Advancing Standards and Labelling Globally by Leveraging Analysis of Consumer Products and Commercial Equipment

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Abstract

Around the world, equipment energy efficiency standards and test methods are being implemented and regularly revised for a range of domestic, commercial and industrial products. 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 Standards (MEPS) and labelling schemes 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 share of its GDP, energy use and CO_2 emissions (Waide et al 2010). 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 EU, India, Japan and the 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 initiatives being promoted is the Super-efficient Equipment and Appliances Deployment (SEAD) programme, which is working with stakeholders to identify and accelerate deployment of advanced efficient technologies in priority appliances. In another recent development the IEA's 4E Implementing Agreement brings together some of the major economies in a common cooperative framework addressing energy efficiency in electric equipment. Furthermore, the EU and USA have established a regular cooperative forum where senior program managers exchange information on their standards and labelling programs 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 energy efficiency standards and labelling schemes it seems appropriate to consider what lessons may be derived from the sharing of analysis and findings for otherwise 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 – it may be possible to draw comparisons between the previously published analyses and any new analysis being prepared. The published analyses can be used to assess differences in performance levels, costs, payback periods and other critical metrics underpinning a regulatory analysis.
- A parallel analysis / comparative benchmark – depending on the level of detail associated with the published analytical data, it may be possible to adapt the analysis to local market conditions and use the findings as a validation tool on the primary analysis, demonstrating the reasonableness of primary analysis conducted. The published analysis could also be used to calibrate the new analysis, enabling a higher degree of precision in the findings.
- The analysis itself – if sufficient detail is available in a published analysis, it may be possible to scale or adapt the analysis to serve as the primary analytical basis for the new market assessment. This adaptation could include making adjustments for voltage, frequency of use, model design or other critical features.

At present it can be complex to compare requirements around the world because product definitions may differ, energy test procedures 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-my-leader" effect. Furthermore, harmonised testing and efficiency definitions can greatly facilitate industry 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 the leverage of 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 standards 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: which products are regulated in the other economies, the test procedures 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 procedures 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 US-EU 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 of those in other economies and are thus rarely informed by those in other economies, so there is no coordination in the scheduling of the products to be analysed. Within the last year, regulators at the European Commission and in the US Department of Energy 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 procedures (i.e. test standards) to measure the performance of products because all the national or regional standards bodies that issue test procedures are also members of the international standardisation bodies such as ISO and 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 procedures. Even countries which make comparatively less use of international test procedures 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 energy performance test procedures developed and adopted at the international level are not adopted for use in domestic energy efficiency regulations and locally specific test procedures are mandated for use by the domestic regulatory agency. Furthermore, the domestic test procedures 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 procedures 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 they have the resulting international standards are designed to be reflective of significant differences in local operation and usage conditions.

Limited resources and time

Constraints in time and resources 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 equipment energy efficiency regulations 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 procedures and regulatory levels has had a positive impact on international equipment energy efficiency settings.

Power and Distribution Transformers

In the case study outlined below CLASP supported the European Commission's Ecodesign process by helping to introduce analysis published by the US Department of Energy (DOE) to the European deliberations about the techno-economic options to improve transformer energy efficiency. Through this, it was found that the EU analysis 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 US analysis. The US analysis was subsequently adapted to the specific circumstances applying in Europe and repeated for certain specific transformer types to obtain an improved assessment of the techno-economic options to improve transformer energy efficiency and these were presented to the European Commission for consideration in the regulatory development process.

