

Market analysis for China energy efficient products

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Abstract

The Chinese total residential electricity consumption has increased more than 10 % per year since 2007. This is mainly due to wider use of electric equipment. The Chinese government wishes to improve the products' energy efficiency. There are already 48 MEPS in place for residential and industrial products and the China Energy Label covers 27 products. Several rebate programs have been put into force to promote the high efficiency products.

The objective of the study "Market Analysis of China Energy Efficient Products" by Top10 and CLASP is to analyse the current market status of efficient products, calculate potential energy savings and provide policy recommendations. Nine major products were selected for the analysis: fixed and variable speed air conditioners, refrigerators, washing machines, TVs, rice cookers, induction cookers, monitors and copiers.

Detailed market data were gathered from a number of sources. From this large amount of data, the analysis showed that: 1) The model shares of products under each energy efficiency tier vary greatly among products and technologies. The share of the most efficient products in tier 1 shows two opposite situations – either they make up almost all of the market or there are almost none. For the products with over-representation in tier 1, flat-panel TVs, copiers, computer monitors, washing machines and refrigerators, the up-scaling of the energy efficiency tier is urgently needed. 2) The relationship between energy efficiency and capacity varies according to products, but the absolute energy consumption increases with the capacity for all the products.

3) MEPS and energy label thresholds influence pricing strategies of energy efficient products. The energy efficiency tiers have a very close relation with the retail price, which shows an increase with good energy efficiency tiers. However, the energy efficiency information has limited impacts on the price for some products.

Introduction

The total electricity consumption of China kept increasing in recent years. The 2012 total consumption reached 4,959 TWh (NEA, 2013). The total electricity consumption is distributed into four sectors: primary industry, secondary industry, tertiary industry and urban and rural residential. Comparing with the fluctuant increasing rate of the total electricity consumption, the annual increasing rate of residential electricity is stable at the high level of more than 10 % since 2007 (Figure 1). The residential electricity represented 12.5 % of all electricity consumption in 2012. Due to the social and economic development, urbanization and life style evolution, the total and residential electricity consumptions are expected to continue to increase in the coming years.

Almost all the urban and rural electricity is consumed by the end-use products. China is one of the largest markets in the world for manufacturing, selling and stocking of home appliances (CHEAA, 2011). In the past two decades, a large number of major appliances have been widely deployed among urban households. The ownership rate of major appliances (refrigerator, air conditioner, washing machine and TV) is higher than 90 %. Many urban households have started renewing and replacing their appliances with new generation models. Meanwhile, China has witnessed an accelerated process of appliances penetration into rural areas as well. Ownership rates of the ma-

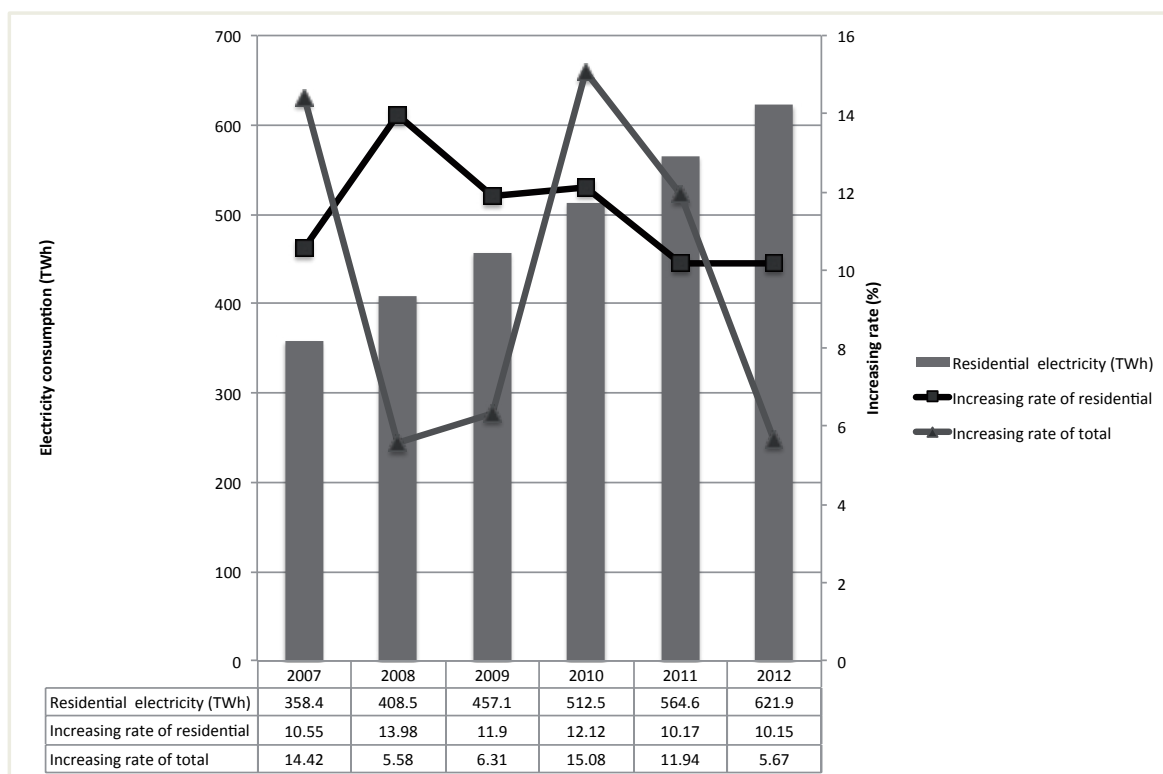


Figure 1. Electricity consumption and annual increase rate of urban and rural residential sector. Source: National Energy Administration (NEA).

major appliances in rural households kept increasing for the last 10 years (GF Securities, 2011). At the same time, in evaluating which appliances to purchase, users are paying more and more attention to energy efficiency as one of the key factors. More than 90 % of the consumers took the energy consumption into purchasing decision making (ZDC, 2010).

