Harmonization of Energy Efficiency Standards: Searching for the Common Ground.

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ABSTRACT

Energy efficiency standards for household appliances and lighting products have increasingly been adopted by countries to reduce energy use and mitigate the impact of GHG emissions. As standards proliferate, manufacturers of regulated and traded products are facing a labyrinth of national standards in order to reach the global market, increasing the costs of testing and qualifying their products. These challenges can be reduced through international harmonization, but harmonization efforts also face many challenges as well, given that each country tends to advocate its own standards. In this paper, we examine several recent cases of international efforts to harmonize efficiency standards for products such as office equipment, external power supplies, and compact fluorescent lamps, in order to illuminate issues of institutional, technological, and market factors that shape the outcome of such efforts.

Introduction

Energy efficiency standards for household appliances and lighting products have increasingly been adopted by countries to reduce energy use and mitigate impact of GHG emissions (Wiel and McMahon, 2003). As standards proliferate, manufacturers of regulated and traded products are facing a labyrinth of national standards in order to reach the global market, increasing the costs of testing and qualifying their products (Fridley and Wiel, 2004). These challenges can be reduced through international harmonization of various aspects of energy efficiency standards or labeling requirements: for example, through adopting the same test procedures, by mutual recognition of test results, and by harmonizing the performance standard levels and energy labeling criteria.

However, harmonization efforts face many challenges, given that each country tends to advocate its own standards. While harmonization of standards may reduce trade barriers and promote greater efficiency in consumer appliances, not all stakeholders in the standard setting process share the same strategic interests. In this paper, we examine several recent cases of international efforts to harmonize efficiency standards for products such as office equipment, external power supplies, and compact fluorescent lamps (CFL), in order to illuminate issues of institutional, technological, and market factors that shape the outcome of such efforts.

Development Process of Appliance Standards and Barriers to Harmonization

Energy efficiency standards and labels have proven to be effective policy tools to promote energy efficiency in household appliances and to mitigate the climate impact of energy use. According to the Collaborative Labeling and Appliances Standards Program (CLASP), there are now over 40 economies and regions that have adopted some form of efficiency standards or labels for appliances. Over 80 types of products, ranging from white appliances to consumer electronics, lighting products, and automobiles, are covered under these programs (CLASP 2006).

Minimum energy efficiency or performance standards (MEPS) are typically developed and issued by national governmental agencies such as the Department of Energy in the US (US DOE), Natural Resources Canada in Canada (NRCan), and the State Administration of Quality Supervision, Inspections, and Quarantine (AQSIQ) in China. However, sometimes they are developed by regional authorities such as the European Commission.

These national agencies are given the mandate, either by the legislature or national governments, to regulate products for sales in their respective national markets. Therefore, they have no authority and little interest in products destined for other markets. As such, there is no natural champion to promote harmonization of appliance efficiency standards.

In the past, most of the traditional appliance products under regulation have distinctive regional characteristics, making it hard to compare their performance (Lin and Iyer, 2005). A good example is residential clothes washers. In North America, the traditional washers are top-loading machines with a central agitator (the “agitator type”). In Europe, the typical clothes washers are front-loading horizontal axis machines (often called the “drum type”). In Japan, the typical clothes washers are top-loading impeller types with a rotating disc at the bottom of the tub (the “impeller type”).

The usage habits differ significantly as well across regions. In Japan, clothes are washed in cold water; in Europe, clothes are washed normally in hot water; and in the US, clothes washing is more evenly distributed among hot, warm, and cold wash cycles. These differences in usage patterns lead to different testing procedures that are used in these regions to measure the energy performance of clothes washers.

Under such circumstances, it would be very difficult to harmonize appliance standards or labels, either programmatically or on the technical level, since without common testing procedures it is impossible to compare the performance of appliance on a consistent basis.

As global trade in appliances increases, however, many multinational manufacturers have introduced their products to new markets, creating the need to develop more consistent testing protocols for competing product types. For example, Japanese style impeller clothes washers were first introduced in China in the 1980s. As European manufacturers expand their presence in China and as Chinese manufacturers start to offer European style drum clothes washers, both types of washers become widely available in one market. But there are no consistent testing procedures to measure the energy performance of these two types of washers (Lin and Iyer, 2005). The Japanese type of washers are still evaluated based on an adopted version of the Japanese testing protocol, which tests washers under the cold wash cycle, while the European type of washers are evaluated under an adopted version of the ISO testing protocol, which tests washers under the hot wash cycle. This makes it difficult to develop energy efficiency standards and labels for clothes washers that could evaluate energy performance of competing washers in China (AQSIQ, 2003).

