

# Assessing the Implementation of Household Appliance Efficiency Standards in China

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## ABSTRACT

China began to formulate its first energy efficiency standards for appliances in the mid-1980s. By the 1990s, several major standards had been updated, including those for refrigerators and air conditioners. Yet implementation of the refrigerator and air conditioner standards has not been evaluated until now. This research included surveys of manufacturers, consumers, retailers, and implementation agencies in seven Chinese cities in different regions of the country. We found that the standards are being met by most products sold but that the standards could be strengthened further. Improvements are recommended in the following areas: (1) standards-setting methods; (2) monitoring of standards implementation; and (3) promotion to encourage purchase of products that exceed the mandatory standards.

## Refrigerator and Air Conditioner Energy Efficiency Standards in China

To date, China has implemented two policy instruments aimed at improving the energy efficiency of household appliances: mandatory minimum energy performance standards (MEPS) and a voluntary endorsement-style energy label for higher efficiency products with third-party certification of energy performance. In addition, a new comparative style energy label is expected to be implemented, initially in 2004 for refrigerators. In Chinese standards, MEPS levels are called *maximum allowable values of energy consumption* and levels used for endorsement labels are called *evaluating values of energy conservation*. Implementation of the MEPS phases out products that do not meet the mandatory efficiency requirement. Voluntary efficiency levels promote sales of products that significantly exceed the MEPS levels.

Formulation of energy efficiency (EE) standards for household appliances in China began in the 1980s. By the 1990s, the old standards were outdated and efforts were begun to revise the major standards. Since 1995, China has published six efficiency standards for household electrical appliances and related products. These include standards for refrigerators, room air conditioners, washers, electrical cookers, electrical fans, and fluorescent lamp ballasts. Among these, the refrigerator and room air conditioner standards are generally considered to be the flagship standards due to their high sales, energy use, and energy savings.

These recent EE standards were established by standard formulation teams chaired by the China National Institute of Standardization (CNIS). These teams included industry associations (like the China Household Electrical Appliances Association), related research institutes (like the China Household Electrical Appliances Research Institute), and various manufacturers. The State General Administration for Quality Supervision, Inspection and Quarantine (AQSIQ) is the government authority responsible for standard approval, publication, implementation, and supervision.

## **Refrigerator Standards**

The refrigerator EE standard has been revised twice, first in the late-1990s and again in 2003. The first revision, GB12021.2-1999, was published in August 1999 and came into force April 1, 2000. It included a mandatory minimum-efficiency standard as well as a higher voluntary standard which was used to determine eligibility for the endorsement label. However, due to technical developments and market competition, most refrigerators sold soon easily exceeded the minimum standard and many even exceeded the evaluating value. Thus, the standard soon became out-of-date as it was no longer driving energy efficiency improvements.

A process was undertaken to revise this standard and after two years' work by the standard formulation team, the second revision was completed. Standard GB12021.2-2003 was published in May 2003 and came into effect on November 1, 2003. This standard differed from the 1999 edition in two major respects. First, the efficiency levels are more stringent—the mandatory level by 15% and the voluntary level by 10%. Second, in anticipation of the issuing of a new comparative energy label, due to be issued in 2004, the 2003 refrigerator EE standard included the definition of five EE grades (1, 2, 3, 4, and 5) such that Grade 1 appliances are the most efficient and Grade 5 appliances are the least efficient that are legally permissible on the market. Other changes included refinements to product categories and to the structure of the formulas by which the standards are specified.

## **Room Air Conditioner Standards**

The room air conditioner standard, GB12021.3-2000, was published in September 2000 and came into force on April 1, 2001. Like the refrigerator standard, it included a mandatory minimum-efficiency value and a voluntary evaluating value used for the certification label. Presently, this standard is being revised again, with a new standard scheduled to be published in 2004, becoming effective in 2005.

## **Assessing China's Refrigerator and Air Conditioner Standards**

Since it has now been nearly a decade since China began to publish revised efficiency standards, many participants working on Chinese EE standards felt that an assessment of how effectively refrigerator and room air conditioner efficiency standards are being implemented in China today would be useful. The assessment was led by the China Household Electric Appliances Association (CHEAA) with assistance from the American Council for an Energy-Efficient Economy (ACEEE) and funding from the China Sustainable Energy Program of the Energy Foundation. The objective of the study was to examine and assess impacts on product technology, efficiency, sales, costs, and manufacturing and based on these assessments, develop recommendations to improve the standards program in the future.

