

International Comparison of Energy Efficiency Standard and Labels: Development Process and Implementation Phase

*Sho Hirayama, Hidetoshi Nakagami, Chiharu Murakoshi, Mikiko Nakamura, and Suguru Mizutani, Jyukankyo Research Institute Inc.
Shuji Okuda, Stanford University*

ABSTRACT

Energy-efficiency standards and labeling programs for household appliances, equipment and lighting have been adopted not only in developed countries but also in the developing countries. They are contributing greatly to the achievement of energy conservation. Many countries have mandatory minimum energy-efficiency standards and labeling programs. Meanwhile some countries have voluntary programs. Japan has established and adopted her own Top-Runner program. Although the key elements of standard and labeling programs are available on the web or documents, there are few sources that document comprehensively the development process and implementation phase of standard and labeling programs.

For many countries, in particular the developing Asian nations whose energy demand is expected to experience continues rapid growth in the near future, it is one of the crucial issues of energy efficiency promotion to provide policymakers with comprehensive information on implementation phase of standard programs.

We surveyed the development process and implementation phase of standards and labeling programs in the U.S.A., Canada, the European Union (European Council, UK, Germany and France), China, Korea and Japan. We obtained information about designing, developing, implementing, enforcing, monitoring and maintaining standards and labeling programs. In this paper, we present an international comparison framework of the standards-setting processes and labeling implementation in these countries. This comparative analysis will help policymakers to introduce and revise energy efficiency standards and labeling programs.

Introduction

Energy-efficiency standards and labeling programs (Standards & Labeling; S&L) for household appliances, equipment and lighting have been adopted not only in developed countries but also in the developing countries. They are contributing greatly to the achievement of energy conservation. In years to come, S&L introduction and development will be important, especially in developing Asian countries, which expect energy strong demand growth. Information on the direct and effective methods to implement S&L will be indispensable for policy makers in these countries.

Although the thrust of S&L programs, such as energy efficiency standards, labeling of target products (whether mandatory or not), are available on the CLASP web site and in each country's governmental department in charge, there are few sources that comprehensively provide development process and implementation phase of S&L programs.

We surveyed efficiency standard of household appliances, developing process of labeling and the implementation facts in seven countries U.S.A., Canada, the European Union (European Council, UK, Germany, and France), China, Korea and Japan. The survey was conducted with

policy makers, business persons in charge and researchers in each country, interviews with manufacturers and published documentation. We collected information country by country about the organization responsible and their role, the process of planning, compliance with standards, surveillance and revision of standard.

International Comparison of Energy Efficiency Standards and Target Products

Energy-efficiency standards for equipment and appliances are Minimum Energy Performance Standard (MEPS) except for Japan. The sale of products that meet a standard is regulated in most countries. In the case of Japan, however, the Top Runner approach is unique. While energy efficiency standards are mostly mandatory, voluntary standards are included in part.

Labeling is performed with the minimum and mandatory standard in most countries. By this system, the high efficiency in a market as a whole is attained by limiting labels only to what exceeds the minimum requirement. In this case, no matter whether the labeling system is voluntary or mandatory, labeling has an important meaning and a lot of countries adopt an efficiency grading system so as to make the difference in efficiency among products clearly recognized. On the other hand as in Japan, when setting a Standard Value as efficiency of the highest in the market, whether this is cleared or not has the most important meaning. Therefore, the importance degree of grade display is largely different depending on whether the standard is of minimum efficiency or of the top-runners.

