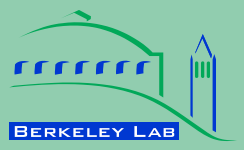
LBNL-6141E



ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Development and implementation of energy efficiency standards and labeling programs in China: Progress and challenges

Nan Zhou, Nina Zheng Khanna, David Fridley and John Romankiewicz
China Energy Group
Environmental Energy Technologies Division
Lawrence Berkeley National Laboratory

January 2013

This work was supported by the China Sustainable Energy Program of the Energy Foundation through the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

Disclaimer

Development and implementation of energy efficiency standards and labeling programs in China: Progress and challenges

Nan Zhou, Nina Khanna, David Fridley and John Romankiewicz
China Energy Group
Environmental Energy Technologies Division
Lawrence Berkeley National Laboratory

Executive Summary

Over the last twenty years, with growing policy emphasis on improving energy efficiency and reducing environmental pollution and carbon emissions, China has implemented a series of new minimum energy performance standards (MEPS) and mandatory and voluntary energy labels to improve appliance energy efficiency. As China begins planning for the next phase of standards and labeling (S&L) program development under the 12th Five Year Plan, an evaluation of recent program developments and future directions is needed to identify gaps that still exist when compared with international best practices. The review of China's S&L program development and implementation in comparison with major findings from international experiences reveal that there are still areas of improvement, particularly when compared to success factors observed across leading international S&L program.

China currently lacks a formalized regulatory process for standard-setting and do not have any legal or regulatory guidance on elements of S&L development such as stakeholder participation or the issue of legal precedence between conflicting national, industrial and local standards. Consequently, China's laws regarding standard-setting and management of the mandatory energy label program could be updated, as they have not been amended or revised recently and no longer reflects the current situation.

While China uses similar principles for choosing target products as the U.S., Australia, EU and Japan, including high energy-consumption, mature industry and testing procedure and stakeholder support, recent MEPS revisions have generally aimed at only eliminating the bottom 20% efficiency of the market. Setting a firm principle based on maximizing energy savings that are technically feasible and economically justified may help improve the stringency of China's MEPS program and reduce the need for frequent revisions.

China also lacks robust survey data and relies primarily on market research data in relatively simple techno-economic analyses used to determine its efficiency standards levels rather than the specific sets of analyses and tools used internationally. Based on international experiences, inclusion of more

detailed energy consumption surveys in the Chinese national census surveys and statistical reporting systems could help provide the necessary data for more comprehensive standard-setting analyses.

In terms of stakeholder participation in the standards development process, stakeholder participation in China is limited to membership on technical committees responsible for developing or revising standards and generally do not include environmental groups, consumer associations, utilities and other NGOs. Increasing stakeholder involvement to broader interest groups could help garner more support and feedback in the S&L implementation process.

China has emerged as a leader in a national verification testing scheme with complementary pilot check-testing projects, but it still faces challenges with insufficient funding, low local awareness amongst some regulatory agencies and resistance to check-testing by some manufacturers, limited product sampling scope, and testing inconsistency and incomparability of results. Thus, further financial and staff resources and capacity building will be needed to overcome these remaining challenges and to expand impacts evaluations to assess the actual effectiveness of implementation and enforcement.

Table of Contents

1. Introduction

As a growing consumer of household appliances, lighting and electronic products, China has seen a steady rise in residential electricity use with 13% average annual growth since the 1980s. In 1989, China introduced MEPS for appliances but efficiency standards did not gain traction in the policy arena until the late 1990s when it was formally endorsed by legislation. Likewise, China did not establish a voluntary energy labeling program until 1999 and the mandatory information labeling program only came into existence in 2005.

Over the last twenty years, with growing policy emphasis on improving energy efficiency and reducing environmental pollution and carbon emissions, China has implemented a series of new minimum energy performance standards (MEPS) and mandatory and voluntary energy labels to improve appliance energy efficiency. As China begins planning for the next phase of standards and labeling (S&L) program development under the 12th Five Year Plan, an evaluation of recent program developments and future directions is needed to identify gaps that still exist when compared with international best practices.

2. Review of China's S&L Programs

2.1 Legal Framework

The concept of appliance efficiency standard was introduced in 1988 after the Standardization Law of China (中华人民共和国标准化法) was adopted during the Fifth Session of the Standing Committee of the Seventh National People's Congress. This law sets the basis for the formulation, implementation, management and other related responsibilities of efficiency standards and designates the State Council's administrative department of standardization to oversee an unified national mandatory efficiency standards program. As a result, the first batch of minimum energy performance standards (MEPS) was adopted in 1989 for eight major products, including refrigerators, room air conditioners, clothes washers, rice cookers and televisions. In 1995, the China National Institute of Standardization (CNIS) was authorized to organize MEPS development and revision. However, the standards were not formally endorsed in a legal manner until the 1997 National Energy Conservation Law of China (中华人民共和国节约能源法) provided the regulatory basis of mandatory energy efficiency standards for energy-consuming products and equipment and helped motivate program improvements. Specifically, Article 14 of the Law calls for the formulation of national standards by the administrative department for standardization under the State Council which manufacturers are legally bound to comply with under Article 24 (National People's Congress 2008). If manufacturers are found in violation of the standard, then the administrative department may submit a proposal to suspend production by the manufacturer and possibly mandate its closure under Article 43. The Energy Conservation Law also promoted the concept of energy efficiency labels in Article 18 and laid the regulatory foundation by discussing possible punitive measures for counterfeit labels under Article 48.

