

中国地质科学院全球矿产资源战略研究中心

Research Center for Strategy of Global Mineral Resources, CAGS



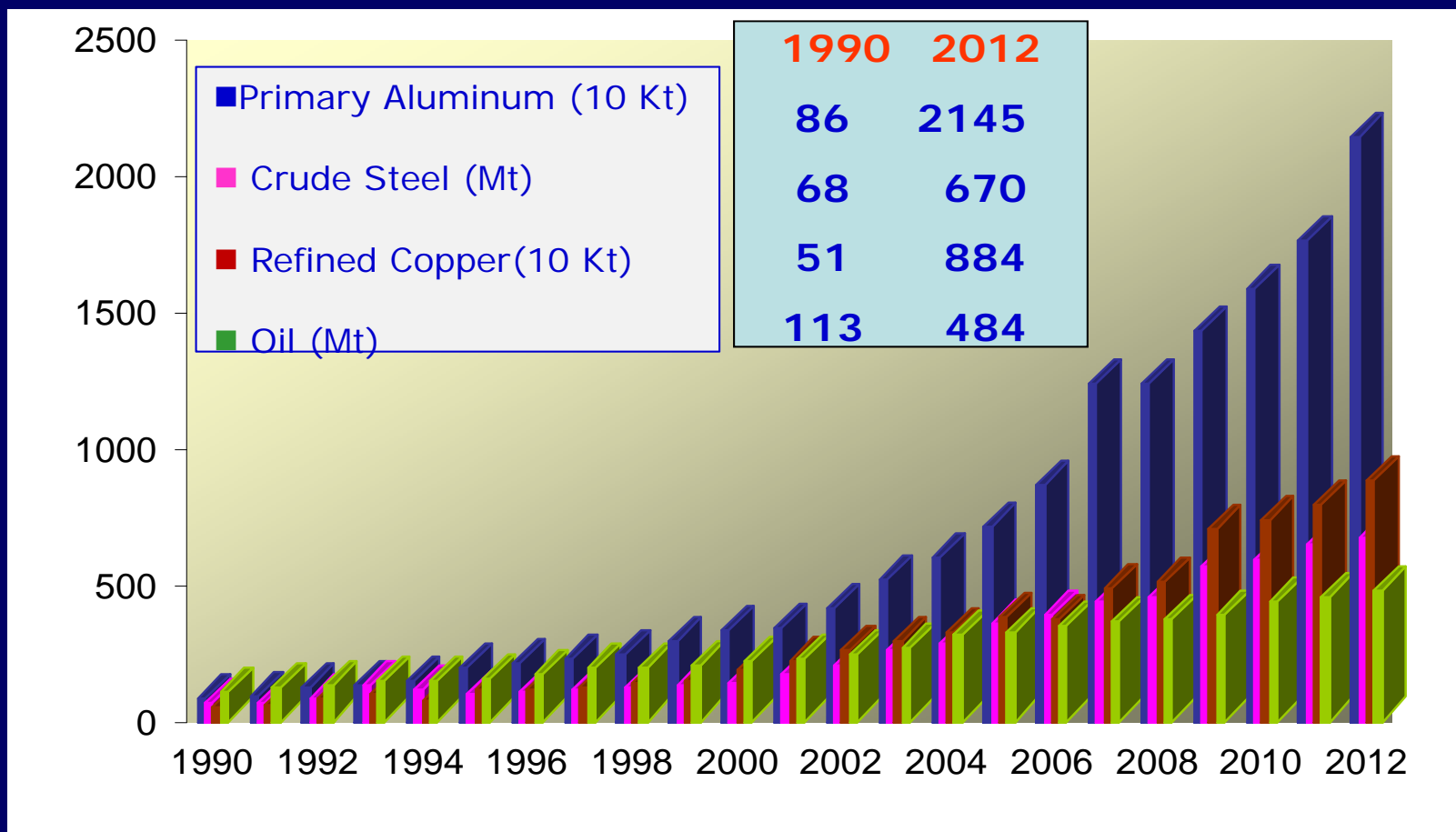
Chinese and Global Demand for Key Mineral Resources

Wang Anjian
Dong Shuwen

Chinese Academy of Geological Sciences

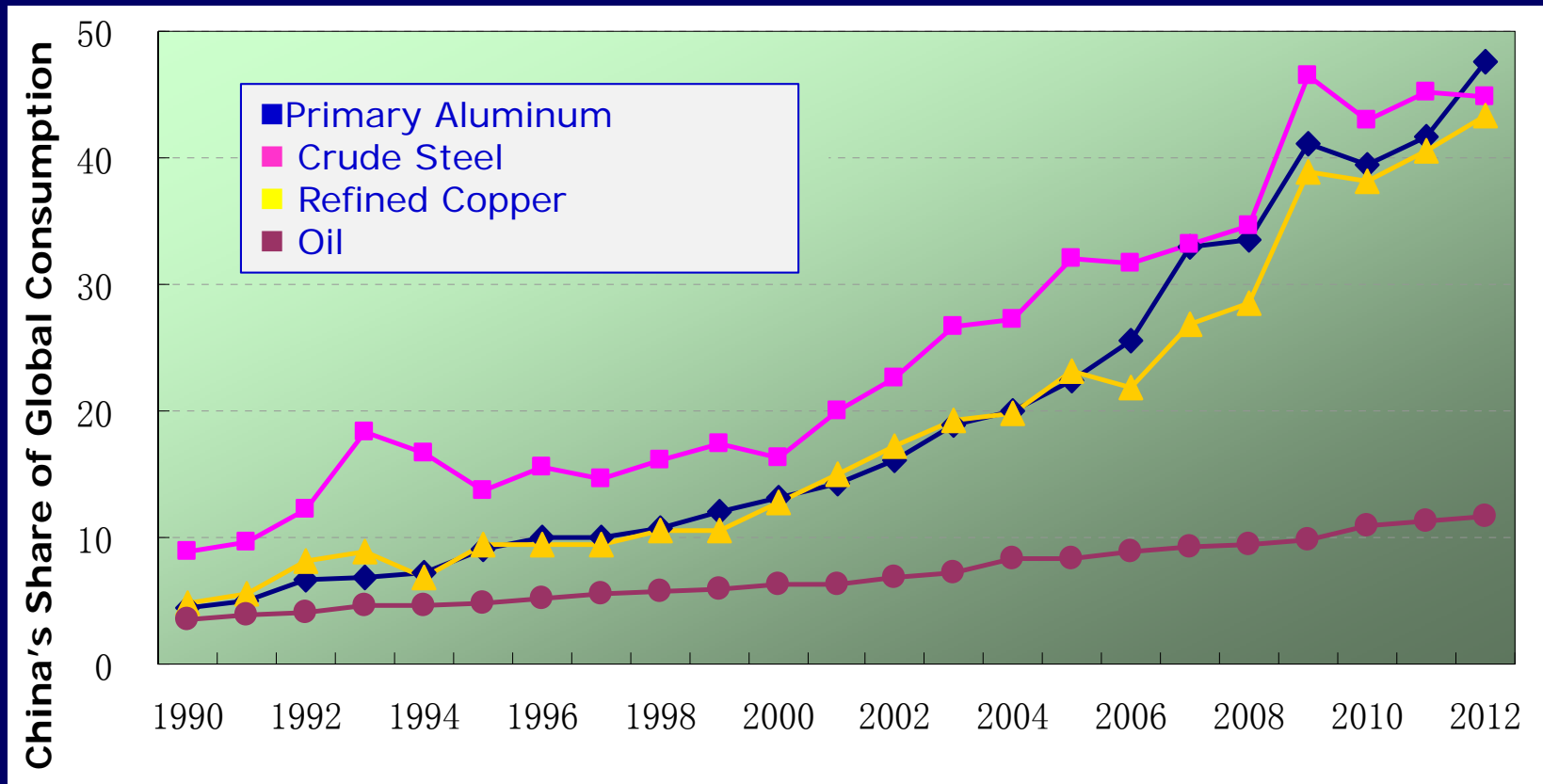


1. Bring up the Question
2. The Laws of Energy and Mineral Resources Consumption
3. Demand for Key Mineral Resources by 2030
4. Summary



China's Consumption of Oil, Crude Steel, Refined Copper and Primary Aluminum

Data: National Bureau of Statistics of China, China Iron and Steel Association



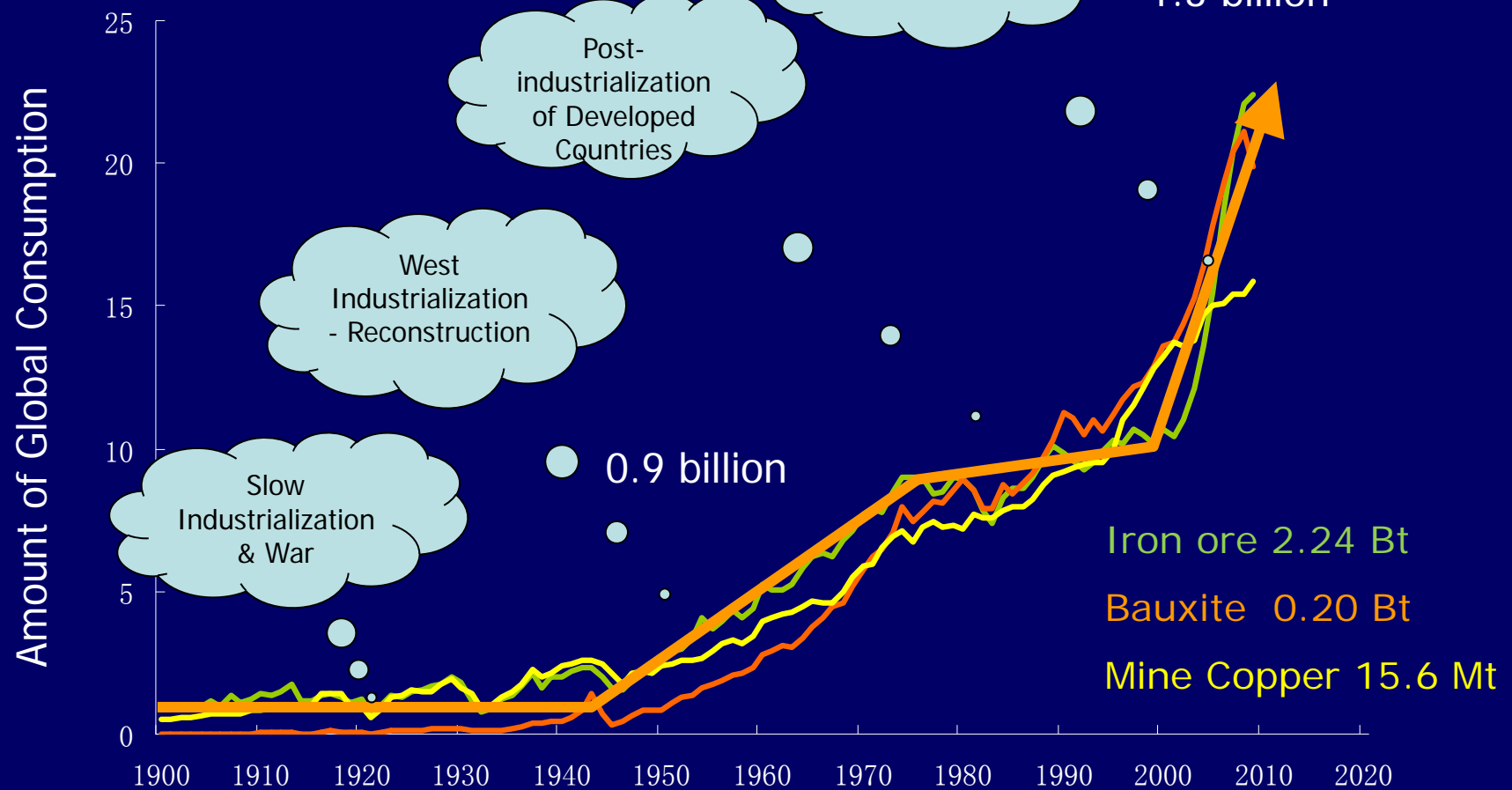
China's Share of Global Consumption

Year 2012: Oil 11.7%; Crude Steel 44.9%, Refined Copper 43.4%; Primary Aluminum 47.6%

