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# Appliance Energy Efficiency Opportunities: China 2013

China is the world's largest producer and consumer of household appliances, lighting, and other residential and commercial equipment. China's appliance energy efficiency program is one of the most comprehensive in the world. However, as this report illustrates, there are tremendous opportunities to capture additional savings through more stringent energy efficiency policies for major energy-consuming appliances. If China can capture these opportunities, then its program will be comprehensive and its policies on par with or exceeding the most advanced appliance energy efficiency policies in the world.

Since 1989, China has developed and implemented over 40 energy efficiency (EE) standards and over 20 mandatory energy labels for a wide range of domestic, commercial, and selected industrial equipment. From 2006 to 2010, in China's 11th Five Year Plan, appliance EE policies contributed to a 19% reduction in energy intensity. In its most recent 12th Five Year Plan, China identified an ambitious goal of reducing the energy intensity of its economy by 40–45% from 2005 levels by 2020. CLASP, along with its Chinese and international partners, is assisting the Chinese government to develop policies to meet this national target.

CLASP provides international best practices, technical analysis, and strategic policy advice to Chinese policymakers, including development and revision of energy efficiency standards and labels; monitoring compliance with appliance energy efficiency policies; and design and implementation of market transformation programs towards more energy efficient products. Two CLASP-supported policies implemented in 2010—EE standards for televisions and distribution transformers—will result in the abatement of 20 $MtCO_2$ in 2020; CLASP has supported an additional 18 policies that are pending or have been implemented in the past year.


## Opportunities for energy efficiency improvement

In 2012, CLASP initiated a series of studies to identify further opportunities for energy savings through appliance efficiency in China. These studies were designed to provide the most accurate depiction of the market for energy efficient appliances, quantify the energy savings potential resulting from increased stringency of appliance standards, and evaluate the effectiveness of incentive policies already implemented for EE appliances. The goal of these studies was to provide Chinese policymakers with key findings and recommendations, based on rigorous analyses, which could be used to prioritize products and inform standards revisions. The executive summary of each study, mentioned in brief below, is included in the appendix of this report.

The table on page 2 ranks selected appliances in order of priority for policy revision based on criteria that includes potential energy savings and feasibility of policy implementation.

### *Prioritizing Products to Capture Energy Savings*

To assess the stringency of current Chinese appliance EE standards, CLASP adopted a three-part approach which comprised: (1) analysis of market data, (2) quantification of energy savings potential, and (3) benchmarking China's EE standards to those of peer economies around the world. This approach led to four independent but complementary studies, the results of which enabled CLASP to produce a comprehensive set of policy recommendations and product policy prioritization.

The four studies are:

***(1) Market Analysis of China Energy Efficient Products (MACEEP)***

*Completed in collaboration with TopTen China, Jeffcott Associates, and the China Sustainable Energy Program (CSEP)*

This study collected market data to compare the distribution of energy efficient products within existing EE tiers. For products with a large market share in the top one or two efficiency levels, the EE standards should be made more stringent and energy labeling tiers should be revised to better differentiate energy efficient products.

***(2) Energy Savings Potential analysis***

*Completed in collaboration with Kevin Lane Oxford, Ltd.*

This study estimated the energy savings potential for various products in the market and provided evidence-based recommendations for priority policy revisions.

***(3) and (4) Benchmarking of refrigerators and clothes washers***

*Completed in collaboration with Stricker Associates, Inc., Consumer Research Associates, China Standards Certification Center, and Intertek*

These studies compared China's national energy efficiency standards and market characteristics for refrigerators and clothes washers with those of other economies, such as the EU and the US. The study provided a clear illustration to Chinese policymakers of the potential to capture additional energy savings by adapting standards that are already in use in other countries around the world.

These four studies are complementary; taken together, they provide a clear rationale for policy decisions that would result in significant energy savings. The MACEEP study can be updated regularly with new market data to provide up-to-date information about market evolution. The Energy Savings Potential analysis provides clear quantitative information about the benefits of improved EE policies. The benchmarking studies (and similar studies for other products) provide clear information as to how China's policies compare to those in peer economies.

