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Overview on China's Rare Earth Industry Restructuring and Regulation Reform

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Outline

1. Major Issues: ***Why important***?
2. Rare Earths Industry Restructuring: ***How***?
3. Regulation Effects: ***What about***?
4. Closing Remarks: ***Where Is Next step***?

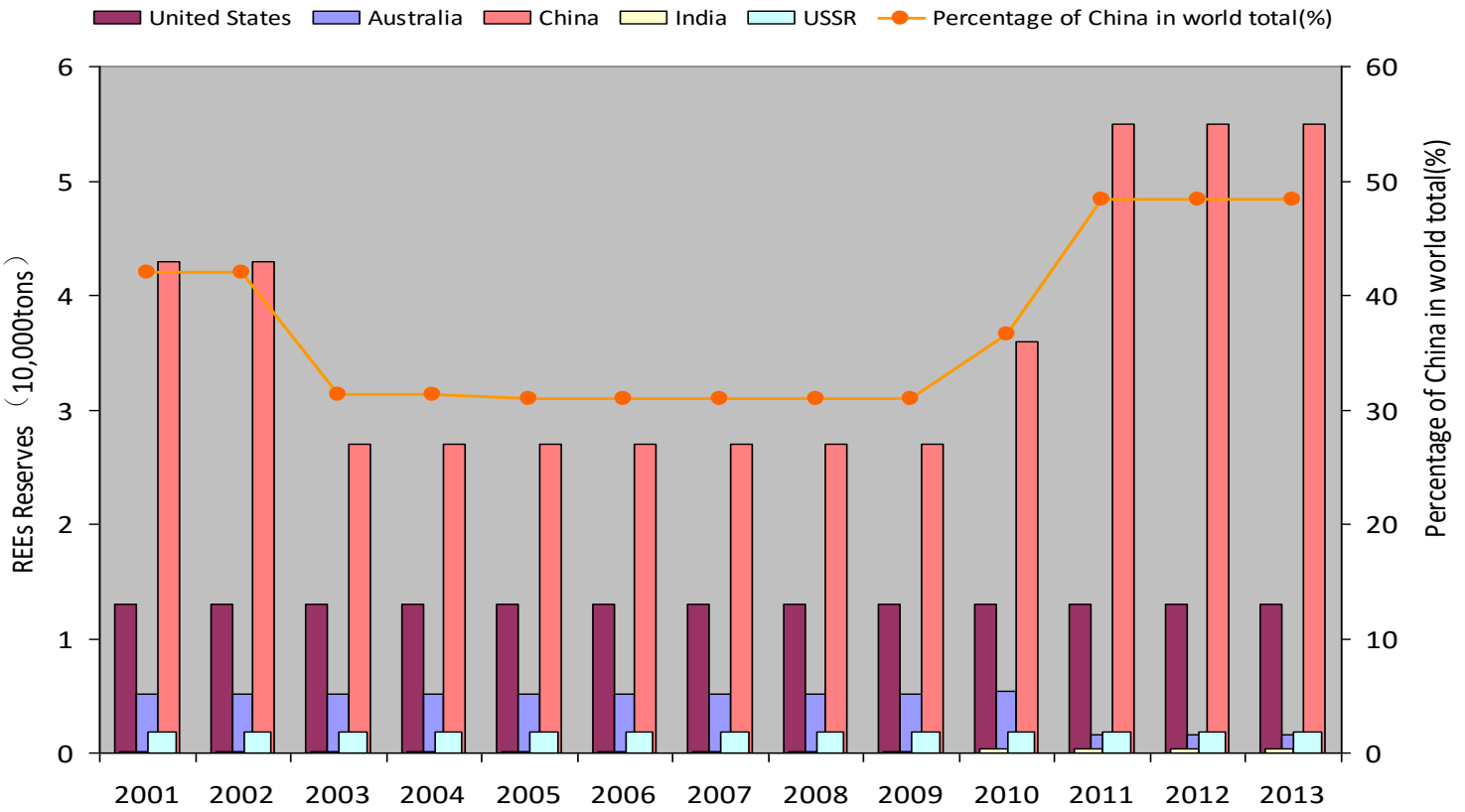
1 Major Issues

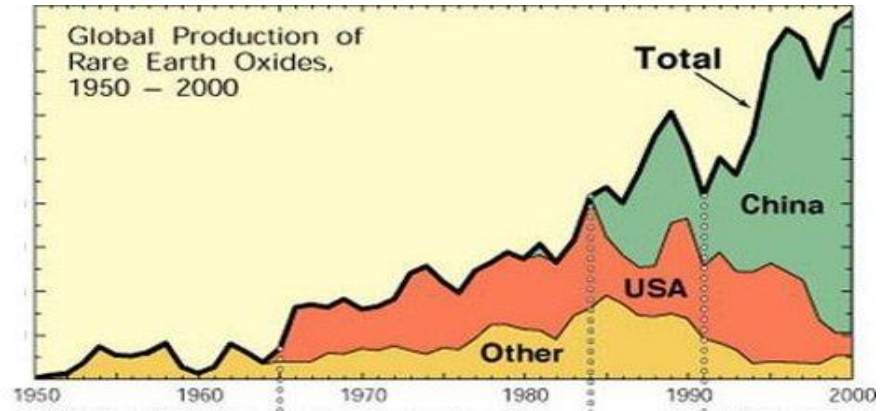
Rare Earth Elements (REEs): 17 elements

Resources dilemma: Dominance of China's supply

China accounts for less than 1/3~1/2 of rare earths reserves in the world total!

The reserves of China's REEs sharply decreased from 2003 to 2009 then increased slightly in 2010 and remained at 55,000 tons over last 5 years!