In China, the wording “Energy efficiency standard” covers both minimum energy performance standard (MEPS) and energy labeling. The Chinese Energy efficiency standards for end-use products have proven to be effective policy tools to eliminate inefficient products and push market transformation towards higher efficiency (CNIS, 2012). They are also the technical basis of incentive programs such as public procurement and the subsidy program for the energy efficient products. They are recognized as one of the most important tools serving the national “Energy Saving and Emission Reduction” policy and the overall emission intensity reduction goal, which is to achieve 16 % reduction of energy per capita in 2015 compared to 2010.

In June 2012, a new program named “100 energy efficiency standards” was jointly initiated and launched by Standardization Administration of China (SAC) and National Development and Reform Commission (NDRC). This program aims at revising and developing 100 energy efficiency standards covering the industry production processes, buildings and end-use products.

The “Market Analysis for China Energy Efficient Products” (MACEEP) study is jointly conducted by Top10 China and CLASP and funded by the Energy Foundation. This project analyzed the market status of efficient products, calculated potential energy savings and introduced policy recommendations. Nine major products were selected for analysis: fixed and variable speed air conditioners, refrigerators, washing machines, flat-panel TVs, rice cookers, induction cookers, computer

monitors and copiers. These products are the most commonly used in homes and they are covered by energy labels; air conditioners, refrigerators, washing machines and flat-panel TVs are also included in the latest subsidy program. In addition there is very good data availability for them. This project focuses on available product models on the retail market. Several data sources including retailers, independent market research companies and labeling program were integrated into one database for the analysis. It covers the product basic information, energy information and the retail price. The energy related data such as the energy consumption, capacity, energy efficiency tier and index comes from manufacturers’ declaration for the products such as the nameplates, product instructions and energy labels. The price information was sampled from two large retail-chains (Gome, Suning), on-line stores and independent information providers (ZOL, ETao) in June 2012.

The MACEEP report (Top10 & CLASP, 2013) covers various aspects of products, based on product specific analysis. Every product has its unique characteristics and priorities. This paper summarizes the general status, findings, conclusions and recommendations from the report. It presents the current status of China energy efficiency standards and energy label, the distribution of energy efficiency tiers, the efficiency, absolute energy consumption and capacities and the impacts of energy efficiency on the retail price.

China energy efficiency standards, energy label and incentive policies for energy using products

The first batch of 9 end-use product energy efficient standards was implemented in 1990 (Liang, 2003). There are currently 48 energy efficiency standards in place (end of 2012), which

Table 1. Domestic and Commercial Energy Using Products covered by Energy Efficiency Standards and Labels.*

Products	Standard Reference	Standard Implementation Date	China Energy Label Implementation Date	Energy Efficiency Tiers
Compact fluorescent lamps (CFL)	GB 19044-2003	2003-9-1	2008-6-1	3
High pressure sodium lamps	GB 19573 2004	2005-2-1	2008-6-1	3
Washing machines	GB 12021.4-2004	2005-5-1	2007-3-1	5
Gas water heaters	GB 20665-2006	2007-7-1	2008-6-1	3
Variable speed air conditioners	GB 21455-2008	2008-9-1	2009-3-1	5
Induction cookers	GB 21456-2008	2008-9-1	2009-3-1	5
Electrical water heaters	GB 21519-2008	2008-11-1	2009-3-1	5
Copying machines	GB 21251-2008	2008-11-1	2009-3-1	3
Computer monitors	GB 21520-2008	2008-11-1	2009-3-1	2**
Refrigerators	GB 12021.2-2008	2009-5-1	2005-3-1	5
Rice cookers	GB 12021.6-2008	2009-6-1	2010-3-1	5
Fans	GB 12021.9-2008	2009-6-1	2010-3-1	3
Fixed speed air conditioners	GB 12021.3-2010	2010-6-1	2005-3-1	3
Flat-panel TVs	GB 24850-2010	2010-12-1	2011-3-1	3
Microwave ovens	GB 24849- 2010	2010-12-1	2011-3-1	5
Printer & Faxes	GB 25956-2010	2011-7-1	2012-1-1	3
Set-top boxes	GB 25957-2010	2011-7-1	2012-1-1	3
Household solar water heaters	GB 26969-2011	2012-8-1	2012-9-1	3
Microcomputers	GB 28380 -2012	2012-9-1	2012-2-1	3

* Industrial products are not listed in this table.

** The tiers were reduced to 2 in November 2011.

cover household appliances, commercial products and industrial equipment.

The China Energy Label program was launched in 2005 and covers 27 products (end of 2012). It is based on an energy efficiency classification set in correspondence with the energy efficiency standards. The products analyzed in this paper were selected from the labeled products.

Chinese government has implemented a series of financial incentive programs to promote the market penetration of appliances in recent years: the “Subsidy program for home appliance replacement”, the “Appliances to Rural Areas” and the “Project to promote energy-efficient products for the benefit of the people”. These policies set direct or indirect requirements regarding the energy efficiency for the qualifying products.

The “Project to promote energy-efficient products for the benefit of the people” was launched in June 2009. It subsidized the products according to energy efficiency performance. The fixed speed air conditioner was the first major household appliance subsidized between 2009 and 2011. From June 2012 to

May 2013, around 3.3 billion Euros will be used to subsidize fixed and variable speed air conditioners, refrigerators, washing machines, flat-panel TVs, water heaters, micro-computers and other industrial equipment.

Energy efficiency tiers market status

The Energy efficiency tiers show the energy efficiency differences between the products. The China Energy Label program has two classification scales – with either 3 or 5 tiers. In both scales the lower the tier, the higher the energy efficiency. Energy efficiency tiers play key roles in the policies. Tier 3 or 5 are the mandatory minimum requirements for products to access the market. Tiers 2 and 1 are generally endorsement requirements for the energy efficient product certification and incentive policies. Energy efficiency tiers also have impacts on the product prices (see below).

