Appliances Guide
Get super efficient appliances

bigEE

Energy efficient Air-conditioners

Country

China

Authors

Hu Bo/Zhao Feiyan

Published: 2014/3

Index

1 Subtypes and markets

Typical size

Split-air conditioning is the most widely used technology for air conditioners in China. It consists of indoor and outdoor components. In terms of indoor components, there are wall-mounted and free-standing split air conditioners. In general, the cooling capacity of wall-mounted air conditioner is below 5 kW and the cooling capacity of free-standing air conditioners is above 5 kW.

Energy efficiency of air conditioners is classified into various categories as per their cooling capacity. The energy efficiency standards of fixed speed (FS) air-conditioners and variable speed (VS) air-conditioners are classified into three sub-categories based on the cooling capacity of air-conditioners: below 4.5 kW, between 4.5 kW and 7.1 kW and between 7.1 kW and 14 kW. Air-conditioners with a cooling capacity above 14 kW are not considered as household air conditioners and their energy performance is thus regulated by other standards.

Main types of technology

There are two main air conditioner technologies in the Chinese market: fixed-speed (FS) air-conditioners and variable-speed (VS) air-conditioners. Normally, the energy efficiency of VS air-conditioners is better than FS air-conditioners because VS air-conditioners can adjust the compressor frequency for varying environmental conditions.

It is expected that FS air-conditions will slowly disappear from the market due to increasing household incomes and technological advances. FS air-conditioners still have a bigger market share, mostly because they are less expensive. The following figure shows the market distribution of VS air-conditioners and FS air-conditioners.

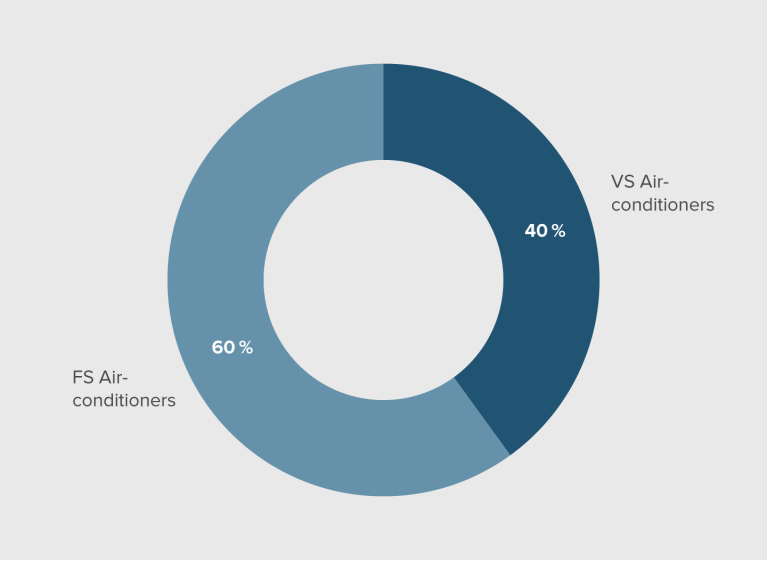

Figure 1: Market distribution of VS air-conditioners and FS air-conditioner

Typical usage pattern and relevant parameters

According to the investigation of electronic equipment and household appliances using pattern in China conducted by Collaborative Labelling and Appliance Standard Program (CLASP) in 2014, the average daily usage time of air conditioner (reversible type) is 5.5 hours for cooling and 2.8 hours for heating. Most investigated families set 25.5 °C as the cooling setpoint temperature and 26.4 °C as the heating setpoint temperature, which is in accordance with the government's suggested temperatures for energy saving1.

Current stock and market volume

In 2012, the market penetration of air-conditioners in rural areas was about 25.4% of all households, which has increased from 22.6% in 2011. In urban areas, in 2012 the rate was 126.8% , up from 122% in 20112.

Rapid economic development and urbanization in China has led to rapidly increasing sales of room air conditioner units (both fixed and variable speed) over the last five years. Sales of room air conditioners remained flat between 2007 and 2009, but rose rapidly in 2010 and 2011 as a result of a series of incentive programs. However, in 2012, the annual sales fell back following the phase out of the incentive policies3.

