered in the Ecodesign process) as there is no history of compiling the required data that can be drawn upon for the analysis. The principal difficulty that the Ecodesign analytical process has suffered from is a wholly unrealistic matching of analytical requirements to the means put at the disposal to conduct the analysis. The typical budget for an Ecodesign product study addressing all of the above analyses is €300k which is roughly a tenth of the commensurate budget allocated to the commensurate studies in the USA. The Commission has undoubtedly generally got very good value for money for the studies it has conducted but the European Community as a whole, including the needs of consumers, industry and the environment, would be far better served were greater resources committed to conducting these assessments and were their calibre to be raised accordingly.

Japanese Methodology

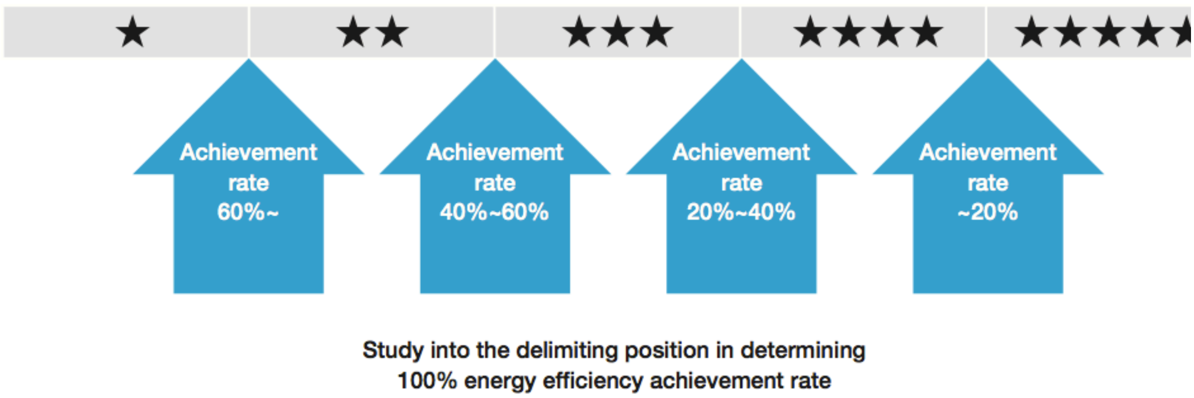
A key guiding principle of the Top Runner approach, and the one which gives it its name, is that a priori the regulatory efficiency thresholds (the target standard value) will be set at the level of the current most efficient product on the national market. The technical assessment will aim to determine if it is reasonable to expect the whole market to attain this efficiency level in the near future, or whether there are unreasonable entry barriers such as wholly proprietary technology etc. Depending on the product, the target standard value for each category can be set by a single numeric value or defined using a formula related to product attributes such as TV screen size. For home electric appliances and office equipment, the reduction of standby power consumption must be taken into account when setting the standard value. The target year, which differs by product, is set three to ten years ahead depending on the relationship between current efficiency levels, the target value and expectations regarding the rate of technological progress.

Therefore the primary analysis to be conducted is the determination of the most efficient product on the market followed by an assessment of whether there are any inherent reasons why the requirements should not be set at that level. This “habeas corpus” approach has the advantage that it is based on the performance of actual products that have been shown to achieve the given efficiency level but it’s advantage is also its weakness, in that it is constrained to not consider potential design options that are of a higher efficiency than are currently on the market. In practice this limitation is not as important in Japan as it might be in other markets as there is a long established tradition of Japanese product producers competing on energy efficiency. This is fuelled by a comparative lack of access to domestically derived energy resources, high energy prices and a culture of economy which promotes innovation in efficiency and energy saving. As a result the main regulatory decision is to decide how long the rest of the market will be given to catch up with the current highest efficiency "Top Runner" level. This is informed by the working group analyses that consider the technologies used to reach the Top Runner level and their associated trade-offs. The working groups assembled to do these analyses have members with strong subject matter expertise. The analyses they conduct involves a degree of technical assessment to determine the means by which the most efficient products will satisfy the technical design options. Nonetheless, the analyses are not generally of the same rigour as those done in Europe or the USA.

The approach adopted is akin to the EU's BAT assessment but does not encompass the BNAT assessment that is done in the EU and USA (although it is not called as such in the latter). In general, the importance of doing rigorous and competent energy engineering and techno-economic analyses cannot be overemphasised. When done well these analyses are not bounded by the technology currently available on the market but demonstrate what savings could be achieved for what additional cost were all potentially conceivable design changes to be adopted. In Europe such analyses have previously been done that showed that it was possible to more than double the efficiency of clothes driers currently or the market or to produce refrigerator-freezers that used 60% less energy than a class-A appliance for the same functionality. Without these analyses energy label thresholds would not have been set at levels that stimulated the production of heat pump driers or A+++ refrigerator-freezers and products at these efficiency levels would be unknown to the market. Experience has shown that setting very demanding efficiency thresholds in labelling requirements has not only stimulated the production and sale of such models but has rapidly driven down their incremental costs and thus helped trigger a much more profound an enduring market transformation than would otherwise have occurred. Thus investment in such analyses is one of the key means of ensuring cost-effective policy driven outcomes in line with broad societal goals for the environment, energy security and the economy.

The approach applied in Japan does partly address these concerns, however, as the labelling design involves setting efficiency levels for the highest efficiency classes that are not currently met by products on the market. In the case of the uniform energy label a systematic approach is used to set the efficiency thresholds between the star rating classes as shown in Figure 7.2. When the Top Runner standard is first designed ~60% of products should be able to attain a 1-star rating, from 40-60% a 2-star rating, from 20-40% a 3-star rating and ~20% a 4-star rating with none attaining a 5-star rating.

Figure 7.2 Attribution of star rating class thresholds in the uniform energy label in accordance with the proportion of the market which attains the threshold



The Japanese approach does have some other important merits. The simplified technical assessments based on actual product performance are quick to set, relatively inexpensive to conduct and easy to revise, which means that regulations can be developed and issued for less administrative and financial resources. Market monitoring continuously feeds into regulatory development and threshold revision decisions and is structured to trigger them automatically in accordance with certain market share principles. On the other hand, it is weak on assessing cost-benefits and determining value for money for consumers and society as a whole.

US Methodology

The original US Energy Policy Conservation Act lists at least six criteria that the DOE must take into consideration when establishing a new or amended energy conservation standard. The six statutory criteria represent the key questions that the Secretary takes into consideration when proposing and adopting the DOE regulatory standards:

a) the savings in operating costs throughout the estimated average life of the covered product in the type (or class) compared to any increase in the price of, or in the initial charges for, or maintenance expenses of, the covered products which are likely to result from the imposition of the standard
b) the total projected amount of energy, or as applicable, water, savings likely to result directly from the imposition of the standard
c) any lessening of the utility or the performance of the covered products likely to result from the imposition of the standard
d) the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard
e) the need for national energy and water conservation
f) other factors the Secretary considers relevant

Overall, the Secretary is required to choose the standard level that is designed to achieve the maximum improvement in energy-efficiency that is technologically feasible and economically justified. These requirements and the procedure used to assess them was reviewed and revised in 1995-6. The outcome was the issue of a revised process rule (Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products - hereafter referred to as the Process Rule) which sets forth guidelines for developing efficiency standards. These guidelines are designed to provide for greater and more productive interaction between the Department and interested parties throughout the process. They are also designed so that key analyses are performed earlier in the process, with early opportunities for public input to, and comment on, the analyses. The improvements it introduced are summarised as follows.

