

Consumer Comprehension of the China Energy Label and Household Appliance-using Habits in China

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CLASP
All China Market Research Co. Ltd.

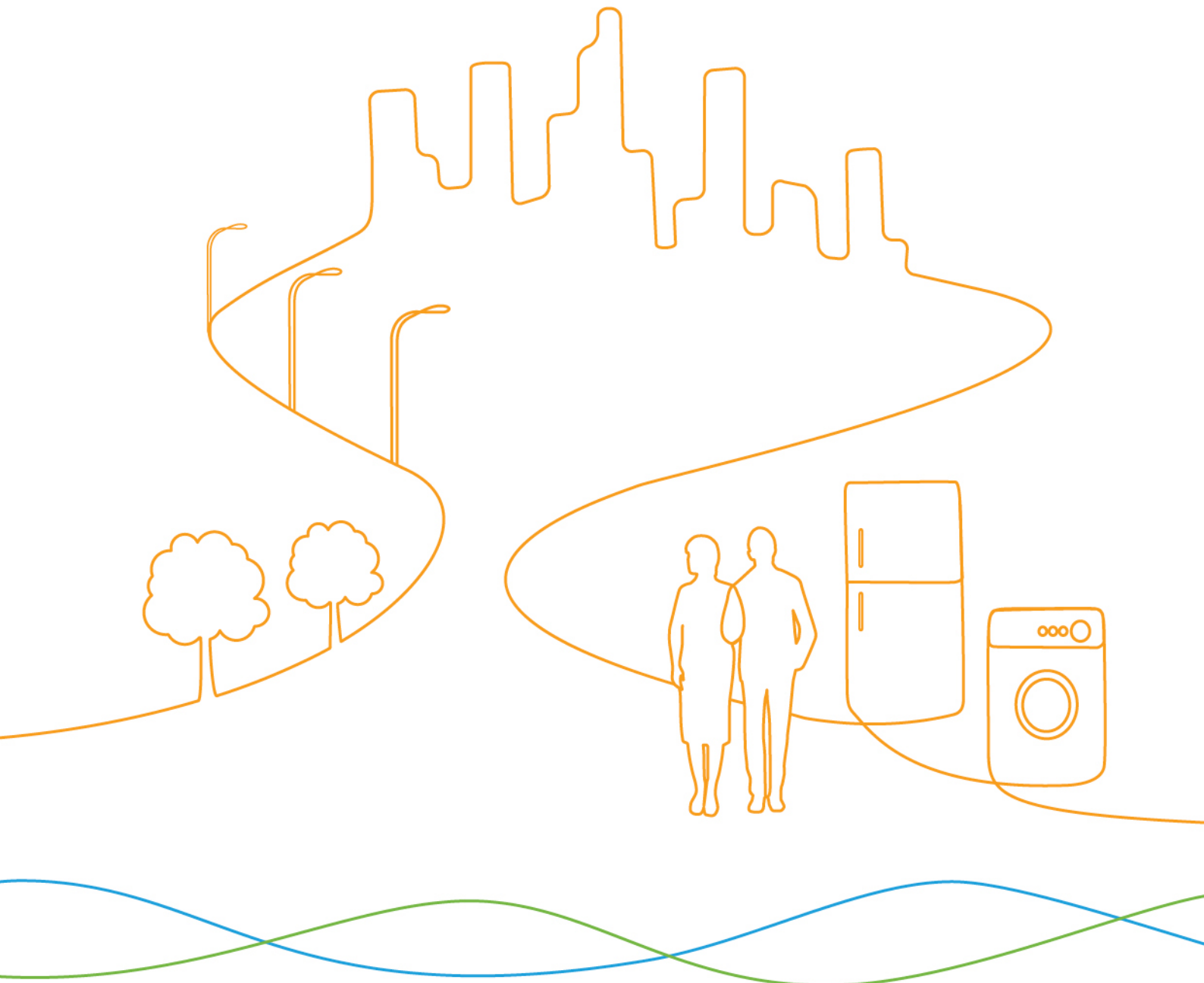


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01 Introduction: Background

China is the largest manufacturer and consumer of household appliances in the world. China's fast-growing economy and accelerating urbanization process have benefited the population enormously over the past few decades, with better living standards and more disposable income. As a result, demand for household appliances is increasing, as is the amount of energy consumed by those appliances.

The Chinese Government has long recognized the importance of energy-saving potentials from appliances. Since the 1980s, China has implemented over 50 minimum energy performance standards (MEPS). In 2005, China launched its mandatory China Energy Label (CEL) program, which now covers over 30 product categories. These two programs have greatly contributed to market transformation towards highly efficient appliances. As the programs continue to cover more products and gain more exposure to the public, more and more consumers are becoming aware of the CEL and reference it in the decision-making process when purchasing appliances.

In order to understand the degree to which consumers comprehend the CEL, as well as how appliances are used in typical urban Chinese households, CLASP collaborated with All China Market Research Co. Ltd. (ACMR) to conduct market research with the following objectives:

- Understand urban consumer views and attitudes towards the CEL, including their general understanding of the label, its overall design, and specific parameters included for various products; and seek suggestions and recommendations from consumers for improvement of the label design;
- Understand appliance-using habits in urban Chinese households, including frequency and duration of use, as well as other relevant information that can be used to facilitate improvements in test methods and calculating energy saving potential.

This market research report primarily consists of two parts, each of which addresses one of the above-mentioned objectives. Section 3 of this paper investigates consumer comprehension of the CEL for nine types of household appliances, namely refrigerators, washing machines, televisions, water heaters, induction cookers, rice cookers, microwaves, computers (including monitors) and air conditioners. Section 4 examines how appliances are being used in typical Chinese households.



02 Methodology

2.1. Overview

This study employs several different methodologies, which are summarized below.

Table 1: Methodology overview

Objective	Online questionnaire	Personal interview	Home visit	Appliance "diary"
Consumer comprehension of China energy labels	✓	✓		
Household appliance-using habits			✓	✓

Online questionnaires:

This was the primary method used in assessing consumer comprehension of the China' Energy Label. An online questionnaire was designed and distributed to a pool of selected respondents from different cities across varying ages, genders, income levels, and education backgrounds.

Personal interviews:

Recognizing that the online questionnaire respondents were mostly young and middle- aged consumers who were considered more "internet-savvy," we supplemented the online survey with personal interviews of elderlies (age 60 or above). Elderlies were intercepted for interviews at various locations such as parks, community centers, and news stands. The questionnaire used for personal interviews was exactly the same as the online questionnaire.

Home visits:

For each household that participated in the appliance-using habits study, one trained interviewer was sent to conduct a home visit. The purpose of the home visit was to survey the different types of appliances used in each household (including brand, model, technical parameters, and photos) and to train the household member who was responsible for this study how to record their appliance-using habits using a pre-designed diary.

Appliance diary:

The household participants were required to record their appliance-using habits for one entire week using the pre-designed diary. The recording period took place from October 19 to 25, 2013. Nine types of primary household appliances were included in the diary, namely refrigerators, washing machines, televisions, water heaters, induction cookers, rice cookers, microwaves, computers (including monitors), and air conditioners. Participants were only required to complete the diary for appliances that they owned.

2.2. Methodology for Label Comprehension Study

Questionnaire design

The label comprehension questionnaire was comprised of two parts. The first part aimed to examine consumers' general understanding of the CEL, with reference to the following points:

- Whether consumers had seen the China Energy Label;
- On which type of appliances consumers saw the label;
- Whether consumers understood the classification of energy efficiency tiers on the label;

- Whether consumers were able to differentiate between highly efficient and less efficient products;
- What information on the labels consumers considered the most important; and
- Other relevant information.

The second part of the questionnaire assessed consumers' understanding of each of the technical parameters (such as "rated volume" or "24 hour energy consumption") included on the label for some specific products. For each technical parameter, consumers were first asked whether they understood the meaning of the parameter; they were then asked to answer a specific question regarding that parameter to test whether or not they genuinely understood it.