## *The Effectiveness of Current Incentive Policies*

In June 2012, the Chinese government launched a $4.26 billion program to incentivize the purchase of energy-efficient appliances. In order to evaluate the impact of this program, which is the largest of its kind, CLASP—in collaboration with All China Marketing Research—conducted a national survey of over 2,500 consumers to determine whether the program had an impact on purchasing decisions that would drive market transformation towards more energy efficient appliances.

Markets for each major appliance in China are growing at a rate of 1.3 to 7% per year.

## The Market for Energy Efficient Appliances

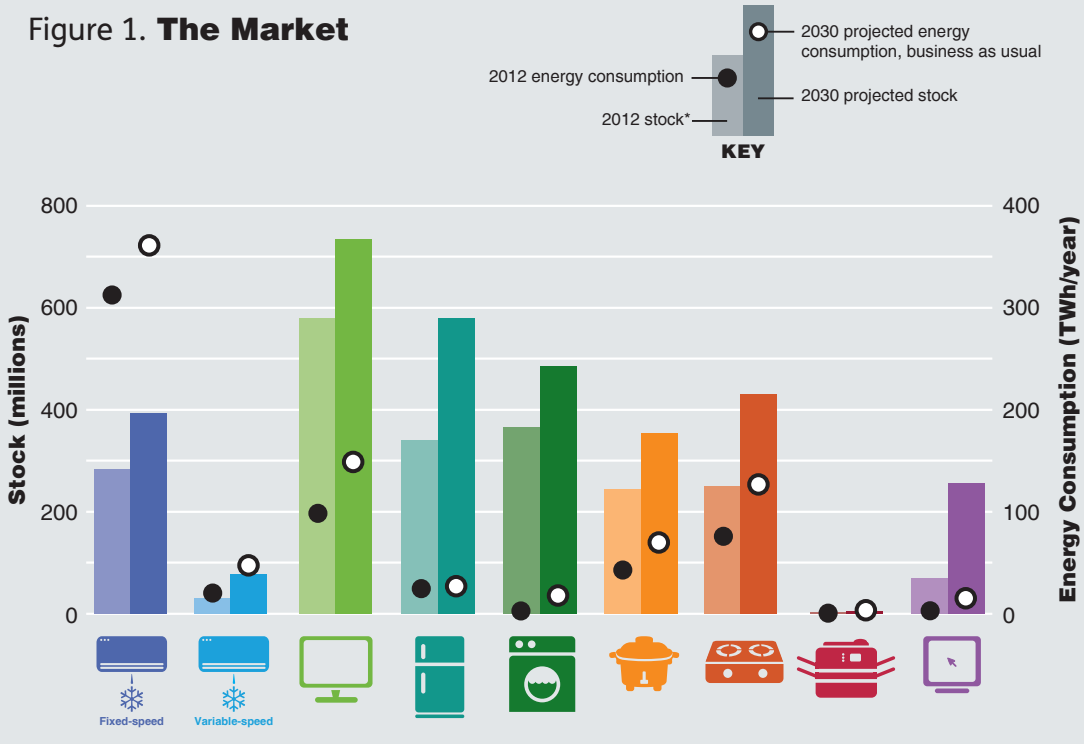
Though China is already the world's largest consumer of household appliances, lighting, and other residential and commercial equipment, strong GDP growth and increasing consumer purchasing power is expected to drive aggressive sales growth through 2030 and beyond. As the installed stock of appliances grows over time, the total amount of energy they consume each year will increase as well.

Figure 1 shows the projected market growth and energy consumption growth associated with major appliances from 2012[1] to 2030. The market for each of these major appliances is growing at rates from about 1.3–7% per year. Figure 1 also shows that, in a business as usual scenario, the appliances that are projected to use the most energy nationwide in China in 2030 are fixed speed air conditioners, televisions, hobs, and rice cookers—and therefore, these products should be prioritized for policy revision.