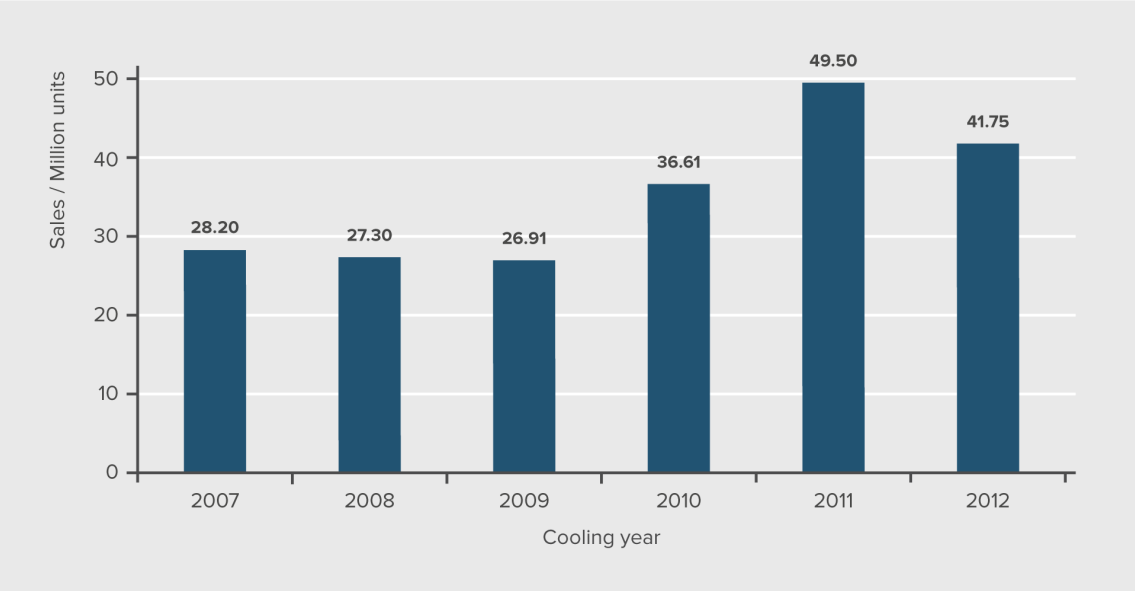

Figure 2: Domestic air conditioner sales in recent years

* Cooling year: from September- to next year August

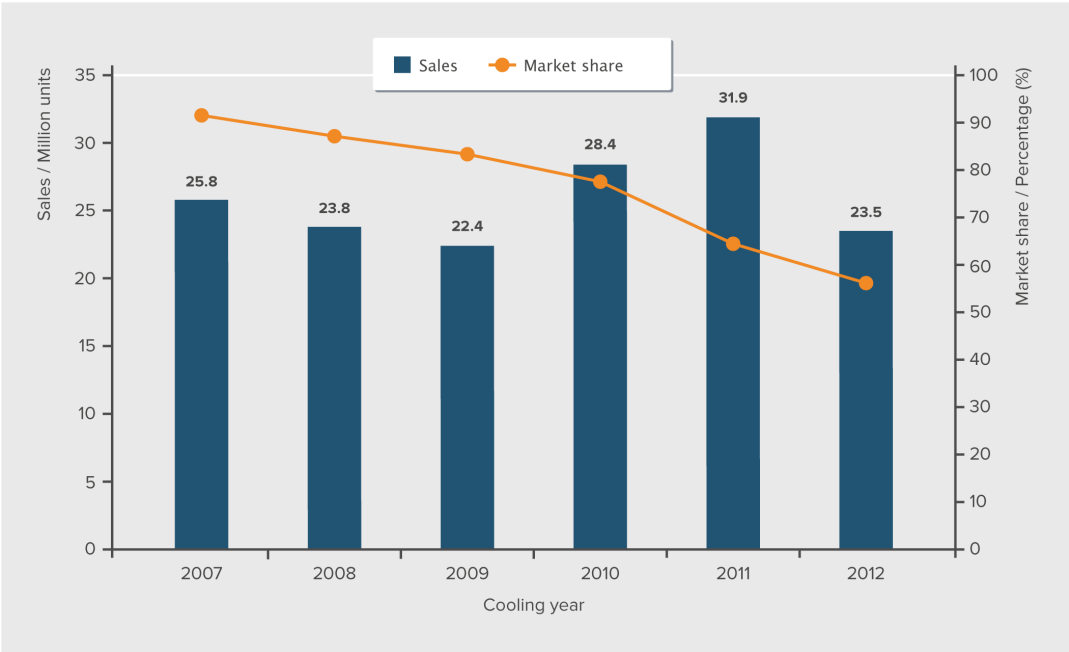

Figure 3: Domestic sales and market share of FS air conditioner in recent years

Variable speed air conditioners were introduced into the Chinese market in the 1990s. Although, sales remained low until 2009, in 2010 and 2011, sales doubled on an annual basis, with the share of variable speed air conditioners growing from 16% in 2009 to 35% in 2011. It appears that at least part of this growth was related to the increased consumer confidence in the product performance which was