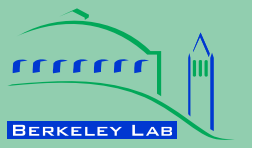


ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Check-Testing of Manufacturer Self Reported Labeling Data & Compliance with MEPS

Nan Zhou, Nina Zheng, David Fridley

Environmental Energy Technologies Division

Ruohong Wang

China National Institute of Standardization (CNIS)

Christine Egan

Collaborative Labeling and Appliance Standards Program (CLASP)

March 2008

The work described in this report was funded by This the Ministry of Economy Trade and Industry and the Institute of Energy Economics, Japan. This work was supported by the Collaborative Labeling and Appliance Standard Program (CLASP) through the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

DISCLAIMER

Table of Contents

Tables and Figures

Executive Summary

China first adopted minimum energy performance standards (MEPS) in 1989. Today, there are standards for a wide range of domestic, commercial and selected industrial equipment. In 1999, China launched a voluntary endorsement label, which has grown to cover over 40 products including water-saving products. Further, in 2005, China started a mandatory energy information label that initially covered two products and in 2007 was extended to cover four products total including: air conditioners; household refrigerators; clothes washers; and unitary air conditioners. These programs have had an important impact in reducing the energy consumption of appliances in China. China has built up a strong infrastructure to develop and implement standards. Historically, however, the government's primary focus has been on the technical requirements for specifying efficiency performance. Less attention has been paid to monitoring and enforcement with a minimal commitment of resources and little expansion of administrative capacity in this area. Thus, market compliance with both mandatory standard and labeling programs has been questionable. Furthermore, actual energy savings have quite possibly been undermined as a result. The establishment of a regularized monitoring system for tracking compliance with the mandatory standard and energy information label programs in China is a major area for program improvement.

Over the years, the Collaborative Labeling and Appliance Standards Program (CLASP) has partnered with several Chinese institutions to promote energy-efficient products in China. CLASP, together with its implementing partner Lawrence Berkeley National Laboratory (LBNL), has assisted China in developing and updating the above-mentioned standards and labeling programs. Because of the increasing need for the development of a monitoring system to track compliance with the standard, CLASP, with support from Japan's Ministry of Economy, Trade and Industry (METI) and the Institute of Energy Economics, Japan (IEEJ), has expanded its on-going collaboration with the China National Institute of Standards (CNIS) to include enforcement and monitoring. CNIS has already begun working on the issue of compliance. In early 2007, LBNL compiled a report, with the support of METI, summarizing the findings from these activities and indicating China's progress to date. The report concluded that although the existing legal basis for monitoring and enforcement is sufficient— with multiple laws and regulations defining the responsibility of each government agency and specifying a system of fines and penalties for non-compliance—compared with international best practices, there is still a big gap in China's monitoring and enforcement efforts for mandatory standards and labels.

Concerned about the integrity of the mandatory energy information labeling and MEPS, CNIS conducted modest sample testing in 2006 for refrigerators and room air-conditioners. In contrast to the national product quality testing, where samples are taken from manufacturers' warehouses, samples were purchased from retail markets in Beijing, Heifei, and Guangzhou. They were then tested in three national test laboratories in those same three cities. Tests were done in two rounds with products that failed the first time re-tested for a second time.

As a second phase of this effort (and with support from METI/IEEJ), CNIS repeated the same task in 2007 with a similar sample size for three products (refrigerators, air-conditioners and clothes washers). Tests were done in two rounds with products that failed the first time re-tested for a second time.

The 2007 results showed that while most products meet the claimed performance levels, there were also cases of non-compliance. Varying compliance rates were observed both by product type and by city. Overall, in the first-round of 2007 testing, refrigerators, air-conditioners and clothes washers had higher compliance rates than did freezers. The compliance rates were:

- 91 percent for air-conditioners;
- 90 percent for clothes washers;
- 87 percent for refrigerators; and
- 71 percent for freezers;

The results after re-testing were more favorable and the overall compliance for all products reached 96 percent in 2007. These out-of-compliance products were composed of two clothes washer models (1 each from Beijing and Guangzhou) and 1 refrigerator model from Guangzhou. These three model samples came from three different manufacturers, which represent 6.8 percent of the 48 surveyed manufacturers.

Regarding the geographic distribution of the testing results, in 2007, Beijing had higher compliance rates for each type of product than Guangzhou and Hefei. Of the three cities Guangzhou had the lowest compliance rate for refrigerators and clothes washers, as well as a relatively low compliance rate for its freezer sample. Clothes washers had more significant geographically divergent compliance rates than the other products. Specifically, Beijing had a 94 percent compliance rate while Guangzhou had only a 67 percent compliance rate in the 2007 testing,

In comparison with the 2006 testing results, the 2007 testing showed significant improvements in compliance across product types and regions. The number of non-compliant product models (after the second round of testing in each year) decreased from 11 out of 54 in 2006, to only three out of 73 models in 2007[1]. On the regional level, Beijing not only achieved higher compliance rates for refrigerators (from 86 percent to 100 percent), but also achieved 100 percent compliance for air-conditioners and 94 percent for clothes washers. Further, the 2006 performance and compliance rates varied between models sold in high-end, first- tier appliance retailers versus those sold in second- and third-tier retailers, with those sold in high-end retailers having higher compliance. In 2007, this result was not replicated. However, because the vast majority (69 out of 73) of

[1] The sample size discussed for each year (2006 and 2007) represents the number of models tested. In both cases, the number of individual units tested is actually higher than that due to the re-testing of models that failed to be found compliant the first round of testing. Sample size (N) in both years is equal to the number of models, and not the higher number of individual units tested.

the sample was taken from a single high-end retailer, it is not clear that this actually signifies an improvement in the compliance of lower-tier retailers.

Also, the results from both years suggested that the testing results can vary significantly when tested in different laboratories. Improving the consistency of test results between test laboratories is a critical and necessary step in setting up a comprehensive national testing program. This can be achieved through a round-robin testing scheme and capacity-building activities.

Further, the 2007 testing shows that most products' actual energy efficiency is in compliance with the product's energy efficiency rating. Also, no systematic variation (e.g., by product, by class, etc) was observed in deviations between actual performance and ratings. There is a slight tendency to over-rate energy efficiency. However, the difference is not significant. Among the different products, refrigerators show slightly greater overrating with an average deviation of 3.3 percent.

Another finding regarding sample selection was that the selection of testing samples seems to be biased towards certain grades. In 2007, the tested refrigerators were all selected from grade 1 while freezers were selected from grades 3, 4, and 5. The sample air-conditioners and clothes washers were from a wider distribution of grades but lacked a focus on some particular grades. In order to make the testing more meaningful, future selection of test products should target a wider variety of products from across the entire market. Similarly, as noted above, the 2007 study is limited by the fact that so much of the sample came from a single retail chain.

In sum, the report concludes that while the sample size is far smaller than the mid-term goal of developing a regular check testing program for 20 percent of the market for each of the three products, this study provides highly valuable feedback on manufacturer compliance rates in the absence of a large-scale national testing program. With METI/IEEJ support, CLASP could assist the China Energy Label Center (CELC) in expanding its verification testing programs to cover more models and products, and in developing a plan for ramping up the national verification testing program over the next three to five years. This is particularly important as the information labeling program gains more visibility and expands to additional product categories. CLASP could also assist CELC to plan for a round-robin testing scheme—first among three national laboratories with subsequent expansion of this program to other regional test laboratories—with the goal of improving the consistency of testing results from different testing laboratories.

1. Introduction

China first adopted minimum energy performance standards (MEPS) in 1989. Today, there are standards for a wide range of domestic, commercial and selected industrial equipment, including: domestic refrigerators/freezers; room air conditioners; clothes washers; electric irons; automatic rice cookers; televisions; radio receivers and recorders; electric fans; fluorescent lamp ballasts; small electric motors; compact fluorescent lamps; linear fluorescent lamps; HPS lamps; HPS lamp ballasts; instantaneous gas water heaters; external power supplies; and commercial packaged air conditioners.

In 1999, China launched a voluntary endorsement label, which has grown to cover over 40 products including water-saving products (Figure 1). Some of the products, such as consumer electronics and office equipment, are generally not subject to MEPS development, and the voluntary endorsement label serves as the only efficiency program for these products. Other products, such as refrigerators, air conditioners, clothes washers, external power supplies, and gas water heaters, are included within the MEPS program, and the voluntary efficiency specifications are developed as part of the MEPS process. Further, in 2005, China started a mandatory energy information label (also referred to as the "Energy Label"). Today, the Energy Label is applied to four products including: air conditioners; household refrigerators; clothes washers; and unitary air conditioners (Figure 2).

Figure 1 China's Voluntary Energy Efficiency Label

MEPS and the voluntary endorsement labeling specifications have been updated and revised in order to reflect technology improvements to those products in the market. These programs have had an important impact in reducing energy consumption of appliances in China. Indeed, China has built up a strong infrastructure to develop and implement product standards. Historically, however, the government's primary focus has been on the technical requirements for efficiency performance. Less attention has been paid to monitoring and enforcement with a minimal commitment of resources and little expansion of administrative capacity in this area. Thus, market compliance with both mandatory standards and labeling programs has been questionable and actual energy savings may have been undermined as a result. The establishment of a regularized monitoring system for tracking compliance with the mandatory standard and energy information label in China is a major area for program improvement.

Figure 2. China's Mandatory Information Label

Over the years, the Collaborative Labeling and Appliance Standards Program (CLASP) has partnered with several Chinese institutions to promote energy-efficient products in China. CLASP, together with its implementing partner Lawrence Berkeley National Laboratory (LBNL), has assisted China in developing and updating the above-mentioned standards and labeling programs. Because of the increasing need for the development of a monitoring system to track compliance with standards and labeling, CLASP, with support from Japan's Ministry of Economy, Trade and Industry (METI), has expanded its on-going collaboration with the China National Institute of Standards (CNIS) to include enforcement and monitoring. CNIS has already begun working on the issue of compliance. Since 2005, CNIS has: (1) held a workshop with key stakeholders on enforcement and monitoring roadmap planning; (2) interviewed stakeholders on the need and scope of national compliance tests and a testing infrastructure; (3) conducted research on past enforcement activities; (4) analyzed compliance data from the mandatory energy information labeling program; and (5) developed a roadmap for future activities. In early 2007, LBNL compiled a report (with the support of METI/IEEJ) summarizing the findings from these activities and identified China's progress to date. The report concluded that although the existing legal basis for monitoring and enforcement is sufficient—with multiple laws and regulations defining the responsibility of each government agency and specifying a system of fines and penalties for non-compliance—compared with international best practices, there is still a big gap in China's monitoring and enforcement efforts for mandatory standards and labels. The key gaps identified were:

1. There are no product registration and reporting requirement for MEPS;
2. Although product registration and reporting requirements are in place for the energy information label, as of the end of 2006, they only covered two products (refrigerators and room air conditioners)[2];

[2] In 2007, clothes washers and unitary air conditioners were added to this list.

3. Monitoring and verification of product performance are inadequate, both for the MEPS and the energy information label; in particular, they are limited by sample sizes that are too small to qualify for vigorous monitoring as well as a lack of attention to energy efficiency versus other issues such as health and safety;
4. There is insufficient funding to undertake verification testing for MEPS and the energy information label; and
5. The testing infrastructure in China is relatively weak in comparison with needs.

Concerned about the integrity of the mandatory energy information label and MEPS, CNIS conducted modest sample testing in 2006 for refrigerators, freezers and room air-conditioners. In contrast to the national product quality testing, where samples are taken from manufacturers' warehouses; samples were purchased from retail markets in Beijing, Heifei, and Guangzhou. They were then tested in three national test laboratories in those same three cities. The three testing laboratories were: the National Centre for Quality Supervision and Inspection and Household Appliances (Beijing) (BJS); Guangzhou Electric Testing Institute (GKS); and National Quality Supervision and Inspection Center for Compressor Refrigeration Equipment.

The results were published in mid-2007 (See Appendix A for a copy of the Final Report for the 2006 Study), and showed that while most products met the claimed performance, there were also cases of serious non-compliance.

As a second phase of this effort and with support from METI/IEEJ, CNIS has repeated the same task in 2007 with a similar sample size for three products (refrigerators, freezers, air-conditioners and clothes washers). The findings from this second sample test are reported here. With technical support from CLASP's implementing partner LBNL, the 2007 results are synthesized in this report and, in addition, a comparison of the results from the 2006 and 2007 phase is included in order to identify improvements and continuing gaps in market compliance between the two years.

The 2007 sampling and testing was conducted by CELC and the three national test facilities from October 2007 through February 2008. Preliminary testing results were compiled by the end of November 2007 and distributed to the manufacturing companies for confirmation. Manufacturers with products found to be non-compliant could request re-testing of two additional units if they disagreed with the results. Re-sampling was then done at the same retailer in the same region by CELC and follow-up re-testing was then conducted. Final results were reported to CELC in early February 2008.