Sampling

1281 survey respondents were selected from six regions in China. The number of respondents from each region was proportional to its regional population (see Table 2). Since the online survey respondents were mostly between the ages of 25 and 60, we also conducted face-to-face interviews for elderlies over 60 years of age (see Table 3). The number of online and elderly respondents were 1100 and 181, respectively, for a grand total of 1281 participants.

Table 2: Regional Distribution of Online Survey Respondents

Region	Province/city	Respondents
North China	Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia	136
Northeast	Heilongjiang, Jilin, Liaoning	115
East China	Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong	353
Mid-South	Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Shenzhen	296
Southwest	Chongqing, Sichuan, Yunnan, Guizhou, Xizang	126
Northwest	Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang	74
Total		1100

Table 3: Regional Distribution of Elderly Survey Respondents

Region	Province/city	Respondents
North China	Beijing	31
Northeast	Shenyang	30
East China	Shanghai	30
Mid-South	Guangzhou	30
Southwest	Chengdu	30
Northwest	Xi'an	30
Total		181

The project team determined that the questionnaire would be too lengthy for the respondents if all nine product types covered in the survey were included in one questionnaire. Therefore, we randomly divided the respondents into two groups, with Group A being surveyed for four types of products and Group B for the other five, as shown in Table 4 below.

Table 4: Respondent Distribution by product group

Group	Products	# of respondents
A	Refrigerator, television, water heater, rice cooker, microwave	642
B	Washing machine, induction cooker, computer (monitor), air conditioner	639

2.3. Methodology for Appliance-using Habits Study

Home visits and diary-recording

A combination of home visits and diary-recording was used in the study of appliance-using habits in Chinese households. One of the primary users of appliances in each participating family was required to keep record of how they used their appliance every day for one entire week. The team designed a diary (see Appendix 1) to help consumers record their appliance-using habits, including factors such as frequency and duration of use, temperature settings, time in standby mode, and whether or not the appliance was unplugged after use.

Prior to the diary recording process, trained project coordinators visited the home of each participating family to survey the appliances used and to train the designated family member - the main user of the selected appliances with the greatest understanding of how to use them - on how to record in the diary. The coordinators also followed up with each participating family by phone on the first day of the recording period and every other day after that. These calls helped the coordinators to ensure that the families were recording the diary properly, as well as answer any

questions raised. The coordinators collected the diaries from the families the day after the last day of the recording period.

Sampling

A total number of 215 families were selected from six cities - one from each of the six regions in China. The sample covered various family member structures and income levels. At least 30 families had to be selected in each city in order for the samples to be statistically significant. Table 5 shows the distribution of the number of participating families in each city in this study.

Table 5: Regional Distribution of Participating Families in Appliance-using Habits Study

Region	Province/city	# of families
North China	Beijing	51
Northeast	Guangzhou	34
East China	Nanjing	33
Mid-South	Chengdu	34
Southwest	Xianyang	32
Northwest	Jinzhou	31
Total		215

03 Consumer Comprehension of the China Energy Label

3.1. General Awareness & Understanding

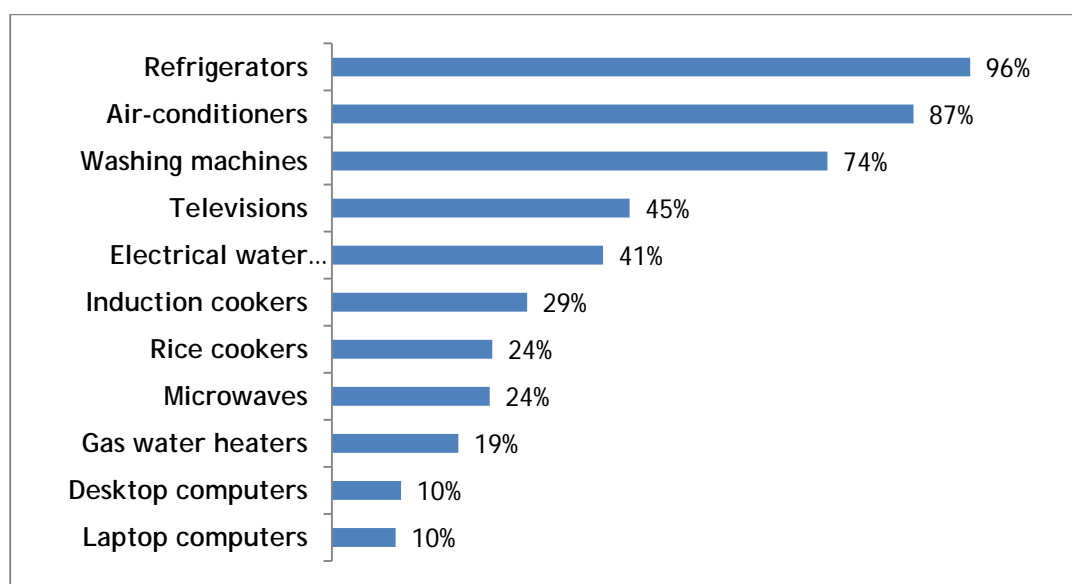
General awareness

A screening question of whether or not the respondents had seen the CEL was asked to 5920 respondents, among which 97% claimed that they had seen the label before. Only 3% of respondents claimed that they had never seen the label. In a previous consumer awareness assessment conducted by CLASP and ACMR in 2010, only 62% of surveyed respondents claimed that they had seen the CEL before. The general increase in awareness could be attributed to promotion and education about the CEL, as well as the additional years of exposure to its presence in the market.

Recognition of labels for different appliances

Consumer label awareness for different appliances varied. The top-ranking appliances in terms of label recognition are all primary appliances - e.g. air conditioners, washing machines, televisions, and electrical water heaters - which were included in the early phase of China's energy labeling program. Refrigerators had the highest rate of recognition; over 96% of respondents claimed that they had seen the refrigerator energy label. However, recognition among consumers was found to be much lower for computers and microwaves (see Figure 1). This is most likely due to the fact that these products entered the labeling program more recently, in 2012 and 2011 respectively.

Figure 1: Consumer Recognition of the China Energy Label for Different Appliances

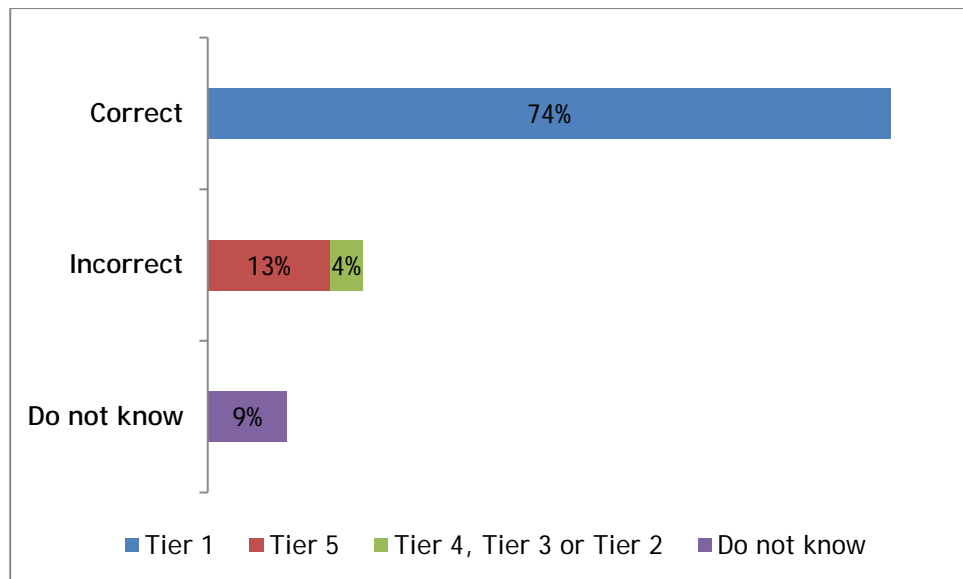


Understanding of energy efficiency tiers

The CEL is a categorical label with three or five energy efficiency tiers for different appliances. Tier 1 represents the highest level of energy efficiency, while Tier 3 or Tier 5 - whichever one is the lowest tier on the label - represents the minimum energy performance requirement.

