Recovery Act: Nanoengineered Ultracapacitor Material Surpasses the $/kW Threshold for Use in EDVs

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ARRAVT011

Overview

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

Timeline

- **Start**: April 2010
- **Target End**: March 2012
- ~35% 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 Will Be the Key to Energy Storage

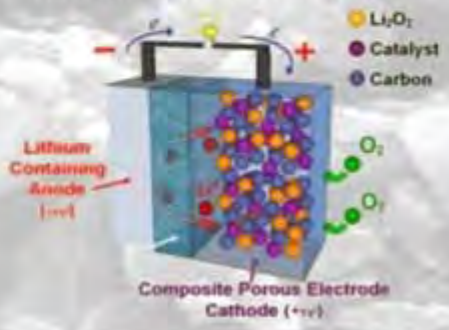
Ultracapacitor Electrodes

Advanced Lead Acid Electrodes

Electrochemical Performance Depends on High Purity and Optimized Nanostructure

Improved Li-ion Anodes

Advanced Li Chemistries



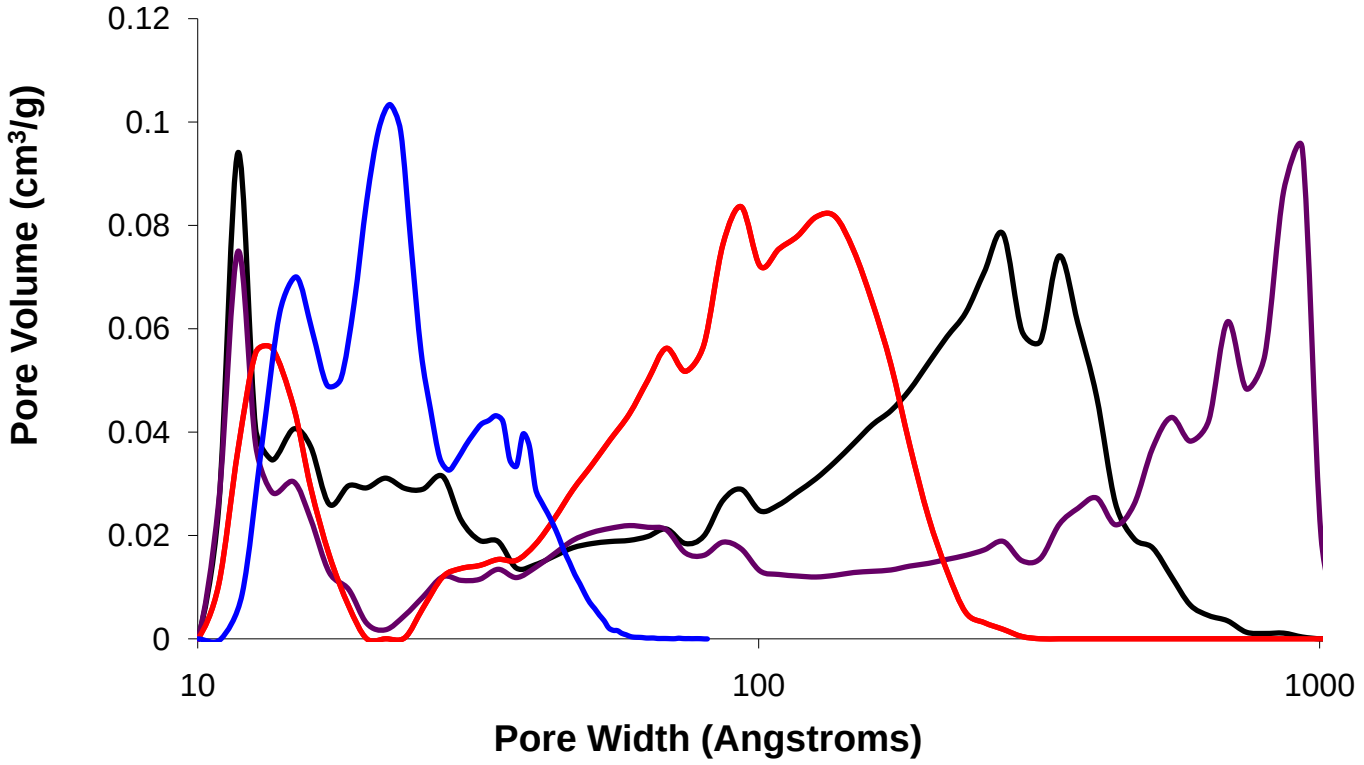
Relevance

- **Technical Advancements and Unique Capabilities**
  - EnerG2 NC-Series Electrode Carbon will result in a new generation ultracapacitor with significantly higher power density and much lower cost per kW
  - Enable the combining of ultracapacitors and batteries in EDVs to reduce capital and battery replacement costs while improving mileage efficiency and vehicle performance