Table1. Types of Energy-Efficiency Standard Programs and Target Products

Country	Program Type	Target Product
EU	Mandatory	Refrigerators, Freezers, Refrigerator-freezers, Ballasts (Magnetic), Boilers (Gas)
	Voluntary	11 products including Clothes Washers, Dishwashers, Audio Equipment, Water Heaters (Electric), TVs, VCRs and/or DVDs, Motors (3-phase Induction), etc
	Under consideration	21 products including Boilers, Water heaters, PCs, Imaging equipment, TVs, Battery Chargers, External Power Supplies, Dishwashers, Washing Machines, etc
USA	Mandatory	22 products including Refrigerators, Freezers, Refrigerator-freezers, RACs, Boilers, Clothes Washers, Clothes Dryers, Ballasts, Passenger cars, etc
	Voluntary	Cooktops and Ranges/Ovens, Microwave Ovens
	Under consideration	8 products including Battery Chargers, External Power Adapters, Transformers, Dehumidifiers, Vending Machines, Ceiling Fan Light Kits, etc
Canada	Mandatory	35 products including Refrigerator-freezers, Central ACs, RACs, Clothes Washers/Dryer, Ballasts, Boilers, Heaters, Heat Pumps, Furnaces, Computers, etc
China	Mandatory	26 products including Ballasts, Refrigerator-freezers, Central ACs, CFLs, Clothes Washers, TVs, Irons, RACs, Rice Cookers, Transformers, Passenger cars, etc
	Under consideration	12 products including Boiler, Water Heaters (Electric), Commercial refrigerator, Cooktops and Ranges/Ovens, Copiers, Set-top Boxes, Multi connected ACs, etc
South Korea	Mandatory	21 products including Refrigerator-Freezers, Kim-chi Refrigerators, RACs, Clothes Washers, Fluorescent Lamps, Rice Cookers, Passenger cars, etc
Japan	Mandatory	21 products including Refrigerators, Freezers, RACs, Fluorescent Lights, TVs, DVD Recorders, Electric Rice Cookers, Electric Toilet Seats, Passenger cars, etc

Canada is the country with the most numerous target products with energy efficiency standards with around 35 target products. It is followed by China with 26, the U.S. with 22, South Korea with 21, and Japan with 21. Although the number of target products of EU is as

small as 5 for present, it developing proposal to add a range of new items through the Energy Using Products Directive. The appliances most commonly specified as target products are refrigerators, air-conditioners, lights, fluorescent lamps and ballasts.

Generally, target products covered by energy efficiency standards are those appliances that are used widely in each country, which may partly explain the low coverage in the EU at this stage. On the other hand, in the developing Asian countries, introduction of energy efficiency standards is spreading, and many appliances have been already specified as target products in China. It reflects the growth of home electronics and the associated increase of energy consumption, particularly in China. The number of target products is likely to be increased further.

International Comparison of Labeling Programs, Label Types and Target Products

Table2. Type of Labeling Programs and Target products

Country	Label Type and Name		Target Product
EU	Mandatory	EU Energy Label (Comparative)	21 products including Boilers, Refrigerator-freezers, RACs, Clothes Dryers, Clothes Washers, Clothes Washers/Dryer, etc
	Voluntary	EU Eco-Label (Endorsement)	9 products including Clothes Washers, Computers, TVs, Dishwashers, Fluorescent Lamps, Refrigerator, etc
		EU Energy Star (Endorsement)	Computers, Copiers, Fax Machines, Monitors, Printers, Scanners
USA	Mandatory	Energy Guide (Comparative)	17 products including Ballasts (Electronic), Boilers, Central AC, Clothes Washers, RACs, Refrigerator-freezers, etc
	Voluntary	Energy Star (Endorsement)	47 products including Battery Chargers, Ceiling Fans, CFLs, Clothes Dryers, Computers, Laptops, MFDs, Monitors, etc
Canada	Mandatory	EnerGuide (Comparative)	15 products including Refrigerator-freezers, Clothes Washers/Dryer, Cooktops and Ranges/Ovens, RASs, etc
	Voluntary	Energy Star (Endorsement)	48 products including Battery Chargers, Ceiling Fans, CFLs, Computers, Dehumidifiers, TVs, VCRs, Monitors, etc
China	Mandatory	China Energy Label (Comparative)	Central ACs, Clothes Washers, Freezers, RACs (Window), Refrigerator, Refrigerator-freezers, Self-ballasted Fluorescent Lamps, High Pressure Sodium Lamps, Small and medium Three-phase Asynchronous Motors
	Voluntary	Energy Conservation Certification Label (Endorsement)	35 products including Ballasts, Central ACs, CFLs, Clothes Washers, TVs, Fluorescent Lamps, RACs, Rice Cooker, etc
South Korea	Mandatory	Energy Efficiency Label (Comparative)	20 products including Dishwashers, Drum washing machines, Kim-chi Refrigerators, RACs (Split), Passenger cars, etc
	Voluntary	High-efficiency Equipment Label (Endorsement)	34 products including Ballasts (Electronic/Magnetic), Boilers (Gas), CFLs, Fluorescent Lamps, Pumps, etc
		Energy Saving Label (Endorsement)	20 products including Battery Chargers, Bidets, Computers, Copiers, Cordless Phones, TVs, VCRs and/or DVDs, etc
	Mandatory (from 2009)	Energy saving mark (Endorsement) / Warning label (Dis-Endorsement)	17 products including TVs, VCRs, audio, DVDs, Microwave Oven, set top box, Computers, etc (This labeling program is conducted with 1-Watt standby power program.)
Japan	Mandatory	Energy Saving Label (Comparative)	RACs, Refrigerator-freezers, TVs
		Energy Saving Label (Endorsement)	20 products including Toilet Electric Seats, VCRs, DVDs, Rice Cooker, Microwave Ovens, Hard-disk drives, etc
	Voluntary	Energy Star (Endorsement)	Computers, Copiers, Fax Machines, Hard-disk drives, Monitors, MFDs, Scanners

