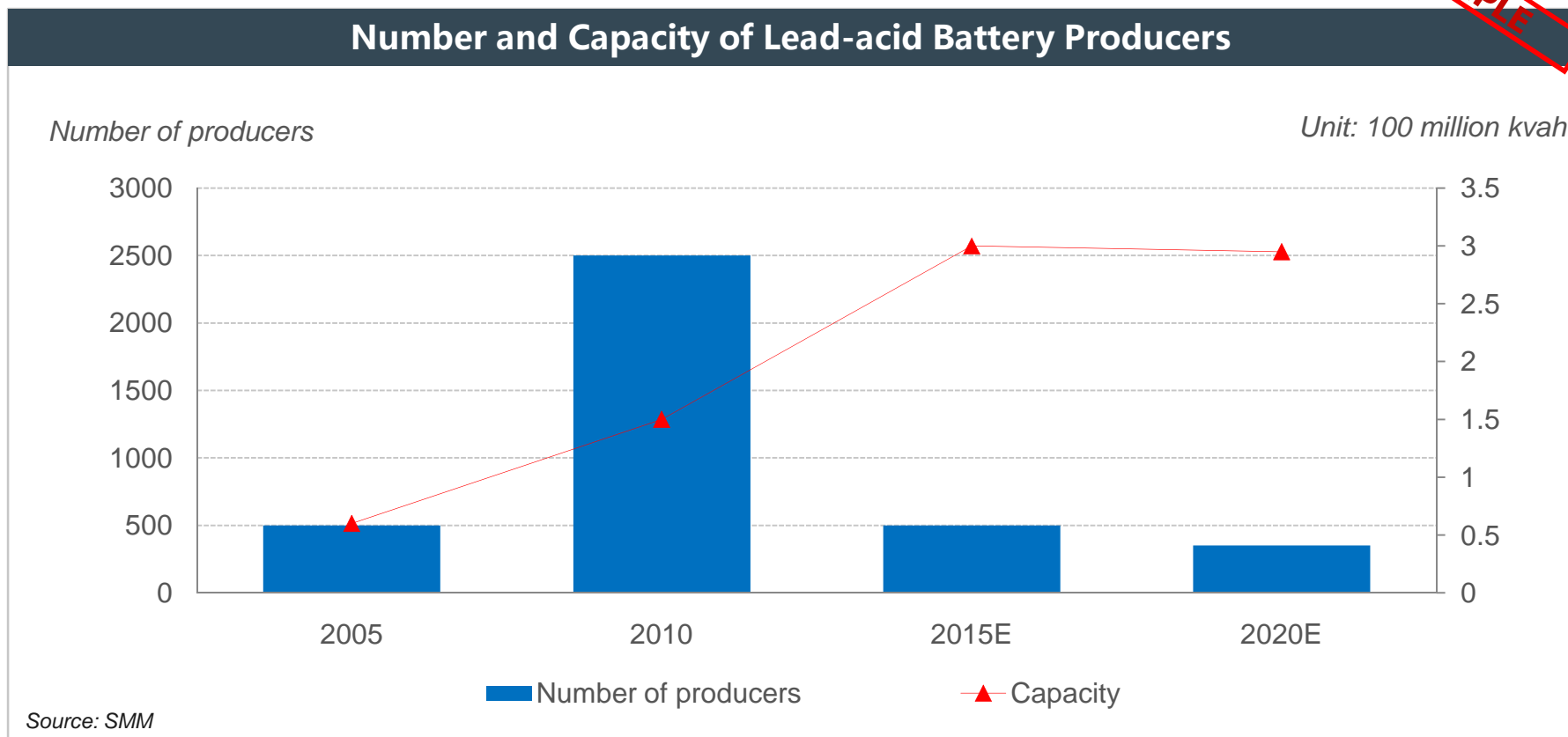


# China Lead-Acid Battery Market Study

Lead & zinc team at SMM

Oct. 2015

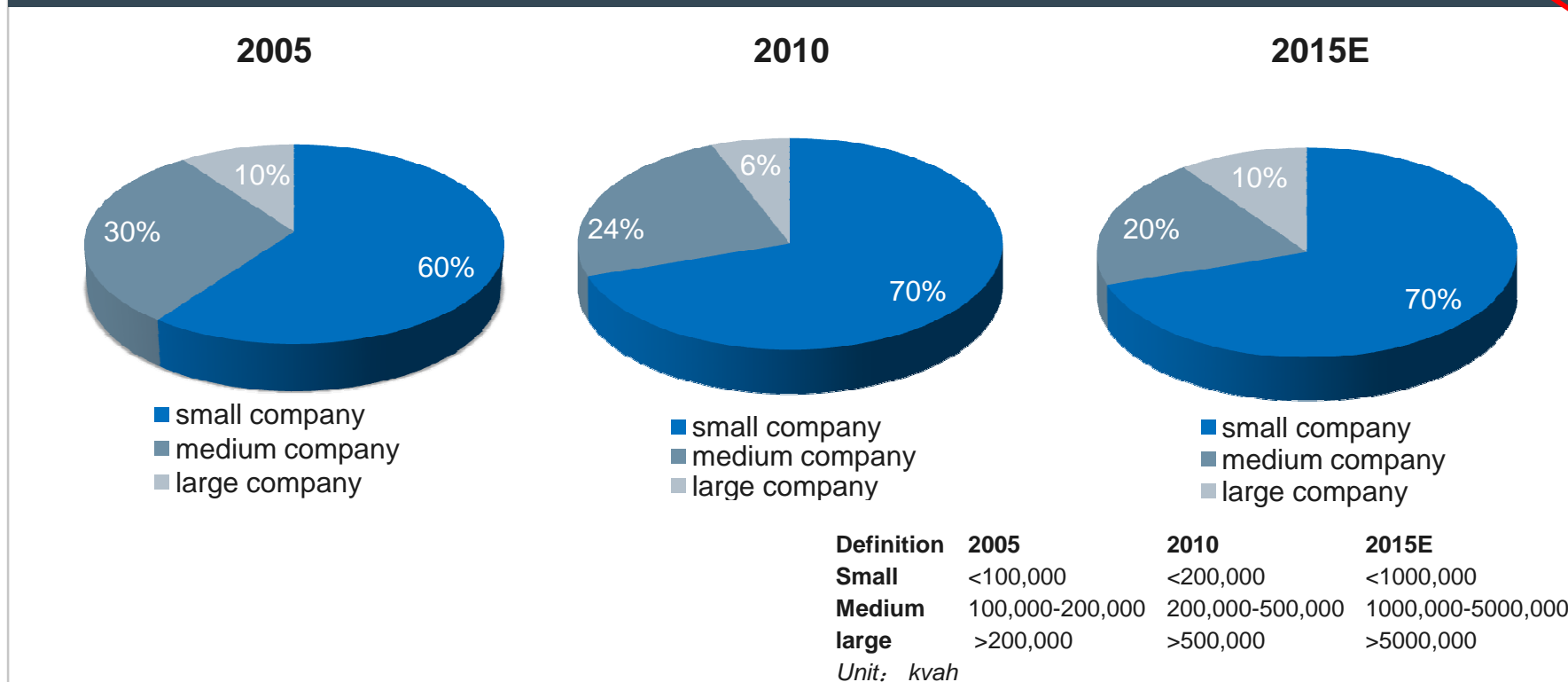
# Number and Capacity of Lead-acid Battery Producers



- Recent years have seen dramatic changes in the number and capacity of lead-acid battery producers.
- The number and capacity of lead-acid battery producers surged during 2005-2010, but most producers were small-scaled ones during the period. China issued the *Lead-Acid Battery Industry Entrance Requirements* (short as *Entrance Requirements*) during 2010-2015, which sets thresholds for entry into the industry. The number of producers unqualified under the *Entrance Requirements* shrank significantly, while qualified producers expanded capacity aggressively.