Another consideration for Chinese policymakers, not reflected in Figure 1, is the contribution of an appliance to spikes in energy demand during times of peak load on electrical grids. Many appliances, such as air conditioners, are used most often at peak load times, stressing electric grids and making it difficult for electricity supply to stay ahead of electricity demand. All of the appliances identified in Table 1 are used more during peak load times except for refrigerators (which are used 24 hours a

1. For most products, the baseline is at 2012; for several products, the baseline is earlier, as stated in Figure 1.

Figure 1. **The Market**




* Baseline stock is from 2012 except for the following products: fixed speed air conditioners (2011), variable speed air conditioners (2011), copiers (2011), and computer monitors (2006).

day). Air conditioners—especially during the summer—are a significant contributor to peak load stresses. In 2011, the contribution of air conditioners to peak load reached almost 50% in big cities like Beijing, Shanghai, and Guangzhou.

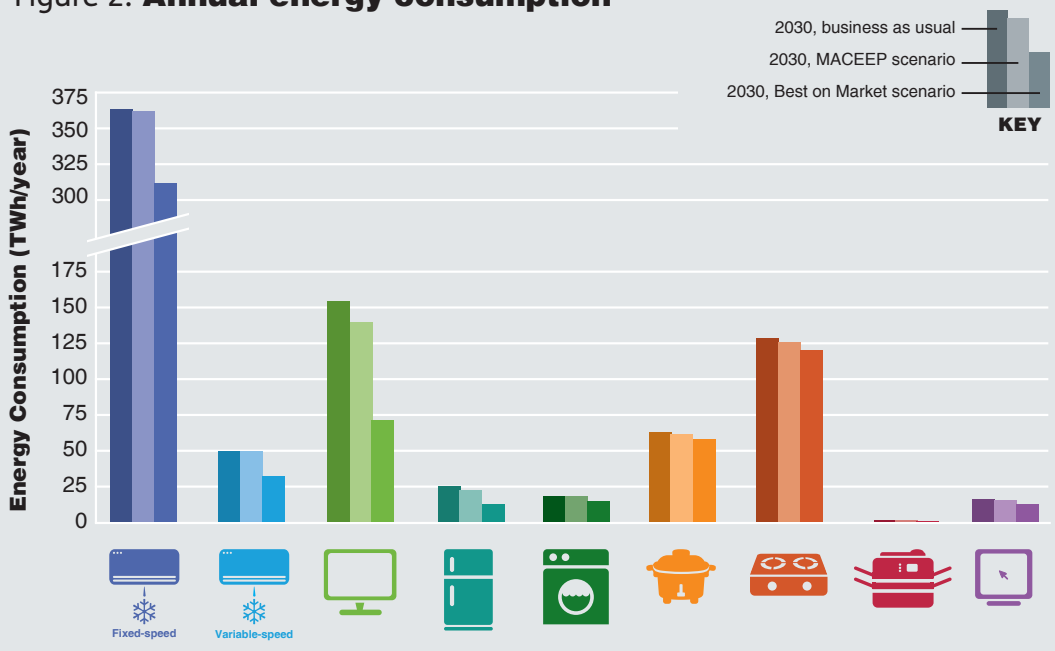
## Potential Energy Savings through Appliance Energy Efficiency Policies

With the total energy consumption of major appliances increasing due to market growth, it is important for policymakers to understand the opportunity to reduce energy consumption through revision of existing product energy efficiency standards and implementation of other efficiency-related policies and initiatives.

Figure 2 shows the **annual projected energy consumption in 2030** of each of these major appliances under three policy scenarios: (1) business as usual; (2) applying the policy recommendations set forth in the MACEEP study (MACEEP scenario); and (3) revising EE standards to reflect the energy performance of the best products currently on the Chinese market (Best on Market scenario). The energy consumption for all products decreases under each scenario, reflecting greater energy efficiency gains from more ambitious policies. All products in Figure 2 show potential for reduced energy consumption in the MACEEP and Best on Market scenarios.