## **Methodology**

The project was built around a total of four questionnaires, each targeted somewhat differently as follows:

1. The **questionnaire for manufacturers** focused on soliciting comments from manufacturers regarding the standards-setting process, implementation, enforcement of

- the standards, and assessing impacts of the EE standard on product technology, cost, and price.
2. The **questionnaire for retailers** included two sections. One, to interview retailers to gain a general idea about changes in the market before and after the launching of EE standards with particular attention to changes in: (a) models on the market; (b) the price of these models; (c) consumer awareness and perception of energy efficient products; (d) manufacturer promotional media campaigns; and (e) the market monitoring system for the standards. The second section surveyed energy efficiency ratings of all refrigerator and air conditioner models displayed and sold in the targeted stores.
  3. The **questionnaire for consumers** was designed to survey people's purchase behavior for refrigerators (or air conditioners), their views on government efficiency policies, and the EE endorsement label.
  4. The **questionnaire for quality monitoring agencies** investigated efforts by quality monitoring agencies to enforce the standards, ensure compliance with appliance efficiency standards, identify problems with compliance, and gain feedback on how to improve the implementation of the EE standards.

A different sampling plan was used for each survey, as follows:

1. **Manufacturer sampling plan.** In total, 12 refrigerator manufacturers and 15 room air conditioner manufacturers were surveyed. The sampling included large manufacturers and a range of small and medium-scale manufacturers.
2. **Retailer sampling plan.** Surveys were conducted in seven cities including Beijing; Ningbo, and Shaoxing (in Zhejiang province); Chengdu and Deyang (in Sichuan province); and Shenyang and Jinzhou (in Liaoning province). In each city, three types of retail stores were surveyed (an appliance division of a department store, an appliance chain store, and an independent appliance store). In total, 21 stores were surveyed in seven cities, 3 stores per city. At these stores, managers were interviewed and data was collected on a total of 650 refrigerator display models and 649 air conditioner display models.
3. **Consumer sampling plan.** Geographical coverage was the same as the retailer survey. In each city, 50 consumers were surveyed, with a total sample of 350 people. Of these surveys, 250 were concerned with refrigerator energy consumption and 112 with air conditioner energy consumption (numbers don't total because some consumers answered both the refrigerator and air conditioner surveys).
4. **Quality monitoring system sampling plan.** A significant purpose for this survey was to examine the quality monitoring system at the state, provincial, and municipal level. The interviewees included local Quality Supervision and Inspection Bureaus in each of the seven cities included in the retailer and consumer survey and also two national research institutes located in Beijing and Guangzhou.

Surveys were developed jointly by ACEEE and CHEAA and administered by CHEAA and contractors hired by CHEAA. The surveys were largely analyzed by CHEAA, with some assistance from ACEEE.

## Survey Results

**Refrigerator manufacturers: standard setting.** Of the refrigerator manufacturers surveyed, 83% are involved in standard formulation or review the standard-setting work. For the standard-setting process, each manufacturer provided basic data concerning the energy efficiency of their products. They also provided comments and attended discussions during the standard formulation and revision work. Their views on the standards are basically positive although, as discussed below, some believe that a few problems exist with the standards and the ways they are set.

The positive aspects of the standard-setting process mentioned by manufacturers included reasonable EE grades (mentioned by 42% of respondents); statistical work and market survey in the first stage (33%); harmonization with equivalent international standards (25%); and the solicitation of comments for the formulation of the 2003 EE standard (25%).

Problems mentioned included unreasonable EE grades (25%); lack of detailed rules for the implementation of the EE grades and the new categorical energy label (25%) (e.g., absence of implementation regulations for the label itself and lack of a fixed market monitoring agency); length of time to finalize the standard (17%); and unspecified standard assessment methods and implementation rules (8%).

When asked how the standards-setting process should be improved, half the respondents suggested that related implementation rules be launched. To be specific, they suggested that the energy labeling system and its implementation rules should be established as early as possible and that the methods for assessing standards (including both mandatory and voluntary standards), the rules of standards implementation, and the agencies responsible for implementation should be specified.

Most of the respondents believed that the economic and technical analyses were sound and effective, and that the level of the lowest allowable energy efficiency index (the maximum allowable energy consumption) was reasonable. They thought it was appropriate to add a higher recommended efficiency value (*evaluating value*) in the standard.

Currently, about six months is allowed after a refrigerator EE standard is published before it comes into force. Most respondents (75%) believed this was enough time to make necessary preparations or adjustments. Some respondents (17%) suggested that one year would be better.