While the targeted sample size is far smaller than the mid-term goal of developing a regular check testing program for 20 percent of the market for each product, this research provides highly valuable feedback on compliance rates by manufacturers in the absence of a large-scale national testing program. With this project, CNIS has follow-up feedback on how seriously Chinese appliance manufacturers are taking the mandatory energy labeling program and initial feedback on the extent of gaps in enforcement. These data are particularly important as the information labeling program gains more visibility and expands to additional product categories.

2. Survey Design

China launched a mandatory energy information label program on March 1, 2005. It initially covered two products—refrigerators and room air conditioners—and was expanded to include clothes washers and unitary air conditioners on March 1, 2007. CELC currently has 496 companies registered in the product database. The database records each product's model number by manufacturer and the declared information label category, along with the product's energy consumption as tested by the company and other relevant MEPS requirements, such as water consumption for clothes washers (See Table 1).

Table 1. Registered Enterprises and Type of Products for Energy Information Label

Product Types	No. of companies	No. of product models
Refrigerators	139	5630
Room air-conditioners	82	7852
Clothes Washers	257	3291
Unitary air-conditioners	18	934

In 2006, CELC organized a special sample test for products in the energy efficiency information label program to measure how closely the labeled information matched the actual energy performance of household refrigerators, freezers and room air conditioners in three sample cities—Beijing, Guangzhou and Hefei. Besides being representative of geographic distribution, these three cities were chosen to be test sites for two other primary reasons. First, each city has an active market for household appliances as well as local manufacturers participating in the energy labeling program. Secondly, it was feasible to conduct sample testing in each of these three cities due to easy access to national standards testing laboratories located within each city.

In 2006, the total sample size for all three products (refrigerators, freezers and room air conditioners), was 54 product models.[3] The results revealed that while most products met the claimed performance, there were also cases of serious non-compliance. Overall, based on the 2006 results, it seemed that the implementation of China's appliance energy labeling program has had mixed success. There were relatively high compliance rates in air conditioner product models and in first-tier retailers in Guangzhou and Beijing. However, the significantly lower compliance rates of refrigerators (and ice chests in particular) sold in second-tier retailers in Hefei underscored the existing challenges to implementing energy labels' performance standards and the need for further studies in this area.

[3] The sample size discussed for each year (2006 and 2007) represents the number of models tested. In both cases, the number of individual units tested is actually higher than that due to the re-testing of models that failed to be found compliant the first round of testing. Sample size (N) in both years is equal to the number of models, and not the higher number of individual units tested.

To further improve the market monitoring mechanism of the energy efficiency label, protect consumer rights, and boost the quality of room air conditioners, refrigerators/freezers, and clothes washers, CELC has developed an implementation plan for expanding national verification sampling programs in accordance with the *Management Method of the Energy Efficiency Label*[4]. According to the implementation plan, CELC and the three national test facilities conducted further sampling and testing in 2007 to check product compliance. Figure 3 illustrates the process used in 2007 for sampling and testing.

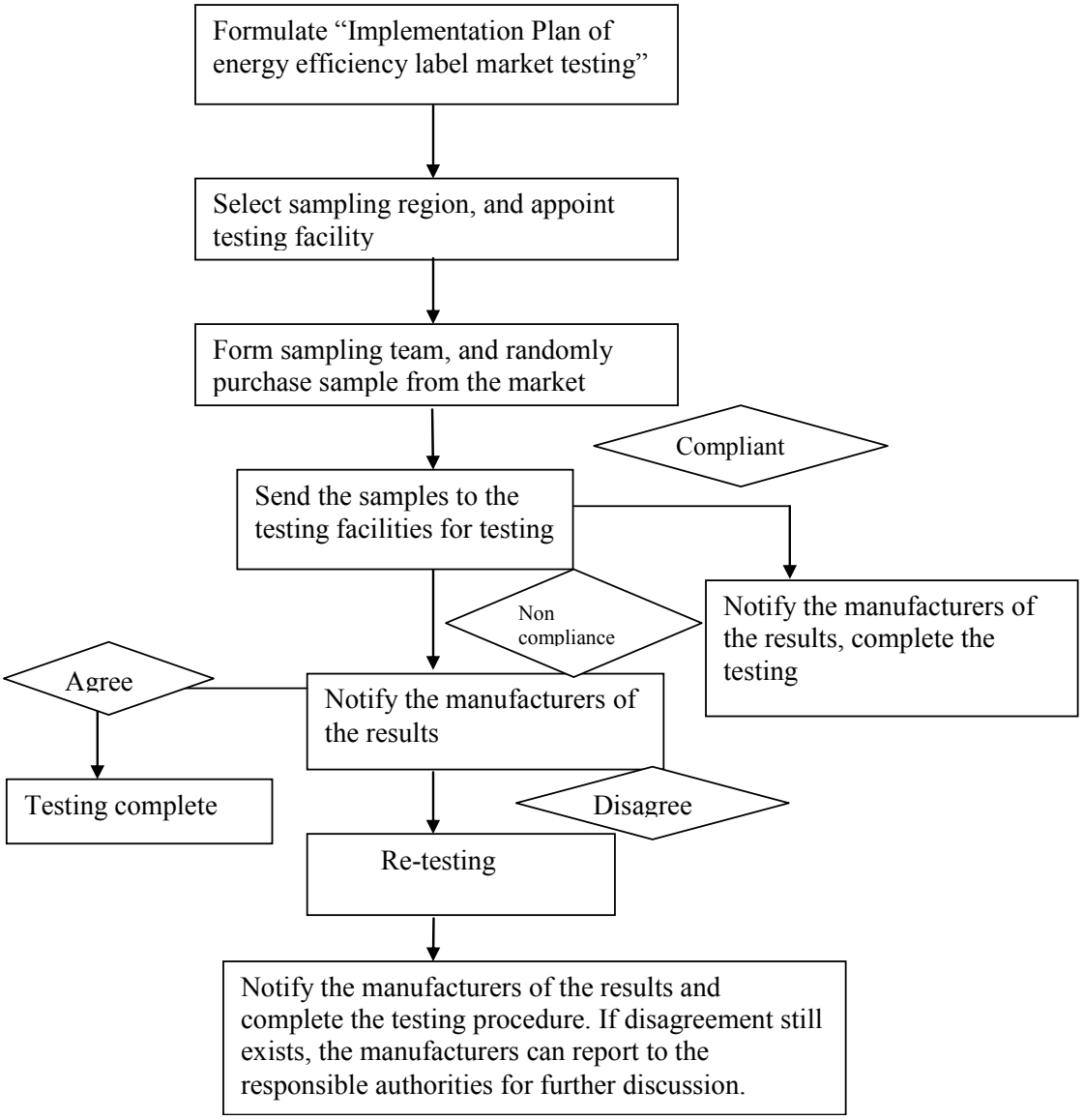


Figure 3. Schematic of the Sampling and Testing Procedure

[4] Available at http://www.energylabel.gov.cn/list.asp?id=356

Preliminary testing results were distributed to the manufacturing companies for confirmation. Manufacturers with products found to be non-compliant could request re-testing of two additional units if they disagreed with the results. Re-sampling was then done at the same retailer in the same region by CELC and re-testing was conducted. Final results were reported to CELC in early February 2008.

2.1 SAMPLING METHODOLOGY

The 2007 sample testing program included: refrigerators/freezers; room air-conditioners; and clothes washers. The methodology and procedures described below were developed for the 2007 testing. The sampling and testing was conducted by CELC and the three national testing facilities from October 2007 to February 2008.

The check-testing activities complied with the following general procedures:

1. CELC developed the sampling plan, identified the products for sampling, and selected locations. The sampling staff consisted of staff at CELC, and they randomly selected and purchased the samples from the market. The testing facility was to send staff to assist with procurement as necessary.
2. The purchase included one unit of each model from selected manufacturers. Details of the purchase, such as the name of the retailer, retail store location, and the product serial number were all registered.
3. The sample products had to be manufactured after March 1, 2006, and be on the list of products selected from the energy information label registry.
4. Products and product grades to be sampled included:

Refrigerators	grade 1
Freezers	grade 5
Room air-conditioner	grade 5
Clothes washer (Impeller)	grade 5
Clothes washer (drum)	grade 1

5. The products purchased for sampling were sent to testing facilities designated by CELC, and tested by the testing facility according to the requirements outlined by CELC. The testing facility submitted a report on the result of the energy efficiency label test in the agreed time period.
6. Sampling locations

Region	Sampling location	Region	Sampling location
□ Beijing	Suning Electric Appliances Co. Ltd	□ Guangzhou	Suning Electric Appliances Co. Ltd
□ Hefei	Suning Electric Appliances Co. Ltd	□ Hefei	Anhui Grand Market

2.2 TESTING METHODOLOGY

2.2.1 Product features to be tested

Prior to testing, the testing laboratory confirmed the product's compliance with label use regulations, including:

- whether the product was labeled in accordance with the provisions;
- whether the label design was in accordance with the requirements; and
- whether the label used was registered in accordance with the provisions.

After compliance with label use regulations was checked, the product was tested in accordance with the relevant testing procedure. The product features that were subject to testing are showed in the following tables:

Room air-conditioners

No.	Product feature	Test Standards
1	Cooling Capacity	GB/T17758-1999 GB/T 7725-2004
2	Cooling Power	GB/T17758-1999 GB/T 7725-2004
3	EER (Energy Efficiency Ratio)	GB 12021.3-2004 and registered energy label

Refrigerators and Freezers

No.	Product feature	Test Standards
1	Electricity Consumption	GB/T8059.1~4-1995
2	Effective Volume	GB/T80591~4-1995
3	EEI (Energy Efficiency Index)	GB 12021.2-2003 and registered energy label

Clothes washers

No.	Product feature	Test Standards
1	Water Consumption	GB/T 4288-2003
2	Electricity Consumption	GB/T 4288-2003
3	Rinse Performance	GB/T 4288-2003
4	Dehydration Performance	GB/T 4288-2003
6	Cleaning Ratio	GB 12021.4-2004 and registered energy label

2.2.2 Testing standards

The product features that were tested as described above derive their definition and specification from the following product and labeling standards:

1. GB/T 7725-2004 *Room Air-conditioner*
2. GT/T 17758-1999 *Unitary Air Conditioner*
3. GB/T 8059.1-4-1995 *Household Cooling Equipment*
4. GB/T 4288-2003 *Household Clothes Washer*
5. GB 12021.3-2004 *The Maximum Allowable Values Of The Energy Consumption And Energy Efficiency Grades For Room Air-Conditioner*
6. GB 12021.2-2003 *The Maximum Allowable Values Of The Energy Consump-*

tion And Energy Efficiency Grades For Household Refrigerators

7. GB 12021.4-2004 *The Maximum Allowable Values Of The Energy Consumption And Energy Efficiency Grades For Clothes Washer*
8. CEL-001-2004 *Household Refrigerator Energy Efficiency Label Implementation Provision*
9. CEL-002-2004 *Room Air-conditioner Energy Efficiency Label Implementation Provision*
10. CEL-003-2005 *Clothes Washer Energy Efficiency Label Implementation Provision*

2.2.3 Sample Testing Criteria

Inspection Criteria
Products that did not have an energy information label, that were improperly labeled, or had a label style that was incorrect, were determined to be non-compliant. Products that had an energy information label on them, but had not registered with an authorized agency, were also found to be non-compliant.

Energy Efficiency Criteria
The energy efficiency criteria presently in effect in China and used in the 2007 study to determine compliance are discussed below by product.

EEI (Energy Efficiency Index) for Refrigerators
China's current national minimum energy performance standard (MEPS) for refrigerators provides standards for: the maximum allowable values of energy consumption; "energy efficiency grades" (threshold values for the information label categories); "energy conservation evaluation values" (energy efficiency specifications for the voluntary endorsement label); energy consumption test methods; and inspection regulations for household refrigerators. China's current (2003) MEPS cover refrigerators with volumes of up to 500 liters. This standard includes required specifications for implementation in 2003, as well as higher efficiency "reach" standards planned for implementation in 2007[5].

The MEPS calculates maximum allowable energy consumption values according to the following formula:

$$E_{\max} = (MV_{adj} + N)/365 \qquad (1)$$

where $E_{\max}$ is the maximum allowable energy consumption (kWh/day), M (kWh/L) and N (kWh) are coefficients (Table 4), and V_{adj} is the adjusted volume in liters.

[5] The 2007 reach standard, (which formally was a part of the 2003 standard) will be superseded by the 2008 standard (which has its own, more stringent 2011 reach standard) and thus was not implemented.