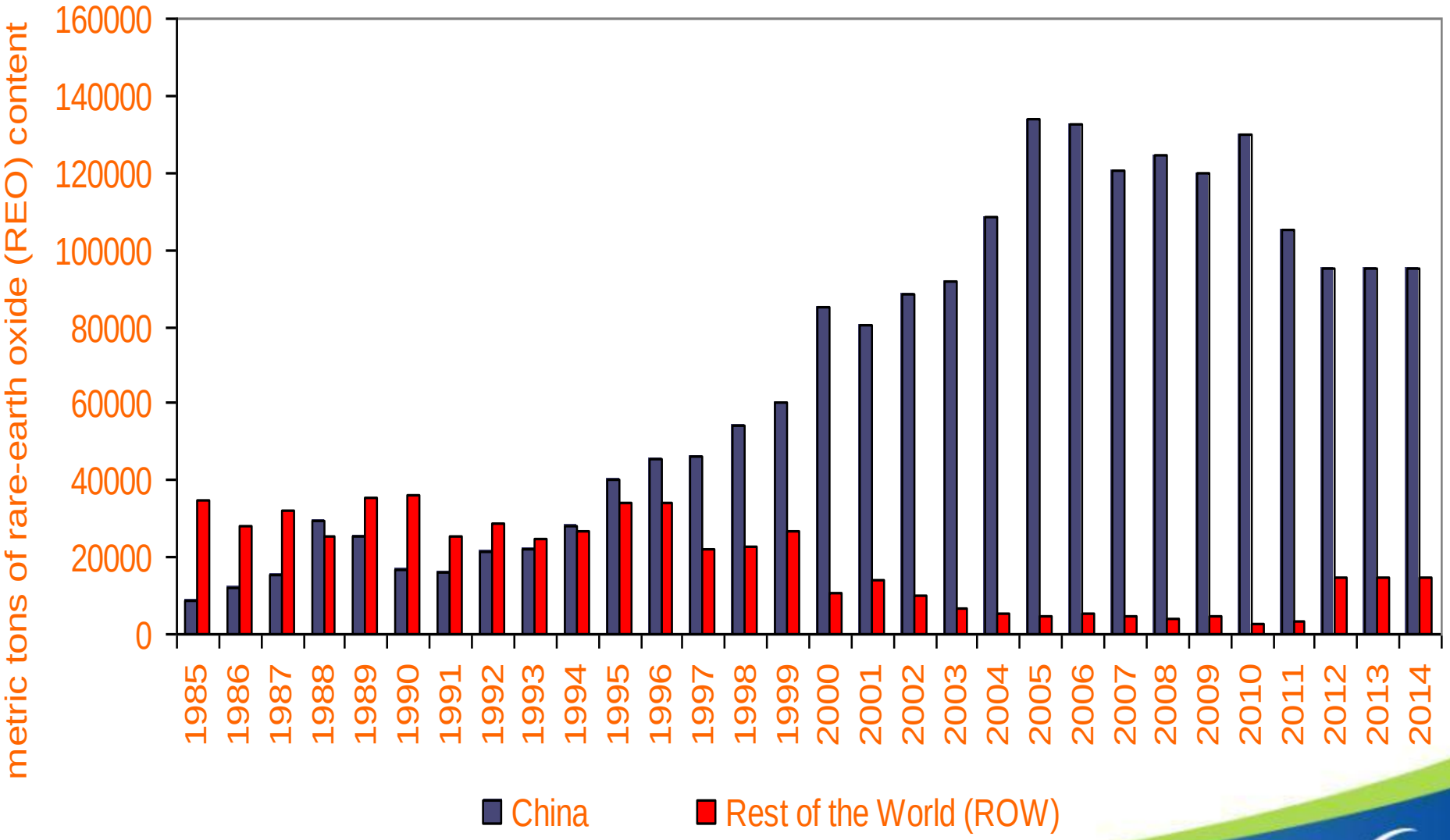




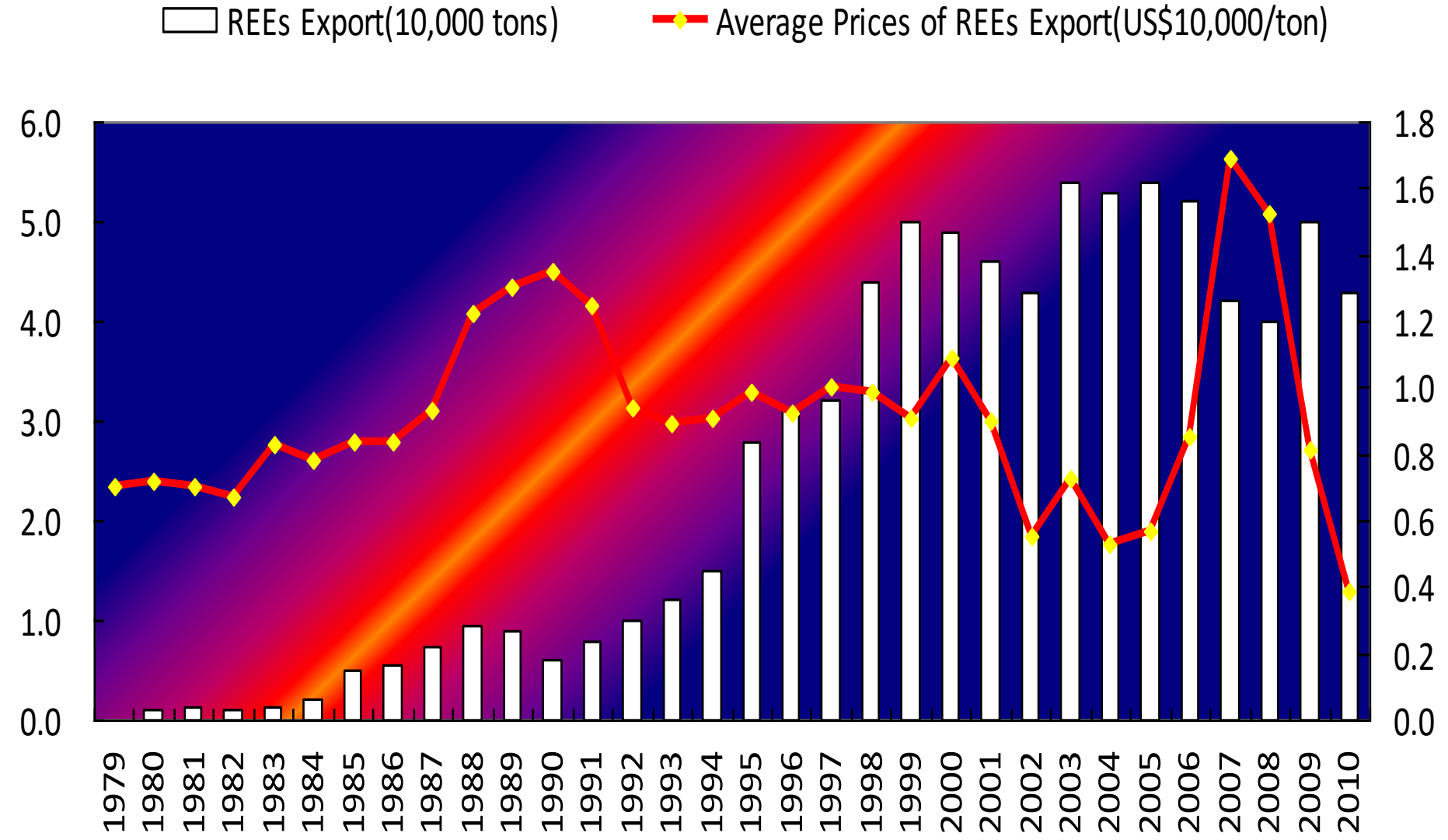
It is forecasted that the reserves of China's REEs will be depleted in next 20 years!

