“Rare Earths: Is Supply Critical in 2013?

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by
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Professor Dudley J. Kingsnorth, through the Industrial Minerals Company of Australia Pty Ltd (“IMCOA”) and Curtin University provides rare earths market and project development advice to a number of rare earths consumers and producers. This advice is provided on a fee for service basis; with no success or promotional fees or obligations. There are Confidentiality Agreements in place with many of these companies, but this does not preclude comment on the public information available on these companies.

Neither Professor Kingsnorth nor IMCOA own any securities in rare earths companies. Similarly, Professor Kingsnorth does not hold any executive or non-executive positions in any company associated with the critical materials sector.
Summary of Presentation

- Recent history of rare earths market
- The rare earths market today
- China
- Future demand and supply
- Conclusion

(Note: ROW refers to Rest of World, outside China)
The Rare Earths Market in 2008

- Estimated global demand in 2008: 124,000t REO
- China dominant:
  - producing 125,000t REO (97% of global supply)
  - consuming 68,000t REO (55% of global demand)
- Japanese consumption: 25,000t REO.
- Mountain Pass & Mt Weld in latter stages of evaluation/study
- Several ROW rare earths projects (>30) being evaluated
The Rare Earths Market in 2010

- Estimated global demand in 2010: 123,000t REO
- Global Market ‘Value’ in 2010: US$2½-3B (US$30-40/kg REO)
- China dominant:
  - producing 109,000t REO (95% of global supply)
  - consuming 74,000t REO (60% of global demand)
- Japanese consumption: 22,500t REO
- China reduces rare earths export quotas by 40%
- China suspends shipments of rare earths to Japan
- Construction at Mt Weld and Mountain Pass commenced
- Many ROW rare earths projects (>150) being evaluated
The Rare Earths Market in 2011

- Estimated global demand in 2011: 110,000t REO
- China dominant:
  - producing 98,000t REO (94% of global supply)
  - consuming 75,000t REO (68% of global demand)
- Huge price increases: 500-1,000%
- Significant smuggling out of China
- Mt Weld & Mountain Pass construction well advanced
- Over 300 ROW rare earths projects being evaluated
China Focus: Vertical Integration

- China promotes ‘value add manufacture’ through:
  - Production quotas
  - Export taxes and quotas
  - No VAT/GST refund on unimproved REOs
  - Comprehensive export controls and inspections

- The Chinese national, provincial and state governments, through SOEs are steadily but surely vertically integrating and consolidating production so that within 5 years there will be minimal quantities of REOs available for export
Rare Earths Demand: Price Is Elastic

- Polishing powders
- FCC catalysts
- Wind turbines
- Hybrid vehicles
Estimated RE Market Value US$/kg REO

(Based on 2011 weighted consumption (ref. IMCOA) of individual rare earth oxides and Metal Pages FOB China Prices)

<table>
<thead>
<tr>
<th>Comparison</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013 YTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Demand Tonnes REO</td>
<td>125,000t</td>
<td>85,000t</td>
<td>125,000t</td>
<td>110,000t</td>
<td>115,000t</td>
<td>&lt;100,000t</td>
</tr>
<tr>
<td>China Demand (%)</td>
<td>55%</td>
<td>70%</td>
<td>60%</td>
<td>70%</td>
<td>70%</td>
<td>66%</td>
</tr>
<tr>
<td>Market Value (Assuming that Chinese prices are 33% less)</td>
<td>US$1½-2B</td>
<td>~US$1B</td>
<td>US$2-3B</td>
<td>US$10-15B</td>
<td>US$4-6B</td>
<td>US$3-5B</td>
</tr>
</tbody>
</table>

History of Weighted Average Rare Earths Prices
US$/kg REO, FOB China 2008-12

(Notes: 1. Data accuracy: ±25% 2. FOB China prices source is Metal Pages© 3. All data have been rounded)
The Rare Earths Market in 2013

- Estimated global demand in 2012: 120-130,000t REO
- Global Market ‘Value’: US$3-5B (US$40-60/kg REO)
- China still dominant:
  - producing 90-100,000t REO (80-85% of global supply)
  - consuming 80-85,000t REO (66% of global demand)
- Japanese consumption: 10-20,000t REO
- China: cutting production, stockpiling, consolidating, trying to set prices
- Mt Weld & Mountain Pass achieve Phase 1 production target
- Fewer ROW rare earths projects (<50) under evaluation
The Outlook to 2016

- China will not directly deny rare earths to ROW; but it will continue to take the measures necessary to maximise ‘value add’ within China.
- Consolidation of Chinese industry will continue.
- Impact of *Baotou Rare Earths Trading Platform* could become significant and set a global pricing benchmark.
- The impetus for replacement, recycling and reduction will remain until new projects are well established.
- The supply of heavy rare earths will remain a concern.
- The next generation of new projects could be starting-up.
- Will China be more transparent with its intentions/forecasts?
Rare Earths Supply & Demand

Source: IMCOA and discussions with Rare Earths Industry Stakeholders
Global Supply/Demand Balance for some Individual Rare Earths in 2016

Forecast Supply and Demand for Selected Rare Earths in 2016
(assuming no more reserves identified in China)

<table>
<thead>
<tr>
<th>Rare Earth Oxide</th>
<th>Demand @ 150-170,000tpa REO</th>
<th>Supply @ 180-210,000tpa REO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerium</td>
<td>70,000t REO</td>
<td>80,000t REO</td>
</tr>
<tr>
<td>Neodymium</td>
<td>25-30,000t REO</td>
<td>30-35,000t REO</td>
</tr>
<tr>
<td>Europium</td>
<td>350-400t REO</td>
<td>400-450t REO</td>
</tr>
<tr>
<td>Dysprosium</td>
<td>800-850t REO</td>
<td>1,000 REO</td>
</tr>
<tr>
<td>Terbium</td>
<td>450-500t REO</td>
<td>250-300t REO</td>
</tr>
<tr>
<td>Yttrium</td>
<td>9-10,000t REO</td>
<td>7-8,000t REO</td>
</tr>
</tbody>
</table>
Supply & Demand Trends 2016-2020

- Demand in 2020: 200-240,000tpa REO.

- Demand trends:
  - Greater availability of non-Chinese products.
  - Greater total supply chain management.
  - Growth will be limited until new ROW producers are proven.

- Supply in 2020: 240-280,000tpa REO

- Supply trends:
  - Availability of HREEs will remain an issue.
  - Ongoing consolidation of industry worldwide.
  - Will low iron ore prices impact on the viability of Baogang?

- Long Term Prices: US$40-60/kg REO (weighted average consumption basis)
Is Rare Earths Supply Critical in 2013? - What is the outlook for the future?

- With the start-up of Mt Weld and Mountain Pass the rare earths industry has been rejuvenated.
- ROW consumers can now look forward to a sustainable supply of light rare earths – new applications can be developed with confidence.
- In the light of the vertical integration and consolidation of the rare earths industry in China; the ROW needs to develop independent rare earths supply chains – from mine to showroom.
- The supply of heavy rare earths (Eu, Tb and Y) will remain critical until heavy new rare earth projects are successfully developed inside and outside China.
- **The supply of light rare earths is no longer critical; whereas the supply of heavy rare earths will remain critical for the foreseeable future.**
Any Questions (Later)?

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