There are two major kinds of labeling systems, comparative labels, which enable the comparison of energy efficiency among the products of same type on the market, and endorsement labels, which identify products that exceed a fixed energy efficiency level.

Comparative labels are often used together with energy efficiency standards. Display of the label is mandatory in almost all the countries that have adopted them. Number of target products is small compared with endorsement labels in many cases.

On the other hand, endorsement labels are mostly a voluntary system (they are designed to only cover the top performers) and manufacturers need to receive attestation in posting of labels by a disinterested organization. ENERGY STAR represents endorsement labels. It was developed in the U.S. and adopted in EU, Canada, and Japan.

Developing Process of Standard System and Its Implementation Phase in Each Country

EU Standards Development Process

The Directorate General Energy and Transport (DG TREN) of the European Commission takes charge of developing both Minimum Energy Performance Standards (MEPS) and labeling standards. It is implemented by each country's organization in charge, reflecting the requirements of the EU Directive.

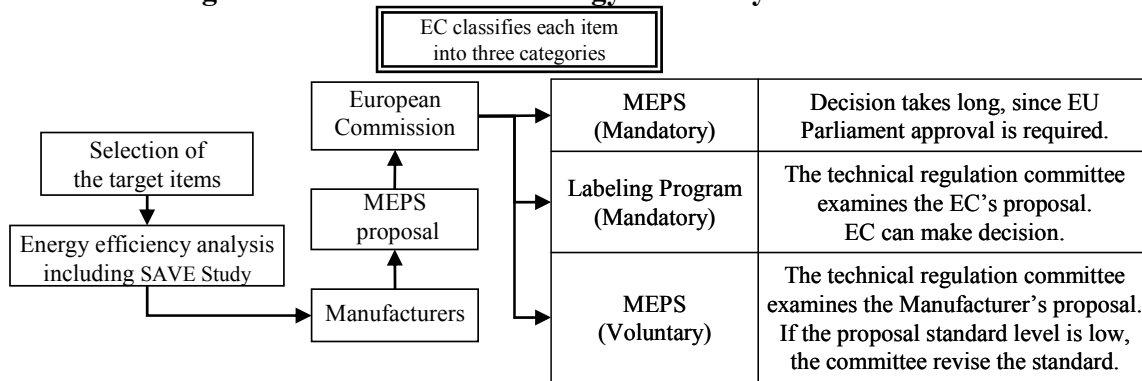
On selection of the target products, priority is given to those products with a large potential for efficiency improvement. Data is collected country by country, and is submitted to the European Commission. For example, in France, manufacturers are responsible for measurement of data. Household Appliance Manufacturer Association (GIFAM) collects the data. Environment and the Energy Management Agency (ADEME) compiles that data and submits them to the European Commission. Private-sector research institutions or European Commission (EC) uniquely performs analysis used for decision. In the determination of a Standard Value, the representatives of each country and the representatives of specialist and industrial field gather and discuss this issue. The committee classifies each item into three categories (mandatory standard, labeling program, voluntary standard).

In the case of the EU, it was pointed out that development of mandatory efficiency standard took too long, since EU Parliament approval was needed for each new product. However, "comitology" procedure was introduced recent years, aiming to speed up standard development procedure. It is a process by which the European Commission forms a technical regulation committee consisting of representatives of member nations which make decisions on each product and adopts tense as European Commission directives, thus, succeeded in skipping the deliberation process of Parliament or an executive board.