caused by the introduction of the efficiency standard and energy label for air conditioners in 2008 and 2009, respectively. Sales plateaued in 2012, but the overall market share increased to 44% as a result of declining sales of fixed speed units.

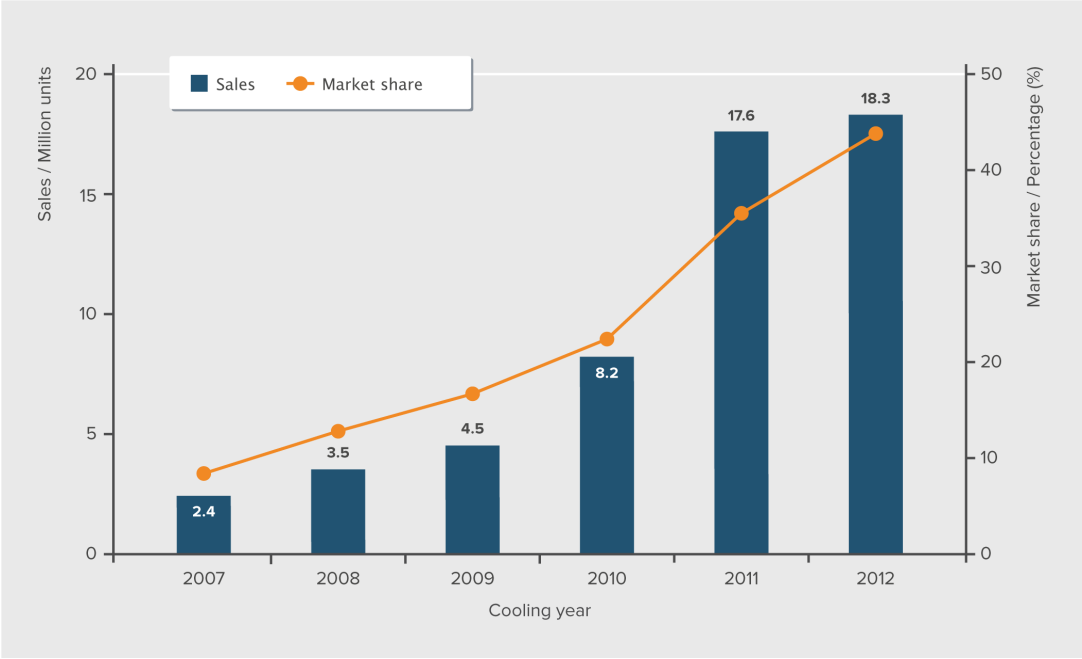

Figure 4: Domestic sales and market share of VS air conditioner in recent years

All productivity and sales data indicate that VS air-conditioners will become the dominant technology on the market.

Market share differentiated as per the main types of this product group

The following two figures show the cooling capacity market distribution of FS air-conditioners and VS air-conditioners.

