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Historic Mission of Industrial Wastes by Fly Ash, etc in China's 2050

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Main points

- 1 Output and utilization of fly ash in China in recent years
- 2 Output in the future, and Prospect of fly ash application in China

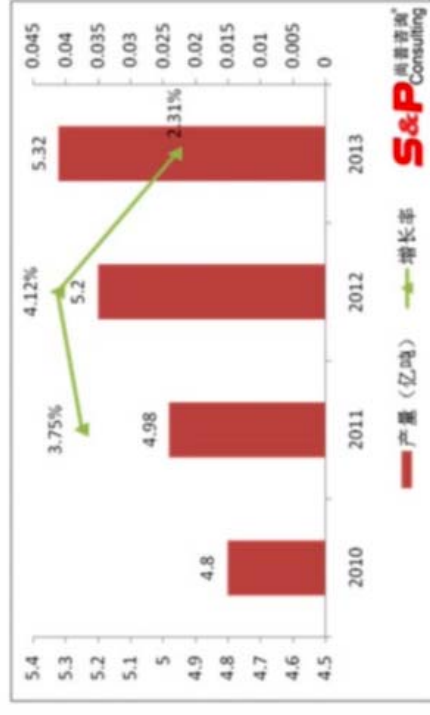


1 Output & utilization of fly ash in China in recent years

1.1 Output of fly ash

Table1 The output and growth rate of fly ash in China in recent years

	2011	2012	2013
Output (million tons/Y)	498	520	532
Growth Rate	3.75%	4.12%	2.31%



数据来源：尚普咨询

The growth rate of fly ash output began to slow down since 2013; And in 2014, I have not got the statistical data, but I surmised it would be 530.40 million tons, based on the calculation of one ton of coal which produce 0.28 ton of fly ash !

This means a net falling down of fly ash output, which is similar to the coal output that was decreased since 2014 !

For the controlling of fog and haze breaking out in a large area, Chinese government starts to impose a restriction to the coal consumption in recent years. This has been leading to a going down of coal consumption, which was a 2.9% drop when comparing with the year in 2013 !

1 Output & utilization of fly ash in China in recent years

1.2 Utilization rate of fly ash

Table 2 The utilization rate of fly ash in Chian from 2000-2010

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Output /100mil tons	1.20	1.54	1.81	2.17	2.63	3.02	3.52	3.88	3.95	4.00	4.80
Used /100mil tons	0.79	0.97	1.19	1.41	1.71	1.99	2.32	2.60	2.65	2.68	3.26
utilization rate /%	58	63	66	65	65	66	66	67	67	67	68

Utilization rate of fly ash goes up from 58% to 68% between 2000 and 2010, with about 1% of increase each year on average.