It is well known among consumers that tier 1 is the best and tiers 5 to 3 are the worst of all available products on the market

(ZDC, 2010). However, the tier distribution shows great variety for different products. The tiers distribution of the 9 selected products are shown in Figure 2.

The shares of tier 1 products show two opposite situations: either they make up almost all of the market or there are almost none.

The share of tier 1 products of copiers reaches 94 %. For the flat-panel TVs, the energy efficiency standard came into effect only one and a half years ago, but still the tier 1 products already have more than a 60 % share. For monitors and washing machines, tier 1 products reach a share of almost half the market. For those products, consumers can not distinguish the most efficient products from the energy efficiency tiers, because 58 % of consumers do not understand the efficiency information provided by labels; they only understand the energy efficiency tiers (ZDC, 2010).

However, for the air conditioners (fixed and variable speed), rice cookers and induction cookers, the share of tier 1 products is lower than 8 %. For the rice cookers and induction cookers, tier 1 products are almost not available on the market. For those products, tier 1 products are really the most efficient on the market.

For the products which have energy efficiency tier 5, the total share of tiers 4 and 5 products is very low. The highest share

reaches only 16 % for variable speed air conditioners, while the lowest share is even lower than 2 %. For refrigerators and washing machines, the share of tiers 4 and 5 products is so low that these products can be ignored when looking at the market. The general trend is that, while developing and revising energy efficiency standards, the scale of the energy efficiency tiers is being reduced from 5 to 3. According to Table 1, almost all the new and revised standards after 2010 adopted an energy efficiency tier scale of 3 except microwave ovens. In the revised GB 12021.3-2010 for fixed speed air conditioners, the number of energy efficiency tiers was reduced from 5 to 3. In the draft GB 21455-201X for the variable speed air conditioners, the number of the energy efficiency tiers is proposed to be reduced from 5 to 3.

Technologies and energy efficiency tiers

Five products have at least two mainstream technologies.

Separate energy efficiency requirements are set according to the technologies for air conditioners, flat-panel TVs and washing machines, while the rest of products regulate different technologies with the same indicators and requirements.

Technologies have great impacts on the energy performance and efficiency tiers, no matter if they are regulated by different or similar requirements. The tiers analysis of washing ma-

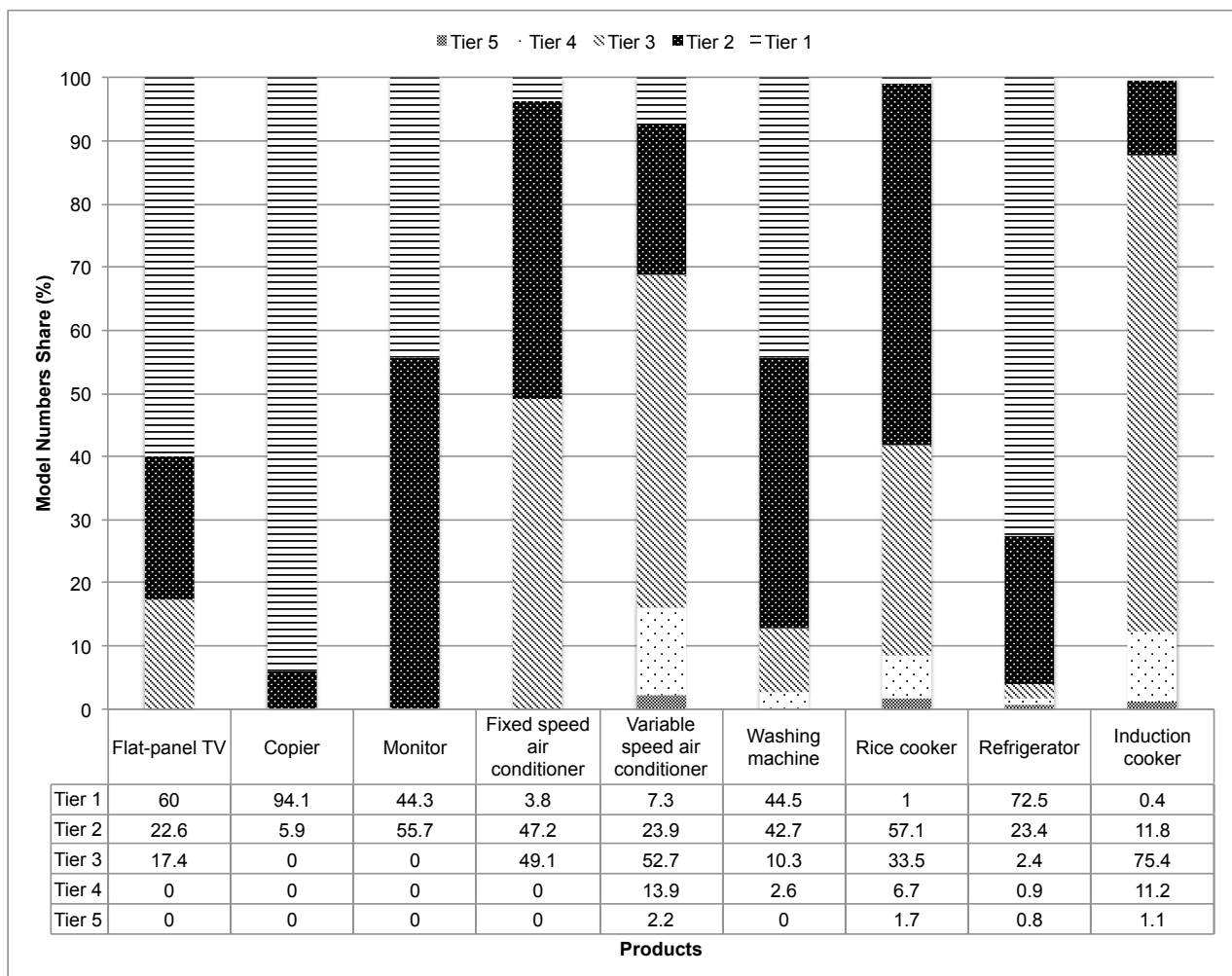


Figure 2. Energy efficiency tier model distribution of 9 selected products.