**Refrigerator manufacturers: standards implementation.** When asked about the impact of the refrigerator EE standard on product design, most manufacturers believed that the 2003 version is having a greater impact than the 1999 version. For the 2003 edition, 92% of respondents believed that at least some of their products needed to be redesigned and on average reported that 30% of their models are affected. In comparison, for the 1999 standard, the corresponding ratios were 50% of respondents believed that at least some of their products needed to be redesigned and reported that on average 25% of their models were affected.

To improve the efficiency levels of their refrigerators, manufacturers reported they are redesigning models in four ways: (1) adopting higher efficiency compressors or variable-speed compressors; (2) improving system matching and optimizing the refrigeration system; (3) increasing the thickness of the foam insulation or using vacuum insulation panels (now being used by a Panasonic factory in Wuxi); and (4) transforming the cooling mode (e.g., change from forced-air to natural convection or mixed cooling mode).

According to the manufacturers surveyed, improvements that involved only the first two aforementioned methods require investments of RMB 1 to 1.5 million (US\$120,000 to 180,000) and less than a year to make the changes. If design changes are needed that require changes to dies and the foaming system, more than half a year is needed and millions of RMB (many hundreds of thousands of US\$) need to be invested. If the product must be redesigned (e.g., changing the cooling mode), the time needed can be one to two years or longer, and the money required can reach tens of millions of RMB (ten million RMB equals US\$1.2 million).

Manufacturers reported that both revisions of the standard increased manufacturers' costs by approximately RMB 50 (US\$6) per unit on average. However, the highest cost increase reported due to the implementation of the 2003 standard was RMB 400 (US\$48), nearly twice the highest cost increase caused by 1999 standard. Regarding the impact on the consumer price, the 2003 edition is having less impact than the 1999 edition. Only 25% of the respondents believed no price increase was caused by 1999 standard and 50% expect no price increase to result from the 2003 edition. Possible reasons for the more modest price impacts of the 2003 standard relative to the 1999 standard include increased market competition and the fact that many manufacturers are now more familiar with the range of options for improving efficiency. Most respondents (75%) claimed that the energy efficiency standard is a crucial factor in their product development plans.

**Refrigerator manufacturers: standards enforcement.** To ensure their refrigerators meet the mandatory efficiency requirement, manufacturers reported that they take the following measures: (1) conduct energy efficiency tests on more models to make sure their energy consumption is lower than the maximum allowable energy consumption limit; (2) phase-out old models gradually and design new models to meet Grade 1 or Grade 2 efficiency thresholds (as defined in the 2003 EE standard); and (3) improve product design (such as optimizing the refrigeration system, employing high efficiency compressors, or improving the insulating properties of the foam).

Most respondents (75%) believed that almost all products in the market meet the mandatory efficiency requirements. According to respondents, only a small proportion falls short of that limit, estimated to be between 5 and 10%. Manufacturers reported that they have more difficulty bringing fan-cooled models into compliance with the standard than natural convection models. Manufacturers also reported that although the lowest energy efficiency level is mandatory, the government does little to enforce the standard and so it is largely up to manufacturers to self-enforce for their own products.

When asked how to improve the implementation or enforcement of the standards, the manufacturers suggested that the following measures could be carried out: (1) launching government incentive programs to promote equipment at the highest efficiency levels; (2) developing additional rules regarding the implementation of the standards; (3) strengthening market monitoring agencies to better supervise implementation of the standards; and (4) alleviating the burden of the standards on manufacturers by reducing the fees for appliance certification.

**Air conditioner manufacturers: standards setting.** Of the 15 air conditioner manufacturers surveyed, 53% took part in the formulation or review of the air conditioner efficiency standard. They were mainly involved in establishing the standard criteria system, exploring the testing method, and participating in drafting and reviewing the standard. Most manufacturers have a positive attitude toward the standard-setting process although some problems exist.

The positive aspects of the standard-setting process mentioned by manufacturers included field survey and comment solicitation before setting the standard (mentioned by 40%); the clear definition of the Maximum Allowable Value of Energy Consumption (27%); and that the standard is basically compatible with the efficiency level of products on the market, which makes it easy for manufacturers to meet the standards with modest investments (20%).

Problems mentioned were inadequate communication with the manufacturers (27%); problems with the certification labeling system (27%); conflicts in definitions and other technical factors between the EE standard and an earlier product standard (20%); the fact that the standard is inapplicable to inverter models, multi-split models, and mobile models (20%); and the low efficiency requirement that makes it hard to harmonize with international standards (13%).

