Commercial Development of the SES U-GAS® Gasification Technology

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• Proven U-GAS® fluidized bed technology for a wide range of coal and biomass fuels

• U-GAS® technology exclusive license with the Gas Technology Institute (GTI)

• Developing SES equity projects and 3rd party U-GAS® technology license opportunities

• First project completed and operating; Zao Zhuang City, Shandong Province, China

• Second project funded and in EPC phase; Yima City, Henan Province, China

• Primary offices in Houston, Texas and Shanghai, China

• GTI Flex-Fuel pilot facility in Chicago, Illinois

• NASDAQ traded SYMX
**Business Strategy**

*Build SES equity projects where U-GAS® technology can enable a low cost producer platform*
- Target opportunities which take advantage of U-GAS® ability to gasify the most challenging coals
- Proximity to low rank coals – lignite, sub-bituminous, high ash, coals – secure low cost fuel for project
- Energy products such as SNG, power, methanol, gasoline, DME and high margin chemicals

**Accelerate U-GAS® growth - Technology licensing**
- U-GAS® enables licensees to lower production cost of syngas derived products – fuels and chemicals
- Biomass and biomass blending capability for renewable and lower carbon footprint projects

**Target Regions**
- China focus for business launch; World's most active gasification market
- High energy growth regions with abundance of low rank/high ash coals; India, U.S., Australia
- Areas with renewable energy growth through biomass and coal/biomass blended fuels

**Organizational Capability - Project Development and Management, Technology and Plant Operations**
- Experienced global project developer
- U-GAS® technology experts from GTI
- Engineering and technology expertise in China – 55 employees in Shanghai
- Strong operating team with growing knowledge base of plant operations – 160 employees at Zao Zhuang
U-GAS® Low Cost Producer Platform

- A proprietary agglomerating fluidized-bed technology
- Efficiently converts carbon into high-value syngas
- Utilizes a wide-range of feed-stocks
- SES engineers continue to improve U-GAS®

**COAL**
Bituminous, Low Rank
Coal, Coke, Pet-Coke & Coal Wastes

**BIOMASS**
Danish Willow, Bagasse, RdF

**U-GAS® GASIFIER**

CO₂ Capture Capable

SYNGAS
CO₂, CO, H₂

**Transportation Fuels**
SNG, Methanol, Gasoline, DME

**Industrial Chemicals**
Glycols, MeOH, Ammonia

**Power Generation**
IGCC
The Development of U-GAS®

1975 Bituminous Caking Coal

1978 Lignite Coal

1980 Biomass pilot HP, 10 tpd

1983 10 tpd, 35 bara PDU

1980 Awarded DOE grant (Memphis) – scale up of technology to 1,000 tpd gasifier, plant not built

1992 Biomass demonstration 80 tpd in Tampere, Finland

1995 DOE awarded 1,250 tpd biomass IGCC project, plant not built

1995 Commercial 150 tpd air-blown in Shanghai, China

1998 Biomass demonstration plant 100 tpd in Maui, Hawaii

2005 High ash Indian Coal tested for IGCC

2008 SES 400 tpd Oxygen-blown in Zao Zhuang, China

2012 SES Yima project 2,400 tpd sub bituminous

- Developed over last 35 years
- Primary funding by U.S. DOE-ERDA; AGA; private industry
- Originally developed for SNG and then Power
Scale-up History of U-GAS® Technology

Single Gasifier Capacity → 400 tpd → 3,000 tpd Coal Feed
U-GAS® Fluidized Bed – A Simple Solution

U-GAS® (Principles of how FB works and why this is good)
- good mixing for even temperature control
- long solids residence times for high conversion
- long gas residence times tolerant to fuel variations
- capable of gasifying fine particles
- low cost, high availability due to moderate temperatures

Coal Fuel

<table>
<thead>
<tr>
<th>Fuel Property</th>
<th>Tested Range</th>
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</thead>
<tbody>
<tr>
<td>Moisture Content, wt %</td>
<td>1 – 41</td>
</tr>
<tr>
<td>Volatile Matter, wt %</td>
<td>3 – 69</td>
</tr>
<tr>
<td>Fixed Carbon, wt %</td>
<td>6 – 83</td>
</tr>
<tr>
<td>Sulfur, wt %</td>
<td>0.2 – 4.6</td>
</tr>
<tr>
<td>Free Swelling Index</td>
<td>0 – 8</td>
</tr>
<tr>
<td>Ash Content, wt %</td>
<td>&lt;1 – 42%</td>
</tr>
<tr>
<td>Ash Softening – $T_1$, °F</td>
<td>1,900 – 2,500</td>
</tr>
<tr>
<td>Heating Value, HHV, Btu/lb</td>
<td>5,500 – 14,000</td>
</tr>
</tbody>
</table>