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 around 10 kVA (approximately 10,000 watt) or greater. Although much smaller transformers are used in products like external power supplies for game consoles and laptop computers, these are not the products addressed in this case study. 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 US DOE published minimum mandatory regulations on distribution transformers in October 2007 which took effect on the 1st of 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 European Commission initiated its work on power and distribution transformers in 2008 and (at the time of this draft) is completing its preparatory study. CLASP participated in the 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 Commission's preparatory study only considered high efficiency amorphous core transformer designs for one of the seven representative models being analysed (VITO 2010). And for that one model, the amorphous core designs prepared were found to be both more expensive and less efficient than would have been expected from the US analysis. The design work published by DOE (US DOE 2007) was then compared with the Commission's contractor's draft findings that had been published for comment. CLASP extracted price and performance data for a similar transformer from the DOE work and scaled the design parameters in order to make it more comparable to the European designs. This analysis confirmed that the treatment of the amorphous designs in the draft preparatory study was out of line with the results that would be expected from the US analysis.

Figure 1, shows price versus efficiency estimates for transformers. The three draft amorphous designs prepared in the initial preparatory study for the Commission are shown as red diamonds and are shown to be considerably more expensive and not much more efficient than the standard silicon steel designs (depicted as red boxes). The US DOE data was superimposed on this graph as scatter plot of blue diamonds, spanning a wide range of efficiency levels. 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, increasing in cost and efficiency from that point. At the lower end of the efficiency scale, there is reasonably good correlation between the European and US 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.

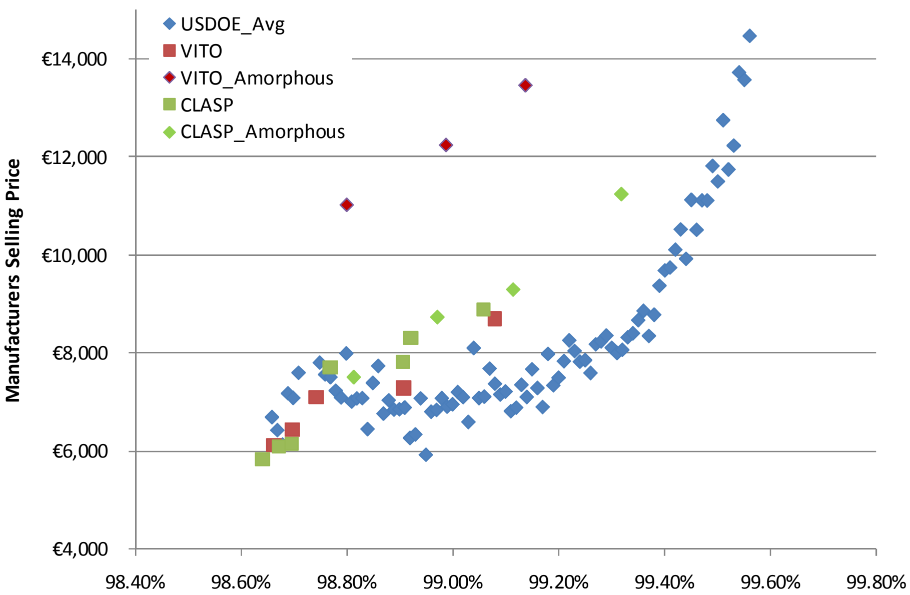

Figure 1. Scatter Plot of Draft EU and US Transformer Designs, Price vs. Efficiency

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 previously published designs in the US. CLASP then endeavoured to work closely with the Commission's contractors in developing new amorphous designs that might be supportive to the preparatory study. CLASP assembled a transformer design team who worked with the same design constraints and material costs that were used as inputs to the Commission's draft analysis and new designs were prepared that better tracked the relationship between cost and efficiency (CLASP 2010). These designs were submitted to the Commission for review and were found to have merit. Ultimately, these designs were adapted for use in the preparatory study by the Commission's contractors.

Furthermore, in the July 2010 draft analysis, the Commission had only been considering amorphous-based designs for one out of seven representative models being analysed. This was of concern because there were several other representative (i.e basecase) models that had commercially-available amorphous designs in the market, and yet the high-efficiency core material was not incorporated into the analysis. Referencing the US DOE analysis as well as manufacturer catalogues, this issue was brought to the attention of the Commission and their contractors and it was suggested that amorphous material design options be considered in several other representative models. In the end, five out of the seven representative models incorporated amorphous material in their design portfolio as the most efficient option.