Manufacturers believed that the following measures can be taken to improve the standard setting work: strengthen cooperation and information exchange with manufacturers and take their comments and suggestions into consideration (40%); avoid conflicts among different standards (13%); set up applicable standards for inverter models, multi-split models, and mobile models (13%); enhance the efficiency requirement to narrow the gap with the international standards (13%); and launch incentive programs to backup EE certification work (13%).

More than half of the respondents (53%) believed that the technical and economic analysis to set the standard was sufficient and effective.

The majority of respondents (67%) believed that the mandatory efficiency requirement set in the 2000 standard was rational and compatible with the real situation of the industry. Those who considered the requirement “too low” and “too high” accounted for 20% and 7%, respectively. The 2000 air conditioner EE standard also incorporated a recommended higher efficiency value. However, a larger proportion of the respondents (53%) held negative views toward this recommended value because they did not believe consumers cared about efficiency and because there was a lack of supporting policies or incentive measures to promote products meeting this higher value.

As with the refrigerator standard, a half-year was provided between when the air conditioner standard was published and when it took effect. Forty-seven percent of respondents thought this was long enough, while the same percentage of respondents believed it is too short and suggested that at least one year be provided.

Regarding the upcoming 2004 standard, the committee developing this standard is now considering whether to set two standards in 2004, one that may go into effect in 2005 and a second that would be stronger but not go into effect until about 2009. More than half (60%) of the respondents to the manufacturer survey believed the two standards should be established at the same time. In comparison, 27% prefer setting only the 2005 standard and delaying establishment of the 2009 standard until later.

**Air conditioner manufacturers: standards implementation.** More than half (53%) of the respondents believed that they had to redesign at least some of their products to meet the requirements of the new standard. On average, 22.5% of the models were affected by the standard. To improve the efficiency level of these products, the manufacturers usually took the following measures: redesign the refrigeration loop and increase its heat exchanging capability; employ higher efficiency compressors; improve system matching and optimization of the refrigeration system; and adopt higher efficiency key components (e.g., inverter control units).

To make these improvements, manufacturers said it could take at least half a year and sometimes a full year and require investment of several million RMB (one million RMB equal US\$120,000). As for the impact of the standard on manufacturers’ costs, 40% claimed that unit

costs increased, with the average increase around 125 RMB (US\$15). Regarding the impact of the standard on consumer prices, 33% of respondents believed the price increased (with an average increase of 6.5%); 20% believed that the standard had no direct impact since prices are mainly controlled by the market environment, competition, and pricing strategy of the company; and 47% expressed no opinion on this question.

Most respondents (67%) believed that product efficiency is a key factor when they make their product development plans.

**Air conditioner manufacturers: standards enforcement.** To make sure their products meet the mandatory efficiency requirement, the following measures were taken by the manufacturers: (1) integrate requirements of both the EE standard and GB/T7725-1996 (an earlier product standard); (2) set more strict internal control objectives (higher than the lowest efficiency requirement) to leave slack to allow for fluctuations in the manufacturing process; (3) introduce a quality control system that includes testing and certification during the design stage, assessment before batch production, and quality control during batch production; and (4) improved product design, (e.g., altering compressor models, increasing effectiveness of the heat exchanger, developing more efficient dies, and optimizing the system).

When asked whether air conditioners on the market all meet the mandatory efficiency requirement, more than half (53%) answered “unclear” or made no reply, while 27% answered “yes.” Some 20% believed various products do not meet the mandatory requirement since products from small-scale enterprises (family workshops with 3–5 employees) have trouble meeting the requirement. As with refrigerators, even though the lowest energy efficiency level is mandatory, it is currently largely self-policed by manufacturers.

Regarding how to improve the implementation and enforcement of the standard, manufacturers suggested the following: implementation should be considered before setting the standard based on adequate field surveys and analysis of the industry and consumers; monitoring and supervision of compliance should be strengthened, taking the practices of 3C certification (named after the certification mark “China Compulsory Certification” or CCC, which deals with health, safety, and security issues) as a reference; related incentive programs and penalties should be launched; an arbitration agency and related laboratory should be established; and a media campaign should be carried out to raise the awareness and perception of the standard.

**Retailers.** The survey of retailers found that in general retailers are unfamiliar with the refrigerator and air conditioner EE standards. Of all the interviewees, 5% had heard about the standards and knew something about the content, 62% had heard about the standards but did not know any details, and 33% claimed they had never heard about the standards. Where retailers had heard about the standards, leading sources of information were manufacturers and media reports.

