Advancing standards and labelling globally by leveraging analysis of consumer products and commercial equipment

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Abstract
Around the world, energy performance requirements and test methods are being implemented and regularly revised for a range of domestic, commercial and industrial products and equipment. A significant amount of analytical effort is required to develop these requirements and optimise them to best reflect overall policy objectives; however, very often this work is done with only limited or partial knowledge of similar activities that have been done in other economies. Effort can be saved and outcomes improved for many products through properly reviewing published studies in other economies and utilising the information that is relevant in the local context. This paper presents a practical illustration of the potential to improve the quality of such analyses through four examples working on transformers, televisions, electric motors and external power supplies. This paper also discusses barriers to leveraging these analyses and makes recommendations around leveraging cross-economy analyses to accelerate global adoption of test methods and energy-efficiency requirements.

Introduction
Minimum energy performance requirements or so-called standards (MEPS) and labelling policies are currently in place for a variety of end-use equipment types in countries that account for about 80 % of the world's population and a higher proportion of its gross domestic product (GDP), energy use and carbon dioxide (CO_2) emissions (Waide et al 2011a). While these programmes have saved significant amounts of energy and CO_2 emissions, and are generally highly cost effective, these programmes have not benefitted from sharing data, analysis and resources. In the past, there was only limited cooperation between certain states such as Canada and the United States, however in the last two years there has been more signs of international engagement. Major economies including China, the European Union (EU), India, Japan and the United States of America (USA) have recently established the International Partnership for Energy Efficiency Cooperation (IPEEC), which is a high-level forum to facilitate the exchange of information and cooperation on energy efficiency policy. Under IPEEC, one of the programmes being promoted is the Super-efficient Equipment and Appliances Deployment (SEAD) Initiative, which is working with stakeholders to identify and accelerate deployment of advanced efficient technologies for certain priority appliances. (CLASP is the Operating Agent for SEAD.) In another recent initiative, the International Energy Agency's (IEA) Efficient Electrical End-use Equipment (4E) Implementing Agreement brings together some of the major economies into a common cooperative framework addressing energy-efficiency in electric equipment. Furthermore, the EU and the USA have established an EU-US High Level Regulatory Forum where senior program managers exchange information on their respective programmes and numerous other bilateral efforts are accelerating the rapidity of knowledge transfer between the principal policy makers.

Given the high degree of international activity with respect to MEPS and labelling schemes, it seems appropriate to consider what lessons may be derived from the sharing of analysis and findings for equivalent products being sold into different markets. In our experience, leveraging relevant parts of a regulatory analysis published in one jurisdiction to another can provide:

- A sanity-check on findings under review – the published regulatory analysis of one jurisdiction may be able to be used to compare against a new draft regulatory analysis issued for review. The published analyses can be used as a comparative reference when reviewing product performance levels, manufacturing costs, lifecycle payback periods and other critical analytical metrics.
- A parallel analysis/comparative benchmark – if sufficiently detailed, the published regulatory analysis of one jurisdiction could be adapted or scaled for use as a validation tool or benchmark to demonstrate the reasonableness of the regulatory analysis under review. The published analysis could also be used to calibrate the new analysis, enabling a higher degree of precision in the findings.
- The analysis itself – for certain products and with sufficient detail, it may be possible for the regulatory analysis of one jurisdiction to be adapted to serve as the primary analytical basis for the new market. This adaptation could include making adjustments for voltage, usage profile, model design or certain key features incorporated into the product.

At present, it can be complex to compare requirements around the world because product definitions may differ, energy test methods are often not aligned, efficiency metrics diverge and policy terms of reference are not the same. Nonetheless, in many cases there is a sufficient degree of alignment in these factors that it is possible to make more informed comparisons and in some other cases full alignment renders direct comparison possible. Such comparisons can greatly assist the policy making process because they remove uncertainty about the feasibility of reaching certain efficiency levels and facilitate fast-tracking of policy development through a "follow-the-leader" effect. Furthermore, harmonised test methods and product definitions can greatly facilitate manufacturers in the design, production and diffusion of energy-efficient equipment because they enhance clarity over efficiency requirements in different jurisdictions, reduce testing and compliance costs and minimise the need for regionally distinct product platforms.

Barriers to leveraging

Although leveraging analysis has the potential to save money, improve analytical quality and encourage objective assessment of regulatory standards, there are still barriers that would (and do) need to be overcome in order to realise the benefits. The barriers are associated with lack of awareness of other regulatory and standardisation processes, the disconnections in the current regulatory and standardisation processes, and limited resources.

