Expansion of Domestic Production of Lithium Carbonate and Lithium Hydroxide to Supply US Battery Industry

John Groves
Jeff Davis
Chemetall Foote Corp
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Overview
Expand Lithium Raw Material Base in US

Timeline
Start Date: April 14, 2010
End Date: February, 2013

Barriers
Geothermal Resource
Strength and Viability of Geothermal resource

Budget
DOE Share - $28.4 million
Rockwood Share - $39.5 million

Partners
Engineering: BE&K® (a KBR company)
Environmental Assessment: Nevada Bureau of Land Mgmt
Relevance: Domestic Source of Strategic Materials

• Objectives

– Expand domestic lithium carbonate and lithium hydroxide production to supply the US electric drive automotive market.

– Deliver high quality lithium products to battery component manufacturers to produce high quality lithium ion batteries.

– Create construction jobs over the first two years in the US and permanent jobs for production of lithium raw materials.

– Stimulate the US economy with worthwhile long term benefits that will support the conversion to electric drive mobility.
Relevance: Domestic Source of Strategic Materials

- **Milestones**
  - Deliver battery grade lithium products to the DOE and component manufacturers in 2012 from this project.
  - Maintain the long term viability of domestic production of lithium raw materials by lowering operating cost and at the same time reducing fossil fuel based energy consumption.
  - Job Creation throughout 2010-2012 for engineering and construction peak at over 100 workers and 35 permanent Chemetall Foote positions.
  - Stimulate the US economy with nearly $70 Million in direct spending over the three year period.
Relevance: Job Creation

- **Construction**
- **Engineering**
- **Production**
  - Permanent 37

KM Hydroxide Startup Q1 2012, Silver Peak Q1 2013

Month / Year

# of People Directly Employed
Relevance: Economic Stimulus

Direct Spending (not including peripheral effect)
Approach: Expand Domestic Production of Key Lithium Raw Materials

Clayton Valley
Silver Peak, Nevada
Lithium Carbonate Production

Kings Mountain, NC
Lithium Hydroxide Production
Approach: Lithium Carbonate Expansion
Solar Evaporation Ponds in Silver Peak, Nevada
Approach: Lithium Carbonate Expansion

- Expand lithium carbonate plant in Nevada using green technology.
  - Expand use of solar energy used to evaporate water and concentrate lithium in brine.
  - Install a new geothermal power plant to provide electricity for pumping and processing lithium brines and conversion into lithium carbonate.
  - Create the greenest lithium carbonate plant in the world with an energy usage of 99+ % solar and geothermal.
  - Technical barrier is geothermal viability. Exploration will determine whether sufficient resource is available. Early indications are favorable.
  - Go/no-go decision on geothermal in 2011 based on resource temperature and flow.
  - Environmental assessment of geothermal production currently underway in joint effort between Chemetall Foote, DOE and Nevada BLM.
Approach: Geothermal Power Plant

4.0 MW Net Binary Condensing Steam Plant Schematic

PRODUCTION WELLS
$T_{b, in} = 121 \, ^{\circ}C$
2,500,000 lbs/hr

INJECTION WELL
$T_{b, out} = 65 \, ^{\circ}C$

CONDENSER

SINGLE STAGE TURBINE

VAPORIZER

FREHEATER

WORKING FLUID PUMP

FEED PUMP

GENERATOR

EXISTING HEAT SINK

(LITHIUM PRODUCTION)

55\(^\circ\) F WET

5,000 kW Gross Output
- 227 kW Prod. Well Pump
- 227 kW Inj. Well Pump
- 150 kW CW Pumps
- 10 kW Cooling Fans
- 355 kW Feed Pumps
- 30 kW Misc. Loads
4,011 kW Net Output

note: 20% parasitic electrical load

Chemetall ...the Lithium company

ROCKWOOD
Approach: Geothermal Power Plant

Results of Geotechnical Evaluation

- Fractured zones (fault lines) identified
- Blue = rock
- Red = brine

![Diagram showing geothermal lease area and key features]
Approach: Lithium Hydroxide Plant

• Kings Mountain Lithium Hydroxide Plant will use best available technology developed by Chemetall Foote.

• Combination of purification techniques will provide battery grade lithium hydroxide for the automotive industry.

• Key parameters are low variability, low concentration of contaminants.

• Major milestones are start of construction late 2010 and startup early 2012.
Technical Accomplishments and Progress

• Project Approved April 14, 2010.
• Lithium Hydroxide Basic and Detailed Engineering Nearly Complete
• KM Major equipment ordered
• KM Pre-construction demolition 95% complete
• Geotechnical evaluation completed at Silver Peak shows high feasibility for geothermal power plant
• Drill Rig, Salt Harvester and other main equipment purchased
• Overall Spending nearly $10 Million of $70 Million forecast
Kings Mountain Plant February 2011
Silver Peak Well Drill Rig February 2011
Collaborations/Partnerships

• Engineering to date has been primarily in conjunction with BE&K (a KBR company located in Birmingham, AL).

• Environmental assessment for Geothermal is a joint effort by DOE, Chemetall Foote and the Nevada BLM.
### Completed and Future Work

**2010**
- Completed basic engineering Lithium Hydroxide, purchased major equipment, began preparation for construction
- Completed exploration for Silver Peak Geothermal and reach first go/no-go point on resource viability
- Complete drilling and pond expansion for Silver Peak lithium carbonate expansion

**2011**
- Complete construction of lithium hydroxide plant
- Drill observation and production wells for geothermal plant and reach second go/no-go point
- Complete lithium carbonate expansion

**2012**
- Start up lithium hydroxide plant
- Build geothermal power plant
Summary

• Objective: Supply key raw materials to lithium battery industry and create jobs and support stimulus of US economy.

• Relevance: Chemetall Foote is only domestic supplier to lithium battery industry and is expanding operations.

• Approach: Lower costs and improve technology to enhance ability to be long term supplier to industry.

• Milestones: Geothermal plant go/no-go feasibility decision point reached in 2011 but other portions of project are low risk – proven technologies being implemented.

• Timeline: All projects implemented between first quarter 2012 and first quarter 2013.