# Lead-acid Battery Output and Share by Type

## Changes in Company Scale 2005-2015E



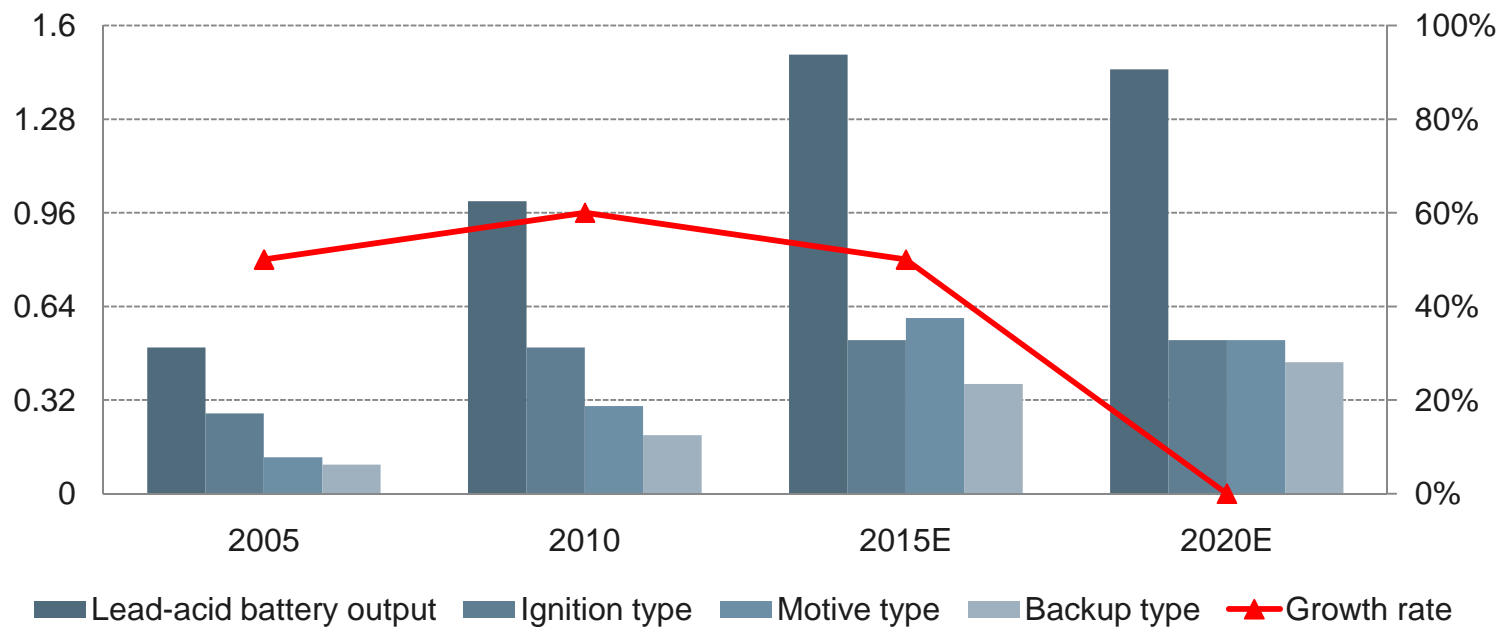
Source: SMM

- Under the *Entrance Requirements*, annual capacity for existing lead-acid battery producers must  $\geq 200,000$  kvah, and annual capacity for new lead-acid battery producers must  $\geq 500,000$  kvah, and annual capacity for existing polar plate producers that produce polar plate for sale must  $\geq 1$  million kvah. In 2012, lead-acid battery producers whose annual capacity were less than 200,000 kvah took up 71% of total lead-acid battery capacity.
- Capacity at lead-acid battery producers expanded gradually after the *Entrance Requirements* took effect. The definitions of small, medium and large producers changed dramatically during 2005-2015.