Retailers were also asked about changes in the market immediately after the different standards came into force (e.g., they were asked about changes in the market in 2001 when the refrigerator standards took effect, irregardless of whether the respondent was familiar with the standards). After the new refrigerator standards took effect, the retailers noticed that refrigerator products changed, including more model choices, lower prices, higher energy efficiency, and increased sales volume (these items were mentioned by 78%, 67%, 50%, and 39% of the respondents, respectively). The retailers said that the increase in efficiency was noticed by some consumers (about one-third).

According to retailers, when consumers make refrigerator purchase decisions, energy efficiency is generally not a decisive factor, but when consumers learn that a new model is more efficient, about 40% will show increased interest. After the new standards came into effect, many manufacturers held workshops for consumers (mentioned by 100% of retailers surveyed), provided print materials (mentioned by 61%), conducted a media campaign (mentioned by 44%), and/or held in-store promotion events (22%). When asked about the usefulness of this information to consumers in an open-ended question, 56% of respondents specifically said the media campaigns were useful (and 6% said they were not useful), 22% said the in-store promotions were useful, and 33% said the print material was *not* useful

After the new air conditioner EE standards took effect, retailers reported that the air conditioners in the market experienced similar changes as the refrigerator products, including lower price, more model choices, increased sales volume, and improved efficiency (mentioned by 81%, 67%, 52%, and 48% of the respondents, respectively). The retailers said that the increase in efficiency was noticed by some consumers (about 40%).

When consumers make air conditioner purchase decisions, efficiency is a relatively unimportant factor. However, 43% of retailers reported that consumers show increased interest when high efficiency products are mentioned. After the new standards came into effect, many manufacturers held workshops for consumers (mentioned by 76% of retailers surveyed), provided print materials (mentioned by 62%), conducted a media campaign (mentioned by 48%), and/or held in-store promotion events (29%). When asked about the usefulness of this information to consumers in an open-ended question, 52% of respondents specifically said the media campaigns were useful (and 14% said they were not useful) and 19% said the print material was useful (and 24% said it was not useful).

Regarding compliance with the standards, the retailers believed that manufacturers should be responsible for compliance with the retailers acting as a monitor (e.g., checking manufacturer product ratings with appropriate agencies), although the government definitely should also play a role in this process. Some 81% of the respondents thought that the manufacturers should examine whether their products meet the mandatory requirements and 43% thought that retailers should also act as monitors. Another 19% said the government should assume the primary responsibility to check compliance.

When asked if government agencies had visited their store to check compliance with the standards, 62% of respondents claimed that a government agency had come to inspect for compliance with the standards. But since 95% of the respondents are not familiar with the EE standards, this ratio is not consistent, so perhaps many respondents were referring to safety or other government standards and not energy standards.

As part of the retailer survey, data was collected on refrigerators and air conditioners on display. Based on this survey, it was found that:

- All of the refrigerators on display met the 1999 refrigerator standard according to manufacturer claims of model efficiency as submitted by manufacturers to CHEAA. In addition, all but 0.2% met the 2003 standard, even though that standard was not yet mandatory at the time of the store visits. Data was collected on a total of 650 display models. Of these, 3% exceeded the 2003 standard by 1–20%, 49% exceeded the standard by 21–40%, 44% exceeded the standard by 41–60%, and 4% exceeded the standard by more than 60%. On average, the display models exceeded the 2003 standard by 40%.
- All but 0.2% of the air conditioners on display met the 2001 air conditioner standard, again according to manufacturer claims of model efficiency as submitted by



manufacturers to CHEAA. Data was collected on a total of 649 display models. Of these, 29% exceeded the 2001 standard by 1–10%, 60% exceeded the standard by 11–20%, 8% exceeded the standard by 21–30%, and 2% exceeded the standard by more than 30%. On average, the display models exceeded the 2001 standard by 13%.

- The use of the China Efficiency Certificate Product Label (CECP Label — an endorsement-type label) on refrigerator and air conditioner products is limited. On average, 10% of refrigerators and 8% of air conditioners on display have a CECP label. In four of the seven cities surveyed, labeled refrigerators accounted for less than 8% of display models. And in four cities, labeled air conditioners accounted for less than 3% of display models. Based on their claimed efficiency, 96% of refrigerators on display and 77% of the air conditioners on display could earn the label, so the limited number of labels implies limited participation by manufacturers and retailers.
- The adjusted volume of the average refrigerator in our sample of floor models was 285 liters with a daily average energy consumption of 0.77 kWh/day. The cooling capacity of the average air conditioner surveyed was 3,600 Watts (output) with an average Energy Efficiency Ratio (EER) of 2.67 W/W.