Televisions

Televisions 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. Televisions 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 the global testing standard for televisions currently used around the world, IEC 62087:2008.

Starting in 2005, Ecos Consulting conducted testing of televisions on behalf of the California Energy Commission's Public Interest Energy Research (PIER) programme using IEC 62087:2002, the previous version of the IEC testing standard. 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 EPA ENERGY STAR, NYSERDA and Natural Resources Canada. As part of that project, Ecos Consulting purchased and tested 22 televisions, monitors and projectors and studied power consumption, screen luminance and other performance measures under a wide range of settings. Based on the findings of that work a variety of refinements and improvements were recommended to the EPA ENERGY STAR test procedure and the energy efficiency metrics that governments around the world were starting to investigate in a regulatory context.

The test method for energy consumption and performance of televisions is specified in the international test standard IEC62087 - *Methods of measurement for the power consumption of audio, video and related equipment*. Edition 2 of the standard was published in October 2008 and was informed by the findings of the earlier work. The new IEC standard specifies methods of measurement for the power consumption of television sets, video recording equipment, Set Top Boxes (STBs), audio equipment and multi-function equipment for consumer use. Television sets include, but are not limited to, those with CRT, LCD, PDP or projection technologies.

Edition 1 of this standard, published in 2002, covered only CRT technologies, where were dominant at the time. Edition 2 is a full technical revision of the standard that specifically addresses the energy consumption of the new and emerging display technologies that now dominate in new televisions.

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

Televisions 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. That said, the regulations reviewed for this paper found significant differences in efficiency levels between televisions, even when accounting for key functionality variables. China, the EU and Japan all apply minimum energy performance regulations for televisions, and China and India have voluntary energy labelling. The US does not have regulations or mandatory energy labels for televisions, 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 EU regulations are the first to make use of the new international test standard, which addresses many deficiencies in earlier test procedures. 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" CRT and about 43% more stringent for a 32" LCD), although some of this difference may be explained through differences in the test procedures 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 procedure and the launching of fresh and revision 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* 2011). 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 minimum energy performance standards for the most common types of industrial electric motors. The US and EU MEPS address AC asynchronous induction motors from 0.75 to 375kW. The Chinese MEPS cover motors of a similar size range. Neither Japan nor India currently has minimum energy performance requirements for electric motors but India applies voluntary labelling to induction motors rated from 0.75kW to 15kW 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 procedure and those that used the IEEE test procedure. 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 new IEA's Implementing Agreement for Efficient Electrical End-Use Equipment in November 2008. Its work is now continued within the 4E Motor Systems annex. The SEEEM initiative helped to galvanise international government and industry players around the need to revise the IEC test procedure 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 procedure. As a result a broadly accepted international energy efficiency test standard (IEC 60034-2-1) was adopted in September 2007 and is now used in most of the major economies. This development has allowed minimum energy performance standards and labelling requirements to be set on the basis of a common test procedure and thus facilitates the comparison of energy performance requirements between economies. To further support this process the IEC introduced a new motor energy efficiency classification standard 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 NEMA Premium)
- IE2 High Efficiency (equivalent to 60 Hz operation with EPAct, similar to 50 Hz operation with Eff1)
- IE1 Standard Efficiency (similar in 50 Hz operation with Eff2)

The updated IEC 60034-31 standard introduced in 2010 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.

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

Motor Efficiency Class	International	USA	EU	China	India
Super Premium	IE4 (IEC 60034-31:2010)	-	-	-	-
Premium	IE3 (60034-30:2008)	NEMA Premium	Now IE3	-	-
High	IE2 (60034-30:2008)	EPAct	Now IE2 for motors with VSDs. Formerly Eff1	Grade 1 (under consideration for new MEPS)	Eff1 (top label class)
Standard	IE1 (60034-30:2008)	-	Eff2	Grade 2	Eff2 (lower label class)
Below standard		-	Eff3	Grade 3 (current minimum)	-

There is considerable international harmonisation in both testing (although some economies have not yet moved over to the new IEC test standard), 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 energy label grade 3 matches the old Eff3 level.