# Lead-acid Battery Output and Share by Type

**Lead-acid Battery Output and Share by Type 2005-2020E**

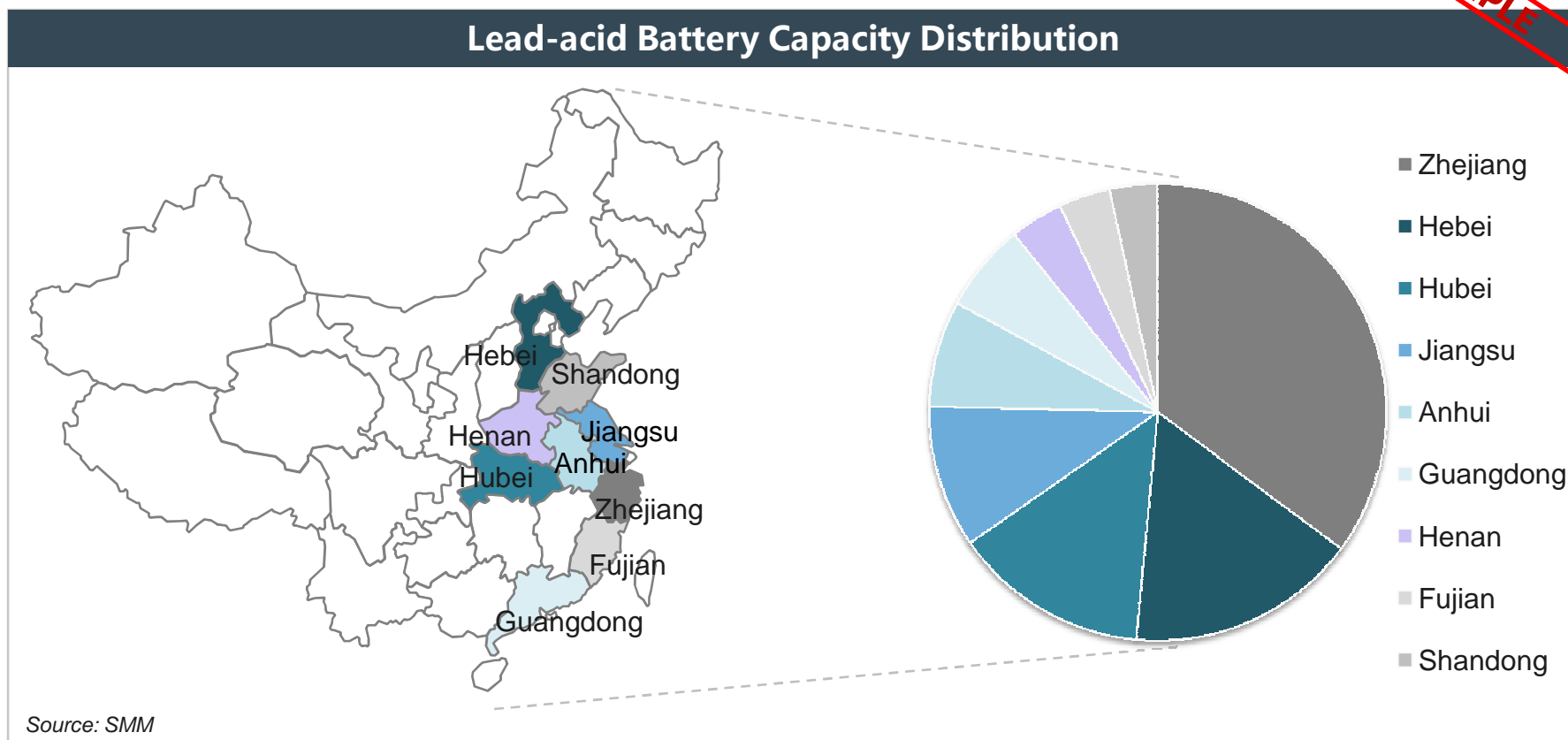
Unit: 100 million kvah



Source: SMM

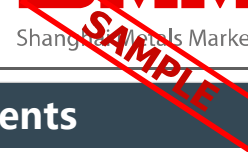
- Lead-acid battery capacity expanded rapidly over the past decade or so, leading to overcapacity and negative impact. Motive lead-acid battery –40% of total lead-acid battery capacity – is affected the most. Lead-acid battery production growth is likely to continue slowing down in coming five years or even enter negative territory.

# Lead-acid Battery Capacity Distribution



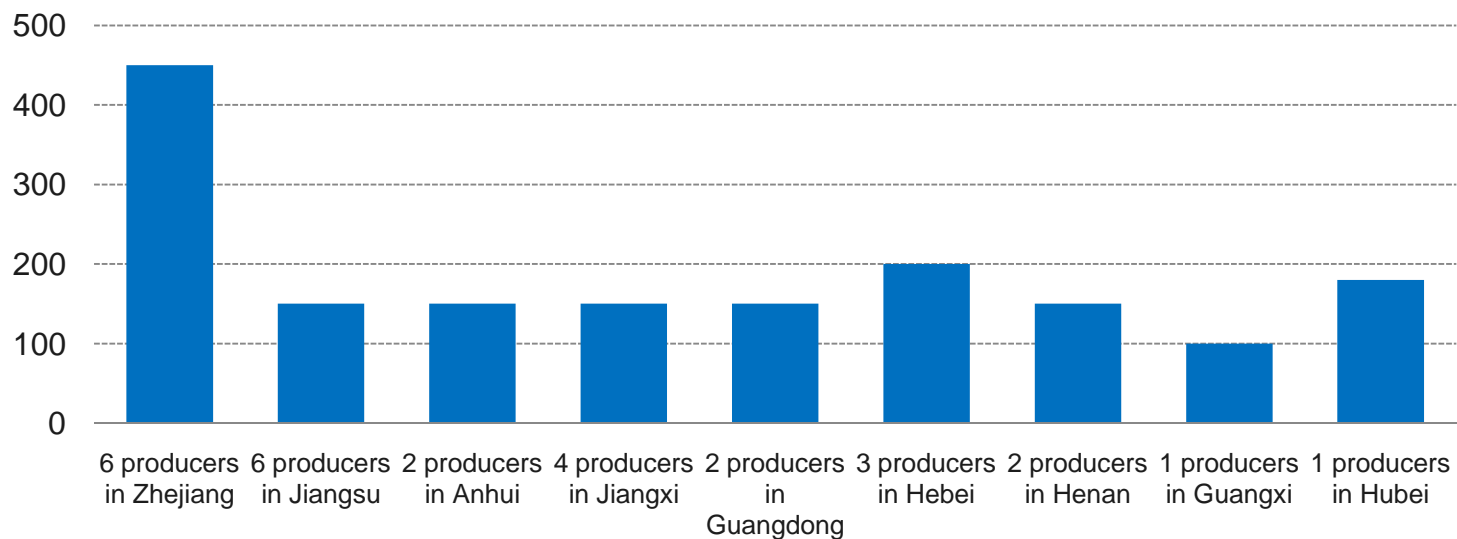
- Lead-acid battery capacity is shifting from east China to central part of the country in recent years due to various factors. Hebei, Hubei and Anhui have become major lead-acid battery producing regions.
- Zhejiang, Hebei, Hubei, Jiangsu and Anhui were China's top five lead-acid battery producing regions in H1 2015.

# Qualified Lead-acid Battery Producers



## Producers Qualified for Lead-Acid Battery Industry Entrance Requirements

Unit: 10,000 kvah



Source: SMM



Currently, 27 producers are qualified for the Entrance Requirements, whose polar plate capacity is 43.95 million kvah and assembly capacity is 38.29 million kvah.

# Lead-acid Battery Producers Required to Eliminate Outdated Capacity

## Lead-acid Battery Capacity Elimination

Lead-acid Battery Outdated Capacity Elimination				
Time	List	Number of producers	Capacity ( 10,000 kvah )	
			Polar plate	Assembly
Jul. 11, 2012	1st	92	1541.195	1495.975
Sept. 7, 2012	2nd	22	126.4	94.94
Jul. 18, 2013	1 <sup>st</sup>	44	779.92	816.89
Sept. 9, 2013	3 <sup>rd</sup>	11	629	311
Jul. 8, 2014	1 <sup>st</sup>	39	848	531
Aug. 12, 2014	2 <sup>nd</sup>	17	970	566.7

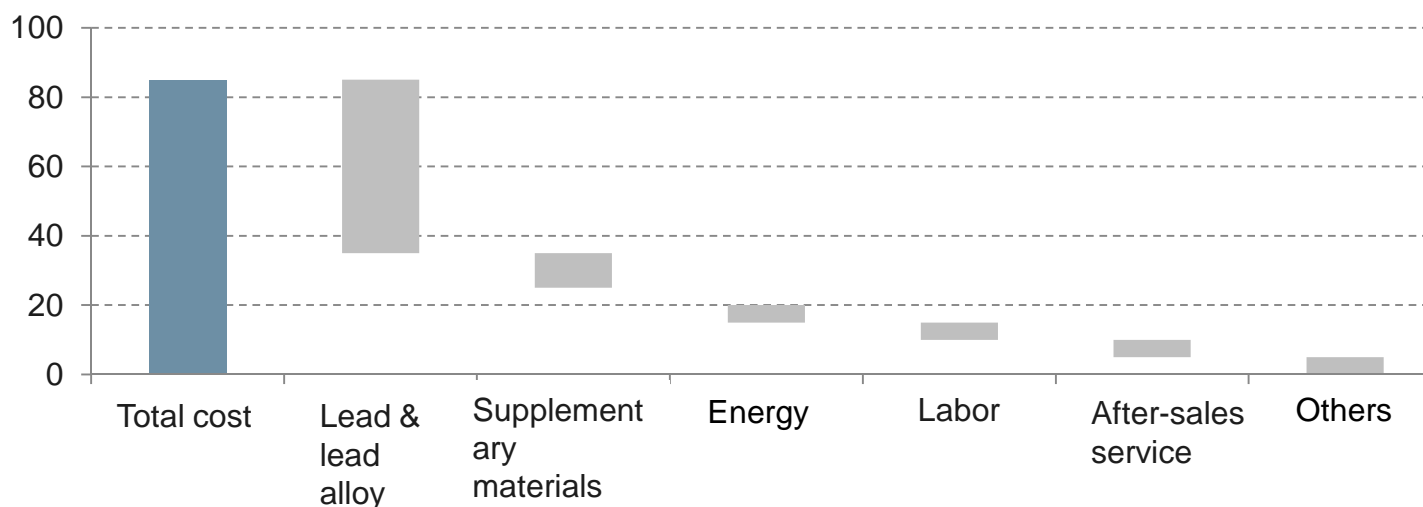
Sources: SMM, MIIT

- During 2012-2014, the Ministry of Industry & Information Technology (MIIT) released six lists of lead-acid battery producers required to eliminate outdated capacity. These lists target 225 producers, involving polar plate capacity at 48.945 million kvah and assembly capacity at 38.16 million kvah.