Table 2. Coefficient Values for China Refrigerator 2000 MEPS

Type	Description	*M*	*N*
1	Refrigerator, no-star compartment	0.233	245
2	Refrigerator, 1-star compartment	0.643	191
3	Refrigerator, 2-star compartment	0.450	245
4	Refrigerator, 3-star compartment	0.657	235
5	Refrigerator/Freezer	0.777	303
6	Chest frozen food cooler	0.558	200
7	Chest food freezer	0.597	216
8	Upright frozen food cooler	0.624	223
9	Upright food freezer	0.519	315

The juxtaposition of Tables 2 and 3 illustrates the increase of the stringency of the ratings of refrigerator efficiency between 2000 and 2003. The M and N coefficient values decreased by 10 percent for Type 5 refrigerator/freezers and by 5 percent for all other categories; equations and methodology remained constant between the 2000 and 2003 revisions.

Table 3 Coefficient Values for China Refrigerator 2003 MEPS

Type	Description	*M*	*N*
1	Refrigerator, no-star compartment	0.221	233
2	Refrigerator, 1-star compartment	0.611	181
3	Refrigerator, 2-star compartment	0.428	233
4	Refrigerator, 3-star compartment	0.624	223
5	Refrigerator/Freezer	0.697	272
6	Chest frozen food cooler	0.530	190
7	Chest food freezer	0.567	205

This standard determines energy efficiency grades according to index values calculated with the following formula:

$$\eta = E_t / E_{\max} \quad (2)$$

where: η is the energy efficiency index and E_t represents the tested value of energy consumption (kWh/day).

Table 4. Energy Efficiency Grades for Household Refrigerators

Energy Efficiency Index	Energy-Efficiency Grade
$\eta < 55\%$	1*
$55\% \le \eta < 65\%$	2*
$65\% \le \eta < 80\%$	3
$80\% \le \eta < 90\%$	4
$90\% \le \eta \le 100\%$	5

* denotes “energy-conserving product” category eligible for the voluntary endorsement label..

The China Standards Certification Center certifies energy-efficient products meeting the requirements of grades 1 and 2 and awards endorsement labels. As shown in Table 4, endorsement labels can be awarded for refrigerators that are at least 35 percent more efficient than the minimum standard per category.

EER (Energy Efficiency Ratio) for Air-conditioners

China's national MEPS for air conditioners provides: maximum allowable values of energy consumption; energy efficiency grades (mandatory energy information label category thresholds); evaluation value for energy conservation (voluntary energy efficiency label specifications) energy consumption test methods; and inspection regulations for room air conditioners with a cooling capacity less than or equal to 14,000 Watts. The standard includes UEC (Unit Energy Consumption) values for the 2005 implementation of standards and labels, as well as "reach" values for 2009 implementation.

The former MEPS implemented in 2000 are shown in Table 5 (cooling only) and the 2005 MEPS are shown in Table 6. The 2005 standard, however, reorganized the capacity categories with the main focus being on 2500-4500 W split air conditioners—the most common air conditioners in the Chinese market today. The 2005 MEPS represented only an incremental increase in minimum efficiency of about 6 percent over 2000.

Table 5. Room Air Conditioner 2000 MEPS

Category	**Rated Cooling Capacity (CC) (Watts)**	**Energy Efficiency Ratio (EER) (W/W)**
Single-package	CC ≤4500	2.20
	CC >4500	-
Split unit	CC ≤2500	2.50
	2500<CC≤4500	2.45
	4500<CC≤7100	2.40
	CC >7100	2.30

Table 6. Room Air Conditioner 2005 MEPS

Category	**Rated Cooling Capacity (CC) (Watts)**	**Energy Efficiency Ratio (EER) (W/W)**
Single-package	CC ≤ 14,000	2.30
Split unit	CC ≤ 4,500	2.60
	4,500 <CC≤ 7,100	2.50
	7,100 < CC ≤ 14,000	2.40

On 1 January 2009, the reach standard will go into effect, raising the minimum standard as shown in Table 7. We include this table for information only. It was not a baseline against which products were compared for the 2007 compliance testing.

Table 7. Room Air Conditioner 2009 MEPS

Category	**Rated Cooling Capacity (CC) (Watts)**	**Energy Efficiency Ratio (EER) (W/W)**
Single-package	CC ≤ 14,000	2.90
Split unit	CC ≤ 4,500	3.20
	4,500 <CC≤ 7,100	3.10
	7,100 < CC ≤ 14,000	3.00

A comparison of Table 7 with Table 6 illustrates an overall increased stringency of approximately 25 percent between 2005 and 2009. The reach standard does not specify the energy efficiency grades or the energy efficiency specification to go into effect at that time.

The 2005 MEPS defines the five efficiency grades as shown in Table 8.[6] The grades represent the same percentage bins as defined in Table 4. Room air conditioners that achieve grades 1 and 2 are eligible for energy-efficiency labeling.

[6] Within Japan's 2006 Top Runner Program Revised Edition, the target EER values for the three categories of split-unit air conditioners described in Table 8 are 3.23 (up to 4 kW), 3.23 (4-7 kW), and 2.47 (above 7 kW).

Table 8. Room Air Conditioner 2005 Energy Efficiency Grade Specification

Category	Rated Cooling Capacity (Watts)	Energy Efficiency Grade (EER)				
		5	4	3	2	1
Single-package	CC ≤ 14,000	2.30	2.50	2.70	2.90	3.10
Split unit	CC ≤ 4,500	2.60	2.80	3.00	3.20	3.40
	4,500 <CC≤ 7,100	2.50	2.70	2.90	3.10	3.30
	7,100 < CC ≤ 14,000	2.40	2.60	2.80	3.00	3.20

Energy Efficiency for Clothes Washer

MEPS for Clothes Washers provides: maximum allowable values of energy consumption; energy efficiency grades (thresholds for the mandatory energy information label categories); energy conservation evaluation values (voluntary energy efficiency labeling specifications); maximum allowable values for water consumption; energy consumption test methods; and inspection regulations for clothes washers.

Table 9. Clothes washer MEPS and Energy Efficiency Criteria 2004

Clothes washer Type	Efficiency Level	Unit Energy Consumption (kWh/cycle/kg)	Unit Water Consumption (liters/cycle/kg)
Vertical/Impeller	MEPS	≤0.032	≤36
	Energy Efficient	≤0.017	≤24
Horizontal/Drum	MEPS	≤0.350	≤20
	Energy Efficient	≤0.23	≤14

Table 9 illustrates the energy-water tradeoff between clothes washer types. Vertical, top-loading units are energy efficient, but consume more water. By contrast, horizontal, drum-units are more energy consumptive, but consume less water. Both energy and water are serious conservation topics in China today.[7]

Table 10 provides the details of the five-grade efficiency categories for clothes washers. Those washers meeting grades 1 and 2 meet the voluntary endorsement labeling criteria.

[7] Per-capita water availability in China is among the lowest in the world, and water resources are unevenly distributed. The northern part of the country, for example, contains 63 percent of China's land but possesses only 19 percent of the water resources. Water quality, declining water tables, and insufficient water for agriculture are additional challenges China's face. CSC, which runs China's voluntary energy efficiency labeling program, also runs China's water-efficiency labeling program.

Table 10. China Clothes Washer 2004 Energy Efficiency Grade Specifications

Energy Efficiency Grade	Vertical Clothes Washers		Horizontal Clothes Washers	
	UEC (kWh/cycle/kg)	UWC (L/cycle/kg)	UEC (kWh/cycle/kg)	UWC (L/cycle/kg)
1	≤0.012	≤20	≤0.19	≤12
2	≤0.017	≤24	≤0.23	≤14
3	≤0.022	≤28	≤0.27	≤16
4	≤0.027	≤32	≤0.31	≤18
5	≤0.032	≤36	≤0.35	≤20

Testing Criteria (By Product Type)
The testing criteria presently in effect in China and used in the 2007 study to determine compliance are discussed below by product.

Refrigerators
These products have to meet the following criteria:

1) Measured effective volume should not be smaller than 97 percent of the rated effective volume;
2) Measured electricity consumption of the refrigerators, refrigerator/freezer, frost-free refrigerator, frost-free refrigerator/freezer, frost-free freezer, frost-free frozen food storage cabinet, and frost-free food freezers should be less than 115 percent of the rated power consumption; measured electricity consumption of the freezer should not exceed 110 percent of the rated value;
3) Measured electricity consumption should be less than or equivalent to the maximum allowable value; and
4) EEI from the test result should not exceed the maximum EEI designated by the energy grade level of the refrigerator as noted on the label.

Room Air Conditioners
These products have to meet the following criteria:

1) Measured cooling capacity should not be smaller than 95 percent of the rated value;
2) Measured cooling consumption power should not exceed 110 percent of the rated value;
3) Measured EER should be equivalent to or more than the maximum allowable value; and
4) EER from the test result should be equivalent to or more than the minimum EER requested by the labeled energy efficiency grade level.

Clothes Washers
All technical parameters should not exceed what is claimed on the energy label.

2.3 RE-SAMPLING

CELC notified manufacturers of the test results. Manufacturers with products found to be non-compliant could request re-testing of two additional units within five days if they disagreed with the results. The manufacturer were required to pay RMB¥20,000 (about JPY¥297,000) for sample acquisition and testing costs. Re-sampling had to be from the same retailer in the same region, by the staff of CELC. Two units of the product were to be randomly selected for each model. The testing facility was to send staff to assist if necessary. Both of the products selected had to meet the specified criteria or else the manufacturer was determined to be non-compliant.

The test results on non-compliant products were to be reported to, and confirmed with, the manufacturer. A "rectification notice" was to be issued to the company according to the *Management Method of the Energy Efficiency Label*. The notice was to specify what rectifications are necessary along with the associated deadlines for completing the work. CELC was to then follow up after the deadline to ensure compliance. The products identified for follow-up testing could be purchased from the market randomly, taken from the product line or from the warehouse. The company was to bear the cost of sampling and testing. CELC had the right to suspend the registration of the energy label to any manufacturer that could not complete the rectification or whose products still failed to meet the relevant requirements. For serious violations, CELC would not have approved the testing report of the energy-labeled product provided by the company and third-party testing of the product would have been required with a report to CELC. For enterprises that are members of the Energy Labeling Enterprise Credibility Alliance[8], a written notice was to be released, and their membership would have been suspended if the above issues could not be solved after two consecutive years. At the same time, the names of those enterprises not completing the rectification work within specified deadlines would be shared with the local quality supervision departments at all levels to ensure the resolution of issues arising from the testing. Non-compliant companies were to be sampled and tested intensively in the following energy label testing year.

3. Analysis of Test Results

The 2007 spot-checking inspection of household refrigerators/freezers, room air conditioners and clothes washers participating in the China Energy Label Program was conducted from October 2007 to January 2008. The sampling for this study was initiated on October 29, 2007 and consists of products from the three testing cities of Beijing, Guang-

[8] CELC established the Energy Efficiency Labeling Enterprise Credibility Alliance (EELECA) in August 28, 2006 for better implementation of the energy efficiency labeling program. It is a self-disciplined organization, with currently 16 refrigerator and air conditioner manufacturing companies registered. The alliance is devoted to establishing a mechanism for the ensuring the credibility of energy information label, and creating an information exchange platform on the application of energy-saving technologies. The membership will be extended to cover other products as the labeling program scope expends. Currently, the chairman is from Qingdao Haier Group, and the vice chairmen are from Zhuhai Geli, Guangdong Meide, Guangdong Kelong and Henan Xinfei .

zhou and Hefei. Table 11 shows, at-a-glance, the products tested by region and type in the 2007 study.[9]

Table 11. Tested Product Samples by Region and Type

	Beijing	Guangzhou	Hefei	Total
Refrigerator	5	18	N/A	23
Freezer	N/A	7	N/A	7
Air Conditioner	5	N/A	17	22
Clothes washer	18	3	N/A	21
Total	28	28	17	73

The 2007 spot-check inspection tests were conducted in two phases in the three different cities. Prior to the second phase of testing, the seven manufacturers whose product sample models failed the spot-check inspection test were notified in December 2007. By January 2008, six of the seven manufacturers had submitted two additional samples per non-compliant product model for re-testing. Phase two of the 2007 testing was then conducted in early February 2008.

3.1 FINDINGS OF 2007 TEST

3.1.1 Compliance Rates by Product Type

As illustrated in Figure 4, varying compliance rates were observed across product types in the 2007 initial testing (i.e., before re-testing). Freezers had the lowest compliance rate. Air conditioners, refrigerators and clothes washers generally had high compliance rates. Specifically, before re-testing:

- For air conditioners, two out of the 22 models tested were found to be out of compliance and 20 models were in compliance, giving an overall rate of 91 percent.
    - The two non-compliant air conditioner sample models were collected and tested in Hefei with all the air conditioner models collected in Beijing found to be in compliance. Air conditioners were not tested in Guangzhou.