Figure 3, which displays the **annual energy savings potential in 2030** under the MACEEP

Figure 2. **Annual energy consumption**



and Best on Market scenarios, more clearly shows the large potential for energy savings under the Best on Market scenario through policy revision for fixed speed air conditioners and televisions. Variable speed air conditioners and refrigerators also show significant potential for annual energy savings in 2030 in the Best on Market scenario. As with Figure 2, all major appliances in Figure 3 have incremental potential energy savings from the MACEEP scenario as well as larger potential energy savings from the more ambitious Best on Market scenario.

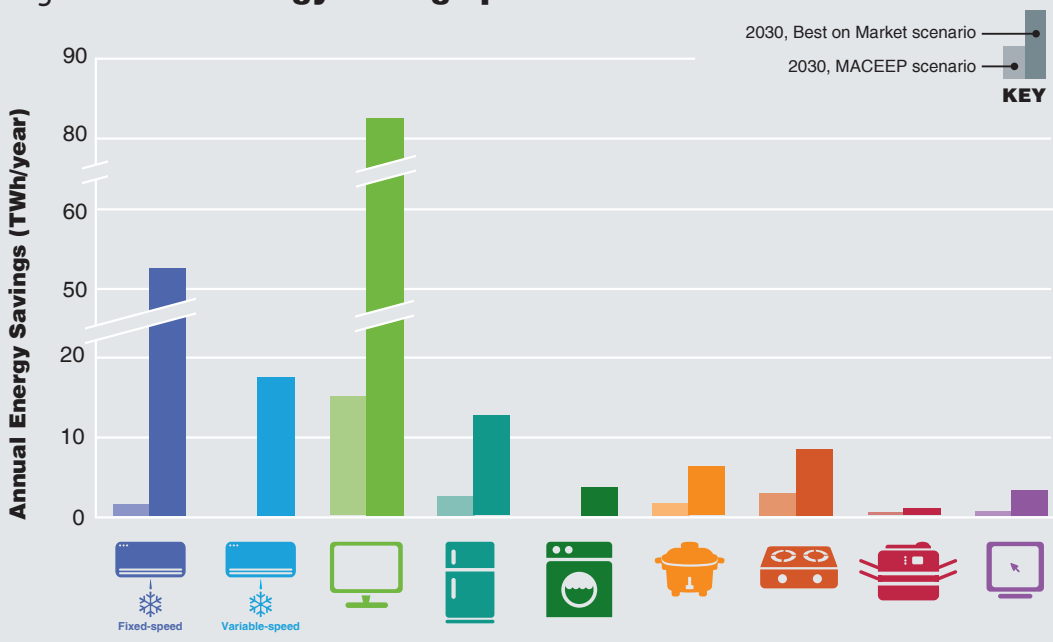
Based on the annual energy savings potentials in 2030 shown in Figure 2 and Figure 3, these nine prioritized products have potential annual energy savings of 189 TWh per year in 2020 in the Best on Market scenario. Fixed speed air conditioners and televisions, in particular, show drastically reduced energy consumption in the Best on Market scenario.

The large potential energy savings for fixed speed air conditioners reflects (1) the large overall energy consumption of air conditioners, (2) an anticipated 30% increase in the stock of fixed speed air conditioners from 2012 to 2030, and (3) a 15% energy efficiency improvement from the average product currently on the market to the most efficient product currently on the market.

The large potential energy savings for flat-screen televisions in the Best on Market scenario reflects (1) that the best product currently on the market uses less than half of the energy of the average product currently on the market, and (2) that the television stock is expected to increase by more than 25% from 2012 to 2030.