China's MEPS are set at the old Eff3 level. The US's are set at the NEMA Premium/IE3 level 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 10kW 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 0.75kW and 375kW of output power and these are the most common category currently regulated (these thresholds also correspond to the limits of scope of the IEC test procedures IEC 60034-30 and IEC 60034-31).

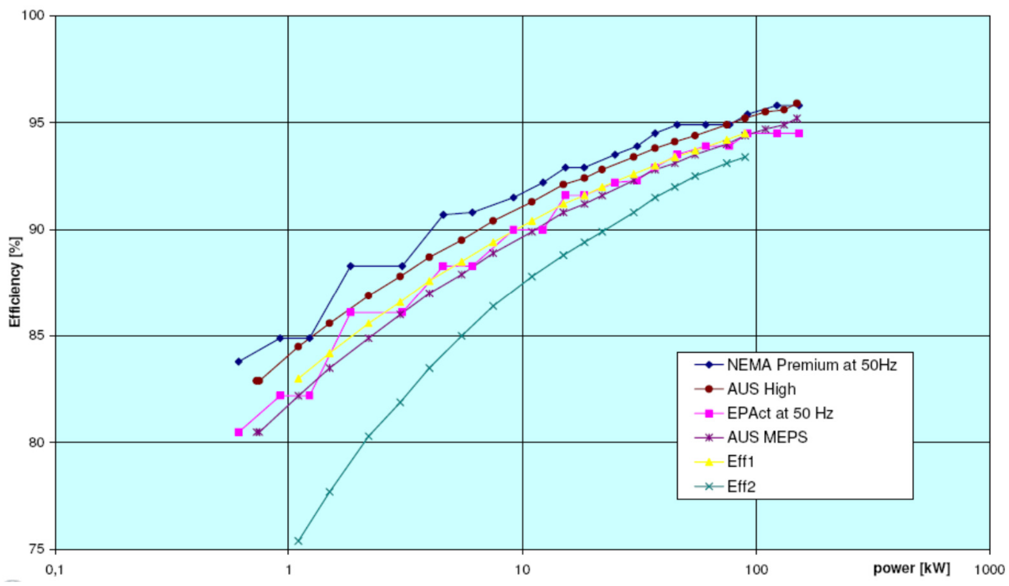

Figure 2. Comparison of Regulations for Electric Motors, Efficiency vs. Power (kW) Rating

Small electric motors of less than 0.75kW 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 375kW 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 minimum energy performance regulations 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 efficient motor markets than those that don't; thus, there is a strong case for India and Japan to follow suit with the other major economies and to adopt mandatory energy performance requirements. 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 procedures for the other significant classes of electric motor.

External Power Supplies

External power supplies (EPS) 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 EPS 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 standard used to underpin EPS MEPS around the world.

The development of a test procedure to measure the efficiency of external power supplies was first undertaken in California. 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 EPS is 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 procedure was subsequently adopted by the US EPA for use in the ENERGY STAR Programme for external power supplies. Following this the test procedure was adopted as the US national test procedure for use in MEPS by the Energy Policy Act of 2005.

In 2005, an international collaborative project between China, Australia, Energy Star International, the State of California and the European Union built on this to develop an international test method for external power supplies. In 2009, Europe adopted this test method in European Commission regulation No 278/2009 of 6 April 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for no-load condition electric power consumption and average active efficiency of external power supplies. The test method in this Directive 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 power output and no load power consumption measured in watts.