1 Output & utilization of fly ash in China in recent years

1.3 Applying fields of fly ash

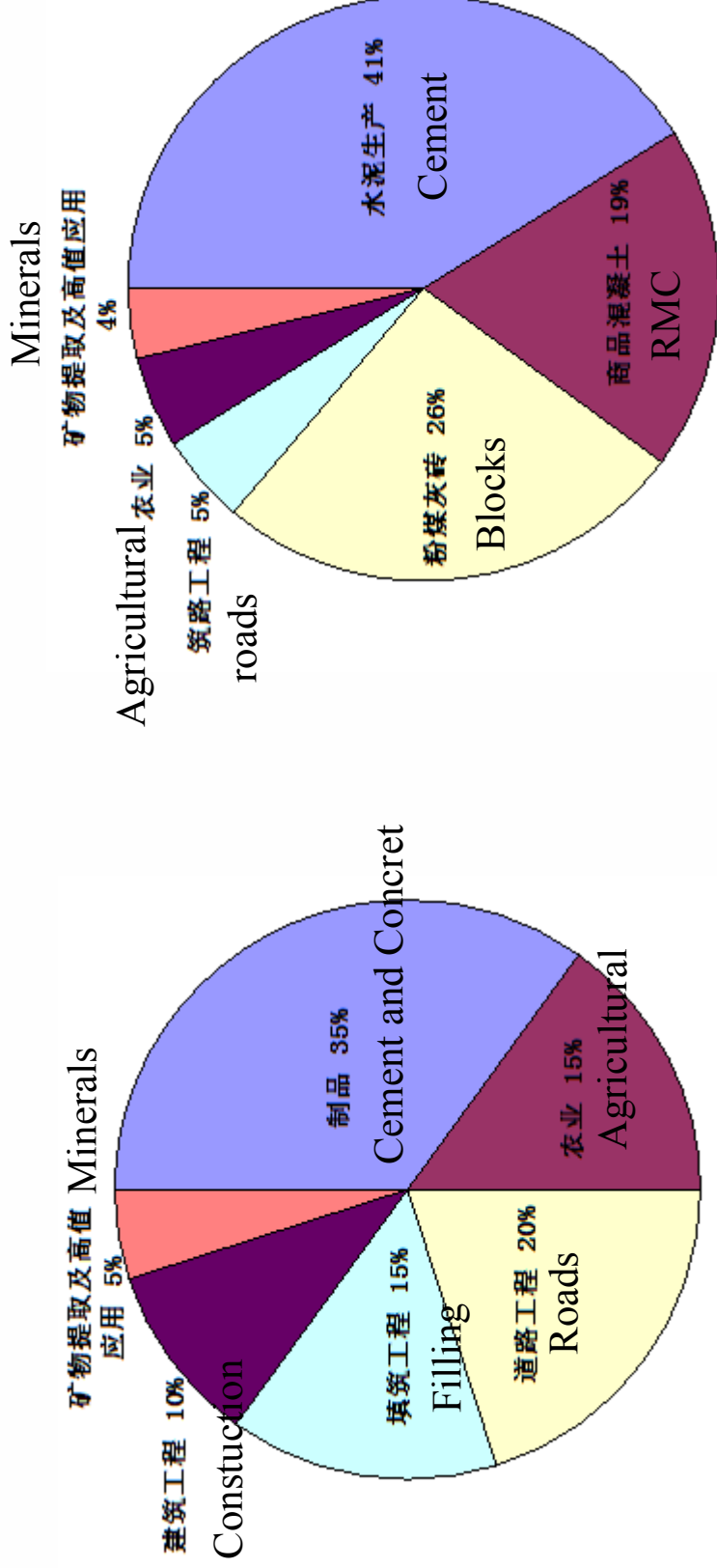


Figure 1 The application field a few years ago

Figure 2 The application field in 2011

The overall proportion applied in agricultural has been reduced, but the its amount may be kept constantly because the sum is increased.

More than 90% of fly ash is used for building materials and construction .

1 Output & utilization of fly ash in China in recent years

1.4 Problems, now we have met at the moment

Problem 1: 30% fly ash is not used, which comes from Coal rich areas, accounted for 160 million tons/year at the moment.