# Lead-acid Battery Cost Structure

## Motive Lead-acid Battery Cost Structure ( Traditional Battery Production Process ) 12V 12AH

Unit: RMB/piece



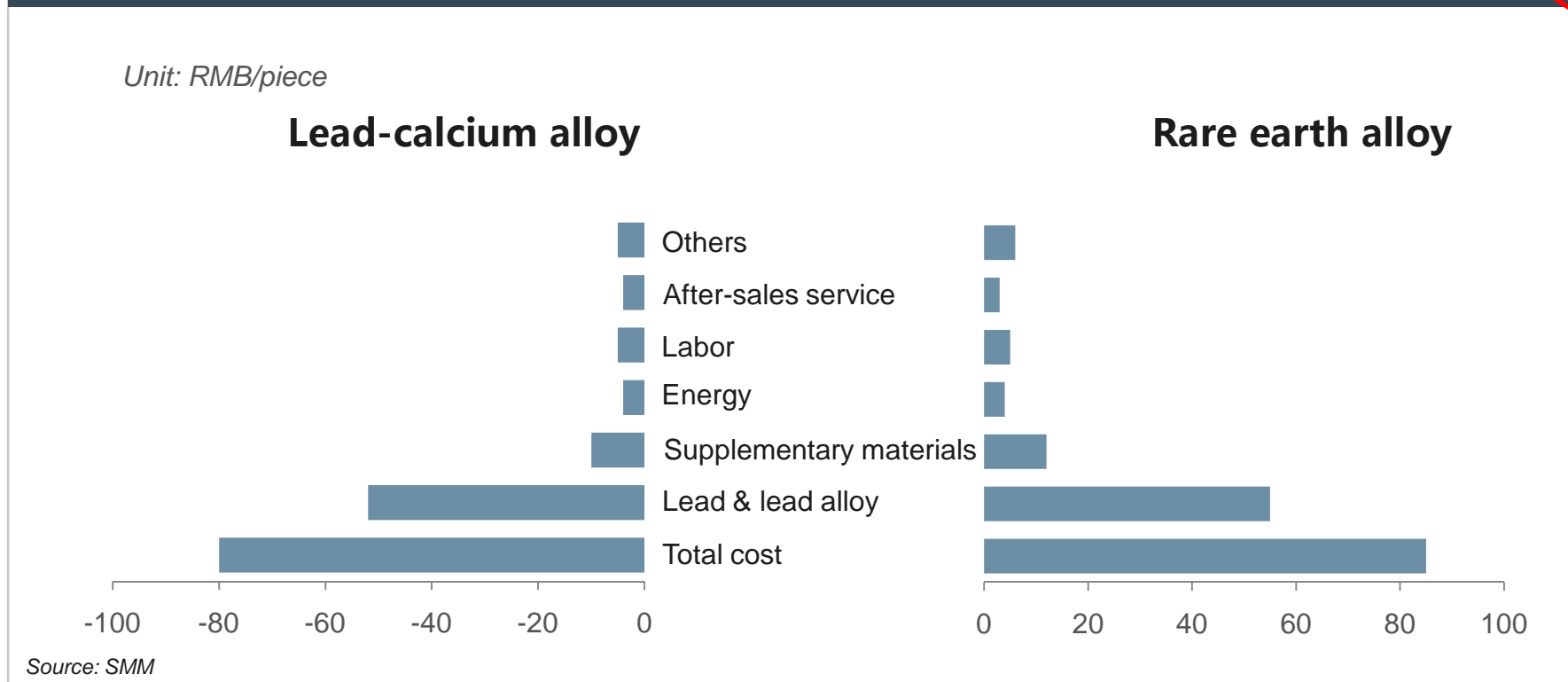
Source: SMM

- Lead-acid battery contains about 70% of lead. As such, changes in lead prices could have significant impact on lead-acid battery costs. Excluding unusual factors, battery sales prices change correspondingly once changes in spot lead prices exceed RMB 1,000/mt.
- The *Entrance Requirements* bans use of traditional battery production process for newly built, upgraded and expanded projects, effective January 1, 2013.