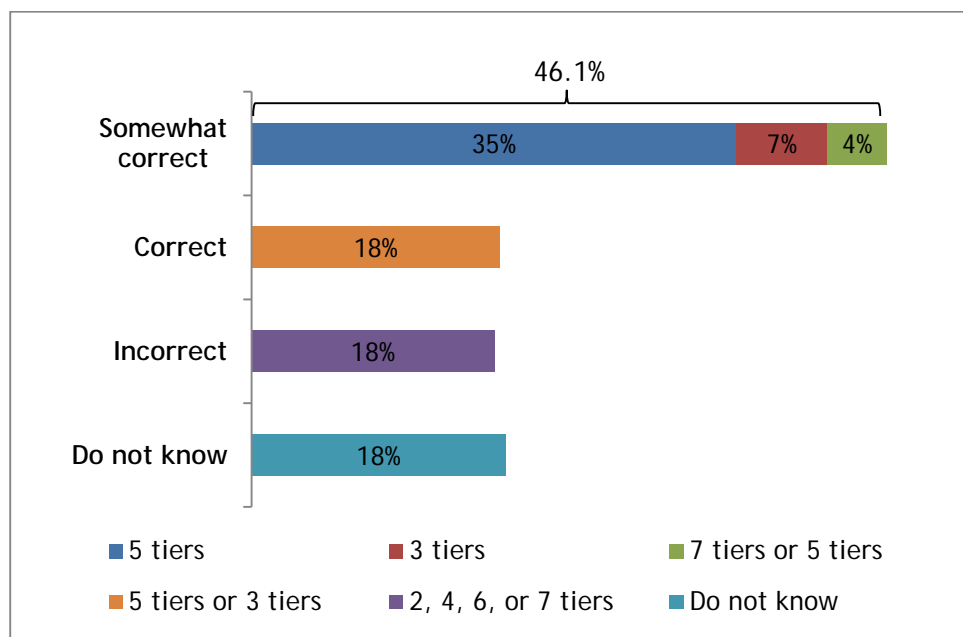
In order to assess Chinese consumers' understanding of the energy labeling tiers, survey respondents were asked to identify the tier that represented the highest energy efficiency level. Overall, 75% of the respondents were able to identify Tier 1 as representing the highest level of energy efficiency; however, as shown in Figure 2 below, 13% of respondents thought that Tier 5 was the highest.

Figure 2: Consumer Comprehension of the Highest Energy Efficiency Tier
 “Which tier represents the highest energy efficiency?”



The survey results also demonstrated that different tier classifications for different appliances are a source of confusion among consumers. Only 18% of respondents knew that labels for some appliances have three tiers, while others have five tiers. As shown in Figure 3 below, a large proportion of respondents (35%) thought that all labels had five tiers. This is understandable when we consider that refrigerators labels, the most widely recognized among consumers, have five tiers.

Figure 3: Consumer Comprehension of Different Labeling Tiers
 “How many tiers are there on China energy labels?”



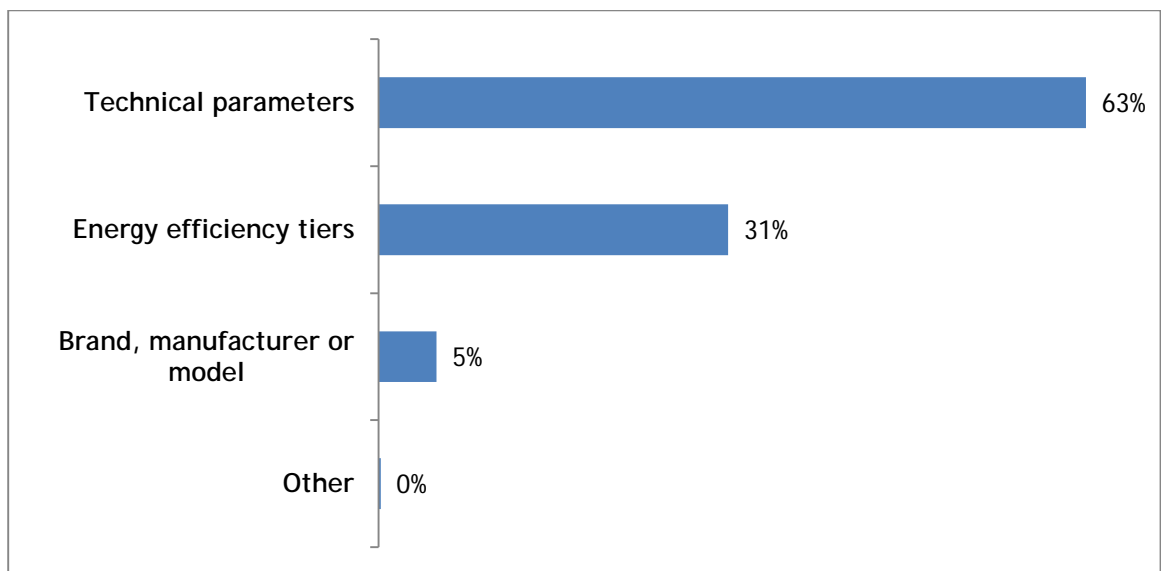
Overall, these results indicate that while Chinese consumers have a certain level of understanding about the CEL, promotion and education efforts must be furthered in order to improve comprehension.

Information on the label

The survey also revealed that Chinese consumers care about the technical parameters provided on the labels more than the energy efficiency tiers. Approximately two-thirds of respondents indicated that technical parameters were the most important information on the labels, as shown in Figure 4 below. At the same time, approximately 35% of respondents thought that some of the technical parameters were too difficult for average consumers to understand, especially among elderlies. Forty percent of consumers expressed that some of the current labels did not directly show the energy consumption by appliances.

Figure 4: Consumer Priorities on Energy Label Information

“What information provided on the China Energy Label is the most important for you?”



The results indicated that technical parameters were very important for consumers, but they had to be easily understood. In addition, consumers would like to see more information on energy consumption and energy or cost savings to help them make an informed choice when purchasing appliances.

3.2. Comprehension of Technical Parameters

The label comprehension survey also focused on specific technical parameters provided on the CEL for various products. For each parameter, we first asked respondents to state whether or not they thought they understood the parameter. They were then asked to answer a specific question regarding this parameter to test whether or not they actually did understand the parameter correctly. For example, respondents were shown the labels for two separate refrigerators and were asked to identify the product that consumed less energy.

Table 6 shows the percentage of respondents who correctly answered the question, demonstrating that they understood the parameter.

Table 6: Consumer Comprehension of Technical Parameters on Product Labels

Appliance	Parameter	Respondents Who Correctly Understood the Parameter
Refrigerator	Refrigerator volume (L)	80.8%
	Freezer volume (L)	80.8%
Washing machine	Energy consumption	62.0%
	Washing capacity (kg)	71.7%
	Water consumption (L/cycle)	68.8%
Television	Cleaning ratio	30.2%
	Standby power (W)	34.9%
	Energy efficiency Index (EEL _{LCD} or EEL _{PDP})	8.4%
Water heater	24hour standby energy loss index (ε)	27.0%
	Hot water production rate (μ)	21.8%
	Rated heat input (kW)	17.9%
Induction cooker	Hot water production efficiency at rated heat input	15.1%
	Standby power (W)	48.5%
	Thermal efficiency (%)	48.2%
Rice cooker	Standby energy loss (Watt hours)	59.2%
	Keep warm energy consumption (Watt hours)	58.7%
	Thermal efficiency (%)	38.5%
Microwave	Inner container material (metallic or non-metallic)	9.5%
	Standby power loss (W)	61.7%
	Off-mode power loss (W)	48.9%
Computer	Efficiency (%)	43.8%
	Barbecue mode energy consumption (Watt hours)	20.4%
	Off-mode energy loss (W)	53.7%
Air conditioner	Product type (A, B, C, or D)	12.8%
	Energy efficiency (cd/W)	45.4
	Typical energy consumption (kWh)	0.8%
Air conditioner	Cooling capacity (W)	44.0%
	Rated cooling capacity (W)	40.7%
	Input power (W)	31.0%
	Annual energy consumption efficiency (%)	21.0%
	Cooling season energy consumption (kWh)	7.6%
Air conditioner	Energy efficiency index	7.5%
	Heating season energy consumption (kWh)	6.7%

As shown above, respondents' comprehension varied greatly for different technical parameters and different appliances. We attempted to divide these parameters into five different categories in order to conduct a clearer analysis:

- i. **Physical parameters:** Parameters related to the physical properties of the appliance, such as size, volume, and material.
- ii. **Simple energy consumption parameters:** Parameters related to energy consumption that use simple expressions such as "energy consumption," "standby loss," and "power."