In late years, a problem was pointed out in the "comitology" procedure. As a result, it was amended by giving the European parliament an authority of scrutiny and veto. However, this revision which makes the process more time consuming, may damage a merit of "comitology" characterized by its swiftness.

Directive 2005/32/EC on the eco-design of Energy-using Products (EuP) was adopted in 2005. EuP is the world's first law that stipulates manufactures to reduce the energy consumption and other negative environmental impacts at the design stage. MEPS are to be integrated into EuP. It is said that standard levels are revised in the framework of EuP.

Figure1. Classification of Energy Efficiency Standard in EU



Standard Implementing Phase

Efficiency standards are imposed on manufacturers through regulation. Manufacturers are responsible for conducting measurements and the application is based on self-authorization. The obligation of labeling is imposed on both manufacturers and retailers. The manufacturers are obliged to supply labels in packaging at the time of shipment, and retailers are obliged to affix labels only on the products currently exhibited at retail outlets. Each country has its own language fiche with is affixed next to the technical strip with indicates the energy consumption and performance.

According to interview organization concerned, surveillance and auditing are mutually practiced among manufacturers and these functions well as to ascertain standard conformity. For example, if a highly efficient product is placed on sale by a certain manufacturer, competitors will test it to check whether it conforms to the standard. Since implementation of conformity is left to each country, it varies by country, In the case of France, the inspection system is deployed by which inspectors patrol and check dealers in order to supervise that products on the market have energy labels correctly displayed.

The U.S.A. Standard Development Process

Department of Energy (DOE) is legally obliged to carry out decision of the U.S. energy efficiency standard. ENERGY GUIDE label (comparison label) is managed by the Federal Trade Commission (FTC), and ENERGY STAR program label, by DOE and Environmental Protection Agency (EPA).

Many organizations participate in the development of efficiency standards in the U.S., and the whole process often takes a long period of time. Target products are examined by the Department of Energy at first, and the manufacturer trade associations collect the basic data from member companies which can be used in the standard development process. Research institutions, such as the Lawrence Berkeley National Laboratory (LBNL), conduct analysis for technical and economical validity based on the collected data. Regarding standards development, it is requirement that the standard must be technically feasible and economically beneficial. It is also legally required that the economic benefits must be quantified and specified.

Based on this analysis result, opinions are exchanged between manufacturers and industrial groups on one side, and NGOs, energy related organizations, consumer organizations and consultants on the other. The US Department of Energy (DOE), in a neutral position, accepts

and adopts the results which are collected as a result of these deliberations. The final outcome from the standards development process is published in the official government gazette each time as a notice of proposed rule making, and is reexamined after receiving public comments. It is reexamined two more time before the last notification, which results in substantial work load. Although this whole process is complicated, it is defined in this way by law. It usually takes three years until notification, and the whole process can sometimes take up to twelve years.

Although the Department of Energy is expected to cover all products, it has omitted new standards development recent years. It became difficult to develop new standards of two or more items simultaneously because of budget and resource restrictions and the complicated and time-consuming procedure required. An environmental group filed a lawsuit against this embarrassing condition. This triggered an acceleration of the process. Namely, the Department of Energy (DOE) is now obliged to decide upon a standard within a fixed period and if an agreement is reached between manufacturers and other parties, including NGOs, the proposal is sent to congress for legislation without the need for the remaining steps which made the process long and complicated.

Standard Implementation Phase

In respect of the compliance with efficiency standards, manufacturers are responsible to measure their own products, and self-authorization is admitted as in EU. It is also audited by mutual inspection of the manufacturers on whether the products comply with the standard. The government is not so active with respect to conformity checking or monitoring. Nevertheless, it is rare for manufacturers to fail requirements as the procedure in this case and the associated consequences for non compliance are substantial.

As for the ENERGY GUIDE label, which is a mandatory system, regulation about affixing labels is prescribed, accompanied by punitive clause applicable for any violation. The display of labels varies between products – many are not affixed. It is because the number of staff and the budget amount of FTC in charge are insufficient to examine an observance situation and supervise them if necessary. However, it is expected that these problems are reexamined and management will be strengthened.

