GreatPoint Energy is commercializing its proprietary bluegas\textsuperscript{TM} process to convert coal and petroleum residues into low cost natural gas and CO\textsubscript{2} for enhanced oil recovery
GreatPoint Company Overview

• **Technology is a step change in the science of gasification and fuels production**
  • Substantially cleaner alternative to coal combustion
  • Integrated capture and sequestration of CO₂ to dramatically reduce emissions
  • Converts criteria pollutants into saleable by-products

• **Process flexibility yields a range of low-cost clean energy products**
  • **Natural gas**
    ➢ Pipeline-grade product allows for flexibility in plant siting
    ➢ Reliable, long term, fixed price contracts tied to abundant low-cost feedstock
  • **Refinery Hydrogen and Near-Zero Emissions Power**
    ➢ reliable, long term, fixed price contracts for oil refiners to use in upgrading and desulfurization
    ➢ Hydrogen (“H₂”) -based power generation offers an opportunity for carbon and clean energy credits
  • **CO₂ for use in Enhanced Oil Recovery**
    ➢ Hundreds of billions of barrels of proven but currently stranded oil globally

• **Uniquely positioned for rapid and scalable commercialization**
  • Significant IP portfolio and competitive technology advantage
  • Strategy is to build, own and operate production facilities
  • Partnering with energy and resource companies in China, N.A. and the Middle East
Prominent Existing Investors

**Industry**

- **Suncor Energy**: Development partner & feedstock supplier
- **Dow**: Collaborated on pilot plant testing & strategic gas partner
- **AES**: Development partner & investor in projects
- **Peabody**: Development partner & preferred feedstock supplier

**Venture Capital & Private Equity**

- **KPCB**: Citi Capital Advisors
- **Khosla Ventures**
- **Draper Fisher Jurvetson**
- **Advanced Technology Ventures**
Key GPE Innovations

Background

• Catalytic gasification first discovered in 1970’s by Exxon
• GPE has many of the key scientists and engineers from the early discovery as exclusive advisors
• DoE sponsored development to pilot scale until 1982; technology abandoned due to low gas prices

GPE

• Rediscovered technology in 2003
• Key innovations vs. Exxon
  – Increased catalyst system activity and improved catalyst recovery
  – Application to petcoke and biomass
  – Near-zero CO₂ footprint; reduced capex and increased efficiency
  – Extension to hydrogen and power production
  – Next generation design with even lower capex, higher efficiency and increased catalyst recovery
The bluegas™ Advantage

GreatPoint Energy Process

- Feedstock, oxygen and steam mix in the presence of the hydromethanation catalyst and react to form a methane-rich gas stream
- Sulfur, nitrogen, mineral matter and trace metals are all safely removed using commercial processes
- CO₂ capture for EOR is innate to the process
- 62 patents issued or pending – strong intellectual property position

Key Advantages vs. Conventional Gasification

- **Better product**: Produces large quantities of valuable CH₄ in the reactor vs CO
- **More high quality gas produced**: Thermally balanced and ~25 - 40% more Btu’s of gas per Btu of feed
- **Higher reliability and lower maintenance costs**: Lower temperature (600 – 700° C), milder operating conditions, and far higher reliability
- **Lower capital costs**: Smaller equipment and less expensive materials
- **Lower cost of products including H₂, SNG, and CO₂ (for EOR)**: 25 - 40% lower cost production

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One Catalyst — Three Reactions

Steam/Carbon: \[ C + H_2O \rightarrow CO + H_2 \]
Water Gas Shift: \[ CO + H_2O \rightarrow H_2 + CO_2 \]
Methanation: \[ CO + 3 H_2 \rightarrow CH_4 \text{ (Methane)} + H_2O \]
Overall: \[ 2C + 2H_2O \rightarrow CH_4 + CO_2 \]
Laboratory Confirmation: the Chemistry Works!

Test Data for Petroleum Coke and Coal Conversion

High carbon conversions on PRB and petroleum coke with blu-100 Series Catalyst

90% Carbon Conversion
GreatPoint Energy combines the minimal carbon footprint of coal production with the lower carbon emissions of natural gas combustion to produce the cleanest commercial fuel.

### Pre-Combustion Emissions

- **CO₂-equivalent emissions from natural gas supply chain** are ~25% of total emissions, compared to 6% for coal.
  - Methane leakage has a global warming potential 21x that of CO₂, creating significant impact from natural gas production and transportation.
  - The global incremental supply of natural gas via LNG has added emissions for liquefaction, tanker transport and regasification.