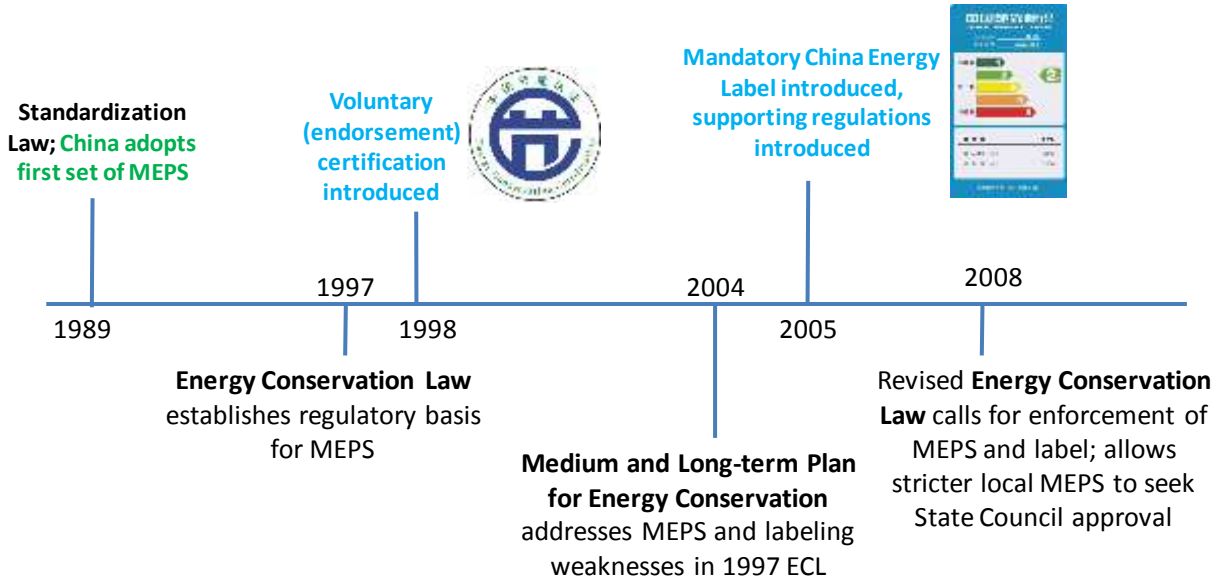
Subsequently in 1999, the China National Institute of Standardization (CNIS) began the process of revising single-period mandatory energy efficiency standards and developing new standards to follow international best practice while the China Standards Certification Center launched a new voluntary energy efficiency endorsement labeling program targeting the top 25% most efficient products. NDRC also issued the Management Method for Energy Conservation Products Certification in 1999 to establish the administrative framework for certifying standards and the voluntary endorsement label. In 2002, the General Administration of Quality Supervision, Inspection and Quarantine (ASQIQ) issued legal authority for its local offices to enforce safety, efficiency and other standards (APEC 2009).

The *Medium and Long-Term Plan for Energy Conservation* issued by NDRC in 2004 further supported the development and implementation of appliance standards and energy labels by addressing weaknesses with lagging efficiency standards, inadequate compliance and slack enforcement of Energy Conservation Law efforts (NDRC 2004). In particular, it encouraged more stringent revisions of energy efficiency standards, tightened market entry and the use of market mechanism to stimulate demand for energy-efficient consumer products as important principles of energy conservation. Household and office electric appliances were also included as a key subcategory for energy conservation within the building sector and implementation of energy efficiency standards and labeling was identified as a key project.

More recently, the mandatory categorical energy information label known as the China Energy Label was established in 2005 following legal provisions in the Energy Conservation Law with supporting regulation and support for implementation in the *Product Quality Law* and *Legislation on Certification & Accreditation* (Jin and Li 2006). The administration of the China Energy Label program along with details on supervision and implementation, penalties and other supplementary provisions were established in the *Administration Regulation on Energy Efficiency Label* (Jin and Li 2006).

With the onset of China's carbon intensity target for 2020 and a ramp up in energy efficiency programs nationwide, the legal basis for China's standards and labeling programs has been strengthened in recent years. In the newly revised 2008 "Energy Conservation Law of People's Republic of China," 11 articles were related to MEPS and called for the examination and supervision of energy conservation regulations for high energy-consuming products. Article 13 also allowed local standards that are more stringent to be submitted to the State Council for approval. Under the revised "Energy Conservation Law" and the "Circular Economy Promotion Law of the People's Republic of China," provisions were also added relating to energy efficiency labeling, and the management mechanism and penalty methods have been clearly defined, thus establishing the legal foundation for incorporating the energy efficiency labeling system as an important national energy saving management measure. The legislative and regulatory history related to China's MEPS and labeling programs are illustrated in Figure 1.

Figure 1. Legislative and Regulatory Timeline of China's MEPS and Labeling Programs, 1989 - Present



Lastly, national and sectoral development plans also have important role in promoting mandatory energy efficiency standards. For example, China's 12th Five Year Plan for national economic and social development clearly indicates that "energy conservation and efficiency regulations and standards will be improved, formulation and implementation of product efficiency standards will be strengthened, and the China Energy Label, voluntary efficiency certification and compulsory government procurement programs will all be improved."

2.2 Standard Setting Process

In China, the principles for choosing target products for standard setting focus on the following characteristics:

- High energy consumption and high energy savings potential
- Widely used with mature industry and well-regulated market
- Mature testing procedure and good testing infrastructure and ability nationwide
- Stakeholder support

In terms of guiding principles for standard-setting, China has generally aimed at eliminating the bottom 20% efficiency of the market with each new standard and standard revision (Li 2012). More recently, economic and technical analysis are also used to help determine the proposed MEPS level.

Unlike other countries such as the U.S. and European Union member states, China does not follow a specific legally prescribed standard-setting process. Rather, according to the 1990 Management Regulations for National Standards (国家标准管理办法), standards development and revision activities are organized and implemented by the national State Council administrative departments of standardization management and leadership and the Technical Committee. Specifically, they are responsible for supervising the progress of national standards development activities and ensuring

completion of planned tasks, including the drafting of new or revised standards. The organization designated to draft the efficiency standards are responsible for providing the quality and technical content in accordance with GuoBiao (国标—GB) standard guidelines and also for preparing the accompanying Explanation of the Standard (编制说明). The Explanation of the Standard provides an overview and summary of the development of that particular standard and may include specific content on:

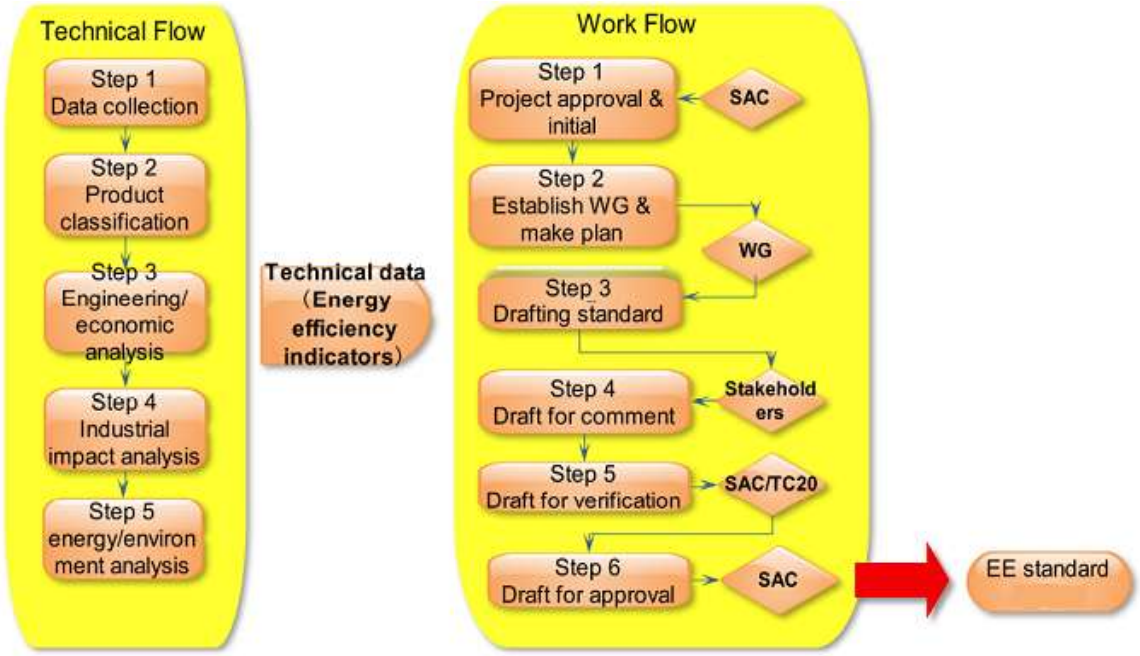
- Work summary: resources, designated organization, key stages of work, main organization for drafting standard
- Principles and main elements of the standard (e.g., technical indicators, parameters, formulae)
- Performance requirements, test procedures and implementation guidelines. For revised standards, a comparison of proposed revision and old standard levels is also provided.
- Key analyses, synthesis, technical and economic feasibility analyses and expected economic impacts
- Review of efficiency standards adopted elsewhere in the world and comparisons with existing international standards, or with foreign products and prototypes
- Relationship to existing laws, regulations and mandatory national standards
- Responses to major divergence in opinions and viewpoints
- Proposals to set national standards as mandatory or recommended standards
- Implementation of national standards and policy initiatives (including organizational measures, technical measures, transitional measures, etc.)
- Proposed repeal of existing standards;

After the draft standard, explanation of the standard and other related documents have been reviewed and finalized by the drafting organization, they are distributed to key organizations involved in the production, distribution, use, technical development and testing of the given product for comments and feedback. There is usually a set time period of approximately two months for comments, during which representatives should provide feedback, or state that they do not have significant comments. For relatively significant objections or arguments, the technical and economic feasibility and basis should also be provided. The standard drafting organization is then responsible for collecting, analyzing and synthesizing all comments in a summary of comments in the appendices of the explanation of the standard. This summary is then sent to the secretariat of the technical committee for review to determine if further review and a second period of commenting are needed.

Although there is not a set of legally prescribed procedures to follow in standards development in China, the main steps in a sample product standard-setting process in China are illustrated in Figure 6. From a technical perspective, once a target product has been identified and the standard development project approved by the Standardization Administration of China (SAC), the first analysis to be conducted is the market survey and market data collection. In the case of CFLs, questionnaire surveys were sent to 188 manufacturers with follow-up on-site visits to stores, lighting industry associations and other testing experts. Markets samples were also purchased and tested to determine the existing efficiency distribution of products in the market. Next, a techno-economic analysis is conducted to evaluate the

potential energy savings and lifecycle costs of different efficiency design options as the basis for developing a draft standard. Although this analysis is known as "engineering/economic analysis" in China, it differs from the engineering analysis that is done in the U.S. standard-setting process in which efficient product models are deconstructed to evaluate the savings from each design element. In China, manufacturing costs and industrial impacts are estimated through interviews with manufacturers, rather than derived directly from modeling analysis. Lastly, the impact of proposed standard levels on national energy use and CO_2 emissions are estimated in the energy and environmental analysis using predicted sales and stock trends and unit energy consumption factors with and without the standard.

Figure 2. China Efficiency Standard-setting Technical and Work Flow Process



Source: Xia 2011.

In terms of the regulatory steps for standard-setting, the draft standard is reviewed and comments by stakeholders are collected, reviewed and addressed during subsequent workshops. Once the standard has been approved, it is submitted to SAC as a national standard. For CFLs, the entire process occurred over 16 months, with 10 months for the initial technical analysis and draft standard development and 6 months for comments, verification and approval (Xia 2011). Typically, standard development and revisions process takes about 1.5 years, with the standard usually going into effect six months after the standard has been approved. This transitional period between the standard approval and implementation is determined by the SAC and may be longer or shorter than six months. Standards are then reviewed by either the technical committee or SAC within five years to determine if revisions are necessary to keep up with the pace of technical and efficiency improvements. If the standard does not need to be revised, then an amendment is added to state that the "standard was verified to remain effective in year XXXX." If the standard is revised, then the standard number remains the same but the revision year will be updated. If the standard is not longer needed, then the review unit will need to issue a written report detailing: review summary, main viewpoints of the reviewers and review findings.

The standard can then be abolished after receiving the consent of the administrative departments overseeing national standards and the SAC.

Table 1. Summary Table of China's Standard Setting Process

Initial Legal Framework	National Standardization Law of 1989, National Energy Conservation Law of 1998
Regulatory Agency	State Administration of Quality, Supervision, Inspection, and Quarantine (AQSIQ), China National Institute of Standardization (CNIS)
Standard Setting Principle	Eliminate bottom 20% of market during each revision; use "reach" standards: two-period, two-tiered standards
Standard Setting Timeline	Standards are reviewed and revised as necessary usually within a period of five years, with the specific time of revision dependent on pace of technical and efficiency improvements. MEPS and mandatory China Energy Labels are also introduced for new products every year, but there is no pre-determined schedule for new or revised standards.
National versus Local Regulatory Precedence	National regulation has full mandate over MEPS and mandatory labeling

2.3 Analytical Tools and Methods

In the process of setting and revising mandatory energy efficiency standards, China generally utilizes techno-economic analysis and market impact analysis for evaluating efficiency levels. Based on international exchanges with comparable developed countries on their experiences, China's analytical methods and tools are considered to be consistent with tools used in the US standards setting process. But owing to the lack of data, financial support and comprehensive technological capabilities, China currently uses relatively simple analyses in determining its efficiency standards levels rather than the analytical models and tools used elsewhere. Results of the analysis are incorporated into the procedures for standards setting and revision and are submitted along with the draft standard to the Standardization Administration of the People's Republic of China (SAC) for review and approval. However, the preparatory documents for standard-setting are not publicly released.

