REE OPPORTUNITIES FROM THE EUROPEAN INDUSTRY PERSPECTIVE

K.A. NYANIN- Technical Manager (LCM)

Less Common Metals - A world leader in rare earth based alloys and high-purity metals
Why the interest in rare earths?

- Many and varied uses
- Often in high-tech industries
- Essential and irreplaceable in many everyday applications
# Global Clean Technology Demand to 2030

## Table

<table>
<thead>
<tr>
<th>Year</th>
<th>Wind Power (MW)</th>
<th>Lighting</th>
<th>Electric Vehicles</th>
<th>Batteries</th>
<th>Catalytic Converter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LFL (Million Cps)</td>
<td>CFL (Million Cps)</td>
<td>LED (Million Cps)</td>
<td>Electric Cars (Car)</td>
</tr>
<tr>
<td>2016</td>
<td>63,350</td>
<td>2142</td>
<td>2903</td>
<td>2675</td>
<td>750,000</td>
</tr>
<tr>
<td>2020</td>
<td>79,005</td>
<td>1604</td>
<td>1491</td>
<td>4828</td>
<td>2,140,000</td>
</tr>
<tr>
<td>2025</td>
<td>76,810</td>
<td>1116</td>
<td>662</td>
<td>5874</td>
<td>7,953,375</td>
</tr>
<tr>
<td>2030</td>
<td>107,488</td>
<td>776</td>
<td>294</td>
<td>7146</td>
<td>29,530,323</td>
</tr>
</tbody>
</table>

## Diagram

The chart shows the demand for rare earth oxides (REO) from 2016 to 2030, categorized by application in global clean technology. The colors represent different elements: La, Ce, Nd, Eu, Tb, Y, and Dy.

Source: Baolu Zhou ID, Zhongxue Li & Congcong Chen, University of Science and Technology Beijing, Beijing 100083, China, (Oct 17).
Current situation in Europe

- Huge level of knowledge and experience in downstream processing of rare earths for production of rare earth magnets
  - However, Europe remains dependent on China for raw material supply
    - The few non-Chinese options focus on supply to far-east producers
- Requirement for magnets also dominated by low cost supply from China
- Prospective new upstream suppliers face huge fundraising challenges
- Mantra is “Stable and Secure Supply at Realistic Prices”
Introduction to LCM

- High quality manufacturer of rare earth alloys for 26 years
  - Main products – alloys for permanent magnet production
- Commercial producer of neodymium metal since 2017
- Long history of co-operation and development with customers and suppliers
- All operations carried out to highest standards of Quality, Environmental and Health & Safety Stewardship
- Participation in European projects gives new opportunities:
  - Establish new all European supply chains.
  - SecREEtS project is especially interesting, though not recycling based.

To recover Tb, Dy, Nd & Y from two types of industrial wastes:

- Tailings from the iron ore industry: representing high volume, but low concentration of REE.
- Magnetic waste material from WEEE recycling industry: representing low volume, but high concentration of REE.
REE4EU Project Objectives (2015 to 2019)

To develop, validate and demonstrate in 2 industrially relevant pilots:

- An innovative Rare Earth Oxide (REO) mixtures extraction technology using ionic liquids.

- A novel direct Rare Earth Alloys (REA) production route for Permanent Magnets (PM) and Secondary Batteries (SB).
LCM in REE4EU

- LCM’s role to demonstrate efficient and clean production of Neodymium-Dysprosium-Iron master alloy from oxide generated from the PM stream.

- The fused salt electrolysis cell developed for REECover was modified for master alloy production.

- NdDyFe master alloy was produced and used to produce strip cast alloy which was supplied to Vac for magnet production.

- Magnets produced by Vac demonstrated the technical viability of REE recycling in Europe.
SecREEets (2018-2022)
Secure European Critical Rare Earth Elements

- €17m Horizon 2020 project aimed at creating integrated value-added supply chain for rare earth permanent magnets fully within Europe

- Main participants
  - Yara - Global fertiliser producer with significant levels of RE bi-products
  - REEtec – Norwegian SME with novel separation technology for rare earth elements
  - Less Common Metals – UK rare earth metals and alloy producer
  - Vacuumsmelze – Europe’s main producer of permanent magnets

- Advisory panel includes Siemens
LCM in SecREETs

- LCM’s role is to demonstrate efficient and clean production of Neodymium and Dysprosium-Iron master alloy from oxide generated.
- New commercial scale fused salt electrolysis cells will be designed and employed in the project.
- RE metals and master alloys produced will be used to produce strip cast alloy to be supplied to Vac for magnet production.
- Magnets produced by Vac demonstrate the technical viability of the integrated European supply chain.
Future Options for new Supply

- Junior miners
  - Several prospects – mainly Canada, USA, Africa and Australia
  - Generally looking for investments ranging from hundreds to billions of dollars
  - Appetite for funding rare earth prospects is weak
  - Cost of servicing debt impacts financial viability of many projects

- Recycling
  - Recycling routes for processing scraps is well established
  - Recovery of rare earths from end-life components increasingly of interest

- Rare earths as by-products of other mining activities
  - For example monazite recovered from beach sand processing
  - Supply route for Toyotsu Rare Earths India
  - Low cost (potentially zero cost) primary raw materials
Rare Earths – A Perspective

"These elements perplex us in our researches, baffle us in our speculations and haunt us in our dreams. They stretch like an unknown sea before us - mocking, mystifying and murmuring strange revelations and possibilities“

Sir William Crookes

Address to the British Association, 1887
Thank you for your attention.

Less Common Metals - A world leader in rare earth based alloys and high-purity metals