In contrast, ENERGY STAR label, which is a voluntary labeling system, has strong links with manufacturers, retailers, the electric power utilities and the states, and is used widely for promotions. Since it has both human and financial resources for this program, Environmental Protection Agency (EPA) can check directly whether and how labels are affixed in the retail store, which leads to success in appropriate management of labeling program.

Recently the minimum efficiency standards and Energy Star are using a common basis for assessment for some products. It is a policy, which guides the whole market efficient by pulling up the efficiency standard to that of Energy Star in several years. This benefits manufacturers too, since future standard revisions can be predicted.

Canada Standard Developing Process

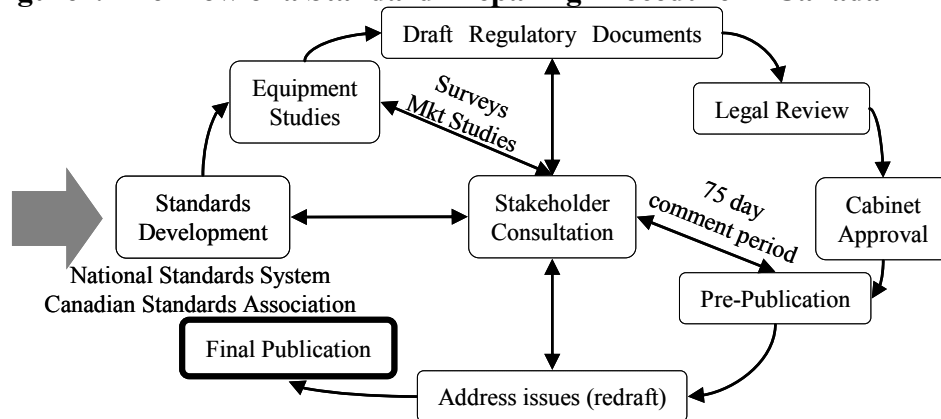
Based on the result of energy consumption analysis and economical analysis, Natural Resources Canada (NRCan) decides upon energy efficiency standard for each product, after consultation with stakeholders such as state governments, the territory governments, product manufacturers and consumers. Advice and assistance provided by these organizations is

indispensable for program development and efficient implementation is possible through private sector cooperation with the government and through sharing of knowledge and information.

Compared with the U.S., standards development process is simple. In Canada, a notification provided in the first step, in contrast to the U.S., which examines a draft three timetables. However, since Canada has only few manufacturers, coordination industry stakeholders is simpler and the level of detailed investigation required in the U.S. is rarely required in Canada. As part of the first step, investigations are conducted to examine whether a product should be chosen for standards development, and a proposed level is prepared in the second step. In the case of the U.S., the reexamination work is conducted in this stage, including a call for public comments, but the approval at a cabinet meeting precedes reexamination in Canada. After approved at a cabinet meeting, public comments are sought, and the result corrected in response to comments and is subsequently enforced as a notification.

It typical takes one to one year and half years to develop standard in Canada. Direct negotiation may take place with manufacturers and industry groups during the drafting stage. The flow of a standard preparing procedure is shown in a following figure.

Figure2. The Flow of a Standard Preparing Procedure in Canada



Source: [NRCan] Office of Energy Efficiency (2007)

Standard Implementation Phase

In Canada, all products must be certified by an approved certification organization, and the results are submitted to obtain a verification mark. A product registration system has been adopted in Canada, and data on all models is put into a database. Data on imports is reported to customs and tracked. Efforts are focused on customs since many products are imported. For this reason, NRCan can track all the models of product currently sold in Canada.

NRCan conducts investigations every two or three years to compare registered data with the data of the energy efficiency displayed on the product currently sold at the market. It can be said that the attestation system at the time of product registration is functioning effectively in Canada.