AWARENESS OF PROGRAMMES IN OTHER ECONOMIES

Regulators are generally aware that the other major economies have MEPS and labelling schemes in place and that these schemes are regularly setting new requirements, however they are often not aware of the relevant details. These details include information on: coverage of regulated products, test methods and efficiency metrics, the type and use of equipment, the stringency of the regulations adopted and the timing of regulatory review and analytical support activity. As a result, the schemes are usually not aware that opportunities may exist to:

- share regulatory development activities, information and costs
- review and amend test methods and efficiency metrics
- emulate aspects of good regulations in place in other economies
- speed up the domestic regulatory processes by leveraging efforts made elsewhere
- compare the coverage, scope and stringency of the domestic regulations against existing, published analysis

DISCONNECTIONS IN THE REGULATORY PROCESSES

The regulatory processes in each economy are primarily based on domestic concerns and are managed through purely domestic processes. The only exception to this is the joint EU-US cooperation for ENERGY STAR applied to Information Technology and Office Equipment, which is managed through a joint regulatory structure staffed by representatives from both economies. In general, equipment energy efficiency regulatory processes are complex and demanding and most regulators are fully occupied in attempting to fulfil the requirements of their respective domestic processes. Regulatory schedules are set independently and are thus rarely informed by those in other economies, so there is no coordination in the scheduling of the products. Within the last year, regulators at the European Commission (EC) and in the US Department of Energy (DOE) have begun to exchange information on their regulatory programmes with a mind to consider potential cooperative opportunities and to be better informed of the nature of the regulations in place in each economy. This activity occurs at a relatively modest level and somewhat informally but does involve regular communication between the regulators in both economies.

Regulators in the major economies occasionally attend international fora (such as conferences and workshops) that discuss aspects of existing standards and labelling schemes and while this is useful as it helps to stimulate a degree of knowledge transfer it rarely results in structured cooperation to exchange information on programmes. That said, many regulators have taken steps to document and publish details of their programmes in the public domain to facilitate transparency for those that are interested in understanding more about their programmes.

DISCONNECTIONS IN THE STANDARDISATION PROCESSES AND THEIR APPLICABILITY

There is more international cooperation for test methods (i.e. test standards) to measure the performance of products because all the national or regional standards bodies that issue test methods are also members of the international standardisation bodies such as the International Standards Organisation (ISO) and the International Electro technical Commission (IEC). The national standardisation bodies send representatives to participate in international test standards development processes of interest to them and vote on the adoption of new or revised international test methods. Even countries which make comparatively less use of international test methods in their domestic regulations, such as the USA, will often participate in the development of new international standards through their nominated national representatives in specific technical committees. Nonetheless a disconnection occurs when test methods developed and adopted at the international level are not adopted for use in domestic MEPS and locally specific test methods are mandated for use by the domestic regulatory agency. Furthermore, the domestic test methods need to be developed and adopted in a manner that works with the demands of the regulatory schedule and it is often difficult to synchronise international standardisation efforts with multiple domestic regulatory programmes.

Another barrier that some regulatory authorities have reported is that international test methods are not necessarily representative of prevalent local conditions and usage patterns and thus are not always deemed to be suitable for adoption within national regulations. This situation is more likely to arise when regulatory authorities have not encouraged national standardisation bodies to proactively participate in international standards setting processes. In most cases where national standardisation bodies have participated, the resulting international standards are designed to accommodate the differences in local operation and usage conditions. Limited resources and time constraints are undoubtedly one of the main barriers to the leverage of analysis published by other countries. Regulators in all the major economies are struggling to satisfy their existing regulatory development requirements and most are severely constrained by limited staff and resources. The perceived tax on time and resources of stronger engagement with international peers is one of the principal barriers.

Case studies

Despite these barriers there is clear evidence that leveraging analysis used to develop MEPS brings tangible benefits in the regulatory development process and leads to better outcomes in terms of cost effective energy savings. The following case studies provide examples of where leveraging analysis and harmonising test methods and regulatory levels has had a positive impact on international equipment energy efficiency settings.

POWER AND DISTRIBUTION TRANSFORMERS

CLASP participated in the first stage of the EC's Ecodesign process as a stakeholder reviewing and commenting on draft chapters of the Preparatory Study. In preparing its comments, CLASP drew upon the transformer analysis published by the DOE in 2007 and compared it to the draft European Analysis. Through this comparison, it was found that the draft Preparatory Study had not considered all the viable options to increase transformer energy efficiency and that the treatment of the most energy-efficient transformer designs (those using amorphous material) was inconsistent with the DOE analysis. The DOE analysis was then adapted to the specific circumstances applying in Europe for a set of specific transformer types to obtain an improved assessment of the techno-economic options to improve transformer energy efficiency. These comments were presented to the preparatory study contractors.

Transformers are electrical devices that have no moving parts, and whose primary function is to raise or lower electrical voltage. Transformers are used at power stations to raise the voltage from the generator to a much higher voltage for long-distance transmission. Transformers are also used near to homes and other end-users, to lower the voltage from the utility's distribution network to the voltage required by domestic and commercial equipment. The transformers addressed in the US and European regulatory processes have power ratings of 10 kVA (~10,000 watt) or greater, as opposed to smaller transformers used in products like external power supplies for game consoles and laptop computers. Transformers are simple in design, consisting of essentially two sets of electrical windings wrapped around a magnetic core. The ratio of the number of turns of one winding to the other determines the change in voltage.