Table 2. Mainstream technologies of the products.

Product	Main technologies	Different indicator or efficiency requirements?
Air conditioners	Variable speed and fixed speed	Yes
Flat-panel TVs	PDP and LCD (CCFL and LED)*	Yes
Monitors	CCFL and LED	No
Washing machines	Front-load and top-load	Yes
Rice cookers	Resistance and induction	No

* PDP – Plasma Display Flat-panel TV, LCD – Liquid Crystal Display, CCFL – Cold Cathode Fluorescent Lamp, LED – Light Emitting Diode.

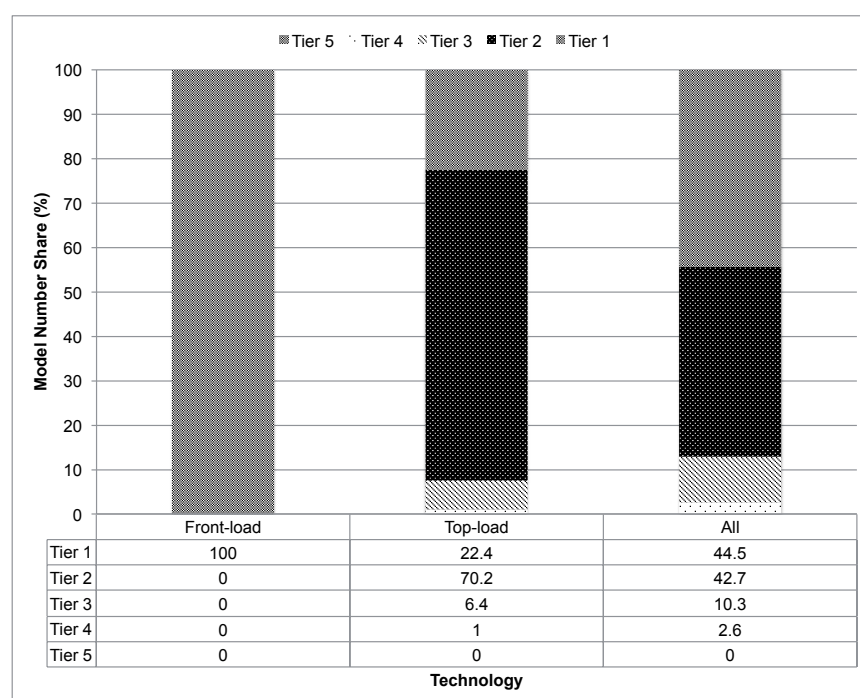


Figure 3. Energy efficiency tier model share of different technologies of washing machines.

chines, monitors and flat-panel TVs will be used as an example to explain this impact.

For washing machines, 100 % of the front-load models are tier 1 products, while only 22 % of the top-load models are tier 1. There are no front-load washing machines available on the market for the other tiers. Tier 2 takes the largest share of the top-load technology. Different testing conditions are applied for front-load and top-load models. Top-load washing machines have cold water inlet at a temperature of 30 ± 2 °C and tested with cold water as inlet. Front-load washing machines have cold water inlet at a temperature of 15 ± 2 °C and are tested with warm water heated by the washing machine at a temperature around 50 ± 2 °C (GB/T 4288, 2008). The front-load washing machine has lower energy efficiency requirements for the same tier than the top-load washing machine due to the different testing conditions. The share of the top-load washing machine is much higher than the front-load ones. Tier 1 and tier 2 products equally share the market when both technologies are considered.

The monitor energy efficiency standards GB 21520-2008 sets different energy efficiency requirements for the older Cathode Ray tube (CRT) and newer LCD technologies. The CRT monitors are actually eliminated from the market due to rapid market development. The two main backlight technologies, LED and CCFL, are regulated by the same requirements. The market share of the tier 1 for LED monitors is much higher than the share of tier 1 for CCFL products. In the overall distribution of the market share of tiers, most tier 1 products come from the LED technology, while most of tier 2 products come from the CCFL technology.

The flat-panel TV energy efficiency standard GB 24850-2010 sets the same testing procedures for the PDP and LCD technologies. However, it sets different energy efficiency requirements for those two technologies. The “technology neutral” approach is not adopted in the standard development for the flat-panel TV. The standard developer took the industry development into consideration in setting the energy efficiency requirements. (Wu, 2010). Comparing with the energy efficiency

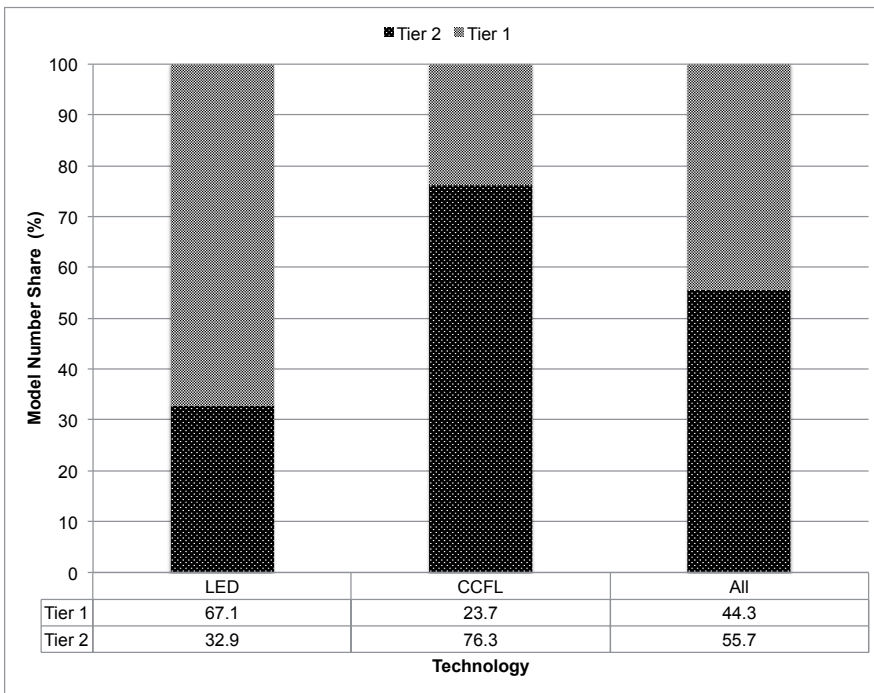


Figure 4. Energy efficiency tier market share of different technologies of LCD monitors.

