Recovery Act: Nanoengineered Ultracapacitor Material Surpasses the $/kW Threshold for Use in EDV's

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EnerG2

May 16, 2012

ARRAVT011

Overview

Design and build a factory for large-scale production of nano-engineered carbon materials

Timeline

- **Start**: April 2010
- **Target End**: May 2012
- ~99% Percent complete

Challenges

- **Phase I**: Finalize process design for scale
- **Phase II**: Ensure on time delivery of processing equipment
- **Phase III**: Resolve uncertainties surrounding a complex construction project
- **Phase IV**: Fine-tune process and equipment parameters

Budget

- **DOE Share**: $21.3 million
- **EnerG2 Share**: $7.4 million
- **Capital**: 77%
- **Operating**: 23%

Key Partners

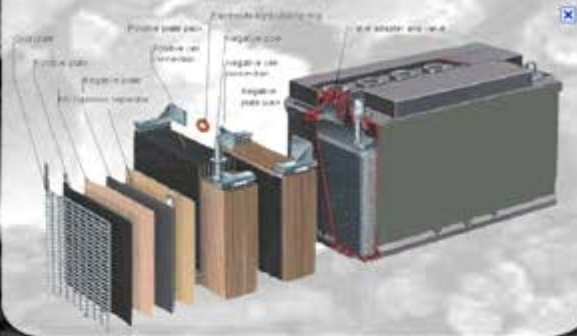
- **Preliminary Design**: CH2M Hill, Portland, OR
- **Construction**: Fisher & Sons, Burlington WA
- **Processing Equipment**:
  - Oregon Freeze Dry, Albany, OR
  - Harper Int'l, Lancaster, NY
  - Procedyne, New Brunswick, NJ