The DOE published MEPS on distribution transformers in October 2007 which took effect on 1 January 2010. DOE published all of its analysis on line, including detailed spread sheets containing engineering design data and life-cycle economic analysis (US DOE 2007). The EC initiated its work on power and distribution transformers in 2008, and the final Ecodesign preparatory study in early February 2011 (VITO 2011). CLASP participated in stakeholder meetings in 2010 conducted by the Commission's contractor, reviewing the draft preparatory study chapters and analysis.

Consideration of the options to design high-efficiency transformers is one of the critical areas identified early in the process. In a draft published in July 2010, the preparatory study only considered high efficiency amorphous core transformer designs for one of the seven representative base cases being analysed (VITO 2010). And for that one base case, the amorphous core designs prepared were found to be both more expensive and less efficient than DOE's scaled designs. CLASP extracted price and performance data for a similar transformer from the DOE work and scaled the design parameters in order to make them comparable to the European designs. This analysis confirmed that the treatment of amorphous material in the July 2010 draft preparatory study was not aligned with the results that would be expected based on the DOE analysis.

Figure 1 shows the DOE and draft European price versus efficiency estimates for transformers. The three draft amorphous designs prepared by VITO in the July 2010 draft preparatory study are shown as diamonds in the figure, and are considerably more expensive and not much more efficient than VITO's silicon steel designs (depicted as circles). The DOE data (shown as "+" marks) was adapted and then superimposed on this graph as a scatter plot, spanning a wide range of efficiency levels that were developed by DOE for its own regulatory process (DOE 2007). The DOE data is a blend of both silicon steel and amorphous designs and it is evident from that design work that there is a continuous trend in cost and performance, such that the amorphous designs overlap with the premium silicon steel designs, as costs increase with efficiency. At the lower end of the efficiency scale, there is reasonably good correlation between the European and DOE designs. However, at the higher efficiency levels (further to the right in the diagram), the DOE data achieves a much higher efficiency rating before the manufacturer's selling prices start to climb steeply.

In this case study, the DOE data confirmed concerns that the relationship between price and efficiency for the draft European amorphous designs were out of alignment with designs previously published in the US. CLASP then endeavoured to

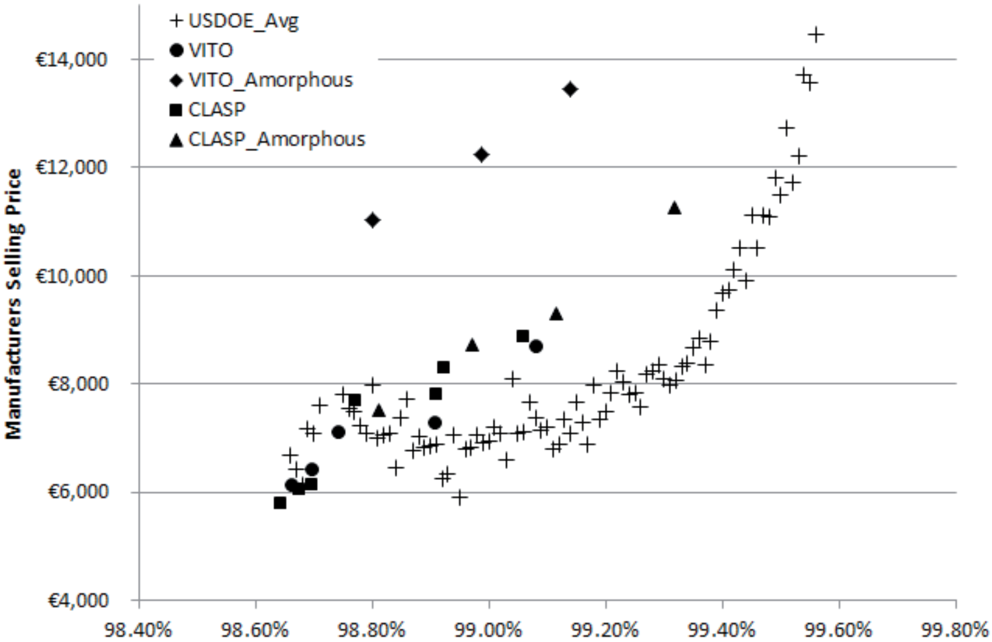

Figure 1. Scatter Plot of Draft EU and US Transformer Designs, Price vs. Efficiency.

work closely with the Commission's contractors in developing new amorphous designs for the preparatory study (depicted as triangles in Figure 1). CLASP assembled a transformer design team who worked with the same design constraints and material costs that were published in the preparatory study and new designs were prepared that better tracked the relationship between cost and efficiency (CLASP 2010). These designs were submitted to the contractors preparing the Preparatory Study, and were adapted for use in the preparatory study.