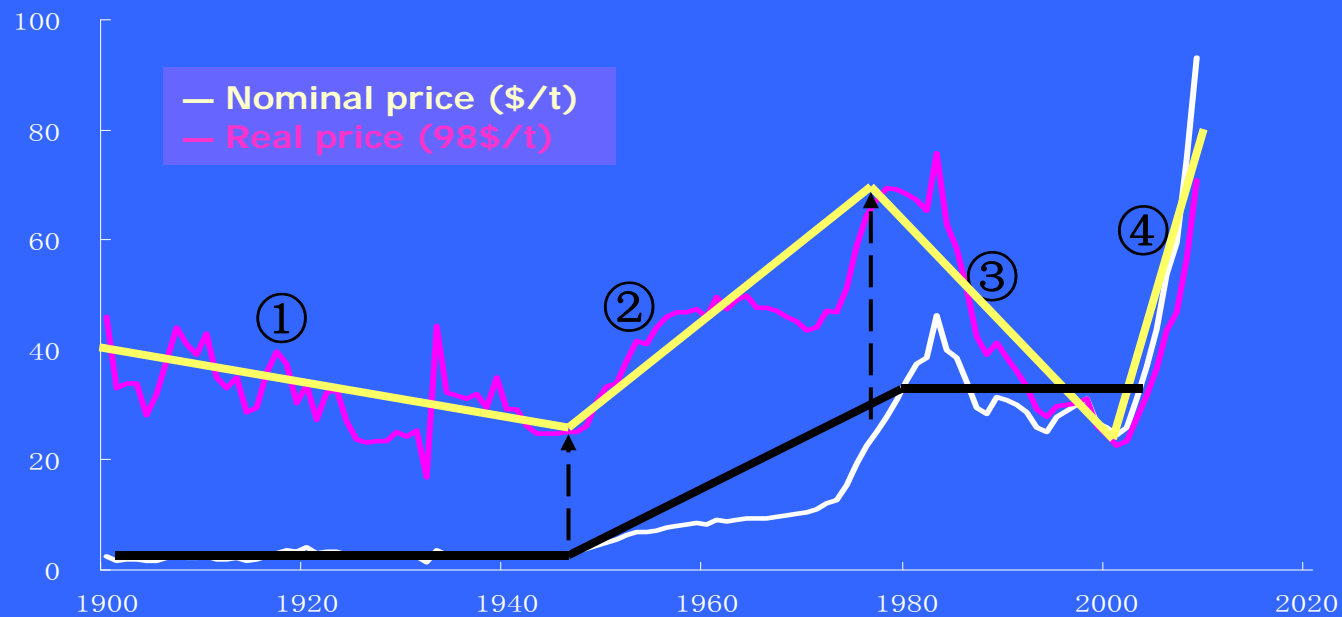
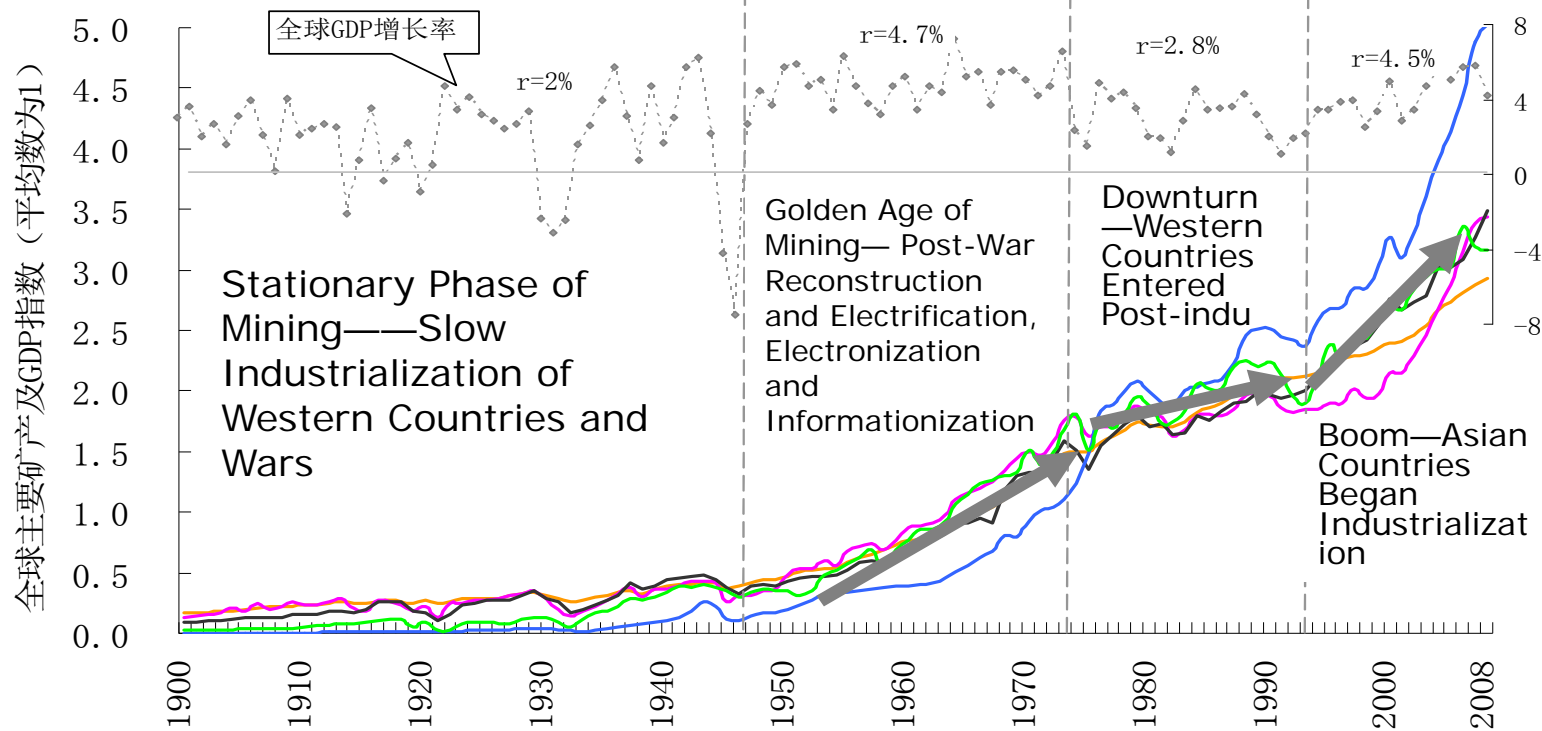
Data: WBMS, WSA, NBSC



History of Global Key Minerals Consumption (Data: WBMS, WSA)



Since 1900, 49.2 Bt of crude steel, 675 Mt of copper and 1047 Mt of aluminum have been consumed by human kind (including recycled).



中国地质科学院全球矿产资源战略研究中心

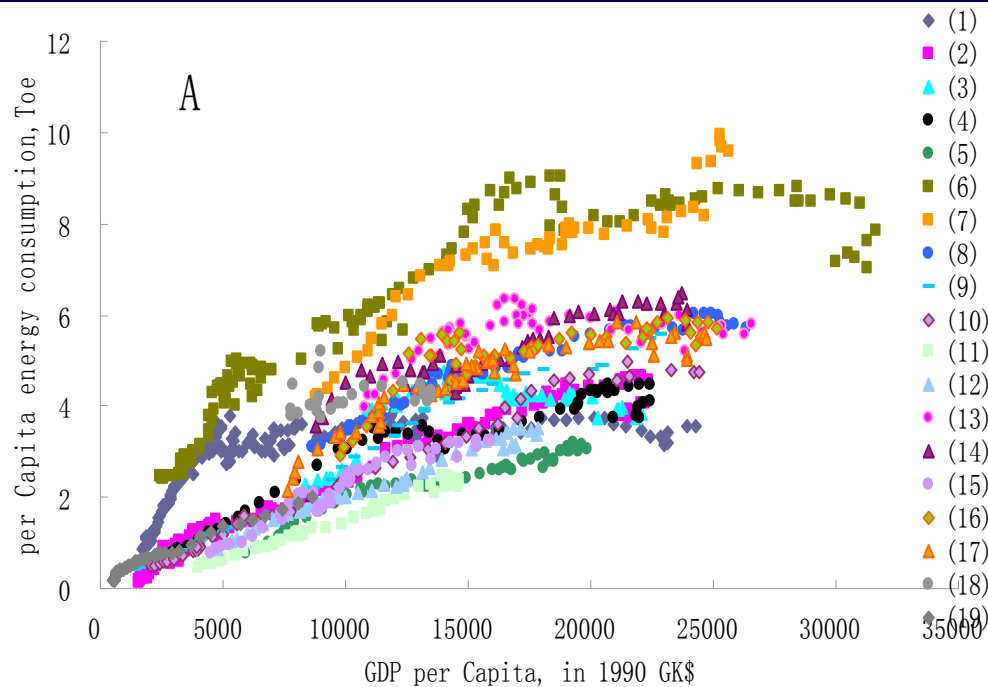
Research Center for Strategy of Global Mineral Resources, CAGS



How much mineral resources will
China and the world need by 2030?



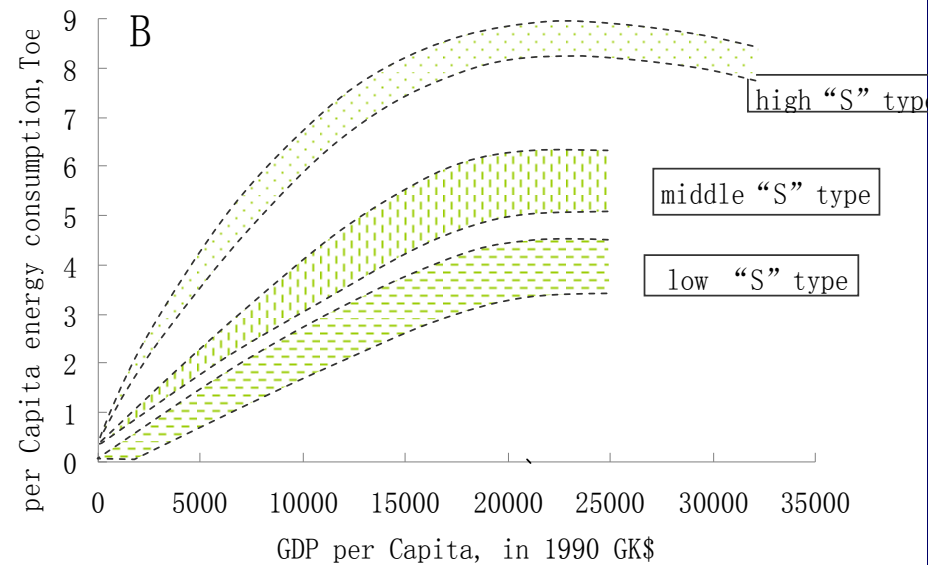
1. Bring up the Question
2. The Laws of Energy and Mineral Resources Consumption
3. Demand for Key Mineral Resources by **2030**
4. Summary