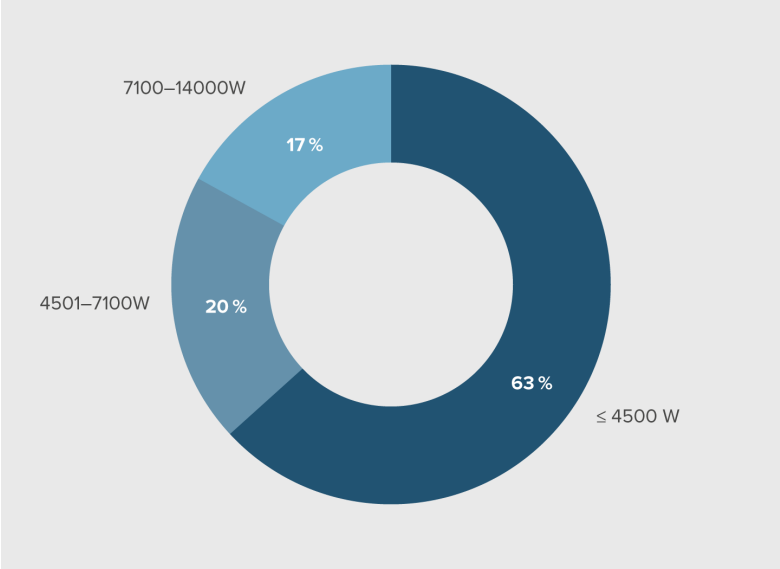

Figure 5: Cooling capacity distribution of FS air-conditioners

As figure 5 shows, 63% of FS air-conditioners' cooling capacity is below 4,500W, while products with a cooling capacity between 4,501 and 7,100 have 20% market share. Usually, bedrooms are equipped

with smaller cooling capacity air conditioners and living rooms are equipped with bigger cooling capacity air conditioners.

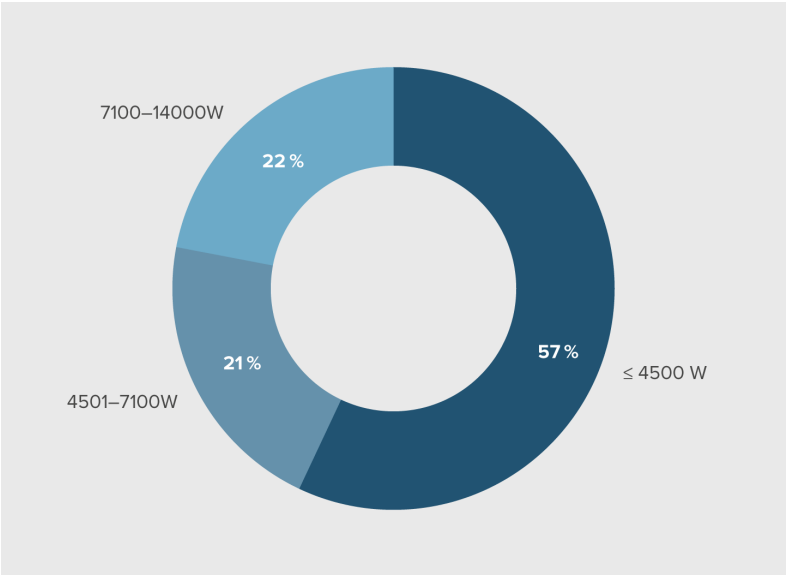

Figure 6: Cooling capacity distribution of VS air-conditioner

VS air-conditioners have the similar cooling capacity distribution as FS air-conditioners. VS air-conditioners with cooling capacity smaller than 4,500W have the largest market share, and the sub-categories with cooling capacity of 4,501-7,100W and 7,100-14,000W have almost the same market share.

2 Efficiency range and user savings

The following table gives a comparison between a typical inefficient appliance and the best available technology.