The emergence of China as a global center of appliance manufacturing also creates new challenges for many importing countries, which have a declining domestic manufacturing base. Regulators in such countries such as Australia find that it would be mutually beneficial to work with the Chinese standard development authority to create harmonized standards for certain sets of appliances, such as room air-conditioners. This was also the case for the coordinated development of efficiency requirements for external power supplies, as China produces a great majority of such products.

In other product categories such as office equipment, the development of the product performance specifications was dominated by a few multinational manufacturers. Thus the increased global trade has lead to adoption of these technical specifications in other markets, creating a "natural harmonization" at the technical levels. In such situations, the barriers to harmonization are somewhat reduced. The success of the international Energy Star program for office equipments demonstrates that it is much easier to achieve harmonization for such "global" products.

These institutional, technical, and market factors introduces different complexities to the process of harmonizing energy efficiency standards across national borders. They need to be carefully considered in any effort to promote standard harmonization.

Case Studies of Recent Harmonization Effort

Three recent cases where international harmonization has been sought illustrate interplay between the various institutional, technical, and market factors. The products in these cases are office equipments, external power supplies, and the compact fluorescent lamps (CFL). These efforts should provide useful lessons for future efforts of standard harmonization.

Office Equipment

The US EPA launched the Energy Star program in 1992, initially with computer monitors and later expanded to cover many other product categories. Products meeting the Energy Star requirements are recognized with the Energy Star logo, which identifies them as energy efficient products. The success of the US Energy Star program in creating greater consumer adoption of energy-efficient office equipment has attracted interests from government agencies around the world (Webber et al, 2004). Since 1995, US EPA has worked with international partners to create an international Energy Star program for office equipment. Currently, Europe (EU), Japan, Canada, Australia, New Zealand and Taiwan have participated in the program, creating a global platform to promote energy efficiency in office equipment.

While China is not a partner in the international Energy Star program, the China Standard Certification Center (CSC) has worked closely with the Energy Star program since 2002, and its certification requirements for office equipment are closely harmonized with the relevant technical specifications of the Energy Star program. However, CSC used its own logo for qualified products on the Chinese market (CSC 2006).

Office equipment are heavily traded internationally and their performance specifications are rather uniform. It is also helpful for wider adoption that Energy Star requirements for office equipment focus on the standby power use initially, and US EPA has championed the development of testing protocols to measure the standby power use. Moreover, because regional customs and personal design tastes are largely irrelevant in consumer choice of office equipment—where the focus is functionality—technology variation among national markets is minor. Similarly, office equipment production tends to be highly concentrated geographically with a high degree of global exports to capture the economies of scale of mass production (Fridley and Wiel 2004). Such product homogeneity lowers the threshold to participation.

Since Energy Star is a voluntary program, it is also simpler for government agencies around the world that are looking for new programs to promote energy efficiency and mitigate the climate impact of energy use to adopt the practice championed by US EPA. This is what can be described as the "follow the leader" model.

External Power Supplies

The growing number of products used in the office and home that use external power supplies (such as laptops, monitors, inkjet printers, cell phone chargers, etc.) has increased attention to the efficiency of the power supply itself. In the US alone, more than 3.1 billion power supplies are in use, and 450 to 600 million units are sold each year (Caldwell 2004). China is currently the world's largest producer of power supplies and its own market is increasing rapidly as well (Horowitz 2004).

In 2003, the Energy Star program of US EPA embarked on a market study of the power supply market as the first step toward developing efficiency specifications. Unlike office equipment, no broadly accepted test procedures exist for testing the efficiency of a power supply at any level below full load, despite the fact that most power supplies operate primarily at less than full load. With support from a range of US consultants, a proposed new testing procedure was developed, measuring the efficiency of power supplies at no-load, 25% load, 50% load, and 100% load. These part-load and full-load results were then averaged to give an active mode average efficiency.

On the basis of successful cooperation between Energy Star and China's CSC, it was proposed that the specification development for the product proceed in a completely harmonized fashion, including work on testing and finalizing the new test procedure and the efficiency specification. Similarly, Australia's energy efficiency office (Australian Greenhouse Office or AGO) agreed to join the process, as did the California Energy Commission (CEC), which is in charge of developing and implementing California's mandatory efficiency standards. As work had been ongoing in the EU as well on external power supplies, they joined in the consultation as well.

For the test procedure, about 800 sets of test data were generated--500 from Chinese test laboratories and the rest from labs in US and Australia. Manufacturers were encouraged to use the test procedure themselves and submit data. This process resulted in minor modifications to and clarifications of the test procedure, which required testing at both the 220V and 110V levels in use in the various countries.