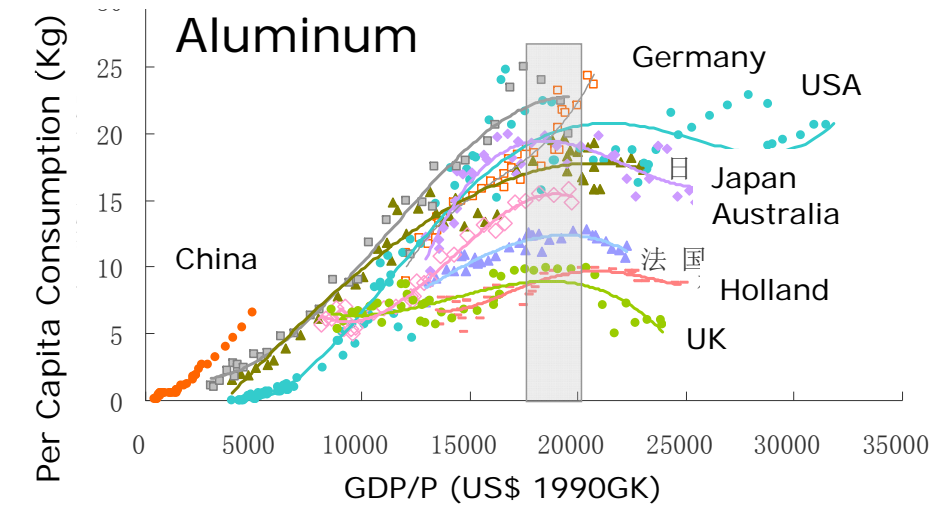
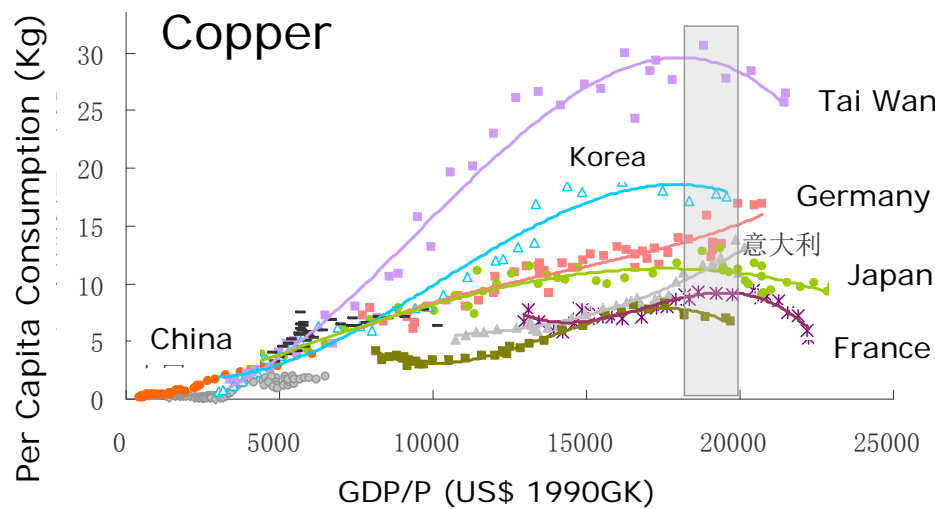
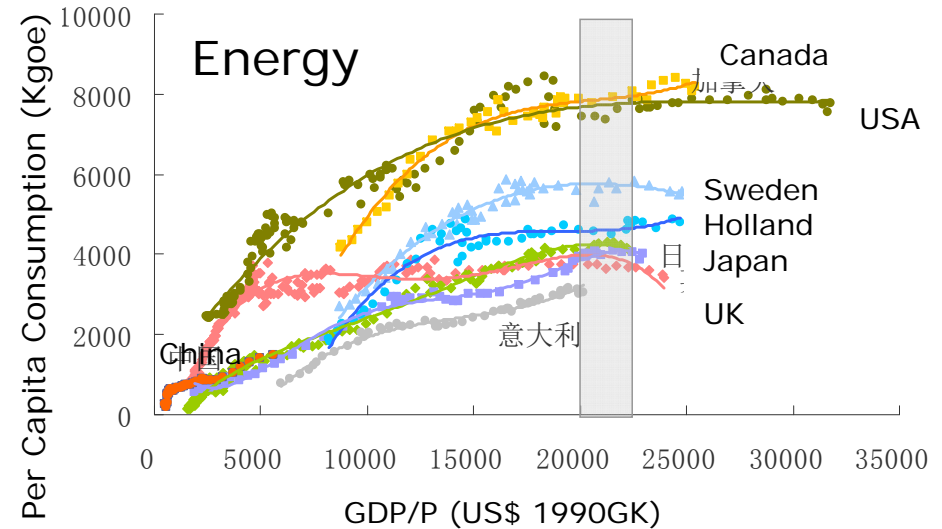
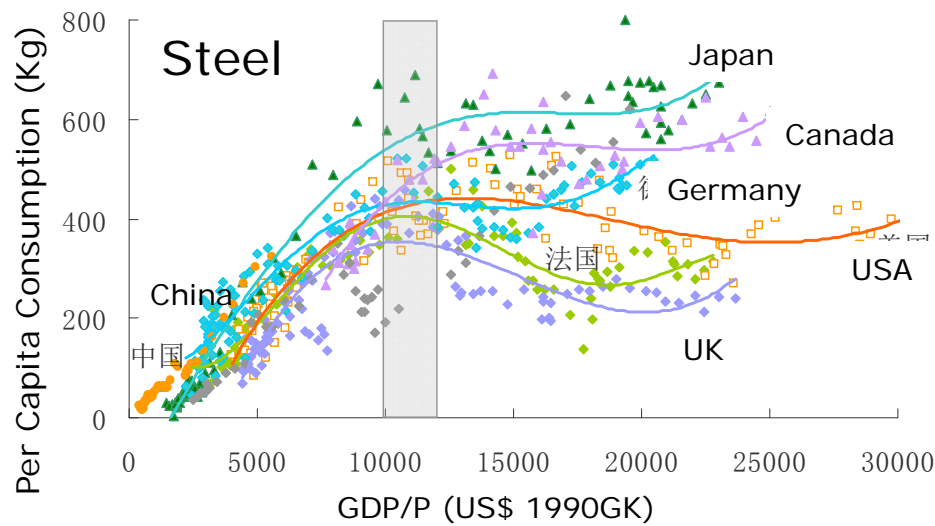


"S" Shape Law of Energy Consumption

Locus of Per Capita Energy Consumption of 25 OECD Countries (Upper) and Model (right)

Data: BP, GGDC



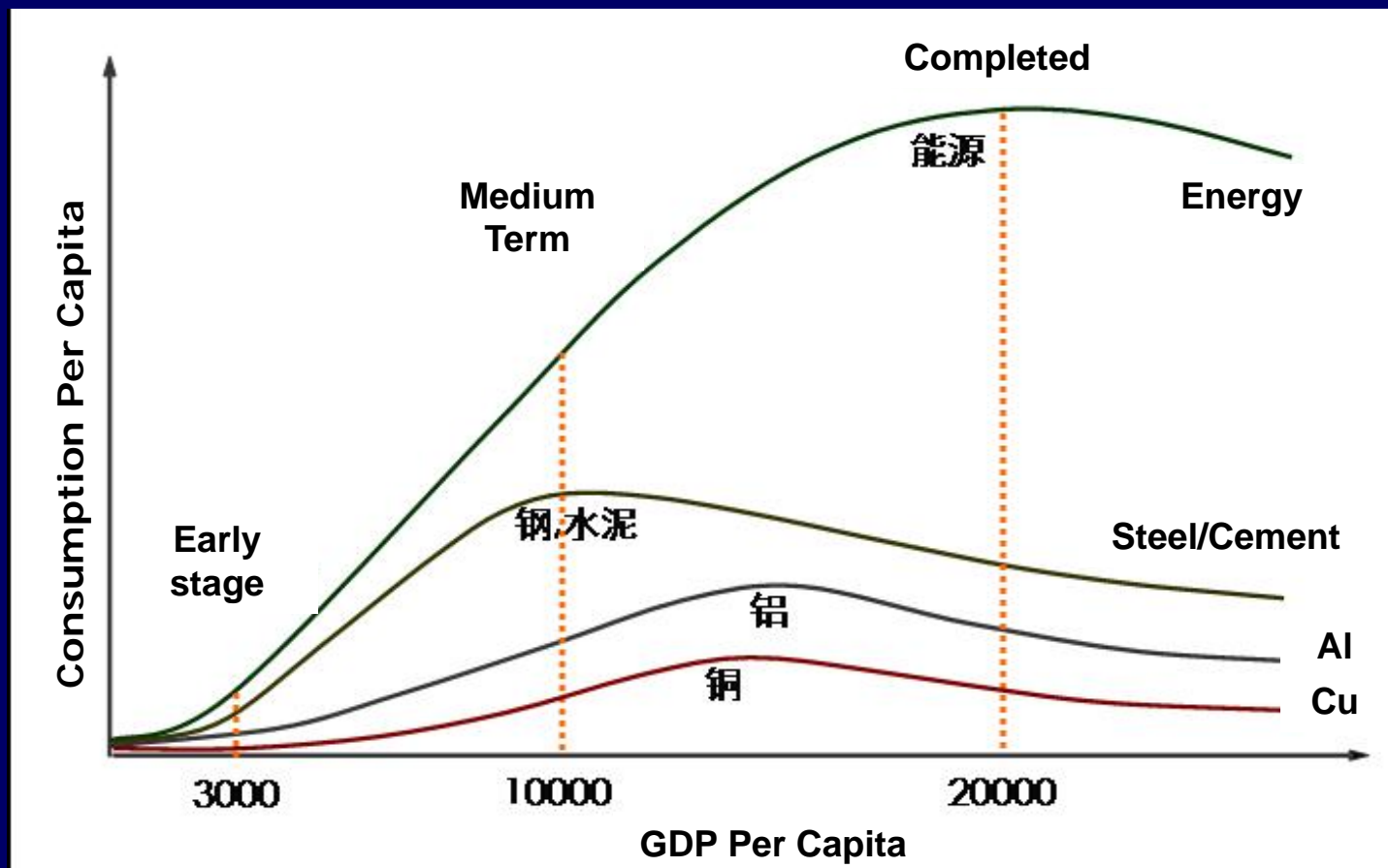


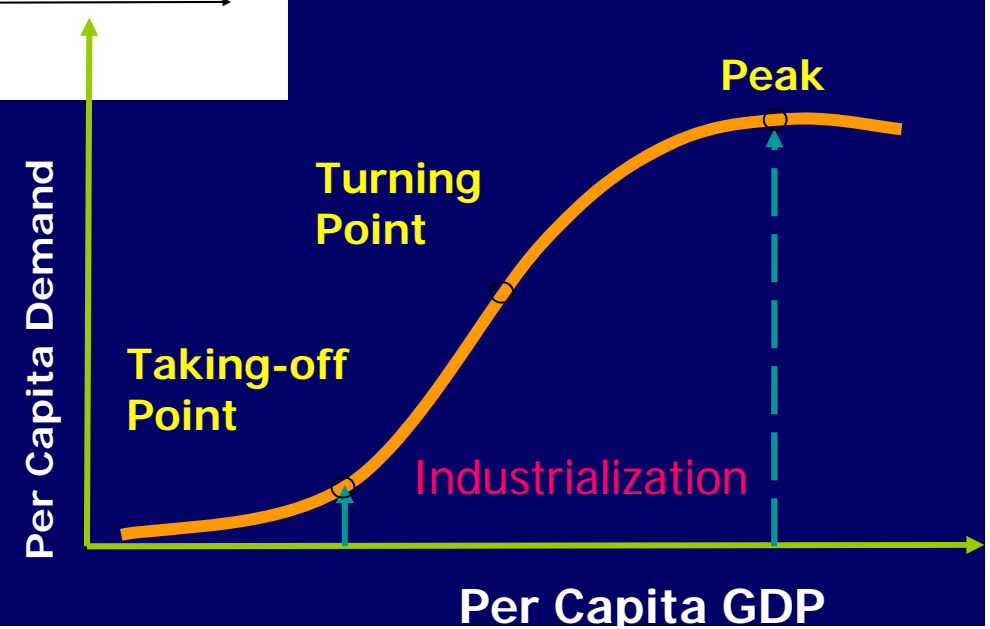
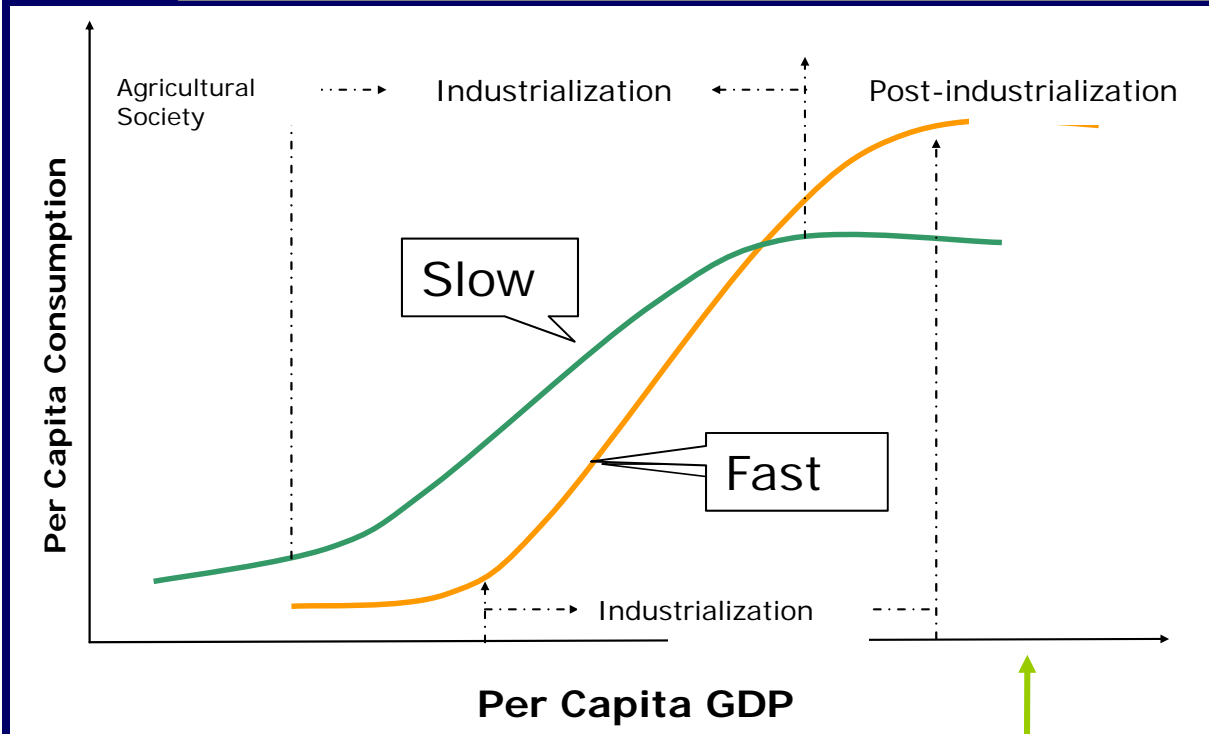
“S” Shape locus of Per Capita Consumption vs. Per Capita GDP
Data: USGS, WBMS, WSA, BP, GGDC