Level	**Typical Inefficient appliance. If MEPS is implemented: Appliance just complying to minimum requirement (MEPS)**	**Typical appliance purchased (BAU – Business As Usual)**	**Best Available Technology (BAT)**	**Typical appliance in the stock (over all appliances in use)**	**Expected future BAT (Best not yet Available Technology)**
Typical Capacity / Size	3500 W				
Category	**Wall-mounted**	**Wall-mounted**	**Wall-mounted**	**Wall-mounted**	**Wall-mounted**
Type	FS air conditioner	VS air conditioner	VS air conditioner	FS air conditioner	VS air conditioner
Lifetime (years)	10	10	10	10	10
Qualitative classification of the provided service (e.g.: washing performance /etc.)	☐ Poor ☑ Low ☐ Average ☐ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☑ Average ☐ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☐ Average ☑Good ☐ Excellent ☐ No information	☑ Poor ☐ Low ☐Average ☐ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☐ Average ☑Good ☐ Excellent ☐ No information

Yearly energy consumption ***Please precise the energy considered (electricity): KWh***	1326	784	706	1510	694
Yearly energy cost (RMB)	663	392	353	705	347
If applicable: yearly energy consumption for further energy carriers (which one?)					
If applicable: yearly water consumption					
Purchase cost in (currency) RMB	2500	4400	5400	2000	Not available
Operation & Maintenance cost	125	220	270	100	
Labelling class (for the aforementioned labels)	3	2	1	5	1

3 Performance and information requirements

Mandatory requirements

There are Minimum Energy Performance Standards (MEPS) and a mandatory definition of energy efficiency tiers both for the more energy-efficient variable speed (VS) and for the cheaper but less efficient fixed speed (FS) air conditioners in China. The FS air conditioner requirements were the first to come into force.

The first **FS air conditioners** mandatory energy efficiency standard (EES) was entitled <GB 12021.3-2000 The limited values of energy efficiency and evaluating values of energy conservation for room air conditioners> and was published in 2000. It was subsequently revised in 2004 and 2010. Compared to the version of 2004, the latest energy efficiency standard only considers the energy efficiency of the cooling function and reduces the number of energy efficiency tiers from 5 to 3. The following table shows the energy efficiency requirement for FS air conditioners[7]. <GB 12021.3-2010> also sets tier 3 as the MEPS. FS air conditioners below tier 3 are not granted access to the market.

Table 1: Energy efficiency requirements of FS air conditioners

Rated cooling capacity (CC)/W	**EER (W/W)**		
	Tier 1	**Tier 2**	**Tier 3**
CC ≤ 4500	3.60	3.40	3.20
4500 < CC ≤ 7100	3.50	3.30	3.10
7100 < CC ≤ 14000	3.40	3.20	3.00

The first VS air-conditioner mandatory energy efficiency standard was entitled <GB 21455-2008 the minimum allowable value of the energy efficiency and energy efficiency grades for variable speed room air conditioners > and was published in 2008. The new version <GB 21455-2013> was implemented from 2013. <GB 21455-2013> reduces the energy efficiency tiers from 5 to 3, enhances the energy efficiency requirements and includes the requirements for heating efficiency as well. The follow-

ing two tables show the energy efficiency requirements of the current version of EES of VS air conditioners. <GB 21455-2013> also starts to set the energy requirements for standby power consumption.

Table 2: Energy efficiency requirements of <GB 21455-2013> for VS air conditioners only with cooling function

Rated cooling capacity (CC)/W	**SEER/[(W.h)/(W.h)**		
	Tier 1	**Tier 2**	**Tier 3**
CC ≤ 4500	5.40	5.00	4.30
4500 < CC ≤ 7100	5.10	4.40	3.90
7100 < CC ≤ 14000	4.70	4.00	3.50

Table 3: Energy efficiency requirements of <GB 21455-2013> for VS air conditioners with cooling and heating functions

Rated cooling capacity (CC)/W	**APF/[(W.h)/(W.h)**		
	Tier 1	**Tier 2**	**Tier 3**
CC ≤ 4500	4.50	4.00	3.50
4500 < CC ≤ 7100	4.00	3.50	3.30
7100 < CC ≤ 14000	3.70	3.30	3.10

<GB 21455-2013> also sets tier 3 as the MEPS. VS air conditioners below tier 3 are denied market access. In addition, for VS air conditioners whose rated cooling capacity is below 4,500W, the stand-by power should not be higher than 3W.

According to the market research of Top10, most air conditioners in Chinese market are classed as tier 3. The following two figures show the tier distribution of FS and VS air conditioners.