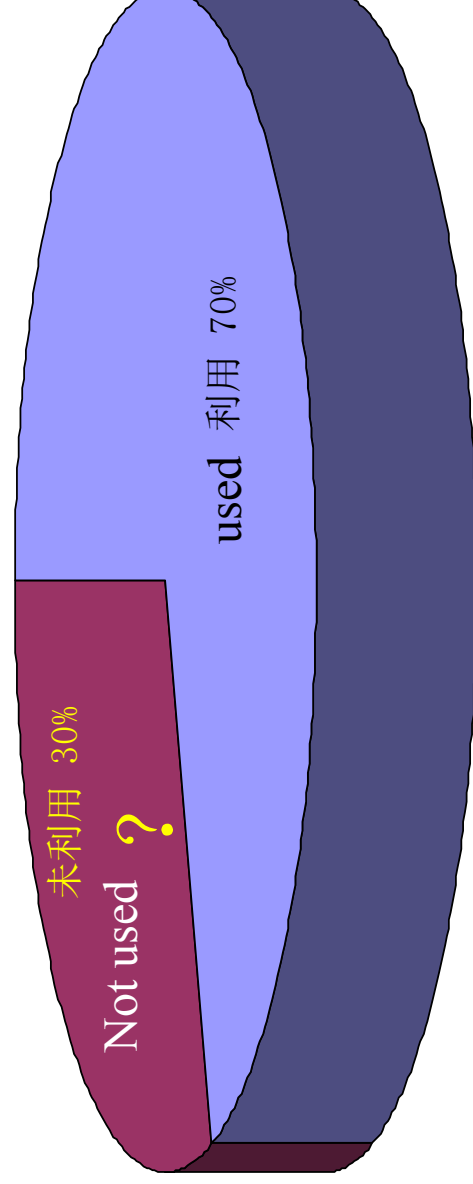


Figure 3 The utilization situation of fly ash in China

From 1994 to 2014, the utilization rate of fly ash in China was up to 70%, with 20 years of efforts, and it is even up to 100% in the eastern coastal and developed provinces ! The supply of fly ash is in a shortage of demand even for now.

But there are about 160 million tons fly ash has not been used, how to use the rest is a big Challenge.

The unused fly ash is mainly existing in farmost and coal rich areas, such as Shanxi, Shaanxi. Inner Monqolia. Ninaxia and Xiniiana.

1 Output & utilization of fly ash in China in recent years

Problem 2: Smog arising with the coal burning more from utilities, as well as cars.



It is in the middle stage of industrialization and urbanization for China, per capita GDP is 6700 USD in 2013, and there is a big growth space, about 5 to 10 times of gap, when compared with developed countries, so does the electricity consumption. We should make a jump in per capita power consumption, But the smog and haze cannot go up like this, and we need to explore green development road, with the controlling coal consumption as the priority.

2 Output of fly ash in the future, and prospect of application in China

2.1 Normal coal consumption for power generation until 2020

Table 3 The consumption of coal and output of fly ash from power station in China (in million MT)

Year	Coal consumption/mil tons	Coal for power/mil tons	Proportion/%	Fly ash output
2004	1935.00	911.55	53.62	263.00
2005	2140.00	1156.00	54.02	302.00
2006	2370.00	1210.00	51.05	352.00
2007	2586.41	1330.00	50.50	388.00
2008	2740.00	1399.50	51.11	395.00
2009	3020.00	1600.60	52.00	400.00
2010	3180.06	1685.43	53.00	421.25
2011	3488.52	1750.43	53.30	498.00
2012	3575.73	1855.00	51.88	520.00
2013	3610.00	1900.00	52.63	532.00
2014	3510.00	1894.30	53.97	530.40
2015*	3800.00	2300.00	60.53%	575.00
2020*	4500.00	2970.00	66.00%	742.50

* Previous forecast data.

2 Output of fly ash in the future, and prospect of application in China

2.2 To reshape the data of forecast of fly ash output according to the newest situation of frog and haze breaking out in a large zone;

Background information:

(1) Electric power consumption per capita:

OECD countries: 6,200-15,000 kWh/year

USA and Canada: 15,000 kWh/year

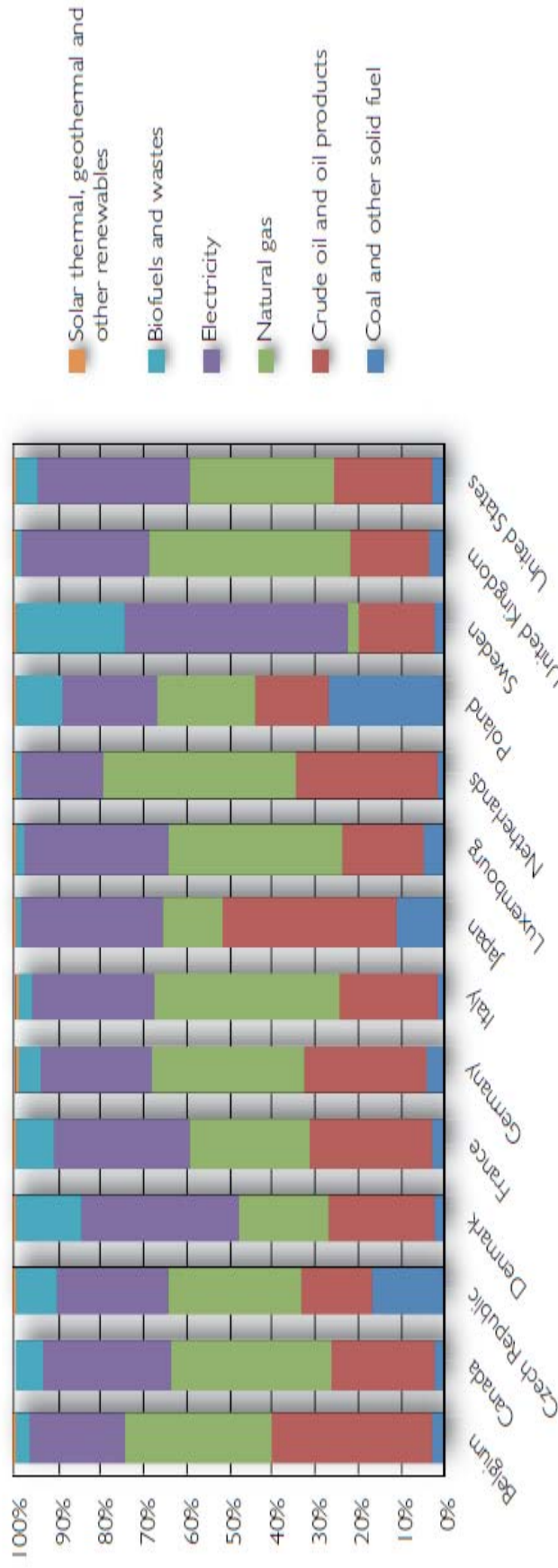
China: 4,031 kWh/year in 2014;

Gap: 3 times at least !

There is a big growth space for electric consumption in China, but not 3 times of frog and haze emission from the coal fired power stations as the priority of choices for China!

2 Output of fly ash in the future, and prospect of application in China

2.3 Reason for controlling fly ash going up from the coal –fired power station



Source: Energy Balances of OECD countries, 2011 edition; International Energy Agency

Figure 5 OECD countries' energy structure

The proportion of coal consumption is up to 65.7% in the primary energy structure in China, and it is the main reason and sources for the smog and haze coming from. However, the proportion of coal-fired power generation is under 10% in general for the OECD countries.

So, New energy is the future for China ! Including Hydropower, Nuclear power, Wind power, Solar energy, etc.

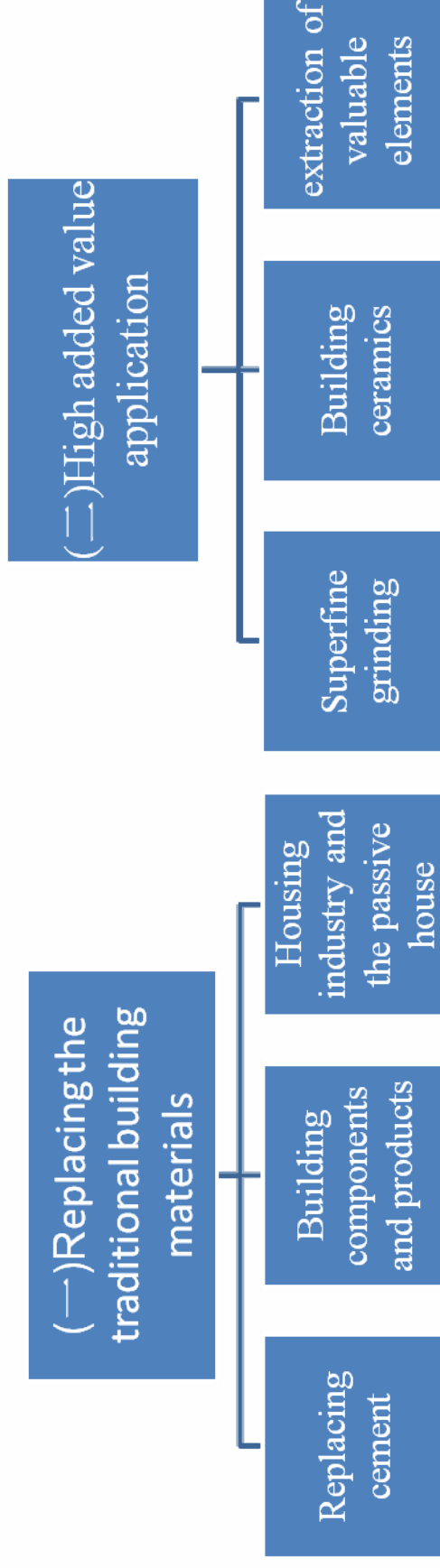
2 Output of fly ash in the future, and prospect of application in China