Furthermore, in the July 2010 draft analysis, the Commission's contractors had only been considering amorphous-based designs for one out of seven representative transformer base cases being analysed. This was a concern because several other representative transformers had commercially-available amorphous designs in the market, although this high-efficiency core material had not been considered by the contractors in the draft analysis. Referencing the US DOE analysis as well as manufacturer catalogues, this issue was brought to the attention of the contractors and it was suggested that amorphous material design options be considered in several other representative base cases. In the end, the contractors included amorphous designs in four of the seven representative base cases, although in CLASP's view, six of the seven should include amorphous as the most efficient option.

TELEVISIONS

Televisions (TVs) are essentially the same product the world over and are widely traded in all markets around the world, thus there is a strong case to be made for more international coordination in regulatory processes. TVs account for approximately half of consumer electronics electricity consumption and are a major and a rapidly growing source of domestic power consumption (IEA 2008). In this case study, we highlight how product testing conducted initially in California was leveraged and ultimately modified and improved IEC 62087: *Methods of measurement for the power consumption of audio, video and related equipment*, which is the global testing method for TVs.

Starting in 2005, Ecos Consulting conducted testing of TVs on behalf of the California Energy Commission's Public Interest Energy Research (PIER) programme using IEC 62087:2002, the current version of the IEC testing method at that time. This testing assessed the impact of changes in screen settings on TV power consumption, and how this varies from one type of display technology to another.The PIER research project was followed by a larger, more in-depth project conducted on behalf of the US Environmental Protection Agency (EPA)'s ENERGY STAR, the New York State Energy Research and Development Authority (NYSERDA) and Natural Resources Canada. As part of that project, Ecos Consulting purchased and tested 22 TVs, monitors and projectors and studied power consumption, screen luminance and other performance measurements under a wide range of settings. Based on the findings of that work, a variety of refinements and improvements were recommended to EPA for the ENERGY STAR test method.

These recommendations percolated up to the IEC Committee responsible for IEC 62087, who took them into consideration. In 2008, a revised version of IEC 62087 was issued, which was informed by those refinements and improvements adopted by EPA ENERGY STAR. The new IEC test method specifies methods of measurement for the power consumption of TV sets, video recording equipment, Set Top Boxes (STBs), audio equipment and multi-function equipment for consumer use. TV sets include, but are not limited to, those with CRT, LCD, PDP or projection technologies. Edition 1 of this test method, published in 2002, covered only CRT technologies, which were dominant at the time. Edition 2 is a full technical revision of the test method that specifically addresses the energy consumption of the new and emerging display technologies that now dominate in new TVs.

Thus today, many governments and organizations around the world have adopted the relevant aspects of the EPA ENERGY STAR test method or made minor modifications to it, depending on whether it is being used for TVs or for small or large computer monitors (Ecos Consulting 2010).

TVs represent a success story in terms of how the work in one jurisdiction can be leveraged and applied more widely and ultimately have a significant impact globally, enabling regulations to be adopted faster and potentially on a consistent basis with existing test methods and metrics. However, the regulations reviewed for this paper found significant differences in efficiency levels for TVs between different jurisdictions, even when accounting for key functionality variables. India has voluntary energy labelling for TVs, China adopted mandatory labelling for flat panel TVs in March 2011, and the EU mandatory labelling will start from 30 November 2011. The US does not have MEPS or mandatory energy labels for TVs, but a regulatory process is pending and ENERGY STAR has specified performance requirements.

The methodological approach used in the Chinese, EU and Japanese regulations are similar because they establish energy thresholds that are related to screen size, but are different in how products are classified by technology type and function. The second stage of EU regulations that comes into force in 2014 is significantly more stringent than Japan's Top Runner requirements (e.g., nominally about 37 % more stringent for a 32 inch (81 cm) CRT and about 43 % more stringent for a 32 inch (81 cm) LCD), although some of this difference may be explained through differences in the test methods used. Both the EU and Japanese regulations address on-mode and standby-mode power requirements, but the EU regulation also includes power management provisions such as automatic power down after 4 hours without a user response and measures to discourage units from being shipped with their highest brightness modes as default.

With the development of the new international test method and the launching of fresh and revised MEPS processes in the US and China respectively, there is a high potential for analysis developed in other jurisdictions to be leveraged and adapted to the new regulatory processes. This product has excellent potential for international harmonisation in both performance measurement and specification terms; however, much work will be needed to help bring the major regulatory processes closer together.

ELECTRIC MOTORS

Electric motors are comfortably the largest single electrical end-use and are estimated to consume between 43 and 46 % of all global electricity demand (Waide et al 2011b). Most of the energy savings opportunities reside in optimising aspects of the motor driven systems but there are still significant cost effective energy savings to be had from the use of more efficient electric motors themselves. In recent years a growing proportion of the world's economies have adopted MEPS for electric motors. For example China, the EU and the US amongst others apply MEPS for the most common types of industrial electric motors. The US and EU MEPS address AC asynchronous induction motors from 0.75 to 375 kW. The Chinese MEPS cover motors of a similar size range. Neither Japan nor India currently has MEPS for electric motors but India applies voluntary labelling to induction motors rated from 0.75 to 15 kW and Japan has been considering the adoption of MEPS for electric motors.