Relevance

Engineered Carbon is the Key to Energy Storage

Ultracapacitor Electrodes

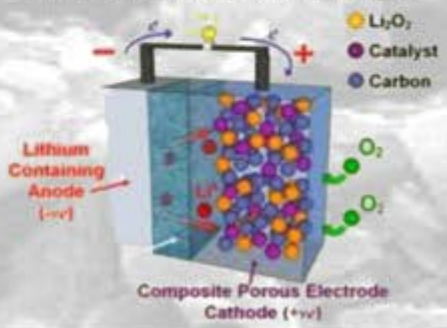
Advanced Lead Acid Electrodes



Electrochemical Performance Depends on High Purity and Optimized Nanostructure

Improved Li-ion Anodes

Advanced Li Chemistries



Relevance

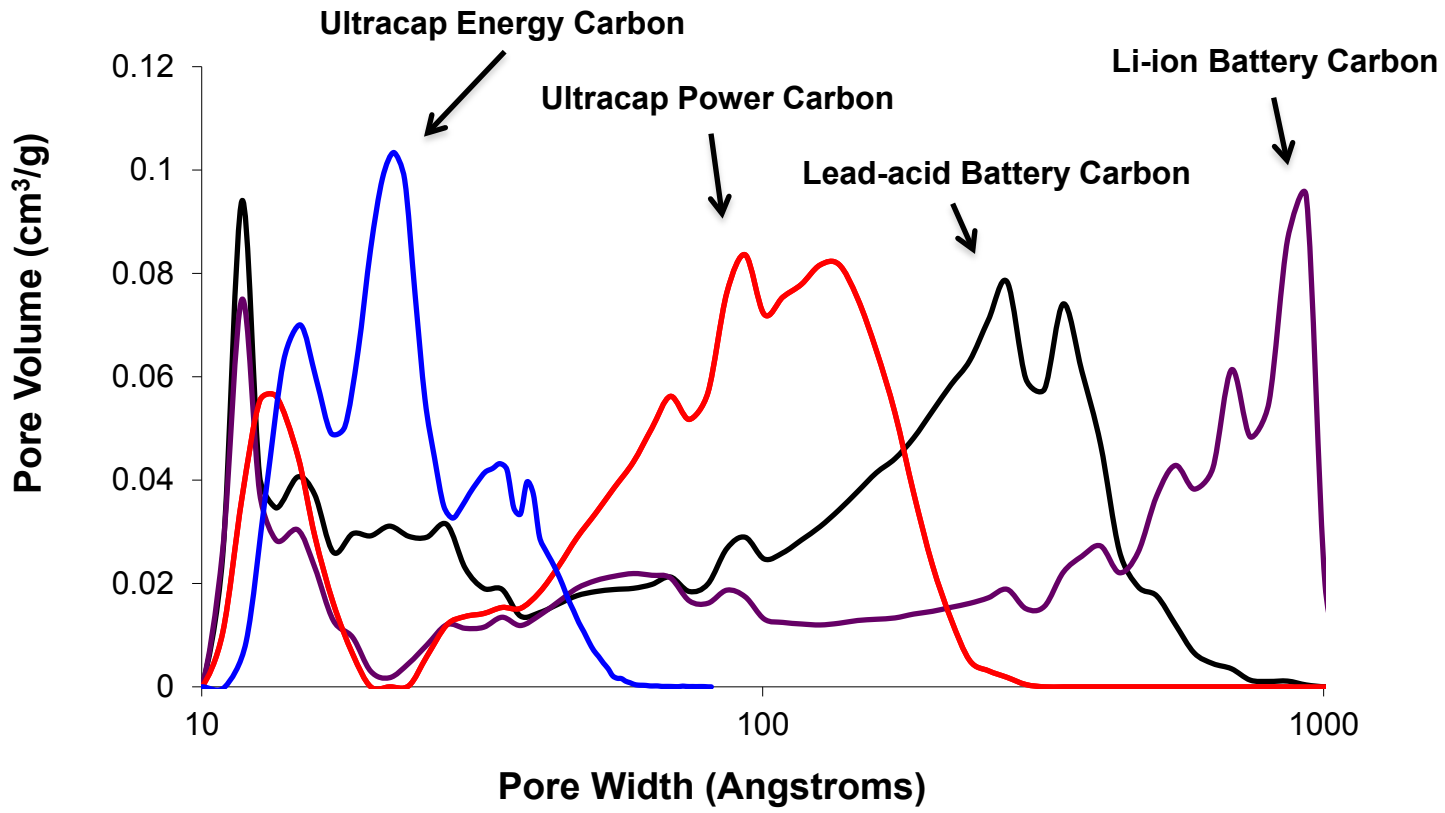
- **Technical Advancements and Unique Capabilities**
  - EnerG2 V2- and P2-Series Electrode Carbon will result in a new generation ultracapacitors with significantly higher power density and much lower $/kW
  - EnerG2 M2-Series Carbon Additives will dramatically improve the cycle life and charge acceptance of Lead Acid Batteries
  - Reducing the initial costs, vehicle efficiency, the total cost of ownership of Electric Drive Vehicles and Hybrid Vehicles while simultaneously improving vehicle performance and overall consumer affordability
  - At full scale, the plant will produce enough electrode carbon to supply production of 60,000 EDVs annually

- **Job Creation and Economic Growth**
  - 210 construction jobs were staffed in the Albany, Oregon area during the design, procurement and construction phases of this project.
  - 10 Full Time Employees are already employed at the facility.
  - In Phase I, which was funded by the DOE, headcount in the factory is expected to be at least 35 full-time employees
  - In Phase II, which will occur in 2013 and 2014, EnerG2 expects to add over 40 additional operators to payroll.

Relevance:

Tuned Pore Structures

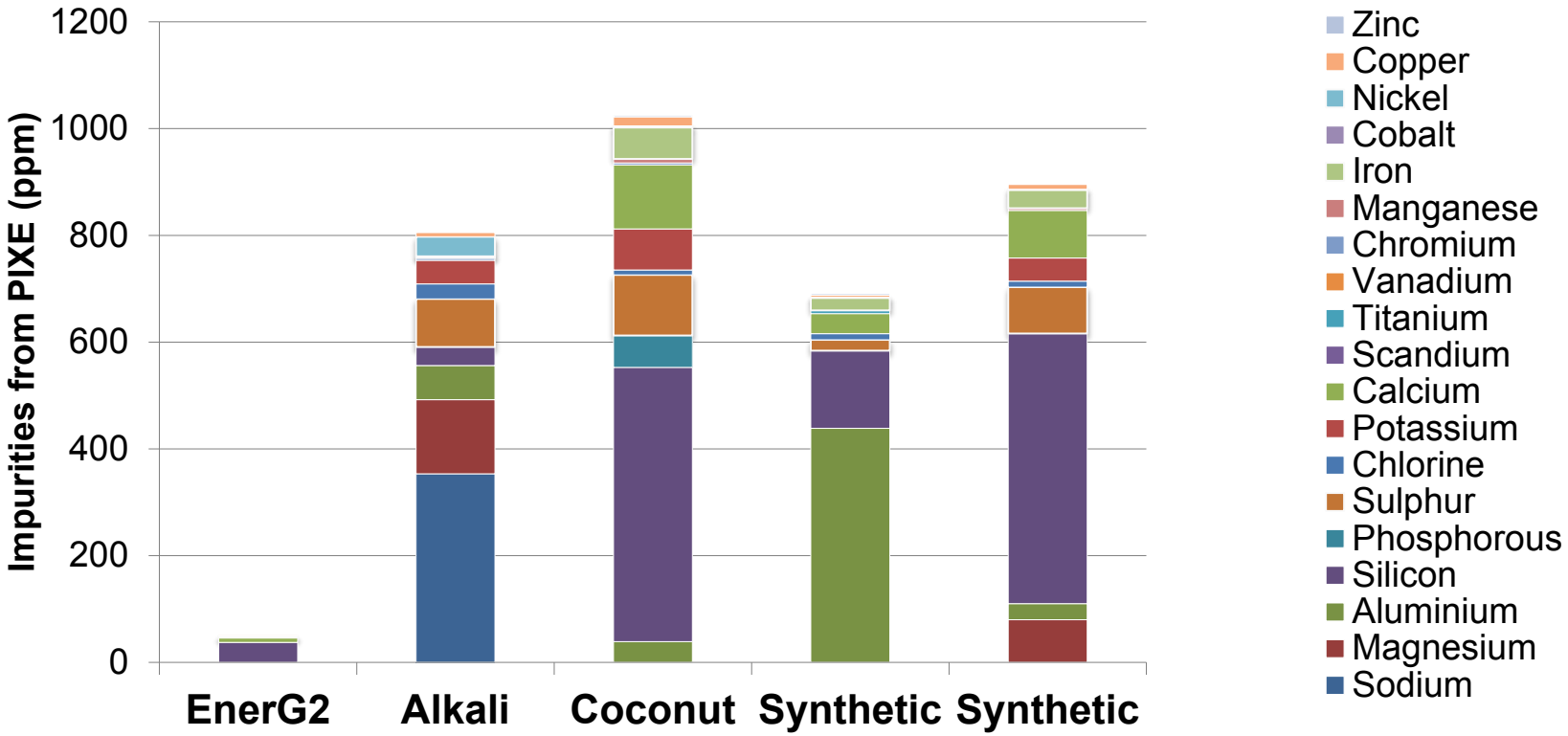
We have the unique ability to tune the pore structure of the precursor and maintain that structure during manufacturing:



Relevance:

Unrivaled Purity

EnerG2 carbon has less than 1/20th of the impurities that are found the best commercial carbons:



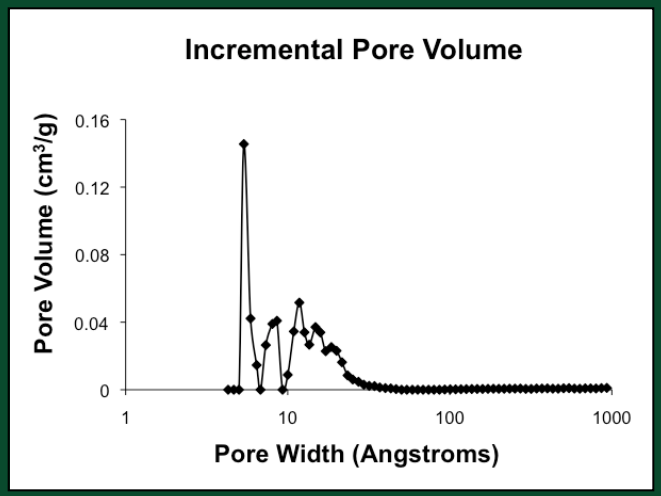
Relevance:

Ultracapacitor Electrodes for EDV and HEV applications

V2 Series

Unrivaled combination of energy density & stability

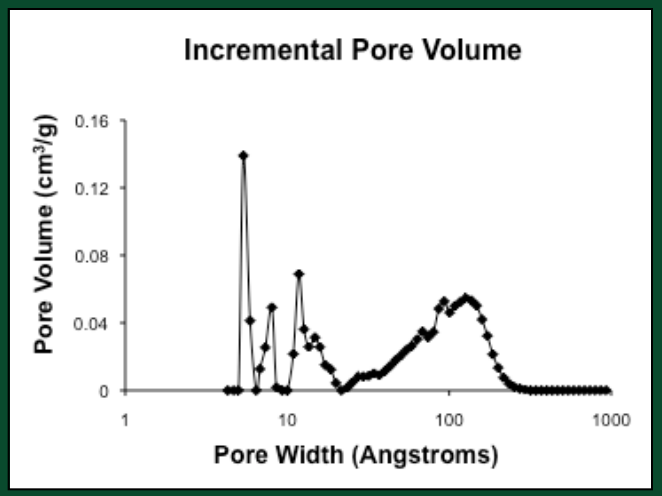
- High volumetric capacitance
- Improved durability / voltage stability
- Low surface functionality



P2 Series

Unmatched stability and power performance in any temp. range

- Superior frequency response
- Lowest resistance
- Superior low temp performance
- Low surface functionality



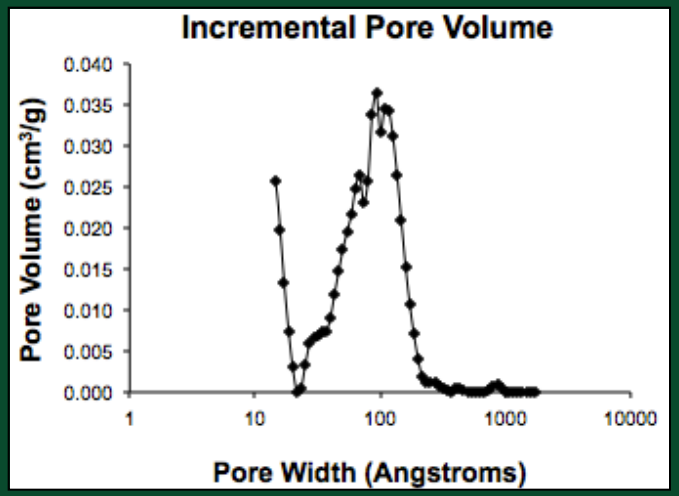
Relevance:

Lead Acid Batteries for Micro HEV applications

M2-23 Series

Highest performing in power, charge acceptance, and cycle life

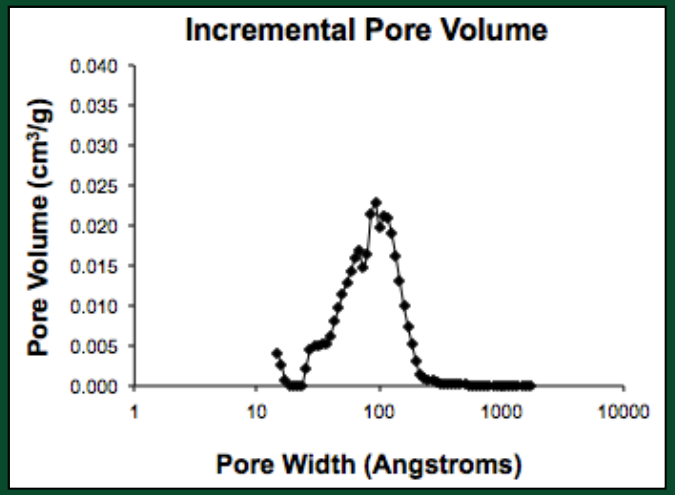
- Micro and meso pore volume
- Highest charge acceptance
- Longest PSoC cycle life
- Low impurities = low gassing



