Appliances Guide

Get super efficient appliances

bigEE

Energy efficient washing-machines

Country

China

Authors

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1 Subtypes and markets

China produced approximately 35.7 million washing machines in 2011, a figure which was 42.5% below that of 2010. The domestic sale of washing machines was 35.8 million in 2011, which was 6.7% lower than in 2010. Even though both production and sales declined, China is still the biggest producer of washing machines in the world. It is estimated that the demand for washing machines in large cities like Beijing and Shanghai will progressively decline but the demand in smaller cities will still be increasing significantly [1].

In 2011, the household penetration of washing machines in urban areas was approximately 97.1%, which increased to 98.0% in 2012. In rural areas, the household penetration of washing machines increased to 67.2% in 2012, up from 62.6% in 2011[2].

Mainstream technologies

There are two main technologies of washing machines: drum (front load) and impeller (top load). Twin-tub washing machines were popular in the 1980s and 1990s. But this type only holds a small market share in the rural area today. Although the prices of drum washing machines are much higher than impeller washing machines, drum washing machines are becoming more popular than impeller washing machines in China. According to the market research of Top10 in January 2014, 49% of the washing machines on the Chinese market are drum washing machines, 48% of the products are impeller washing machines and the twin-tub washing machines only have a 3% market share.

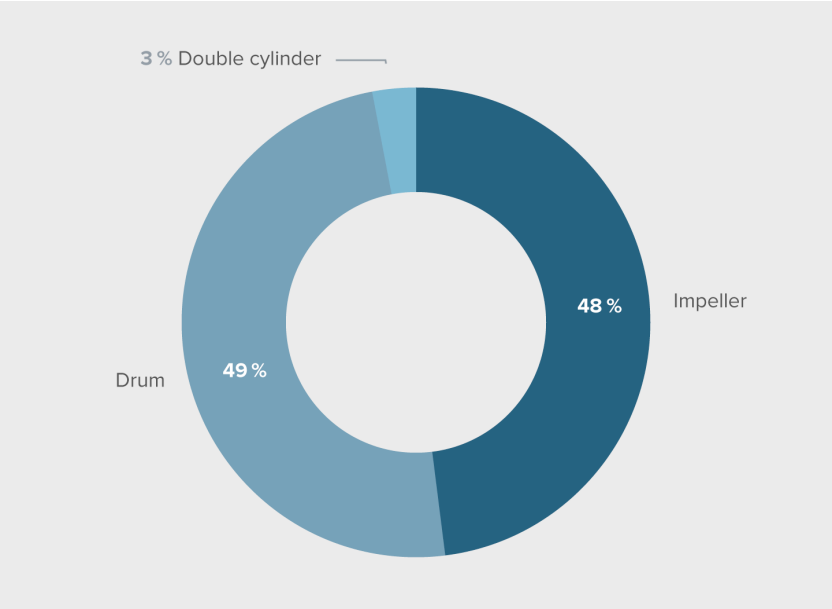

Figure 1: Market share of different types of washing machines

Typical size

Consumers increasingly prefer washing machines with a bigger load capacity. Figure 2 and figure 3 show the washing capacity distribution of impeller washing machines and drum washing machines on the market.