- iii. **Complicated energy consumption parameters:** Parameters related to energy consumption that use more complicated expressions, such as “cooling season energy consumption” and “rated heat input.”
- iv. **Efficiency parameters:** Parameters related to efficiencies, such as hot water production efficiency and thermal efficiency. These parameters are normally expressed as a percentage.
- v. **Index parameters:** Parameters such as energy efficiency index (EEI) and energy efficiency ratio. These parameters are normally unit-less.

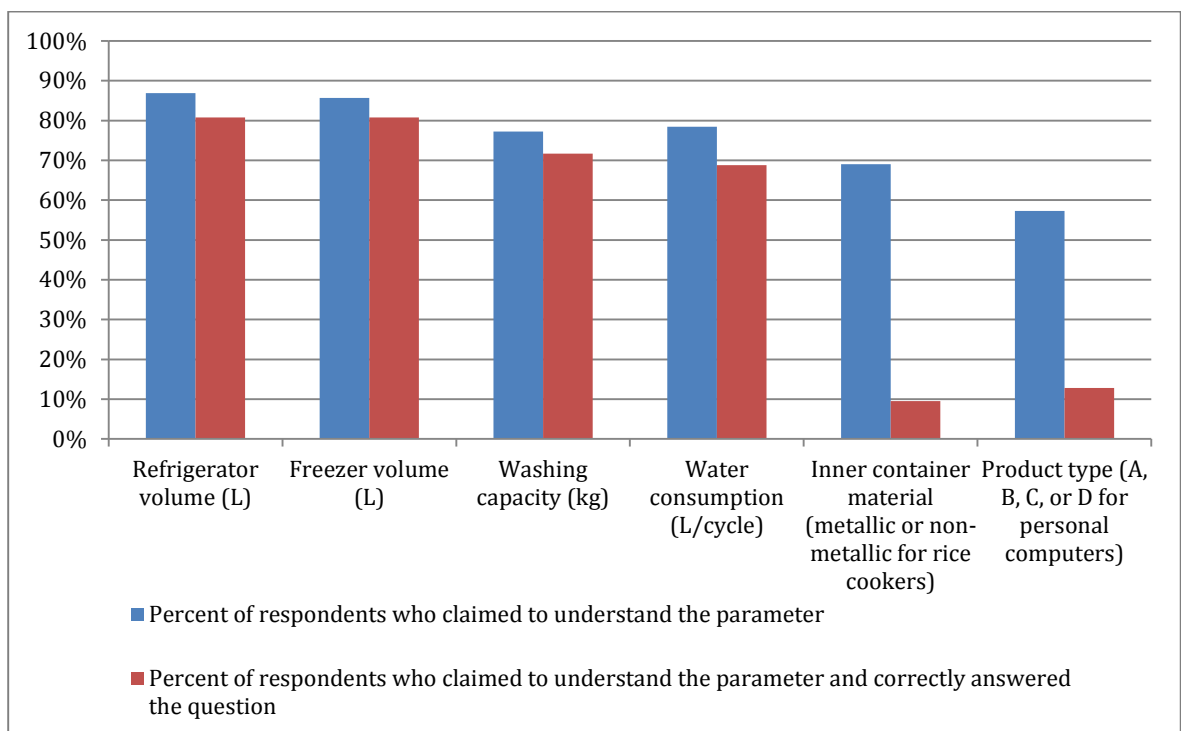
The following figures illustrate respondents’ comprehension the different parameter types.

Physical parameters

Figure 5 below shows that Chinese consumers demonstrate rather high levels of comprehension about physical parameters on the CEL overall. A high percentage of respondents who claimed that they understood the parameters could also answer the specific questions correctly.

However, consumers demonstrated very low levels of comprehension on “product type” for computers and “inner container material” for rice cookers. Computers are divided into four product types on the CEL - A, B, C, and D - based on their central and graphics processing units (CPUs and GPUs). This is significant because energy efficiency tier requirements sometimes differ for different product types. Similarly, inner containers for rice cookers can be either metallic or non-metallic, and the minimum energy performance requirements differ between these two types. Evidently, average consumers do not possess the knowledge of such information and therefore it was difficult for them to understand these parameters.

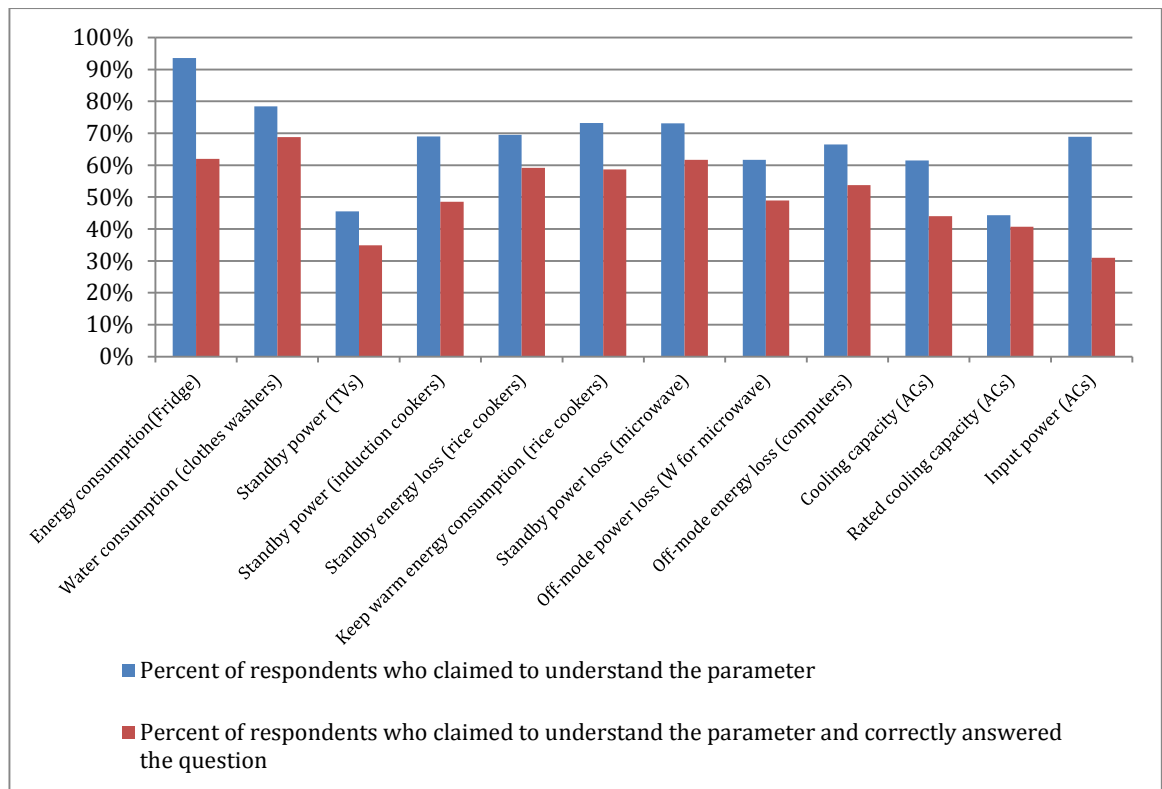
Figure 5: Consumer Comprehension of Physical Parameters



Simple energy consumption parameters

As shown in Figure 6 below, simple energy consumption parameters such as energy consumption, standby energy loss, cooling capacity, and input power, appear to be well-understood among Chinese consumers. Approximately 60% to 80% of consumers were able to correctly answer the questions regarding simple energy consumption parameters.