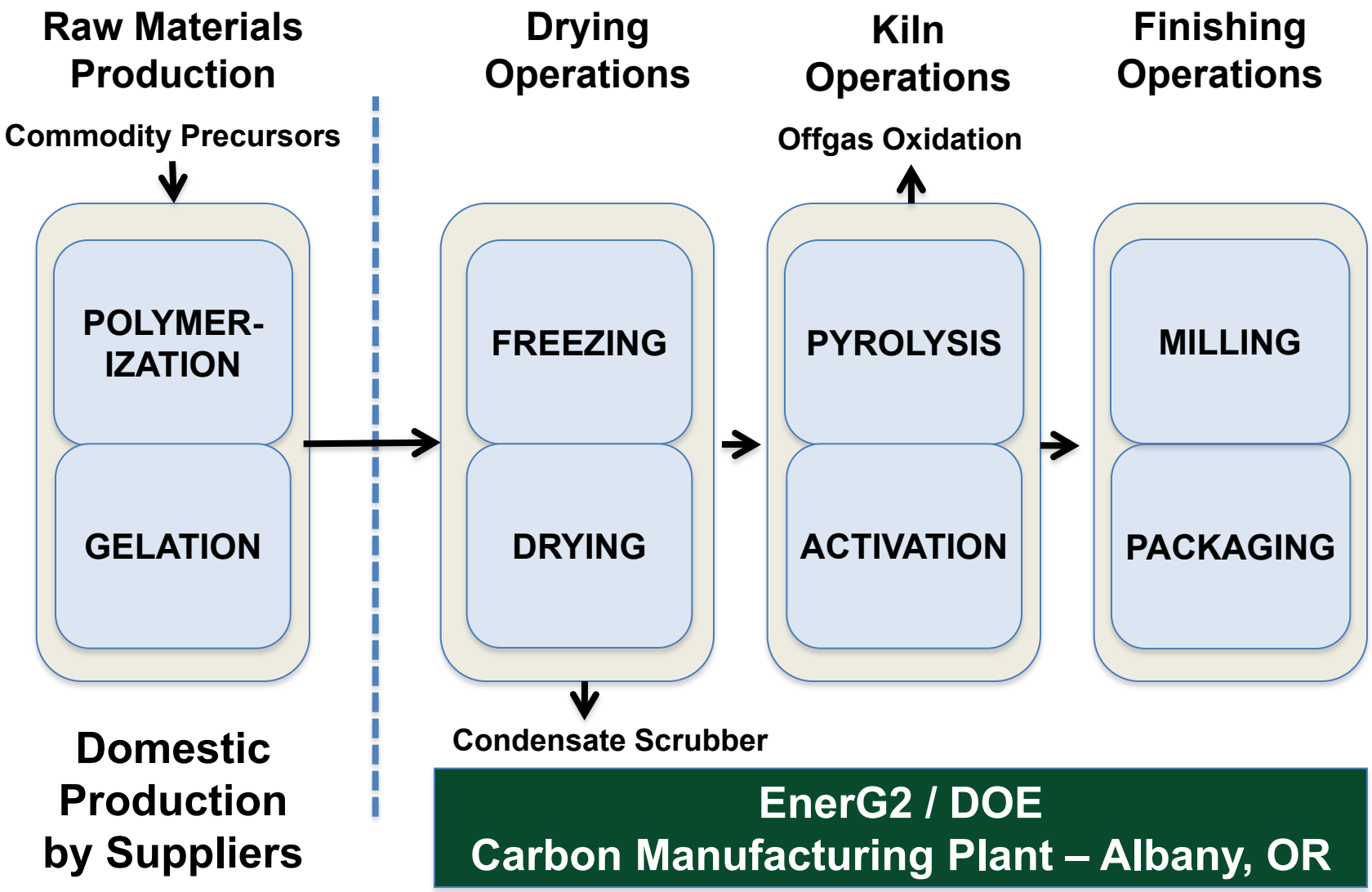
M2-33 Series

Match of power performance and cost effectiveness

- High mesopore volume
- Increased charge acceptance
- Increased power delivery
- Low impurities = low gassing