Given that mandatory energy efficiency standards have had increasingly important impact on the economy and society in recent years, SAC may require that sufficient market and societal impact analysis and risk assessment be conducted as part of the standard setting and revision process in the near future. At the same time, SAC may also conduct public hearings on mandated standards for consumers, manufacturers, government authorities and other stakeholders to express their views. In recent years, the Chinese government has also increased investment in related fields of research and actively supported the research and development of related analytical models and tools.

2.4 Data Collection

At present, the Chinese National Bureau of Statistic does not survey end-use energy consumption and lacks residential and commercial energy consumption surveys) similar to those undertaken by the Energy Information Administration in the U.S (Residential Energy Consumption Survey or RECS and

Commercial Building Energy Consumption Survey or CBECS). As a result, there is a lack of centralized data provided by an authoritative source on the energy use profiles of energy end-use products. At present, the market data, technology development trends, and data on the distribution of energy efficiency levels used in the current energy efficiency standard setting and revision processes are provided by market research agencies, are publicly available, are provided by manufacturers and companies, or are data from the China Energy Label certification process. However, in the absence of a strong surveying and analysis framework and without mandatory legal provisions for manufacturers to report market data, it is difficult to guarantee the quality and reliability of the data currently used. At the same time, due to inadequate funding and financial support, the scope of the survey data used in the efficiency standards setting and revision process is also limited.

2.5 Stakeholder Participation

China's standard setting process currently involves limited stakeholder and public participation. The standard setting process is run by SAC, once technical recommendations have been made by CNIS. After an initial draft of the standard has been formulated by CNIS and approved by a working group convened by SAC, comments from stakeholders on the Technical Committees are collected during workshops and through written communication. For example, for the CFL lighting standard, two workshops were held in Jiangsu and Zhejiang with participants including members of the Working Group, research institutes and manufacturers. Nearly 40 comments were also collected over a two month period and each comment or suggestion was discussed in the Zhejiang workshop (Xia 2011). Other stakeholders that participate in the broader S&L process in China include industry associations, manufacturers, testing institutes, research institutes and universities while participation by environmental groups, consumer associations, utilities and other NGOs are relatively limited. Public meetings are not held currently but may be introduced in the future.

China currently has more than 470 Technical Committees, with the National Energy Foundation and Management of Standardization Technical Committee (SAC/TC20) responsible for energy efficiency standards. The Secretariat of SAC/TC20 is located in CNIS and the Committee is responsible for MEPS, rational use of energy standards, energy management standards, fuel economy standards, energy monitoring standards and other energy infrastructure and management standards. The Committee is composed of representatives from key government agencies, research institutes, industrial associations, leading universities and industrial enterprises.

2.6 Program Enforcement

In China, AQSIQ (State Administration of Quality, Supervision, Inspection and Quarantine) has the official authority over the supervision and the inspection of energy efficiency information, as established by the 1990 and 2005 revised Management Method for Energy Standardization. AQSIQ and its provincial divisions are responsible for national product quality supervision testing for all consumer products, with primary emphasis on product safety and secondary emphasis on product performance. In particular, AQSIQ conducts regular national product quality supervision testing every quarter as well as special product quality testing if there are product quality concerns. Because there are no specific standards or regulations on energy efficiency testing requirements, energy efficiency receives relatively low priority

in national quality testing and the major appliances of clothes washers, refrigerators and air conditioners have only been tested one to three times from 2001 to 2006. For example, clothes washers were tested in the second quarter of 2005 but energy efficiency was not tested, and room air conditioners were tested in a special product quality test in early 2006 (Lin 2006).

In the regular national product quality testing, AQSIQ first establishes a prioritized list of products for testing with priority given to human health, personal and property safety, industrial products essential to the economy and products reported to have quality defects by consumers (Lin 2007). Product samples are then taken by inspection agencies and the relevant provincial departments. Manufacturers then confirm the selected product samples, the samples are tested and an inspection report is issued with the spot-testing results. If a product sample fails the product quality testing, it may be retested and mandatory rectification or punitive measures may be imposed if the sample still fails the retest (CNIS 2006). Previous interviews with Chinese experts and manufacturers have identified weaknesses in the national product quality testing that largely resulted from insufficient government funding, which was previously reported to be only half a million RMB per year for testing all appliances, home electronics and lighting products (Lin 2006). Small sample sizes, inadequate energy efficiency testing and infrequent testing of household appliances have all limited the role of national testing and monitoring of MEPS compliance.

Thus, “enterprise self-declaration” has historically been the key feature of MEPS and energy labeling enforcement as AQSIQ and the other organizations were not allocated sufficient resources to focus on energy efficiency testing. In recent years, however, several random market inspections and investigations of national and local supervision departments have raised questions about the validity of self-reported information as some enterprises and third-party laboratories were found to lack sufficient energy efficiency testing capacity (Zhou et al. 2010b). As a result, the central government has increased efforts to improve the enforcement and monitoring mechanisms for appliance energy efficiency standards in recent years with several energy efficiency testing and verification pilot programs undertaken by CNIS (see sections below).

Most recently in 2010, the China Energy Label Management Center within CNIS launched a special investigation to conduct check-testing of products from targeted manufacturers. Specifically, product samples from manufacturers with reported non-compliance and inconsistent results in the certification database and from the List of Leading Energy Efficiency Manufacturers were purchased from general circulation and sent to the National Quality Inspection Center for testing. The China Energy Label Management Center then suspended the label certification of non-compliant products and issued a deadline for rectification to the manufacturers. The compliance results from this special investigation in 2010 are shown in Table 2.