### Post-Combustion Emissions

- **CO₂-equivalent emissions from natural gas combustion** are 60% less than those from coal-fired emissions.

Source: NREL, NETL, DOE
Technology Validated at Pilot Scale

- Leased facility at Gas Technology Institute

- Stable, reliable operation meeting all performance objectives
  - 1,200 hours of online operations
  - 17 stable, steady state yield periods
  - Start-up and shutdown managed successfully

- Gasification reactor performed as predicted with both PRB coal and petcoke

- Catalyst added, removed and recovered successfully, as predicted; pilot plant at SGS processed more than 250 tons of coal & petcoke

- Validation by investors and partners

<table>
<thead>
<tr>
<th>Primary Demonstration Goals</th>
<th>Results</th>
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</thead>
<tbody>
<tr>
<td>Minimum 85% carbon conversion</td>
<td>85%-90%</td>
</tr>
<tr>
<td>Feed rate minimum</td>
<td>Achieved</td>
</tr>
<tr>
<td>Operate at steady state conditions</td>
<td>Exceeded</td>
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<tr>
<td>Methane yield approaching equilibrium</td>
<td>Achieved</td>
</tr>
<tr>
<td>Proof of concept</td>
<td>Achieved</td>
</tr>
<tr>
<td>Mass balance</td>
<td>Achieved</td>
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</tbody>
</table>
Technology Validation at Mayflower Clean Energy Center

- **Mayflower Clean Energy Center**
  - Somerset, MA
  - Demonstration plant for feedstock optimization
  - Successful runs on Alberta petcoke, Gulf Coast petcoke, and PRB coal
    - ~1,000 hrs of online operations
    - Up to 150 lb/hr
    - Capable of processing coal, biomass, petcoke, asphaltenes, etc.
Core Technology Process Facilities

**Gasification:**
- Steam, O₂, CO & H₂ Supply & Preheat
- Solids Feed
- Solids Discharge
- Gas Discharge Flare

**Coal/Coke Preparation**
- Receive, Store & Reclaim
- Crush/Grind/Size

**Catalyst Load, Dry, Store**

**Catalyst Recovery and Re-use**

**Water Management**
## Evolution of Technology

<table>
<thead>
<tr>
<th>Description</th>
<th>Bluegas Original Version</th>
<th>Bluegas Current Version</th>
<th>Bluegas Version 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMR with syngas recycle through cryo unit</td>
<td>HMR with syngas recycle through gas POX</td>
<td>HMR with in-situ syngas generation through DO-IT</td>
<td></td>
</tr>
<tr>
<td><strong>Per SNG Produced</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Capex</td>
<td>Lower Capex</td>
<td>Lower Capex</td>
<td></td>
</tr>
<tr>
<td>Self sufficient in steam</td>
<td>Self sufficient in steam</td>
<td>Lower catalyst loading</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Lower catalyst OPEX</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simplified operation</td>
<td></td>
</tr>
<tr>
<td><strong>Thermal Efficiency</strong></td>
<td></td>
<td>60%-70%</td>
<td>70%-80%</td>
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<tr>
<td><strong>CO₂</strong></td>
<td>CO₂ Footprint unacceptable</td>
<td>&gt;90% CO₂ capture</td>
<td>&gt;90% CO₂ capture</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td>Initial testing complete</td>
<td>Conceptual design; moving to Version 3.0</td>
<td>PRB Coal testing at EERC</td>
</tr>
</tbody>
</table>
GreatPoint is currently performing research and development of its next generation Direct Oxygen Injection Technology ("DO-IT") based hydromethanation process

- DO-IT has been designed based on improving operability and economics for the PRB based hydromethanation process
- Research will include catalyst performance, pilot scale continuous fluidized bed and pilot scale testing, commercial performance modeling and economic assessment
- Project status to date:
  - A bench scale fluidized bed test was developed to simulate the hydromethanation reactor (HMR) after the injection of oxygen
  - Several bench scale fluidized bed and fixed bed tests were conducted with catalyzed PRB coal to study the impact of CO and CO₂ generated from oxygen injection at the bottom of the reactor in the DO-IT process
  - Preliminary test runs were completed at EERC in the 3” diameter continuous fluidized bed reactor to confirm that we can run the DO-IT tests in the test facility.
  - A test plan is being developed to conduct continuous fluidized bed tests at EERC with catalyzed PRB to validate the mathematical model developed
Intellectual Property

– GPE owns its bluegas™ technology.
– External relationships require GPE ownership/rights of use to improvements and other modifications of the bluegas™ technology.
– Active invention disclosure and patent filing program.
– Strong IP protection with 62 patent application families filed to date (60 active), and 42 published to date (40 active).
– Global filing as appropriate: U.S., China, India, Canada, S. Korea, Japan, Australia and others considered.
– Active “Freedom to Operate” screening program.
– Trademark applications filed for several marks.