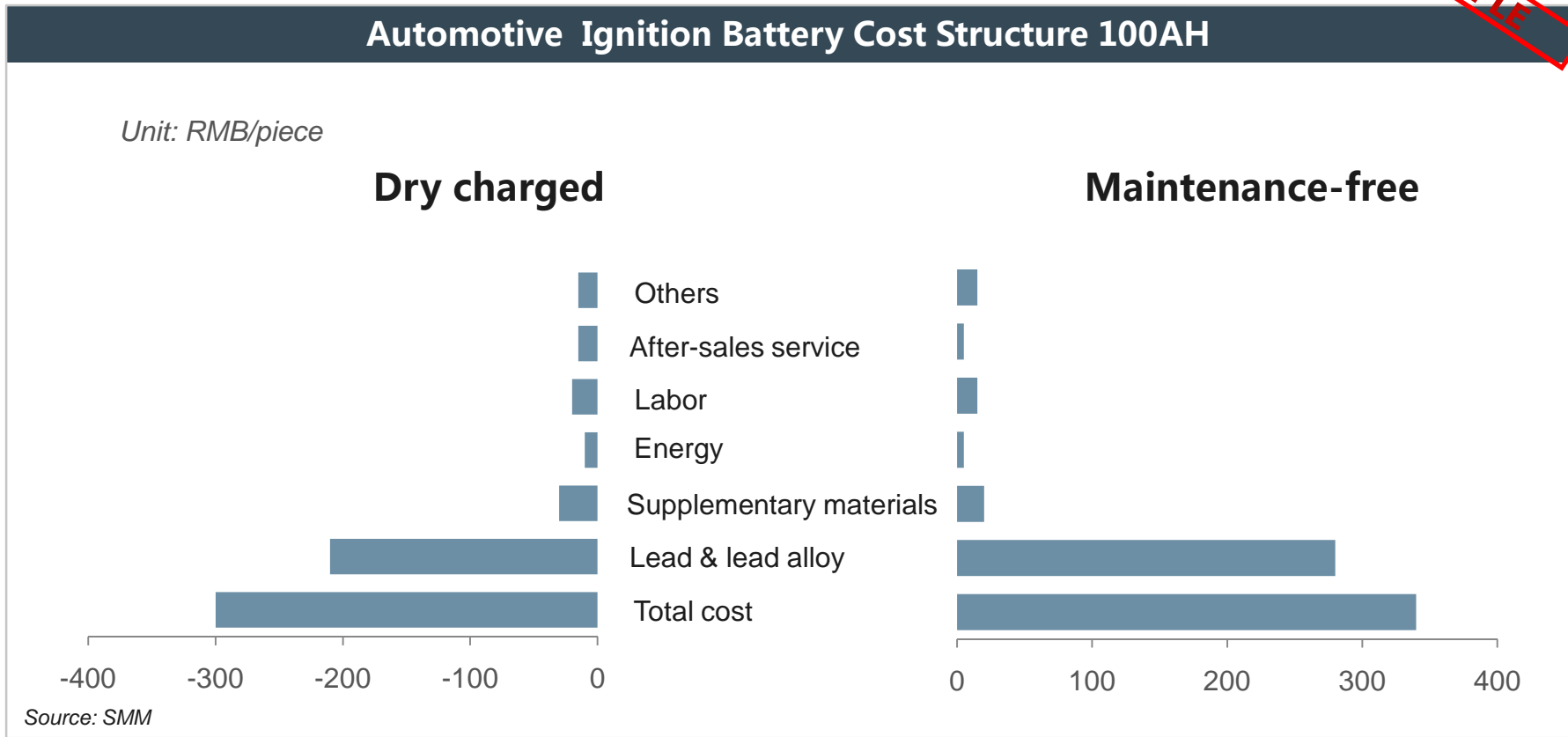
# Lead-acid Battery Cost Structure

## Motive Lead-acid Battery Cost Structure ( Enclosed Battery Formation Process ) 12V-12AH



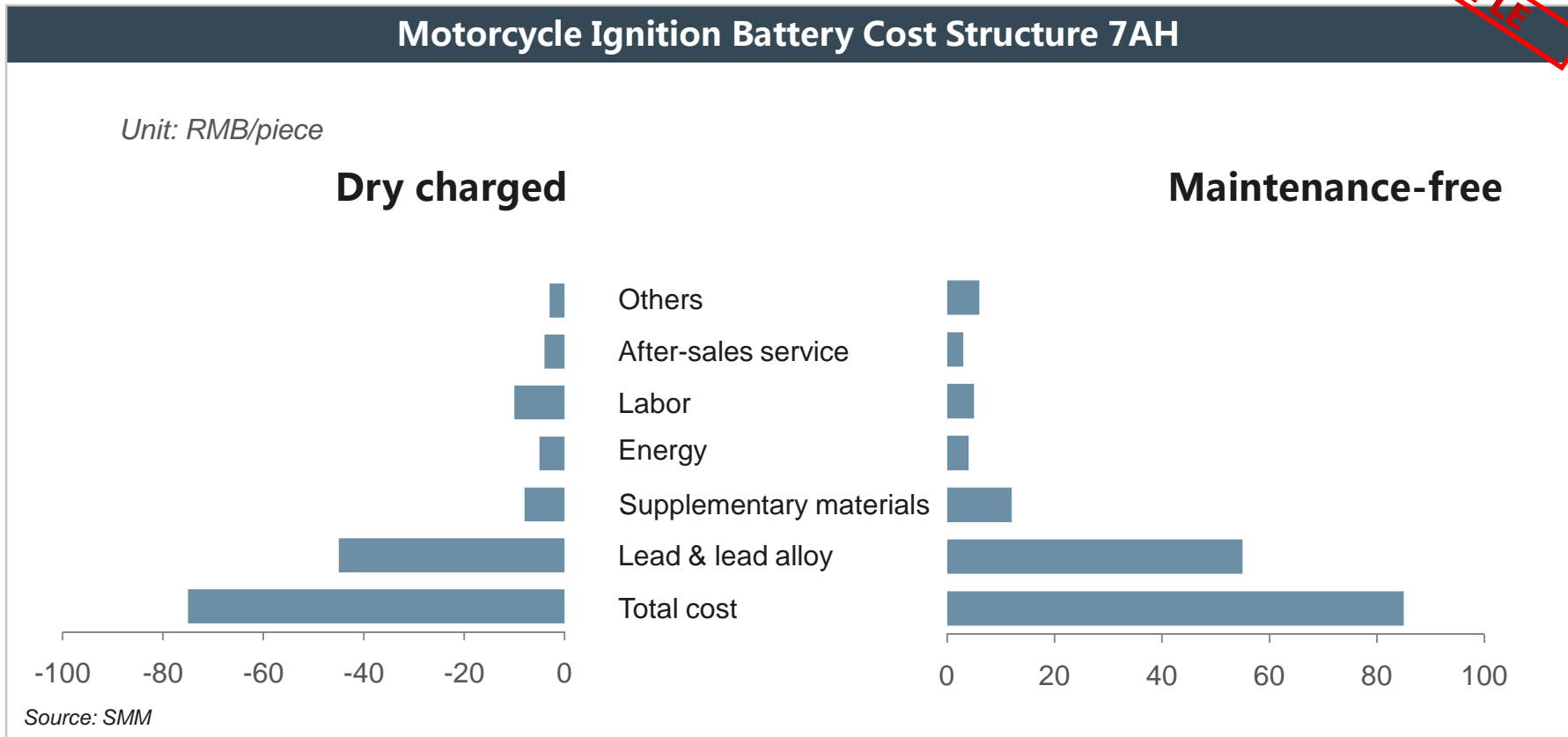
- Enclosed battery formation process, also called cadmium-free enclosed battery formation process, operates in such a way that battery polar plate is solidified and dried before being cut into pieces for assembly and charging is completed in the final stage.
- Compared with traditional process, cadmium-free enclosed battery formation process uses 90% less water and 25.8% less electricity, reduces costs by 15% and occupational disease by 90%. Enclosed battery formation process conforms to the entrance requirements and is environmentally friendly as it adopts lead-calcium alloy, unlike traditional process that uses cadmium and arsenic.

# Lead-acid Battery Cost Structure



- The Entrance Requirements bans new, upgrade and expansion projects for dry charged lead-acid batteries, namely lead-acid batteries which are filled with electrolyte only before use and whose polar plates are dry and in state of charge.
- Major battery manufacturers, such as Fengfan Co. and Camel Group no longer produce such batteries.

# Lead-acid Battery Cost Structure

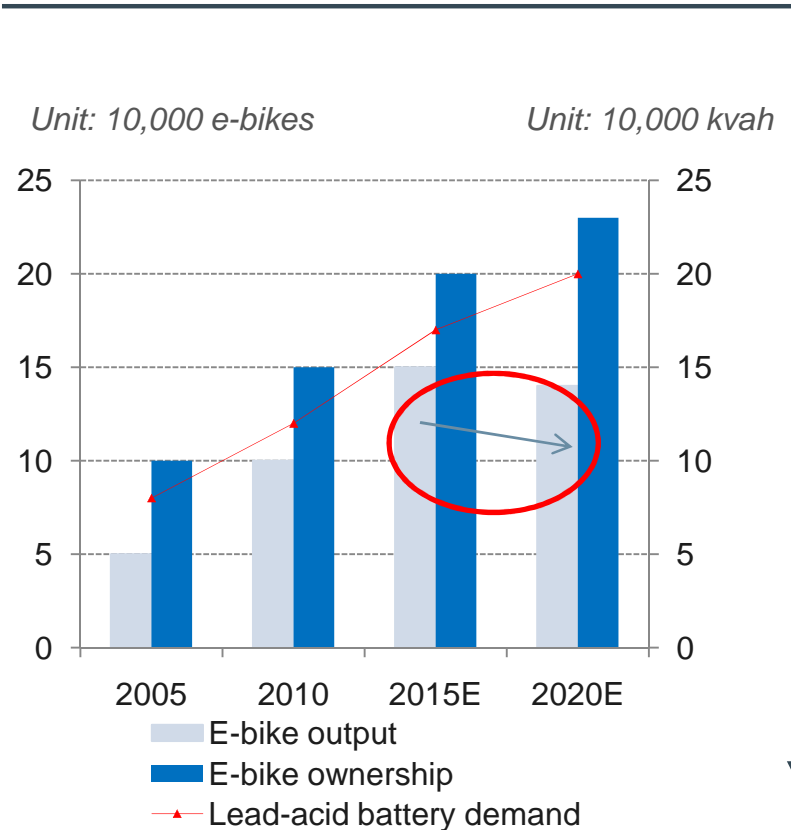


- The *Entrance Requirements* bans open-type lead-acid battery acid projects, i.e. battery that emits SO<sub>2</sub> into the air when in use.