Table 2. 2010 Compliance Investigation of Selected Products

Product Type	Compliance Rate (%)	Non-Compliance Rate (%)	Total Samples (Units)
Storage Water Heaters	93%	7%	15
Alternate Current Fans	75%	25%	12
Gas Water Heater	100%	0%	10
Rice Cookers	93%	7%	15
Household Cooktops	80%	20%	15
Computer Display Monitors	85%	15%	20
Small and Medium-size Three Phase Asynchronous Motors	80%	20%	10
High Pressure Sodium Lamps	100%	0%	5

Source: CNIS 2012

2.6.1 Pilot Energy Efficiency Check-testing Programs

In 2006, CNIS with funding from international organizations[1] launched an unprecedented sample energy efficiency checking and testing program to evaluate MEPS compliance and labeling accuracy. The 2006 program purchased and tested 43 models of refrigerators, room air conditioners and washers from retailers in the major cities of Guangzhou, Beijing and Hefei. The specific check-testing process is discussed further below. The first round of check-testing presented mixed results on the implementation and enforcement of the selected appliance standards, with a range of noncompliant product models in the three cities and overall products compliance rates between 71% and 91% (Zhou et al., 2008). The 2006 test results also showed notable variations in performance and noncompliance rates between product models sold in high-end, first-tier appliance retailers and second and third-tier retailers such as local appliance markets.

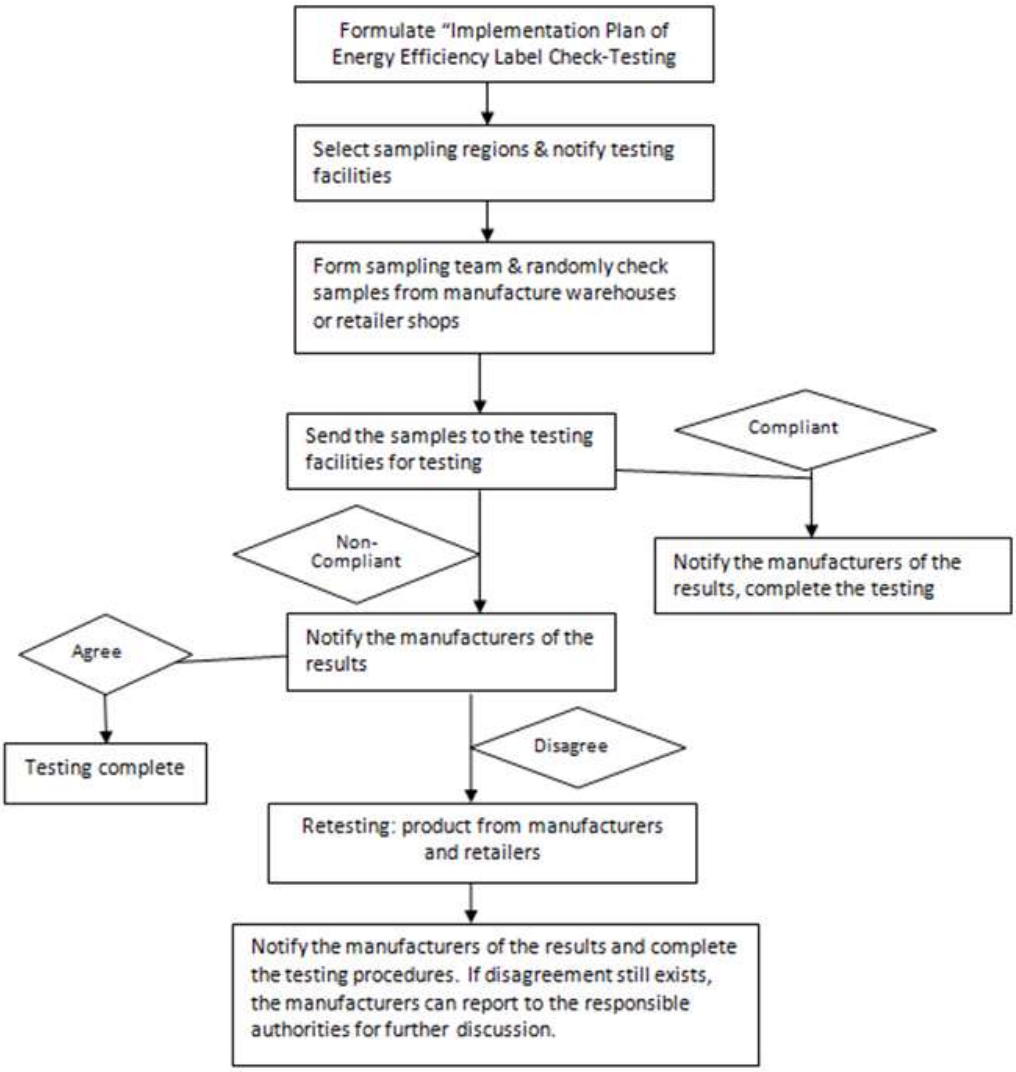
In 2007, appliance check-testing was repeated with a larger sample size of 73 models in the same cities. There was overall improvement in compliance rates for all three tested products with a significant drop in the number of non-compliant models from 11 out of 54 in 2006 to only 3 out of 73 models in 2007 (Zhou et al. 2008). On the regional level, compliance rate improvements were also realized in Beijing and unlike results from the previous year, no major variations in compliance were observed between different appliance markets in 2007. In August of 2009, CNIS launched the National and Local Enforcement of Energy Efficiency Standards and Labeling project with check-testing for a total of seven

[1] China does not have a specified budget for MEPS enforcement and testing as the responsibilities often fall to local jurisdictions with varying financial capacities. The CNIS verification testing and round-robin testing efforts described were primarily funded through research grants from international organizations and foundations including the Japanese Ministry of Economics, Technology and Industry, the Energy Foundation's China Sustainable Energy Program, ClimateWorks Foundation and the Collaborative Labeling and Appliance Standards Program.

products conducted in four pilot locations of Jiangsu, Shandong and Sichuan provinces as well as Shanghai. This round of check-testing incorporated compliance verification for both MEPS and the China Energy Label. For verifying compliance with the China Energy Label, a set of inspection criteria was formulated and inspections were conducted at manufacturers' warehouses and selected retailers. During the inspections, results were recorded by product type and non-compliance was documented by photos of the product model and nameplate. For energy efficiency check-testing, the test procedure stated in each MEPS was followed with the overall check-testing process depicted in Figure 3.