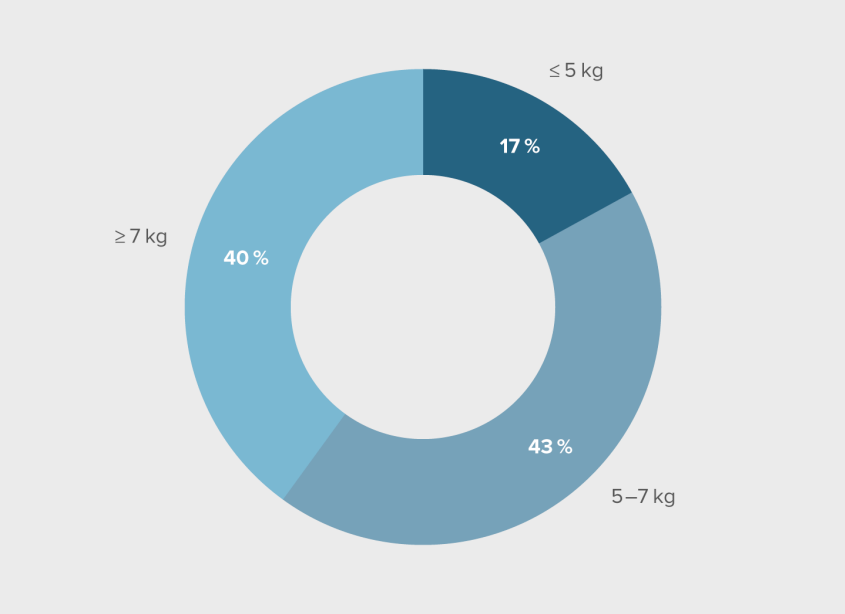

Figure 2: Washing capacity distributions of impeller washing machines

Impeller washing machines with a load capacity between 5 kg and 7 kg are the most popular on the market. Impeller washing machines with washing capacity below 5 kg hold a market share of 1%.

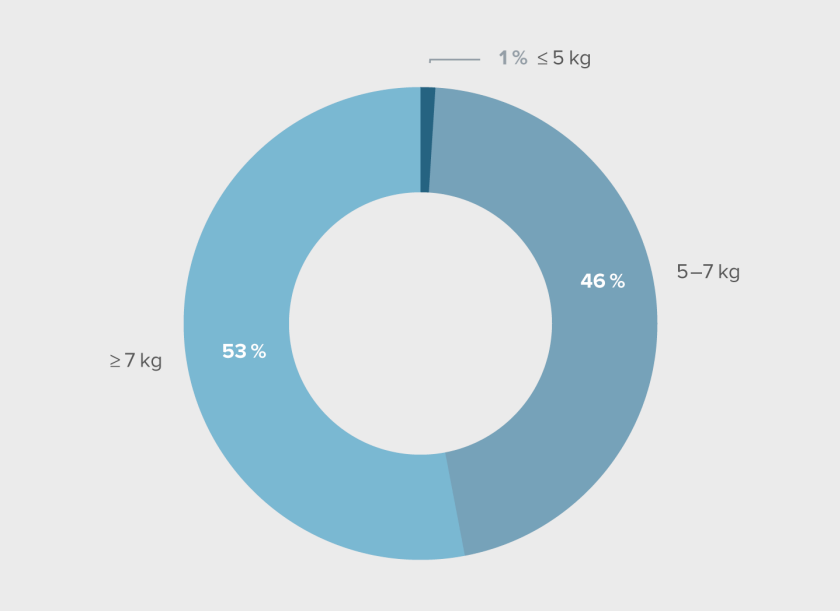

Figure 3: Washing capacity distributions of drum washing machines

For drum washing machines, those with load capacity above 7 kg have the largest share in the market while washing machines with the washing capacity below 5 kg take only a 1% share in the market.

Typical usage pattern and relevant parameters

Apartments very rarely feature a pressurized warm water supply. So, data on typical washing temperature is very limited. Most Chinese families do the washing in cool or cold water that comes directly from the pipe.

The washing frequency differs widely because of the different family sizes and washing habits.

Share of the final energy consumption

According to the study conducted by the China National Institute of Standardization, the total estimated electricity consumption of washing machines in 2011 was around 13 TWh.