**Consumers.** Some 350 consumers were queried about buying habits for refrigerators and air conditioners and their perceptions of government energy-saving policies.

For refrigerators, nearly 100% of consumers surveyed (349 out of 350 consumers surveyed) had purchased a refrigerator and 31% of those had purchased a refrigerator in the last three years while 38% had purchased a refrigerator in the prior five-year period. The remaining consumers had purchased refrigerators more than eight years ago.

For their latest purchase, 82%, 78%, and 62% of the respondents were “content” or “relatively content” with the model choices, function, and price, respectively. For people who had purchased two or more refrigerators during their lifetime (accounting for 49% of all respondents), their latest choice of product models and functions was quite different from their earlier ones. Commonly mentioned changes were larger capacity (mentioned by 61% of respondents), switch from manual defrost to automatic defrost (mentioned by 41%), increased number of doors (22%), use of electronic temperature control (19%), CFC free (18%), and increased energy efficiency (13%). However, consumers on average found prices little changed from their earlier purchases (26% reported level prices, 30% lower prices, and 44% higher prices).

For air conditioners, 52% of consumers surveyed (183 consumers out of 350 surveyed) had purchased an air conditioner, of which 57% made their purchase in the past three years, 38% in the prior five-year period, and only 5% more than eight years ago. Most of these purchases were their first air conditioner. For their latest purchase, 84%, 71%, and 63% of the respondents were “content” or “relatively content” with model choices on the market, functions, and prices, respectively. Those who made multiple purchases (accounting for 19% of the air conditioner purchasers), generally found less changes in products than were found for refrigerators. Of repeat purchasers, 28% mentioned increased availability of wall-mounted and cabinet-type air conditioners and 14% noted higher cooling capacity. These consumers reported no noticeable changes in price (relative to their previous purchase, 38% reported level prices, 29% lower prices, and 33% higher prices) and changes in efficiency were not mentioned by consumers.

Regarding government policies to promote efficient appliances, consumers were generally unfamiliar with the appliance-related governmental efficiency policies or programs. Among the 350 consumers interviewed, only 2% knew something about the policies. Their

information sources were mainly media reports and friends. Consumers were also asked if they had seen the CECP endorsement label. Of the 350 consumers interviewed, only 11% claimed to have seen the label before, and only 5% could explain the meaning of the label to the interviewer.

**Quality monitoring agencies.** The survey of quality monitoring agencies included two national test laboratories and seven municipal Quality Supervision and Inspection Bureaus.

From the national test laboratories, test data were collected on 52 refrigerators and 50 room air conditioners. Analysis of this independent test data found the following:

- All of the tested refrigerators met the 2003 mandatory standard. Of these, based on their Energy Efficiency Index (EEI), 27% can earn EE Grade 1 (on a 1–5 scale, with 1 the best), 44% can earn Grade 2, 27% can earn Grade 3, 2% can earn Grade 4, none are a Grade 5, and 71% can earn the CECP endorsement label. On average, the EEI for tested models was 61% (Grade 2).
- All the tested air conditioners met the 2001 air conditioner mandatory standard. Of these, 24% exceeded the 2001 standard by 1–10%, 50% exceeded the standard by 11–20%, 22% exceeded the standard by 21–30%, and 4% exceeded the standard by more than 30%. On average, the tested models exceeded the 2001 standard by 16%. Based on their EER, 84% of the models can earn the CECP endorsement label.
- The test data show that manufacturer claims of model efficiency (as provided by manufacturers to CHEAA) are reasonably accurate on average for both refrigerators and air conditioners. For both refrigerators and air conditioners, the median difference between the manufacturer claim and the independent test lab assessment of efficiency was less than 1%. However, comparing the difference between the manufacturer claim and the test lab value for individual models, there are more substantial deviations for individual refrigerator models than air conditioner ones. The deviations for air conditioners are generally modest (median deviation of 2.4%), but the refrigerator deviations are more substantial (median deviation of 9.9%). The refrigerator test is much simpler than the air conditioner test. The larger deviation for the refrigerator test implies that testing of refrigerators is not as accurate as it could be and/or that the rules and procedures for testing refrigerators may need to be reviewed and tightened.

The survey of local quality and technology supervision bureaus found that these bureaus play a significant role in monitoring compliance with appliance EE standards. These bureaus periodically test sample models sold in the market, usually once a year, using their own test labs.