Each country undertook its own analysis of the data and conclusions were shared through email, telephone calls, and in periodic meetings of technical experts and program staff held in China and the US. Owing to the different requirement of different programs, and in recognition of differing market development stages of the various economies, the AGO proposed multiple tiers of specifications instead of a single specification adopted by all programs. This novel tiered approach provided flexibility within harmonization; based on a single unified test standard, multiple levels of specifications were created, ranging from an "entry level" tier I to a yet-to-be-announced stringent tier VI specification (Table 1). Each program adopted an efficiency level within the tiered structure, with the understanding it would move up a tier or two over time. By the end of the project, Tier I had been reserved for any power supply not meeting the specifications; Tier II for China's mandatory minimum efficiency standards, and Tier III for the US and China voluntary labeling programs and California and Australia's mandatory minimum standards. Tiers IV and V are expected to be the levels adopted in 2006, 2007 and 2008 (Horowitz and Ellis, 2005).

Table 1. Performance Level Descriptions for EPS Specifications

Mark	Description	Effective Date
I	Used if none of the criteria are met.	Immediately
II	China's CNIS: Proposed Tier 1 Minimum Energy Performance Standard (mandatory).	2006 – III or IV Q
III	US: Adopted EPA ENERGY STAR level Tier 1 (voluntary).	2005 – January 1
	China: Adopted CECP level (voluntary).	2005 – January 1
	California: Adopted CEC Tier 1 standard (mandatory).	2007 – January 1/July 1*
	Australia: Minimum Energy Performance Standard (mandatory). Will be high efficiency until commencement date. Marking Protocol to commence not earlier than April 2008.	2007 – October 1
	China's CNIS: Proposed Tier 2 Minimum Energy Performance Standard.	2 years after start of Tier 1
IV	Australia: Initial "High Efficiency" category (voluntary). Will become mandatory not earlier than October 2010.	2007 – October 1
	California: Adopted CEC Tier 2 standard (mandatory).	2008 – January 1**
V	Future voluntary EPA ENERGY STAR Tier 2 level – actual level to be determined at a later date.	2008 – January 1
VI and Higher	Reserved for future levels.	Some future date

*January 1, 2007 for EPSs sold with laptops, mobile phones, printers, print servers, scanners, PDAs, and digital cameras, July 1, 2007 for EPSs sold with cordless phones and all other devices, to July 1, 2007 (proposed)
**May be postponed

To make it easier to identify the efficiency level of an external power supply, the AGO also proposed a marking regime, whereby each external power supply would be marked with a Roman numeral from I to VI indicating which efficiency tier it met. This would facilitate enforcement as it provided a quick visual check to the efficiency level.

Harmonization of program launch was also considered, but this step was more highly dependent on the degree of progress in stakeholder discussions in each country. In the end, both US Energy Star and the China CSC decided to formally launch their programs on 1 January 2005, with the Australian, Chinese and Californian mandatory standards coming into effect during 2006.

Successful harmonization of the external power supply efficiency criteria relied on several key factors. First was the global nature of the consuming market and the single-country dominance of production. Unlike clothes washers, power supplies were identical in all markets (except for voltage and plug characteristics) and thus presented few challenges to categorization. Moreover, power supplies are not products that end-use consumers have a choice about for the most part, and thus generally not subject to issues of consumer taste and preferences.

A second factor was the absence of an existing globally accepted test procedure, which provided the opportunity to develop a new one of global application from the beginning. Related to this, there were similarly no widely recognized competing test procedures already in use in the different countries; this avoided issues—such as is the case with compact fluorescent lamps (CFLs)—of one program having to adopt a different test procedure after significant testing capacity was already established for another test procedures.

Third, champions for harmonization in each country existed at both a technical and program level. This provided leadership for the effort, existing structures through which to engage manufacturers and other stakeholders, funding support for technical expert participation, and the ability to move rapidly from research to adoption.

A fourth factor of success included the introduction of program flexibility through adoption of tiered specifications, which accommodated both differences in market composition and development and the rapid changes engendered by the short design cycles of the product.

Finally, success was aided by the simplicity of the final specification, which included only the requirements for no-load energy consumption and a formula for calculating the efficiency requirement of active mode, based on the average of the part- and full-load measurements.

Challenges also arose. The European Union had already embarked on a similar program and thus had already developed a proposed specification that varied from that adopted elsewhere. Although EU experts participated in each harmonization meeting, the EU retained a final specification that was similar but not equivalent to those adopted by the other participants. A second challenge is the same as one of the success factors: that external power supplies are not directly demanded by consumers but are usually purchased as part of another piece of equipment. This disconnect between the power supply manufacturer, the equipment manufacturer, and the final consumer increased the complexity of stakeholder involvement with regard to program launch and uptake of the labeling criteria. Fortunately, since external power supplies are part of a fairly homogenous, low-margin market where cost increases are of great concern, the addition of an "energy efficient" mark provided one way for power supply manufacturers to distinguish their product from others and justify cost increases, if any.