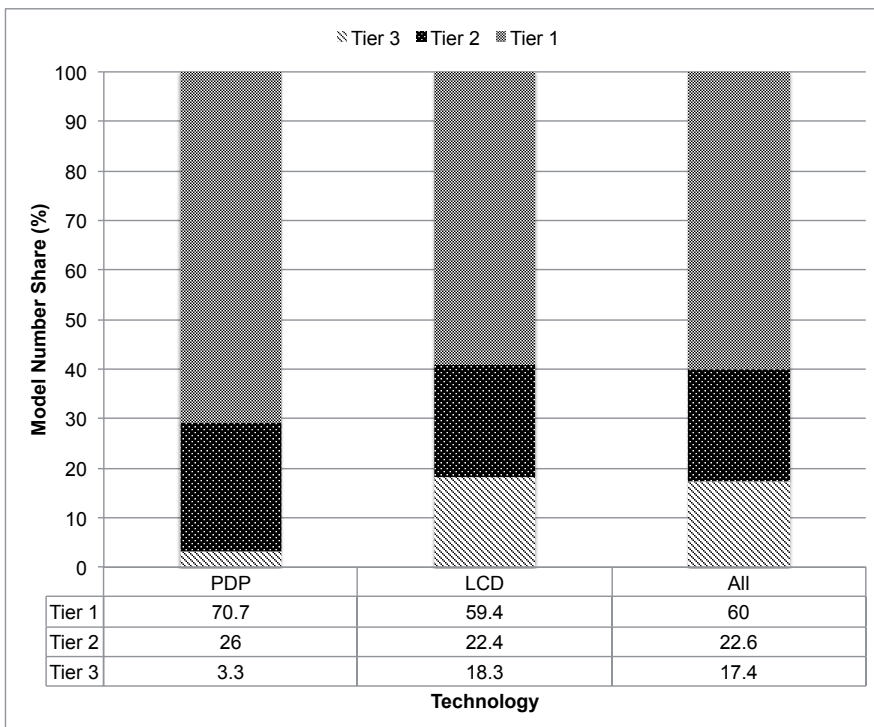


Figure 5. Energy efficiency tier market share of different technologies of flat-panel TVs.

standards of TV from Energy Star and EuP, GB 24850-2010 adopts different energy efficiency indicator, which is the ratio between TV’s luminance and power (Ruan, 2010). The energy efficiency index (EEI) for PDP TV is improved by a correction factor and the requirement for PDP tier 1 (1.2) is 0.2 less than tier 1 requirement of the LCD TV (1.4).

Although PDP technologies have more than 70 % products in tier 1, the actual energy efficiency of the PDP TV is

much lower than the efficiency of LCD TV when taking out of correction factor. The absolute energy consumption of PDP TVs for similar size models is much higher than the LCD TV. Due to low market shares of PDP products, which represent less than 10 % of the LCD TVs, it has very limited impacts on the overall energy efficiency tiers distribution of flat-panel TVs. Tier 1 products are still over-represented on the market with more than 60 % market shares.

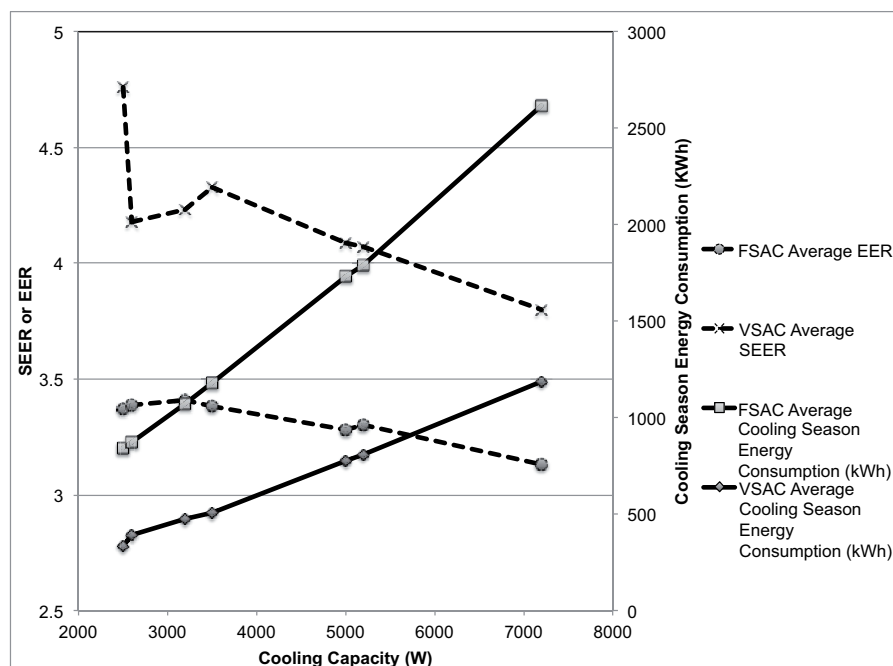


Figure 6. Cooling capacity, energy efficiency ratio (EER) versus cooling season energy consumption of the air conditioners. FSAC is the abbreviation of Fixed Speed Air Conditioners and VSAC is the abbreviation of Variable Speed Air Conditioners. VSAC cooling season energy consumption is calculated according to the Energy Label; FSAC cooling season energy consumption is calculated according to the power and cooling duration for 1,136 hours a year according to GB 21455-2008.