- For clothes washers, two out of 21 models tested were out of compliance and 19 were in compliance, giving an overall compliance rate of 90 percent.
    - Clothes washers were not tested in Heifei. The two non-compliant clothes washers were one each from Beijing and Guangzhou.

[9] The sample size discussed for each year (2006 and 2007) represents the number of models tested. In both cases, the number of individual units tested is actually higher than that due to the re-testing of models that failed to be found compliant the first round of testing. Sample size (N) in both years is equal to the number of models, and not the higher number of individual units tested.

- In Beijing, however, the sample sizes were much larger. Beijing had 17 of 18 clothes washer models in compliance while in Guangzhou, two of a total of three were in compliance. The fact that sample size was so much smaller in Guangzhou, but still a non-compliant model was found, might suggest lower overall compliance than in Beijing.

- For refrigerators, three out of the 23 models tested were out of compliance and 20 models were in compliance, giving an overall compliance rate of 87 percent.
    - Specifically, five out of five refrigerator models tested in Beijing were in compliance while three out of the 18 models tested in Guangzhou were out of compliance. Refrigerators were not tested in Heifei.

- For freezers, two out of seven models tested were out of compliance and five models were in compliance, giving an overall compliance rate of 71 percent.
    - Freezers were only tested in Guangzhou.

.

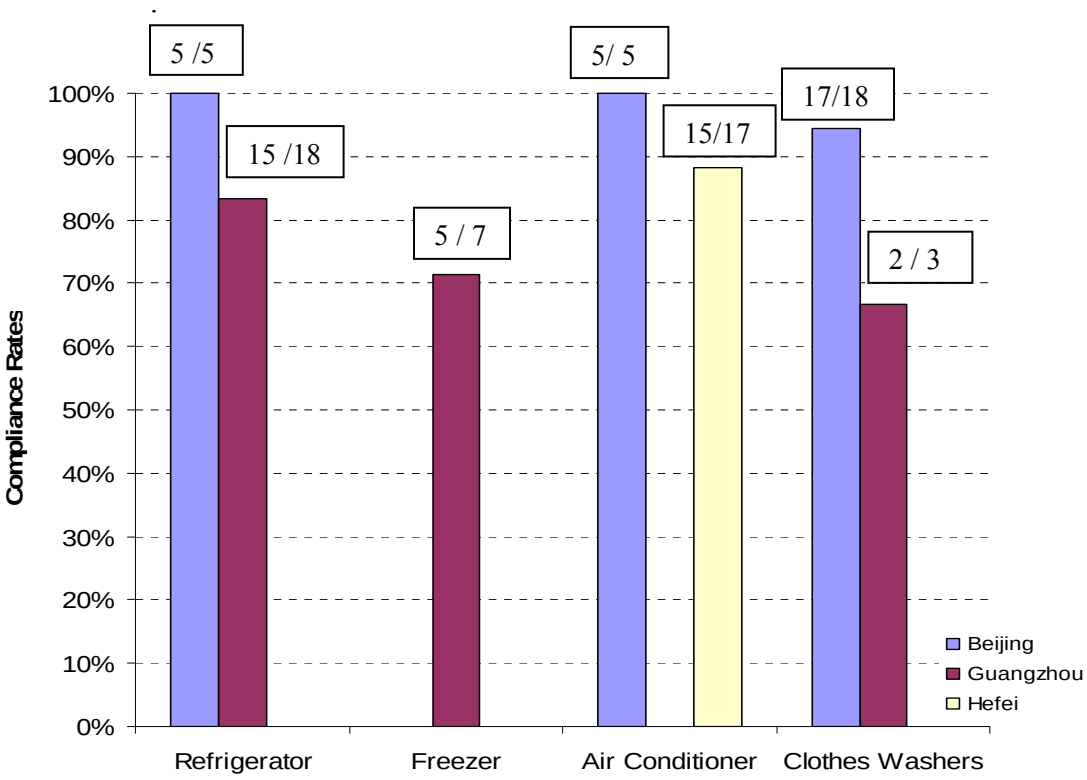


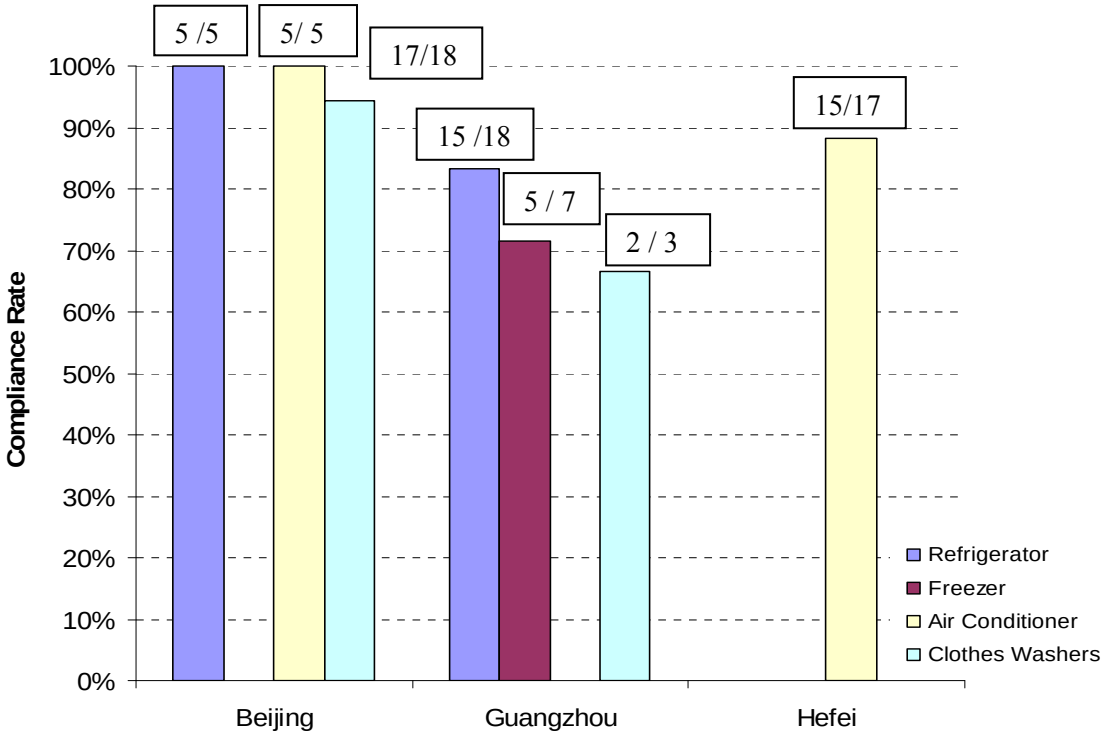
Figure 4. 2007 Testing Compliance Rates by Product Type in Initial Testing

After the 2007 re-testing, the out-of-compliance products included:

- Two clothes washer models (1 each from Beijing and Guangzhou);
- One refrigerator model from Guangzhou;
- Zero air conditioners; and
- Zero freezers.

3.1.2 Compliance rates by region

In terms of the geographic distribution of the 2007 testing results before re-testing, Beijing had higher compliance rates for each type of product than Guangzhou and Hefei (Figure 5). Of the three cities, Guangzhou had the lowest compliance rates for refrigerators and clothes washers (and in the case of clothes washer this is true despite the small sample size that as noted above could hint at a more significant problem) as well as a relatively low compliance rate for its freezer sample.



Total = 73 models

Figure 5. Testing Compliance Rates by Region in Initial Testing

After the 2007 re-testing, the out-of-compliance products included:

- Two products from Guangzhou (one refrigerator and one clothes washer);
- One product from Beijing (a refrigerator) ; and
- Zero products from Heifei.

3.1.3 Compliance Rates by Grade

The 2007 spot-check inspection testing revealed interesting results in terms of the compliance rates by rated-grade of the product models tested. As seen in Table 12 below, the

three final out-of-compliance product models were distributed across grades and, thus, do not reflect higher non-compliance rates for less-efficient products. On the contrary, rated grades 1 and 2 actually had two out of the three out-of-compliance product models while grades 3 and 4 had none. Therefore, as seen in Figure 6, product models with rated grades of 3 and 4 had the highest compliance rates of 100 percent, followed by grades 1, 5 and 2 respectively.

Table 12. Compliance and Out-of-Compliance Distribution by Grade

Rated Grade	Total Sample	In Compli-ance	Out of Compli-ance
1	31	30	1
2	10	9	1
3	10	10	0
4	8	8	0
5	14	13	1

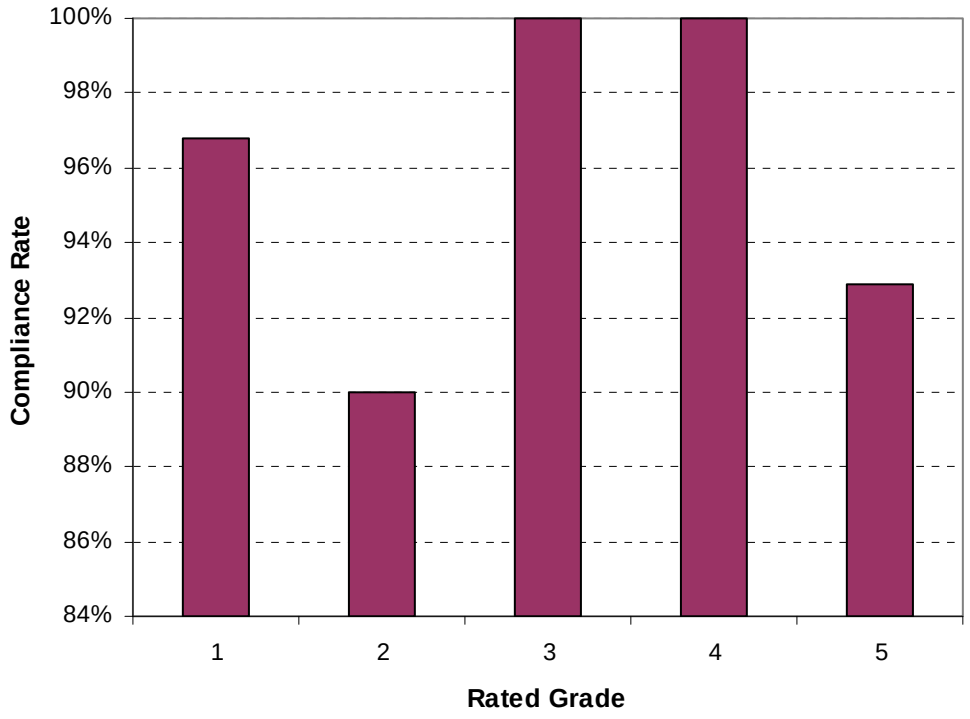


Figure 6. Compliance Rates by Grade

3.1.4 Distribution of Tested Energy Efficiency

In the 2007 testing, the energy efficiency performance of each product model was tested and measured against its rated performance. To measure the energy efficiency performance of a product model, an energy efficiency index (EEI) was used for refrigerators, an

energy efficiency ratio (EER) for air conditioners and energy consumption in terms of kWh per cycle for washing machines. By comparing the rates against the actual performance for all of the product models, observations can be made about the fit of actual energy efficiency compares to the products' rated performance.

Figure 7 to Figure 10 show the rates of conformity of the tested energy efficiency levels to the rated values for the four products. Overall, the results show that the actual energy efficiency of most products is in compliance with the product's claimed energy efficiency, and no systematic variation is observed in deviations between ratings and actual-performance. There is a slight tendency to over-rate product energy efficiency; however the difference is not significant. Among the different products, refrigerators show slightly greater over-rating with an average deviation of 3.3 percent.

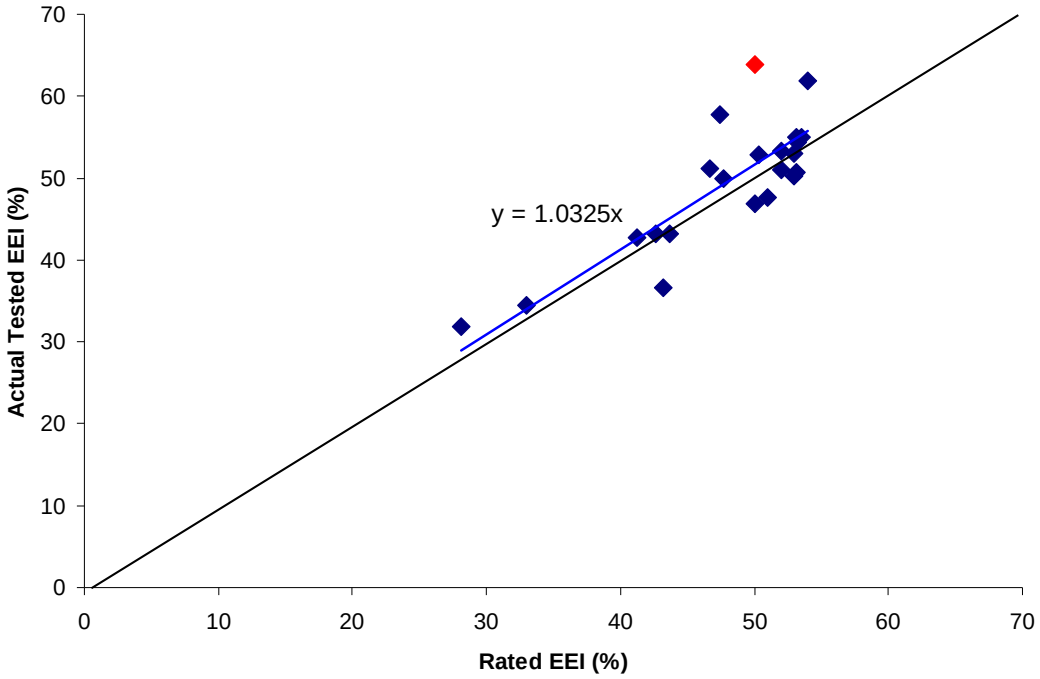


Figure 7. Rated vs. Actual Energy Efficiency Index of Refrigerators[10]

[10] Red square represents the non-compliant product.