China started to provide a large amount of REEs to the world since the middle 1980s.

At least 95% of all rare earths output currently originate from China



Economic impact: Fluctuation of REEs price change



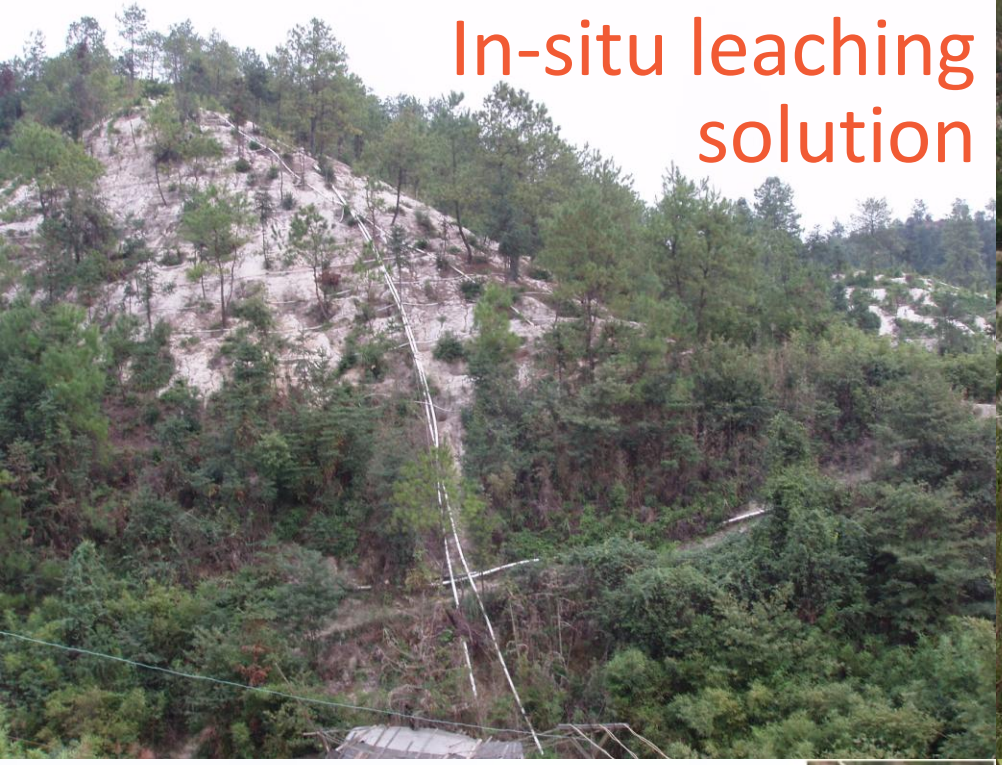
Upside down relationship between REEs export and price fluctuation since 1979 in China

Environmental and ecological Issue

Extensively mining and seriously waste of resources: *three major models of REEs mining technologies in the Southern China*

In-situ leaching map of rare earth deposits in weathered crust of Southern China

In-situ leaching solution



Liquid collecting groove by in-situ leaching of rare earth deposits in weathered crust

The ecological destruction of vegetation, soil erosion, waste emissions

Environmental pollution as a result of REEs processing

Comparisons of three major models of REEs mining technologies in the Southern China

Mining Models	Process Flow Chart
Pool Leaching	Topsoil stripping →Extracting ores →Start leaching→ Precipitation→Burning →Acid dissolution → Precipitation → Burning → Oxidation of rare earth
Dump Leaching	Topsoil stripping → Extracting ores → Leaching in tank → Precipitation → Filtering → Burning → Oxidation of rare earth
In-situ Leaching	Dividing mining field → Tunnels building →Infusion leaching →Purifying→ Precipitation → Filtering →Rare earth carbonate

(Cont'd)

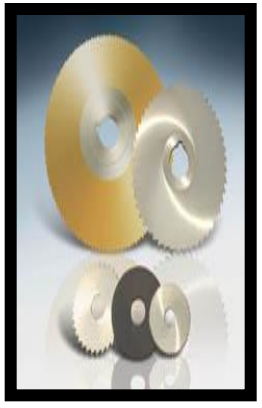
Mining Models	Environment Destruction	Applicability	Resource Utilization
Pool Leaching	Large	General application	Less than 50%
Dump Leaching	Large	General application	Less than 50%
In-situ Leaching	Small	The treatment effect is not ideal for the complicated ore body in geological conditions	More than 75%