Energy efficiency tier is one of the most important indicators for the subsidy program for energy efficient products. Generally, tier 1 or 2 is adopted as the minimum requirements for the subsidy. For the products which have very high share of tier 1 products, the subsidy should not be only based on the energy efficiency tier. In a subsidy program implemented in Beijing in 2009, the subsidy criteria for washing machine is tier 1, which subsidized all the front-load washing machine due to the 100 % tier 1 products of the front-load technology. For the products with more than two technologies, the same energy efficiency tier might have large energy efficiency performance differences for different technologies. However, the subsidy is awarded mainly on the energy efficiency tier. The low efficiency technologies can also be subsidized such as the PDP TVs, which does not help the market transformation towards higher efficiency.

Capacity, energy efficiency and energy consumption

In this paper, “capacity” refers to the parameter characterizing the size of the product/service, such as the cooling capacity for the air conditioners, volume for the refrigerators, screen sizes for the flat-panel TVs, etc. “Energy efficiency” is a relative value used to evaluate the system’s efficiency in transforming energy. “Energy consumption” depends on the input power and duration of usage. High efficiency does not guarantee less energy consumption expect under the condition of the same capacity and duration of usage.

For air conditioners, energy efficiency standards set different energy efficiency requirements for the tiers according to the cooling capacity. The actual energy efficiency decreases with the increase of the cooling capacity. The absolute energy con-

sumption increases with the increase of the cooling capacity in all cases.

For front-load washing machines, energy efficiency remains almost flat comparing to washing capacity. The absolute energy consumption for each wash has a linear increasing relationship with the washing capacity.

For LCD flat-panel TVs, the absolute energy consumption increases with the screen size, and the EEI also increases with the screen size. This means the energy efficiency becomes better for a larger TV, but the absolute energy consumption also becomes bigger.

For rice cookers, the greater the capacity, the higher the energy efficiency and absolute energy consumption.

The absolute energy consumption increases with the capacity. For some products, such as the air conditioners, the capacity is the one of the most decisive indicators to set the minimum requirements of energy efficiency tiers. Different requirements of the same tier are set for different capacities.

Capacity is also one of the important indicators to set the subsidy criteria of the incentive programs. Generally, higher amount of subsidy is available for higher capacity products. This might encourage consumers to buy oversized products which they essentially do not need.

Impact of energy efficiency on price

The purchasing price is affected by many factors, such as brand, design, dimension, quality, technology, and capacity, etc. How do energy efficiency properties, such as the energy efficiency tier and index, affect the price of the energy using products?

Figure 10 shows that the price has a very close relation with the energy efficiency tiers for 5 products, with the price increas-

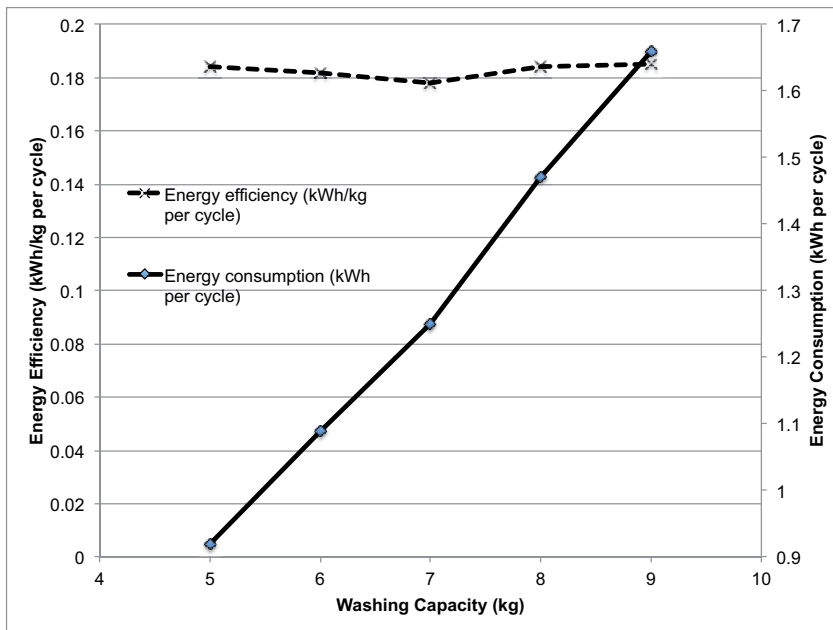


Figure 7. Washing capacity, energy efficiency versus energy consumption of the front-load washing machines.

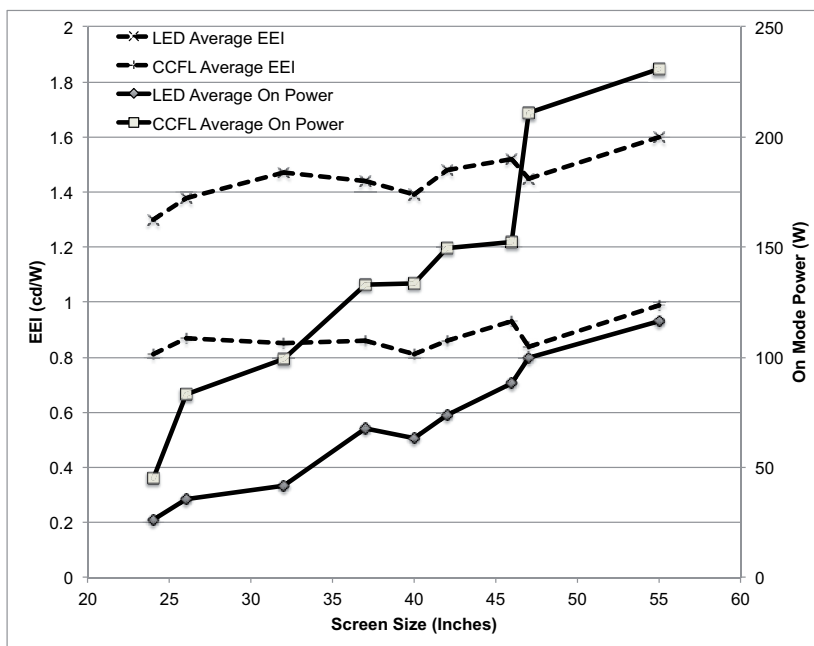


Figure 8. Screen size, EEI versus On mode power of the LCD flat-panel TVs.