  - The plant, when complete, will produce enough NC-Series electrode carbon to supply production of 60,000 EDVs annually
- **Job Creation and Economic Growth**
  - At least 50 jobs will be created or sustained in the Albany, Oregon area during the design, procurement and construction phases of this project.
  - Once the manufacturing facility is up and ready for production, it will employ at least 25 full-time positions to operate the facility.
  - When the plant is at full capacity, the headcount in the factory is expected to be at least 35 full-time employees with potentially more as final detailed designs are completed.
  - Expansion will further accelerate high-quality job creation

Relevance:

Tuned Pore Structures

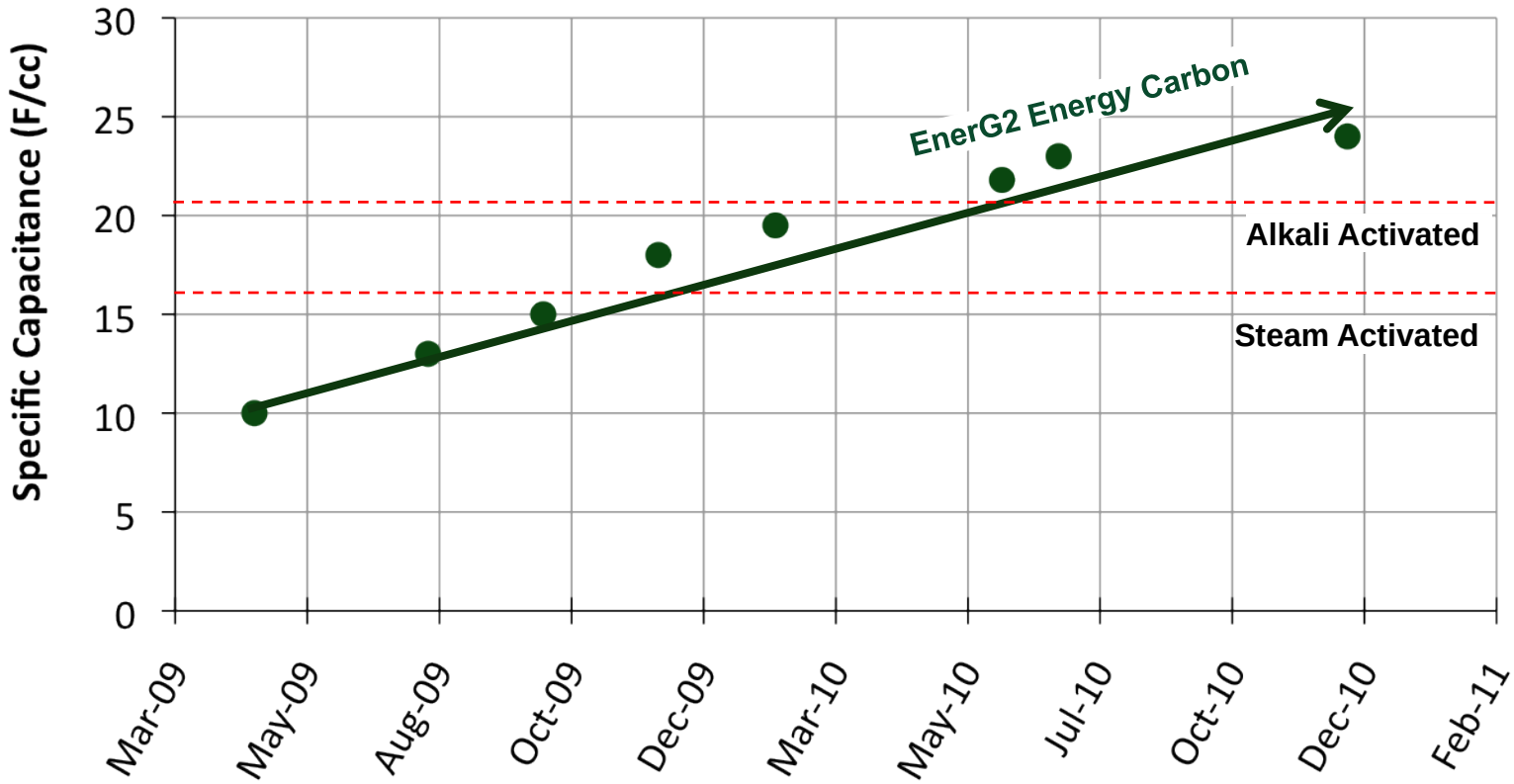
We have the unique ability to tune the pore structure of the precursor and maintain that structure during manufacturing:



Relevance:

Rapid Improvement

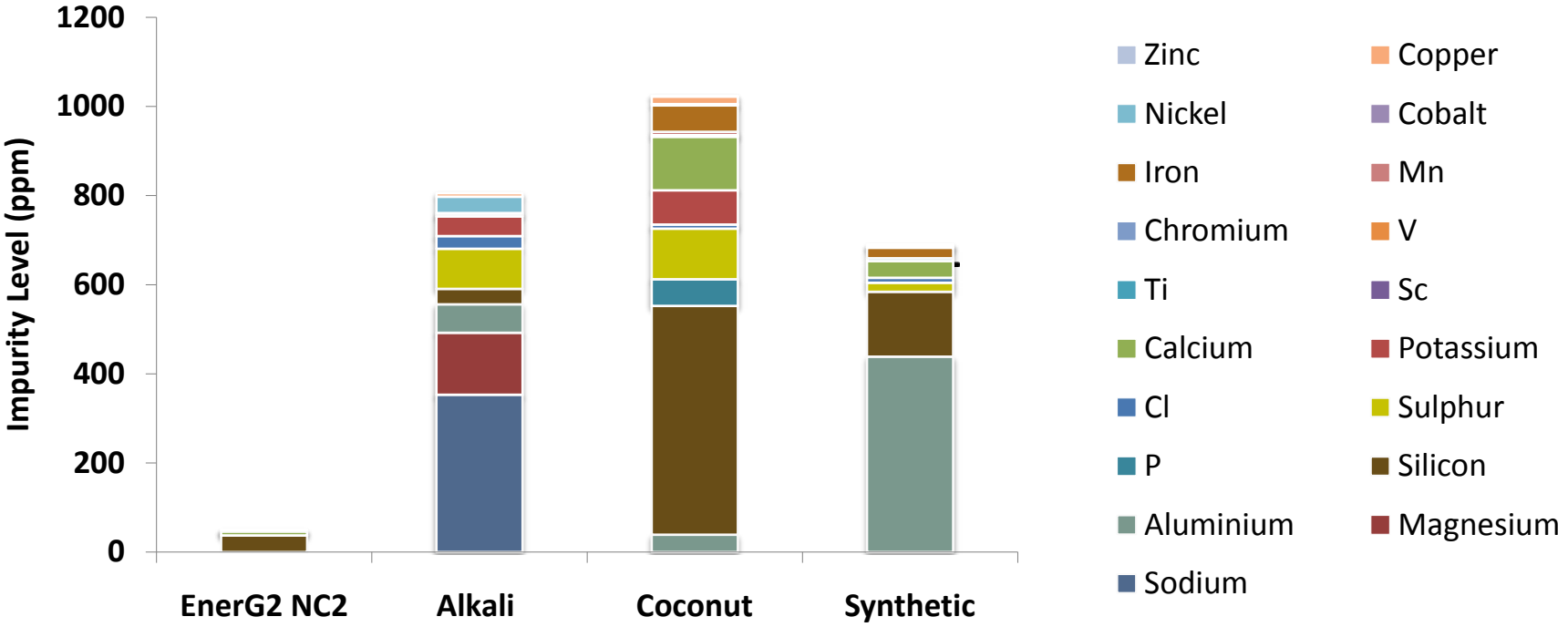
Our ability to engineer carbon pore distribution has enabled rapidly improved performance in our ultracapacitor carbon:



Relevance:

Unrivaled Purity

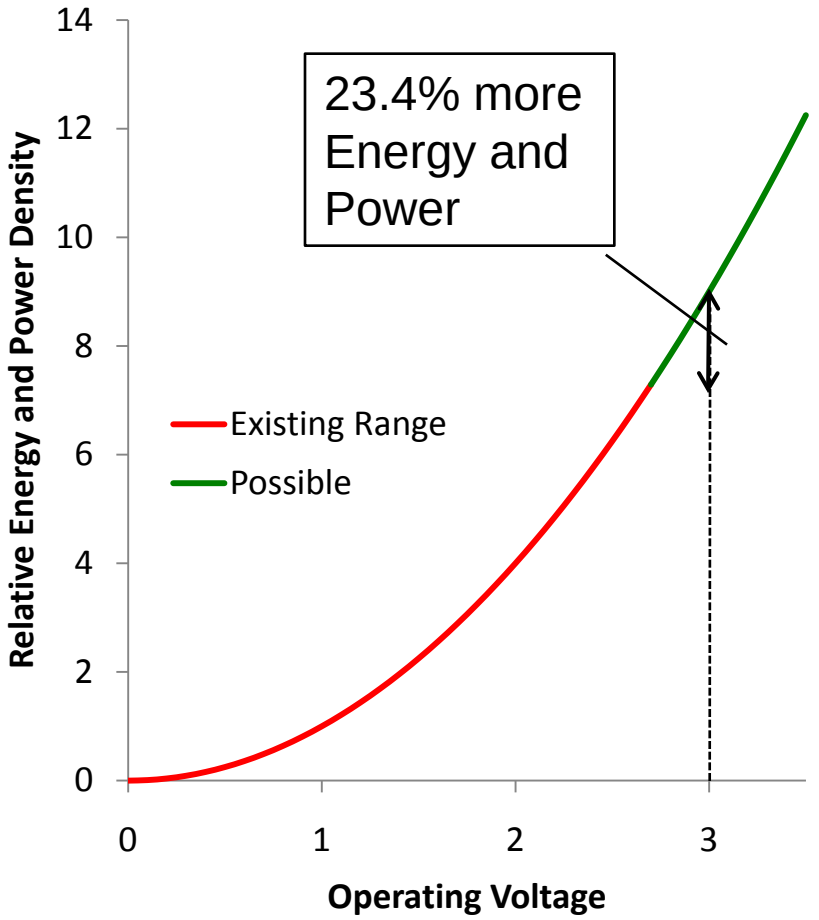
Because we start with pure precursors, EnerG2 carbon has less than 1/10th of the impurities that are found in other activated carbons.



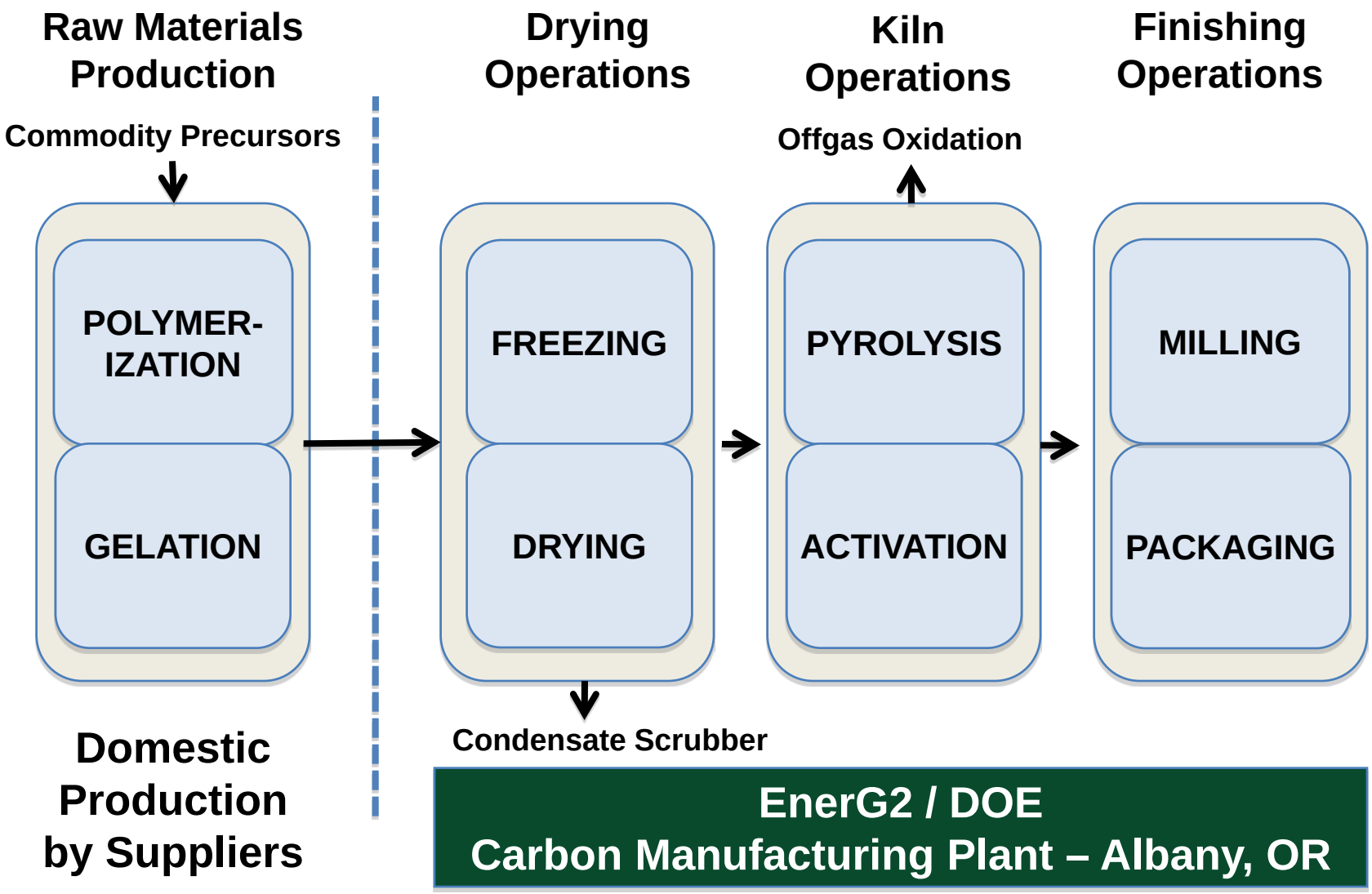
Relevance:

Exponential Storage

- Energy and Power increase with voltage squared
- Operating voltage is maxed at 2.7V for automotive
- Transition from 2.7 to 3.0V yields 23.4% increase in energy and power
- Transition to Li-ion V (3.7V) would nearly double energy and power density



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: Timeline

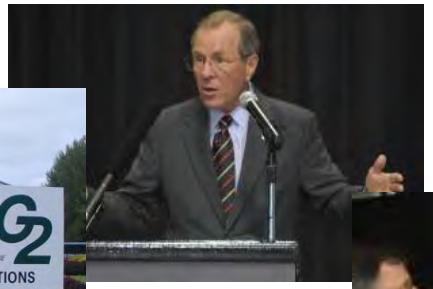
Task	Critical Path?	Start Date	End Date
Phase I – Design			
1.1 – Project Planning and High-Level Design		4/1/2010	11/28/2011
1.2 – Site Acquisition		4/1/2010	4/21/2010
1.3 – Select Design / Build Firm		10/22/10	3/4/2011
1.4 – Finalize Detailed Process Design		2/21/10	2/18/2011
1.5 – Sign Construction Contract		1/1/2011	3/31/11
1.6 – Begin Environmental Permitting Process		5/3/2010	6/7/2011
Phase II – Procurement & Mobilization			
2.1 – Equipment Procurement	√	Q4 2010	7/1/2011
2.2 – Mobilize Building Construction		4/6/2011	6/19/2011
2.3 – Submit Building Permit Applications		3/21/2010	6/19/2011
Phase III – Construction			
3.1 – Initiate Building Construction		6/6/2011	6/19/2011
3.2 – Receive and Install Equipment	√	8/12/2011	12/31/11
3.3 – Connect Utilities Connections		4/20/2011	6/20/2011
3.4 – Install Safety Systems	√	7/15/2011	12/31/2011
3.5 – Environmental & Occupancy Permits Issued	√	8/12/2011	8/12/2011
Phase IV – Startup			
4.1 – Operations Personnel Recruited		8/12/2011	1/31/2012
4.2 – Develop Plant Operating Procedures		9/1/2011	12/31/2011
4.3 – Develop Full QA / QC Program		9/1/2011	2/28/2011
4.4 – Test and Commence Operations		12/31/2011	3/1/2012
START OF PRODUCTION		**Q1 2012**	

