The Role of Lithium

Minerals For A Green Society
MMSA Symposium
February 4, 2010
What is Lithium
Lithium Market Is Relatively Small

End Uses:

Glass and Ceramics
Lubricants
Refrigeration (coolants)
Pharmaceuticals
Polymers
Aluminum Production
Significant Growth in Portable Lithium-Ion Batteries

→ Mobile Electronics
Lithium Consumption by end use

- Batteries: 20%
- Ceramics and glass: 37%
- Other: 10%
- Pharmaceuticals: 2%
- Rubber and thermoplastics: 3%
- Continuous casting: 5%
- Air treatment: 5%
- Aluminium: 7%
- Greases: 11%

Source: Roskill
Significant New Lithium Demand Growth

Major car makers are advancing electric cars
Power Grid Storage & Automobile
Lithium-ion is Battery of Choice
Displacing other battery chemistries

Source: Battery Association of Japan, Barclays Capital
Lithium – Near Term Growth Potential

- Demand from Batteries
- Other Demand Sources

2000

- 71,000 T LCE

2008

- 118,600 T LCE

2020

- Est. 400,000 T LCE*

Li$_2$CO$_3$ = LCE (Lithium Carbonate Equivalent, 5.323 x Li)

*Estimate based on 5% market growth and 10% EV adoption rate over 10 years.
Washington Support for Lithium-ion
$2.4 Billion Stimulus Funding for Lithium Batteries

“New plug-in hybrids roll off our assembly lines, but they will run on batteries made in Korea. Well I do not accept a future where the jobs and industries of tomorrow take root beyond our borders – and I know you don’t either. It is time for America to lead again(524,159),(874,288),”

President Obama.
Potential Growth in U.S. Domestic Market

By 2013 demand capacity for battery grade lithium in the U.S. is forecast to rise to 30,000 tonnes LCE per annum.

<table>
<thead>
<tr>
<th>Company</th>
<th>Millions of Stimulus Funding Awarded</th>
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</thead>
<tbody>
<tr>
<td>JCI &amp; SAFT</td>
<td>$394 (2 plants)</td>
</tr>
<tr>
<td>A123</td>
<td>$249</td>
</tr>
<tr>
<td>Dow Kokam</td>
<td>$161</td>
</tr>
<tr>
<td>Compact</td>
<td>$151</td>
</tr>
<tr>
<td>Enerdel</td>
<td>$118</td>
</tr>
</tbody>
</table>

Stimulus funded U.S. battery plants requiring 20,000 – 30,000 tonnes of LCE in total annually under construction now

*Source: DOE for funding and Western Lithium estimates for LCE requirements.
Pegmatite

Spodumene
Brines
Hectorite Clay
World Lithium Resources – by development plans

Source: Roskill Information Services Ltd., R. Keith Evans, National Research Council and Western Lithium estimates. Estimates are not NI 43-101 compliant.
## Lithium Supply – Top Producers

<table>
<thead>
<tr>
<th>Producer</th>
<th>Location</th>
<th>2008 Production (tonnes LCE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQM</td>
<td>Chile</td>
<td>32,600</td>
</tr>
<tr>
<td>Talison</td>
<td>Australia</td>
<td>28,200</td>
</tr>
<tr>
<td>Rockwood</td>
<td>Chile</td>
<td>22,500</td>
</tr>
<tr>
<td>FMC</td>
<td>Argentina</td>
<td>16,600</td>
</tr>
<tr>
<td>Various</td>
<td>China (Total)</td>
<td>9,900</td>
</tr>
<tr>
<td>Rockwood</td>
<td>USA</td>
<td>3,700</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>5,100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>118,600</strong></td>
</tr>
</tbody>
</table>

Source: Roskill 2009  
Lithium Carbonate Equivalent (LCE)
Lithium Production by Country

Source: Roskill
THE SAUDI ARABIA OF LITHIUM

THE GAS ENGINE MADE PETROLEUM THE WORLD’S BIGGEST COMMODITY. THE ELECTRIC CAR COULD DO THE SAME FOR THE THIRD ELEMENT ON THE PERIODIC TABLE. BY BRENDAN V. TOOLENER

INTRIGUED BY THE PICTURE OF THE SALAR DE ATACAMA, THE ancient Chilean lake shown below, and its north of Santiago may be the best place on Earth to tap lithium, a wonderland strewn with salt-enriched rocks that make one question the annihilation of the world. Lithium is brought from its lake in career type of a few kilometer. The natural water, lithium, with the high altitude, is heated above the freezing point of water, and is reacted with exposed rock to remove lithium and oxygen.
Atacama Salar - Chile
Lithium Carbonate Price

Source: Industrial Minerals. Lithium carbonate, del continental, USA large contracts, US$ per lb.
Lone Domestic Producer of Lithium Brine Nevada

Chemetall Foote Corp
Hectorite – The Next Source of Lithium?

• *Rare – first discovered in Hector, California*

• A magnesium, lithium silicate clay mineral (hydrated aluminum silicate)

• Member of the smectite group of clays – expanding lattice with exchangeable cations (Na, Ca, Mg, OH, K) where Li substitutes for Mg

• Unique physical properties: high viscosity, gel strength, temperature stability, color, suspension properties, rheology control - (paints, cosmetics, greases, coatings, drilling muds)

• Precipitated in a lake environment and associated with hydrothermal fluids rich in Mg & Li
Stage I (PCD) Lens
Potential Impediments to Domestic Resource Development

- Lack of Comprehensive Mineral Policy
- Potential Downside of Mining Law Reform
- Restrictive Regulations – Federal, State, Local
- Restrictive Mineral Access to Public Lands
- NIMBY Attitude
- Competing Land Uses
- Lengthy Regulatory/Permitting Environment