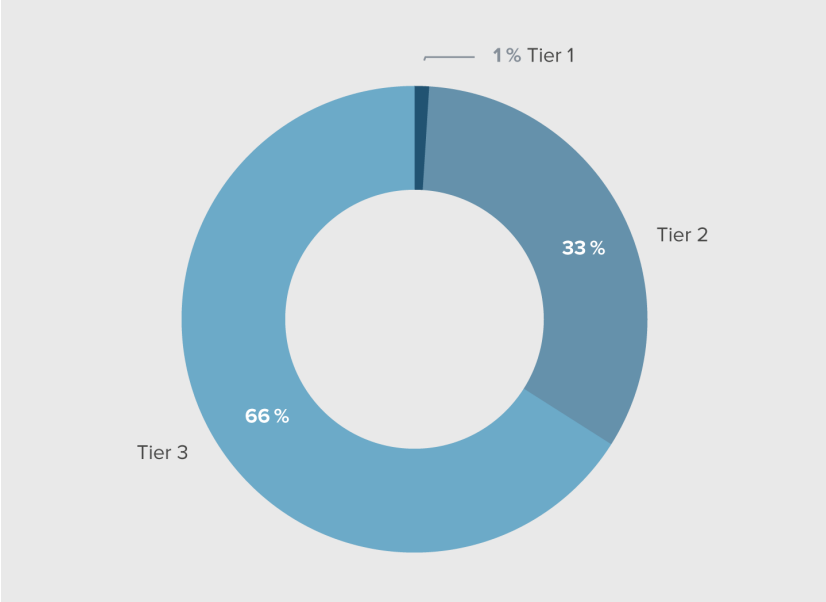

Figure 7: Tiers distribution of FS air conditioners

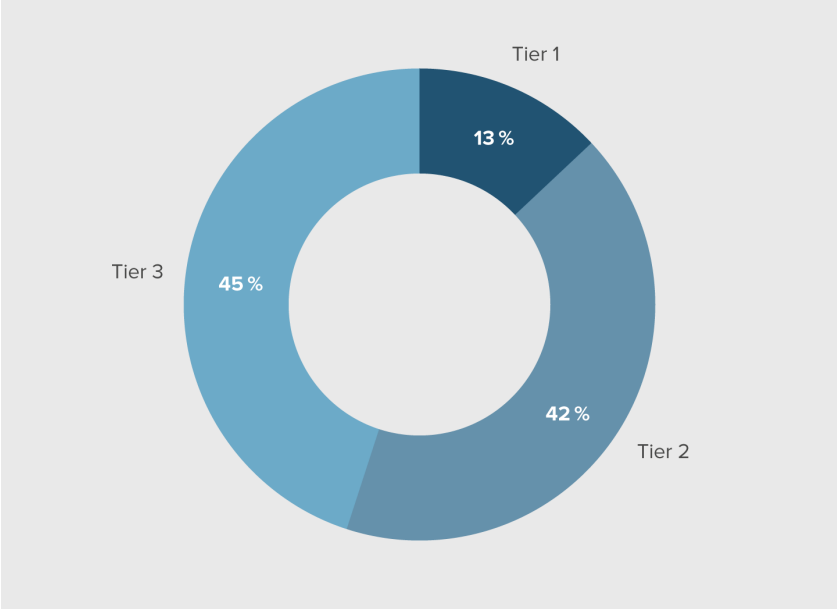

Figure 8: Tiers distribution of VS air conditioners

Mandatory labelling

There is a mandatory energy label for both VS and FS air-conditioners in China. Historically, the label for FS air-conditioners was implemented first.

The energy label for FS air-conditioners started in 2005 following <GB12021.3-2004>. It sets 5 energy efficiency tiers and took EER, cooling capacity and power as the main parameters shown on the label. The subsidy programme was implemented from 2009 to 2011, <GB12021.3> and revised in 2010. It uses the same energy efficiency indicator as the previous version, but only 3 energy efficiency tiers. The following figure is the energy label sample of FS air-conditioner.

Figure 9: Energy label sample of FS air-conditioner

The energy labelling scheme for VS air-conditioners began in 2009 based on <GB 21455-2008>. It sets 5 energy efficiency tiers and took SEER, cooling capacity and cooling season electricity consumption as the main parameters shown on the label. <GB 21455> was revised and put into implementation in 2013. Following the changes of the energy efficiency standard (EES), the energy label began to put the information of APF and hot season energy electricity on the label. The new VS air conditioner EES also reduced the number of energy efficiency tiers from 5 to 3. The Following figure is the latest energy label sample of a VS air-conditioner.