Wave Sequence of Consumption of Various Mineral Resources

Steel(Cement)—Aluminum—Copper—Energy





"S" Shape Law of Per Capita Mineral Resources Consumption



1. Per capita Consumption of energy and mineral resources is an indicator of a country's economic development level. Consumption of mineral resources of a country or area can be predicted through its population and economic development stage.
2. Human demand for energy and minerals has a definite maximum value, and the consumption of key minerals follows a fixed order. With the accumulation of social wealth, the consumption of key minerals reaches the peak and the energy consumption enters a zero-growth stage.



1. Bring up the Question
2. The Laws of Energy and Mineral Resources Consumption
3. Demand for Key Mineral Resources by 2030
4. Summary



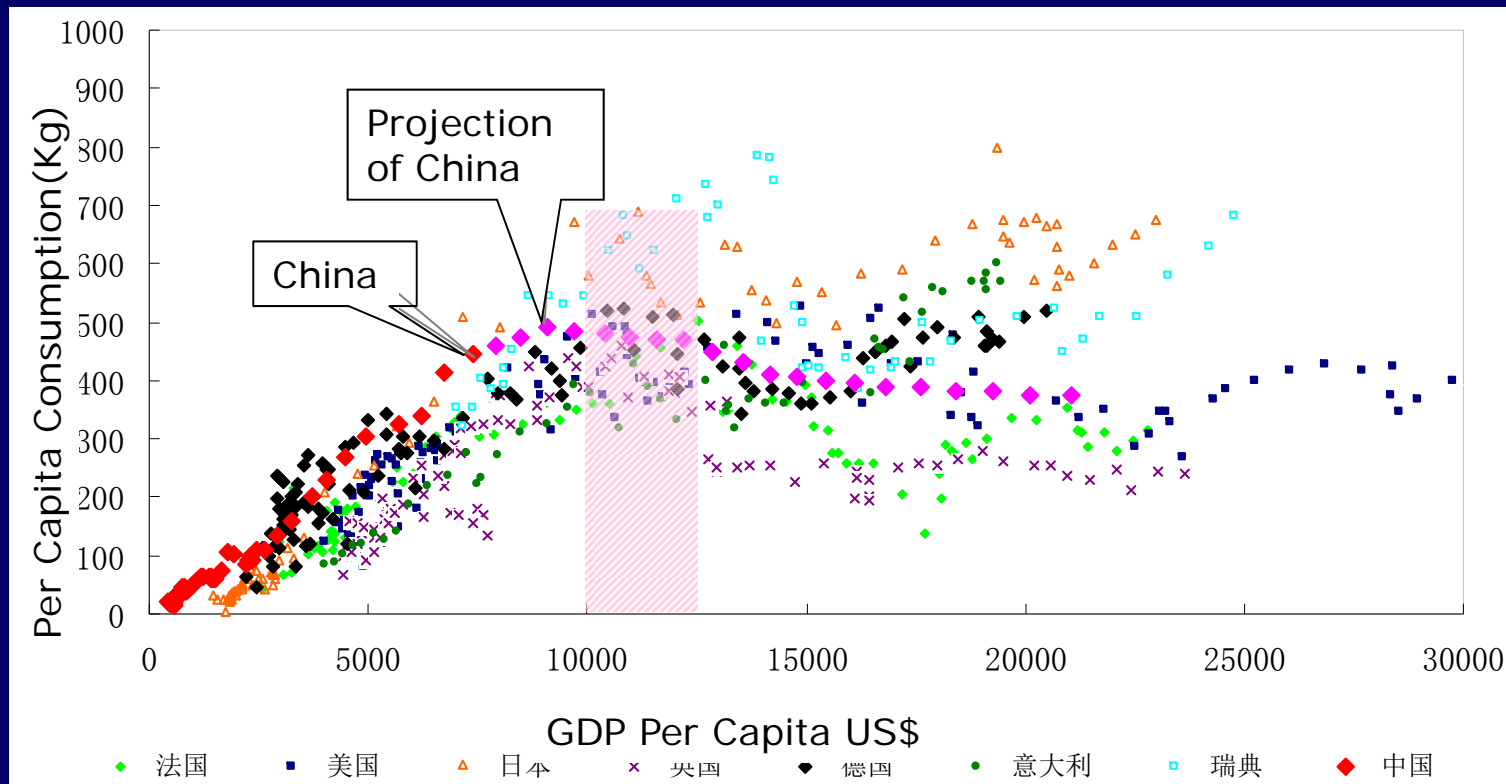
China's Economic Increase Will Slow Down

Year	Increasing Rate of GDP (%)			GDP (trillion US\$)			Per Capita GDP (US\$)		
	2010-2015	2015-2020	2020-2030	2015	2020	2030	2015	2020	2030
Reference Scenario	8.0	6.0	4.7	14.49	19.39	30.7	10380	13550	20990
High-Increase Scenario	9.0	7.0	5.5	15.17	21.28	36.35	10870	14871	24858
Low-Increase Scenario	7.0	5.5	4.2	13.83	18.08	27.28	9909	12632	18653

Expectation of China's GDP Under Different Scenarios During 2010 – 2030



In 2013—2015 China's crude steel consumption will reach the peak of 680-720 Mt/y, and the high level consumption will last for 7-10 years.