<table>
<thead>
<tr>
<th>IP Subject Matter Areas (60 Active)</th>
<th>Patent Activity</th>
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<tr>
<td>Integrated Process (31)</td>
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<td>Byproduct Use (2)</td>
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<td>Feedstock and Catalyst (17)</td>
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<td>Gas Processing (4)</td>
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<td>Other (6)</td>
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<td>2010</td>
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<td><strong>Total Patent Families</strong></td>
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</tr>
<tr>
<td><strong>Active Patent Families</strong></td>
<td></td>
<td><strong>60</strong></td>
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</tbody>
</table>

As of 6/11/10
Development Plan for Commercialization

- **Pilot Plant**
  - GTI

- **Demonstration Plant**
  - 7 - 10 ft diam

- **First Commercial Plant**
  - 22 ft diameter

- **Full Commercial Scale**
  - 2 or 4 x 22 ft diameter

- **Commercial Height Fuel Test Facility**
  - Mayflower

- **GreatPoint Energy**
Key Market Opportunities

- **Substitute Natural Gas**
  - >$1 Trillion global; $250 billion U.S. market
  - Long term price expectation $6-8/MMBtu in U.S.; $10-12/MMBtu (oil-parity) in int’l markets
  - Bluegas independently verified as the lowest cost new source of U.S. natural gas by Nexant

- **Hydrogen**
  - $40B global market
  - 10% annual growth, reaching 20% by 2020
  - Sells for 1.2 – 1.8x natural gas
  - Refinery use to upgrade heavy/sour crudes
  - Key input to ammonia/fertilizer production
  - Feed to combined cycle turbine for clean power

- **CO₂ for EOR**
  - Global EOR potential ~750 billion bbls
  - Growing domestically (2.2MM bbls/d)
  - High attractive economics
  - Supply of CO₂ is limiting factor

- **Low-Cost Feedstocks**
  - COAL
  - PETCOKE & REFINERY RESIDUES
  - BIOMASS

- **Hydromethanation Reactor**

**Source:** EIA
Enormous Coal-to-Gas Conversion Market

Notes: Assumes 15% of coal reserves are converted to natural gas using GPE technology
Source for consumption and reserve data: EIA

Potential Bluegas Opportunity (TCF)
Total Projected Gas Consumption 2010-2030 (TCF)
Conventional Gas Reserves (TCF)

US
Canada
China
India
Australia

Notes: Assumes 15% of coal reserves are converted to natural gas using GPE technology
Source for consumption and reserve data: EIA
Attractive Global Opportunities in Development

ALBERTA
• Alberta petcoke is negative value byproduct
• Substantial CO₂ EOR requirements
• High natural gas demand in oil sands

U.S. GULF COAST
• Substantial EOR opportunities
• Blugas site opportunities for CH₄, H₂ and CO₂ production
• Pet coke feedstock available

POWDER RIVER / ILLINOIS BASINS
• Power or pipeline gas markets
• Underutilized low-cost coal resources
• EOR opportunities for multiple field tie-ins

CALIFORNIA
• Existing EOR
• Low carbon power market
• Pet coke feed available

MIDDLE EAST
• Burgeoning EOR market with vast potential
• Strong power demand, gas constraints and need to displace oil in the power sector
• Surplus residue feedstocks / pet coke available

CHINA
• Strong natural gas demand growth
• Enormous coal resources
• Environmental imperative
• Emerging EOR opportunity
Summary

• **Proven Technology**: Efficient, reliable process ready for commercial deployment

• **Lowest Cost of Production**: Superior economics to conventional hydrogen and natural gas production with a solid feedstock that mitigates pricing volatility

• **Substantial Market Opportunity**: Feedstock flexibility and location independence allow for feedstock and end-use market optimization

• **Enormous EOR Potential**: >700 billion barrels of “stranded” oil globally

• **Superior Environmental Profile**: Integrated CO₂ capture produces near zero emissions

• **Clear Commercialization Path**: Developing first commercial project with planned production in 2013; site opportunities in China, North America, and Middle East

• **Substantial Valuation Upside**: Exploits the Btu valuation gap between coal and gas

• **Superior Executive Management, Technical Team and Investors**: Attracted top tier talent from energy industry and leading financial/strategic investors
bluegas™

Blue. The new green.