Cathode Supply Chain Considerations with focus on North America

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Center for Research in Extreme Batteries: 2022 Spring Bi-Annual Meeting
We are ....

A global materials technology and recycling group

A global leader in automotive catalysts for internal combustion engines, hybrids and fuel cell powered vehicles

A leading supplier of key materials for rechargeable batteries used in electrified transportation and portable electronics

The world’s leading recycler of complex waste streams containing precious and other valuable metals
A global leader in active materials for rechargeable batteries

- Over 20 years in the market
- 8 production sites worldwide
- First cathode producer in Europe
- Carbon neutral production in Europe

This year Umicore will produce enough cathode materials to power 1 million vehicles

From portable electronics to automotive

Over 15 years of sustainable and ethical sourcing of materials

1 out of 5 batteries ever made contains Umicore technology
From mine to wheel
Supply security through unique footprint and know-how

Umicore's unique supply chain set-up

**Metal**
- CHIP (Cobalt)
- MHP (Nickel)

**Intermediate**
- Kokkola, FI
- Olen, BE

**Recycling**
- Hoboken, BE

**Metal salts**
- Ganzhou, CN
- Jiangmen, CN

**Europe**
- Kokkola, FI
- Olen, BE

**Asia**
- Ganzhou, CN
- Jiangmen, CN

**Refining**
- Nysa, PL

**Precursor**
- Nysa, PL

**Cathode**
- Cheonan, KR

**Risks managed**
- Hedging
- Sustainability
- Geographical
- Commercial
- Quality
North American Market Growth

North America Production of BEVs

<table>
<thead>
<tr>
<th>Year</th>
<th># of BEVs (RHS)</th>
<th>BEV Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>2021</td>
<td>24</td>
<td>43</td>
</tr>
<tr>
<td>2023</td>
<td>59</td>
<td>73</td>
</tr>
<tr>
<td>2025</td>
<td>101</td>
<td>109</td>
</tr>
<tr>
<td>2027</td>
<td>110</td>
<td>115</td>
</tr>
<tr>
<td>2029</td>
<td>129</td>
<td>140</td>
</tr>
</tbody>
</table>

2021 US Electrified Vehicle Sales Growth

<table>
<thead>
<tr>
<th>Category</th>
<th>2021</th>
<th>2020</th>
<th>Y-O-Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVs</td>
<td>487,460</td>
<td>257,872</td>
<td>89.0%</td>
</tr>
<tr>
<td>HEVs / PHEVs</td>
<td>969,407</td>
<td>525,605</td>
<td>84.4%</td>
</tr>
<tr>
<td>Total Electrified</td>
<td>1,456,867</td>
<td>783,477</td>
<td>85.9%</td>
</tr>
<tr>
<td>Total Market</td>
<td>15,061,885</td>
<td>14,568,364</td>
<td>3.4%</td>
</tr>
<tr>
<td>% Electrified</td>
<td>9.7%</td>
<td>5.4%</td>
<td>79.9%</td>
</tr>
</tbody>
</table>

Source: IHS Markit © 2022 IHS Markit
US Li-ion battery market and Associated Cathode Supply Chain Requirements

Li-ion GWh demand US

US Cathode materials (2030) ~600 kMT

US Raw materials (2030) NMC8xx family ~300 kMT

*Includes demand from BEV/PHEV/FCEV/HEV, EMMO, 2 & 3 Wheeler & ESS
May 26, 2022 ...Automotive industry leaders have committed more than $500 billion to shifting to electric propulsion over the course of this decade.
Evolution in business models

The linear business model gives way to a more interconnected model seeking to optimize:
- costs,
- supply security,
- product differentiation.

Umicore and Volkswagen AG to create European EV battery materials Joint Venture
Cell makers global footprint

And (largely captured) growth in North America

LG announces a $1.7B ramp-up, 1,200 new jobs, at its Michigan EV battery factory

Samsung SDI, Stellantis Invest $2.5 Billion in US Battery Plant
Current active materials production
Currently dominated by overseas supply

... with announced plans for cathode production in NA mid-decade
NA Cathode production

Considerations

• Financial
  • Access to high capital employed
  • Short-term contracting terms
  • Market uncertainty

• Siting
  • Sustainability - Availability of renewable energy
  • Logistics & Footprint for expected expansion
  • Regulatory

• Raw material supply & Closed loop recycling
  • Limited domestic Ni and Co resources, Li processing early TRL
    • Some potential global production – demand imbalances, especially for premium sources
  • Nascent battery scrap/ End-of-Life market
Takeaways

- The Li-ion battery market in North America is poised for significant growth this decade driven by mobility electrification.
- Automotive OEMs are investing $100’s B to enable vehicle electrification through the creation of a domestic supply chain.
- The automotive supply chain is evolving to create security and economies.
- Leading suppliers are locating to North America led by automotive investment with 2025+ timing.
- Cathode production capacity, largely initially captured for automotive, will grow rapidly through the end of the decade.
- Raw material markets are expected to be tight.
materials for a better life