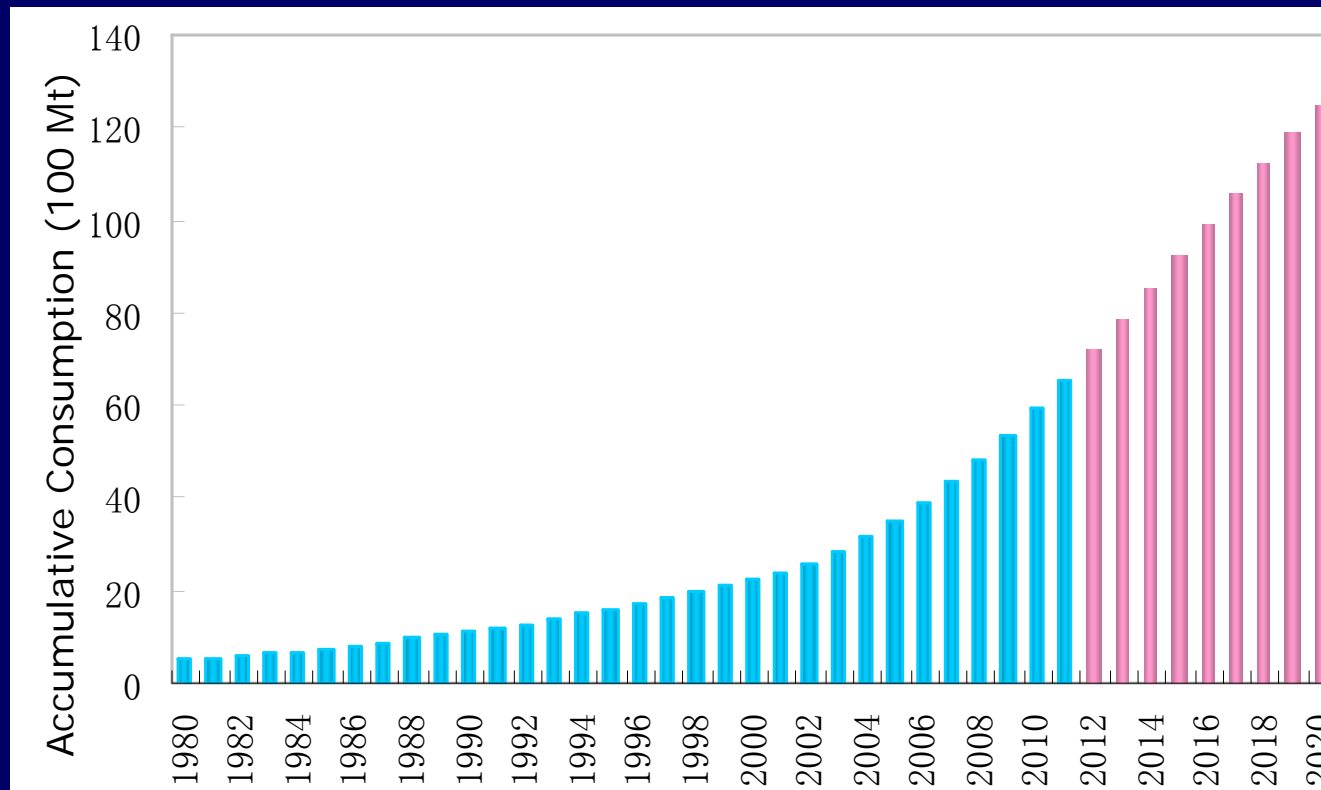


Trend in Per Capita Consumption

Data: WBMS, WSA, NBSC & Author's Prediction



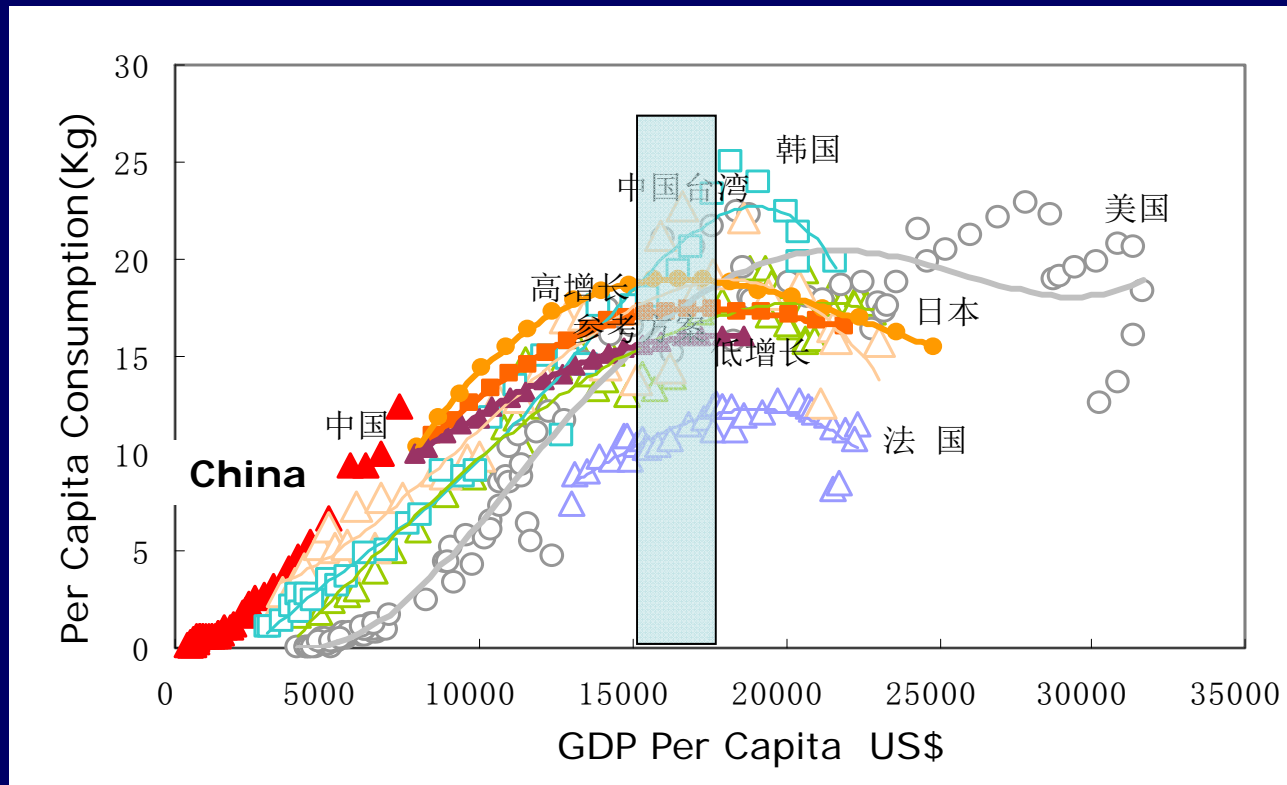
In 2012-2020, China's accumulative consumption of crude steel will be 6 Bt, roughly 9 Bt iron ore (standard)



Trend in China's Accumulative Consumption



In 2022-2025 China's aluminum consumption will reach the peak of 26-29 Mt/y, and the high level consumption will last for 7-10 years.

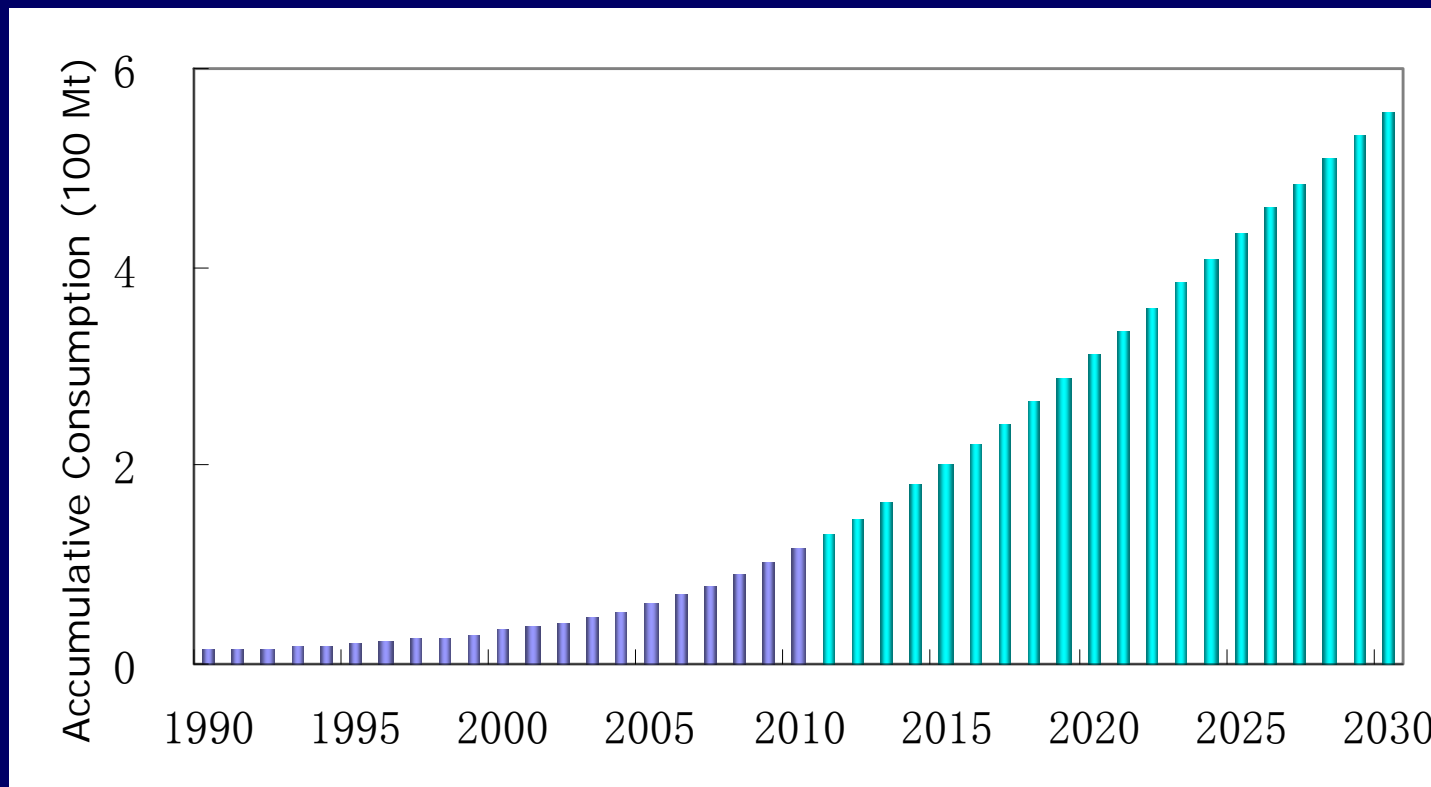


Trend in Per Capita Consumption

Data: WBMS, WSA, NBSC & Author's Prediction



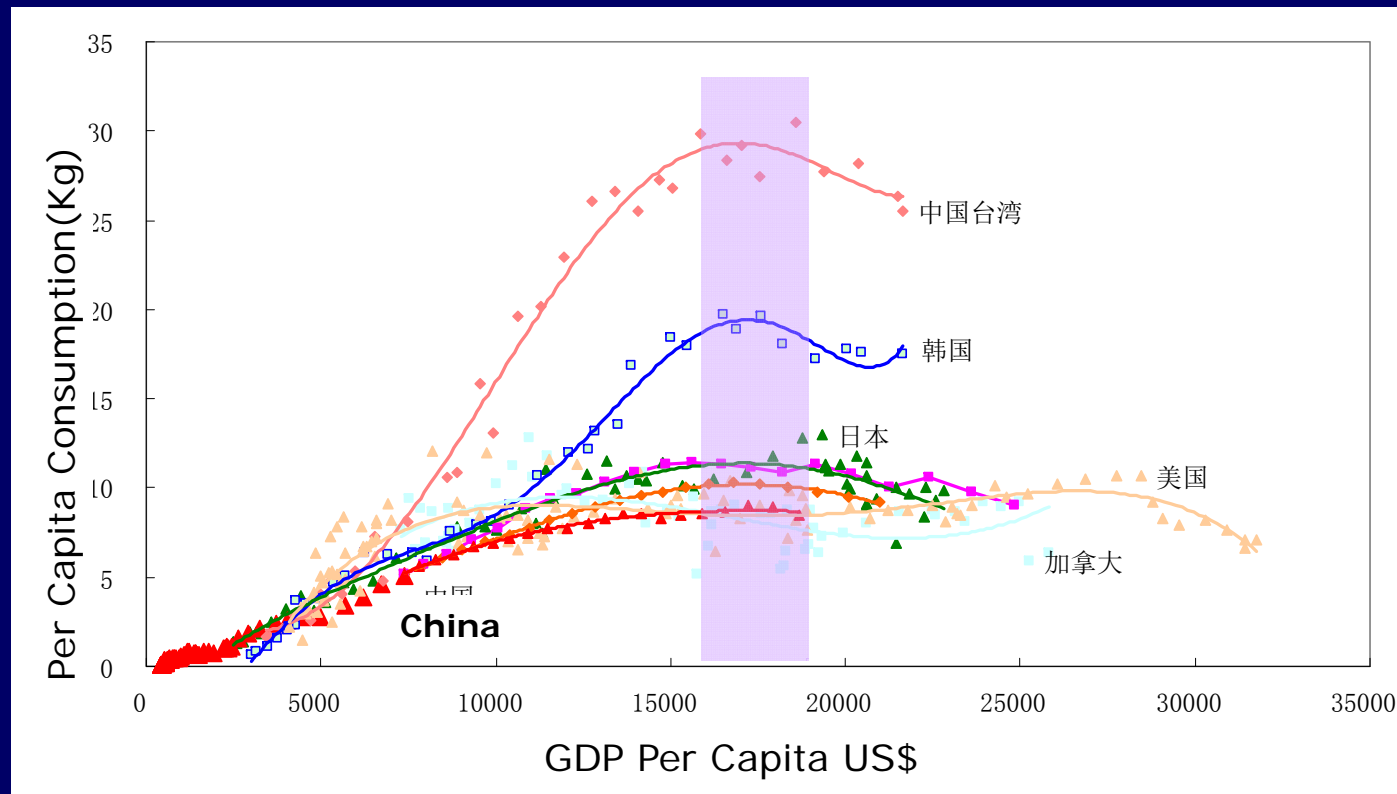
In 2012-2030, China's accumulative consumption of aluminum will be 460 Mt, about 1.8-2 Bt bauxite



Trend in China's Accumulative Consumption



In 2022-2025 China's copper consumption will reach the peak of 14-16 Mt/y, and the high level consumption will last for about 10 years