# Lead-acid Battery End Use — Electric Bicycle (E-Bike)

## E-Bike Ownership

### 1 E-Bike Ownership



### 2 Capacity and Expansion Plans at Major E-Bike Lead-Acid Battery Producers

Company	Capacity ( 10,000 kvah )	Expansion plans
Tianneng Group		
Chilwee Group		
A		
B		
C		
D		

E-bike production and sales recorded negative growth for the first time in 2014 after years of rapid growth.

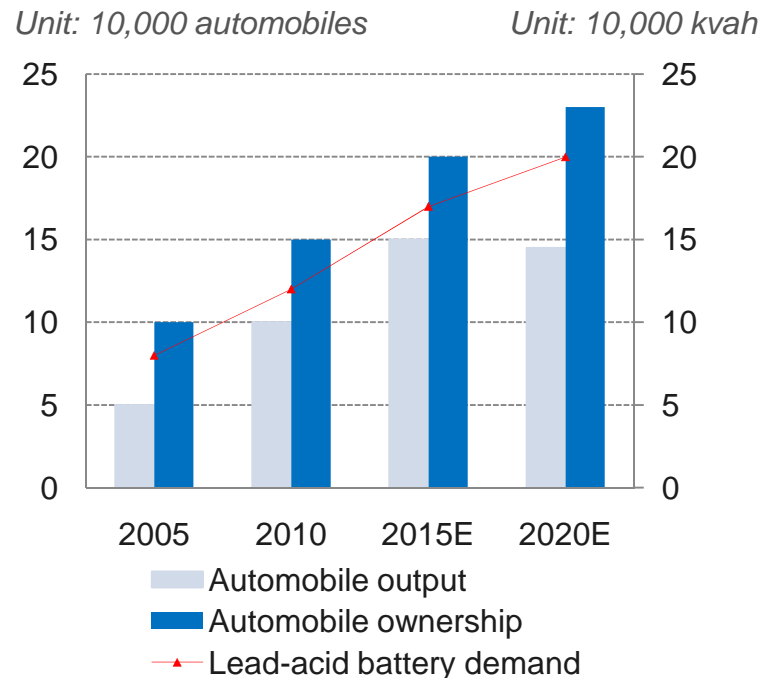
Source: SMM

# Lead-acid Battery End Use—Automobile



## Automobile Ownership

### 1 Automobile Ownership



### 2 Capacity and Expansion Plans at Major Automotive Lead-Acid Battery Producers

Company	Capacity ( 10,000 kvah )	Expansion plans
Fengfan Co.		
Camel Group		
A		
B		
C		
D		

Traditional automobile market slowed. China had reported declines in month-on-month and year-on-year growth of its automobile production and sales for three consecutive months since May 2015. China's automobile production and sales registered less than 1% YoY growth January-July, well below 3% growth forecasted for the entire year of 2015.

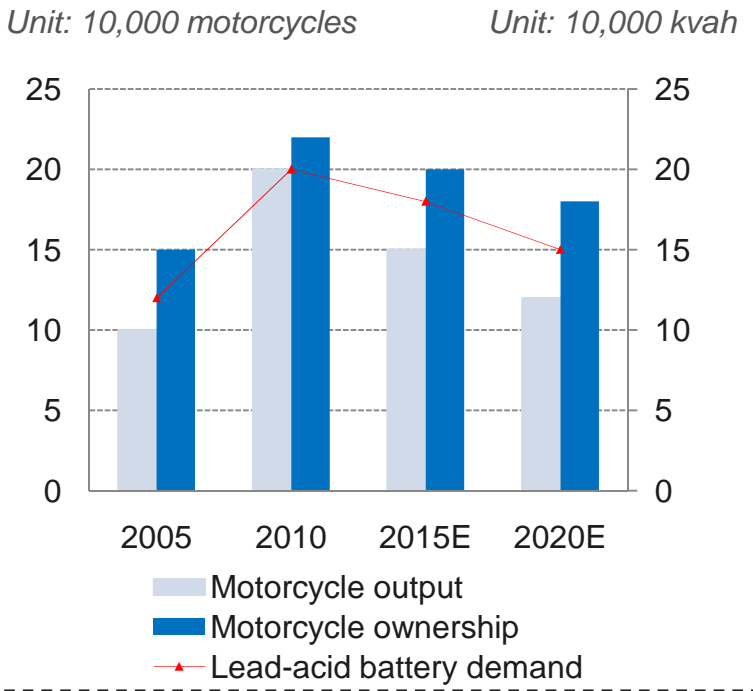
Source: SMM

# Lead-acid Battery End Use—Motorcycle



## Motorcycle Ownership

### 1 Motorcycle Ownership



### 2 Capacity and Expansion Plans at Major Motorcycle Lead-Acid Battery Producers

Company	Capacity ( 10,000 kvah )	Expansion plans
Guangdong Dynavolt Power Technology Co.		
Tinjin Yuasa Batterise Co.		
A		
B		
C		

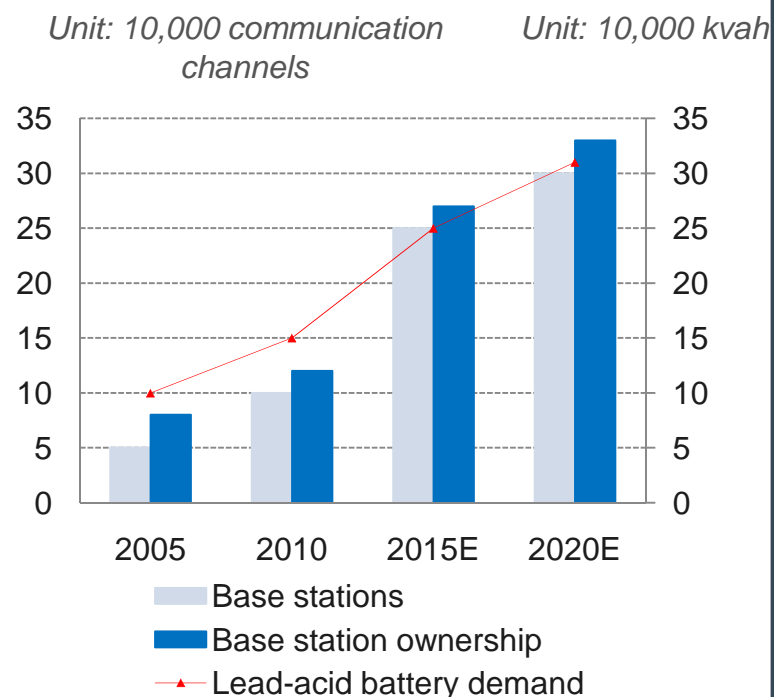
Motorcycle production registered negative growth for several consecutive years as local government restrict or ban motorcycle use. Two-wheel motorcycle, in particular, reported the largest production decline.