Figure 10: Energy label of VS air-conditioner

Voluntary certification

China started the voluntary energy conservation certification scheme for FS air conditioners in 2000. The certification scheme for VS air conditioner was followed in 2009.

The programme is managed by China Quality Certification Centre (CQC). The energy conservation certification is based on the EES and follows the changes of EES because EES sets energy efficiency tier 2 as the threshold of energy conservation certification requirement. The following figure is the sample of the energy conservation label, informing the consumer only about the relatively higher efficiency of the product compared to others. This label therefore, is a endorsement label does not provide detailed performance information as is the case for all certified products.

Figure 11: Energy conservation label sample

Subsidy programme

Both FS air conditioners and VS air conditioners were included in the Chinese national subsidy programme. FS air conditioner was initially subsidized from 2009 to 2011. The subsidy was further supported by the new MEPS. Then both products were included in the latest subsidy programme from June 2012 to May 2013. The subsidy criteria are decided by technology, cooling capacity and energy efficiency tier. The following table shows the subsidy rate, which is typically around 6 to 10 % of the typical sales prices and criteria.

Table 4: FS and VS air conditioner subsidy rates in 2012

Cooling capacity (W)	FS air conditioners (RMB/unit)		VS air conditioners (RMB/unit)	
	Tier 1	Tier 2	Tier 1	Tier 2
CC ≤ 4500	240	180	300	240
4500 < CC ≤ 7100	280	200	350	280
7100 < CC	330	250	400	330

4 Test procedures and standards

<GB/T 7725 Room Air Conditioners> regulates the testing method for air-conditioners and defines the energy efficiency indicators for all air conditioners. FS and VS air-conditioners adopt different energy efficiency indicators and testing methods. There are two different energy efficiency standards for FS and VS air conditioners. <GB 12021.3> is the energy efficiency standard for FS air conditioners, while <GB 21455> is the energy efficiency standard for VS air conditioners.

<GB 12021.3> adopts energy efficiency ratio (EER[1]) as the energy performance indicator for the cooling function, which is the value of tested cooling capacity divided by effective input power (unit: W/W). Heating performance is not included in this standard. <GB 12021.3> only considers the FS air-conditioners of T1 type, which is suitable for a temperate climate zone, the highest environment temperature should not exceed 43 °C.

<GB 21455> adopts seasonal energy efficiency ratio (SEER) as the energy efficiency indicator for cooling performance and heating seasonal performance factor (HSPF) as the heating performance indicator. For VS air conditioners with both cooling and heating functions, an integrated indicator named annual performance factor (APF) is adopted as the only performance indicator[5]. <GB 21455> only suits for the T1 type VS air-conditioners.

<GB 21455-2013> regulates the different cooling and heating time and temperatures to calculate SEER, HSPF and APF. The total annual cooling time applied is 1136 hours and the annual heating time is 433 hours per year.[6]

[1] EER: energy efficiency ratio

5 References

[1] CLASP (2014): Collaborative Labelling and Appliance Standard Program: Investigation of electronic equipment and household appliance using habits in China.

[2] NBS (2013): National Bureau of Statistics of China: Annual report of residents income.

[3] CNIS (2012): China National Institute of Standardization: White paper for the energy efficiency status of China energy-use products.

[4] Hu Bo, Zheng Tan, Jayond Li, Steven Zeng. (2013): Market Analysis of China Energy Efficient Products.

[5] <GB/T 7725 Room Air Conditioners>.

[6] <GB 21455-2013 Minimum allowable values of the energy efficiency and energy efficiency grades for variable speed room air conditioners>.

[7] <GB 12021.3-2010 The minimum allowable value of the energy efficiency and energy efficiency grades for room air conditioners>.

[8] CNIS (2012): China National Institute of Standardization. Online: http://www.energylabel.gov.cn.

[9] ETAO (2015): online: http://www.etao.com.