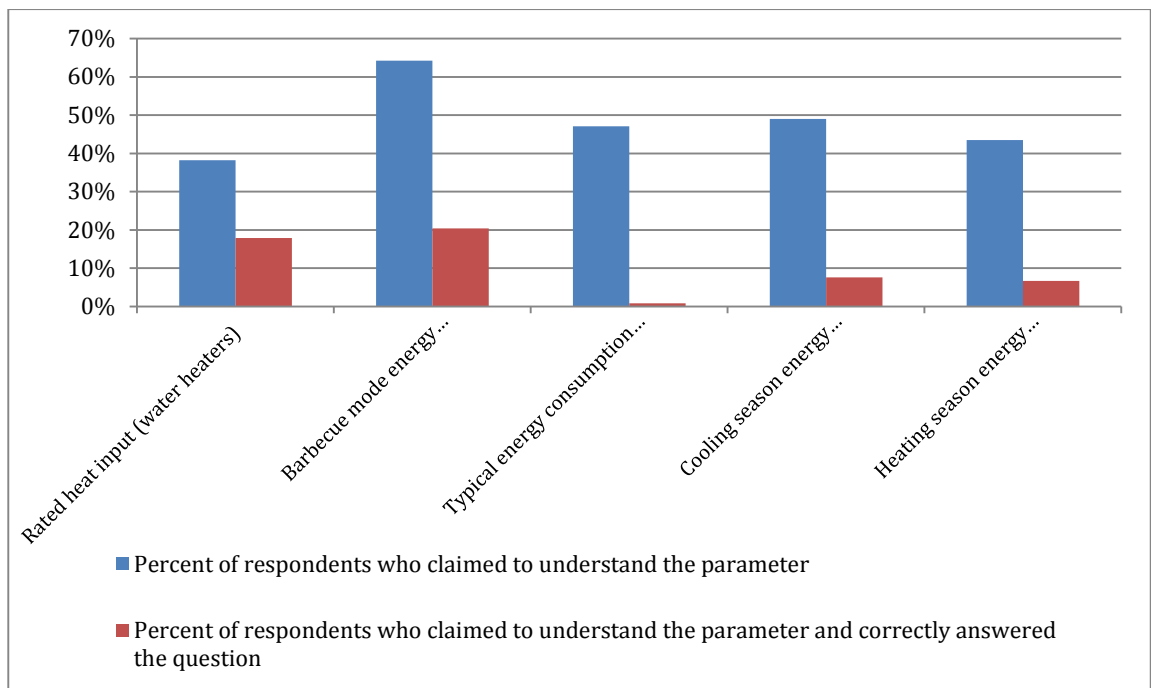
Figure 6: Consumer Comprehension of Simple Energy Consumption Parameters



Complicated Energy Consumption Parameters

Complicated energy consumption parameters appeared to be less familiar and straightforward for consumers. For example, it was difficult for respondents to understand what “cooling season” energy consumption or “barbecue mode” energy consumption referred to. As such, levels of comprehension for these parameters were low - approximately 20% on average - as shown in Figure 7 below.

Figure 7: Consumer Comprehension of Complicated Energy Consumption Parameters

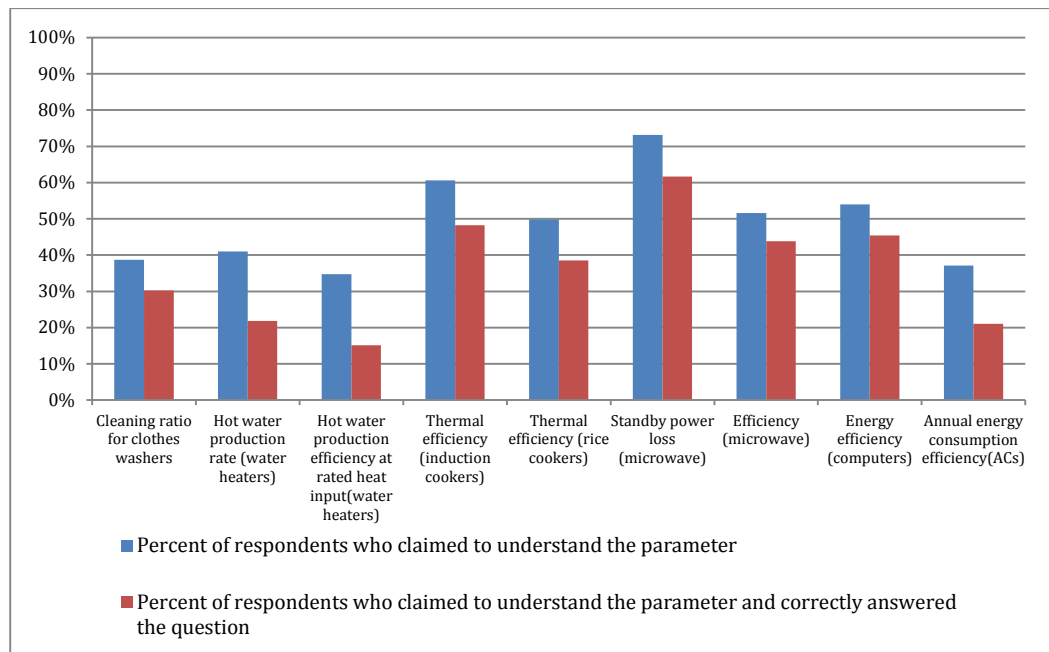


Efficiency Parameters

On average, approximately 40% of survey respondents were able to correctly answer the questions regarding efficiency parameters. Consumers demonstrated higher levels of understanding for simpler parameters such as “thermal efficiency” or “energy efficiency” but showed lower levels of understanding for more complex efficiency parameters such as “Hot water production efficiency at rated heat input” or “Annual energy consumption efficiency,” as shown in Figure 8.

It is interesting to note that for efficiency parameters, many respondents claimed that they did not understand the parameters, yet they were able to answer the questions correctly. It was logical to associate a higher value of efficiency with better performance, and therefore even respondents who did not think they understood the meaning of the parameter could still make the right choice.

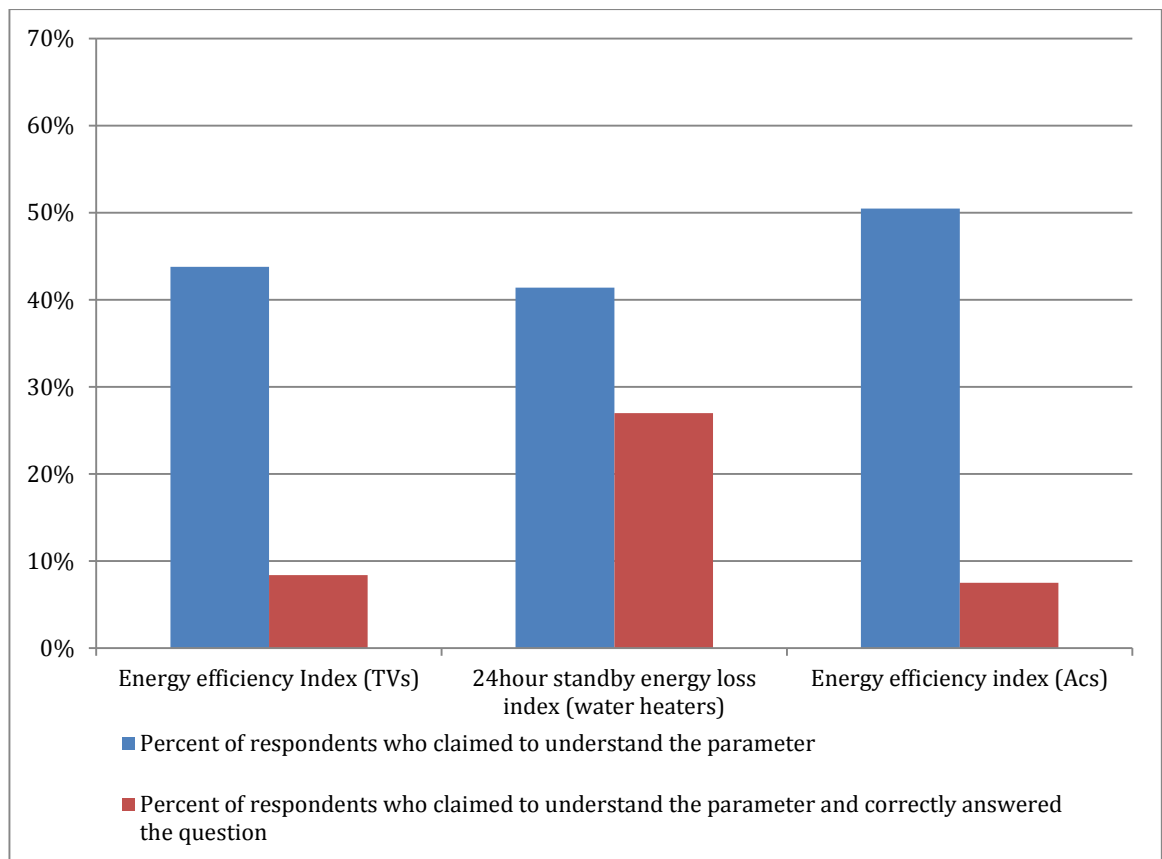
Figure 8: Consumer Comprehension of Efficiency Parameters