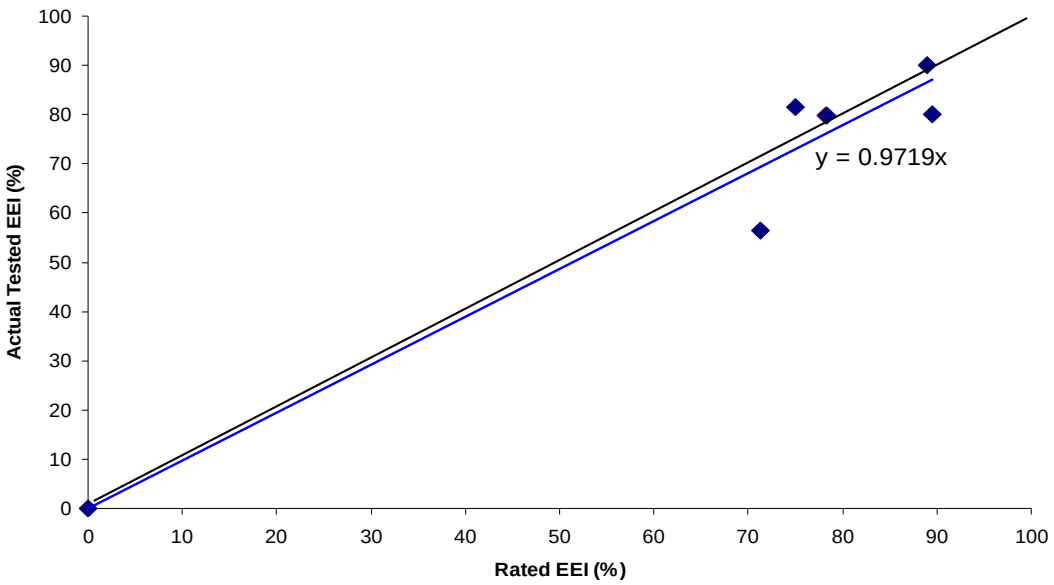


Figure 8. Rated vs. Actual Energy Efficiency Index of Freezers

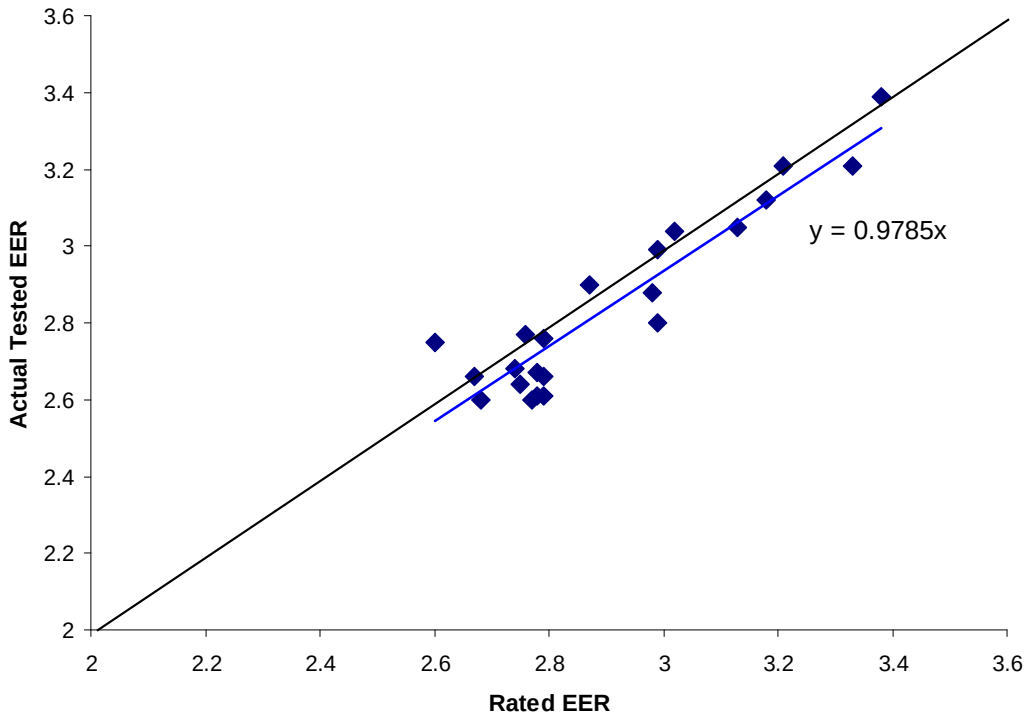


Figure 9. vs. Actual Energy Efficiency Index of Air-conditioners

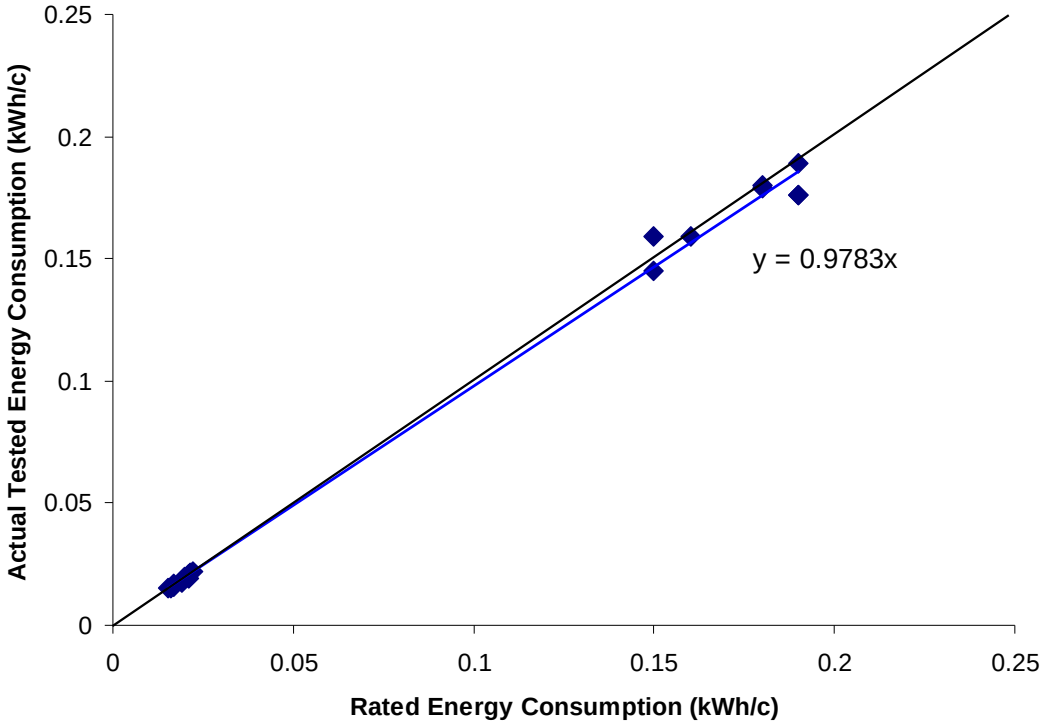


Figure 10. Rated vs. Actual Energy Efficiency Index of Clothes Washers

3.1.5 Distribution of the Sampled Product Grade

The distribution of the grades of sampled products can indicate whether the sample selection is objective and comprehensive. Figure 11 to Figure 14 present the distribution of the sampled products by type. Refrigerators were all selected from grade 1, freezers were from grades 3, 4, and 5, and sample for air-conditioners and clothes washers were more widely distributed but lacked a focus on some particular grades. Overall, selection of testing samples seems to have been biased towards certain grades. In order to make the testing more meaningful, in the future the selection process for test products should attempt to target a wider variety of products according to the actual market distribution.