Regarding compliance with the standards, most respondents believe that products coming from big manufacturers or high-end brands are in compliance with the standards, while low- to mid-end products might have more difficulties in meeting the mandatory standards. However, the local bureaus found it hard to estimate what percent of refrigerators or air conditioners sold are not in compliance.

When asked what problems with compliance are most common, 67% of the respondents reported that the government puts little effort into monitoring compliance and as a result manufacturers feel only limited obligation to meet the standards. According to the local bureaus, comparing refrigerator and air conditioner safety standards with the EE standard, almost all manufacturers meet the corresponding product safety standards, but many make little effort to comply with the EE standards. Also 44% of the respondents reported that due to recent price

wars among manufacturers seeking to retain or build market shares, many manufacturers have had to cut costs by reducing material quantities and product quality, which makes complying with EE standards more difficult. In addition, the respondents reported other problems that hinder manufacturers from complying voluntarily with the EE standards such as the absence of significant incentive measures to push the implementation process and the absence of rules for sample testing of products sold in the market.

Regarding how to improve the implementation and enforcement of the standards, respondents suggested the following: (1) mass media should be employed to increase the public awareness of energy-efficient products and manufacturers' recognition of the importance of standard implementation; (2) government should strengthen monitoring of compliance with the standards in the market by increasing coverage and frequency of spot checking and publicizing the results of these checks; (3) cooperation between standard monitoring centers and other government supervision agencies should be improved; and (4) more training programs and workshops on EE standards should be held for testing institutes to improve their capabilities in checking compliance with the EE standards.

## **Overall Assessment**

Generally speaking, after more than a decade of experience implementing standards, a sound foundation has been established for the setting of refrigerator and air conditioner EE standards. The standards are widely followed and manufacturers appear to have little difficulty meeting the standards.

Regarding the refrigerator standard, after two revisions, the new standard sets rational efficiency grades and has significantly reduced the maximum allowable energy consumption value without significant price increases to consumers. Due to adequate market surveys and efforts to solicit comments during the standard-setting process, the new standard is accepted by the market. Under the support of some international programs, such as the UNDP/GEF *Project for Barrier Removal for the Commercialization of CFC-Free Energy-Efficient Refrigerators in China*, great progress has been made to enhance the general efficiency level of the whole industry, increase awareness of energy-efficient products among consumers, and strengthen industrial competitiveness.

As a result, the more efficient refrigerators are at a level similar to European products. However, the mandatory minimum-efficiency standard in China is well below levels in some other countries. For example, after adjusting for differences in test procedures among countries, the energy use allowed by the Chinese 2003 refrigerator standard for a typical two-door automatic defrost model with an adjusted volume of 300 liters is nearly 50% higher than under the current U.S. standard and about 25% higher than the current Korean standard (ERM Siam 2002).

The air conditioner standard established and identified the concept and requirement for a maximum allowable energy consumption value, which has helped to promote the efficiency level of Chinese air conditioner products. The standard is based on the current efficiency level of the Chinese market and imposed little cost on manufacturers to adjust their products. Currently, a new set of revisions to this standard is being considered. Relative to international standards, the current Chinese minimum-efficiency standard for a 3,500 Watt mini-split cooling-only air conditioner is 33% lower than the Japanese "Top Runner" standard, 14% lower than the Korean standard, 13% lower than the standard now being finalized in Thailand, 4% lower than the

standard in Taiwan, and 3% lower than the standard in the Philippines (APEC 2004; Harrington 2004).

## **Challenges and Recommendations**

While the EE standards are generally functioning fairly well, there are some challenges that should be addressed in the areas of standards-setting methods, monitoring of standards implementation, and promotion to encourage purchase of products that exceed the mandatory standards.

### **Standard-Setting Challenges**

- Communication and information exchange with the manufacturers and other interested parties needs to be improved. More manufacturers and other key stakeholders should be involved in the standard-setting process and in-depth communication should be facilitated.
- Conflicts in definitions and technical issues exist between refrigerator EE standard and the earlier GB8059 product standard and also between the air conditioner EE standard and the GB/T7725-1996 product standard. These differences cause confusion with manufacturers and make it more difficult for them to implement the standards.
- The air conditioner EE standard is inapplicable to inverter models, multi-split models, and mobile models (which together account for about 10% of Chinese room air conditioner production). The low air conditioner efficiency requirement also makes it hard to harmonize with international standards.
- Efficiency grades set in the refrigerator EE standard can be more rational, e.g. “Grade 1” can be divided into several higher grades in order to better differentiate the most efficient products.