- Provide for early input from stakeholders
- Increase the predictability of the rulemaking timetable
- Reduce the time and cost of developing standards
- Increase the use of outside technical expertise
- Eliminate problematic design options early in the process
- Conduct thorough analyses of impacts
- Use transparent and robust analytical methods
- Fully consider non-regulatory approaches
- Articulate policies to guide the selection of standards
- Support efforts to build consensus on standards
- Establish an annual priority-setting process to focus available resources on those efficiency standards likely to produce the greatest benefits

In addition to ensuring that its analyses address the seven EPCA criteria and follow the Process Rule guidelines for developing regulations, the Department must follow numerous procedural requirements—mandated by various statutes and Executive Orders—and perform all associated supporting analysis. These requirements are integrated into the rulemaking process, analysis, and documents. The analyses that DOE performed for the rulemaking, which typically takes 3 years, include:

- **Market and Technology Assessment** to characterise the market (including manufacturers, shipments and trends) and to review technologies and approaches for making the covered product more efficient
- **Screening Analysis** to evaluate technology options for improving efficiency that should not be considered further in the rulemaking because of issues with safety, utility, manufacturability or other defined criteria
- **Engineering Analysis** to study the relationship between manufacturing a product to be more efficient and associated increases in the cost
- **Energy Use and End-Use Load Characterisation** to generate energy use estimates for the covered product in service and end-use load or consumption profiles
- **Mark-up Analysis** to convert manufacturer prices to retail / installed customer prices
- **Life-Cycle Cost (LCC) Analysis** to calculate, at the consumer level, the discounted operating cost savings over the average life of the product, compared to any increase in the retail/installed costs likely to result from the efficiency standard
- **Shipments Analysis** to estimate shipments of the product over the time period examined in the analysis
- **National Impact Analysis** to assess the aggregate impacts at the national level of consumer payback, net present value (NPV) of total consumer LCC, national energy savings (NES) and national employment
- **Life-Cycle Cost Subgroup Analysis** to evaluate impacts on identifiable subgroups of customers who may be disproportionately affected by a national efficiency standard
- **Manufacturer Impact Analysis** to estimate the financial impact of standards on manufacturers of the covered product and to calculate impacts on competition, employment at the manufacturing plant, and manufacturing capacity
- **Utility Impact Analysis** to estimate the effects of proposed standards on the installed capacity and generating base of electric utilities (e.g. any reduction in electricity sales)
- **Employment Impact Analysis** to estimate the impacts of standards on net jobs eliminated or created in the general economy as a consequence of increased spending on the more efficient products and reduced customer spending on energy
- **Environmental Assessment** to evaluate the impacts of proposed standards on certain environmental indicators including CO_2
- **Regulatory Impact Analysis** to present major alternatives to proposed standards that could achieve comparable energy savings at a reasonable cost.

Table 7.1 shows how these analyses support the assessment criteria.

Table 7.1 Assessment criteria and associated analyses under the USDOE rulemaking process

Criteria	Analyses conducted
(a) the economic impact of the standard on the manufacturers and on the consumers of the products subject to such standard	Life-cycle cost and payback analysis (including LCC subgroup analysis Manufacturer impact analysis
(b) the savings in operating costs throughout the estimated average life of the covered product in the type (or class) compared to any increase in the price of, or in the initial charges for, or maintenance expenses of, the covered products which are likely to result from the imposition of the standard	Life-cycle cost and payback analysis (including
(c) the total projected amount of energy, or as applicable, water, savings likely to result directly from the imposition of the standard	National impact analysis including shipments
(d) any lessening of the utility or the performance of the covered products likely to result from the imposition of the standard	Screening analysis Engineering analysis
(e) the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard	Manufacturer impact analysis
(f) the need for national energy and water conservation	National impact analysis including shipments
(g) other factors the Secretary of Energy considers relevant	Environmental assessment Utility impact analysis Employment impact analysis Regulatory impact analysis

These analyses mirror many of those applied in the EU process, however, the difference tends to lie in the depth and rigour of their conduct. Some of the most important analyses conducted in the US rulemaking process are:

Market and Technology Assessment

This assessment characterises the markets and existing technology options for making product under consideration more energy-efficient. Information is gathered on the present and past industry structure and market characteristics of the product(s) concerned. Factors addressed include: national shipments; identification of the largest players in the industry; existing non regulatory efficiency improvement initiatives; developments around standards in States and neighbouring countries; and trends in product characteristics and retail markets. The information collected serves as resource material that DOE use throughout the rulemaking.

In the technology assessment information is gathered about existing technology options and designs to improve energy-efficiency. The sub-division of products into classes that the can be used in a rulemaking is a key feature of this assessment. Covered products are generally subdivided into product classes using the following criteria: the type of energy used, capacity, and performance related features that affect consumer utility or efficiency. These product class definitions are derived using information obtained from manufacturers, trade associations, and other interested parties. As different efficiency standards are likely to be set for the each product sub-division they are an important element affecting the overall impact of the regulation. Historically the EU process has tended to allow more grouping of product types than has occurred in the US process and hence more commonality of treatment. An example is the EU's overarching Ecodesign implementing Directive on standby power, which applies to a large swathe of products using standby power whereas the US regulations on standby are set on a product by product basis. Similarly the EU implementing measure for household lamps covers all omni-directional household lamps whereas the US regulations are set separately for each individual sub-type. The savings are generally larger when a broader approach is taken but this is a question of interpretation as much as methodological process (which is very similar in both jurisdictions).

Screening Analysis

The screening analysis is used to consider whether certain technologies should be used in the rulemaking analysis by assessing them according to four screening criteria: 1) technological feasibility, 2) practicability to manufacture, install, and service, 3) that they should not have an adverse impact on product utility or product availability, and 4) that they should not adversely impact health and safety. Each of the efficiency enhancement design options identified in the technology assessment are screened them against these criteria and if any are found to contravene one or more of them they are excluded from consideration. Although cost is not a screening criterion (it is considered in the life cycle cost assessment) design options are sometimes dropped for quite conservative and somewhat arbitrary reasons. For example, the option of increasing insulation thickness was precluded from the most recent refrigerator rulemaking because it was considered to adversely affect product utility (which appears a strange statement…).

Engineering Analysis

The engineering analysis develops cost versus efficiency relationships for products that are the subject of a rulemaking. This entails analysing the energy savings from applying any given higher efficiency design option that was not precluded in the screening analysis and estimating the change in the cost to manufacture the product. The engineering analysis also determines the maximum technologically feasible energy efficiency level. The outputs are fed into the LCC and manufacturer impact analyses. The design options comprising the maximum technologically feasible level must have been physically demonstrated in at least a prototype form to be considered technologically feasible. In general, three methodologies are used to generate the manufacturing costs needed for the engineering analysis:

1. the design-option approach – reporting the incremental costs of adding design options to a baseline model
2. the efficiency-level approach – reporting relative costs of achieving improvements in energy efficiency
3. the reverse engineering or cost assessment approach – involving a "bottom up" manufacturing cost assessment based on a detailed bill of materials derived from product teardowns

Considerable sums and energy are invested in conducting these analyses to ensure that the simulation tools used are reliable and that the input data (derived from the extensive tear down analyses and other sources) is accurate. These aspects are some of the ley strengths of the US approach and are generally superior to the comparable analyses conducted in the EU processes. As a result is more probable that the US analyses will result in reliable cost versus efficiency relationships.

Mark-ups for Equipment Price Determination

The installed price (or retail price) is derived by applying mark-ups to the manufacturer selling price determined in the engineering analysis. The mark-up analysis considers the value chain, through which products are distributed and the associated mark-ups at each of those stages. Thus an in-depth assessment is made of all the mark-ups, shipping costs, sales taxes and installation costs (if appropriate) associated with bringing a product to market.

Life-Cycle Cost and Payback Period Analyses

The LCC analysis, calculates the discounted savings in operating costs throughout the estimated average life of the covered product compared to any increase in the installed cost for the product likely to result directly from the imposition of a standard. To consider the economic impacts of standards the DOE calculates the changes in LCC that are likely to result from the standard levels considered, as well as a simple payback period. DOE calculates both the LCC and the payback period (PBP) using a Monte Carlo statistical analysis so these results are presented as distributions of consumers with a variety of inputs rather than as simple average values.

Manufacturer Impact Analysis

DOE conducts the manufacturer impact analysis to estimate the financial impact of efficiency standards on manufacturers of those covered products and to assess the impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative components. The quantitative part of the MIA primarily relies on an industry-cash-flow model that takes into account industry cost structure, shipments, and pricing strategies. The model's key output is the industry net present value (INPV), and it assesses the financial impact of higher efficiency standards by comparing changes in INPV between the base case and the various efficiency levels under consideration by DOE. The qualitative part of the analysis addresses factors such as the material supply chain, manufacturing techniques and equipment, and market and product trends, and includes a subgroup assessment of the impacts on small manufacturers.

