Energy Innovation

Invention + Commercialization

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SPE Members in Transition Seminar
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Our Challenge

Global energy demand will double by 2050
Supply will struggle to keep up
Continued dependence on fossil fuels
Need rapid growth in renewables
Urgent need for low carbon technologies

Need: Scientific and Technology Breakthroughs & Unprecedented Collaboration
Solution: Speed up Energy Innovation

- Biofuels
- Wind
- Solar
- CNG/LNG
- Electric Vehicles
- Enhanced Recovery
- Unconventional Oil & Gas
- Deep Water
- Smart Grid
- Energy Efficiency
- Nuclear
- Energy Storage
- Geothermal
- Microgrid
- Water Treatment
- Carbon Capture
But energy innovation is complicated….
Stages of Development

...takes a long time....

FOCUS

- Embryonic: Ideation, Bench testing, Patentability
- Prototype: Proof of concept, Patent filing, Angel financing
- Pilot Stage: Pilot as marketing tool, Generate design data, VC financing
- Demo Plant: Confirm yields, Durability test, Commercial financing
- Full scale: Yield optimization, Max capacity, Profitable operation
- Growth & Expansion: Design improvements, Seek new sites, Profitable operation

NEEDS

- Embryonic: Scientists, Lab facilities, Patent search
- Prototype: Scientists, Few engineers, Cheap facilities, Funding
- Pilot Stage: Engineers, Design capability, explore raw material access, Funding
- Full scale: Raw materials, Refining plants, Blending, Marketing
- Growth & Expansion: Raw materials, Refining plants, Blending, Marketing, Attractive financing

LOCATION

- Embryonic: University Campus
- Prototype: University Campus, Energy incubator
- Pilot Stage: Campus, Energy Incubator, Industrial site
- Demo Plant: Industrial site
- Full scale: Industrial complex, Close to market
- Growth & Expansion: Industrial complex, Close to market

Stages of Development
...has a high failure rate....
Innovation Ecosystem

…innovation needs a lot of support and resources
Routes to innovation have changed

- Public private partnership
  - Universities
  - National laboratories
  - Venture funds
  - Subject Matter Experts
  - Corporate

- Solutions for Shell
  - License, spin-out, divest
  - Key suppliers
  - License in, venture, acquire

Internal technology base

Supply chain

External technology collaborations

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Innovation Best Practices

• Entrepreneur development and support
• Engaged industry cluster, government, academia
• Culture of collaboration
• Funding
• Patience, stamina, flexibility, long term view
• Global connections

Local Support, Global Connectivity
# HOUSTON TECHNOLOGY CENTER ENERGY CLIENTS

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<tr>
<th>AIDAP</th>
<th>Bluenergy Solarwind</th>
<th>CBM Enterprise Solutions, LLC</th>
<th>Dynamic Tubular Systems</th>
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Open Innovation Accelerator

**Inventors**
- Researchers
- Scientists
- Basic
- Applied
- Government
- Universities
- Private

**Developers**
- Entrepreneurs
- Universities
- Industry
- Government

**Resources/Mentors**
- Industry
- Incubators
- Peers
- Universities
- Accelerators
- Non Profits

**Investors**
- Industry
- Angels
- Private Equity
- Government
- Non Profits
- VCs
The Future
NEXT EXIT
Questions /Discussion