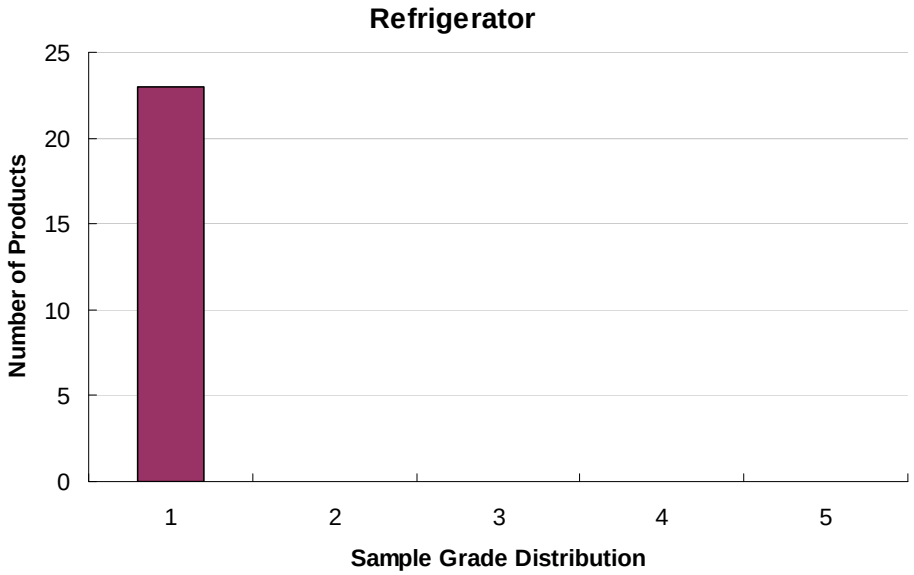


Figure 11. The Distribution of the Sampled Refrigerators by Grade

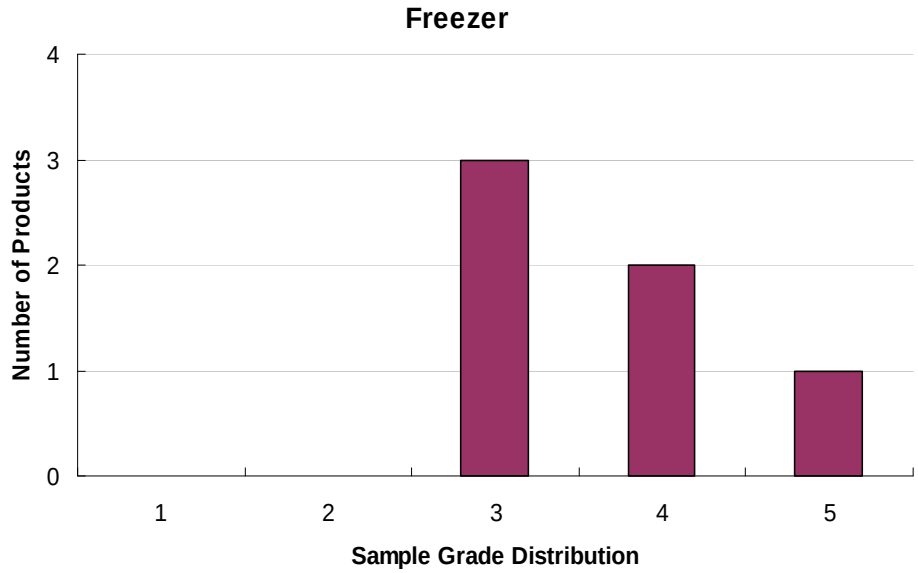


Figure 12. The Distribution of the Sampled Freezers by Grade

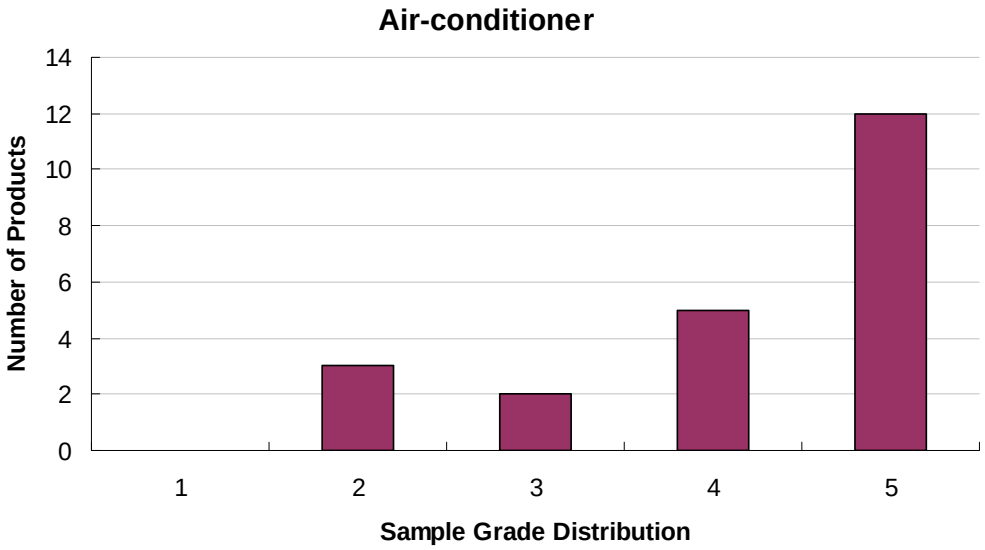


Figure 13. The Distribution of the Sampled Air-conditioner by Grade

Figure 14. The Distribution of the Sampled Clothes Washer by Grade

3.1.6 Other Findings

The report also noted that testing results can vary significantly when tested in different laboratories. In the second phase of testing, five of the six product models retested were found to be in compliance with its label's energy consumption standards. Only one manufacturer remains out of compliance for its refrigerator model sample after retesting. This brings into the question of consistency and accuracy of the testing. Improving the consistency of test results between test laboratories is a critical and necessary step in setting up a comprehensive national testing program. Variability and inconsistency were found in tests among different labs. Some products that failed the first testing passed re-testing at

the same facility or at a different facility. It is not clear whether there is inaccuracy in the equipment used or variability in the procedures followed in conducting the test. This can be improved through capacity building among the labs to enhance replicability of results. It could also be improved by utilization of a round-robin testing scheme.

Lastly, the three model samples found in the end to be out of compliance came from three different manufacturers, which represent 6.8 percent of the 48 surveyed manufacturers.

3.2 COMPARISON WITH 2006 TEST[11]

Overall, the number of registered manufacturers and products in the CELC database has increased from 2006 to 2007 quite significantly. This is not just from the addition of new products being addressed by labeling. For example, by the end of October 2007:

- 139 manufacturers were registered for a total of 5630 models of refrigerators, an increase of 2530 models over 2006;
- 83 manufactures are registered for a total of 7852 models of room air-conditioners, compared with 68 manufactures and 4123 models in 2006.

The number of products sampled and check-tested also increased to 73 products in 2007 from 54 products in 2006.

3.2.1 Increased Overall Compliance with Energy Standards

When compared with the 2006 spot-check inspection testing, the 2007 testing indicated significant improvements in compliance across product type and across regions. The importance of higher overall compliance rates for each product type and in each city is validated by an increase in testing sample size from 54 models in 2006 to 73 models in 2007.

The overall compliance rate for the three previously tested product types, namely air conditioners, refrigerators and freezers, greatly improved from 2006 to 2007. This was demonstrated through both a notable decrease in non-compliant product models (from 11 non-compliant models in 2006 to only 3 models in 2007 after re-testing) and through trends in overall compliance rates for each product type. For example, the compliance rates for air conditioners increased from 91 percent in 2006 to 100 percent in 2007, with especially remarkable improvement in the Hefei market. Similarly, the overall compliance rates for refrigerators improved from 81 percent to 96 percent with a corresponding reduction from four non-compliant models to only one non-compliant model. The increased compliance rate can be partly attributed to improvements in the Beijing market, with a similar 15-percentage point increase in compliance rates. The improvement in the compliance of freezers is even more noteworthy as the compliance rate nearly doubled from 55 percent to 100 percent, and a decrease in non-compliant models from five to ze-

[11] This section compares the results of the testing in 2006 and 2007, and a separate report summarizing the 2006 testing is included in the Appendix A.

ro. It should be noted, however, that the 2007 testing of freezers includes samples from Guangzhou but not Hefei, which had a very low compliance rate in 2006. Thus, it is possible that the overall rate of compliance would have been lower if Heifei were again included.

On the regional level, there have generally been improvements in appliance compliance levels compared with 2006 test results. In particular, Beijing not only achieved higher compliance rates for its refrigerators, but also had 100 percent compliance in its air conditioners and 94 percent compliance in clothes washers. Similarly, Hefei witnessed increased compliance for its air conditioners compared with 2006. In Guangzhou, the change in appliance compliance levels is a little more ambiguous. While Guangzhou was able to retain its 100 percent compliance rate from 2006 for freezers with a larger sample in 2007. New sample testing of refrigerator and clothes washer models yielded relatively low compliance results.

Detailed comparison of 2006 and 2007 testing results are shown in Tables 13 & 14 below.

Table 13. 2006 – 2007 Comparison of Compliance Rates by Product Type and City

	Beijing		Guangzhou		Hefei		Overall	
	2006	2007	2006	2007	2006	2007	2006	2007
Refrigerator	85.71%	100.00%	N/A	83.33%	71.43%	N/A	80.95%	95.65%
Freezer	N/A	N/A	100.00%	100.00%	50.00%	N/A	54.55%	100.00%
Air Conditioner	N/A	100.00%	93.75%	N/A	83.33%	100.00%	90.91%	100.00%
Clothes washer	N/A	94.44%	N/A	66.67%	N/A	N/A	N/A	90.48%

Note: Highlighting shows direct changes in compliance rates within a city, N/A indicates no testing of that product type.

Table 14. 2006 – 2007 Comparison of Number of Non-compliance Models

	Beijing		Guangzhou		Hefei		Overall	
	2006	2007	2006	2007	2006	2007	2006	2007
Refrigerator	2	0	N/A	1	2	N/A	4	1
Freezer	N/A	N/A	0	0	5	N/A	5	0
Air Conditioner	N/A	N/A	1	N/A	1	0	2	0
Clothes washer	N/A	1	N/A	1	N/A	N/A	N/A	2

Note: Highlighting shows direct changes in testing results within a city, N/A indicates no testing of that product type.

3.2.2 Compliance Changes in Energy Performance Ratings

In contrast to 2006, the three non-compliant models for 2007 had relatively high actual energy ratings. These three models all had energy ratings of 1 or 2, whereas more than half of the 2006 non-compliance product models had the lowest energy rating of 5 or worse. In fact, all of the appliances with low energy ratings of 4 or 5 were able to meet their energy performance requirements in either the initial testing or re-testing in 2007. Thus, compared to 2006, the recent absence in the market of non-compliant appliances

that could not meet the minimum energy-savings standards (Grade 5) is a significant achievement.

3.2.3 Reduced Performance Variations between Appliance Markets

While the 2006 test results illustrated variations in performance and compliance rates between product models sold in high-end, first-tier appliance retailers and those sold in second- and third-tier retailers, this has not been demonstrated in the 2007 test results. In contrast to higher compliance rates for refrigerators and air conditioners for first-tier retailers in 2006, all three of the 2007 non-compliance models were actually from first-tier retailers. More specifically, the non-compliant refrigerator and one of the clothes washer models were sold by Guangzhou Suning Appliance Co. Ltd. while the other clothes washer model was sold by Beijing Suning Appliance Co. Ltd. Therefore, a correlation between performance, compliance and retailer is not evident in 2007. At the same time, however, all but two of the 73 samples were taken from Suning Appliance retailers in the three cities so there was inherently less variation in retailer type in the 2007 test sample. Thus, it is not clear that this actually signifies an improvement in the compliance of lower-tier retailers as the 2007 sample strategy was not a good test of this issue.

4. Conclusions

With the support of METI and CLASP, and the technical assistance of LBNL, CELC has been able to initiate the first household appliance check-testing program ever to be implemented in China. The goal of this check-testing was to measure how well the actual information matches the claimed energy performance for refrigerators, room air conditioners and clothes washers in three cities across China. The results showed that while most products meet the claimed performance levels, there are also cases of non-compliance. Perhaps more importantly, however, improvement can be seen when comparing the two years of testing. Specifically, the number of non-compliant product models decreased from 11 out of 54 in 2006, to only three out of 73 models in 2007. The positive change may be attributable to greater awareness of compliance enforcement after the 2006 round of testing. However whether it is the elements in the enforcement plan and regime that induced a change in behavior, or is it simply the existence of this check-testing program that provoked changes remains unclear, further investigation and continuous testing effort is needed in order to observe a systematic trend.

Importantly, compliance rates increased for all products where testing was done in both 2006 and 2007. Though the products tested were not the same in all cases, both Beijing and Heifei achieved higher levels of compliance in 2007 than they did in 2006. For example, Beijing not only achieved higher compliance rates for its refrigerator testing (100 percent in 07 instead of 86 percent in 06), but also had 100 percent compliance in its air-conditioners and 94 percent in clothes washers (neither of which were tested in Beijing in 2006). The results for Guangzhou were more mixed. As in 2006, the compliance rate

was 100 percent for freezers but the rates for clothes washers and refrigerators were the two lowest of any tested in 2007.

In addition, the 2007 testing showed that the actual energy efficiency of most products is in compliance with the claimed energy efficiency, and no systematic variation is observed in deviations between ratings and actual-performance. There is a slight tendency to over-rate energy efficiency; however the difference is not significant.

However, limitations exist in the current testing effort. The sample selection in this study was relatively small. First, sample testing was conducted only in the markets of three top-tier cities: Beijing, Guangzhou and Hefei, and was largely from top-tier retailers. The product model samples tested were representative of only 1 percent of the total product model size, and are not representative of the whole country and the whole market. This is especially true for smaller manufacturers who have fewer models on the market and often sell to smaller cities or rural areas. In addition, product models change quickly, so it is almost impossible to find and then test samples from these smaller producers. This study's test sample included models from 48 different manufacturers, out of a total of more than 200 manufacturers of household refrigerators and air conditioners in China. Many of these 200 manufacturers are small enterprises with low production volume.[12] In future studies, more testing of products from these smaller manufacturers is necessary as this study has highlighted the variation of the performance and compliance of products from second-tier retailers and lower grade in 2006 and 2007 testing effort.

Second, distribution of the grade (i.e., the label ratings 1 to 5) of the sample models also differs greatly. Overall, the selection of testing samples was biased towards certain grades. In order to make the testing more meaningful and the analysis more robust, in the future the selection process for test products should attempt to target a wider variety of products from across the whole market. Similarly, the vast majority of the samples (69 out of 73 overall) were taken from a single retail chain, leaving a question as to whether or not the findings are relevant with appliance retailers overall. Also, some of the limitations could have been avoided with a better sample collection strategy. In order to make the testing more meaningful and the analysis more robust, in the future the selection process should collect samples from multiple retailers. It would also be worthwhile to include a strong selection of lower-tier retailers to determine if compliance among these shops has improved over the 2006 findings.

In addition, the results of both years suggest that the testing results can vary significantly when products are tested in different laboratories. Improving the consistency of test results between test laboratories is a critical and necessary step in setting up a comprehensive national testing program. This can be achieved through a round-robin test scheme and capacity-building activities

[12] Although the names of the manufacturers of sampled product models are not included in this paper, information on the name and type of manufacturer was collected by the Chinese co-authors. This recommendation on further studies focusing on smaller enterprises is based on their analysis.

Further, consolidation of the industry may help to downsize the number of manufacturers and models that need to be tested and monitored.

Nevertheless, spot-testing has the meaningful impact of forcing manufacturers to ensure compliance, as the improvement between 2006 and 2007 compliance rates demonstrates. The experience of this first round of testing could be quite helpful in developing a full-scale national verification testing program. With METI support, CLASP could assist CELC to expand the verification testing program to cover more models and products as well as to develop a plan for ramping up national verification testing over the next three to five years. CLASP could also assist CELC in planning a round-robin testing scheme, first among the three national laboratories, and subsequently expanding this program to other regional test laboratories, with the goal of improving the consistency of testing results from different testing laboratories. CLASP could also facilitate the involvement of leading international test laboratories in this exercise. CELC could then develop training workshops after the round-robin tests to enhance the capacity of regional test laboratories.

Appendix A Analysis of 2006 Testing Results

I. Introduction

This section of the report summarizes the results in 2006 testing. It examines the first spot-check inspections of the performance of household refrigerators and air conditioners, and the implications of the testing results for evaluating the implementation of China's energy labeling program. First, an introduction of the energy labeling program and the purpose and significance of the inspection and sample testing is presented. Next, an overview of the testing methodology and the specific sampling plan is given. The analysis of test results is followed by a discussion of important factors observed in the results, including trends in compliance rates, energy-savings ratings and performance variations between appliance markets. Finally, the conclusions contextualize key findings in the implementation of the energy labeling program and highlight areas of improvements for future spot-check inspection testing.