Until recently, the major economies were divided into two blocks: those which used the IEC test method and those that used the IEEE test method. This division made it difficult to compare motor energy efficiency between the two blocks despite products being essentially the same. Furthermore it complicated the development of common industrial and policy platforms and retarded the adoption of meaningful MEPS as a result.

In recognition of the benefit to be accrued from greater international cooperation and harmonisation a number of private and public sector actors grouped together to support the Standards for Energy Efficiency of Electric Motors Systems (SEEEM) initiative, which was launched at the 2006 Energy Efficiency in Domestic Appliances and Lighting conference and operated until being merged into the IEA's new 4E Implementing Agreement in November 2008. Its work is now continued within IEA's 4E Motor Systems annex. The SEEEM initiative helped to galvanise international government and industry players around the need to revise the IEC test method for electric motors to bring it up to date in the way it treated stray losses and to incorporate the best aspects of the alternative IEEE 112 B test method. As a result a broadly accepted international energy efficiency test method (IEC 60034-2-1) was adopted in September 2007 and is now used in most of the major economies. This development has allowed MEPS and labelling requirements to be set on the basis of a common test method and thus facilitates the comparison of MEPS between economies. To further support this process the IEC introduced a new motor energy efficiency classification structure in 2008 (IEC 60034-30) that offered a three tier classification system aligned with the most commonly adopted energy efficiency thresholds at the time as follows:

- IE3: Premium Efficiency (equivalent to 60 Hz operation with National Electrical Manufacturers Association (NEMA) Premium)
- IE2: High Efficiency (equivalent to 60 Hz operation with EPAct, similar to 50 Hz operation with Eff1)
- IE1: Method Efficiency (similar in 50 Hz operation with Eff2)

The updated IEC 60034-31 method introduced in 2009 offers an additional "super-premium" efficiency level known as IE4. The correspondence between these classifications and the efficiency thresholds used in the major economies is shown in Table 1.

There is considerable international harmonisation in both testing (although some economies have not yet moved over to the new IEC test method), choice of efficiency metric (all economies use the output/input power expressed as a percentage) and in efficiency levels (which are at one of four different thresholds). The NEMA Premium requirement used in the USA and Canada matches the IEC IE3 level, whereas the IEC's IE2 level is roughly equivalent to the old EU Eff1 voluntary level (still used in India and which corresponds to the Chinese energy label grade 1 threshold). The IEC's IE3 level is roughly equivalent to the old EU Eff2 voluntary level (still used in India and which corresponds to the Chinese label grade 2 threshold). China's MEPS are set at energy label grade 3 matches the EU's old Eff3 level.

Table 1. Efficiency Classes from Different Countries and the Corresponding International Method.

Motor Efficiency Class	International	USA	EU	China	India
Super Premium	IE4 (IEC 60034-31:2009)	-	-	-	-
Premium	IE3 (IEC 60034-30:2008)	NEMA Premium	IE3	-	-
High	IE2 (IEC 60034-30:2008)	EPAct	IE2 for motors with VSDs. Formerly Eff1	Grade 1 (under consideration for new MEPS)	Eff1 (top label class)
Method	IE1 (IEC 60034-30:2008)	-	Eff2	Grade 2	Eff2 (lower label class)
Below method		-	Eff3	Grade 3 (current minimum)	-

The US's are set at the NEMA Premium/IE3 level for some motors and IE2/EPAct for other types and the EU's are set at the IE3 level unless a motor is shipped with an integrated variable speed drive in which case they are permitted to use the less stringent IE2 level. For a 10 kW motor moving from Eff3 to IE3 efficiency levels will reduce energy consumption by about 5.4 %. The relative savings are higher for smaller motors and less for larger motors. As electric motors account for 68 % of industrial electricity demand and 19 % of commercial sector electricity demand, small percentage improvements lead to very substantial total energy savings. The largest proportion of motor electricity consumption (about 68 %) is attributable to mid-sized motors of between 0.75 kW and 375 kW of output power and these are the most common categories currently regulated, which correspond to the limits of scope of the IEC test methods IEC 60034-30 and IEC 60034-31.

Small electric motors of less than 0.75 kW of output power are by far the most numerous type of motor but only account for about 9 % of all electric motor power use. The US is the only economy which has specific efficiency requirements for motors in this size range but there are many exceptions even in US coverage. Some of these motors are used in products which are already subject to MEPS and thus are indirectly regulated. There are still gaps in regulatory requirements applying to mid-sized motors because different types of motors (i.e. those that are not AC synchronous induction motors) are not currently covered by efficiency requirements in any economy.

Large electric motors, of greater than 375 kW output power, are usually high voltage AC motors that are custom designed, built to order and are assembled with an electro-mechanical system on site. They comprise just 0.03 % of the electric motor stock in terms of numbers, but account for about 23 % of all motor power consumption, thus they are a very significant source of global power consumption in their own right (about 10.4 %). These motors are not currently subject to MEPS in any part of the world.