China Standard Development Process

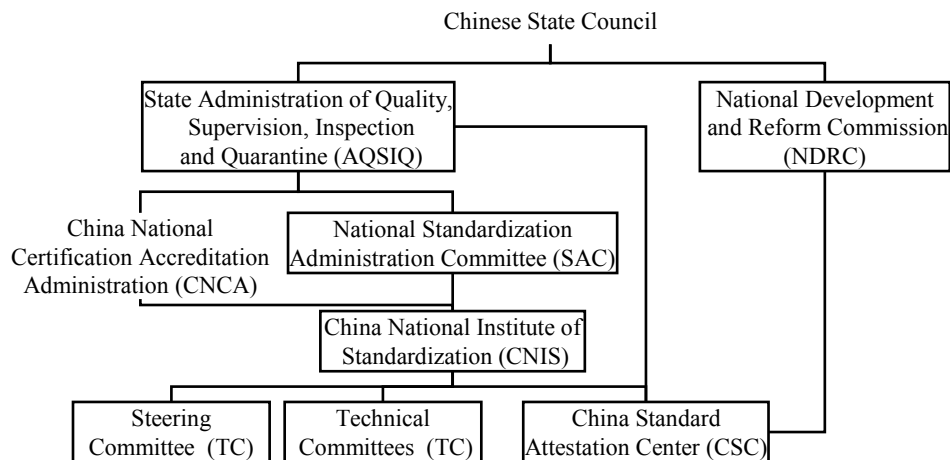
The minimum energy performance standard (MEPS) and the standard of energy efficiency label are developed, taken lead by China National Institute of Standardization (CNIS)

under the National Standardization Administration Committee (SAC) affiliating with State Administration of Quality, Supervision, Inspection and Quarantine (AQSIQ). AQSIQ takes charge of their operation management.

The analytical data for new or revised standards is collected from China Standard Attestation Center (CSC), registration center, etc. based on the measurement data of manufacturers or testing bodies. A number of experts teams are used to develop standards, including various Technical Committees (TC) and department technical committees (SC), who conduct evaluation analysis in cooperation with AQSIQ. TC and SC are organized by inviting academic experts as committee members from manufacturers, the certification authority, testing bodies, consultants, consumer organizations, etc. The standard proposal, as discussed by TC or SC, is reported to the National Standardization Administration Committee (SAC) via the China National Institute of Standardization (CNIS), after deliberation in the form of public comments.

On the other hand, a China Standard Attestation Center (CSC) conducts the standard development and operation management of target products of voluntary labeling programs. CSC decides upon the basic standard of a labeling program independently, by making analysis and evaluation of market data, pursuant to the regulation of a country, and based upon standards of industries. It is deliberated with companies and industry groups. The technical data of CSC sometimes serves as a reference to developing MEPS.

Figure3. Structure of S&L Organizations in China



Standard Implementation Phase

Manufacturers or the contractors who import products to China are obliged to observe the GB (Guo jia Biao zhun) standard as the national product standard (along with any performance requirements) and to display the energy efficiency labels. Performance of products, such as quality and the energy efficiency, are confirmed to comply with GB standard through the results of their own company’s testing or examination by public test body. When applying for the energy-saving attestation label, which is voluntary scheme, it is obligatory to have products examined by the testing body which is endorsed by the government.

The GB standard system has a regulation with respect of the sampling of a product for compliance. The examination of three samples or more is required at the time of new products release or when there is a design change of existing products. Even when there is no change of existing products, a regime of a random inspection is imposed, and a random inspection is

carried out at least once a year. If false claims regarding the compliance energy efficiency standards have been made, punitive clause can be applied. For compliance breaches, sometimes name of the company is announced in publicly.

Minimum Energy Performance Standard (MEPS) are reexamined at the same time that the GB standard is revised, as required, to reflect the trends in the market. China State Bureau of Technical Supervision, which belongs to SAC, develops the GB standard. At present, reexamination and revision are conducted frequently. The GB standards harmonize with international standards of ISO (International Standardization Organization) and IEC (International Electro-technical Commission) in many cases

With regard to implementation of efficiency standards, the main issues facing China are as follows;

- The system of laws and regulations requires further work,
- Punitive clause does not generally have sufficient effect,
- Market research is inadequate,
- Public relations and education system for manufactures and contractors are still inadequate.

Currently, the various systems are being reviewed in order to increase their effectiveness, and review of successful examples is being undertaken, including the West and Japan.

South Korea Standard Developing Process

In South Korea, the Korean Energy Management Corporation (KEMCO), which has been appointed by the Ministry of Knowledge Economy (MKE), is responsible for the development of efficiency Standards, along with the policy development, implementation and management of Korea's energy labeling program.

KEMCO commissions the government endorsed testing bodies (9 Labs including Korea Testing Laboratory) to collect data to support the development of efficiency standards. The testing body, which receives requests with regard to specific products, collects data from the manufacturers. This data, along with sales information, is used to develop sales weighted efficiency data which reflects the mixture of products purchased in the market. An efficiency standard proposal is developed by undertaking a statistical analysis of the product data.