Index parameters:

The survey showed that consumer comprehension about index parameters is also low. Index parameters are unit-less values with very complex calculation processes that are not shown on the label. In some cases, a lower index value represents better energy performances, while in other cases it is the opposite. These index parameters evidently carried little meaning to survey respondents, so it was more difficult for them to make educated guesses.

Figure 9: Consumer Comprehension of Index Parameters



From all of the above data, we are able to draw the following conclusions:

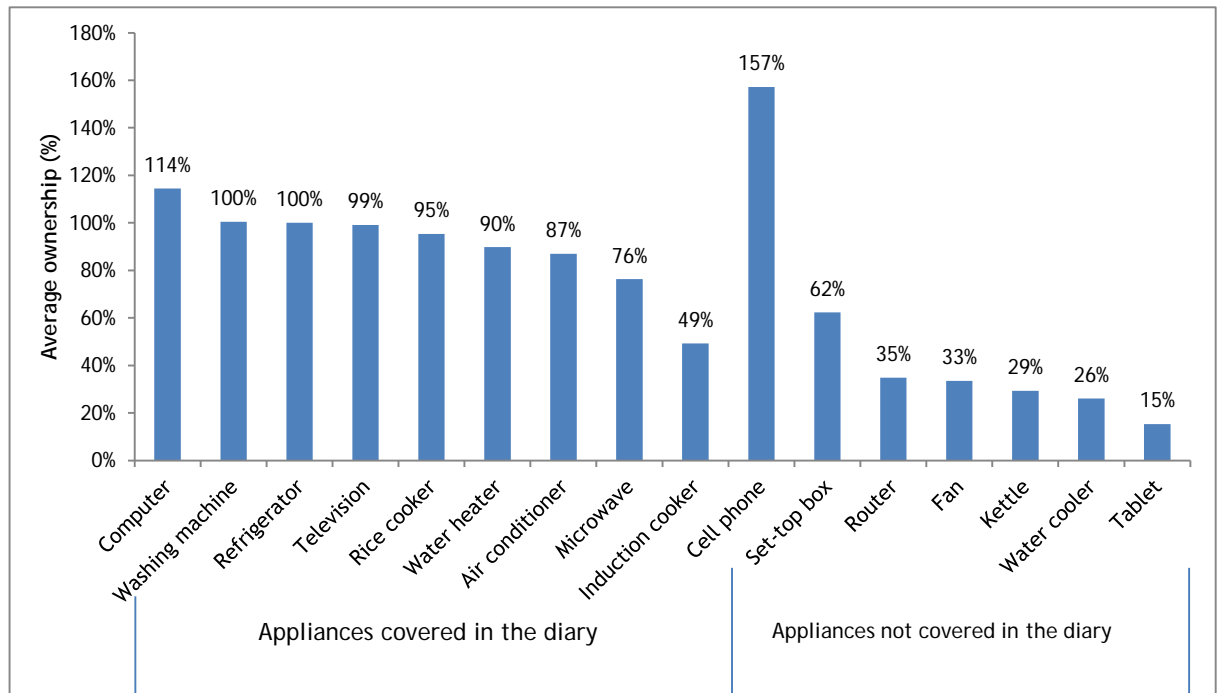
- Simplicity and perhaps familiarity of the parameters appear to be key components for easy comprehension by consumers, evidenced by the fact that physical parameters and simple energy consumption parameters were generally well-understood among consumers.
- Complicated energy consumption parameters and efficiency parameters were both difficult for consumers to understand.
- Index parameters are not expressed in specific units, and therefore it was difficult for consumers to understand them or utilize them in purchasing decisions.

04 Appliance-using Habits

Appliance ownership in urban families

In order to assess appliance-using habits among Chinese consumers, the project team conducted an appliance ownership survey, including 215 families from six different cities with various family structures and income levels. As shown in Figure 10 below, the results demonstrate that computers (both desktops and laptops), refrigerators, washing machines, and televisions are very popular; all reached or exceeded 100%. Ownership of rice cookers, water heaters, and air conditioners is slightly lower, but still between 80% and 95%.

Figure 10: Appliance Ownership in Chinese Urban Families



Gas water heaters were found to be more widely used than electrical water heaters - 52% ownership as opposed to 38% ownership of electrical water heaters. Washing machine ownership is still dominated by top-loading models at 73%, while front-loading machines ownership only reached 28%. Ownerships for desktop computers and laptop computers were 65% and 48%, respectively.

Appliance-using Habits

Table 7 summarizes the appliance-using habits of Chinese consumers for the nine types of appliances covered in this study. Since the functions of these appliances differ, different parameters were tracked for each. Generally, however, the parameters can be grouped into three categories:

- **Duration or frequency of use**, such as viewing duration for TVs or number of wash loads per week for washing machines.
- **Appliance settings**, such as temperature setting on water heaters or power used by induction cookers.
- **Other habits**, such as whether or not consumers watch TVs with background light and/or unplug them after use

Table 7: Appliance-using Habits Among Chinese Consumers

Appliance	Parameter	Results
Refrigerators	Refrigerator volume and use	Approximately 2/3 of the total refrigerator volume
	Freezer occupancy	Approximately 2/3 of the total freezer volume
	Number of freezer door openings	1.8 times per day
	Number of refrigerator door openings	4.5 times per day
Washing machines ¹	Number of wash loads	4.1 loads per week
	Cloth occupancy	Approximately 2/3 of the total volume
	Temperature settings (front-load models only)	18 out of the 60 families used warm wash with an average temperature setting of 36° C.
	Unplug after use	64% of families
Televisions	Average viewing duration	4 hours per day
	Unplug after use	66% of families
	Background light	61% medium, 21% strong, 18% weak ²
	Brightness and contrast adjustment	82% of families used default settings
Water heaters ³	Average daily use	51 minutes per day
	Only turn on when use? (electrical only)	38% of families only turn on the water heaters when use; 61% of families keep the water heaters on all the time
	Average temperature setting (electrical)	46°C
	Average temperature setting (gas)	43°C
Induction cookers	Average daily use	30 minutes per day
	Average standby duration	90 minutes per day
	Average power used	1400 W
Rice cookers	Average daily use	36 minutes per day
	Average keep-warm duration	14 minutes per day
	Unplug after use	93% of families
	Inner container occupancy	Approximately 50% of the inner container volume (i.e. half load)
Microwaves	Average daily use	5 minutes per day
	Unplug after use	66% of families
Computers ⁴	Average daily use	3.2 hours per day
	Average sleep duration	54% of families used sleep function, averaging 1.1 hours per day
	Average hibernate duration	28% of families used the hibernate function, averaging 4.3 hours per day

¹ This sample included 60 front-load units and 156 top-load 156 units.

² See Appendix 1 for detailed definition for background light.

³ This sample included 81 electrical units and 112 gas units.

⁴ This sample included 140 desktop units and 106 laptop units.