Beyond the Best on Market scenario, which generally indicates incremental change (though at a faster pace than the MACEEP

Figure 3. **The energy savings potential**

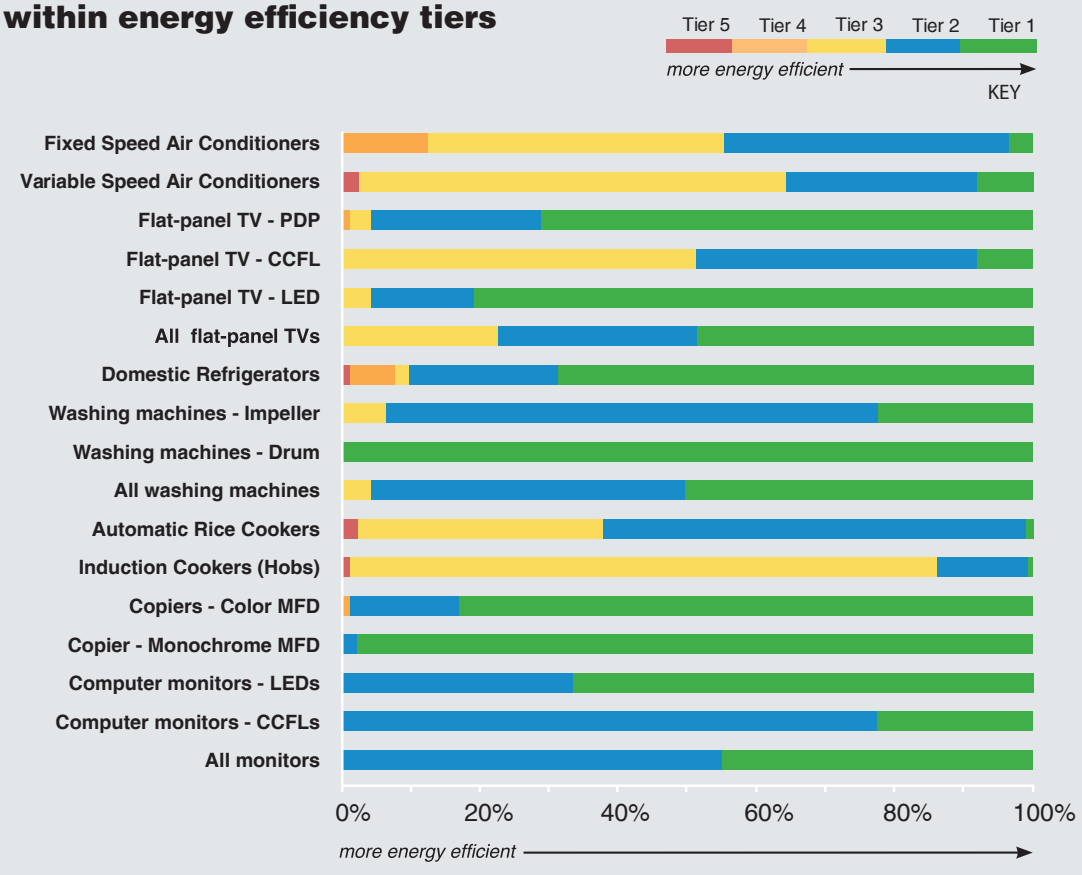


scenario), it is possible for China to implement policies that generate transformational changes in the market for some major appliances. Two examples of this are air conditioners and electric storage water heaters (not included in the figures).

Figure 2 and Figure 3 show very large potential energy savings from revision to the policy for fixed speed air conditioners (52 TWh/year). However, the potential energy savings in 2030 are three times larger—over 160 TWh/year—if EE standards were to incorporate a transition from fixed speed to variable speed air conditioners (Lawrence Berkeley National Laboratory, 2012, *Potential for Further Savings from Appliance Efficiency Programs in China*). Similarly, the potential energy savings from electric storage water heaters in the Best on Market scenario is about equivalent to rice cookers (7 TWh/year). However, a market transformation to heat pump water heaters—a much more energy-efficient technology—would result in energy savings of about 250 TWh/year (Lawrence Berkeley National Laboratory, 2012, *Potential for Further Savings from Appliance Efficiency Programs in China*).