The test method defines the required equipment for voltage supply, load and power measurement. A reference voltage with less the 2% total harmonic distortion is required. Products with a switchable output voltage are tested at the lowest and highest value. Products that have a rated voltage and frequency range that spans 230V/50Hz or 115V/60Hz are tested at both conditions.

This has been adopted for 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 procedure has been adopted in the EU test procedures 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 procedure China, the EU and the US all now have MEPS for external power supplies and the US is considering expanding coverage and setting requirements to a wider scope of covered products. There are currently no requirements or labels for external power supplies 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 external power supply requirements in 2011 and this may be an opportunity to consider adopting the EU/US levels. In consequence there seem to be good prospects for enhanced harmonisation for external power supply specifications.

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 energy performance measurement standards, energy performance metrics, energy performance product classifications, energy labelling requirements, minimum energy efficiency performance regulations and energy performance conformity assessments. For test procedures, regulatory bodies are able to start from and adapt test methods that have already been subject to public review. As in the case of the televisions and EPS, 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 classifications standards

Adoption of efficiency metrics and product classifications is always determined by the energy efficiency regulatory agencies but is often informed by metrics and product classifications proposed in energy performance measurement standards. Thus if the measurement standards are internationally harmonised there is much greater probability that the efficiency metrics and product categories used in the regulations will be too. The product classifications used will often also be informed by local market considerations and the locally preferred product mix and usage profiles. There is also 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 within the national/local regulations. This process used to be very non-systematic in all economies and some would pay almost no attention to activities in other parts of the world. In the last few years though the European Commission has begun to request that all Ecodesign studies review other international requirements and standards as an early activity and the US DOE has started to initiate the same process in the USA. 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 even in asking national consultants to review the international scene the European Commission and the DOE have begun a regular review and meeting process to discuss each others' programmes and to consider what can be learnt from them. 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.

Energy regulations

The situation with regulations is very similar to that for the efficiency metrics and product classifications. Sometimes systematic or sometimes occasional information exchange occurs between the various local regulatory processes that results in a partial harmonisation of requirements. China for example partially harmonised some of their efficiency thresholds to those applied in the EU (e.g. for refrigerators where 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. Similarly, for electric motors the Chinese grade 1 level corresponds to the old EU Eff 1 voluntary efficiency classification, which has now been superseded by the recent Ecodesign adoption of the new IEC efficiency classification, which is itself largely based on the IEEE test procedure that has been used in the US for some years. 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 also adopted by the DOE as US Federal requirements. Whenever, there are products which have not previously been regulated in any jurisdiction it becomes much easier to harmonise subsequent national regulations.

Increase future harmonisation

Whenever, there are products which have not previously been regulated in any jurisdiction it becomes much easier to harmonise subsequent national regulations. 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 that greater information exchange and harmonisation occurs thus the key to enhancing harmonisation is to extend and support the dialogue among all the major regulatory and standardisation bodies. The institutions cited above all have a key role to play enhancing this process and much could be done to strengthen the existing level of dialogue and in increasing its pertinence and timeliness. As test procedures 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 procedures well ahead of any regulatory needs they may have. This will maximise the prospects that commonly accepted test procedures will be in place when regulations are up for review. This in turn increases the comparability and applicability of all the supporting analysis used in the regulations and hence facilitates it being leveraged more widely. Ultimately, if regulators are able to find the time and resources to establish mechanisms to facilitate broader international information exchange and pragmatic programmatic coordination efforts it will save on future programmatic costs and improve outcomes thereby leading to higher savings at less expense.

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Glossary

AC	alternating current
CEMEP	European Committee of Manufacturers of Machines and Power Electronics
CLASP	Collaborative Labeling and Appliance Standards Program
DC	direct current
DOE	US Department of Energy
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
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 60034-30 and IEC 60034-31
IEA	International Energy Agency, Paris, France
IEC	International Electrotechnical Commission, Geneva, Switzerland
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
MEPS	Minimum energy performance standard
NEMA	National Electrical Manufacturer's 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)