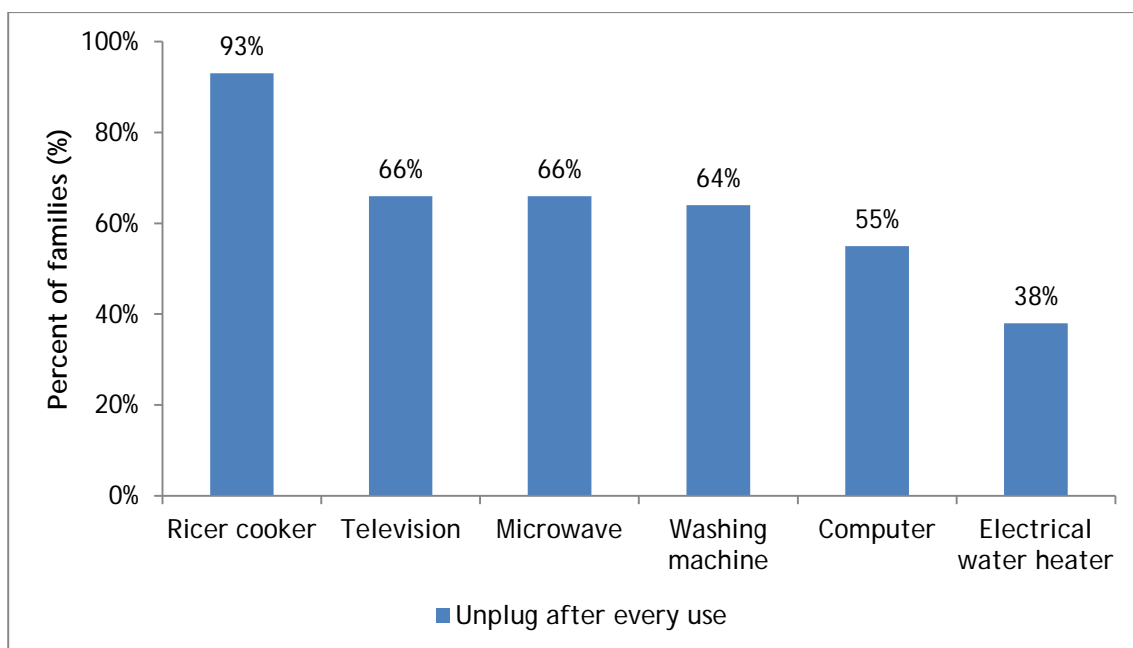
	Brightness and contrast adjustment	86% of families used default settings
	Unplug after use	Desktops: 55% of families Laptops: 69% of families
Air conditioners	Average temperature setting	For cooling: 25.5° C For heating: 26.4° C
	Average daily use	For cooling: 5.5 hours per day For heating: 2.8 hours per day

The most notable of the above results are as follows:

- Household washing machines are dominated by top-loading models; only 1/3 of the families owned front-loading machines. However, among those who owned front-loaders, only 30% used warm wash, which uses more energy to heat the water.
- On average, every family watched 4 hours of TV and spent 3.2 hours using computers daily.
- The majority of families chose to use default settings for brightness and contrast when using computers or TVs. This is significant because these settings affect how much energy the product consumed.
- Following on the above, almost all families chose to watch TV with some level of background light; a majority of families preferred to use medium background light.
- Rice cookers are very popular among Chinese families. Those surveyed used rice cookers once per day, with average duration of 36 minutes. On average, the cookers were filled only half way.
- Microwaves were not very frequently used, with a daily duration of approximately 5 minutes.
- Only 62 families used air conditioners during the study since the study was conducted in October. For both cooling and heating purposes, the temperatures for air conditioners were set at approximately 26°C on average, which is the temperature promoted by the government and environmental protection organizations.⁵
- As shown in Figure 11 below, a large proportion of families chose to unplug their appliances after use. A smaller proportion chose to unplug electrical water heaters after use. It is possible that more families chose to not unplug electrical water heaters after use because they wanted to have immediate hot water access, and electrical water heaters require time to heat water to the desired temperature.

⁵ Decisions on enhancing energy conservation effort, issued by the State Council. (In Chinese). http://www.gov.cn/gongbao/content/2006/content_389909.htm [Date accessed: 2014 Nov. 24]

Figure 11: Percentage of Families Who Unplug Appliances After Use



Household electricity consumption

The project team recorded the electric meter readings for each participating family before and after the study. The average electricity consumption during the week was 38 kWh. Therefore, we estimate that average monthly electricity consumption is 163 kWh.⁶ This is much lower than in developed countries such as the US, where the average residential electricity consumption was over 900 kWh per month in 2012.⁷

Our analysis reveals that average electricity consumption per household does not vary with the number of family members. For example, the average electricity consumption for singles or couples was slightly lower than that of larger families, but the difference was small. This could be explained by the fact that most of the major energy-consuming appliances are now essential for all families, independent of the number of family members.

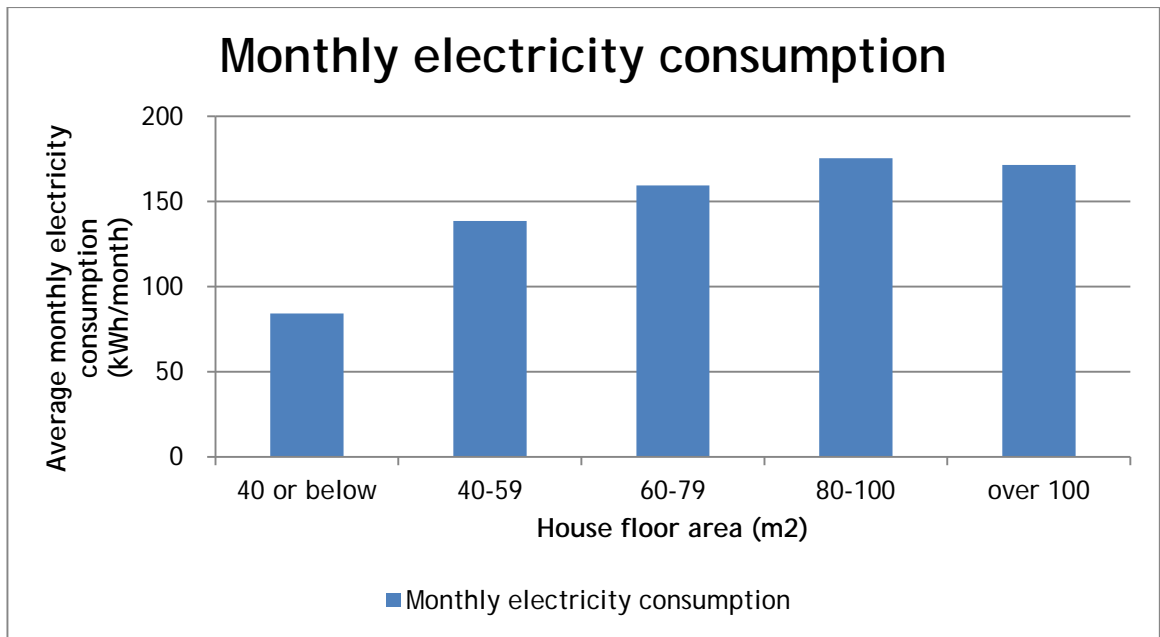
Average electricity consumption was found higher for larger houses, as illustrated in Figure 12 below. Average electricity consumption for families with over 80 square meters (m²) of floor area was twice that of families with less than 40m². This is likely due to the fact that a large house is normally equipped with appliances of larger sizes. For example, a larger living room would require a large capacity air conditioner to cool, and more rooms mean more lighting fixtures.⁸

⁶ It should be noted that electricity consumption may vary in different months. This estimation was based on one week of measurement in October.

⁷ US Energy Information Administration: <http://www.eia.gov/tools/faqs/faq.cfm?id=97&t=3> [Date accessed: 2014 Oct. 23]

⁸ It is interesting to note that average monthly electricity consumption in households with over 100m² of floor area is slightly lower than that of houses of 80-100 m²; however, further analysis would be required to determine why this is the case.