DOE also conducts an assessment of impacts on appropriate subgroups of manufacturers. DOE is aware that smaller manufacturers, niche players, or manufacturers exhibiting a cost structure that differs from the industry average and who could be more negatively impacted by energy efficiency standards.

The US DOE has applied a number of innovations to these analyses in recent years. A shadow value of carbon has been applied to the operating cost in the life cycle cost analyses which has the effect of shifting the efficiency level associated with the least lifecycle cost to a higher level. Furthermore, the economic analyses have moved away from static production cost assumptions and have started to take into account the effect of learning (discussed below) on the future incremental cost associated with any given product efficiency level. This again has the effect of strengthening the ambition of the standards as the least life cycle cost is determined over the lifetime of the regulation, not just the moment it comes into effect, and this allows for the likelihood that incremental product costs associated with any given efficiency level are liable to decline over time.

Learning curves

Over the years since energy efficiency standards and labelling schemes have been implemented it has become clear that there is a significant energy efficiency learning curve affect which is not independent of energy efficiency policy settings. The learning curve concerns not just the rate of improvement in energy efficiency but also the incremental cost of higher efficiency technologies. Historical reviews of the predicted increase in product cost as a function of energy efficiency improvement derived from regulatory impact assessment analyses have shown that the projected increase in costs have rarely if ever occurred to the extent estimated and often there has been no discernible increase in product cost in response to a regulatory induced efficiency increase. Estimates of the incremental costs of higher efficiency products are usually produced early in the regulatory development process and have traditionally been implicitly assumed to be static i.e. invariant with time. Given the growing appreciation of the significant conservatism that this assumption imposes some regulatory processes are now exploring how to account for learning curve effects within the analyses. The US Secretary of State for Energy, Stephen Chu, has spoken about the importance of correctly accounting for this effect in the efficiency standards development process and the DOE has recently built learning effects into its regulatory analysis.

Reach standards

A “reach standard” is a more demanding 2nd tier efficiency standard that is announced at the same time that a less demanding efficiency standard is adopted. China has used this approach in many of its recent regulations and the EU likewise. The approach is to adopt a new MEPS level while simultaneously setting higher efficiency energy labelling thresholds. The future reach MEPS are set at one of the higher energy label efficiency levels but with a lead time of a few years before they will take effect. This approach has the benefit of ensuring that the regulatory requirements have on-going improvement built in and of giving advanced notice to industry of what the future efficiency requirements will be, which enables them to better plan their investments.

Summary

In general, the importance of doing rigorous and competent energy engineering and techno-economic analyses cannot be overemphasised. When done well these analyses are not bounded by the technology currently available on the market but demonstrate what savings could be achieved for what additional cost were all potentially conceivable design changes to be adopted. The EU and USA have the most comprehensive methodologies for MEPS development which include looking at products that could be on the market as well as those that already are. They employ appropriate sets of analyses in principle but the US process is sometimes rather arbitrarily constrained by conservatisms in product classification and technology screenings whereas the EU process is mainly constrained by inadequate budgets to conduct the analyses needed to a suitable level of depth and quality. The US process for determining the real production costs, both when the standard is developed ad in the future, and associated bill of materials for products is much more comprehensive than that applied in Europe. Similarly, the analytical tools used to assess higher efficiency design options in the USA are usually more robust due to substantial investment in their development and verification.

Experience has shown that setting demanding efficiency thresholds in MEPS and labelling requirements has not only stimulated the production and sale of models with previously unavailable efficiency levels but has rapidly driven down their incremental costs and thus helped trigger a much more profound and enduring market transformation than would otherwise have occurred. Thus investment in such analyses is one of the key means of ensuring cost-effective policy driven outcomes in line with broad societal goals for the environment, energy security and the economy.

8. Stringency

One way of assessing the ambition of product energy efficiency regulations is to consider the degree of energy efficiency improvement they have stimulated in the market. Another is to compare their stringency to those in place in peer economies. However, determining the stringency of efficiency requirements set in the different peer economies is challenging, not least because of substantial differences in product energy performance measurement test procedures, product classifications and energy efficiency metrics. There have been very few studies that have attempted to do such an assessment in a comprehensive way. The most comprehensive general assessment of this issue yet produced was the CLASP study on harmonisation of international energy efficiency standards (CLASP 2011); however, this relied on rather simplified adjustments to benchmark MEPS stringency for each product type. The EU Ecodesign preparatory studies are required to examine international regulations applied to the product in question but they tend to report the requirements as specified in the local economy. They rarely attempt to interpret the stringency of the regulations using metrics that would allow direct comparison with the efficiency of products and stringency of regulations on the EU market unless exactly the same product classification and efficiency metrics are used.

The IEA 4E Implementing Agreement has conducted a number of benchmarking studies which aim to compare product energy efficiency levels across leading markets; however, these have not always been of a depth that allows differences in test procedures, efficiency metrics and product classes to be properly accounted for. In general, however, there is a growing interest in this topic and work is underway under the SEAD programme of the Clean Energy Ministerial to develop more reliable product energy efficiency benchmarking tools on a product-by-product basis. Summaries by economy of what is known about the stringency of MEPS are presented below.

Australia

Australia has adopted a policy where they aim to set MEPS to be aligned with the highest prevalent level among their major trading partners. As a result the level of MEPS in place is usually reasonably stringent albeit rarely internationally leading. The exception to this is the policy to phase out incandescent lamps for which Australia were the first nation to implement incandescent phase-out regulations among the OECD economies.

China

To date China has rarely set MEPS levels at the most stringent levels in place among the peer economies but the gap in stringency is narrowing. In one or two instances where China is the only economy to have regulated a specific product, such as compressors, the Chinese MEPS are the most stringent but China has usually been content to set levels that are slightly less demanding than the most stringent international requirements.

The EU

The EU has led the world in its Ecodesign standby power requirements as they apply to such a broad swathe of product types. Similarly its requirements on circulators and industrial fans are world leading. For other products the picture is more mixed although the EU requirements are seldom far behind the most advanced. EU MEPS requirements for clothes-washers are World leading for their type although other economies may lower total energy specifications but based on a non-comparable wash cycle. EU MEPS for refrigerators are roughly as stringent as any currently in place but comparisons with the US, Japan and Australia are difficult and the recently passed US MEPS are likely to be more stringent when they come into effect. EU requirements for electric motors are not as stringent as those in the USA except that they give a gentle encouragement to sell the motors coupled with variable speed drives (a two tier approach is used such that if the motor is sold without a VSD it has to meet an efficiency level which is equivalent to the US MEPS but if sold with a VSD it is allowed to be at a lower efficiency level). It is a moot point as to which approach produces the greater energy savings as were VSD deployment to be enhanced via the lower stringency of the EU motor MEPS it might actually produce larger savings than attainment of the higher motor efficiency level alone. The EU's household lamps requirements are also more demanding than those in place elsewhere except that they essentially produce exactly the same outcome – the prohibition of sale of standard incandescent lamps. Often the coverage of EU requirements is broader than in other economies and the approach taken, that considers what is the basic service provided in a broad way and then avoids prescriptions on product classifications and features that lock-in and insulate technologies from competition with alternative technologies, is a sound one and often leads to much greater savings than more narrowly focused regulations. This has been one of the key strengths of the Ecodesign process and is an area where the other peer economies could learn from it. Apart from the standby case and household lamps MEPS already mentioned, others include Tertiary lighting (that encourages competition across equivalent light sources)

Japan

METI has conducted evaluations of energy efficiency improvements and these generally indicate quite significant improvements in fleet average efficiency levels for new products, e.g. see the results reported in Table 8.1.