Compact Fluorescent Lamps

Following the successful launch of a harmonized external power supply efficiency program, standards and labeling program managers in the US, China, and Australia embarked on a second, more complex, market for harmonization: compact fluorescent lamps, or CFLs.

The choice of this product fulfilled several needs at once: Australia had launched a Green Lights program and was looking to develop new standards for a range of lighting products; the US Energy Star program was considering a further revision of its CFL specifications, and China CSC had taken management control of the Efficient Lighting Initiative (ELI) and was planning to revise the ELI and Chinese domestic CFL specifications to bring them in line with each other.

This effort was formally launched at the Right Lights 6 conference in Shanghai in May 2005. At this meeting, over 80 participants from 12 countries and regions agreed to form a "community of practice" as the framework for furthering discussion and negotiation on the adoption of a harmonized test procedure and set of CFL specifications. At the meeting, five working groups were formed, including groups on test protocol, specifications, testing capacity, compliance mechanisms and international enforcement. The goal was to develop position papers on the subjects for review at a November 2005 meeting in Seoul. The program has targeted completion of the work by 2007.

Compared to the process involved with external power supplies, this effort is more challenging. In terms of the test protocols, two major global standards exist: the IEC series and the US ANSI series. Although the differences between the two series of test requirements are small (Fridley et al, 2005c, and Lin et al, 2005), national programs require laboratories to use one specific series of tests and do not accept the results from laboratories testing to the alternative standard. Thus, CFL harmonization in the world's largest markets, the US and China, must first deal with the differences in the basic test procedure itself, a time-consuming task.

Secondly, the specifications for CFLs are much more complex than for power supplies, including, for example, not only energy efficiency, but also requirements for color, lifetime, startup time, lumen depreciation, and other factors that impact performance and consumer acceptance. As a result, the development of a tiered set of specifications—also envisioned in this approach—is complicated by the tradeoffs among these various performance factors. This complicates the ability to develop a simple linear improvement for each factor as a way to define the set of performance specifications chosen for each tier.

A third challenge relates to sharp differences in quality of CFLs across markets. Unlike the case with external power supplies, where the huge differences in efficiency are hidden from the consumer, the differences of quality in CFLs are immediately known by the consumer: a short-lived CFL leaves the consumer in the dark. Since quality and perception of quality versus price influences consumers' decision to buy additional CFLs, national programs have expressed strong concern over the need to maintain high product quality. In the short-term, this has been reflected in the strong national preferences for national testing as a way to provide such quality assurances and a disinclination to accept test results from other countries' testing programs. For full harmonization to achieve mutual recognition of test results, this challenge must be overcome as well. This has lead to effort to introduce round-robin test among testing labs across selected APEC countries. Similarly, programs of market transformation that rely on labeled products for consumer rebates are concerned about ensuring high quality of CFLs in order to deliver and sustain expected energy savings.

Conclusion

As national standard and label programs multiply and global trade in appliances continues to grow, standard harmonization effort will gain more momentum. There are clear benefits to manufacturers, consumers, and national government agencies in charge of standard development in reducing trade barriers, increasing trade flows, and promoting higher energy efficiency.

Harmonization of appliance standards and labels could take in a variety of forms: harmonizing testing procedures, mutual recognition of test results from accredited testing laboratories, harmonizing the performance standard levels and energy labeling criteria, and full harmonization.

Given the differences in the stage of development and in consumer preference of product characteristics, as well as in testing protocols, harmonization effort of national programs need to be careful in choosing product groups, national partners, and realistic targets. Factors to consider in development of a harmonization effort include:

- Similarity in product performance characteristics (for example, washing machines)
- Common test procedures
- Product quality and performance issues beyond efficiency
- Champions for harmonization among stakeholders
- Institutional arrangement for mutual recognition of test results from participating countries
- Degree of integration (full specification harmonization and mutual recognition; specification harmonization; or tiered specifications)

Trade flow patterns offer a logical guidance for regional harmonization effort such as within North America, since most appliance trade takes place among countries within a region. Additionally, product characteristics are often similar among countries within a region.

Emerging information technology products are also promising areas, given that their designs and performance specifications are global in nature, compared to "legacy products" that are more determined by local taste. There are often opportunities to develop brand new and consistent global testing protocols for emerging products, which provide excellent institutional setting to develop tiers of performance specifications that can be adopted by different countries according to their own market situation and schedules.

Full program harmonization should include mutual recognition of testing results to reduce cost of multiple testing in multiple countries. However, low confidence of testing results across countries, lack of "round-robin" testing to increase the confidence of testing results, and issue of program sovereignty remain significant challenges to achieving this goal. However, even harmonization only at a technical level or through a tiered performance approach can provide a foundation on which full harmonization may be eventually achieved.

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