A Proprietary Agglomerating Gasifier
- decakes
- devolatilizes
- gasifies
- agglomerates

Biomass Fuels
- woody
- herbaceous
- agri-waste
- MSW
Advantages of SES U-GAS® Technology

### Entrained Flow
- Gas
- Ash
- Coal
- Steam + O2
- Slag

### U-GAS® Fluidized Bed
- Gas
- Coal
- Steam + O2
- Ash
- SES

### Moving or Fixed Bed
- Coal
- Gas
- Steam + O2
- Ash
- Dry or slag

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**U-GAS® Advantages**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Operational Costs</th>
<th>Scalability</th>
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<tbody>
<tr>
<td>Ability to efficiently gasify a wide range of fuels – low rank and waste coals and biomass</td>
<td>Moderate temperature process reduces maintenance costs and downtime in refractory and feed nozzles, increases availability</td>
<td>Cost effective on an industrial scale</td>
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GTI Energy Development Center

HYGAS – SNG

U-GAS® – Syngas

STEAM-IRON – $H_2$

Mild-GAS – Coal-refining

RENU GAS® – Syngas

1951-1996 – Chicago, Illinois
U-GAS®
- Coal gasification
- Coal + biomass blends
- Biomass gasification
- 35+ years of data

Gasification Test Facilities
- Coal 20 T/D with O₂
- Biomass 40 T/D with O₂
- Over 400 psig pressure
- Gas cleanup and conditioning

Process Evaluation
Commercial Operator Training
Gasifier Projects

- 1992: 80 ton per day Gasification Pilot Plant in Finland using biomass & coal
- 1995: 8x150 ton per day U-GAS® Industrial fuel gas in Shanghai, China using coal
- 1998: 100 ton per day Bioenergy Demo Plant in Hawaii using bagasse
- 2006: 150 ton per day CHP Plant in Denmark using wood
- 2008: 2x400 ton per day U-GAS® in Zao Zhuang City, China using coal
Zao Zhuang Plant Overview

- Coal Storage Yard
- Pretreatment Unit
- Gasifier Island
- (AGR) Acid Gas Removal
- (ASU) Air Separation Unit
- Office Building
- Storehouse
- Bag-house Filter
- Scrubber
- Deslat Water
- Repair Shop
- Power Distribution Center
- Cooling Water Tower
- Flare
- 2nd Period Project
- 3rd Period Project
Zao Zhuang Accomplishments Summary

Zao Zhuang Plant is successfully demonstrating the U-GAS® platform

- Engineered and constructed plant in record time
- Demonstrated U-GAS® fuel flexibility capability (ash 30 - 42%)
- Demonstrated ability to run a stable operation
  (1 operational + 1 spare demonstrating 98% on-stream time)
- Demonstrated large turn-down capability of U-GAS® (>50%)
- Achieved COD within 1st year of operation
- Successfully tested Yima project coal in Zao Zhuang gasifiers
- Growing SES plant operating knowledge
- Leverage valuable experience for next projects
Zao Zhuang Lessons Learned

Improving with Experience

- Select a qualified EPC firm or CDI
- Quality inspections for plant construction
- Early and better operator training
- ASU shut downs, interlock control failures
- Bottom char discharge – more cooling capacity
- Cyclones and fines recycle system – cold flow tests and pilot unit data
- Feed system – improve piping layout
- Steam supply – more robust steam source
- Power interruptions – improve design considerations
Yima – A Multi-Phased Project

| Location       | Henan Province, China
                | Mazhuang Coal Chemical Industrial Park |
|----------------|--------------------------------------|
| Partner        | Yima Coal Industry Group Co.         |
| Capacity       | 2,400 tpd coal                       |
| Product        | Refined methanol                     |
| Fuel           | Sub-bituminous; 30 – 35% ash         |
| Capital Cost   | Approx. $250 million                 |
| Structure      | 75% Yima / 25% SES                   |
| Mechanical Completion | Early-Mid 2012     |
|                | COD – approx 6 months later          |
Yima – A Multi-Phased Project

Selected a world class CDI in CNCEC’s Third Design Institute

Qualifying a Jianli to monitor and guarantee quality in construction

Gasification Island technology advances:

• Advance operating pressure to 10 bars gauge
• Scale-up gasifier island throughput to 1200 tpd per gasifier
• Improved char discharge system
• Improved fines management system specific for Yima coal
• Cold flow testing to validate the modifications
Conclusion

• SES is a global gasification company
• A proven and well-developed gasification platform in the U-GAS® technology
• U-GAS® has many years of experience and development with scale up, pressure and feed stocks
• Targeting lower cost fuels for coal and biomass
• We have one commercial plant operating and one in construction
• We are a build, own and operate company and also license the technology to third parties