Accomplishments

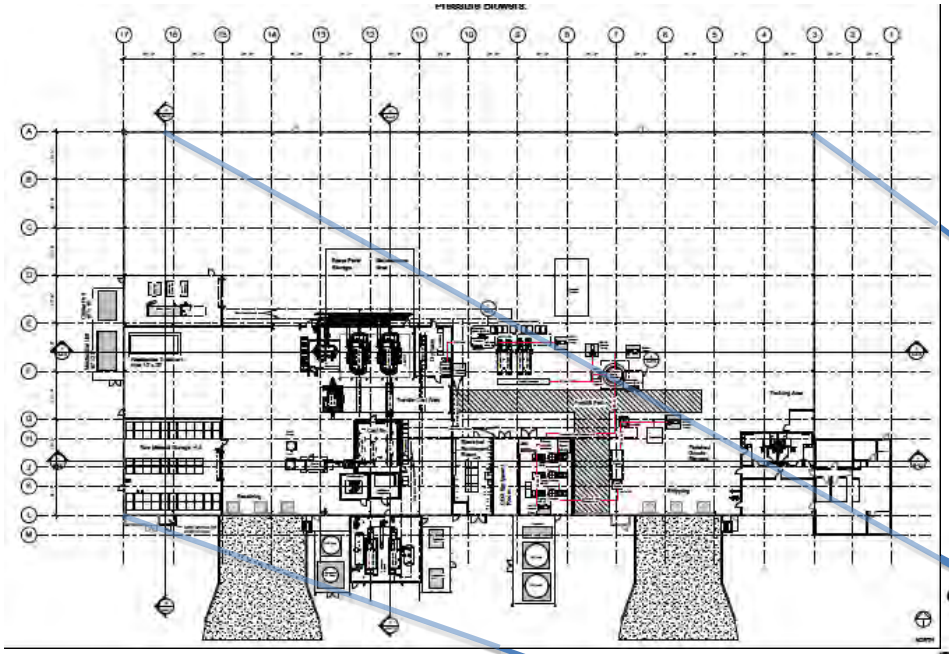
- Projected Job Creation Timeline (all in OR)

Current	Q2 2011	Q3 2011	Q4 2011	Q1 2012
3	6	14	20	35

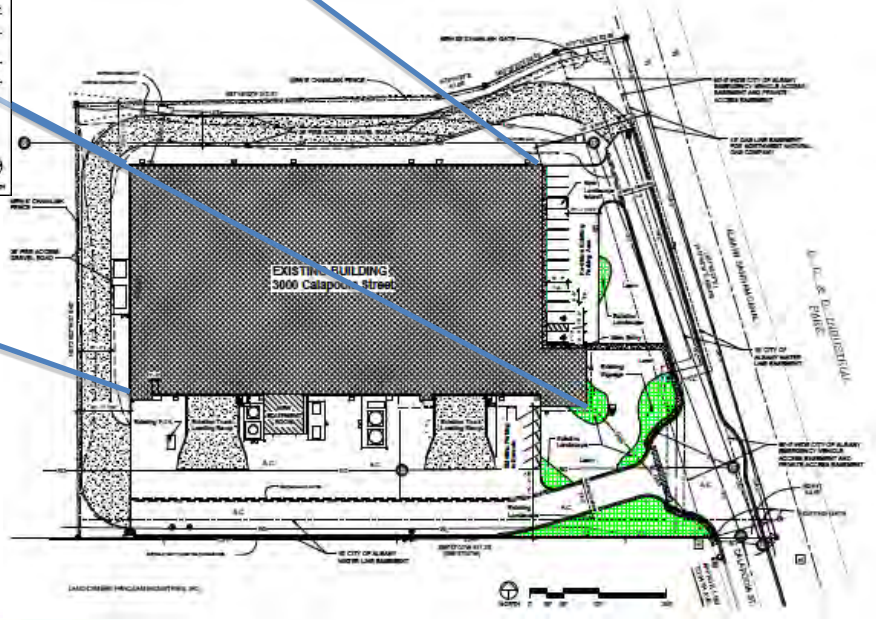
- NEPA Complete; FONSI issued April 7, 2010
- Groundbreaking held August 10, 2010