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	7 kg				
Category	**Vertical**	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**
Type	Impeller washing machine	Drum washing machine	Impeller washing machine	Drum washing machine	Impeller washing machine
Lifetime (years)	8	8	8	8	8
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, gas,...):*** ***Electricity/120cycles annually***	18.5	72	8.4	72	8.2
If applicable: yearly water consumption (L)/120 cycles annually	23520	5760	11400	5760	11400
Purchase cost in (currency) RMB	800	2088	1888	2088	
Operation & Maintenance cost	No information	No information	No information	No information	No information
Labelling class (for the aforementioned labels)	5	1	1	1	1

3 Performance and information requirements

Mandatory requirements

(1) Mandatory requirement in China

<GB12021.4-2013> defines five energy efficiency tiers for washing machines. Energy consumption per kilogram, water consumption per kilogram and rate of washing effectiveness are the three parameters to identify the energy efficiency tiers of the washing machine. Tier 5 corresponds to the minimum performance standard (MEPS) and tier 1 is the most efficient. The requirements for impeller washing machines and drum washing machines are defined separately because of the different test methods. The following two tables will show the energy efficiency requirements for impeller washing machines and drum washing machines.

Table 1: Energy efficiency requirements for impeller washing machines

Grade	Energy consumption per kilogram (kW•h)/(cycle•kg)	Water consumption per kilogram L/(cycle•kg)	Washing effectiveness
1	≤0.011	≤14	≥0.90
2	≤0.012	≤16	≥0.80
3	≤0.015	≤20	≥0.80
4	≤0.017	≤24	≥0.80
5	≤0.022	≤28	≥0.80

Table 2: Energy efficiency requirement for drum washing machines

Grade	Energy consumption per kilogram (kW•h)/(cycle•kg)	Water consumption per kilogram L/(cycle•kg)	Rate of washing ability
1	≤0.110	≤7	≥1.03
2	≤0.130	≤8	≥1.03
3	≤0.150	≤9	≥1.03
4	≤0.170	≤10	≥1.03
5	≤0.190	≤12	≥1.03

Besides the energy consumption levels, <GB 12021.4-2013> also defines the water consumption levels. There are five water efficiency tiers. Tier 1 is the most efficient. The following two tables show the water efficiency requirements for impeller washing machines and drum washing machines.

Table 3: Water efficiency requirements for impeller washing machines

Grade	Energy consumption per kilogram (kW•h)/(cycle•kg)	Water consumption per kilogram L/(cycle•kg)	Washing effectiveness
1	≤0.022	≤10	≥0.90
2		≤14	≥0.80
3		≤18	
4		≤22	
5		≤28	

Table 4: Water efficiency requirements for drum washing machines

Grade	Energy consumption per kilogram (kW•h)/(cycle•kg)	Water consumption per kilogram L/(cycle•kg)	Washing effectiveness
1	≤0.190	≤6	≥1.03
2		≤7	

3		≤8	
4		≤10	
5		≤12	

Energy efficiency tier 5 or water efficiency tier 5 sets the minimum energy performance standard for washing machines. Washing machines below the requirements set by tier 5 are not allowed to enter the market.

(2) Energy efficiency standard in the EU and US

The US introduced the mandatory energy efficiency label (Energy Guide) for washing machine in 1980, but did not include water consumption until 2011. The volunteer standard (Energy Star) was introduced in 1992. The following table shows the different requirements of Energy Guide and Energy Star.

Table 5: Different requirements of Energy Guide and Energy star

Standard types	First phase requirement	Second phase requirement (after 2011-1-1)
Energy Star	MEF ≥1.8; WF ≤7.5	MEF ≥2.0; WF ≤6.0
Energy Guide	MEF ≥1.26	MEF ≥1.26; WF ≤9.5

MEF (modified energy factor) is the ratio of washing capacity to the energy consumption of each cycle.

WF (water factor) is the ratio of water consumption per cycle to washing capacity.

American standards use the same method to calculate the energy efficiency factor for impeller washing machine and drum washing machines. But there is no washing ability requirement from American standards.

The EU released Energy Labelling Implementing Regulations for Washing Machines (G/TBT/N/EEC/319) and set eco-design requirements for washing machines (G/TBT/N/EEC/320) in 2010. The EU defines the energy efficiency index (EEI) as the parameter to measure the energy efficiency performance of washing machines.

$$EEI=AE_C/SAE_C*100$$

AE_C: Annual energy consumption of washing machine.

