Establish and Expand Commercial Production of Graphite Anode Materials for High Performance Lithium-ion Batteries

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May 11, 2011

Project ID: ARRAVT012

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Overview

Timeline

- Project start date – August 2010
- Project end date – March 2012
- 70 Percent complete

Budget

- Total project funding- $27,625,429
  - DOE share-45.6%
  - Contractor share-54.4%

Barriers

- Retrofitting process into an existing manufacturing asset with different equipment than the ConocoPhillips' semi-works
- Process scale-up
- Very aggressive project timeline

Partners

- ConocoPhillips

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Key Objectives
Recovery Act – Electric Drive Vehicle Battery and Component Manufacturing Initiative

- Protect national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy
- Construction of U.S. based manufacturing plants to produce batteries and electric drive components
- To the greatest extent possible utilize domestically produced precursors
- Establish a successful business by leveraging other battery markets
- Stimulate the economy and create and retain jobs
- Cost-effective production to support introduction of electric drive vehicles
- Accelerate the development and production of various electric drive vehicle systems to substantially reduce petroleum consumption

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Relevance

- Protect national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy.
- The facility will produce 10,000,000 pounds per year of anode material, enough anode material to manufacture batteries for 2,000,000 hybrid-electric vehicles per year

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Relevance

Construction of U.S. based manufacturing plants to produce batteries and electric drive components.

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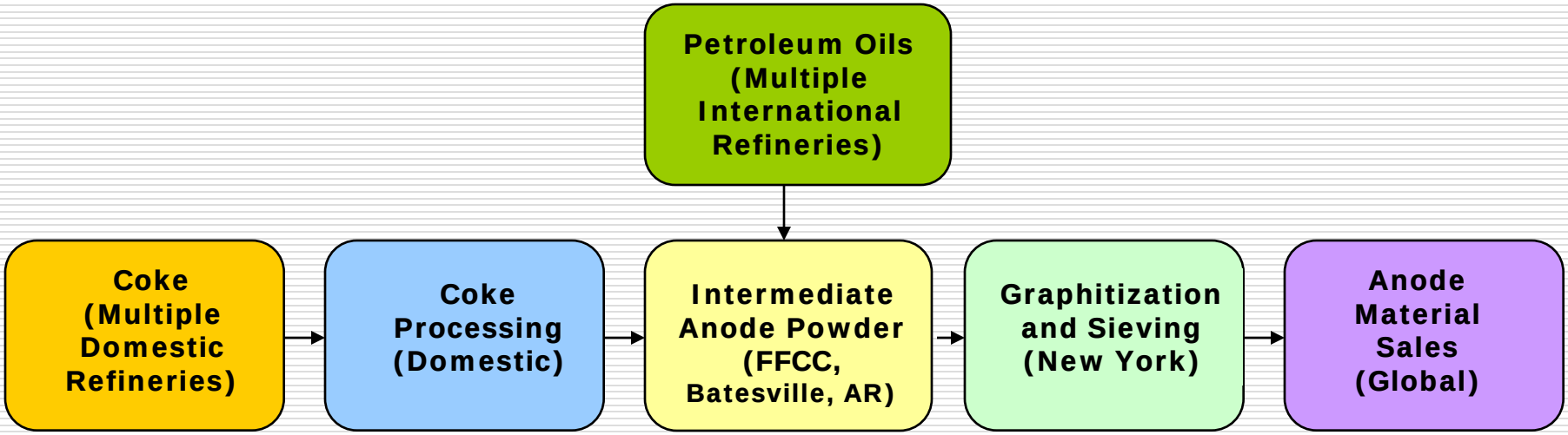
Relevance

To the greatest extent possible, utilize domestically produced precursors.



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Relevance

- Establish a successful business by leveraging other battery markets

- ConocoPhillips has six commercial anode materials
- ConocoPhillips' anode materials are currently being purchased by six cell and battery manufacturers and are qualified in multiple electric vehicle platforms
- ConocoPhillips' anode materials are utilized in power tools, defense, aerospace, hybrid-electric vehicles, and electric vehicles
- For the past several years ConocoPhillips has been supplying anode material from its semi-works facility in Ponca City, Oklahoma
- To meet demand, ConocoPhillips has increased the capacity of its semi-works multiple times and demand can no longer be met by debottlenecking

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Relevance

- Stimulate the economy and create and retain jobs

Construction

- >100 construction jobs
- >$4.8M equipment and material purchases

Commercial Production

- >30 permanent jobs in 2014

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Relevance and Approach

- Cost-effective production to support introduction of electric drive vehicles
- Accelerate the development and production of various electric drive vehicle systems to substantially reduce petroleum consumption

- Integrate anode production with existing chemical manufacturing site
  - Utility and waste treatment systems available
  - Only minor air permit modifications required
  - Experienced on-site management, technical staff, maintenance, and operations personnel

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Relevance and Approach

- Cost-effective production to support introduction of electric drive vehicles
- Accelerate the development and production of various electric drive vehicle systems to substantially reduce petroleum consumption

- Retrofitting existing manufacturing asset
  - Fraction of the capital cost of new plant
  - Fraction of the time to construct new assets
  - 70% of process equipment and 60% of pumps in place
  - 100% of required floor space available