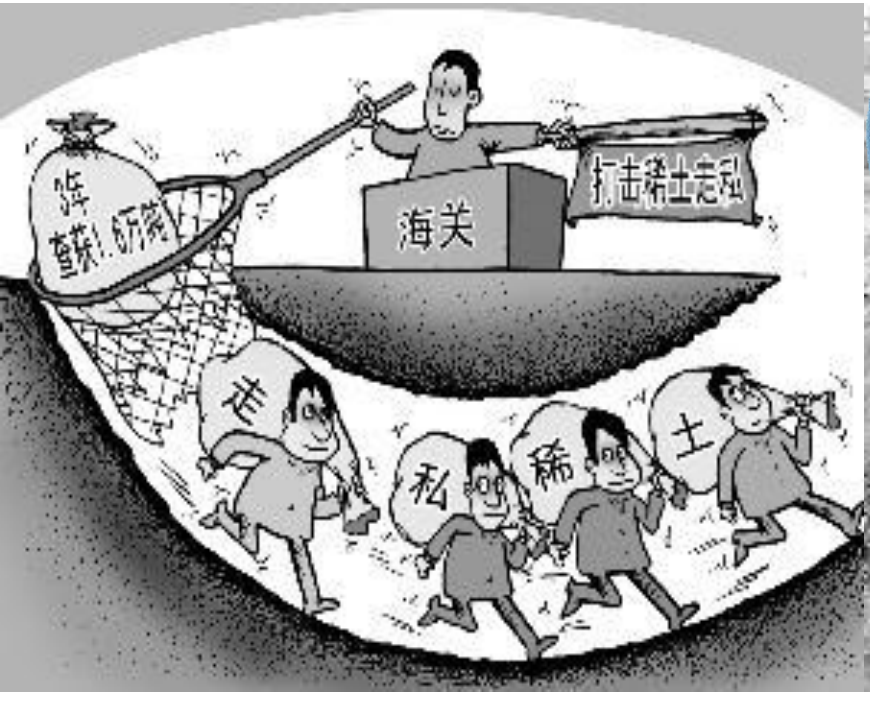
(Cont'd)

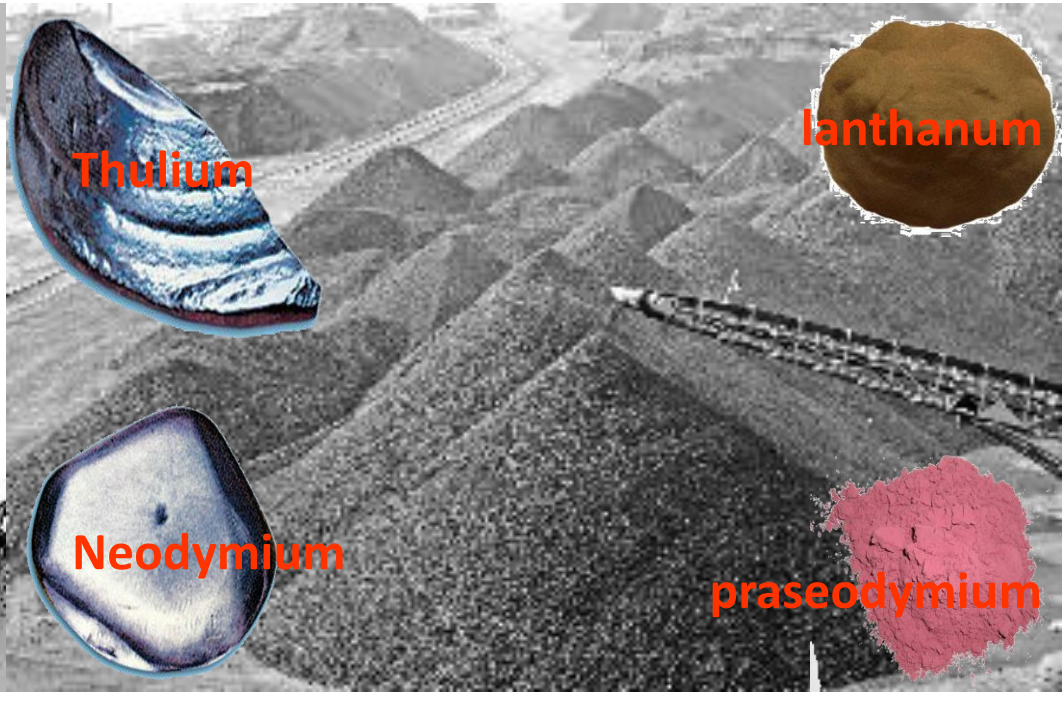
Mining Models	Extraction Efficiency	Technology	Production Costs	Pollution Control
Pool Leaching	Low	Simple	High	Easy centralized control, centralized management
Dump Leaching	Low	Simple	High	Easy centralized control, centralized management
In-situ Leaching	More than 70%	Complex	Low	Not easy centralized management