Source: SMM

# Lead-acid Battery End Use—Base Stations

## Number of Base Stations

### 1 Number of Base Stations



### 2 Capacity and Expansion Plans at Major Energy-Storage Lead-Acid Battery Producers

Company	Capacity ( 10,000 kvah )	Expansion plans
Narada Power Source Co.		
Shandong Sacred Sun Power Sources Co.		
A		
B		
C		

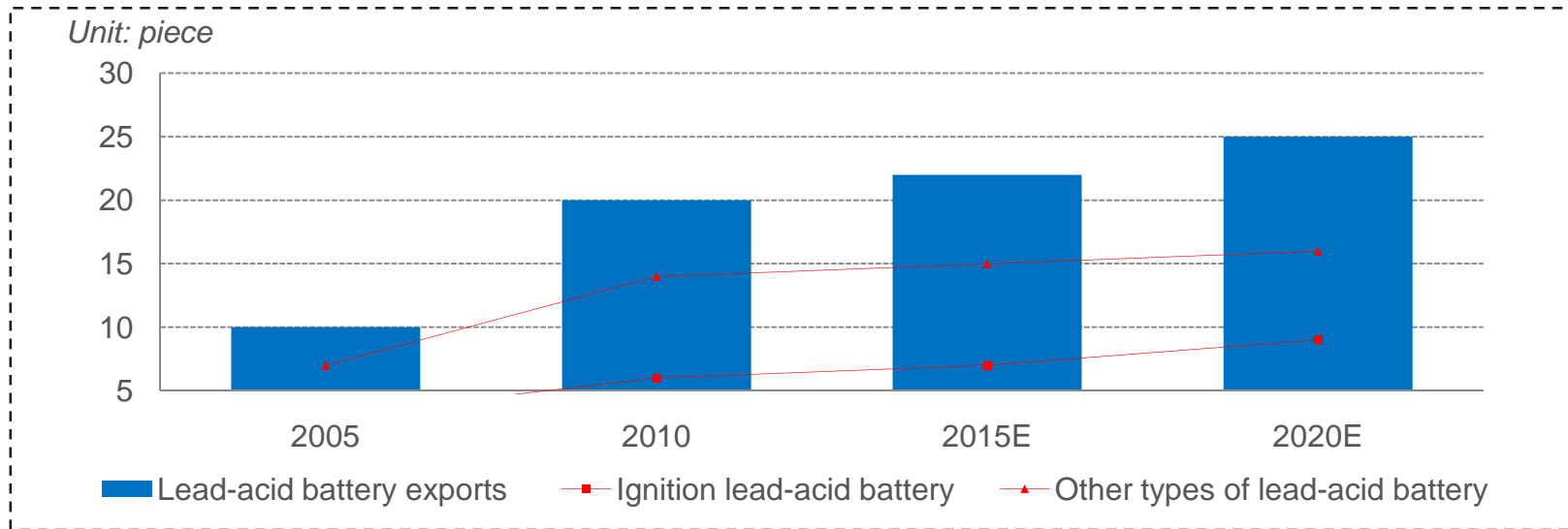
The MIIT issued 4G TD-LTE licenses to China Mobile, China Telecom and China Unicom – China’s three telecom giants – in December 2013. This allowed the number of base stations to shoot up in 2014, which will continue boosting demand for batteries used in telecommunication over the next five years.

Source: SMM

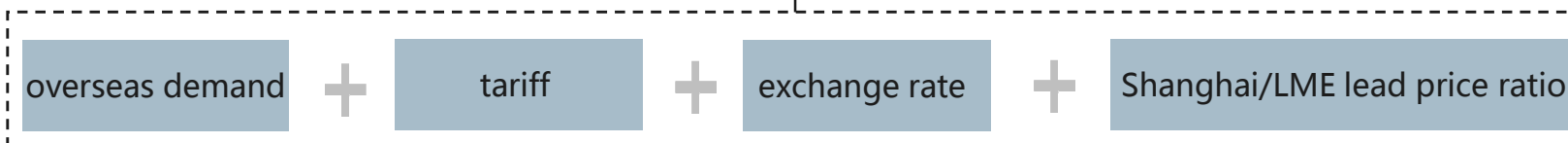
# Lead-acid Battery End Use—Exports

## Lead-acid Battery Exports

### 1 Lead-acid Battery Exports 2005-2020E



### 2 contributory factor



- China will put lead-acid battery consumption tax into effect in 2016, which will push up costs for Chinese lead-acid battery producers. This move will also weaken competitiveness of Chinese lead-acid battery in overseas market, thus affecting battery export growth.

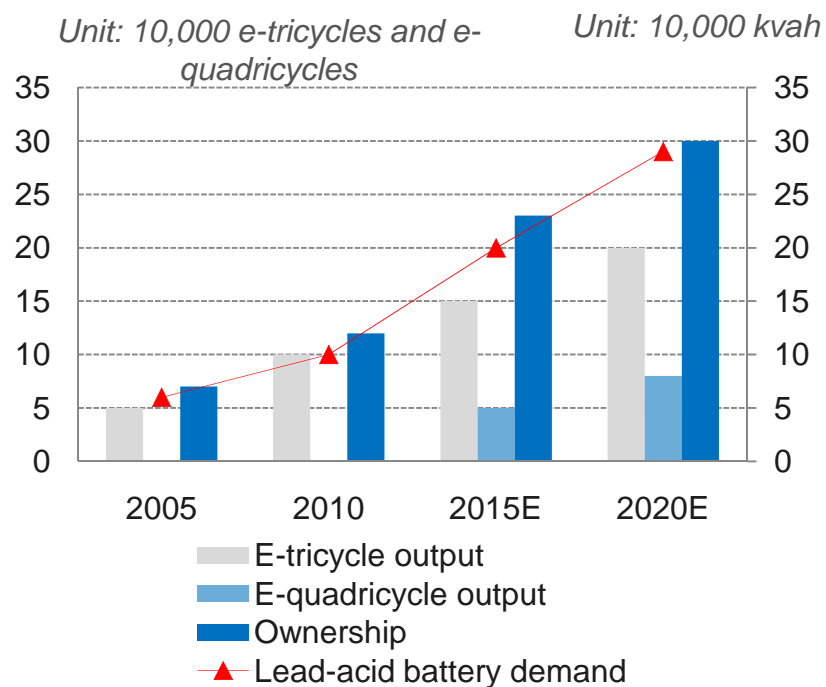
Source: SMM



# New Drivers of Lead-acid Battery Consumption

## E-Tricycle and E-Quadricycle Ownership

### 1 E-Tricycle and E-Quadricycle Ownership



### 2 Market Conditions

- Shandong is one of the major producing regions of e-tricycles. E-tricycles are quite popular in second-tier and third-tier cities. However, some local governments restrict use of e-tricycles in recent years.
- E-quadricycle was new in China until two years ago. E-quadricycle battery is mainly sold to e-quadricycle manufacturers at present. Tianneng Group is the major producer of e-quadricycle battery.