ing with better tiers. The similar relation of price and energy efficiency tiers can be observed in Europe (Attali, 2009). Generally, the manufacturing cost of the high energy efficiency products is higher than the low efficiency ones. For some products such as variable speed air conditioners, the price differences between tier 1, 2 and 3 are so significant that one can deduce that manufacturers and retailers develop their product pricing strategy according to energy efficiency tiers (and not according to the actual added cost of better equipment). A further research on the manufacturing costs, retail price, energy efficiency and market competition should be conducted for those products.

For rice cookers, the price is not related to the energy efficiency tier. Some low tier products even have much higher

price than high efficiency ones. The price of tier 4 is very high, because most of the tier 4 products are the imported multi-functional rice cookers. The quality and other factors play a more important role in the product pricing than the energy efficiency tier.

However, the MACEEP study also shows that prices were actually affected in a limited way by the energy efficiency information shown on the energy label for some products. 77 % consumers know that "the lower the energy efficiency tier, the higher the efficiency", but 58 % consumers do not understand the efficiency information on the label (ZDC, 2010).

Washing machines are used as an example to explain this observation.

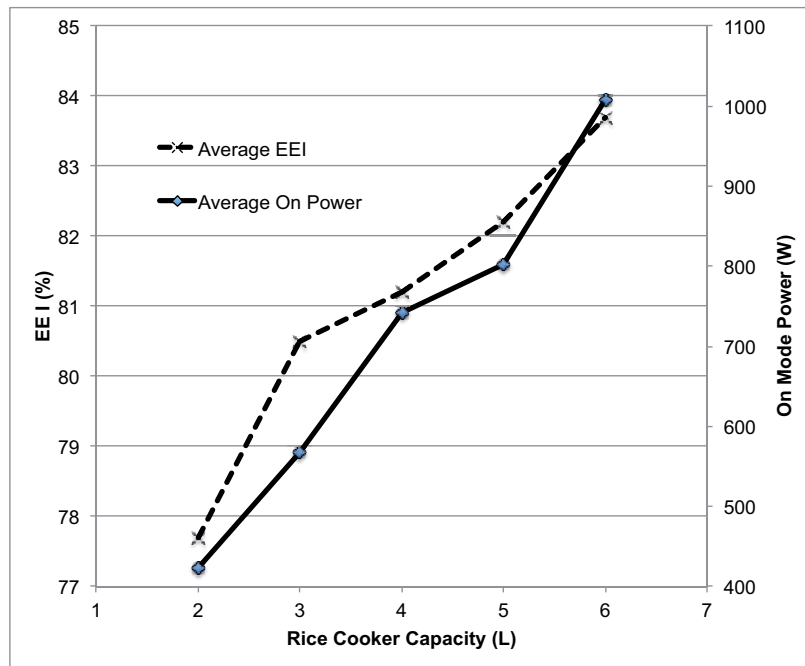


Figure 9. Cooking capacity, EEI and On mode power of the rice cookers.

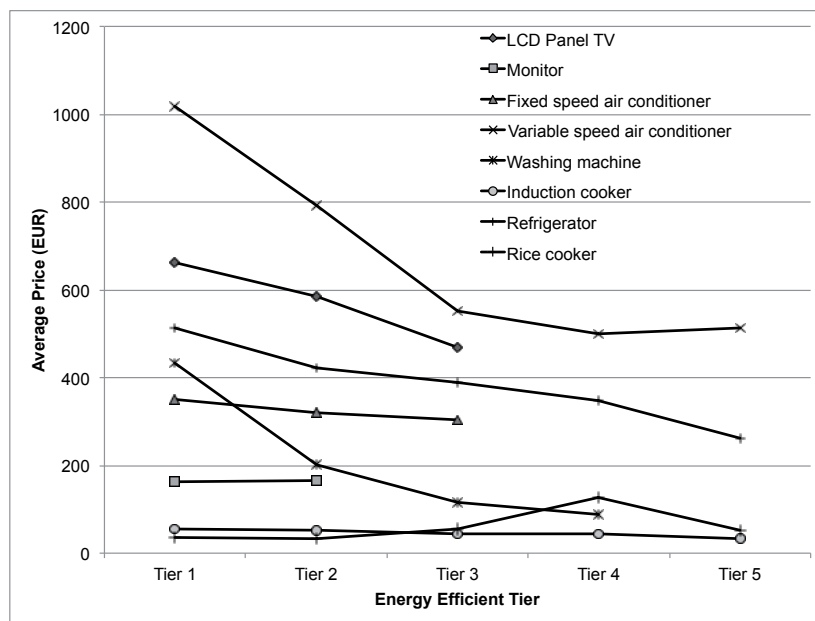


Figure 10. Energy efficiency tiers versus average price of 8 selected products.

All front-load washing machines are labeled under tier 1, and therefore consumers have no information on potential energy efficiency differences between products. In this situation, only detailed energy efficiency indicators could be used. No patterns can be observed from Figure 11, which indicates that the energy efficiency indicator information does not affect the price.

However, for top-load washing machines, the general pattern is that the price goes down as the energy efficiency decreases, because there are 3 energy efficiency tiers for the top-load technologies. The similar phenomenon can be found for the water efficiency of front-load and top-load washing machines, in which the water efficiency of the top-load washing machines is much lower than the front-load ones (Top10 & CLASP, 2013).