Table 8.1 Anticipated and actual market average efficiency improvements for products regulated under the Top Runner programme

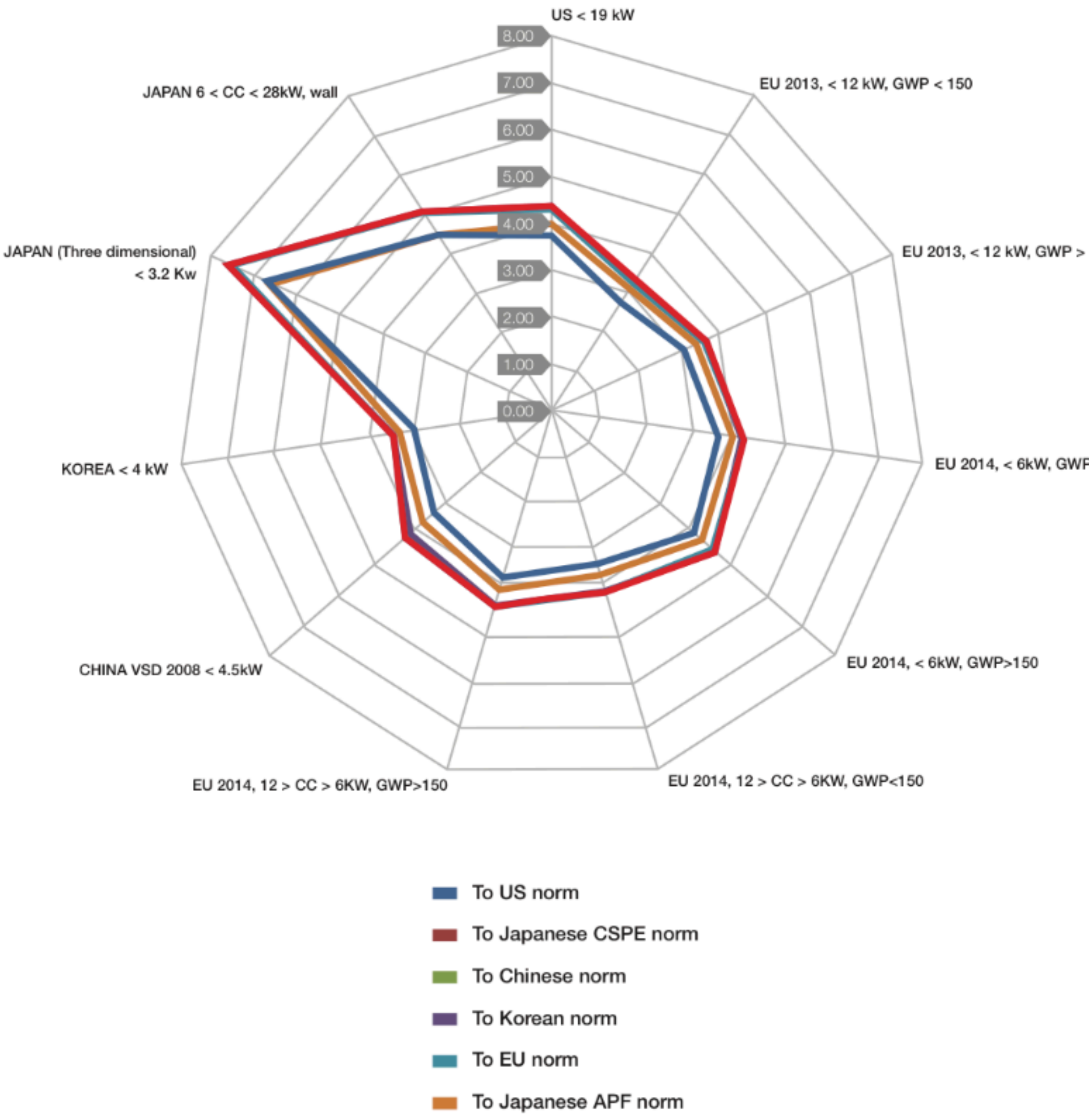
Product category	Energy efficiency improvement (result)	Energy efficiency improvement (initial expectation)
TV receivers (TV sets using CRTs)	25.7% (FY 1997 →FY 2003)	16.4%
VCRs	73.6% (FY 1997 →FY 2003)	58.7%
Air conditioners * (Room air conditioners)	67.8% (FY 1997 →2004 freezing year)	66.1%
Electric refrigerators	55.2% (FY 1998 →FY 2004)	30.5%
Electric freezers	29.6% (FY 1998→FY 2004)	22.9%
Gasoline passenger vehicles *	22.8% (FY 1995→FY 2005)	22.8% (FY 1995→FY 2010)
Diesel freight vehicles *	21.7% (FY 1995→FY 2005)	6.5%
Vending machines	37.3% (FY 2000→FY 2005)	33.9%
Computers	99.1% (FY 1997 →FY 2005)	83.0%
Magnetic disk units	98.2% (FY 1997 →FY 2005)	78.0%
Fluorescent lights *	35.6% (FY 1997 →FY 2005)	16.6%

Historically the energy efficiency levels of Japanese equipment and regulations have not been directly benchmarked against those in other economies and because of differences in test procedures it is not a simple matter to make these comparisons. In recent times there have been some efforts to bridge this gap although much still remains to be done.

The 2010 CLASP study to benchmark the efficiency of room air conditioners developed a method to adjust for differences in test procedures to enable proper efficiency comparisons to be made. Some limited testing of the same products according to different international test procedures was used to verify that the results of the test procedure conversion algorithm are viable. The subsequent benchmarking of regulatory stringency showed that the Japanese Top runner requirements for the most common categories of room air conditioner were substantially more demanding than those in place in the EU, the USA, Korea or China

(Figure 8.1) and it is clear that the average efficiency of air conditioners sold in Japan are much higher than for other leading markets. For example if the Top Runner efficiency requirements are converted into the equivalent values that are expected when measured using the EU's test procedure they would equate to a European seasonal energy efficiency ratio (ESEER)of about 7.5 W/W for products of less than 3.2kW of cooling capacity. This is roughly twice as high as the recently adopted EU MEPS, which are for ESEERs of between 3.3 and 3.7 W/W in 2013 (depending on the GWP of the refrigerant used).

Figure 8.1 Comparison of seasonal energy efficiency standard requirements by economy when adjusted for test procedures used in each economy, for variable-speed, non-ducted split AC units - The results show Japan currently has the most ambitious policy settings (CLASP 2012)

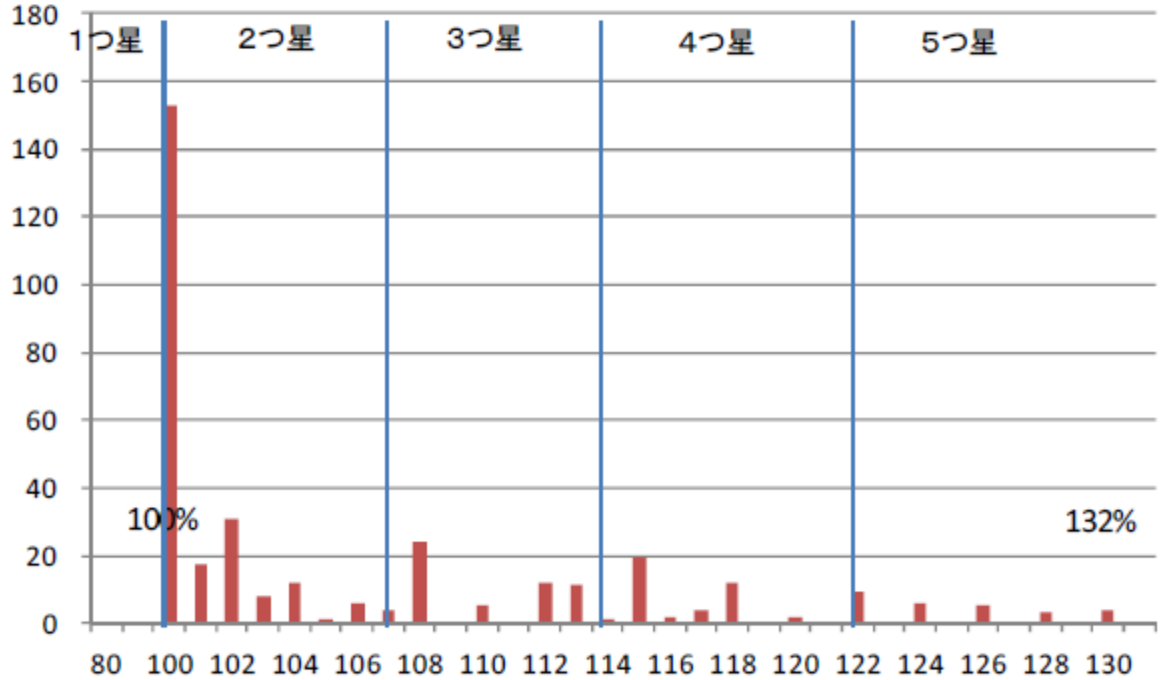


Work is also currently underway though the SEAD programme to properly benchmark policy settings for refrigerators, noting that the analysis done for the IEA-4E benchmarking study did not properly take account of very important differences in test procedures and product features, such as large differences in the average internal and external temperature conditions, that are expected to greatly influence the results. From first inspection; however, it appears that the most efficient Japanese refrigerators are as efficient as the most efficient models sold in the EU.