SAE_C: Standard annual energy consumption of washing machine.

G/TBT/N/EEC/319 sets A+++, A++, A+, A, B, C, D seven energy efficiency tiers, A+++ is the most energy efficient tier. The following table shows the EEI requirements for different tiers.

Table 6: EEI requirements in G/TBT/N/EEC/319

Tiers	EEI requirements
A+++	40≤EEI<46
A++	46≤EEI<52
A+	52≤EEI<59
A	59≤EEI<68
B	68≤EEI<77
C	77≤EEI<87
D	87≤EEI<100

Besides the energy efficiency tiers, G/TBT/N/EEC/319 also sets the dewatering efficiency tiers for washing machines.

Table 7: Dewatering Efficiency tier requirements in G/TBT/N/EEC/319

Dewatering efficiency tiers	Percentage of the left water (%)
A	D<45
B	45≤EEI<54
C	54≤EEI<63
D	63≤EEI<72
E	72≤EEI<81
F	81≤EEI<90

G	D≥90

G/TBT/N/EEC/320 regulates the general eco-design requirements and special eco-design requirements. The special eco-design requirements include the requirements on EEI, washing efficiency index (Iw) and water consumption (Wt).

From July 1st 2010, the EEI for all consumer washing machines should be below 68. For households using washing machines with a washing capacity above 3kg, IW should be above 1.03; for washing machines with a washing capacity of 3kg of less, the IW should be above 1.00. For all washing machines, Wt should be 5*C+35 or below. (C: rated washing capacity).

After July 1st 2013, the EEI should be below 59 for consumer washing machines with a washing capacity of 4kg or more. Wt should be smaller than 5*C1/2+35 (C1/2: rated washing capacity when partly loaded) [5].

Mandatory labelling

China introduced a mandatory labelling programme for washing machine in 2007, which was based on <GB12021-2004> and was valid until October 2013. The washing machine labelling programme is currently based on <GB12021-2013>. Figure 4 shows an energy label sample of washing machines, which includes information on energy consumption and water consumption of a washing cycle, washing effectiveness and the rated washing capacity of the washing machine.

Figure 4: Energy label sample of washing machine

According to the market research in January 2014, tier 2 has the biggest market share. The market share of tier 1 is 30%and tier 3 has a market share of 26%, respectively. Tier 4 and 5 are represented insignificantly, together covering around 4%.

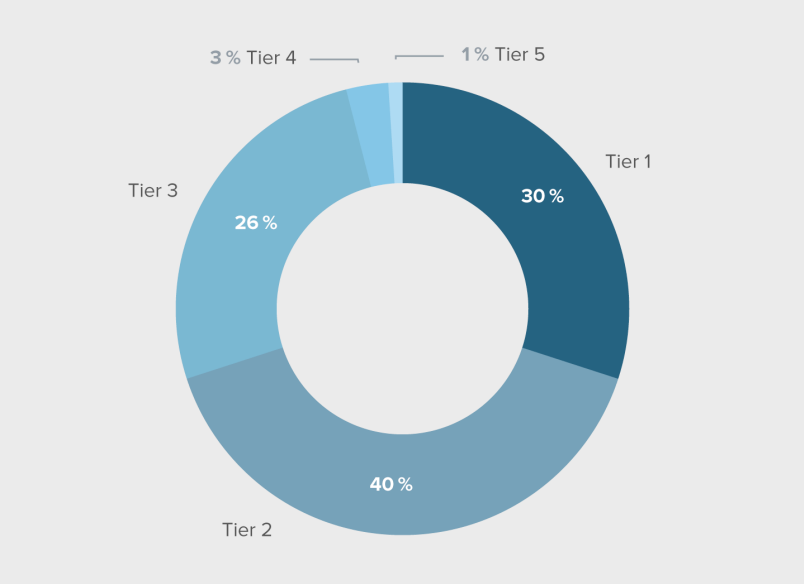

Figure 5: Energy efficiency tiers distribution on the market

Voluntary requirements

China initiated the voluntary energy conservation certification for washing machines in 2003. The certification process is managed by the China Quality Certification Centre (CQC). Energy efficiency tier 2 is a pre-requirement for the award of an energy conservation certification. Figure 6 shows the energy conservation label. While the sample informs consumers about the product's energy efficiency, no detailed information is provided on the label.