Non-compliant manufacturers and retailers were subject to penalties based on the relevant laws and regulations and a list of non-compliant manufacturers were published on the China Energy Label website. In general, under the 2008 revised Energy Conservation Law, the specific possible penalties for violating mandatory labeling requirements are detailed and include fines of 10,000 to 30,000 RMB if the label is absent or do not comply with the specific labeling requirements and fines of 50,000 to 100,000 RMB for misleading or falsifying labeling results (NPC 2008). For serious violations, the business license of the manufacturer may also be revoked. For MEPS violations, enterprises that manufacturer, import or sell non-compliant products are ordered to stop production, import or sales and illegal gains from non-compliant products will be confiscated and the violator may be further fined 100% to 500% of the illegal proceeds from non-compliant products (NPC 2008).

Figure 3. Energy Efficiency Sampling and Testing Process for China's Pilot Check-testing Programs



Source: Zhou et al. 2011

The 2009 round of testing found that Sichuan province had the lowest overall compliance for both standards and labeling. Although the specific reasons for lower compliance could not be directly identified, possible challenges with enforcement in Sichuan could include slower economic development and lower awareness, staff expertise and funding to support standards and labeling enforcement (Zhou et al. 2011). Other challenges identified in the 2009 testing include lack of awareness and lack of an initial publicity campaign which resulted in manufactures' failing to register their products; retailers' resistance to inspection; lack of timely updating of product information online; incidents of different laboratories reaching different results for the same product; higher compliance rates for products produced by large manufacturers along with lack of attention to enforcement for smaller manufacturers (Zhou et. al. 2011).

2.6.2 Pilot Round-Robin Testing Program

The early check-testing rounds highlighted sample selection concerns with uneven distribution in the grade of testing samples selected for each product and inconsistent test results with significant variations in results when tested in different laboratories. In order to identify the possible differences between laboratories and to improve consistency, reliability, accuracy, and credibility of the China Energy Label, an inter-laboratory round robin testing (RRT) program was launched by CNIS in 2009. A leading domestic manufacturer was asked to produce three sets of split air conditioners, with an additional sample initially tested in Australia, and the samples were sent to six Chinese laboratories and a Japanese laboratory for efficiency testing following the MEPS. In the end, 43 tests were completed in 4 Chinese laboratories and the results showed a good level of quality for the measurement of the efficiencies and the capacities of air/air air conditioners (Saheb et al. 2010). Nevertheless, the test also revealed room for improvement in specific testing methods within specific laboratories and the transportation, installation and setting of samples.

Table 3. Summary of China's National Product Quality Testing and Pilot Energy Efficiency Check-testing Programs

	China
Certification requirements	Self-reported manufacturer certification for China Energy Label
Check-testing	May be included in national product quality testing organized by AQSIQ. *Pilot energy efficiency check-testing program focused on MEPS compliance launched in selected provinces in 2006, 2007 and 2009.*
Sample Selection Method	Samples randomly selected from manufacturers' warehouses and/or retailers.
Sample Size	Varies by product and type of quality testing (regular versus special). *Pilot energy efficiency check-testing varies by province and product and ranged from 5 to 30 batches of samples in 2009.*
Testing Process	Two stages of testing, with re-testing in Stage 2 requested by manufacturers. *For 2009 pilot energy efficiency check-testing, testing done on batches of samples.*
Compliance verification	National product quality testing primarily focuses on product safety and performance, with minimal emphasis on energy efficiency. *Pilot energy efficiency check-testing focused on energy efficiency testing and MEPS compliance, but 2009 pilot check-testing also verified labeling compliance.*
Fines/penalty for Non-compliance	Negligent or false use of voluntary label has RMB 30,000-100,000 penalty; no label or false use of mandatory label has a fine of RMB 10,000-30,000 and 50,000-100,000, respectively; For MEPS, companies can be fined 1-5 times any illegal gains made from products sold that are not in compliance with MEPS.
Testing budget	Historically, AQSIQ has been allocated 500,000 RMB per year for national product quality testing of all household appliances, home electronics and lighting products. *In pilot energy efficiency check-testing, 200,000 RMB allocated to each pilot region with additional regional funding expected.*

Informal enforcement mechanisms	None
Information sharing between agencies or jurisdictions	None
Voluntary certification programs	Voluntary energy efficiency certification program managed by China Quality Certification Centre.

Note: Italics indicate enforcement elements that only apply to pilot energy efficiency check-testing programs.

The pilot energy efficiency check-testing and round-robin testing are particularly significant given that China remains a rapidly developing economy, yet developed economies still lack robust and regular enforcement testing. For example, the U.S. does not have a national check-testing enforcement program for MEPS and only recently launched enforcement testing program for ENERGY STAR along with round-robin testing. At the same time, however, expanding China's verification testing programs to cover more models and products and developing a plan for ramping up the national verification testing program over the next three to five years are important next steps in strengthening appliance standards and labeling implementation. Further improvement in enforcement could also come about through more awareness and educational campaigns both at the national and provincial level; more publicity for those who continuously excel in compliance and those who fail; the designation of specific funding and staffing from central and provincial governments for local enforcement projects; emphasis on targeting non-compliant manufacturers in subsequent years; and greater emphasis on implementing standardized testing tools and procedures among different testing laboratories. This will be particularly important as the information labeling program gains more visibility and expands to additional product categories.

2.7 Basis for Test Procedures

The test procedures for products are typically developed and set by the product-specific or industry-specific standardization technical committees and the test procedures will be referenced and integrated into the relevant sections of the energy efficiency standard during the standard setting process. Since a guiding principle of standards development in China is encouraging the adoption and revision of ISO or IEC international standards on the basis of domestic conditions, the product standardization technical committees will generally adopt or revise relevant ISO or IEC standards during the test procedure development process after evaluating if it is more suitable and appropriate to adopt existing international standards. At the same time, the technical committees may also elect to develop a China-specific test procedure that differs from existing international test procedures if it is believed to better represent national conditions or criteria, as was the case for televisions. In the absence of existing international test procedures - such as the case for products not yet covered by international standards and labeling programs - the technical committees will develop a new test procedure for China. Due to the differing product timeline for standard development, if a standardization technical committee has not initiated test procedure development process when efficiency standards setting is undertaken, then related ISO or IEC standards are revised and used in China. In recent years, due to the fast pace development of technology, China have referenced test procedures from EnergyStar, European Union's

EcoLabel and other international product associations such as the International Commission on Illumination (CIE) in the standard setting process.