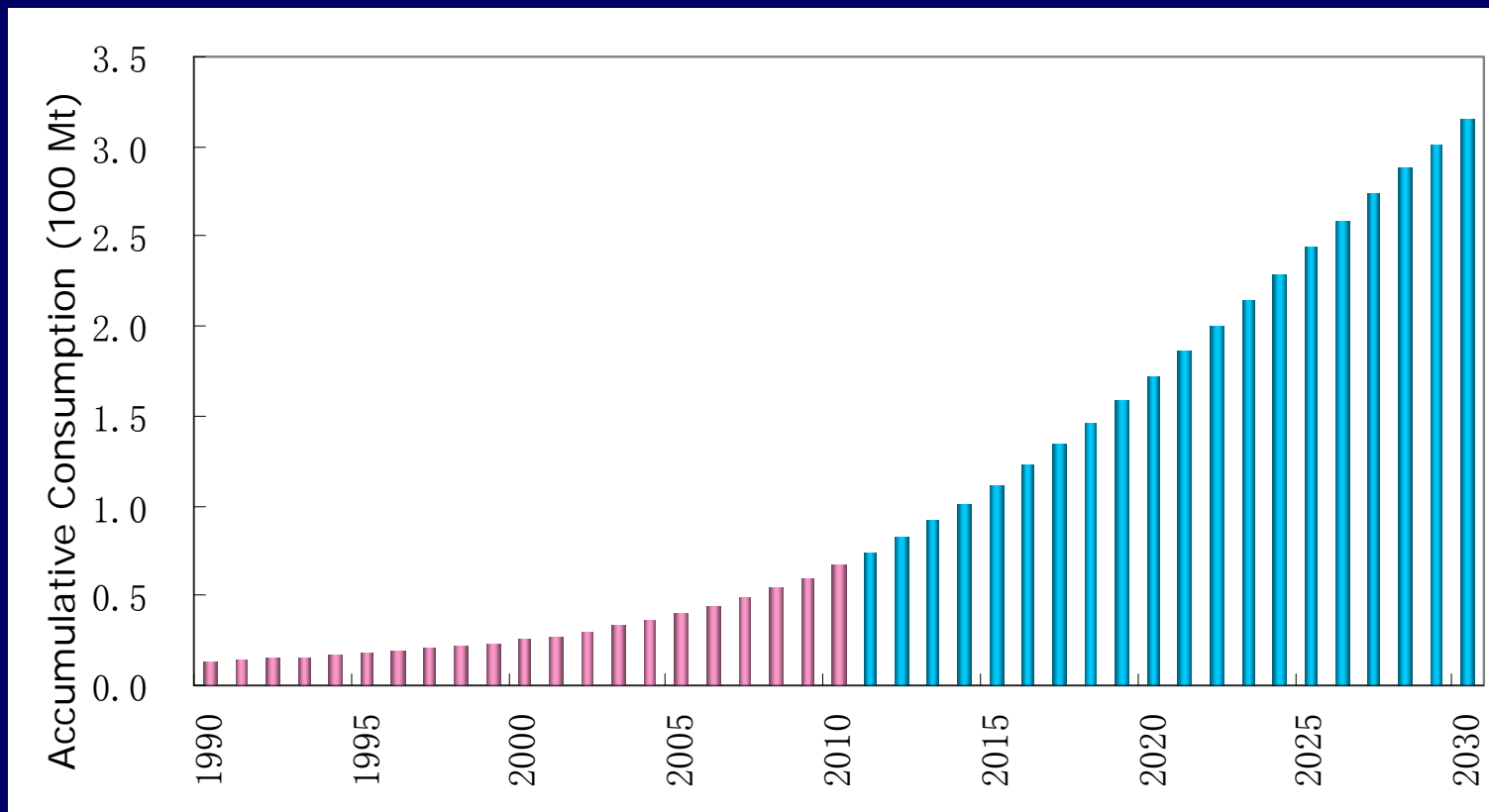


Trend in Per Capita Consumption

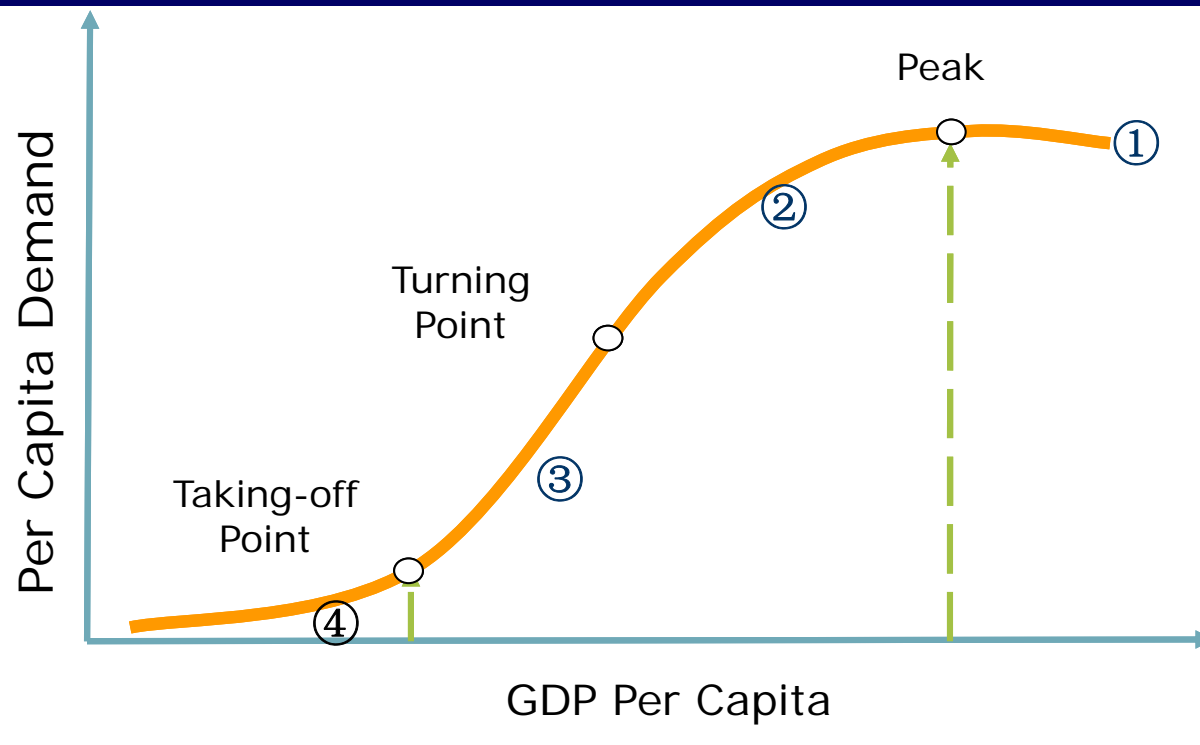
Data: WBMS, WSA, NBSC & Author's Prediction



In 2012-2030 China's accumulative consumption of copper will be 240 Mt



Trend in China's Accumulative Consumption



Global Demand for Bulk Minerals

All countries are grouped into 4 categories according to their economic development level and stage.

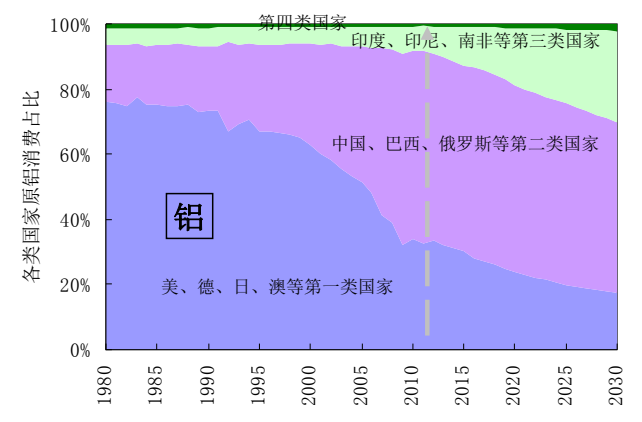
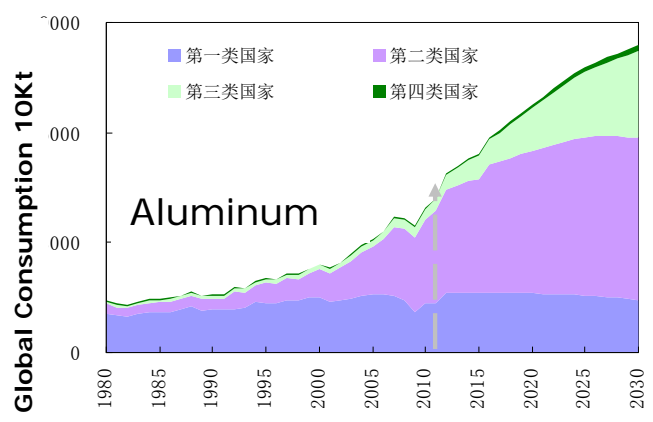
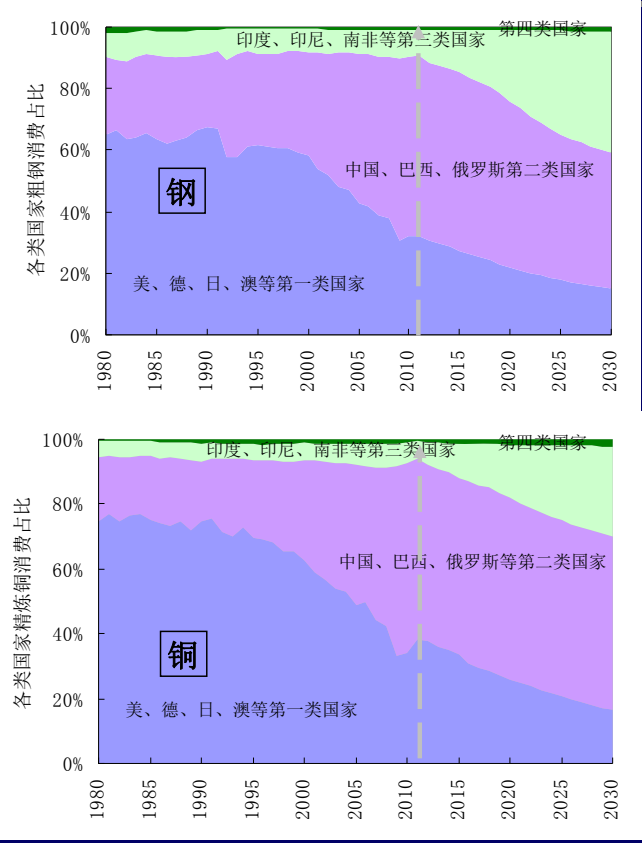
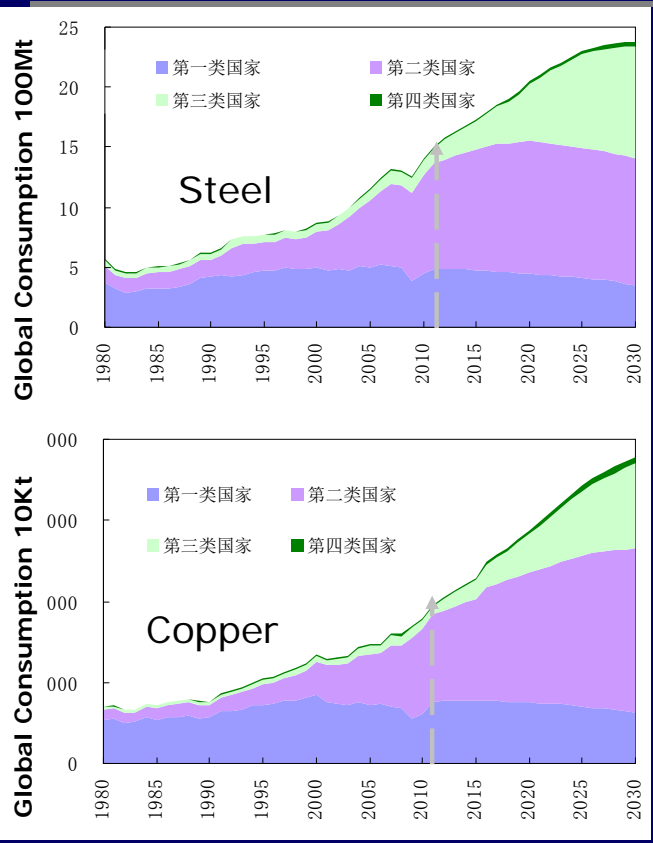
- ✧ The first category includes **UK, USA** and other developed countries;
- ✧ The second category includes **China, Brazil** and other industrializing countries ;
- ✧ The third category includes **India, ASEAN** and other countries starting industrialization;
- ✧ The third category includes **Bangladesh, Pakistan, Nigeria** and other under developed countries



Prediction of World's Population and GDP

Groups	parameters	Year				
		2011	2015	2020	2025	2030
1st Category (GDP Per Capita > 17000 US\$)	Population(100Mt)	9.39	9.66	9.85	10	10.12
	GDP Per Capita (US\$)	25293	27057	29582	32183	35013
	Increasing rate of GDP Per Capita (%)	1.25	1.7	1.8	1.7	1.7
2nd Category (GDP Per Capita 6000-17000 US\$)	Population(100Mt)	24.95	25.68	26.42	26.93	27.24
	GDP Per Capita (US\$)	7989	9579	11803	14226	16776
	Increasing rate of GDP Per Capita (%)	6.15	4.6	4.3	3.8	3.4
3rd Category (GDP Per Capita 3000-6000 US\$)	Population(100Mt)	20.26	21.57	22.73	23.77	24.66
	GDP Per Capita (US\$)	3981	5121	7183	9167	11153
	Increasing rate of GDP Per Capita (%)	5	7	7	5	4
4th Category (GDP Per Capita < 3000 US\$)	Population(100Mt)	10.52	11.77	13.02	14.26	15.49
	GDP Per Capita (US\$)	1678	1852	2096	2429	2956
	Increasing rate of GDP Per Capita (%)	3	3	3	3	4

Data: GGDC, WB, IMF and Author



In 2030, global demand: crude steel 2.4 Bt, copper 38 Mt, aluminum 84 Mt.