Figure 6: Energy conservation certification label

Other relevant requirements

There was subsidy programme for energy efficient washing machines from June 2012 to May 2013, which was based on <GB12021.4-2004>.

Table 7: 2012 subsidies for washing machines

Product type	EET and Energy efficiency requirements	Subsidy amount (RMB/Unit)
Full-automatic impeller	Washing capacity≤3.5 kg, Tier 2 and Tier 1	100
	Washing capacity **>** 3.5 kg，Tier 1	200
Drum	Tier 1，Washing ability≥1.03，Water consumption≤10 L/kg，Energy consumption≤0.17 kWh/kg	260

4 Test procedures and standards

Applicable measurement standards

The testing standard for washing machines is defined in the national standard, entitled as <GB/T 4288-2008 Household and similar electrical washing machine>. The testing method measures the same performance variables for both types of washing machines including energy consumption, water consumption and washing quality. However, the testing conditions for the two types of machine have significant differences:

Impeller washing machines are tested using cool water at 30 ± 2°C. Water is heated from ambient temperatures to the test temperature externally, and the energy used to heat the water is not included in the declared energy consumption.

Drum washing machines are tested using hot water. For units with an integrated water heater, the washing machine is filled with cold water of 15 ± 2°C and run at the default standard hot washing setting. For units without an integrated water heater, the washing machine is filled with hot water at 50 ± 2°C. Again, this water is heated from ambient to target temperature externally and the energy used to heat the water is not included in the declared energy consumption [3].

Energy efficiency standard

Based on <GB/T 4288-2003>, the first energy efficiency standard of washing machine was launched in October 2004. <GB 12021.4-2004 The maximum allowable values of the energy consumption and energy efficiency grade for household electric washing machines> became mandatory in 2005.

In 2013, Chinese government revised <GB 12021.4-2004>. The new energy efficiency standard of washing machine <GB 12021.4-2013> was implemented since October 2013. Compared with the old version, <GB12021.4-2013> adds the half-load test in the process of measuring energy consumption per kilogram and water consumption per kilogram [4].

The formula for the calculation of energy consumption per kg:

$$E_e = I_e * (E1 + 2E2)/(2m)$$

E_e: Energy consumption per kg. (kW•h)/(cycle•kg)

I_e: Energy efficiency compensation coefficient
For impeller washing machines the coefficient is 0.75
For drum washing machines it is 0.85

E1: Energy consumption of washing cycle with the rated washing capacity in kWh
E2: Energy consumption of washing cycle with half-rated washing capacity in kWh
m: Rated washing capacity in kg

The formula to calculate the water consumption per kg:

$$W_e = I_w * (W1 + 2W2)/(2m)$$

W_e: Water consumption per kilogram. L/(cycle•kg)

I_w: Water consumption efficiency compensation coefficient 0.75

W1: Water consumption of washing cycle with the rated washing capacity L

W2: Water consumption of washing cycle with half-rated washing capacity L

m: Rated washing capacity in kg

5 References

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

[2] National bureau of statistics of China (2013): Annual report of the income of urban and rural residents.

[3] <GB/T 4288-2008 Household and similar electrical washing machine>.

[4] <GB12021.4-2013 Maximum allowable values of the energy, water consumption and grades for household electric washing machines>.

[5] Zhou Shuhua, Zhang Huan, Pan Yang (2012): EU energy efficiency standard of washing machine and the related measure from China.

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

[7] ETAO (2015): Online: http://www.etao.com.