Approach


Raw Materials Production
Drying Operations
Kiln Operations
Finishing Operations
Commodity Precursors
Offgas Oxidation
POLYMER-IZATION
GELATION
FREEZING
DRYING
PYROLYSIS
ACTIVATION
MILLING
PACKAGING
Condensate Scrubber
Domestic Production by Suppliers
EnerG2 / DOE
Carbon Manufacturing Plant – Albany, OR

Approach: Milestone Status

Milestone	Status	Comments
Phase I – Design		
1.1 – Project Management and Planning	99%	Expected project completion: May 31, 2012.
1.2 – Confirm building site selection	100%	**Complete**
1.3 – Building and process design	100%	**Complete**
1.4 – Subcontractor selection	100%	**Complete**
1.5 – Begin long-lead time equipment procurement	100%	**Complete**
1.6 – Begin environmental permitting process	100%	**Complete**
Phase II – Procurement & Mobilization		
2.1 – Begin equipment procurement for all systems	100%	**Complete**
2.2 – Manage building retrofit and upgrades	100%	**Complete**
2.3 – Continue environment permitting process	100%	**Complete**
Phase III – Construction		
3.1 – Continue building construction	100%	**Complete**
3.2 – Receive and install equipment for all systems	100%	**Complete**
3.3 – Utilities connections	100%	**Complete**
3.4 – Safety systems installed	100%	**Complete**
3.5 – Environmental permitting complete	100%	**Complete**
3.6 – Initiate personnel recruitment and HR systems	100%	**Complete**
3.7 – Develop Plant Operating Procedures	100%	**Complete**
3.8 – Develop full QA/QC program	100%	**Complete**
Phase IV – Startup		
4.1 – Startup Operations	99%	Expected completion: May 31, 2012.
4.2 – Complete personnel recruitment	100%	**Complete**
4.3 – Integrate QC processes into operations	99%	Expected completion: May 31, 2012

Accomplishments

- Projected Job Creation Timeline (all in Oregon)

Current	Dec-2012	Jun-2013	Dec-2013	Jun-2014
11	24	41	53	65

- Groundbreaking held August 10, 2010
- Ribbon Cutting held February 13, 2012 (18 months later)

Accomplishments

Production Facility Now Online

Collaborators

Partner	Role on Project
CH2M Hill (Portland, OR)	Preliminary design and scale-up engineering; material handling systems
Fisher & Sons, Inc. (Burlington, WA)	Detailed design and construction, equipment installation
Oregon Freeze Dry (Albany, OR)	Design and engineering of freeze drying equipment
Harper International (Lancaster, NY)	Engineering and production of pyrolysis kiln systems
Procedyne (New Brunswick, NJ)	Engineering and production of activation kiln systems
Jet Pulverizer Co. (Moorestown, NJ)	Engineering and production of milling systems

Future Work

	Phase I – DOE funded Albany Operations	**Phase II –** Expansion within Albany Plant	**Phase III –** Modular Scale-up(Location TBD)
Likely Timing	**Project complete**; operations online Q1 2012	Additional equipment installed throughout CY 2012 & 2013	2015, depending on customer demand and pipeline
Total Capacity	20-30 MTs / month	100-120 MTs /month	500-1,000 MTs / month
Revenue : CapEx	1 : 1	2 : 1	5 : 1
Total Job Creation	35 FTEs	80 FTEs	Hundreds of FTEs

Summary

- Game-changing material will rapidly enhance energy storage technologies
- ARRA funds have helped to create a new industry in the United States
- New factory creating significant of jobs and industrial growth in a region suffering from acute unemployment
- Cadre of domestic suppliers kept the project on time and on budget and will continue to supply after facility start-up
- First products produced in Q1 2012; company is commencing growth phase