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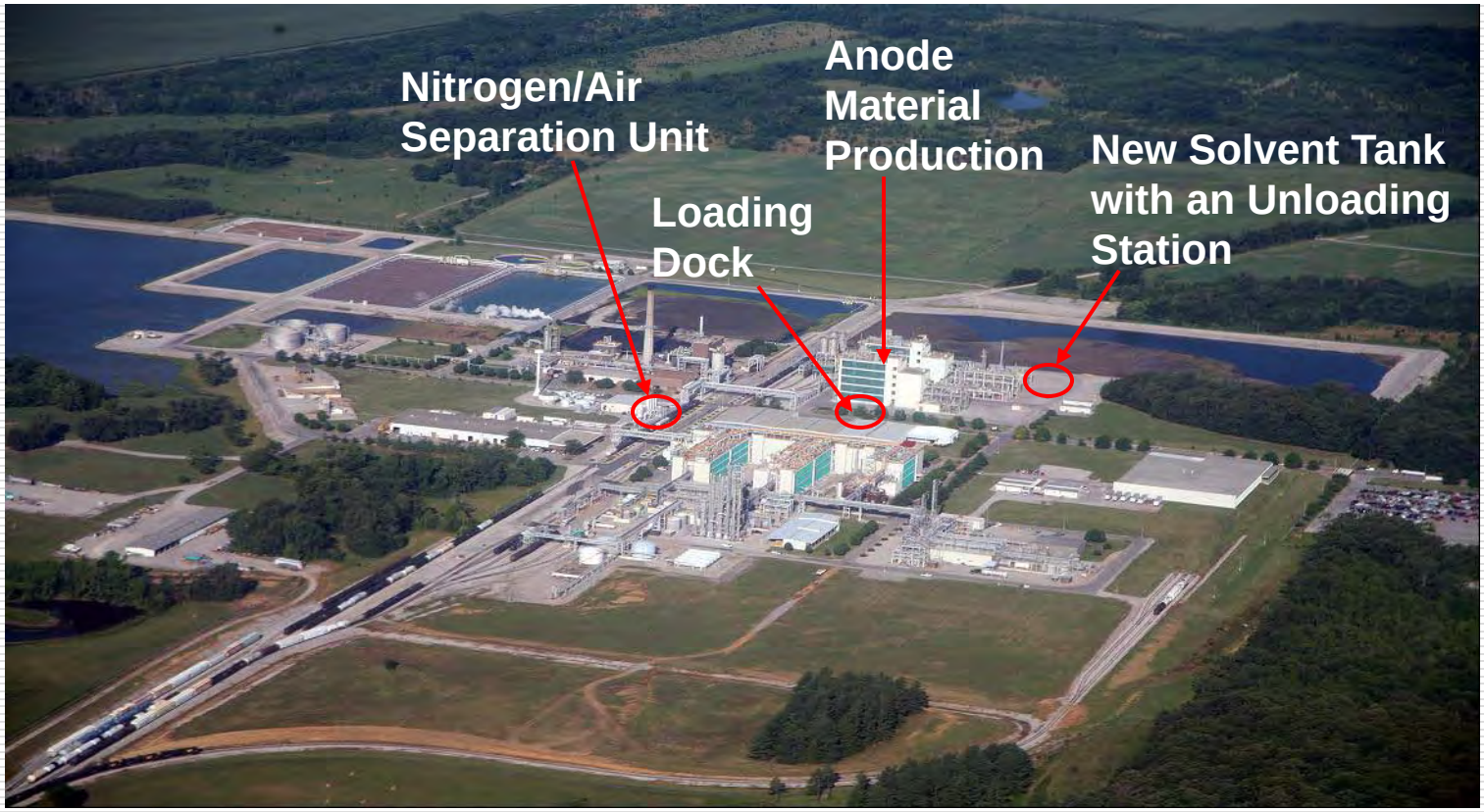
Relevance and Approach



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Approach

- Leverage ConocoPhillips' technical expertise, production experience, and semi-works facility
  - ConocoPhillips' engineers participated in the PHA, P&ID development, and equipment specification development
  - ConocoPhillips' project engineer on site
  - Train FutureFuel Operations personnel
  - Train FutureFuel QC personnel
- Leverage FutureFuel's expertise in solid/liquid separation, solids handling, dust control, process control, and process safety
- Extensive overlap of engineering, procurement, construction, checkout, and commissioning activities

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Technical Accomplishments

- Conducted successful trials of key process equipment
  - Melt extruder
  - Powder cooler
  - Solid bowl centrifuge
  - Ring dryer
  - Rotary valves (wear testing)
- Resolved safety issues associated with ring dryer
  - Chilworth study
  - Optical oxygen analyzer
- Scaled-up and retrofitted process into existing manufacturing assets
  - Utilized variable speed drives to maximize use of existing pumps and piping
  - Utilized existing emission control system

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Progress

- NEPA assessment complete and FONSI issued
- Process Hazard Analysis complete
- Process equipment testing complete
- Engineering complete
- Air Permit Modification complete
- Procurement complete
- QC personnel training complete
- Construction – 80% complete
- Operator training – 50% complete
- Equipment checkout and commissioning – 30% complete

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Collaborations / Partnerships

- ConocoPhillips – Technology Provider and Customer
- Lauren Engineers and Constructors – Engineering Contractor
- Plant Maintenance Service Corp. – Construction Contractor

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Future Work

- Complete construction
- Complete operator training
- Complete equipment checkout and commissioning
- Introduction of chemicals
- Process start-up
- Qualification and validation
- Commercial production

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Summary

- In March 2012 there will be domestic, large-scale production of graphite anode materials for lithium-ion batteries

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