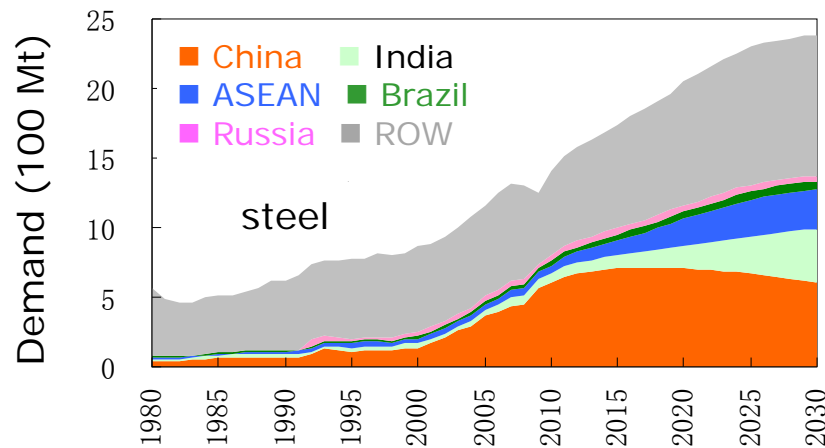
2013-2030, global accumulative demand: crude steel 37 Bt, copper 0.54 Bt, aluminum 1.25 Bt.

Data: WBMS, WSA before 2011; the author

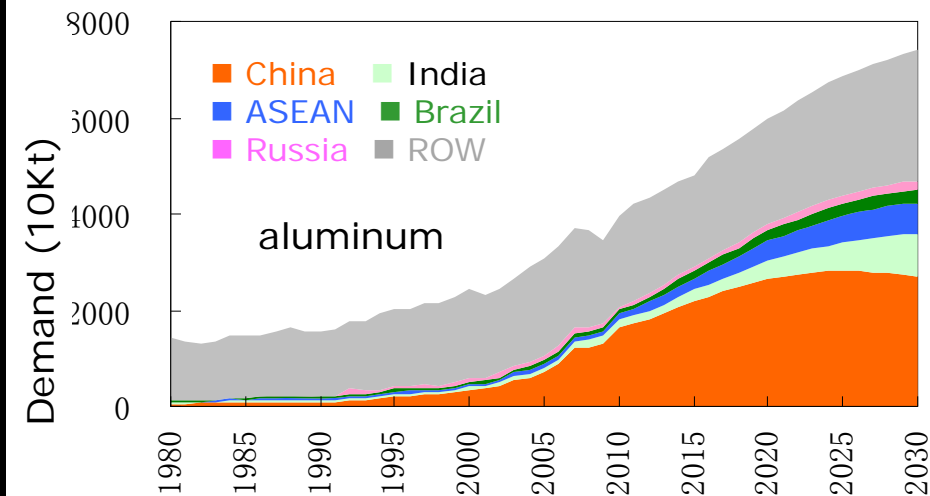
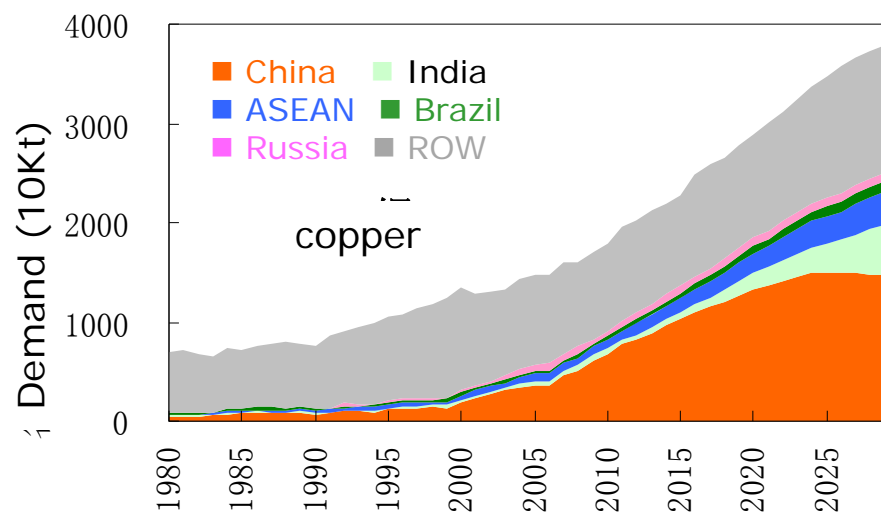
- 1st category
- 2nd category
- 3rd category
- 4th category

Global Demand—India

In the next 20 years, Indian demand for resources will increase quickly and its proportion of the world consumption will enlarge.

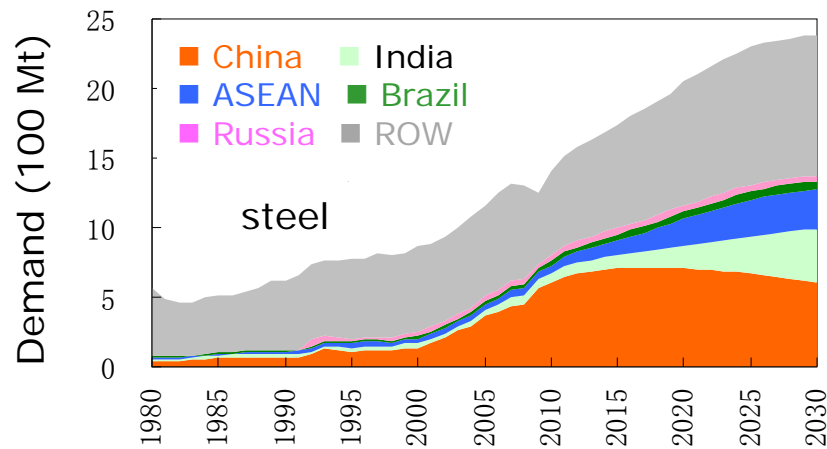


- Steel: from 76 Mt to 385 Mt
- Copper: from 0.41 Mt to 5.79 Mt
- Aluminum: from 1.63 Mt to 8.91 Mt
- Proportion: from 5% to 16%, 15% and 10% respectively



Global Demand—ASEAN

The 10 countries of ASEAN have a population of 0.6 billion, and in the next 20 years its demand for resources will increase quickly.

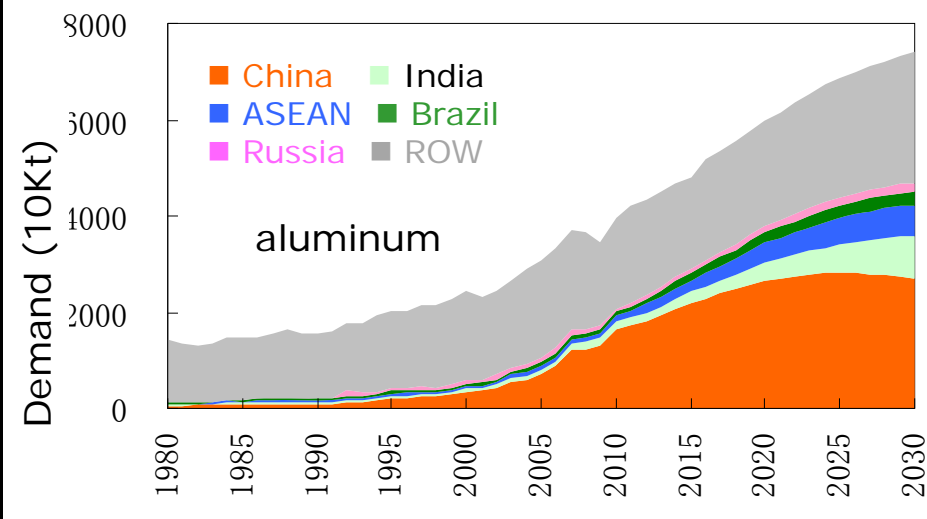
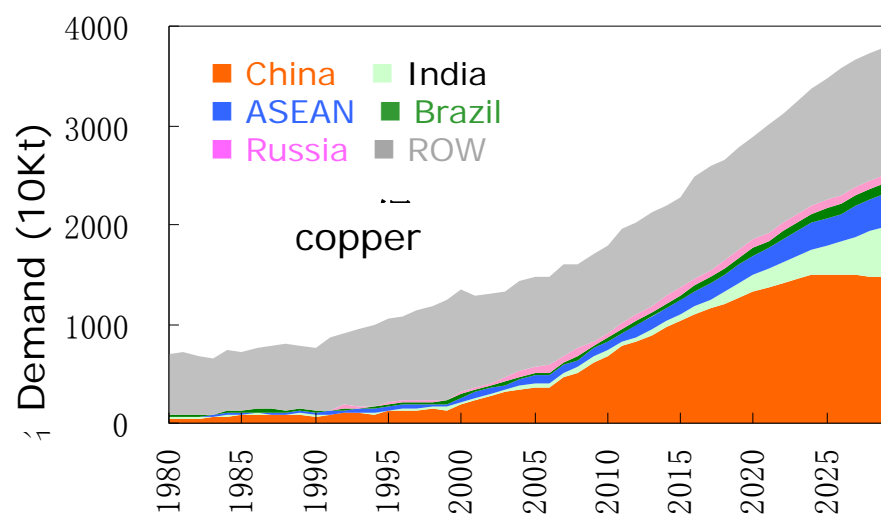