These two examples are extremely ambitious, and unlikely to be undertaken in the near term. However, they show a large, currently untapped potential for future energy savings that could exist through product policy revision in the Chinese market.

Figure 4. **Energy labels: market distribution within energy efficiency tiers**



For almost all products, product models cluster in Tier 1 and Tier 2. This indicates to consumers that all products are "most efficient."

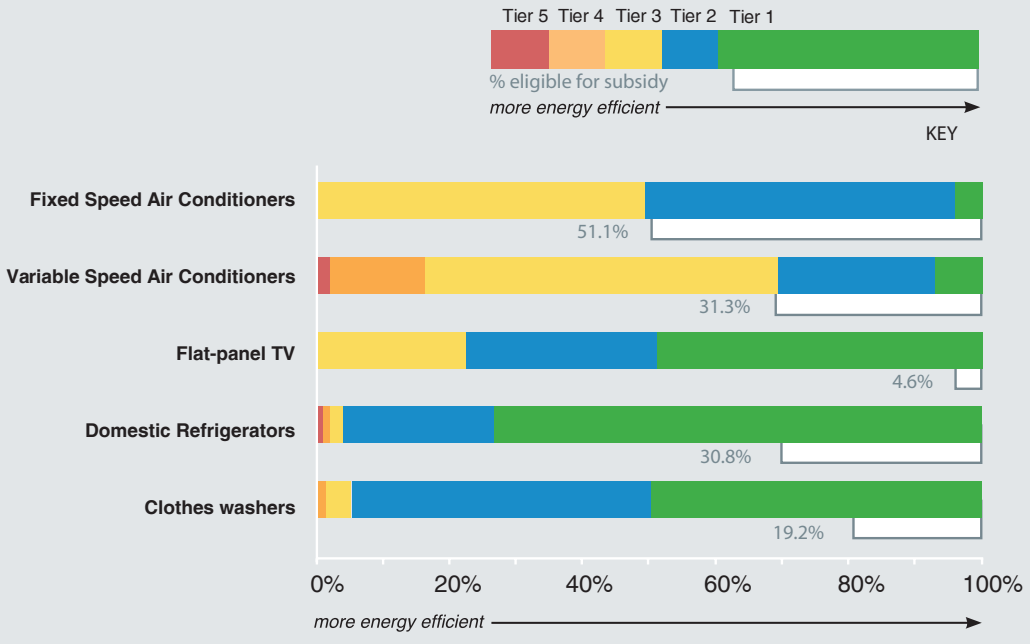
## Energy Efficiency Tiers and Incentive Programs

In addition to examining the quantified energy savings potential of product policy revisions, it is important to consider how consumers make appliance purchasing decisions. Mandatory energy labels that include either a five-tier or three-tier scale from most efficient ( Tier 1) to least efficient (either tier 3 or tier 5) exist for over 20 products in China.

Figure 4 shows the tier distribution in Chinese markets for selected appliances, as collected directly from market data in the MACEEP study. For almost all products displayed in Figure 4, the market reflects the clustering of product models in Tier 1 and Tier 2. This clustering suggests that there is substantial room to raise the EE standards for these products, and also diminishes consumers' ability to differentiate products based on energy efficiency—with so many models in the top two tiers, all models appear to consumers to be most efficient. For many products, there is an opportunity to revise the energy labeling tiers to differentiate energy efficient products, spur the market towards higher energy efficiency, and capture additional energy savings.

In addition, the Chinese government relied on these tiers to determine product eligibility for the subsidy program of US$4.26 billion launched in June 2012. As is evident in Figure 5, subsidized products faced one of two circumstances with regards to energy labels. For air conditioners, the top two tiers were eligible for subsidies, resulting in subsidies for a very large percentage of models on the market. For the other subsidized products—flat panel televisions, refrigerators, and clothes

Figure 5. **Energy efficiency tiers and percentage of products eligible for 2012–2013 subsidy**



washers—only a portion of models in the top tier were eligible for the subsidy. For these three products, the top EE tier was too saturated to sufficiently differentiate the most efficient products, so the Chinese government had to put in place more stringent eligibility criteria for subsidies. This signifies a need for policymakers to revise these tiers to better differentiate the energy efficiency of product models, both for consumer decision making and for more effective incentive policies.