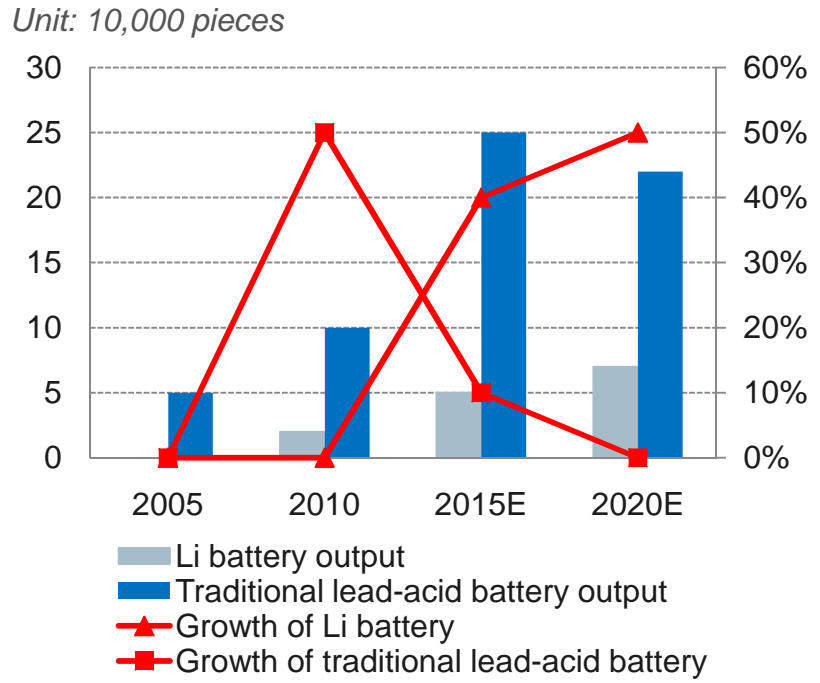
Source: SMM

# Li Battery Substitution for Traditional Lead-acid Battery



## Li Battery Substitution for Traditional Lead-acid Battery

### 1 Production of Li Battery Vs Lead-acid Battery



### 2 Li Battery Market

- Advantages of Li battery: 1. Lightness; 2. More energy efficient and environmentally friendly than lead-acid battery; 3. Life of Li battery is typically twice longer than that of lead-acid battery.
- E-bike is the first example of Li battery substitution for lead-acid battery. Li battery is increasingly chipping away at the market share of automotive lead-acid battery as new energy vehicle market is expanding rapidly during 2014-2015. Currently, substitution rate of Li battery for lead-acid battery is around 10% in China. China's Li battery production is expected to grow at about 10% pace each year.

Source: SMM

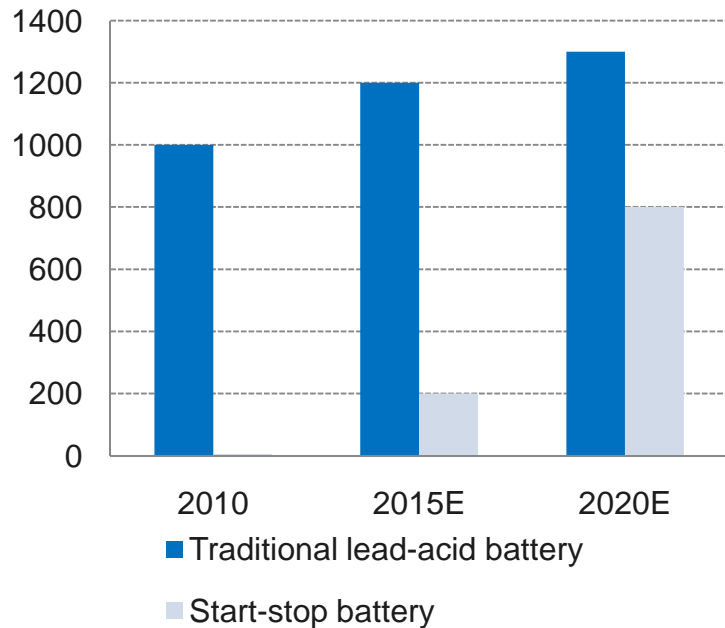
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# Traditional Lead-acid Battery Producers Set Foot into New Types of Batteries

## Start-Stop Battery

**1** Development Trend of Start-stop Battery in Coming Five Years

Unit: 10,000 kvah



**2** Capacity and Expansion Plans at Major Start-Stop Battery Producers

Company	Capacity ( 10,000 kvah )	Expansion plans
Fengfan Co.		
Camel Group		
Johnson Controls		
A		
B		
C		

Major Chinese battery manufacturers are ramping up investment and production of start-stop batteries, which enjoy bright market prospects because of its energy efficiency and environmentally friendliness. Market share of start-stop batteries is less than 10% in China, well below 40% in Europe and the US. However, its market share is expected to rise to 40-50% in coming five years.

Source: SMM  
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# Traditional Lead-acid Battery Producers Set Foot into New Types of Batteries

## Lead-carbon battery: motive battery suitable for use in new energy vehicles

Indicator	Lead-carbon battery	Ordinary lead-acid battery	Company	Existing Capacity	Expansion Plans
specific power	240W/kg	180W/kg			
IEC61427 and GB/T22473-2008 cycle endurance life ( >3times )	15 times ( remaining capacity 93% )	4 times	Shandong Sacred Sun Power Sources Co.	...	...
80%DOD cycle life	1600 times ( remaining capacity 93% )	400 times			
30%DOD cycle life	3500 times ( remaining capacity 93% )	1000 times	Narada Power Source Co.	...	...
GB/T22473-2008 ability to receive charge ( >2.0 )	2.8	2			
GB/T22473-2008 low-temperature performance ( discharge capacity >80% when temperature is -10°C )	90%	80%	Guangdong Dynavolt Power Technology Co.	...	...
Fast charge ability	1h	12h			
SBA-S0101 hybrid motive battery cycle life	>150000 times	30000 times	A	...	...
			B	...	...
design life ( hybrid motive type )			C	...	...

- Lead-carbon battery represents technical innovation of lead-acid battery and has many advantages: 1. Charge eight times faster than lead-acid battery; 2. Discharge power is three times higher than lead-acid battery; 3. Cycle life is as long as 2,000 times, which is six times longer than lead-acid battery; 4. High price-performance ratio. Although lead-carbon battery is more expensive than lead-acid battery, much longer cycle life allows it to have higher price-performance ratio; 5. Safe and stable. Lead-carbon battery could be widely used in energy-saving field.

Source: SMM

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# Raw Material Use in Lead-acid Battery: Substitution of Secondary Lead for Primary Lead



## Secondary Lead Use by Lead-acid Battery Producers

Type	Company	Ratio of Secondary Lead and Primary Lead Use					
		2010		2015E		2020E	
		secondary lead	primary lead	secondary lead	primary lead	secondary lead	primary lead
motive battery	Tianneng Group	...	...	...	...	...	...
	Chilwee Group	...	...	...	...	...	...
ignition battery	Fengfan Co.	...	...	...	...	...	...
	Camel Group	...	...	...	...	...	...
backup battery	Narada Power Source Co.	...	...	...	...	...	...
	Shandong Sacred Sun Power Sources Co.	...	...	...	...	...	...

Source: SMM

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# Lead-acid Battery Market Trend



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