In general the energy efficiency levels of Japanese products using heat pump technology (refrigerators, air conditioners, vending machines, heat pump space and water heaters, commercial refrigeration etc.) tend to be high or very high and the Top Runner policy settings mirror this.

Japan is actually in the process of further revising upwards its already very ambitious Top Runner room air conditioner requirements and according to the latest January 2012 survey data the most efficient air conditioners are over 30% more efficient than the Top Runner threshold (Figure 8.2).

Figure 8.2 Distribution of Japanese room air conditioners as a function of the Top-Runner standard achievement rate, where 100% = the present Top Runner requirement (ANRE 2012)



Similarly impressive efficiency levels are probable for fluorescent and LED lighting products, and standby power loads. Also Japan is clearly a world leader in car fuel economy (especially for standard internal combustion engine powered vehicles and for hybrid petrol vehicles) and for HGVs (where it is the only economy to have established a fuel economy test procedure and to have set efficiency requirements). It is also thought to be the world leader in the adoption of power electronics and variable speed drive technology in industrial motor driven applications such as compressors, pumping, ventilation and mechanical movers (an area where there is a very large potential to save energy in most economies). By contrast Japan is lagging in the adoption of regulatory measures for electric motors and for HID lighting. The existing Top Runner requirements for TVs are thought to be less stringent than those applied in the EU and someway behind the latest MEPS set in the USA. Little is known about the relative efficiency of Japan's gas fuelled appliances while some of the other Top Runner measures are unlikely to be world leading (e.g. for distribution transformers although overall Japan has the lowest transmission and distribution losses of any major economy).

The USA

Historically the efficiency requirements specified in US MEPS have used very different test procedures, efficiency metrics from those applied outside North America and efficiency stringency comparisons have been greatly complicated as a result. The US clearly has the world leading MEPS for electric motors (excluding the VSD element in the EU MEPS discussed earlier) and TVs and probably does for many other products where the comparison is less evident. A limitation of the US MEPS is a tendency to set levels by rather narrowly prescribed product groups, which sometime limits competition from competing technologies that essentially provide the solution. This could be said to apply to the separate rulemaking processes that are applied for screw-based A-lamps, bulge-reflector lamps, elliptical reflector lamps, incandescent reflector lamps and other reflector lamps rather than say the EU's process of setting requirements for all household lamps and distinguishing service based on whether the light emitted is directional or omni-directional. It is quite likely that substantial savings could be lost through such narrow product classifications.

9. Review and revision

The review and revision process adopted in the peer economies has many similarities. In the EU the implementing measure regulations stipulates when the provisions need to be reviewed within a period of typically 4 to 5 years from the date the measure enters into force. In the USA the review periods are fixed by statute and are typically a maximum of 7 years. In Australia, China and Japan it is up to the regulators to decide how frequently they will review and revise the MEPS regulations.

In all cases, however, once the programme matures the review and revision of existing MEPS becomes a larger part of the total workload and this needs to be reflected in planning determinations and resource allocations. Essentially, as a larger proportion of energy-using and energy-related products are subject to regulations or voluntary measures the amount of activity required to review and maintain those requirements increases proportionately. As Japan and USA have the most structured processes – as opposed to China and Australia - we shall focus the analysis only on these two peer economies.

Japan

In the case of Japan Top Runner requirements have been in place for some products for 11 years and these products are now entering their third review period i.e. the requirements have already been updated twice and are now poised for their third assessment and revision. This is the case for air conditioners, computers, electric toilets, fluorescent lighting, passenger vehicles and refrigerators (ANRE 2012). In consequence 2012 is a particularly charged year for the review and revision of existing Top Runner requirements with many product assessments being initiated in the same time frame. In some cases this has also triggered a simultaneous review of the existing test procedures. For example, METI is currently reviewing the test procedure and Top Runner requirements for room air conditioners. The review of Top Runner specifications occurs simultaneously with the review of the Uniform labelling requirements. For all products METI conducts an annual assessment of the sales-weighted distribution of product energy efficiency and this is also a key input into the Top Runner and labelling review determinations.

USA

The 2007 Energy Independence and Security Act revised the previous requirements in the Energy Policy Conservation Act to require that the DOE review and update all energy conservation standards and test procedures on an on-going basis. This means that every energy conservation standard and every test procedure must be reviewed every 6 and 7 years through a public participative process. Specifically, the statute now requires:

- Six years after issuance of a final rule establishing an energy conservation standard, DOE must either publish a notice of proposed rulemaking (NOPR) to amend the standard or a notice of determination that an amended standard is not warranted (42 U.S.C. 6295(m)(1) and 6313(a)(6)(C)(i)).

- DOE must review all test procedures on a seven-year cycle (42 U.S.C. 6293(b)(1)(A) and 6314(a)(1)).

Of 15 product groups that the DOE has plans to issue MEPS for between the end of 2012 and 2017 some 7 are for revisions to existing requirements. The DOE is also reviewing energy performance test procedures for 4 product groups over the same timeframe.

10. Compliance and rigour

Historically compliance has been a somewhat neglected area of most equipment energy efficiency programmes, with only a limited number of jurisdictions committing significant resources into compliance related activities. Interest in the topic has increased in recent years and all of the peer programmes are giving more attention to the issue as the importance of the topic becomes more apparent. Compliance typically embraces two main aspects. First, that products sold on the market are legally eligible for sale and meet the specifications of the energy efficiency regulations such as MEPS. Second, that they are properly labelled and their declared energy performance is accurate. Among the peer economies Australia has been operating a long standing compliance programme with regular product energy performance verification testing and in store surveys to ensure products are properly labelled at the point of sale. In the EU responsibility for compliance lies with each EU Member State and the level of effort has varied from almost nothing up to programmes of a slightly lesser scale than the Australian programme. Denmark and the UK are two of the countries in the latter bracket that have operated long standing check testing and compliance activities. The Chinese authorities have been doing much more vigorous check testing in recent years and have initiated a number of efforts to verify energy performance and improve compliance with labelling provisions. In the USA, the Obama administration has elevated the importance of compliance activities within the energy conservation standards programme. In addition to a long standing tradition of sanctioning industry association led third party product energy performance certification efforts for a number of products, the DOE has now commissioned extensive third party check testing efforts and in some cases launched some high profile law suits against offending producers and suppliers; the results of which were widely publicised.

The third aspect of compliance is the magnitude of penalty imposed on non-compliant producers, suppliers and retailers and the degree of deterrence this creates. In most of the peer economies bad publicity can be a major deterrent, especially if the offending entity has a well-known brand; however, there has often been a reluctance to pursue non-compliance through the courts, in part because the burden of taking out a lawsuit and seeing it through to its conclusion is quite heavy for cash and resource strapped administrations. The magnitude of penalties which can be imposed in the event of a successful prosecution also vary substantially. Within the EU Member States alone the maximum imposable penalty for non-compliance ranges from as little as €580 to as high as €4m depending on the Member State in question. The lower values are so small that they are scarcely likely to be a deterrent to non-compliance. Another key concern has been the lack of cooperation between

Member State authorities until recently and the non-recognition of test results from one country to another, which limits the effect of sanction in one MS on the EU market as a whole.