International trade issue: Export disorder and weak supervision

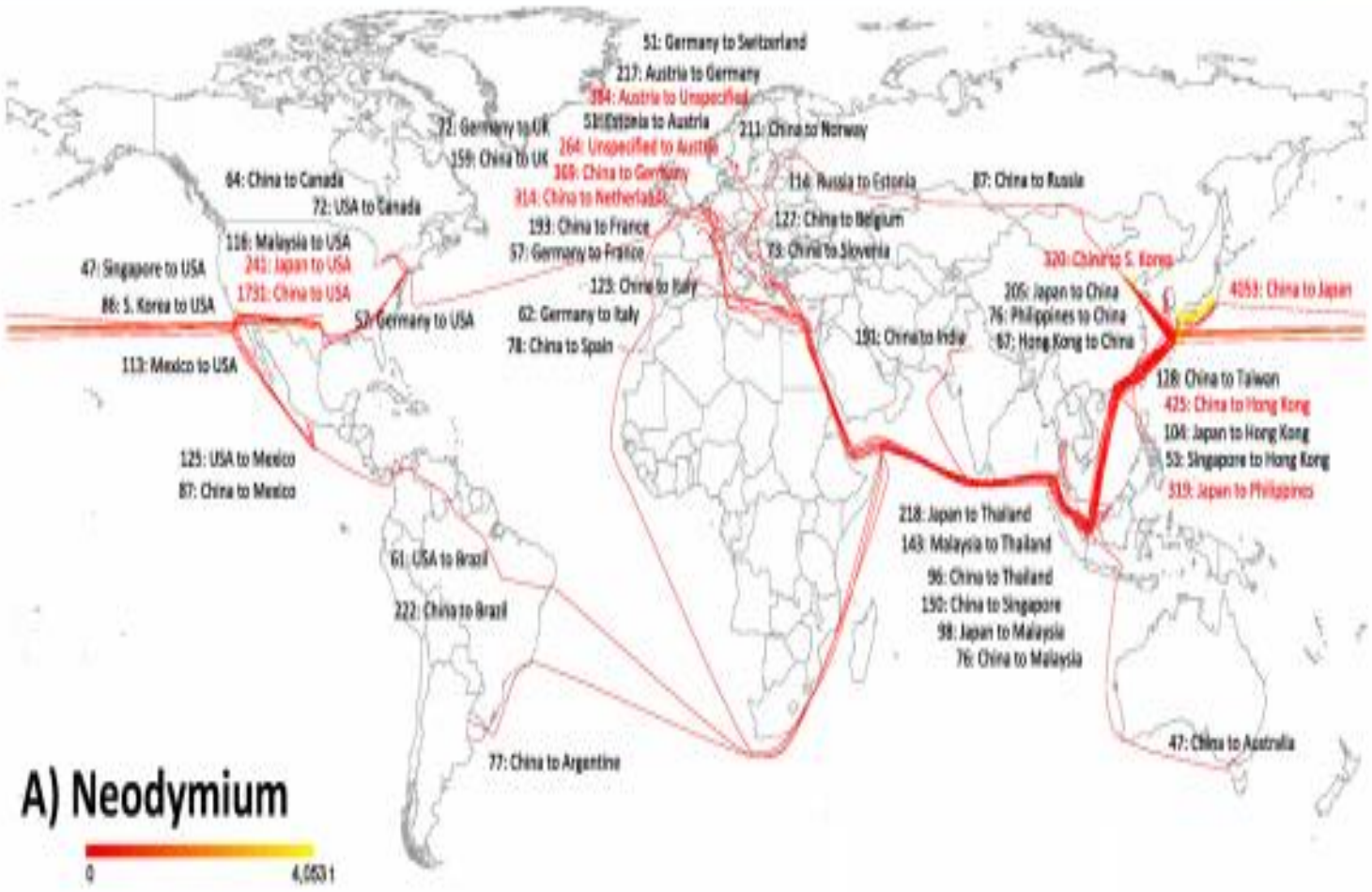


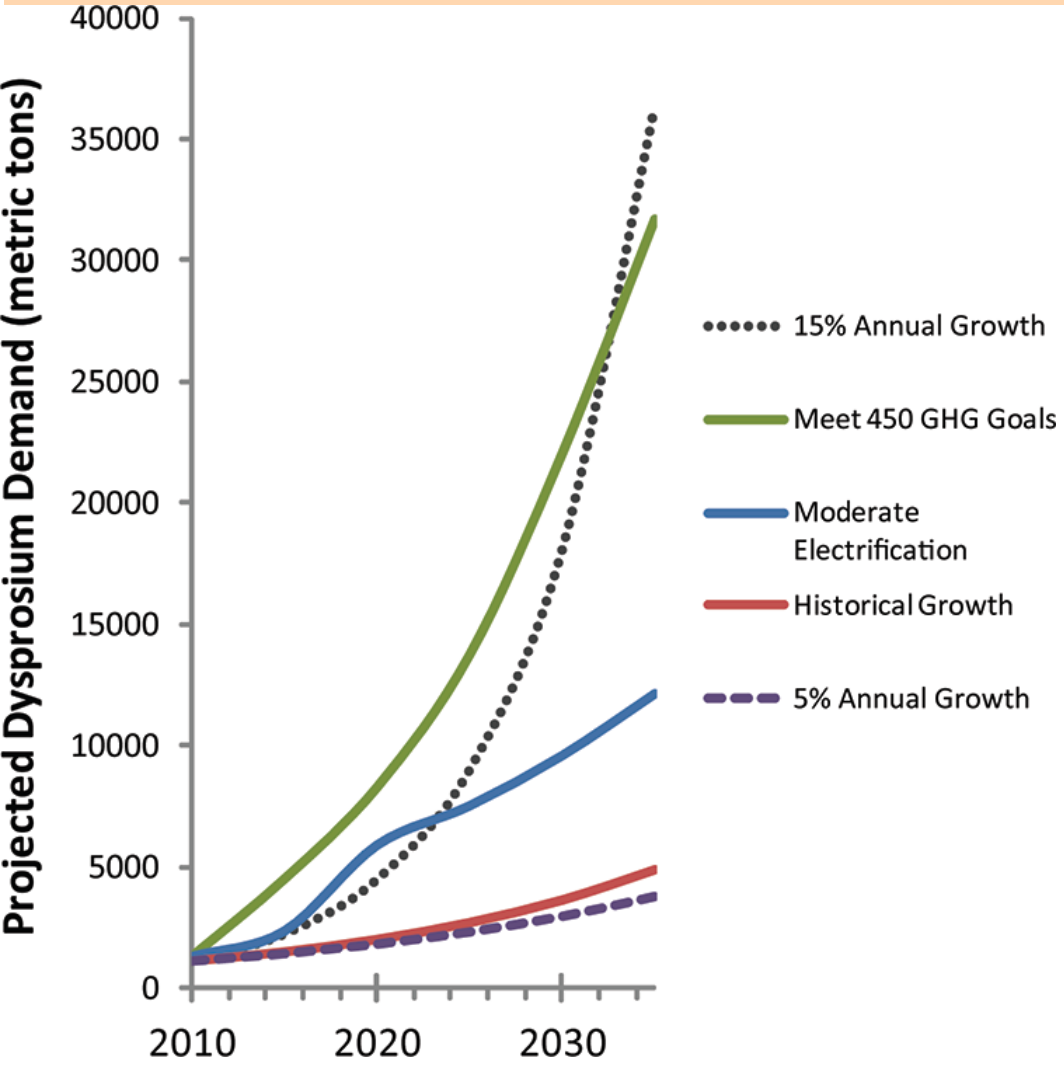


Trade flows of one vey important rare metal – Neodymium



Nansai, K., Nakajima, K., Kagawa, S., Kondo, Y., Suh, S., Shigetomi, Y., Oshita, Y., 2014. Global Flows of Critical Metals Necessary for Low-Carbon Technologies: The Case of Neodymium, Cobalt, and Platinum. *Environ. Sci. Technol*. 48, 1391–1400. doi:10.1021/es4033452