Accomplishments

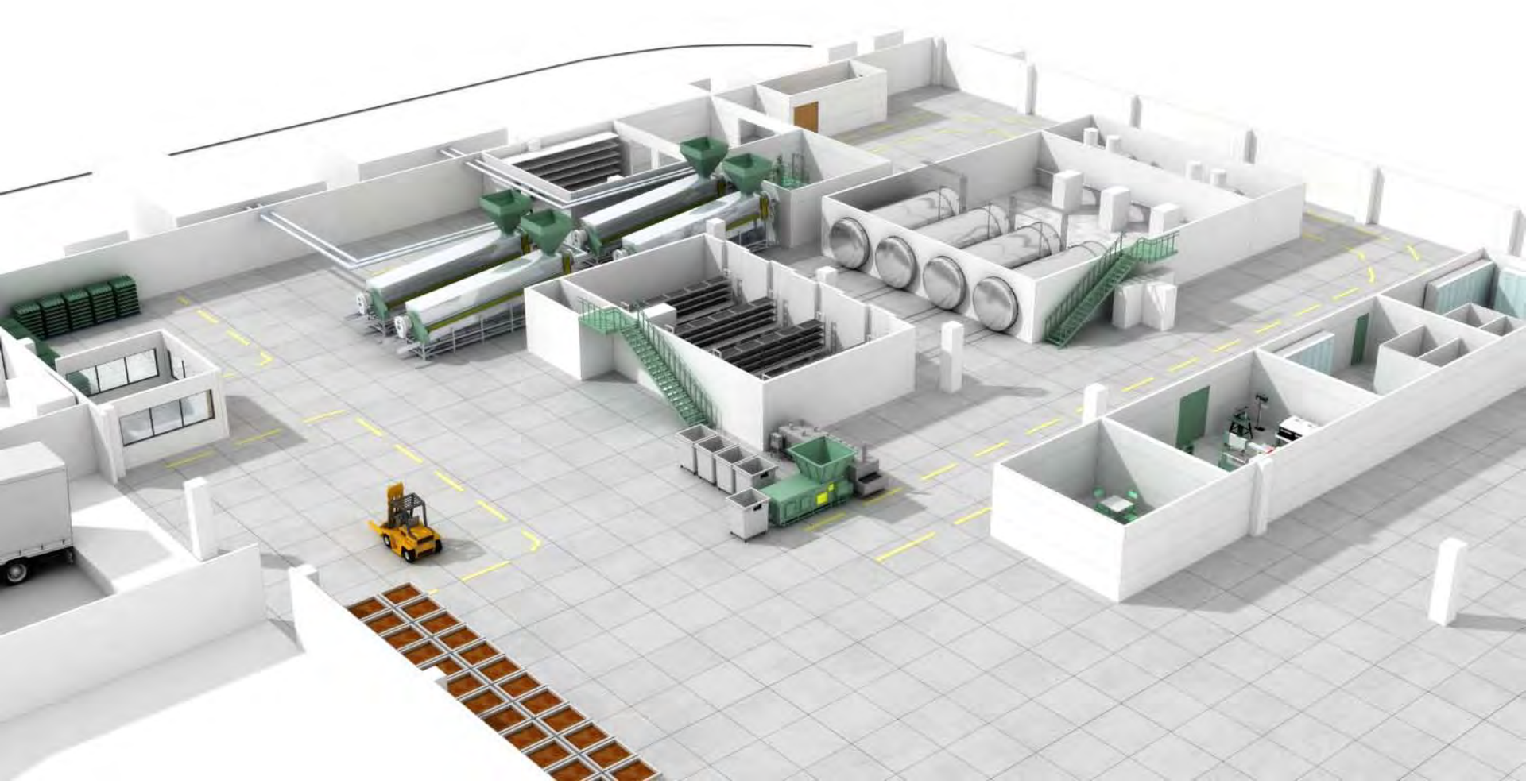


Design Complete April 2011



Site Acquired April 2010

Accomplishments



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)	Engineering, production and installation 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 II – Equipment Procurement and Design Finalized	**Phase III –** Construction	**Phase IV –** Start-up
Likely Timing	January 2011 through May 200	April 2011 through December 2011	January & February 2012
Key Activities	• Design, specify and procure all processing equipment • Complete process and material handling design to guide construction decisions	• Hire subcontractors • Mobilize for construction • Demolition • Construction • Equipment installation • Secure occupancy permits • Hire initial contingency of operators	• Tune equipment for specified process parameters • Hire all remaining operations personnel • Finish quality documentation and SOPs; train employees • Commence operations

Summary

- Game-changing material will rapidly enhance energy storage technologies
- ARRA funds are helping to create a new industry in the United States
- New factory will create significant number of jobs and industrial growth in a region suffering from acute unemployment
- Cadre of domestic suppliers are helping to keep the project on time and on budget
- First products scheduled to be produced in Q1 2011, if not before