Conclusion and recommendations

1. Chinese energy efficiency standards and energy labels cover most of the energy using products. Energy efficiency tiers have become the core elements for incentive policies. The lowest tier is recognized as a minimum requirement to access the market. Generally, the highest tiers (tier 1 and 2) are required to be met in order to benefit from the subsidy programs with more rebates provided for tier 1 than for tier 2 products. Future subsidy programs should focus on tier 1 for subsidies only.

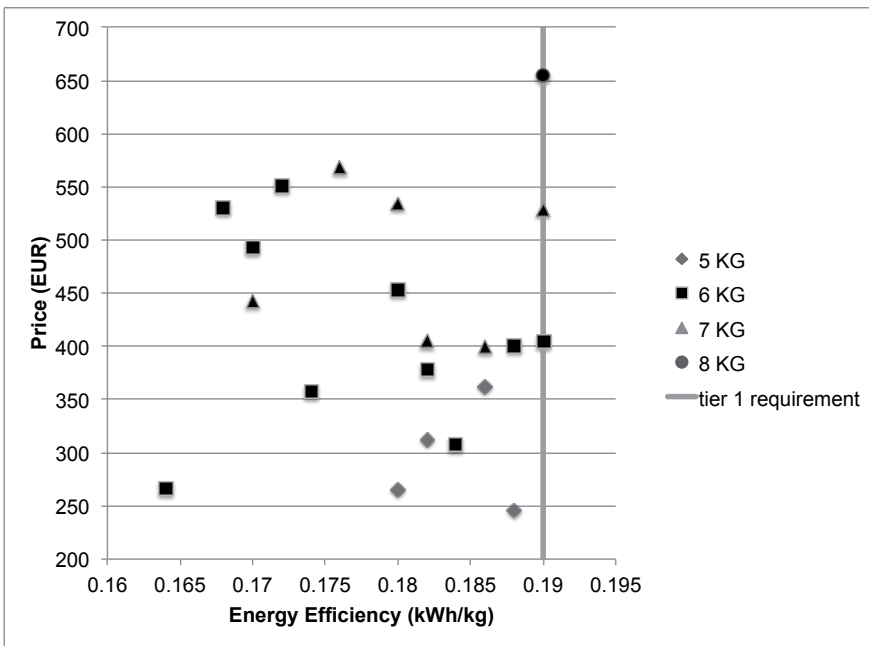


Figure 11. Energy efficiency versus average price of front-load washing machines.

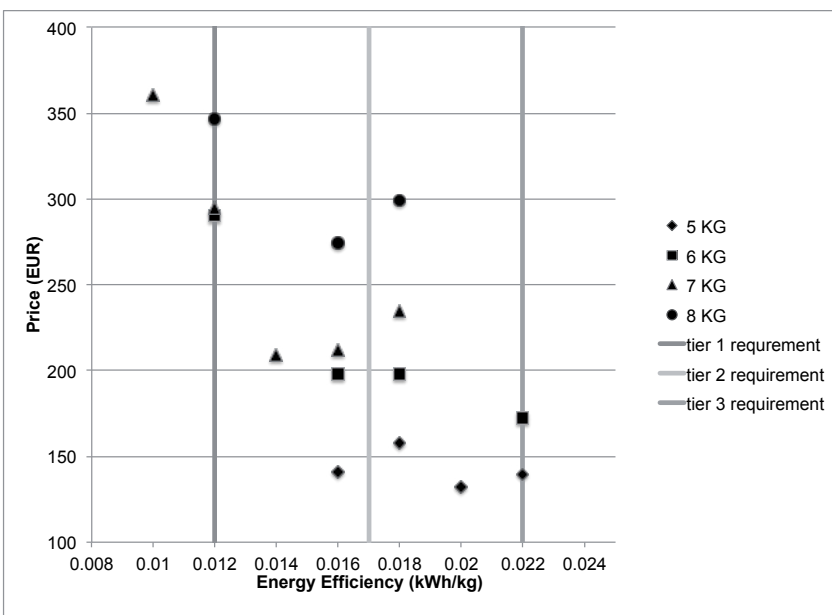


Figure 12. Energy efficiency versus average price of top-load washing machines.

2. The market shares of products under each tier vary greatly among products and technologies. The share of tier 1 products shows two opposite situations – either tier 1 includes almost all of the market or includes almost no products. For the over-represented products, which are flat-panel TVs, copiers, monitors, washing machines and refrigerators, up-scaling of the energy efficiency tiers is urgently needed. Some of the energy efficiency standards are already in the process of revision. The incentive policies for those products should not simply use energy efficiency tiers as the only requirement. Technologies have a significant impact on energy efficiency performances and tiers. Some technologies such as LED help to increase the market share of

tier 1 products. When different technologies can be used for the same functions, they should be regulated by the same requirements, as it helps accelerating the process of eliminating inefficient technologies.

3. The relationship between energy efficiency and capacity varies among products, but the absolute energy consumption increases with an increase in capacity for all the products. Although energy efficiency keeps improving with the capacity for some products, the absolute energy consumption also keeps increasing. In the Chinese energy subsidy program, the subsidy is awarded according to the capacity (size) and energy efficiency. The bigger the capacity or

size, the higher the subsidy awarded. The subsidy program could potentially halt subsidizing oversized products or set higher energy efficiency requirements for those products. The subsidy program could also stop the subsidy for some nominal highly efficient products benefitting from a correction factor such as PDP TVs, which have very high absolute energy consumption. Larger capacity should not be subsidized.

- Purchase price is affected by many factors. From the energy efficiency aspects, the energy efficiency tiers are positively related to the price for most of the selected products. It is possible to say that the difference in retail price is higher than the difference in manufacturing cost between different tiers for some products such as variable speed air conditioners. However, the energy efficiency indicator information, which sets the thresholds for energy efficiency tiers, has limited impacts on the price for some products. The reason might be that it is not easy for consumers to understand the technical terms and the comparability of the indicators which are not as visible and understandable as the tiers. Manufacturers need to be informed not to overprice higher efficiency products.

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