Comparisons of levels of compliance across economies have only ever been done in a limited manner and present certain difficulties. First, only the more active programmes have tended to conduct check testing and in store surveys and thus these are likely to indicate compliance in the better managed programmes. Second, the check testing in some economies tends to be targeted towards suspected offenders and hence may overstate the degree of non-compliance. Nonetheless the findings suggest that there is a significant problem with non-compliance in almost all jurisdictions and that an important part of the programme benefits are liable to be lost as result.

Australia

Australia operates one of the World's most thorough and efficient energy efficiency standards and labelling compliance programmes. It uses a mixture of regular random check testing of products subject to labelling or MEPS to determine the accuracy of declared information and also regular in-store surveys to determine retailer compliance with energy labelling requirements. In addition all products subject to MEPS or energy labelling have to be registered on a centrally managed database before they are eligible for sale. This greatly facilitates tracking the models currently on the market and follow-up with manufacturers during the compliance process.

In the case of the energy performance check testing programme the product sampling is coordinated centrally and products are tested in a handful of approved test laboratories. The quality and uniformity of these tests is ensured through periodic benchmark testing across the laboratories.

As a result of these efforts the levels of compliance with requirements are high when compared to international peer economies. In the most recent store survey the percentage of products where the label was fully correctly displayed varied from a low of 89.1% of room air conditioners to a high of 98.5% for refrigerators & freezers and for clothes washers and is generally above 95% (ARC 2011).

Table 10.1 shows a summary of the results of the compliance check testing over a one year period, and indicates that compliance rates are reasonably high for many product categories although some problems were encountered. It should be noted that these results may overstate the actual average rate of non-compliance as the programme managers are more likely to test products they consider may be problematic than those they think most likely to comply (based on experience gathered over many years of compliance testing).

Table 10.1 Summary of Australian equipment energy efficiency (E3) programme product energy performance check tests for the period 2009-10 as of June 2010, (E3 2011a)

Product Type	Products tested	Products passed	Products failed
Electric Motors	26	25	1
Refrigerator/Freezers	19	17	2
Air Conditioners	2		2
Water Heaters	9	9	
Refrigerated display cabinets	4	4	
Clothes washers	1	1	
Fluorescent lamps	24	21	3

The Australian government has shown itself willing to enforce the law in the event of non-compliance being identified. Following the check testing efforts during 2009/10, one air conditioner was deemed to be non-compliant. This resulted in the product being de-registered and no longer having the right to be sold or imported into Australia and New Zealand (E3 2011a). As a further deterrent the findings were widely publicised. New legislation being adopted in Australia is bringing in a clearer non-compliance process and stronger penalties for non-compliance including significant fines.

Japan

The details of the verification and enforcement procedures followed in Japan do not appear to have been made fully publicly available and so there are significant uncertainties about certain aspects and their overall rigour. METI is understood to commission checks to ensure the requirements of the Top Runner program are being complied with. These include the inspection of documents submitted by manufacturers and importers, noting that each is required to submit a list of all products they have sold in Japan to METI in January each year. It is not clear, however, how sales-weighted efficiency levels can really be checked and many international experts consider this to be a weakness in the Top Runner approach, which makes it impractical for other economies to adopt in the same manner as in Japan. Note, conventional MEPS programmes do not specify minimum fleet-average efficiency levels as Top-Runner does, but rather set minimum performance levels that all products must meet. In this case it is much simpler to verify the compliance of any given product.

The various industry associations are believed to take responsibility for ensuring that products of the types their members produce are correctly labelled. It is also reported that a government agency conducts tests to ensure products are labelled correctly. For example, some 150 manufacturers and importers were surveyed in 2009 and it was reported that some 12000 products sold by 119 companies were correctly labelled.

It is also understood that depending on the product category, many industry associations conduct tests on randomly selected products and use peer-review amongst member companies to ensure the accuracy of the information presented on the energy labels. Thus a system of producer self-policing is thought to apply.

METI is understood to use a relatively light touch to enforce the product efficiency regulations. If a producer or importer is not meeting the programme requirements they are asked to come into compliance and if they do not do they are believed to be named and shamed. METI also has the option of imposing fines and ordering suppliers to stop selling non-compliant products, but it is thought that simply contacting non-compliant market actors has largely been sufficient for them to remedy their transgressions to date. Details of exactly what enforcement actions have been pursued and how frequently are not publically available.

China and the USA

Details of the compliance activities in these two economies are not reviewed in this report; however, it is known that both have been increasing their programme compliance efforts in recent years. Since the advent of the Obama administration the US DOE is understood to have employed four advocates to administer non-compliance procedures and lead prosecutions against offenders. Furthermore, some industry associations in the US manage third party certification schemes which address the energy performance declarations of their members products and provide some assurance that those producers operating within the scheme are providing accurate product performance declarations.

Summary

Compliance is an area where the product energy efficiency programmes in all the peer economies have plenty of scope for improvement. Among them Australia has historically organised the most comprehensive product check testing and conformity surveillance efforts and has managed to do this with a rather modest budget through the efficiency with which the effort is organised. In general the EU appears to have the largest problems with compliance, which is exacerbated by the patchwork of compliance responsibilities in place across the Single Market. While some EU Member States have been moderately proactive in this regard others have done very little. It is interesting that Australia initially faced the same difficulties, due to each state having authority for compliance, but agreement was reached between them to cooperate in a centrally coordinated compliance programme and since that time the effectiveness of the effort has improved considerably.

The benefit-cost ratio from investment in improved compliance is extremely favourable but this is poorly understood and compliance is a difficult activity to raise funding for in times of austerity.

11. Monitoring and impacts

Continuous evaluation is a key aspect of programme success as it helps identify areas where implementation is not occurring as foreseen and it ensures that savings are being delivered in line with expectations. Impact evaluation requires the monitoring of markets from before and after the policy measures are implemented to help identify policy induced changes in market trends. The usual approach is to focus on the headline “leading” indicators of the trends in the efficiency of new products entering the market as determined according to standard test procedures; however, this is insufficient as it is also necessary to evaluate the impact on the “lagging” indicator of the energy consumption of the stock of equipment in actual use and the factors that are influencing it.

While most programmes have made some efforts to gather data on the leading indicators few have made systematic efforts to assess the lagging indicators, which are the real measure of programme impact. Process evaluations, which aim to assess key aspects of programme implementation, are also somewhat scarce. They are important as they help ensure that market actors are aware of their responsibilities and acting accordingly, that regulations are developed efficiently and implemented on time, that the means of certifying energy efficiency and related performance is in place, that compliance authorities are under taking meaningful activities that are a proper deterrent to non-compliance, that the key aspects of the programme are communicated to the affected stakeholders, that data needed to is design and evaluate the programme is being collected in a timely way and that all the technical infrastructure that the programme rests on, such as test procedures, efficiency metrics, etc. are being developed in a timely manner and in a way that furthers the programme's objectives.

With the pressure to deliver visible policy settings it is tempting for programme administrators to place little emphasis on these activities, unless required to do so for statutory regulatory impact assessments or other factors; however, this is undesirable. The quality of the impact assessments is likely to have a large bearing on both effective programme design and delivery but also on the perception of programme success and resource allocations, thus ensuring that on-going robust assessments are conducted is a critical aspect of programme growth.

The assessments which have been conducted have generally shown that the equipment energy efficiency standards and labelling programmes deliver remarkably high benefit cost ratios and very considerable environmental benefits and generally with a high degree of certainty. The magnitude of these results merits being communicated much more widely than has hitherto been the case to help clarify exactly what is at stake from the effective design and implementation of these programmes and how much benefit stands to be lost from sub-optimal programmes. Where impact evaluations have been more ambiguous in their findings it has invariably been due to a dearth of clear data to establish a sound baseline and this is the result of inadequate foresight when the programme is established.