2.8 Program Resources

In China, AQSIQ is allocated RMB 500,000 per year for the standards development and testing of all household appliances, home electronics, and lighting products. Most of this funding was used to pay for the national product quality supervision testing fees, in the range of RMB 200,000-300,000. Of the total AQSIQ funding, CNIS and its Standardization Committee receive about RMB 20,000 to 30,000 for the development of one standard. In addition, CNIS has historically received 50,000 to 100,000 USD from international organizations such as the Energy Foundation for the development of one standard. Because AQSIQ is responsible for all types of product standards and treat each type equally and NDRC does not have the authority to directly increase the funding for energy efficiency standards development, national funding for MEPS development and enforcement is relatively limited. However, it is possible for NDRC and the central government to provide more funding to the China Energy Labeling program as it currently receives no direct government funding. Rather, the China Energy Label program is supported solely by international funding such as the Energy Foundation, and the United Nations End-Use Energy Efficiency Programme (EUEEP) and Global Environmental Fund program. While China has significantly increased the government funding for energy efficiency with growth in funding from RMB 9 billion in 2007 to RMB 36 billion in 2009 (Zhou et al. 2010a), most of the funding related to appliance energy efficiency was used for subsidy and rebate programs such as "Appliances to the Countryside （家电下乡）" and the "Energy-Efficient Product Subsidy Program (惠民工程). This suggests that the financial resources provided by the central government for appliance standards and labeling programs are insufficient and the programs could be strengthened with additional government funding.

3. Summary of Key Findings from International Review

A separate LBNL report provides in-depth review and comparative analysis of the development and recent advancements in the U.S. MEPS and Energy Star, Australia MEPS and Energy Label, European Union MEPS and Eco-Design Label and Japanese Top Runner programs. Specific details on the individual programs and the comprehensive comparison of the four regions can be found in Zhou et al. 2012. Based on this comparative analysis, best practice examples of key programmatic elements as well as cross-cutting factors for success and lessons learned in S&L program development and implementation are identified. In particular, the comparative review of standards and labeling programs in the U.S., Australia, EU and Japan has uncovered some overarching themes and highlighted several key factors to successful program elements:

Sound Legal Framework for Standard-Setting

Standard-setting and programmatic implementation can benefit significantly from a legal framework that directly specifies a timeline or schedule for standard-setting and revision, product coverage and legal sanctions for non-compliance.

Standard-setting Principle Focused on Maximizing Feasible Energy Savings

Programs in the four regions revealed similarities in guiding principles of standards development that focus on achieving significant energy savings that are technically feasible and economically justified. This helps ensure that future MEPS will be set at levels that exceed the average product efficiency on the market and will effectively push the market forward towards higher efficiency levels once implemented.

Data and Analytical Support for Comprehensive Standard-Setting Analysis

In terms of analytical support for standard-setting, detailed survey data such as the U.S. Residential Energy Consumption Survey and rigorous sets of technical, economic, energy and environmental analyses provide a strong foundation for setting a particular standard level.

Active Stakeholder Participation in Standards Development and Implementation Process

Stakeholder participation also strengthens the standard-setting process by incorporating insights from different groups of stakeholders, although the particular form of participation may vary from product-specific stakeholder forums to membership on technical committees to public comments to technical analyses.

Effective Enforcement and Program Resources

Sufficient program resources are critical to the effectiveness of standards and labeling programs and cost-sharing between national and local governments can be undertaken to ensure adequate resources and uniform implementation. Resources are needed to support enforcement mechanisms such as check-testing and monitoring, which in turn impact the effectiveness of punitive measures such as cancellation of registration or product sales-based fines as effective deterrents for non-compliance.

In addition to these overarching factors for success, the international review of the four selected regions also illustrates that while no single country has best practices in all elements of standards and labeling development and implementation, national examples of best practices for individual elements do exist. For example, the U.S. has demonstrated rigorous analyses for standard-setting and robust data source with the RECS database while Japan's Top Runner standard-setting principle has been effective in motivating manufacturers to exceed targets ahead of time. In terms of standards implementation and enforcement, Australia has demonstrated success in enforcement with its long history of check-testing and enforcement initiatives while mandatory information-sharing between EU jurisdictions on compliance results is another important enforcement mechanism. As reflected by these examples, it is important to understand not only the drivers of different paths of standards and labeling development, but also the country-specific context for examples of best practices in understanding why certain S&L programs have been effective.

4. Implications for China from International Review

4.1 Legal Framework

As an important legal foundation for appliance efficiency standards in China, the *Standardization Law of China* has not been amended or revised in a long time and thus lags behind market and technological

developments since its passage. Likewise, the China Energy Label Management Law promulgated along with the 2007 revision of the Energy Conservation Law could also be updated to reflect rapid changes in the labeling program over the past few years. This is especially relevant given the lack of specific legal or regulatory requirements for China's entire standard-setting and revision process, stakeholder involvement and participation, and implementation and enforcement of the mandatory MEPS and labeling programs. In addition, the coordination and legal precedence between national standards, industrial standards and local standards is another area that has yet to be addressed. Consequently, China's laws regarding standard-setting and management of the mandatory energy label program may require updating, as they have not been amended or revised recently and no longer reflects recent developments and the current situation.

4.2 Standard-setting Principles

China uses similar principles for choosing target products, including high energy-consumption, mature industry and in-place testing procedures and stakeholder support, but recent MEPS revisions have generally aimed at only eliminating the bottom 20% efficiency of the market. Setting a firm principle based on maximizing energy savings that are technically feasible and economically justified may help improve the stringency of China's MEPS program and reduce the need for frequent revisions.

4.3 Standard Development Analyses and Data

Technical analyses and data availability provide underlying foundation for the development of effective efficiency standards and labeling programs. Currently, China lacks capacity in both data collection and a comprehensive framework for standard-setting analysis. Because there is no designated and authoritative source for necessary data inputs to technical analyses, including basic data on end-use usage patterns and energy consumption patterns and detailed sales data by efficiency level, standard-setting analyses are largely dependent on simplified market data that may not always be consistent. Based on international experiences, inclusion of more detailed energy consumption surveys in the Chinese national census surveys and statistical reporting systems could help provide the necessary data for more comprehensive standard-setting analyses.