On March 1, 2005, China initiated an energy labeling program to increase consumer awareness and standardize the performance of energy efficient models of household refrigerators and air conditioners. As two widely-used household appliances in China, refrigerators and air conditioners have a very high potential for energy conservation applications. In particular, a standardized and effective labeling program can serve as an important source of consumer information on the most energy efficient appliance models. By August 2006, participants in the energy labeling program included168 enterprises (97 refrigerator manufacturers and 71 air conditioner manufacturers), and over five thousand product models. For participating products, the China energy label will provide information on the product's manufacturer and model number, its energy efficiency level and energy consumption, and the national energy performance rating for that type of appliance.[13] Specifically, the energy performance ratings range from 1 to 5, with 1 being the most energy-efficient and 5 being the least energy-efficient.

In 2006, inspections and spot-checking of the energy efficiency of participating products was initiated in collaboration with the Chinese Standardization Research Institute to help strengthen the implementation of the energy labeling program. This study performed spot-check inspections of household refrigerators and air conditioners with energy labels from three sample cities—Beijing, Guangzhou and Hefei. The total sample size was 54 product models. By spot-checking each product model's stated energy efficiency ratings with actual performance results, the study helps evaluate the implementation of, and product compliance with, the energy labeling program. This initiative is particularly noteworthy as one of the first efforts to strengthen the enforcement of energy conservation regulations and to address weaknesses and challenges in the implementation of the energy labeling program. Moreover, these quality testing inspections were also intended to help enhance the product quality and competitiveness of energy-efficient refrigerators and air conditioners.

---

[13] Chinese National Institute of Standardization, "**Regulation on Energy-Efficiency Labeling Administration**", 2005, Available at: http://energylabel.gov.cn/list.asp?id=397

II. Methodology

II.1 Sampling Plan

The spot-check inspection study of household refrigerators and air conditioners participating in the China Energy Labeling Program is supported by the Chinese Standardization Research Institute. The study was conducted from September 2006 to January 2007.

The study's sample testing was conducted in three major cities, Beijing in northern China, Guangzhou of southern Guangdong Province and Hefei of central Anhui Province. Besides being representative of geographic distribution, these three cities were chosen to be test sites for two other primary reasons. Firstly, each city has an active market for household appliances as well as local manufacturers participating in the energy labeling program. Secondly, it was feasible to conduct sample testing in each of these three cities due to easy access to national standards testing laboratories located within each city.

The study's total sample size was 54 different household refrigerator and air conditioner product models from the three chosen cities. This included 14 product models from Beijing, 17 product models from Guangzhou and 23 product models from Hefei. Within these 54 product models, 22 models are for household air conditioners and 32 are for household refrigerators.[14] The relatively small sample size of approximately 1 percent of total product models in the energy labeling program was due to budget constraints for this first spot-check inspection effort.

The spot-check inspection tests were conducted in two phases. The first phase of the study consisted of the testing of all 54 product models in the three cities. The second phase of the study consisted of retesting product model samples from 12 companies that were found to be out of compliance with energy label standards in the first phase of testing. For data analysis purposes, data results from the two phases are aggregated.

III. Analysis of Test Results

III.1 Overall Compliance with Energy Label Standards

Based on the two phases of spot-check inspection tests, different compliance rates for refrigerators and air conditioners are observed in each city.

---

[14] The study makes a slight differentiation between household refrigerators and household ice chests, but because of similar testing procedures and standards, both are considered as refrigerators in the results summary.

First, the overall results for the 32 refrigerator product models tested were 23 in compliance and nine not in compliance with energy label standards. More specifically, in Beijing, two refrigerator product models were found to be non-compliant with energy label standards, out of 12 sample models. In Guangzhou, the one refrigerator product model tested was in compliance with energy label standards. In Hefei, seven out of 19 refrigerator product models tested were found to be non-compliant.

Second, the overall results for the 22 air conditioner product models tested showed that 20 models were in compliance and two were not in compliance with energy label standards. Sample testing for air conditioners was conducted only in Guangzhou and Hefei. In Guangzhou, one out of a total of 16 models tested was not in compliance while in Hefei, one out of a total six models tested were not in compliance with energy standards.

The figure below shows the compliance rates of refrigerators and air conditioners by region.

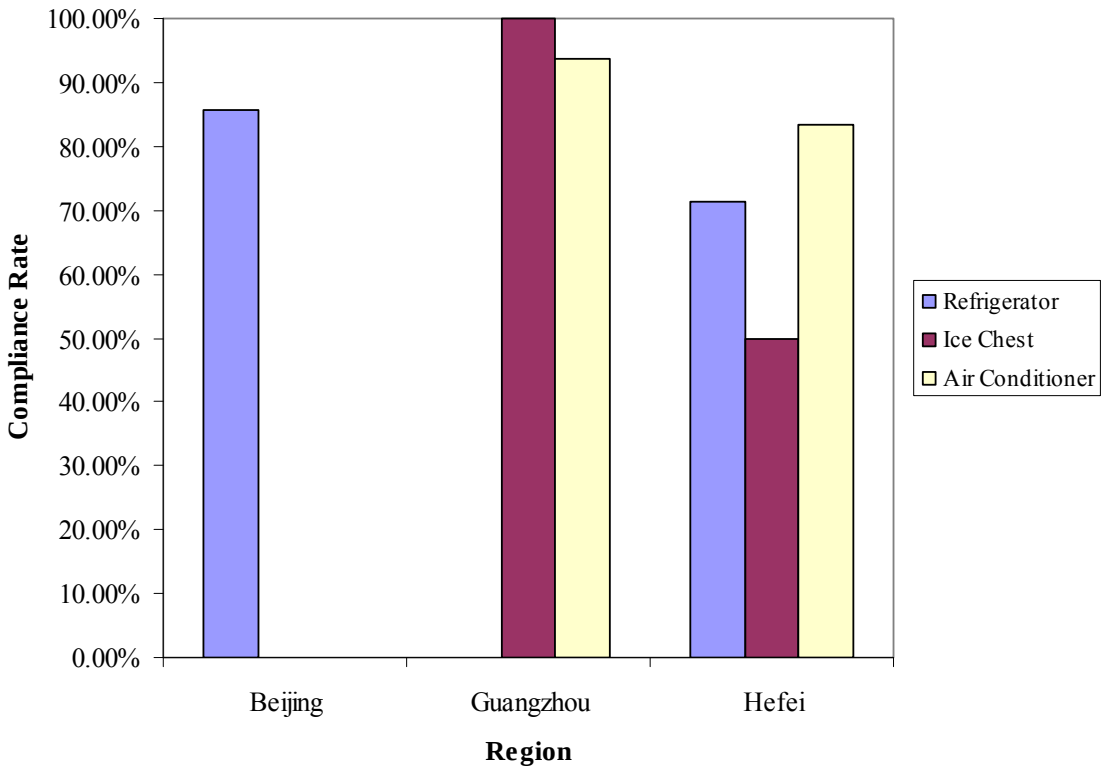


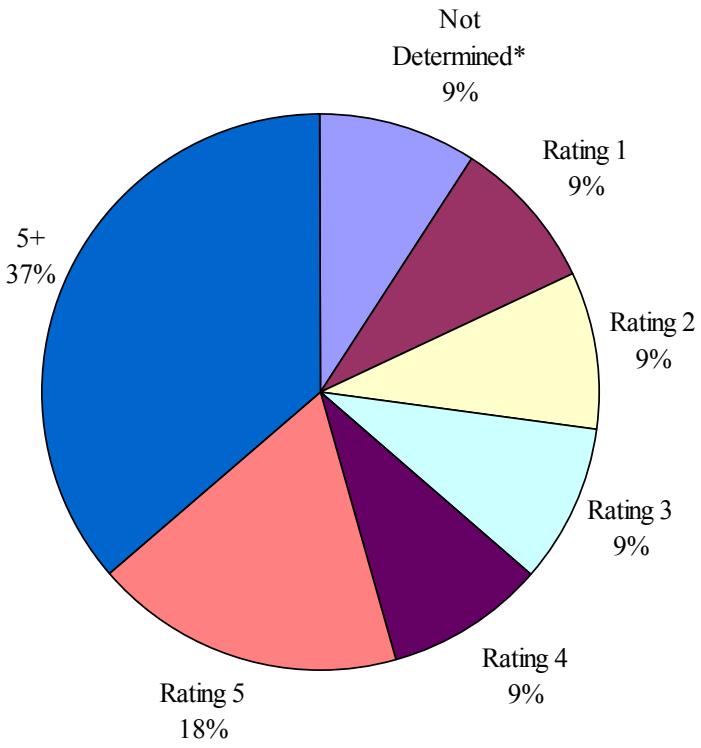
Figure A- 1 Appliances Energy Label Compliance Rates by Region

III.2 Energy Performance Ratings

Through the spot-check inspection tests, nine out of the 11 product models found to be not compliant with energy label standards had actual energy performance ratings that were below the stated ratings. This included eight refrigerator product models and one air

conditioner product model. In some cases, the actual energy performance ratings were one step below the stated rating on the energy label. In other cases though, there were greater differences between the actual and stated energy performance ratings. For example, refrigerator product model BD/BD-191H had a stated rating of 3 but the actual rating determined by the testing was a 5.

Under national regulations, appliances that fail to meet the minimum energy performance rating of 5 are not allowed to enter the market. The inspection testing, however, found that of the 11 product models that did not meet the standards for their energy-savings ratings, four also failed to meet the minimum energy-savings standards of a rating of 5. This included three refrigerator product models (BD/BC-190, BD/BC-183, BD/C-190) and 1 air conditioner product model (KF-36GW/A31AA). These four product models represent 36 percent of the non-compliant product models and 9 percent of the total product model sample.



Total: 11 Models

*Note: * = actual rating not determined for this model because it failed to meet the capacity and electricity consumption standards.*

Figure A- 2 Proportion of Non-Compliance Product Models by Actual Energy Performance Rating

III.3 Performance Variations between Appliance Markets

The spot-check inspection test results show notable variations in performance and compliance rates between product models sold in different appliance markets. In particular, the test results show different performance between product models sold in high-end, first-tier appliance retailers like Suning Appliance Co. Ltd. and those sold in second- and third-tier retailers like the Anhui Market. While Suning Appliance Co. Ltd. is a national appliance retailer that carries products manufactured by major appliance chains, Anhui Market is a local second-tier retailer that carries products from different manufacturers at lower prices. As a result, different product performance and quality can be expected between Suning Appliance Co. and Anhui Market.

Of the 40 household refrigerator and air conditioner product models sold in first-tier Suning appliance retailer in all three cities, six models were found to be not in compliance with label standards. The first-tier retailer product compliance rate of 85 percent is higher than that of second-tier retail markets like the Anhui Market, with six out of 14 product models not in compliance there and a compliance rate of 57.1 percent. The performance variation in markets is particularly apparent in tests on the performance of refrigerators, as models sold in Hefei's second-tier retailer had the lowest compliance rate of the three regions.

Table A- 1 Appliance Compliance Rates by Type of Retailer

	1st-Tier Retailers		2nd-Tier Retailers	
	Refrigerator	**Air Conditioner**	**Refrigerator**	**Air Conditioner**
Compliance	16	18	6	1
Non-Compliance	4	2	6	1*
Total Units	20	20	12	2
Compliance Rate	80.00%	90.00%	50.00%	50.00%

*Note: 1 of the 2 air conditioner sample models tested for 2nd-tier retailer was found to be non-compliant in phase 1 of testing, but phase 2 re-test found model to be in compliance.

IV. Study Limitations and Recommendations

IV.1 Sample Size

As a result of funding and budget constraints, the sample selection in this study was relatively small. First, sample testing was conducted only in the markets of three cities: Beijing, Guangzhou and Hefei. Within each city, the proportion of refrigerators to air conditioner sample models also differs greatly. In particular, refrigerator samples were taken and tested primarily in Beijing and Hefei, while air conditioner samples were tested only in Guangzhou and Hefei. As the test results show, regional differences in appliance product performance exist, so greater sample testing of both types of appliances in each city would help strengthen compliance analyses. In addition, further testing in other cities and regions is needed to better represent geographic variations within China.

Second, the product model samples tested were representative of only 1 percent of the all product models. This study's test sample included models from 48 different manufacturers, out of a total of more than 200 manufacturers of household refrigerators and air conditioners. Many of these 200 manufacturers are small enterprises with low production volume.[15] In future studies, more testing of products from these smaller manufacturers is necessary as this study has highlighted the lower performance and compliance of products manufactured by smaller enterprises for second-tier retailers.