The experience with electric motors is a good example of the successful application of formal and informal international harmonisation in energy efficiency requirements and demonstrates that it is quite possible to develop harmonised requirements for commonly traded products. The development of a set of common efficiency thresholds for the most important class of electric motors has allowed economies to pick and choose performance thresholds in response to their needs and to know that they are aligned with those in use elsewhere. The older Eff1 to Eff3 classification system that became commonly used in major parts of the world is giving way to the newer and more ambitious IEC IE1 to IE3 classification – this also includes an aspirational IE4 level that is not yet applied in any economy but could become so as new more efficient products are introduced.

The new IEC test method is more accurate than the older one and should be adopted by all economies as soon as possible. The challenge many economies face is to increase the coverage of motor requirements to apply to as many motor types as possible and to increase stringency to levels that are economically justified or justified by environmental benefits. There is clear evidence that those economies which apply mandatory efficiency requirements have significantly more energy-efficient motor markets than those that don't; thus, there is a strong case for India, Japan and other countries to follow suit and adopt MEPS. There is also every prospect of a fully harmonised global system being developed and adopted albeit with the prospect for divergent efficiency thresholds continuing for some time. There would be considerable value from globally coordinated efforts to develop serviceable energy performance test methods for the other significant classes of electric motor.

EXTERNAL POWER SUPPLIES

External power supplies (EPSs) are used to operate most small electronic devices. They convert alternating current electricity to the low voltage direct current used to power electronic products including MP3 players, Personal Digital Assistants (PDAs), camcorders, digital cameras, laptops and cordless or mobile phones. In the United States alone it estimated that there are 2.7 billion EPSs in use, which equates to roughly nine per person (EPA 2011). Similarly high ownership levels are found in other affluent economies and even in less affluent societies the use of EPS is high. This case study focuses on the fact that a test methodology developed in California in 2004 was leveraged and became the international test method used to underpin EPS MEPS around the world today.

The development of a test method to measure the efficiency of external power supplies was first undertaken in California.

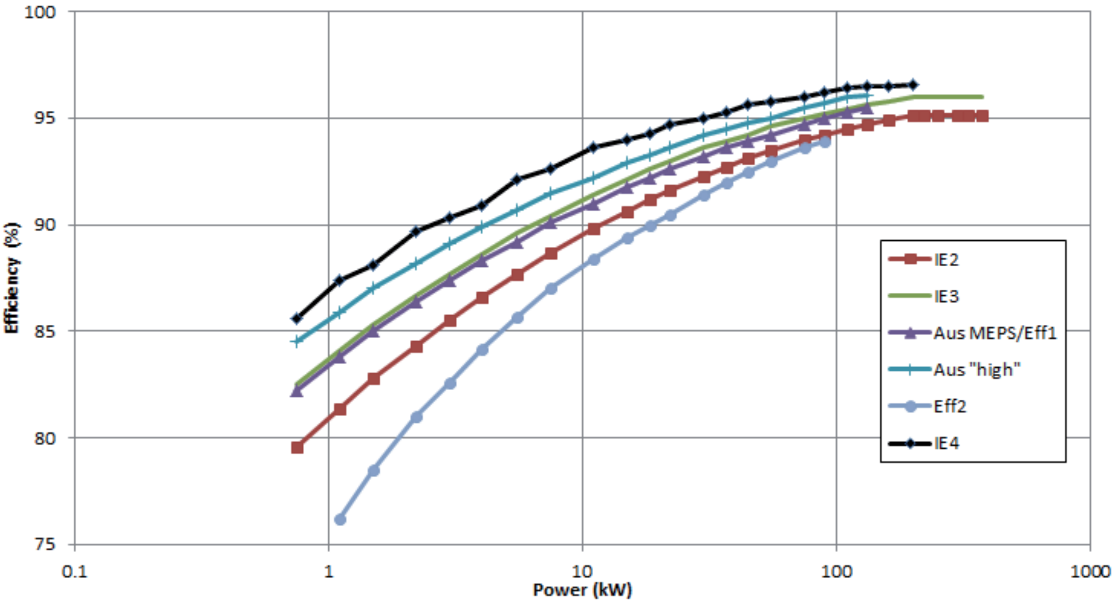

Figure 2. Comparison of Regulations for Electric Motors, Efficiency vs. Power (kW) Rating.

The original test method was developed by Ecos Consulting for the California Energy Commission and was called the 'Test Method for Calculating the Energy Efficiency of Single-Voltage External AC–DC and AC–AC Power Supplies' August 11, 2004. This test method measures no-load mode and active mode power consumption. The no-load mode occurs when the power supply is connected to mains power (e.g. household electric current) but the output is not connected to any consumer product. Active mode occurs when the power supply is connected to mains power and the EPSs are delivering power to the consumer product. The test method records the power consumed under no-load and the efficiency (output divided by input) in active mode at 25 %, 50 %, 75 % and 100 % of rated output power. The California test method was subsequently adopted by the EPA for use in the ENERGY STAR Programme for external power supplies. Following this, the test method was adopted as the US national test method for regulating EPSs in the Energy Policy Act of 2005.

