Rare earth user costs in China and their implications

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Outline

- Rare earth resources
- E&H Issues
- User costs
- Observations
Resources - LREE in China

LREE: rocks of carbonatites, pegmatites, hydrothermal/magmatic deposits; minerals of bastnasite, monazite, xenotime, loparite, apatite

LREO reserves:
- 35Mt-Baotou, 5.58%
- 4Mt-Weishan;
- 2Mt-Panxi

Light REE: Sc La Ce Pr Nd Pm Sm Eu
Heavy REE: Gd Tb Dy Ho Er Tm Yb Lu Y
Resources - HREE in China

Light REE: Sc La Ce Pr Nd Pm Sm Eu

Heavy REE: Gd Tb Dy Ho Er Tm Yb Lu Y

HREE: rocks of peralkalines; weathered clays in a warm humid climate such as in Jiangxi Province, and in Provinces of Fujian, Hunan, Guangdong, Guangxi

0.03%-0.3% REOs
Resources - RE in the world

Resources - RE in the world

2015 RE reserves (81.09 Mt in total with China share 23%)
REEs not rare on Earth, abundant as Cu, Zn, Sn, Pb. Due to their properties, REEs typically dispersed and seldom found in concentrated or economically exploitable forms.
Issues - LRE E&H hazards

RE lake - tailing pond in Baotou with identified hazards of radioactive thorium & toxic fluorine in ecosystems
Radioactive contamination to ecosystems was reported to be associated with human/animal anomaly syndromes.
Issues - HRE E&H hazards

Mountains stripped by extracting HRE in Southern China
With chemical substances, metal contaminants, vegetation and plant losses, and landscape disturbances
Issues - HRE E&H hazards

In Ganzhou, chemicals from RE processes reported to contaminate drinking water and irrigation.

Studies showed RE exposure exceeded safe limits and had health impacts.
Issues - HSEC in China

- MIIT estimated a need of CNY38M for environmental restoration in Ganzhou.
- As the major LRE producer, Inner Mongolia Rare-Earth Hi-Tech Co did not passed EIA until 2012 while supplying most of LRE to the world.
- Needless to say any HIA
The Mountain Pass mine closed in 2002 due to E&H problems together with low prices, involving radioactive contamination. Though it is now reopening.
Issues - HSEC in Malaysia

- The Mitsubishi’s Asian rare earth plant at Bukit Merah was linked to cases of leukaemia and birth defects in 1992.
- Pakatan Rakyat asked the State to rescind its agreement allowing HK’s CVM to explore RE mining in Bukit Merah.
- Fears of radiation resulted in Malaysian protest against the RE refinery in Pahang by Lynas for processing Mt Weld RE ores.
It is reported that key challenges for proposed RE projects in Alberta & Northwest Territories also revolve around E&H issues.
User cost - Background

- The WTO ruling ended the Chinese RE export quota and tariff controls &
- will lead to more market oriented mechanisms to address RE resource depletion, community health, and environmental degradation problems
One direction is to internalize negative externalities from RE exploitation and to share or balance social costs induced by RE extraction and benefits brought by RE product application.
Another is to encourage the concentration of RE producers by establishing the industrial ACREI & restructuring state-owned groups such as Minmetals & Chalco to build technological & managerial capacity of exploitation for supply sustainability.
This paper propose a user cost approach to RE resource depletion. It is argued that over-depletion of nonrenewable resources such as RE will lead to the loss of opportunities or ability and environmental degradation for future generations.
This opportunity loss & degradation has not been adequately accounted for in the current RE prices.

An approach to address the problem is to take user cost into account for inter- and intra-generational compensations.
The user cost of capital is defined as minimum rate of return—to cover the costs of assets, pay the taxes, and compensate investors for funds.

Similarly, mineral reserves can be regarded as natural capitals; they deplete in mining exploitation.
Lower user costs typically translate into higher investment levels but over-depletion and degradation.

Such depletion or degradation can be partly accounted as the user cost of non-renewable resource capital assets to be utilized.
User cost - Concept

- This resource user cost is accounted to compensate for exhaustion, asset decline or environmental degradation
- to retain owner ability to reinvest in other capital, explore new resource, develop substitute & promote nature rehabilitation to sustain resourcing and environmental service
User cost - Concept

- The mathematical form for the user cost is \( U = R - X = R/(1+r)^{n+1} \)

- where \( U \) is user cost, \( R \) is capitalized value of a finite series over a period of \( n \) years, \( X \) is true income from resource sales in infinite series of years, and \( r \) is discount rate
Analyses on the sensitivity of user cost to resource utilization factor at different discount rates has been conducted, and the results are shown in Figure 1 for LREO and in Figure 2 for HREO.
User cost - Results

Figure 1 User cost for LREO

(a) Discount rate of 4%
(b) Discount rate of 8%
User cost - Results

(a) Discount rate of 4%
(b) Discount rate of 8%

Figure 2 User cost for HREO

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To take a discount rate of 4% for example, the user cost is CNY374/t LREO or CNY955/t HREO in 2010.

Taxes are CNY60/t ROM LREM (CNY6,000/t LREO); or CNY30/t ROM HREO (CNY30,000/t HREO).

User cost is 3 to 5% of resource tax.
A contrast of user costs to taxes shows that an account of user cost into RE prices will not add much burden to RE producers.

However, the user cost mechanism will help set aside money for compensation.
User cost - Implications

- and build capacity for long-term sustainability by encouraging
- preservation of rare earth resources
- improving of resource utilization
- suppression of over-depletion
- protection of community environment
- promotion of supply sustainability
Observations - REE’s role

- REEs not so rare as politicians have escalated & occurs over tens of countries such as CIS, US, AU & CA
- RE market is small, fluctuating & volatile, compared to other minerals
- RE role in long range sustainability is no more critical than that in certain innovative systems
Observations - disputes

- China’s dominant share of market was a result of its promotional policies with low factor costs & little E&H liabilities in the early years of reforms, but not intended monopoly.

- Its currently intervention is a consequence of social needs for societal betterment.
Rare earths contribute to the global green energy and green economy.

Their extraction degrades E&H and induces externalities or social costs.

To be sustainable, inclusive & equitable, higher taxes/royalties and user costs may be assessed to internalize RE externalities & share RE benefits.
Thank you for your attention

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