Australia

The Australian programme managers organise regular impact evaluations of the entire programme. The most recent impact assessment (GWA 2009) was the fourth such study undertaken by the programme and analysed the projected impacts of the E3 Programme within Australia for the period 2000-2020. These programme-wide impact assessments draw upon numerous data collection efforts organised through the E3 programme that include:

- Regular on-going monitoring of product sales and energy efficiency characteristics
- Surveys of equipment ownership and usage
- Extensive end-use metering campaigns to determine actual equipment usage levels and energy consumption among end-users
- Detailed bottom-up modelling of equipment energy use

The combination of these activities enables the Australian E3 programme to have a thorough understanding of all the factors affecting the impact of the programme and to make credible and detailed assessments of the programmatic impacts and to project expected future impacts. As the programme has matured and more data has been assembled the results have not only confirmed that the expected impacts have generally been achieved but have also shown the impacts of such factors as slight delays in the regulatory process on future energy savings.

According to the most recent collective impact assessment the E3 programme is expected to save almost 22 TWh per annum by 2020 in the residential sector and 10.3 TWh per annum in the non-residential sector. These energy savings are expected to result in cumulative emissions abatement of 250.2 Mt CO_2e over the period 2000-2020 (E3 2011a, GWA 2009).

Overall the programme is projected to yield a cumulative economic benefit to Australia of AUD $22.4 billion by 2020[7] with an overall benefits-to-cost ratio of 2.9.

If we consider that the total government expenditure on the E3 programme and its predecessors will have totalled around AUD$25m by 2011 each government dollar spent will have helped leverage net economic savings of around AUD$850 by the time the majority of impacts are experienced even when discounting the value of future savings.

In terms of abatement costs it is estimated that each tonne of CO2 saved through the E3 programme will save the Australian economy AUD$56 i.e. has a negative net abatement cost of –AUD$56/tonne. Thus, these savings reflect not only economic and environmental benefits, but also significant savings for households, businesses and industry throughout Australia and New Zealand.

In addition to these savings the estimated net benefits to the New Zealand economy are NZD $5.11 billion by 2036. Savings to date for the program in New Zealand are estimated to be around NZ$530 million in net cost and 8.6Peta –Joules of energy consumption (more than 200 000 toe).

The comprehensive nature of the Australian evaluation process is a good role model for other economies to emulate. It begins with the production of regulatory impact assessments that derive expected impacts when new MEPS are drafted and considered for implementation. New product sales, energy consumption and efficiency data is gathered on an on-going basis before and after the MEPS and labels are designed and implemented. This is coupled to data on compliance rates and ownership and fed into a bottom up stock model to forecast impacts on actual in situ energy consumption. Detailed end-use energy metering data is gathered to inform and validate assumptions on usage and other factors that affect real world product energy efficiency and that are used in the bottom-up energy models. The same data is also used to inform product energy performance test procedure development and maintenance to ensure that the test procedures produce results that are genuinely representative on energy consumption in real use. In addition detailed process evaluations are also conducted to ensure the programme implementation is occurring as planned and is on track.

EU

The regulations adopted under the Ecodesign Directive are forecast to save about 400 TWh of electricity demand per year in 2020, corresponding to 13% of the electricity consumption in Europe in 2007 or more than the electricity consumption of Italy per year. Associated CO2 emissions reductions of 160 million tonnes were estimated. The remaining product groups under varying degrees of development are expected to ultimately lead to far larger savings again (VHK 2012, Ecofys 2012). The extension of the Ecodesign Directive's scope to address energy-related products opens the prospect of yet greater savings, most of which have yet to be properly determined.

As is the case in Australia the Commission also conducts regulatory impact assessments that project expected impacts when new implementing measures are under consideration for adoption. An impact assessment has also been conducted of the entire Ecodesign directive since it was first launched. This assessment included both a process evaluation and an impact assessment; however, in the latter case it mostly was unable to draw firm conclusions due to a lack of data from before and after the regulations were developed and implemented. The collection of data is still rather ad hoc and tends to occur through the course of the Ecodesign preparatory studies but not so much otherwise. There is no

[7] Net present value (NPV) in 2008, calculated assuming a discount rate of 7.5%, excluding a carbon price

systematic effort to gather continuous time series of product sales, energy and efficiency data for all major energy using and energy related products in the EU although numerous ad hoc processes are undertaken, sometimes at the community-wide level and sometimes at the level of individual Member States or regions. As a result there is a patchwork of data, which is much richer for some products than others and which is rarely centrally managed. There have been many end-use metering studies conducted at various times in EU Member States, but again this data is usually not centrally managed and analysed to attain a community-wide picture of real energy usage in situ, the degree to which it corresponds to energy measured under the standard test procedure and the factors which affect actual product energy usage.

Given the huge scale of the potential savings from the Ecodesign and energy labelling measures and the degree to which benefits could be increased and optimised from proper implementation it is essential that more be done to improve the frequency and calibre of the evaluations so the virtuous circle articulated in the case of Australia can also be realised in the EU. Most importantly there is a need to establish continual surveys of new products and the stock of existing products and ensure that necessary data is being gathered to allow proper on-going evaluations to be conducted, better regulatory design, better test procedures to be developed, reliable bottom-up energy and emissions models to be developed and maintained and improved impact forecasts to be developed.

The process evaluation identified many of the elements already alluded to in this report, including the problems created by a lack of administrative capacity to manage the programme.

USA

There have been many impact assessments conducted on the US appliance and equipment energy efficiency standards programme over the years since it was launched. One of the most recent concludes that the existing appliance efficiency standards reduced US electricity consumption by about 280 terawatt-hours (TWh) in 2010, a 7% reduction (ASAP 2012). The electricity savings are projected to grow to about 680 TWh in 2025 and 720 TWh in 2035, reducing U.S. electricity consumption by about 14% in each of those years. It goes on to estimate that in 2035 the existing standards will further produce:

- Annual natural gas savings of about 950 trillion British thermal units (TBtu), or enough to heat 32% of all natural-gas-heated US homes
- Peak demand savings of about 240 GW, saving about 18% of what the total generating capacity projected for 2035 would have been without standards
- Annual emissions reductions of around 470 Mt CO_2, an amount equal to the emissions of 118 coal-fired power plants

By 2035, the cumulative energy savings are projected to reach more than 200 quads (214 EJ), an amount equal to about two years of total US energy consumption.

The cumulative net economic benefit of these standards to consumers and businesses is estimated to be worth more than US$1.1 trillion. Overall the standards are projected to deliver a discounted net benefit to cost ratio of 4:1 and US$60,000 for each US$1 spent on programme development and administration. Thus despite the roughly factor of 10 greater expenditure on the design and administration of the US energy efficiency standards programme compared with the EU's the return on each $ invested is still remarkably high.

As in the EU and Australia the DOE also conducts regulatory impact assessments when each new MEPS ruling is nearing completion. These have to be assessed and approved by the Office of Budget and Management and thus must pass third party scrutiny. The assessments of the impacts of the whole programme which are produced by the DOE are also subject to third party verification by the OBM. Process evaluations are also conducted in the US but as in the EU there has perhaps been less work done to determine real energy use in situ than has occurred in Australia and so this is an area where there is still scope for improvement.

12. Conclusions and recommendations

This review of leading international equipment energy efficiency standards and labelling programmes has shown that while much progress has been made in the design and implementation of these programmes over the years and substantial and extremely cost-effective savings have already been achieved, that much more remains to be done to realise their full potential. The review has confirmed some important aspects of product energy efficiency policy development which are already well understood, including that:

- the magnitude of energy and cost savings achievable by such programmes is of a very significant scale such that they should form a major component of overall energy and environmental policy
- the coverage of MEPS should be sufficient to realise the large majority of potential energy savings
- the interaction between MEPS and labelling is important and should be designed to be complementary so that labels create an effective incentive for higher efficiency products to be introduced onto the market and MEPS remove poorer performing products from the market that no longer satisfy reasonable energy performance levels
- both MEPS and labelling should be dynamic and frequently revised to take account of technological progress – it is important that the regulatory schedule and administrative capacity should be sufficient to process the revisions required in a timely manner
- MEPS should be based on realistic and well-informed information about the techno-economic savings potentials from raising energy efficiency over the product life-cycle; the technology and cost assumptions used to guide the regulations should take into account the technology and production learning effect if they are to properly optimise the full potential for cost and energy savings reductions over the application period of the regulatory measure
- a priori, there is an asymmetry of information regarding product energy efficiency between industry and policy makers and therefore regulators need to invest in extensive independent technical expertise to enable the required knowledge to be gathered for regulatory design purposes. As there may be little market demand for this specialised expertise outside of the regulatory development process, it needs to be fostered and maintained to ensure there is adequate and reliable information for regulatory design and review purposes
- the stringency of regulatory settings should be adequately informed by the related settings in peer economies to ensure that viable energy savings opportunities are not being missed due to incomplete information regarding technological potential
- the fostering of globally aligned test standards, efficiency metrics, and product category definitions used in regulatory settings would facilitate regulatory benchmarking and comparison across peer economies while accelerating technology transfer
- compliance with MEPS and labelling should be monitored through systematic energy performance verification testing that is applied to a sufficient proportion of the products subject to the MEPS and labelling requirements so as to act as an effective deterrence to non-compliance