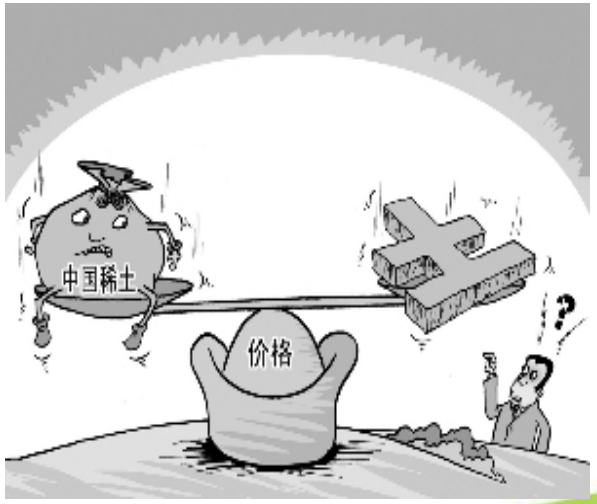
High-tech challenge: Green energy technology demand for REEs



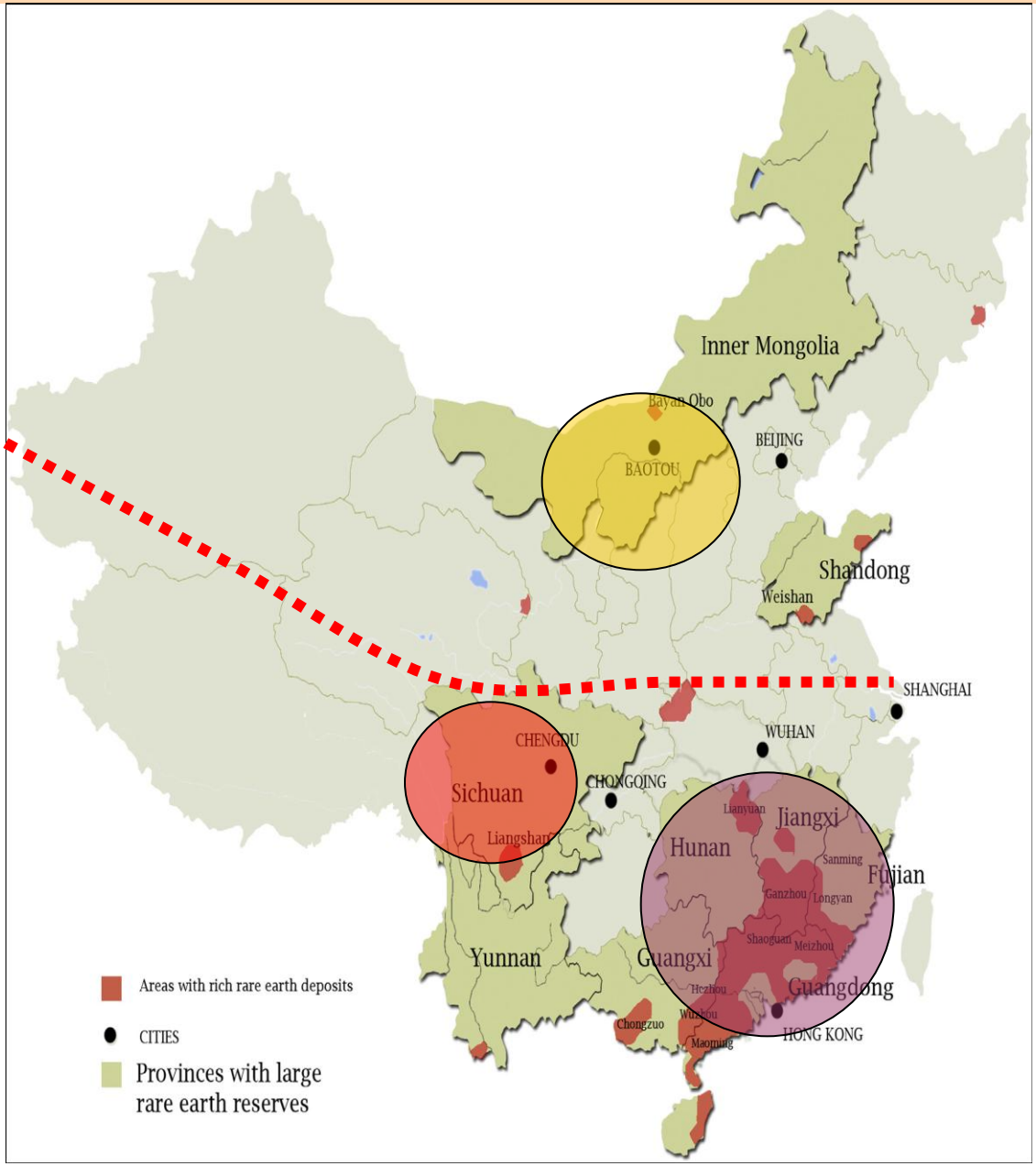
Global demand for rare earth materials such lanthanum and neodymium was and will be surging as the world's green energy technology developed and appetite for hybrid cars, wind turbines and ever-faster phones with better screens increased.

