The role of rare metals as critical supply chain bottlenecks in priority energy technologies

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• The large-scale deployment of low-carbon technologies is a prerequisite for meeting the European energy and climate policy targets for 2020 and beyond (SET-Plan)

  ➢ Wind energy: 56 GW (2007) ➞ 400 GW (2030)
  ➢ …

• Increased capacities implies increased material consumption

• Material should become available at rates that match capacity increase rates
• Rare metals are essential parts of energy technologies
  - 3 MW wind turbine - 2 t magnet - 600 kg Nd
  - 350 GW of additional wind power in EU = 210 kt Nd = 10 kt/y Nd

• ... as well as in other important applications (incl. consumer and defence electronics)
  - 1 hybrid motor – 1 kg Nd
  - 100 million vehicles by 2030 in EU = 100 kt Nd = 5 kt/y Nd

• Resources of some rare and noble metals are limited and often concentrated in a small number of countries
  - Nd annual production: 20 kt
  - Chinese monopoly
The importance is growing ...

The automotive sector is currently the largest user of rare metals

Rapid increase in the number of motors for one automobile, other than for driving and for electrical power steering (Nd) (presently almost 100)

Metal processing (manufacturing plant)

- Steel components (additives of special steel, high tension steel) (Cr, Mn, V, Ni etc.)
- Rapid increase in the number of motors for one automobile, other than for driving and for electrical power steering (Nd) (presently almost 100)
- Machine tools for processing/manufacturing, driving motor of robots (Nd, Dy)
- Cemented carbide tools for metal processing (WC, Co)
- Exhaust purification catalysts (gasoline cars: three-way catalysts (Pt, Pd, Rh), diesel cars: platinum catalysts (Pt))
- Liquid crystal display (In)
- Hybrid cars, rechargeable electrical cars, fuel cell electrical cars, driving motors (Nd, Dy)
- Fuel cell (electrodes) (Pt)
- LED light (Ga)
- Nickel-hydrogen cell (Ni, Co), lithium-ion cell (Li, Co)

Source: AIST

JP foresees a rapid increase in the demand for rare metals

Estimated by Yano Research Institute
Soaring prices

The cost of Nd increased from 7 $/kg in 2003 to 120 $/kg today

Source: MCE Inc.
The power of reserve holders

- **Export quotas**

- **Export tariffs**
  - CN: 31% additional cost to importers
  - Waived if manufacturing is done in CN ➔ loss of jobs and innovation in the EU?

- **Control of global market**
  - CN can control global REO prices
  - CN buys REO mines and industries around the world
  - CN is now the most attractive partner in the rare metal business
Potential bottlenecks

• Europe is 100% import dependent for many of these materials

• There is a growing demand, limited global supplies and geopolitical competition over the control of resources.

• Increasing production is difficult, environmentally challenging and takes a long time.

• The availability of rare metals may dictate the rate of deployment of low-carbon technologies.
Potential solutions

- Smart exploration of investment opportunities
  - Toyota invests in Vietnamese mines
- Improved access to raw materials
  - USA are reopening the Mountain Pass mine
- Improved trade agreements
  - JP / Indian Rare Metals Ltd agreement
- Improved efficiency in material utilisation
- Enhanced recycling practices (urban mining)
- R&D on material substitution
  - Permanent magnets: Nd-Fe-B $\rightarrow$ Sm-Fe-B
The JRC commissioned a study on rare metals as bottlenecks to energy technology deployment. Its aims:

- Identify rare metal requirements for the high-priority low-carbon technologies: wind, solar, bio-energy, CCS, nuclear and electricity grids
- Examine the impact of rare metal supply and its disruption on the deployment of these technologies based on technology penetration scenarios
- Explore possible strategies to prevent or mitigate the negative impacts of rare metal supply and its restrictions on the SET-Plan goals
The study will answer the following questions:

**Comprehensive analysis of critical rare metals**
- In which countries are key resources located and what are the associated political risks?
- What are the processing routes for these metals?
- What are the competing applications for these metals?

**Policy implications**
- Which metals are critical for the achievement of the SET-Plan targets?
- In which quantities will they be needed under different scenarios?
- How would supply shortages or political disruptions affect the realisation of the SET-Plan targets?

**Policy recommendations for mitigating potential bottlenecks**
- How can critical rare metals be substituted in some applications?
- Is there potential to increase European mine production?
- What role can reuse, recycling and waste reduction play?