Figure 12: Electricity Consumption in Families by Household Floor Area



05 Policy Recommendations

Based on our analysis above, we recommend that the Chinese Government focus on revising the aspects of the CEL described below in order to increase consumer comprehension and thereby further promote the purchase of energy efficient appliances.

- **Improve the readability of parameters**

The consumer comprehension survey and interviews demonstrated that technical parameters are the most important aspect of the CEL for consumers; therefore, policymakers should consider improving the readability of technical parameters and make it a top priority so that consumers are able to understand the parameters correctly and make informed decisions when purchasing appliances.

In analyzing consumers' comprehension of 34 technical parameters over nine types of appliances, we observed that simple energy consumption metrics (e.g. input power, standby power, or energy consumption) and physical parameters (e.g. volume, washing capacity) can be easily understood by consumers. Efficiency parameters (e.g. hot water production rate), on the other hand, are more complex and difficult for consumers to understand, and complicated energy consumption parameters (e.g. heating season energy consumption) and index parameters (e.g. 24 hour standby energy loss index) are the most difficult. As such, we recommend that policymakers to use simpler terms on the label design and reduce the technical content of parameters.

- **Add information regarding consumption and savings to the label**

Policymakers may want to consider including information regarding consumption and cost savings on the product labels. Using the data collected in the appliance-using habit diary activity above and appliance power or energy consumption information, we can calculate typical energy consumption for appliances included in the study - such as daily energy consumption, annual energy consumption, or energy consumption per cycle. Energy consumption can then be converted to monetary savings, which is more direct and relevant for the consumers. In addition, the label could reference the most and least efficient models of that product on the market, so that it will be easy for consumers to make comparisons.

Adding the estimated operation cost on the labels could help consumers to visualize the financial benefits of adopting energy efficient appliances. Policymakers may wish to conduct further research to investigate whether adding energy consumption and cost on the label could encourage consumers to choose highly efficient appliances.

- **Clarify the relationship between energy efficiency tiers and energy consumption**

Based on the results of the label comprehension survey described in Section 2, the current China Energy Labels does not clearly communicate the relationship between energy efficiency tiers and energy consumption, which is confusing for some consumers. While many consumers appear to associate higher energy efficiency tiers with lower energy consumption, in some cases survey respondents did not think that a higher efficiency tier indicated lower energy consumption. Therefore, we recommend that a typical energy consumption value for similar products be included as reference on each energy efficiency tier, so that consumers can clearly see the energy consumption differences between different tiers. By providing more direct and intuitive information on the label, it will be easier for consumers to visualize the benefits of choosing a highly efficient appliance that consumes less energy.



- **Revise energy savings estimates using appliance usage data**

Energy savings estimates are typically calculated based on how appliances are being used by consumers in their homes, and the accuracy of this consumer data determines the robustness of the estimates. Historically, very few studies have been done in China regarding consumer appliance usage habits of consumers; therefore, most estimates of energy savings had to be calculated based on assumptions. This study is the first attempt to bridge the information gap and provide policymakers with real consumer data on appliance usage habits, and policymakers may wish to revise existing energy saving estimates based the data offered here.

- **Consider appliance usage habits when developing or revising MEPS or test procedures**

To effectively push the market towards energy efficient products, MEPS should be designed based on realistic energy savings estimates (as discussed above), and test procedures should be closely aligned with how appliances are used in real-life conditions. In some cases, however, real appliance usage conditions were very different from the conditions set in Chinese MEPS and test standards. For example, the current washing machine test procedure requires models to be tested at full load capacity, but our surveys show that most of families only load their washing machines to two-thirds of the full load. Similarly, the test procedure for TVs requires models to be tested in a dark room, whereas our survey demonstrates that people always watch TV with some background light. For microwaves ovens, the survey shows that 66% of the households unplug the microwave after use; thus, it is questionable whether or not it is necessary to include standby power as part of the MEPS. We therefore recommend that policymakers take appliance usage habits into consideration when developing or revising MEPS and test procedures such that the final policies best reflect how appliances are being used in real-life conditions.

- **Expanding the usage habits study in future to get even more accurate data**

In this study, we investigated the appliance usage habits in 215 households in China. While the results have provided many useful insights, the study was limited by several factors. Firstly, the diary recording method allows significant room for human error. Despite our efforts to train the participants and regularly communicate with them to answer questions, participants may still have made mistakes in their entries. In future studies, individual electric meters could be installed for each appliance to enable accurate and continuous monitoring of the electricity consumption for each household appliance.

Secondly, the sample size in this study was very small, particularly considering China's large population size. Ideally, surveys should be carried out and replicated in more households in various regions and cities across China to obtain a more complete picture of how appliances are being used.

Thirdly, the diary recording exercise took place in a period of one week in October, and it is very likely that seasonal changes would result in different measurements in the spring or summer. Therefore, we suggest that future study be performed in different seasons of the year to reflect the seasonal variation of appliance usage habits.

Overall, we recommend that policymakers consider repeating and expanding the appliance usage habit study in future to obtain more detailed and accurate data.



Appendix 1: Diary for Appliance-using Habits

Refrigerator

Brand: _____ Model: _____

	Load ⁹		# of door openings per day	
	Refrigerator	Freezer	Refrigerator	Freezer
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				
Sunday				

⁹ Very full (more than 90% of space occupied) , full (70%-90%) , medium (50%-70%) , low (30%-50%) , very low (less than 30%)

Front-load washing Machines

Brand: _____ Model: _____

	# of loads	Temperature setting ¹⁰	Load ¹¹	Unplug after use?
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				
Sunday				

¹⁰ Temperature settings: record temperature if applicable¹¹ Wash load: Full (more than 75% space occupied), half load (50% or less)

Top-load washing machines

Brand: _____ Model: _____

	# of loads	Load ¹²	Unplug after use?
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
Saturday			
Sunday			

¹² Wash load: Full (more than 75% space occupied), half load (50% or less)

Television (LCD or plasma)

Brand: _____ Model: _____

	Time on	Time off	Background light ¹³	Unplug after use	Standby duration if not unplug after every use?	Use default brightness/contrast settings?
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						

¹³ Definition for background light: strong (you can clearly read a book), medium (you can read a book reluctantly), and weak (you cannot read a book at all)

Electrical storage water heaters

Brand: _____ Model: _____

	# of use	Duration (hour)	Purpose ¹⁴	Unplug after use?	Temperature setting
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					

¹⁴ Purpose: shower, clothes washing, cooking, others (please indicate)

Gas instantaneous water heaters

Brand: _____ Model: _____

	# of use	Duration (hour)	Purpose ¹⁵	Temperature setting
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				
Sunday				

¹⁵ Purpose: shower, clothes washing, cooking, others (please indicate)

Induction cooker

Brand: _____ Model: _____

	Duration (hour)	Standby duration (hour)	Purpose ¹⁶	Power (W) ¹⁷
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				
Sunday				

¹⁶ Purpose: hot pot, water boiling, cooking, others (please indicate)

¹⁷ Power: power used. Estimate average if power was adjusted during the cooking process

Rice cooker

Brand: _____ Model: _____

	# of use	Cooking duration	Keep-warm duration	Purpose	Inner container load	Unplug after use	Standby duration (if applicable)
Monday							
Tuesday							
Wednesday							
Thursday							
Friday							
Saturday							
Sunday							

Microwave

Brand: _____ Model: _____

	# of use	Duration (minute)	Unplug after use?	Power	Purpose	Covered when use?
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						

Computer

Brand: _____ Model: _____

	Time on	Time off	Sleep duration (hour)	Hibernate duration (hour)	Programs run ¹⁸	Use of default settings for brightness or contrast?	Unplug after use?
Monday							
Tuesday							
Wednesday							
Thursday							
Friday							
Saturday							
Sunday							

¹⁸ Programs: web surfing, office software, games, entertainment (video or audio)

Air conditioner:

Brand: _____ Model: _____

	Time on	Time off	Function used ¹⁹	Temperature setting
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				
Sunday				

¹⁹ Cooling, heating, moisture removal, ventilation, fan, or other function (Please indicate