## Global Comparison of China's Energy Efficiency Standards

Chinese policymakers have an additional incentive to revise existing product policies that are less stringent, and in some cases, much less stringent, than other major national and regional efficiency standards. In 2013, CLASP completed benchmarking studies comparing Chinese policies and markets to those in other economies for refrigerators and washing machines.

Refrigerator performance in China has improved rapidly since the last revision of EE standards and labels in 2009. International comparisons show that Chinese efficiency requirements for small-sized refrigerators are similar to those of other economies, and the distribution of small-sized refrigerator models on the Chinese market reflects higher energy efficiency than in other economies. As far as EE standards, a refrigerator with an adjusted volume of 300 liters is permitted to use up to about 375 kWh/year in China, while the same size refrigerator in Switzerland (the international benchmark) can use about 175 kWh/year and in the EU can use about 300 kWh/year (which will be reduced to about 225 kWh/year in 2014). When examining products on the market, Chinese small refrigerators (adjusted volume of 300 liters) cluster around an energy consumption of 100–250 kWh/year, while the same sized refrigerators from other economies tend to cluster around 200–350 kWh/year.

However, comparisons with other markets show that China can increase the energy efficiency of large refrigerators. To determine EE standards for refrigerators, each standard uses a multiplier to determine how much more energy is allowed as the adjusted volume of the refrigerator increases. This multiplier is higher in China than in other economies, meaning that the EE requirements for large refrigerators are more lenient in China than elsewhere. For example, a refrigerator with an adjusted volume of 1100 liters is permitted to use up to about 750 kWh/year in China, while the same size refrigerator in Switzerland (the international benchmark) can only use up to about 350 kWh/year—less than 50% of the energy consumption allowed in China—and in the EU can use about 650 kWh/year (to be reduced to about 475 kWh/year in 2014).

Currently, refrigerators found on the Chinese market cluster at small adjusted volumes, which implies that purchased refrigerators are energy efficient when compared to international models. However, as the Chinese economy continues to grow, there is a risk that if consumers begin to buy larger refrigerator models—as happened in the US in the 1970s and 1980s—then the current EE standard will lead to large increases in energy consumption of refrigerators.

In contrast, energy efficiency labelling tiers for front-loading clothes washers in China

are well-correlated with tiers used for EU energy labels. For a small sample of tested products, clothes washers with energy consumption at the Tier 1 level in China correlated to the A+++ level in the EU, and clothes washers at the Tier 3 level in China correlated to the A+ or A level in the EU. However, China can achieve additional energy savings by encouraging the continued transition from top-loading impeller type clothes washers to front-loading drum type clothes washers.

## Conclusion

To contribute to prioritizing product policy revisions in China, CLASP collected and produced product-specific information about market trends, projected energy consumption, potential energy savings, market distribution among the energy efficiency tiers, and how Chinese policies compare with those in peer economies. Each of these individual analyses provided Chinese policymakers with useful insights, and when taken together, they provide a snapshot in 2013 of China's opportunities to improve appliance energy efficiency.

These studies illustrate that tremendous energy savings are available through China appliance energy efficiency policies including revisions to EE standards, revisions of tiers for energy labels, and the impacts of both of these on incentive policies. Much of these potential energy savings stem from policy revisions for air conditioners (fixed speed and variable speed), flat-screen televisions, refrigerators, and clothes washers, with additional potential energy savings from rice cookers, induction cookers (hobs), copiers, and computer monitors.

Additionally, for these high priority products, a high percentage of product models cluster in the highest-efficiency tiers, Tier 1 and Tier 2. Chinese policymakers should revise EE standards to eliminate least efficient products from the market, and revise the tiers used in energy labels to better differentiate the energy efficiency of product models, both for consumer decision making and for more effective incentive policies.

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