- So, we have the direction for fly ash application in the future as follows:
- (1). 600 million tons of fly ash produced each year should be as a limitation to choose for China in the future;
- (2). If 600 million X 2, 3 or 4, that's not a good choice, and that would be a big disaster for China; has no ways to go;
- (3). So, the future of Chinese electronic growth must be relied on the new sustainable green energies;
- (4). For current remained fly ash, about 160 million tons or more in the future, we would like to take following 2 measures mainly:
 - (a) with deepen processing of fly ash, increasing application in building materials and construction fields; such the passive house and modular house and precast infrastructures;
 - (b) to make other value added applications, like metal abstraction, and etc..

2 Output of fly ash in the future, and prospect of application in China

2.4 That means: Two ways for fly ash application in the future in China

We believe that only take the following two measures, can effectively solve the problem of utilization of fly ash , according to the situation of our country.



For the amount of high quality infrastructure - ultra high performance concrete(UHPC), China has only 1/3~1/4 of that in the developed countries.

2 Output of fly ash in the future, and prospect of application in China

2.5 Prospect of fly ash and other industrial wastes

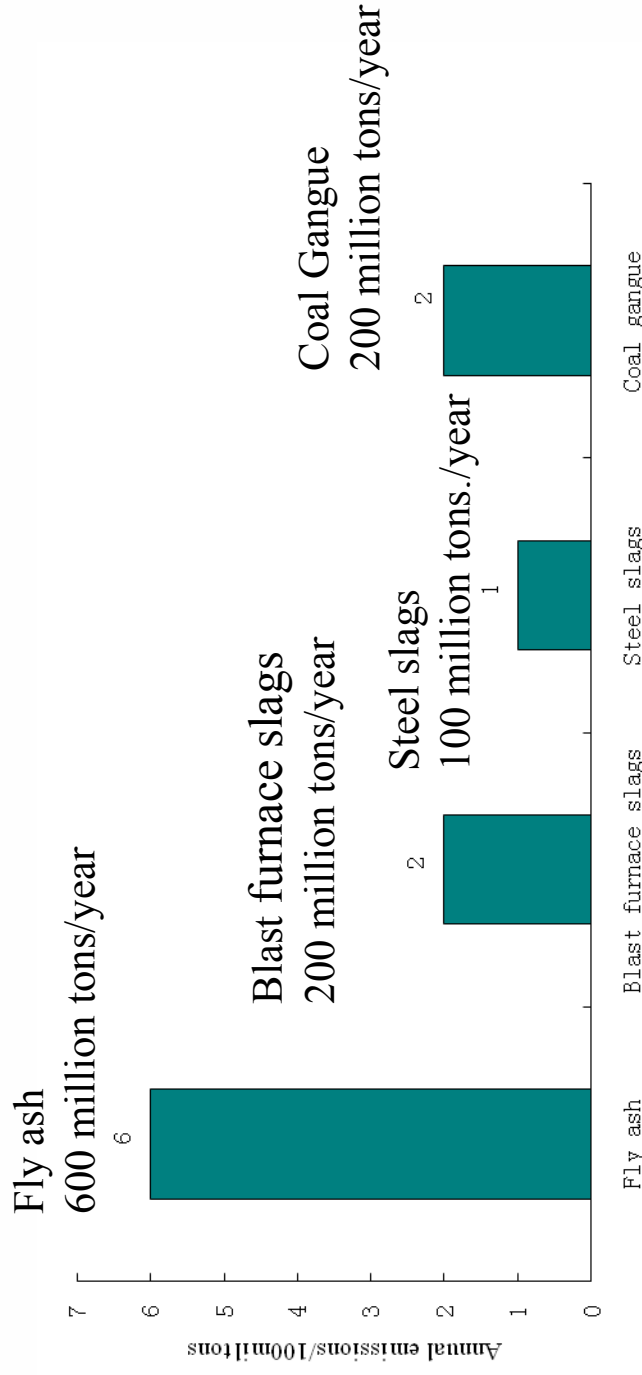


Figure 6 The annual output of industrial solid waste in China