In 2005, an international collaborative project between China, Australia, ENERGY STAR International, the State of California and the EU built on this to develop an international test method for EPSs. In 2009, Europe adopted this test method in a Commission Regulation No 278/2009 of 6 April 2009 on no-load condition electric power consumption and average active efficiency of external power supplies. The test method in this Regulation and those of other jurisdictions is the same as the one developed originally for California, with the average efficiency measured at 4 defined points: 25 %, 50 %, 75 % and 100 % of rated output power and no-load power consumption measured in watts.

This test method has now been adopted in a range of regional energy programs. In Australia, a version of this test method has been published as AS/NZS 4665 Part 1 and Part 2 whereas a similar method has been adopted in the EU test methods and in South Korea in the e-Standby Programme. These regulators were able to not only avoid the cost and delays associated with developing their own test method for external power supplies, but they were able to adopt something that was already widely known and accepted in the industry and thereby reduced regulatory burdens on manufacturers.

Following the development and adoption of this test method China, the EU and the US all now have MEPS for external power supplies and the US is considering expanding coverage and setting requirements on a wider scope of covered products. There are currently no requirements or labels for EPSs in other economies. The EU and US MEPS are fully harmonised, which came about as a result of sustained policy discussion between key technical experts and policy makers informing the decision process in both regions. China is planning to amend their EPS requirements in 2011 and this may be an opportunity to consider adopting the EU/US levels. Thus, there are good prospects for enhanced harmonisation for EPS specifications worldwide.

Lessons learned and recommendations

Clearly, there is great potential to leverage analysis from one economy to another thereby enable improvement in the analysis underpinning regulations. Given the high degree of international activity with respect to energy efficiency standards and labelling schemes, regulatory authorities can benefit both from improving the accuracy of the analysis underpinning their regulations while also reducing costs and promoting harmonisation of test methods and of energy-efficiency ratings where appropriate. As discussed earlier, there are varying degrees of benefit that leveraging relevant parts of a regulatory analysis can offer (1) a sanity-check on findings under review, (2) a parallel analysis / comparative benchmark, or (3) the analysis itself.

The leveraged analysis can be used to support the development of MEPS, energy metrics, product classifications, labelling requirements, test methods and energy performance conformity assessments. For test methods, regulatory bodies are able to start from and adapt test methods that have already been subject to public review. As in the case of TVs and EPSs, the test methods developed in one jurisdiction ultimately became the basis for those applied around the world and enabled energy efficiency policy settings, such as MEPS and labels to be adopted much more rapidly and seamlessly than would have been the case had the work not been shared and leveraged.

ENERGY PERFORMANCE METRICS AND PRODUCT CLASSES

The adoption of energy-efficiency metrics and product classes by the competent regulatory agency should be informed by the metrics and product classes used in MEPS elsewhere in the world. If the test methods are harmonised, there is much greater probability that the efficiency metrics and product classes used in the regulations will be too. The product classes used are also often influenced by local market considerations and the locally preferred product mix and usage profiles. There is also a considerable amount of informal harmonisation wherein regulators (or those that are informing the regulatory process) will hear about what is done in another economy and may decide to adopt the same practice. In the past, this practice was not followed, and some regulators would pay no attention to activities in other parts of the world. In the last few years though, the EC began requiring that all Ecodesign studies review other international requirements and standards as an early activity. The DOE has recently initiated a similar requirement in its regulatory analyses in the US. The Chinese and Indian regulatory processes have always tended to investigate international practices as a part of their national regulatory deliberative process, but not all the pertinent information is always delivered at the appropriate time. In recognition of the limitations that can exist in these processes, the EC and the DOE have begun a regular meeting process to discuss their respective programmes. None of the other economies are doing this on a systematic basis but all of them have informal information exchange processes that at least allow some of the relevant information on international practice to be on the table during the domestic regulatory deliberation process.

UPDATING TESTING METHODS

As a practical matter, it can be difficult for international test methods to keep pace with product innovations. The process for developing an international testing method often takes several years, and by that time, manufacturers have innovated and developed next generation products using technologies and incorporating features that may not be able to be measured by the test method. For this reason, when drafting a test method, it is important that engineers and technical experts involved in the process ensure, as much as possible, that the method is flexible and able to accommodate newer versions of existing products. Furthermore, when adapting international test methods in to the various regulatory programmes around the world, regulators may need to make a deviation from or modification to some aspect of the test method that would otherwise not be applicable. Any of these deviations should be reported back to the international committee, exactly as Ecos Consulting and EPA ENERGY STAR did in the case study discussed above on IEC 62087, resulting in an updated redraft of the IEC method being issued.