The standard proposal development is lead by KEMCO, who consults with the government endorsed testing body, which conducts preliminary surveys (collection of data, efficiency standard preparation, etc.) and also offers technical support, together with manufacturers and academic experts for each product. A standards proposal is submitted to the committee established by KEMCO, and is finalized in consultation with manufacturers and academic experts, after taking future technology trends into consideration.

The final proposal is recommended to MKE via KEMCO, and is approved and implementation after the deliberations of a governmental rule administration committee.

Standard Implementation Phase

Manufacturers and manufactured goods importers (distributors excluded) are required to measure the efficiency of energy use, the energy consumption, and the energy efficiency grade

with testing bodies, as well as display (affix) energy labels to products supplied to market. The performance tests for standards conformity must be conducted by the testing body that has been endorsed by the government. Although manufacturers may undertake their own standard conformity tests and do so for several specified products, the number of manufacturers who have test equipment and approval to do this at present is only two. Manufacturers register products and supply the test results together with other specified information to KEMCO through Internet.

In order to verify standards compliance, KEMCO purchases products randomly in the market, and requests their examination by the testing body. The testing body reports the performance test result to KEMCO. When the result deviates from the requirements, KEMCO issues directions to the manufacturer to rectify the problem. Fixed monitoring is carried out every year, and in addition irregular monitoring is also carried using market research and the information from consumer organizations where possible.

Japan Standard Developing Process

The target products specified by the Top Runner standard are appliances which are common in the home, which use to have a significant consumption of energy, and whose improvement in efficiency is especially required. Within this framework, target products are selected by the Energy Efficiency Standards Subcommittee (EESS) that belongs to the Ministry of Economy, Trade and Industry (METI). EESS is constituted by representatives of academic experts, manufacturers, labor unions, and consumer organizations.

A proposal of Standard Value level is examined by the Evaluation Standard Subcommittee (ESS) under EESS for each type of machinery and equipment. The data used to develop a Standard Value proposal is measured and collected by the manufacturers, and is submitted to ESS. The data is analyzed by product classification, and the efficiency level of Top Runner products currently on the market is examined. Simultaneously, examination is also focuses on future technical development possibilities and the influence of the standard proposal on the price of appliances. A Top Runner standard proposal is then determined, taking into account the potential for further technical development and the efficiency of Top Runner products.

Public comment is sought, and after considering feedback, the final Standard Value proposal is determined by the Evaluation Standard Subcommittee. It is then reported to the Energy-Saving Standard Sectional Meeting and deliberated. It is formally implemented as a Top Runner standard after approval in Parliament.

Standard Implementation Phase

Manufacturers are responsible for measurement themselves and submit reports to the government about conformity with the standard, together with the volume of product shipments. Standard conformity is ascertained by the mutual surveillance among manufacturers and surveillance by consumer organizations, researchers and mass media. Although the government is required to undertake shop front investigation to assess whether labels are affixed on products, there is little activity in this area.

Although false statements by manufacturers have not been reported so far, there was a case that the value reported by manufacturers was different to the actual measurement value because of a difference of the measurement method. As for refrigerators, which are a good

example of measurement method differences, the measuring method of JIS (Japanese Industrial Standards) was revised so that it became closer to an actual use condition (door openings and food loads). Recently, the evaluation of air-conditioner efficiency has been discussed with particular reference to laboratory measurements and how these differ from that of actual use.

Regarding the revision of a Standard Value, it is also necessary to re-investigate thoroughly efficiency standards in force in foreign countries. It is characteristic of the Top Runner system adopted in Japan that existing energy efficiency targets can be just replaced with the efficiency level of the most efficient product currently on the market, which is the Top Runner level at that moment. This makes the standard revision quite simple.

Conclusion

Based on the comparative analysis among countries (or regions), the important issues are pointed out for developing process of energy efficiency standards.