Alonso et al. » Evaluating Rare Earth Element Availability: A Case with Revolutionary Demand from Clean Technologies." Environ. Sci. Technol. 2012, 46, 3406−3414

2 Rare Earths Industry Restructuring



Current status of rare earths restructuring

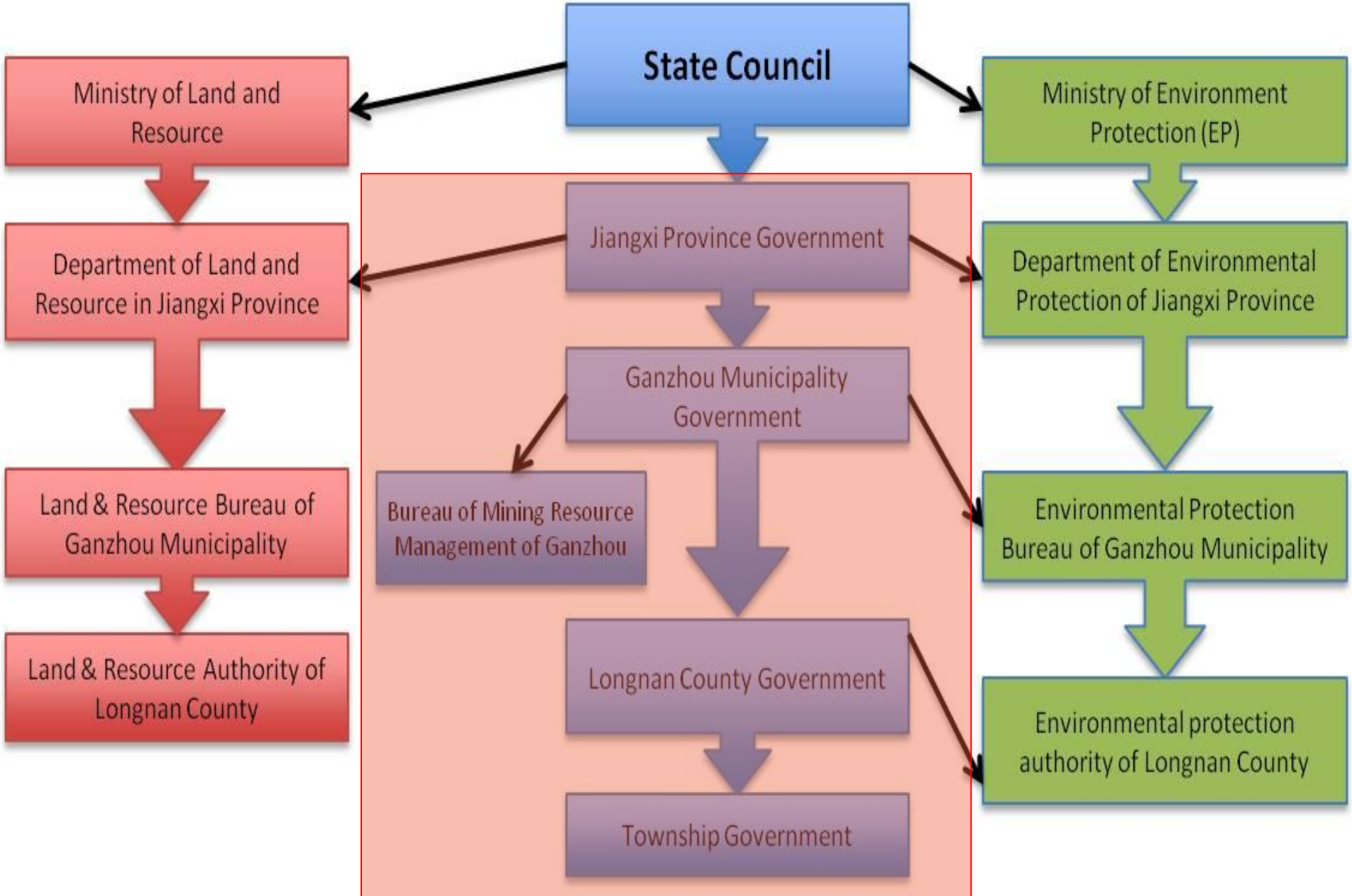


Geographical distribution of REEs resources in China

The Chinese rare earth industry has formed three major bases and two production systems of rare earths, strongly relying on the core area of rare earth resources, including

- three Bases:
  - the north production base of rare earth dominated by Baotou
  - the medium- and heavy- rare earth production base in Jiangxi and other seven provinces in South China ;
  - the production base of bastnaesite in Mianning of Sichuan.
- Two systems:
  - the northern light rare earths process system
  - the southern medium- and heavy- rare earths producing system

Institutional Conflicts: a ‘double-leadership' (central and local) and the independent line of management on REEs in China



Progress in restructuring

- **National Level:** constructed 6 comprehensive public technology service platforms, a number of high-end materials and devices projects. It is predicted that all rare earths enterprises will be controlled less than 20 within next few years by ways of asset reorganization and merger integration.
- **Regional Level:** some provinces (region) like Inner Mongolia, Guangdong, Jiangxi, Fujian and others have basically completed integrations of rare earth mining, smelting and separation enterprise within their areas and formed large scale enterprise groups of REEs.
- **Enterprise Level:** "1+5" giant state-owned enterprises like Baotou, plus China Minmetals, China Aluminium Corp (also known as Chinalco) and others have intensified structural adjustment and enhanced their industrial scale and comprehensive strength.