ENERGY REGULATIONS

The situation with MEPS is similar to that of performance metrics and product classes. An exchange of information occurs between local regulatory agencies and it can facilitate harmonisation of requirements. China, for example, partially harmonised some of their efficiency thresholds with the EU (e.g., for refrigerators, the Chinese energy label class 1 threshold is harmonised with the EU energy label class A, and the efficiency metrics and product classifications used in China are essentially the same as those used in the EU). For electric motors, the Chinese grade 1 level corresponds to the old EU Eff1 voluntary efficiency classification, which has now been superseded by the recent Ecodesign adoption of the new IEC efficiency classifications, which itself is largely based on the IEEE test method from the US. Sometimes regulations are perfectly harmonised because they were informed by the same experts and direct dialogue occurred between the regulators; this is exactly what happened with the Californian and EU external power supply (EPS) regulations, which were subsequently adopted by the US Congress as a national regulation. New products that have not previously been regulated in a jurisdiction are easier to harmonise across economies because there aren't existing test method and MEPS levels to overcome when adopting a harmonised approach.

POTENTIAL PATHWAY TO HARMONISATION

Products that have not previously been regulated in any jurisdiction are easier to harmonise in various national regulatory programmes. Currently this happens through a range of formal or informal exchanges; however, it is clear from past experience that whenever dialogue is present in a timely manner, greater information exchange and harmonisation occurs. Therefore, CLASP has found that the key to enhancing harmonisation is to extend and support the dialogue among all the major regulatory and standardisation bodies. The institutions cited in this paper all have a key role to play enhancing this process, and strengthening the existing level of dialogue and increasing its pertinence and timeliness. Due to the fact that test methods underpin regulations yet take considerable time to develop, it is important that regulators interested in strengthening the leverage from international regulatory work should plan international efforts to develop coordinated test methods well ahead of their regulatory schedule. This will maximise the potential that commonly accepted test methods will be in place when regulations are reviewed. This step will increase the comparability and applicability of the regulatory analyses and hence facilitate it being leveraged more widely. Ultimately, if regulators are able to establish mechanisms to facilitate broader international information exchange and pragmatic programmatic coordination efforts, it will save on future regulatory programmatic costs, and improve outcomes leading to higher savings at less expense.

ENFORCEMENT OF MEPS ACROSS MARKETS

Manufacturers may have one particular model that is sold across several markets, and sometimes under different brand names. If an enforcement agency finds a particular model to be in violation of its regulation, this information should be shared with other enforcement agencies in countries that have the same regulation. In Europe, the sharing of data on market surveillance across the European Union and the European Economic Area markets is the function of the Administrative Cooperation (ADCO) Working Group, which this year is being chaired by Germany. Due to the fact that regulations are set at an EU level but enforced at a country level, a strong opportunity exists for ADCO to share data across the EU Member States and facilitate and lower the costs of enforcement. Looking beyond the EU market, as harmonisation becomes more prevalent in the market (with the aforementioned lower costs associated with the regulatory analysis), sharing of enforcement data between regulatory entities can also help to lower administrative costs and protect the markets from unscrupulous manufacturers or importers who seek to undercut the regulations.

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Glossary

4E: Efficient Electrical End-use Equipment (IEA programme)
AC: alternating current
CEMEP: European Committee of Manufacturers of Machines and Power Electronics
CLASP: Collaborative Labeling and Appliance Standards Program
CO2: Carbon Dioxide
DC: direct current
DOE: US Department of Energy
EC: European Commission
Ecodesign: EC Directive for Energy Related Products 2009/125/EC
Eff: voluntary motor classification (Eff1, Eff2, Eff3) of the European Committee of Manufacturers of Machines and Power Electronics (CEMEP)
EPA: US Environmental Protection Agency
EPAct: Energy Policy Act, 1992 minimum energy performance standards for electric motors in the USA
EU: European Union
GDP: Gross Domestic Product
IE1: New IEC 60034 30 Energy Efficiency Classes for electric motors (roughly equivalent to Eff2)
IE2: New IEC 60034 30 Energy Efficiency Classes for electric motors (roughly equivalent to Eff1 and EPAct)
IE3: New IEC 60034 30 Energy Efficiency Classes for electric motors (roughly equivalent to NEMA Premium)
IE4: Super premium efficiency level as defined within IEC 60034-31:2009
IEA: International Energy Agency (Paris, France)
IEC: International Electrotechnical Commission (Geneva, Switzerland)
IEEE: Institute of Electrical and Electronics Engineers
IPEEC: International Partnership for Energy Efficiency Cooperation
ISO: International Organization for Standardisation
MEPS: Minimum energy performance standards (i.e., regulatory requirements)
NEMA: National Electrical Manufacturers Association (US)
NYSERDA: New York State Energy Research and Development Authority
SEAD: Super-efficient Equipment and Appliances Deployment
SEEEM: Standards for Energy Efficiency of Electric Motor systems (www.seeem.org)