IV.2 Standardization of Sample Testing

In this study, the sample testing was conducted in national standards testing laboratories located in each of the three cities where sample products were taken. Although all three test sites are national standards testing laboratories, there are inevitably still variations between the three facilities. For instance, facility differences in terms of staff, equipment, and specific procedures and rules for following the standards testing protocol exist. Thus, there should be greater efforts to standardize testing facilities in order to minimize potential effects of variance in testing procedures on future results.

V. Conclusion

The first spot-check inspections of the energy performance of household refrigerators and air conditioners has revealed mixed results in terms of compliance with the energy labels of product models. Overall, the compliance rate of the air conditioner product models tested was better than the compliance rate of refrigerator product models. Among the refrigerators tested specifically, ice chests from Hefei had poorer performance and lower compliance rates. Other factors with demonstrated correlation to poor performance and non-compliance with energy label standards include the actual energy performance ratings and the type of appliance market where the product model was sold.

This study has therefore shown that the implementation of China's appliance energy labels program has had mixed success, with relatively high compliance rates in air conditioner product models and in first-tier retailers in Guangzhou and Beijing. However, the significantly lower compliance rates of refrigerators (and ice chests in particular) sold in second-tier retailers in Hefei underscores the existing challenges for implementing energy labels' performance standards and the need for further studies in this area.

[15] Although the names of the manufacturers of sampled product models are not included in this paper, information on the name and type of manufacturer was collected by the Chinese co-authors. This recommendation on further studies focusing on smaller enterprises is based on their results analysis.

Appendix B 2007 Initial Testing Results

Table B- 1 Refrigerator and Freezer

	Product	Sample location	Testing facility	Effective capacity (L)		Electricity Consumption (kW/h)		EEI (%)		Energy Effi-ciency Grade	
				Rated value	Tested value	Rated value	Tested value	Rated value	Tested value	Rated value	Tested value
1.	Refrigerator	Suning, Guangzhou	GKS	205	211.2	0.63	0.712	53.2	54.3	1	1
2.	Refrigerator	Suning, Guangzhou	GKS	182	183.4	0.59	0.79*	50	63.9*	1	2*
3.	Refrigerator	Suning, Guangzhou	GKS	207	201.8	0.64	0.69	53.5	55	1	1
4.	Refrigerator	Suning, Guangzhou	GKS	187	184.5	0.59	0.667	52	53.3	1	1
5.	Refrigerator	Suning, Guangzhou	GKS	232	231	0.49	0.562		41.3	1	1
6.	Refrigerator	Suning, Guangzhou	GKS	208	210.5	0.65	0.67	50.31	52.8	1	1
7.	Refrigerator	Suning, Beijing	GKS	245	246	0.70	0.694	52.9	50.3	1	1
8.	Refrigerator	Suning, Guangzhou	GKS	254	251.1	0.60	0.608	42.6	43.2	1	1
9.	Refrigerator	Suning, Guangzhou	GKS	195	189.8	0.48	0.453	43.2	36.6	1	1
10.	Refrigerator	Suning, Guangzhou	GKS	207	202.4	0.49	0.56	43.65	43.2	1	1
11.	Refrigerator	Suning, Guangzhou	GKS	196	190.2	0.38	0.431	33	34.4	1	1
12.	Refrigerator	Suning, Guangzhou	GKS	220	220.7	0.64	0.66	53.1	50.7	1	1
13.	Refrigerator	Suning, Guangzhou	GKS	176	171.1	0.58	0.66	53.1	55	1	1
14.	Refrigerator	Suning, Guangzhou	GKS	188	185.8	0.35	0.396	28.07	31.9	1	1
15.	Refrigerator	Suning, Guangzhou	GKS	206	200.1	0.48	0.541	41.2	42.8	1	1
16.	Refrigerator	Suning, Guangzhou	GKS	205	203.4	0.64	0.668	52	51	1	1
17.	Refrigerator	Suning, Beijing	BJS	219	217.1	0.59	0.65	47.7	50	1	1
18.	Refrigerator	Suning, Beijing	BJS	226	227.9	0.61	0.64	51	47.7	1	1
19.	Refrigerator	Suning, Guangzhou	GKS	245	242.1	0.70	0.72	52.9	53	1	1
20.	Refrigerator	Suning, Beijing	BJS	256	257.1	0.65	0.67	50	46.8	1	1
21.	Refrigerator	Suning, Beijing	BJS	223	225.4	0.6	0.69	46.71	51.1	1	1
22.	Refrigerator	Suning, Guangzhou	GKS	221	219.2	0.66	0.822*	53.95	61.9*	1	2*
23.	Refrigerator	Suning, Guangzhou	GKS	226	221.5	0.64	0.83*	47.43	57.8*	1	2*
24.	Freezer	Suning, Guangzhou	GKS	207	201.9	0.9	0.76	71.3	56.5	3	2

25.	Freezer	Suning, Guangzhou	GKS	230	226.2	1.2	1.05	78.2	79.7	3	3
26.	Freezer	Suning, Guangzhou	GKS	248	240.9	1.32	1.093	89.56	80	4	4
27.	Freezer	Suning, Guangzhou	GKS	302	295	1.38	1.392	89	90	4	4
28.	Freezer	Suning, Guangzhou	GKS	261	254.2	1.06	1.126	78.3	79.8	3	3
29.	Freezer	Suning, Guangzhou	GKS	258	236.3*	1.4	2.15*	93	159.3	5	Non-compliant*
30.	Freezer	Suning, Guangzhou	GKS	272	268.1	1.05	1.189*	75	81.6*	3	4*

Table B- 2 Room Air-conditioner

No.	Sample location	Testing facility	cooling capacity		cooling con-sumption power		EER		Energy efficiency grade	
			Rated value	Tested value	Rated value	Tested value	Rated value	Tested value	Rated value	Tested value
31	Suning, Hefei	HFS	2500	2533	960	920	2.60	2.75	5	5
32	Suning,	HFS	3200	3107	1165	1179	2.75	2.64	5	5
33	Hefei	HFS	3500	3615	1255	1346	2.79	2.66	5	5
34	Suning,	HFS	3200	3049	1145	1169	2.79	2.61	5	5
35	Hefei	HFS	3200	3150	960	982	3.33	3.21	2	2
36	Suning,	HFS	3300	3227	1190	1239	2.77	2.60	5	5
37	Hefei	HFS	3200	3108	1150	1193	2.78	2.61	5	5
38	Suning,	HFS	3200	3063	1170	1145	2.74	2.68	5	5
39	Hefei	HFS	3200	3098	1200	1192	2.68	2.60	5	5
40	Suning,	HFS	3200	3190	1200	1200	2.67	2.66	5	5
41	Hefei	HFS	3600	3462	1204	1236	2.99	2.80	4	4
42	Suning,	HFS	3300	3426	1150	1180	2.87	2.90	4	4
43	Hefei	HFS	3250	3257	1020	1043	3.18	3.12	3	3
44	Baida, He-fei	HFS	3600	3605	1210	1251	2.98	2.88	4	4
45	Baida, He-fei	HFS	3500	3475	1260	1302	2.78	2.67	5	5
46	Guomei, Hefei	HFS	3500	3531	1090	1116*	3.21	3.16*	2	3*
47	Wuxing Electric	HFS	3200	3168	1160	1271*	2.76	2.49*	5	Non-com-pliant
48	Suning, Beijing	BJS	2500	2534.1	835	848.5	2.99	2.99	4	4
49	Suning, Beijing	BJS	3500	3600.3	1160	1185.1	3.02	3.04	4	4
50	Suning, Beijing	BJS	3500	3637.5	1255	1318.3	2.79	2.76	5	5
51	Suning, Beijing	BJS	2700	2712.2	800	801	3.38	3.39	2	2
52	Suning, Beijing	BJS	3500	3612.9	1120	1186	3.13	3.05	3	3

Table B- 3 Clothes Washer

	product	Sample location	Testing facility	Electricity con-sumption kWh/c		Water consumption l/c		Cleaning Ratio		Energy effi-ciency grade	
				Rated value	Tested value	Rated value	Tested value	Rated value	Tested value	Rated value	Tested value
53	Horizontal	Suning, Beijing	BJS	0.15	0.145	11	10.3	1.08	1.08	1	1
54	Horizontal	Suning, Beijing	BJS	0.18	0.18	11	10.8	1.04	1.074	1	1
55	Horizontal	Suning, Beijing	BJS	0.19	0.189	12	10.8	1.14	1.141	1	1
56	Horizontal	Suning, Beijing	BJS	0.15	0.159	9	8.4	1.12	1.12	1	1
57	Horizontal	Suning, Beijing	BJS	0.19	0.176	12	10.4	1.03	1.141	1	1
58	Horizontal	Suning, Beijing	BJS	0.18	0.179	9	8.6	1.03	1.041	1	1
59	Horizontal	Suning, Beijing	BJS	0.19	0.176	12	9.1	0.98	1.00	2	2
60	Horizontal	Suning, Beijing	BJS	0.16	0.159	9	8.5	1.12	1.126	1	1
61	Horizontal	Suning, Guang-zhou	GKS		0.223		11.38		0.947	2	2
								EIL not labeled			
62	Horizontal	Sunign, Beijing	BJS		0.217		11.1		1.03		1
								EIL not labeled			
63	全自动	Suning, Beijing	BJS	0.0154	0.0151	24	22.1	0.90	0.90	2	2
64	全自动	Suning, Beijing	BJS	0.017	0.0167	24	23	0.80	0.82	2	2
65	全自动	Suning, Beijing	BJS	0.017	0.0166	20	19.9	0.84	0.847	2	2
66	全自动	Suning, Beijing	BJS	0.021	0.0191	28	25.9	0.80	0.871	3	3
67	全自动	Suning, Beijing	BJS	0.016	0.0154	20	20	0.81	0.83	2	2
68	全自动	Suning, Beijing	BJS	0.019	0.0177	29	29	0.76	0.762	4	4
69	全自动	Suning, Beijing	BJS	0.017	0.0156	24	24	0.81	0.81	2	2
70	全自动	Suning, Beijing	BJS	0.022	0.0218	26	25.5	0.80	0.801	3	3
71	全自动	Suning, Beijing	BJS	0.02	0.02	24.4	24.4	0.80	0.845	3	3
72	双桶	Suning, Beijing	GKS	0.0215	0.0214	22	21.7	0.82	0.825	3	3
73	双桶	Suning, Beijing	GKS	0.021	0.021	27.1	26.6	0.80	0.802	3	3

"*": non-compliant

Appendix C 2007 Re-Testing Results

Table C- 1 Refrigerator and Freezer

Products		Sample location	Testing facility	Effective capacity (L)		Electricity Consumption(kw/h)		Energy efficiency grade	
				Rated value	Tested value	Rated value	Tested value	Rated value	Tested value
Refrigerator	Initial testing	Suning, Guangzhou	GKS	182	183.4	0.59	0.79	1	2
	Re-testing 1	Suning, Guangzhou	GKS	182	183.4	0.59	0.776	1	2
	Re-testing 2	Suning, Guangzhou	GKS	182	183.4	0.59	0.799	1	2
Refrigerator	Initial testing	Suning, Guangzhou	GKS	221	219.2	0.66	0.822	1	2
	Re-testing 1	Suning, Guangzhou	GKS	221	219.2	0.66	0.719	1	1
	Re-testing 2	Suning, Guangzhou	GKS	221	219.2	0.66	0.723	1	1
Refrigerator	Initial testing	Suning, Guangzhou	GKS	226	221.5	0.64	0.83	1	2
	Re-testing 1	Suning, Guangzhou	GKS	226	221.5	0.64	0.726	1	1
	Re-testing 2	Suning, Guangzhou	GKS	226	221.5	0.64	0.692	1	1
Freezer	Initial testing	Suning, Guangzhou	GKS	272	268.1	1.05	1.189	3	4
	Re-testing 1	Suning, Guangzhou	GKS	272	268.1	1.05	1.138	3	3
	Re-testing 2	Suning, Guangzhou	GKS	272	268.1	1.05	1.147	3	3

Table C- 2 Room Air-conditioner

Air-conditioner	Initial testing	Guomei, Hefei	HFS	3500	3531	1090	1116	3.21	3.16	2	3
	Re-testing 1	Beijing	BJS	3500	3366.1	1090	1049.7	3.21	3.21	2	2
	Re-testing 2	Beijing	BJS	3500	3378.2	1090	1039.6	3.21	3.25	2	2
Air-conditioner	Initial testing	Guomei, Hefei	HFS	3200	3168	1160	1271	2.76	2.49	5	Non-compliant*
	Re-testing 1	Beijing	BJS	3200	3088.2	1160	1116.0	2.76	2.77	5	5
	Re-testing 2	Beijing	BJS	3200	3061.4	1160	1124.7	2.76	2.72	5	5