It is possible to control the total of fly ash within 600 million tons if taking the renewable energy route. There are more than 1000 million tons industrial solid waste in China. The amount demanded of cement is only 750 million tons according to our forecast of 500 kilograms per capita demand in 2050. It could meet the demand for the construction in China in the next 35 years if we use the potential activity and amount of industrial wastes well for replacing the Portland cement.

2 Output of fly ash in the future, and prospect of application in China

2.6 The forecasting model for cement demand in China in 2050

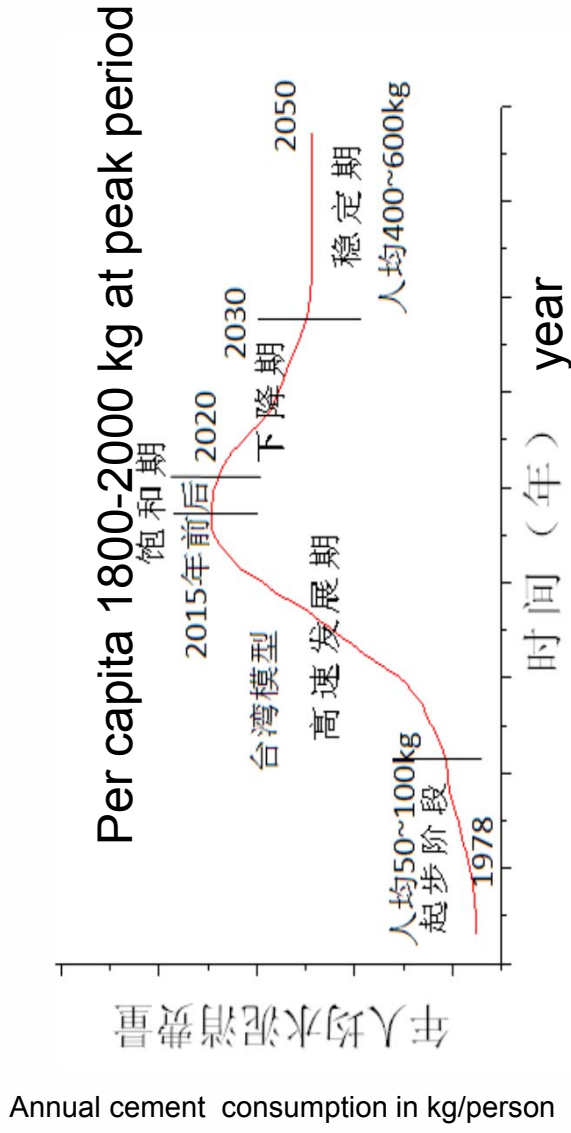



Figure 7 Forecast for 2050 demand and growth model of Chinese cement industry (Data Source: ITIBMIC, 2015)

1800kg—2000kg per capita during 2015 and 2020 at peak stage; total cement output around 2.5-2.7 billion tons/year. Chinese cement demand in 2050: 400kg—600kg per capita; total output would be within 1 billion tons; Going down from some 2.5 billion tons at the moment to be falling down to about 1 billion tons in next 35 years ! This means nearly 2/3 of cement production in China would be cut off in 2050! In 2014, the cement output in China was 2.47 billion tonnes, which was accounted for more than 60% of the total in the world !

Conclusion

- More than 1 billion tons of fly ash and other active industrial wastes could be enough for using as building materials and replacing most of the non-sustainable Portland cement in China in next 30-35 years.
- This is the historical mission of fly ash and other industrial wastes in China until 2050.



Thank you very much
for your attention !