Due to this lack of data as well as inadequate financial support and technological capabilities, China currently uses relatively simple techno-economic analyses in determining its efficiency standards levels rather than the specific sets of analyses and tolls used internationally. For example, compared with other major analyses undertaken in international standards development, China lacks capacity and experience in engineering analysis, energy and water use analysis, mark-up analysis, shipment analysis, national impact analysis, manufacturer impact analysis, life-cycle cost subgroup analysis, employment impact analysis, regulatory impact analysis and environmental assessment analysis. While not all of these analyses may be necessary in standard-setting in China, a more comprehensive analytical approach encompassing at least some of these analyses need to be developed and implemented on a consistent basis. More research is needed to identify the most essential and appropriate analyses that should be included in a standard-setting framework for China.

4.4 Stakeholder Participation

Compared to the international experiences of the four selected regions, stakeholder participation in China is limited to membership on technical committees responsible for developing or revising standards, which generally do not include environmental groups, consumer associations, utilities and other NGOs. Expanding participation to more stakeholders in the standards development and implementation process will help ensure there is not only broad awareness and understanding of China's S&L programs amongst local regulatory agencies, manufacturers and industrial partners, retailers, and consumers, but also continuous support and feedback to the programs.

4.5 Government Resource and Support

As an important government policy tool for improving energy efficiency, energy efficiency standards and labeling programs need the government's strong support in many aspects. At present, the management, guidance and support for the relevant government agencies responsible for implementing the energy efficiency standards and labeling programs in China are insufficient. Energy efficiency standards inherently have economic externalities given its benefits the public, and therefore often receive financial resources from governments in developed economies to support standards and labeling development and implementation. In China, however, the unstable and insufficient financial resources for S&L programs has resulted in delays in the necessary revisions of existing standards and the lack of a strong technical and scientific basis for the development of some new standards. At the same time, insufficient financial resources have also limited public awareness of standards and evaluations of the impact of these programs.

4.6 Program Enforcement and Resources

While China has emerged as a leader in a national verification testing scheme with complementary pilot check-testing projects, it still faces challenges in enforcement. On the national level, the main regulatory agency responsible for verification testing has limited resources and too many conflicting priorities, resulting in little emphasis on energy efficiency. The smaller scale pilot check-testing projects launched by the China National Institute of Standardization responsible for developing standards and managing the mandatory energy label face insufficient funding, low local awareness amongst some regulatory agencies and resistance to check-testing by some manufacturers, limited product sampling scope, and testing inconsistency and incomparability of results. Further financial and staff resources and capacity building will be needed to overcome these remaining challenges to enforcement and to expand impacts evaluations to assess the actual effectiveness of implementation and enforcement.

Acknowledgments

This work was supported by the China Sustainable Energy Program of the Energy Foundation and the Collaborative Labeling and Appliance Standards Program through the U.S. Department of Energy. The authors are also very grateful to the China National Institute of Standardization and particularly Pengcheng Li for providing valuable insight related to this work.

References

Asia-Pacific Economic Cooperation (APEC). 2009. "People's Republic of China Legislative History Related to Standards & Labels." http://www.apec-esis.org/countryoverview.php?country=People%27s%20Republic%20of%20China&ID=249

China National Institute of Standardization. 2006. "The Research on China's Energy Efficiency Standards Implementation and Monitoring System." China Sustainable Energy Program Project Report. Available at: http://www.efchina.org/FReports.do?act=detail&id=228

Jin, M. and A. Li. 2006. *The Implications and Impacts of China Energy Label*. Proceedings of the 4th International Conference on Energy Efficiency in Domestic Appliances and Lighting, London, 21 – 23 June 2006.

Li Pengcheng. 2012. Personal Communication. 11 December 2012.

Lin, J. 2007. "Creating and Implementing a Regularized Monitoring and Enforcement System for China's Mandatory Standards and Energy Information Label for Appliances." LBNL Report. Berkeley, CA: Lawrence Berkeley National Laboratory.

National Development and Reform Commission (NDRC), 2004. *Medium and Long-Term Plan for Energy Conservation*. Nov 25, 2004.

National People's Congress, 1997. *Energy Conservation Law of China*. Approved by the 28th Standing Committee Meeting of the 8th National People's Congress. 1 November 1997.

National People's Congress. 2008. "Energy Conservation Law of the People's Republic of China (Revised)." Beijing: National People's Congress. 1 April 2008.

Saheb, Y., Zhou, N., Fridley, D. and A. Pierrot. 2010. "Compliance and Verification of Standards and Labeling Programs in China: Lessons Learned." LBNL Report 4599-E. Berkeley, CA: Lawrence Berkeley National Laboratory.

Xia, Y. 2011. "Case Study: Development and Implementation of CFL ES&L in China." Presented at 2011 2nd BRESL Training Workshop. Guilin, China: 14 November 2011.

Zhou, N., Zheng, N., Fridley, D., Wang, R. and C. Egan. 2008. “Check-testing of Manufacturer Self-Reported Labeling Data & Compliance with MEPS. LBNL Report 247-E. Berkeley, CA: Lawrence Berkeley National Laboratory.

Zhou, N., Levine, M. and L. Price. 2010a. Overview of Current Energy Efficiency Policies in China. Energy Policy 38 (11): 6439-6452.

Zhou, N., Fridley, D. and N. Zheng. 2010b. China Energy Efficiency Round Robin Testing Results for Room Air Conditioners. LBNL Report 3502-E. Berkeley, CA: Lawrence Berkeley National Laboratory.

Zhou, N., Zheng, N., Fino-Chen, C. and D. Fridley. 2011. “Status of the Local Enforcement of Energy Efficiency Standards and Labeling Program in China.” LBNL Report 5289-E. Berkeley, CA: Lawrence Berkeley National Laboratory.

Zhou, N., Zheng, N., Fridley, D. 2012. “International Review of the Development and Implementation of Energy Efficiency Standards and Labeling Programs.” LBNL Report 5407-E. Berkeley, CA: Lawrence Berkeley National Laboratory.