1. Energy Saving:
Target items should be selected in view of their nationwide energy saving effect by standard setting. Though MEPS scheme is mostly employed, Top runner scheme would be more effective for rapid improvement in nationwide energy efficiency.
2. Technological feasibility and cost reasonability for meeting the standards
In order to make the MEPS scheme work, the standard level should be technologically feasible and the cost should be reasonable. The U.S law stipulates to demonstrate these two points by means of technology-economic analysis.
3. Rational standards
In most of the countries, the standards are specified through deliberation on their reasonability among the government, manufacturers and experts. In Canada, China, Korea and Japan, the government has strong initiative and the standards are formulated quickly. On the other hands, EU and the US take longer time as they emphasize consensus formation among member countries in EU or among stakeholders in the US. Top runner scheme, in which energy performance of the products circulating in the market defines standards, can shorten the period until standards development.
4. Market adaptability of standards

For the sake of effectiveness, the standards scheme should be flexible so that it can quickly follow market transformation. In EU which requires congressional approval on standard development and in the US which stipulates twice revision from draft standards, longer period for standards development has been one of the critical issues for effectiveness. However, actions to shorten this period are currently taken. It would be important to strike balance between rationality of standard levels and flexibility of standard scheme towards market.

In addition, there are two types of standard certification methodology:

- Self-certification: manufacturers check whether products meet the standards.
- Third-party certification: The third-party institute measures energy performance and certifies or manufacturers submit self-measured data to the third-party institute.

Since manufactures conducts mutual verification in both case, it would be reasonable to certify mandatory standards by self-certification and voluntary standards by third-party certification. If the market is mature, voluntary standards can also be economically certified by self-certification.

Acknowledgement

We would like to thank following organizations that contributed valuable information on the subject.

International Energy Agency (EU), French Environment and Energy Management Agency (EU), European Commission Directorate-General Energy and Transport (EU), Department for Environment, Food and Rural Affairs Ashdown House (EU), Bundesministerium fur Wirtschaft (EU), Joint Research Centre (EU), Collaborative Labeling and Appliance Standards Program (U.S.A.), Association Of Home Appliance Manufacturers (U.S.A.), Natural Resources Defense Council (U.S.A.), Lawrence Berkeley National Laboratory (U.S.A.), California Energy Commission (U.S.A.), Department of Energy (U.S.A.), American Council for an Energy Efficient-Economy (U.S.A.), Natural Resources Canada (Canada), Certification and Accreditation Administration of the People's Republic of China (China), China National Institute of Standardization (China), China Standard Certification Center (China), Korea Testing Laboratory (Korea) and Korea Energy Management Corporation (Korea)

References

Bertoldi, P. 2006. *EU Energy Law Volume III - EU Environmental Law: Energy Efficiency and Renewable Energy Sources*. Leuven BELGIUM: Claeys & Casteels

China National Institute of Standardization. 2007. "China's Energy Efficiency Standards and Energy Label". Personal communication. 24 January.

Collaborative Labeling and Appliance Standards Program. *Worldwide Summary of S&L Programs*. <http://www.clasponline.org/worldwide.php>.

COMMISSION OF THE EUROPEAN COMMUNITIES. 2006. *Action Plan for Energy Efficiency, SEC(2006)1173*

Energy Conservation Center, Japan. 2008. *Top Runner Program REVISED EDITION/JAN 2008*. http://www.eccj.or.jp/top_runner/index.html

ENERGY POLICY ACT OF 2005. 2005. USA:PUBLIC LAW 109-58

ENERGY STAR website. *ENERGY STAR Qualified Products*. http://www.energystar.gov/index.cfm?fuseaction=find_a_product.

European Commission. *Eco-design of Energy-Using Products*. http://ec.europa.eu/energy/demand/legislation/eco_design_en.htm

European Council for an Energy Efficient Economy. Eco-design EuP pages.
http://www.eceee.org/european_directives/Eco_design/

Ichikawa, Y., ed. 2006. "Introduction to "EuP Directive" for practical implementation of Ecodesign Management." Tokyo, Japan Environmental Management Association for Industry

Korea Energy Management Corporation. 2007. "Korea's Energy Label & Standard". Personal communication. 22 January.

[NRCan] Natural Resources Canada Office of Energy Efficiency. 2007. "Canada's Energy Efficient Equipment Standards, Labelling and Compliance Programs". Personal communication. 23 February.

Wiel S., McMahon J. E, 2005. *Energy-Efficiency Labels and Standards: A Guidebook for Appliances, Equipment, and Lighting (Second Edition)*, USA: Collaborative Labeling and Appliance Standards Program (CLASP)