### **Standard-Setting Recommendations**

- Strengthening and facilitating communications with the industry and other key parties, paying more attention to the experience of the manufacturers and other experts, and making the standard in tune with the Chinese market, the international market, and the development of the Chinese industry.
- Improving the compatibility of the EE standard with the product standard. For example, the relationships of documents referred to in the standards should be clearly outlined, or efficiency should be deleted from the product standard to avoid overlapping of different standard requirements.
- Increasing the efficiency requirement of the air conditioner EE standard to reduce the distance with its international counterparts, and establishing EE standards applicable for inverter, multi-split, and mobile products. When this standard is revised, two tiers should be set—a 2005 standard and a higher 2009 standard. By publishing the 2009 standard now, manufacturers will have plenty of time to prepare for a significant increase in efficiency. In the medium term, there is also room to raise the minimum-efficiency levels for refrigerators.

## **Standards Implementation and Enforcement Challenges**

- Rules to implement the standards were launched too late. Also the rules are not specific enough to avoid possible misunderstandings and to clear the way for standards implementation.
- The rules for the implementation of the categorical energy label are still not in position, which greatly weakens the impact of the standard.
- Supervision is limited and the standards are largely self-enforced by manufacturers. As standards are strengthened, government supervision agencies need to take more responsibility.
- Deviations between manufacturer claims and independent laboratory tests are larger than they should be for refrigerators.

## **Standards Implementation and Enforcement Recommendations**

- Improving monitoring of standards implementation including formulating improved implementation rules, explaining the rules to affected parties, launching the new categorical energy label and its implementing rules, and specifying a government supervision agency to be responsible for the enforcement of EE standards in a more regular way than the current occasional spot-checking. The practices of China's 3C certification mentioned above may be a useful model.
- Establishing incentive programs or policies and penalty measures. For example, the government could encourage manufacturers to develop and commercialize energy-efficient products through awards, subsidies, or tax-reductions, and also cut the production and distribution channel of illegal products by exposing them to harsh penalties. In cases of non-compliance, the non-complying products should be publicized through press releases and those who report the non-compliance should be encouraged and rewarded.
- Investigating reasons for the relatively large deviations in refrigerator testing results and identifying and implementing appropriate solutions.

## **Promotion of Standards Challenges**

- Challenges still exist for the CECP label, including low consumer recognition of the label, an absence of incentive mechanisms and promotions to encourage purchases of labeled products, a high service fee to get the certificate, and lack of enthusiasm from manufacturers.
- Due to the absence of government incentive policies and media campaign programs and also to the limited inclination and capability of the manufacturers to push the implementation process, the perception and impact of the air conditioner standards are restricted and hence limit the effectiveness of standards and related policies to increase the efficiency level of the whole industry. Because of the implementation of the GEF China Energy-Efficient Refrigerator Project, consumer awareness of energy-efficient refrigerator products is much higher than for air conditioner products and the pace of refrigerator efficiency improvements is quicker than those for air conditioners.

## Promotion of Standards Recommendations

- Mass media should be employed to increase the public awareness of the standards and the labels. For instance, public relations programs could be launched to improve consumer recognition and understanding of the EE standards, the CECP label, the forthcoming categorical label, and the availability of high efficiency products.
- The CECP label program should be improved. Products with false labels should be exposed to the public and those who put the false products on the market should be punished. In addition, manufacturers should be encouraged to participate, such as by making certification easier and/or less expensive.

## Conclusions

Overall, the Chinese energy efficiency standards program for refrigerators and air conditioners is functioning reasonably well and having an impact on product efficiency. Standards are progressively becoming stronger, manufacturers are upgrading products, and the standards are having only a small impact on product prices. For both refrigerators and air conditioners, based on the current high availability of models that significantly exceed the current standards and also comparisons with international standards, there is room for further revisions to the mandatory standards and to improve programs that promote efficiency levels beyond the mandatory standards including the existing endorsement label and the forthcoming categorical label. However, this research has identified several recommendations that should significantly improve the program.

## References

- [APEC] Asia Pacific Economic Cooperation, Energy Standards Information System. 2004. "Summary Table of Equipment: Air Conditioners." <http://www.apec-esis.org/equipment.asp?id=100032>. Visited March 16.
- ERM Siam. 2002. *Energy Efficient Refrigerator Prototype Development, Final Report*. Report prepared for the Thai National Energy Policy Office. Bangkok, Thailand: Environmental Resources Management.
- Harrington, Lloyd (Energy Efficient Strategies). 2004. Personal communication with the authors. May.