Major Impacts

- International trade dispute over China's exports of raw materials since March 2012
- Illegally and unplanned production has occurred frequently over China
- Excess capacity of rare earth smelting and separation is also relatively prominent
- Illegal activities of rare earth production and circulation are difficult to cure as a result of unhealthy laws and regulations

Historic rare earth policy evolution

- Since 1978 China has established the leading group or national office associated with the rare earth industry, though different names were used for different subsidiaries at different stages.
- In the past six-run reforms of government institutions under the State Council, management functions for the rare earth industry have always been reserved.
- Since the mid-1980s three development stages :
  - ✓The first stage (1985 – 1998), taking the policy of '*open production and open* supply'
  - ✓The second stage (1998 -2005), taking the policy of 'limit low but encourage high quality of rare earths export'
  - ✓The third stage (2005 – present) , taking the policy of 'comprehensive rare earth new deal'

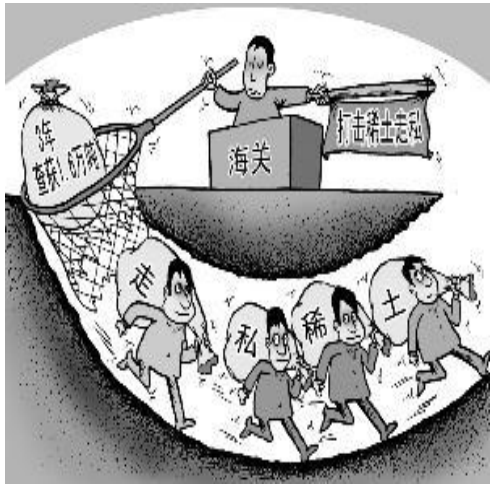
Current rare earth policies

Date	*Policy Name*	*Organization/Committee*	*Policy Goals*
2006-2014	(1) Export Quotas	Ministry of Land and Resources (MLR)	Protect and rationally utilize domestic rare earths while mitigating environmental damage
1980-2014	(2) Environmental Laws: (i.e., Rare Earth Industry Pollutant Discharge Standards)	Ministry of Environmental Protection (MEP)	Coordinate rare earth development and utilization with environmental protection
2006-2014	(3) Export Licenses	Ministry of Commerce (MOC)	Enhance domestic revenues by limiting joint venture licenses; maintain stricter environmental standards
2007-2014	(4) Export Duties	Ministry of Commerce (MOC)	Manage and control the variety and quantity of rare earth products leaving China
2002-2014	(5) Technology for Resources	National Development and Reform Commission (NDRC)	Expand China's rare earth industry to the more elaborate processing sectors
2009-2014	(6) Industry Consolidation: (i.e., Plans for Developing the Rare Earth Industry 2009-2015)	Ministry of Land and Resources (MLR)	Establish three rare earth production districts and two production systems; create a unified front for the entire Chinese rare earth industry
2008-2014	(7) Stockpiling	Rare Earth High-Tech Zone Management Committee	Regulate rare earths pricing and help ensure future supplies

China's REEs Export Quotas in 2009-2014 (metric tons)

	2009	2010	2011	2012	2013	2014
First Batch	21728.1	22283	14446	21226	15499	15110
Second Batch	26427	7976	15738	9770	15502	15500
Supplement	1990					
Total	50145.1	30259	30184	30996	31001	30610

3 Regulation Effects



Implications for small-scale REEs mining

- The current policy adjustment of rare earth industry in China is a serious challenge to regulate small-scale rare earths mines and is not objectively favourable to the development of private and small-scale rare earths enterprises

- Some extremely impact may be arisen for small-scale REEs mining in China
  - ✓a high pressure situation against illegal rare earths ASMs will be always maintained
  - ✓the formation of large-scale rare earth conglomerates will be accelerated in the near future
  - ✓the management on key sections in whole rare earths industry will be reinforced
  - ✓the Chinese government will actively support technological innovation and the development of rare earths application industry
  - ✓some rare earths laws and regulations will be greatly improved

Regulations that have delivered the restructure

- Although a series of reforms on the rare earths industry in China have been made over recent years, some regulations that have delivered the restructure are more or less at work.
- Some new changes and difficulties are as below:
  - ✓ the rare earth export quotas seem to be failure
  - ✓the formation of “one plus five” large-scale rare earths groups has been promoting difficultly
  - ✓the new environmental protection verification was developed for all rare earth enterprises
  - ✓the minimum required indicators for three rates of rare earths resources development and utilization was implemented in China

Indicators of opencast recovery rates of rock ore type REEs mining

Ore-body thickness (m)		Mining recovery rate (%)
Thin ore body	＜5	94
Medium thickness ore body	5 ≤H≤15	95
Thick ore body	H ≥ 15	96

Revision of Mineral Resources Law of China related to REEs

- The most recent revision of the Mineral Resources Law of People's Republic of China started in 2002 but has been progressing slowly. Up to date, this new round of China's mineral law revision has been in suspense either in the government agenda or academic disputes.
- Some changes in mineral resource law revision will be comprehensively amended. It aims to improve the mining by enhancing mineral resource management, implementing a methodical science-based mining strategy, improving the Chinese mining investment environment, and realizing more sustainable development in mining.
- The scope of new legislation will include public welfare and commercial mineral explorations and mining production, environmental protection, the marketing, import and export of mineral products.
- Other establishments in terms of health and safety, labor and local development will be referenced to related laws and regulations.

4 Closing Remarks

Significances and Regulations in general

- China has supplied at least 95 % demand of REEs to the world just by less than half of its REEs reserves over past decade!
- Future regulation will definitely aim to consolidate, focus, and improve a unified management system for its mineral resources, by establishing a classified and hierarchical management system for mineral resources, a strong mineral resource property system and a comprehensive environmental protection system for all mines around China.
- It also seeks to improve the legal system for mineral resource planning, the reserve management system for mineral resources, the management system for lands designated for mining, the management system for ASM.

Regulations Perspectives in particular with REEs industry

- Although the new draft law for ASM was still under open discussion in 2014, the majority of the above objectives are likely to be fully integrated in the year-end finished revision.
- China will definitely continue to adjust and improve the management system for exploration and mining of REEs resources and for managing mining taxes, fees and economic benefit , and clarify legal responsibilities of all stakeholders towards sustainable development of rare earth minerals industry in China.
- To what content and what parts of provisions should be included in the revised laws and regulations with particular reference to rare earths ASM and potential implementation at local level remain to be looked forward to and observed in the near future.

Thank you!

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