- non-compliance enforcement processes, procedures and penalties need to be vigorously implemented and sufficiently strong to effectively deter non-compliance
- market energy performance trends require regular monitoring to facilitate programme impact evaluation and design
- the resources allocated to the design and implementation of MEPS and labelling programmes should be of a sufficient scale to deliver the cost-effective savings potentials
- the regulatory framework needs to be comprehensive and robust enough to capture all viable cost-effective energy savings that could be achieved through MEPS and labelling and related policy instruments, such as green public procurement or utility managed energy efficiency schemes
- the regulatory design administrative and consultative procedures should be rigorous enough to identify all the pertinent information needed to inform regulatory decision-making but operated within an open and properly scheduled process; they should not be so complex as to create substantial delays in the regulatory development timetable
- consultation during the regulatory design process is essential to produce informed and appropriate outcomes but it is important to ensure proportionality and balance in the weighting given to divergent stakeholder views and to ensure that select interests are not able to unduly influence the regulatory design and issuance process
- stakeholder consultation works best when managed within a transparent and clearly set-out structure with a clearly delineated schedule and opportunity to comment
- every energy related end-use is serviced by products produced and marketed by major industries so it is important to invest appropriate attention to the development and implementation of regulations that affect them – there are few viable regulatory shortcuts and care is required to ensure that the administrative and technical capacity is adequate to manage the various programmatic needs

Aspects of international best practice are to be found in all the leading peer programmes but none of them yet delivers their full potential. The scope of potential application of the EU's programme is as high as any and its energy labelling scheme is one of the most successful but the EU is lagging behind other peer economies in important areas of implementation for its minimum energy performance regulations. Specifically, Europe would benefit from emulating aspects of:

- China and the USA in the breadth and scope of their MEPS coverage
- The USA in the rigour of its technical analyses which include: full product tear-down analyses to better estimate cost (e.g. the bill of materials) and performance factors, development and application of dedicate energy performance simulation software; the application of learning curves to estimate the likely future change in product costs over the prospective regulation lifetime; and the application of shadow values for carbon emissions in the techno-economic optimisation analyses
- Japan in the stringency of some of its measures and the dynamism of its policy settings
- Australia in the rigour of its compliance activities and of its end-use metering, forecasting, and market monitoring activity and impact assessments
- China and the USA in the scale of human and administrative resources committed to programme design and administration
- the USA in the scale of the budget committed to technical support activities
- China in the scale of its green public procurement efforts linked to its energy efficiency endorsement label

- the USA in its rigorous regulatory development process linked to a pre-determined time frame and highly structured consultation and dialogue process
- all of these economies in the speed and efficiency with which they develop and issue regulations but especially the USA in recent years, which like Europe has an elaborate and formalised analytical and consultative process

In so doing the EU would take an important step towards increasing the delivery of cost effective energy and emissions savings by strengthening the following areas of regulatory design and development:

- putting in place effective measures to accelerate the speed of regulatory development and adoption without compromising the integrity of the regulatory design process
- strengthening the integrity of the regulatory design process – specifically by: strengthening the efforts to gather and maintain necessary data; developing dedicated energy engineering simulation and economic design option simulation software for each product category to ensure that there is high quality and reliable information on the potential to improve the energy efficiency of each given end use and on the associated impacts on product costs.
- tightening the regulatory calendar to ensure that the development of new regulatory measures is not unacceptably delayed due to procedural failings, administrative staffing shortfalls or changes, or the failure to adequately resource and support the regulatory design process
- better monitoring of the design of test procedures in order to ensure the test procedures properly reflect public policy concerns and that test procedure revision is only approved once an impact assessment of its effects on current regulatory settings are known and can be adjusted for

To assist in the above improvements it will be necessary to invest substantially more in the effective administration and implementation of the Ecodesign and Energy labelling programmes than is currently the case. The extra resources are needed to:

- increase the administrative capacity of the programme, the lack of which being one of the principal bottlenecks currently limiting the programmatic throughput
- improve all aspects of data collection and analysis necessary to optimise the design of the regulations, the review and revision thereof, and to monitor and evaluate impacts
- strengthen monitoring and verification efforts
- strengthen test procedure development and maintenance efforts
- improve impact forecasting

All these factors will need to be addressed if the expected €90-120 billion of savings from the Ecodesign programme for the period 2005-2020 are to be realised or exceeded. Given that the recently estimated implementation costs for the Commission and Member States for the same period are roughly 400 times less than this (CSES 2012) it would clearly be advisable for the EU to invest more in the design and implementation of product energy efficiency policy in order to improve its delivery.

Recommendations

The EU needs to invest in the design and implementation of the Ecodesign and energy labelling Directives if it is to realise their impressive potential for cost-effective energy and carbon savings. The most urgent need is to bolster administrative and technical resources by increasing the number of desk officers administering the development of energy labelling and Ecodesign measures and by raising the budget available to sustain technical support for preparatory studies, data collection, standardisation development, forecasting, monitoring and evaluation. It may also be possible to address part of the administrative capacity shortfall by farming out some functions to other agencies or partners.

The Commission and Member States should consider adoption of a binding administrative schedule that fully clarifies well in advance all the regulatory design, standardisation and consultative procedures and indicates to stakeholders when they will have an opportunity to engage in or comment on the regulatory development process and when the process will conclude.

An associated regulatory development plan should be developed (and frequently revised) that clearly indicates the regulatory development resource requirements, provisional estimated outcomes in terms of energy savings, environmental impacts and economic effects and the impact on the share of total product energy use subject to energy labelling and Ecodesign measures.

The strength of monitoring and compliance activities needs to be substantially enhanced. Most critically efforts should be intensified to ensure adequate resources are committed to compliance at the Member State level and that synergies are explored that would facilitate greater cooperation among national market surveillance authorities. Given the low level of compliance activity seen to date in the EU it may be appropriate for the Commission to be given a coordination role and for legal obligations on the scale of compliance activity to be established.

Other recommendations:

The Ecodesign preparatory studies should consider the application of learning curves to estimate and account for the expected rate of technological and production cost progress associated with higher efficiency design options and the use of this in the techno-economic and least life-cycle cost determinations. Application of a shadow price for carbon emissions should also be considered in the life cycle cost determinations.

The Commission should explore options to strengthen the technical foundations of the preparatory studies by: organising the development and maintenance of product energy and cost simulation tools to be used to examine proposed design changes; conducting product tear -down analyses to establish the bill of materials and associated production costs, establishing longitudinal market and field data collection; farming out the impact assessments to a dedicated consultancy that applies the same approach across all product types; developing a long-term bottom up energy consumption forecasting tool for products in the EU based on stock modelling approach.

Efforts should be taken independently of the preparatory studies to benchmark EU product regulatory energy efficiency settings against those applied in peer economies and clarify reasons for the differences observed

Efforts should be made to work with the standardisation processes in the peer economies to share the developmental burden, enhance international harmonisation and facilitate policy benchmarking and trade.

Stronger efforts should be made to integrate the energy labelling specifications into green public procurement plans potentially including clear targets or obligations across the EU and similarly, to leverage other economic instruments to accelerate the adoption of advanced and innovative technologies.

The EU should consider options to share regulatory development efforts for demanding or green-field (new) product categories with administrations in peer economies.

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