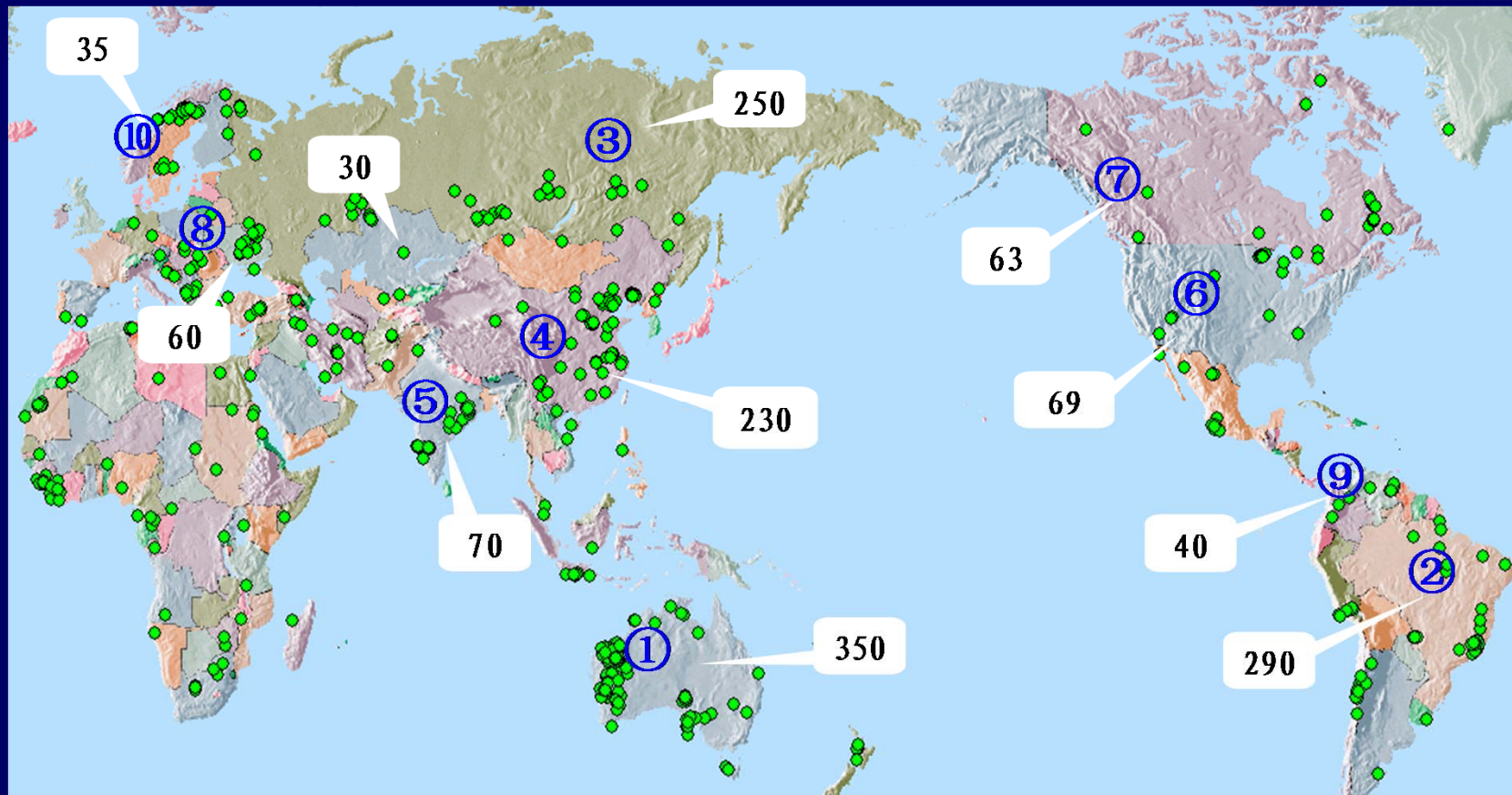
➤ Steel: from 70 Mt to 280 Mt

➤ Copper: from 0.79 Mt to 3.3 Mt

➤ Aluminum: from 1.23 Mt to 6.5 Mt

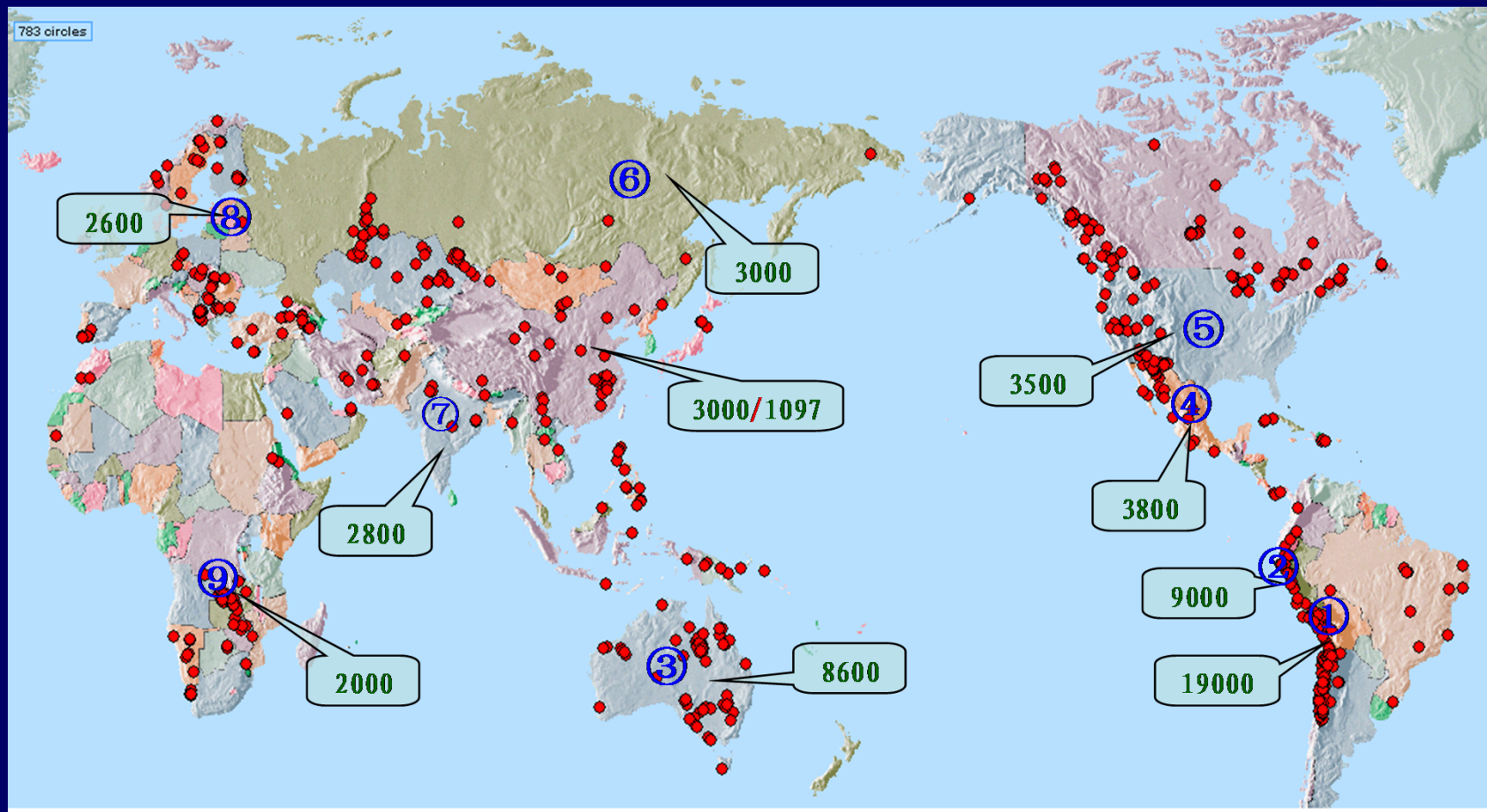
➤ Proportion: 12%, 9% and 8% respectively





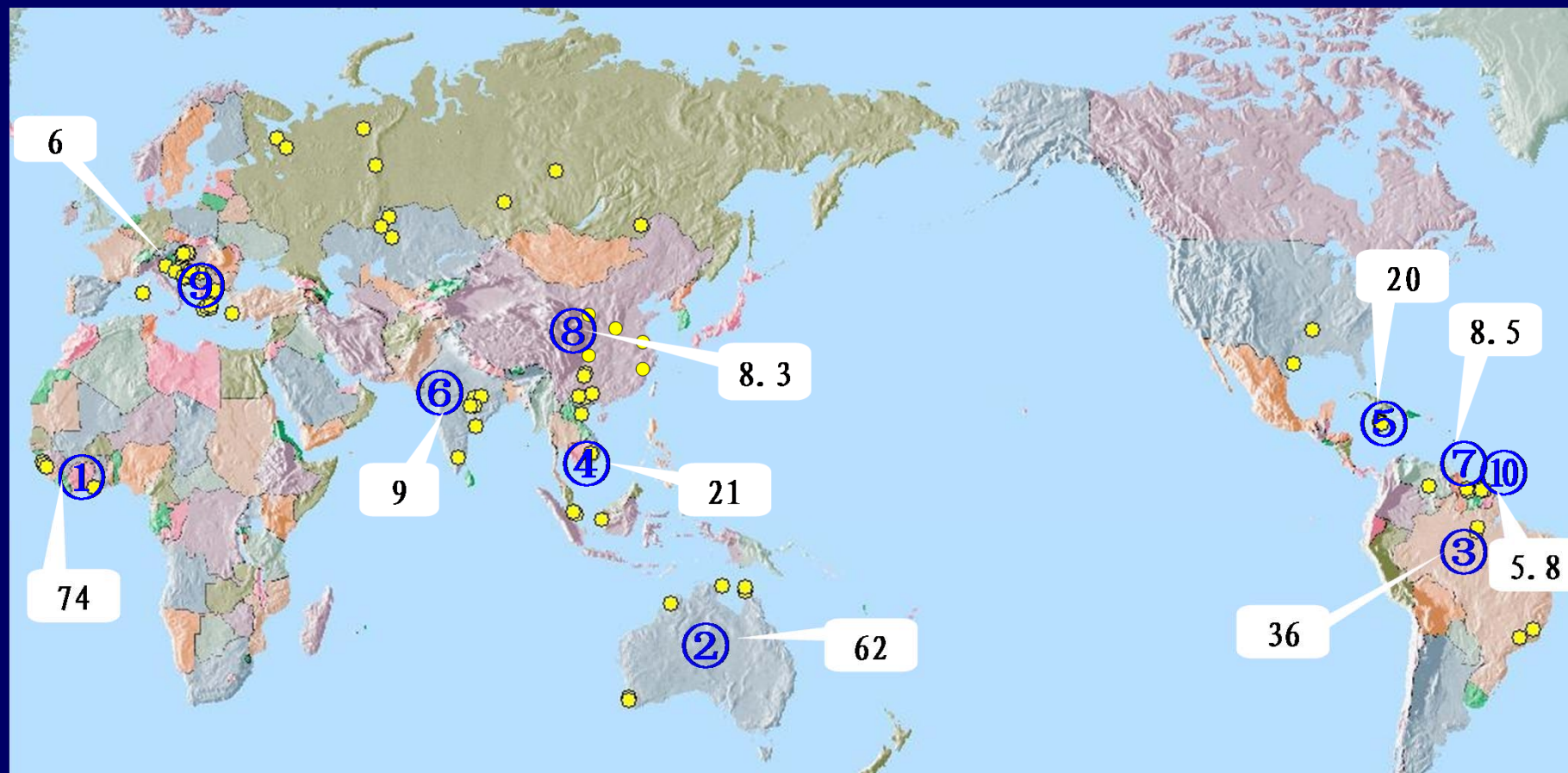
Global distribution of iron ore reserves (170Bt) 2011 (data: USGS)

(①Australia; ②Brazil; ③Russia; ④China; ⑤India; ⑥USA;
⑦Canada; ⑧Ukraine; ⑨Venezuela; ⑩Sweden)



Global distribution of copper reserves (690Mt) 2011
(data: USGS)

(①Chile; ②Peru; ③Australia; ④Mexico; ⑤USA; ⑥China;
⑦Russia; ⑧Indonesia; ⑨Poland; ⑩Zambia)



Global distribution of bauxite reserves (690Mt) 2011

(data: USGS)

(①Guinea; ②Australia; ③Brazil; ④Vietnam; ⑤Jamaica;
⑥India; ⑦Guyana; ⑧China; ⑨Greece; ⑩Surinam)



1. Bring up the Question
2. The Laws of Energy and Mineral Resources Consumption
3. Demand for Key Mineral Resources by 2030
4. Summary



Summary

1. Industrialization is a process of converting natural resources into wealth, during which huge resources are consumed, a great deal of wealth is accumulated, economy developed rapidly and people's living standard is enhanced greatly.

In the last 10 years, with China and Brazil as representatives, a population of 2.7 billion underwent the industrialization, which led to rapid consumption of the world's mineral resources. At present the process is still underway.

In the next 20 years, with India and ASEAN as representatives, 2.5 billion people will begin their industrialization, and the strong demand for mineral resources will persist.



2. Take copper as an example. Considering the development stage and consuming levels of mineral resources in developed countries, the accumulative consumption (excluding recycled) per capita is 350-380Kg. Accordingly, it can be calculated that 1.5 billion tons of copper are needed for 5.2 billion people (the sum of the 2nd and 3rd categories) to complete their industrialization.

According to the data given by USGS, the world's copper reserve in 2011 is only 690 million tons, apparently far from being enough to meet the demand. Finding new resources for future generations is in urgent need.

Though with the progress of science and technology, the efficiency of use will be increased and substitutes will be developed, the huge gap of resources cannot be made up in a considerable long time.



3. The situation of iron ore is not optimistic, either. The accumulative consumption per capita (excluding recycled) of crude steel is 10-12 tons (equivalent to 18-22 tons iron ore), accordingly 94-114 billion tons of iron ore are need for the industrialization of 5.2 billion people.

Estimated by USGS, the world's iron ore reserve is 170 billion tons, among which 70 billion tons are the low grade (less than 30% Fe) ores in China, Russia and Ukraine. Considering the environmental problems and the damage to the global economy by high resource price, the situation of global iron ore is not optimistic.