Allied Syngas Agenda

- Introduction
- BGL Gasifier Design
- BGL Fuel Flexibility
Introduction

- Allied Resource Corporation (Allied) and Safeguard International Fund, L.P. are the principal platforms of a private equity organization in Wayne, PA.

- Allied is commercializing a series of technology-based environmental services operating primarily in Europe and North America.

- Safeguard is a LBO-Fund with capital commitments of $360 million for basic industries in Europe and North America. Investors include CSFB Private Equity, Verizon Pension Fund, CalPers, Duke University Endowment Fund, Pantheon Ventures, Deutsche Bank, others.
Introduction – Allied Resource Corporation

Engineering Services

– Envirotherm GmbH (Essen, Germany), a specialized engineering company for flue gas treatment, gasification, and combustion of secondary raw materials

– Bamag GmbH (Butzbach, Germany), a leading engineering company in innovative water and wastewater treatment technologies

– KWH Katalysatoren GmbH (Essen, Germany), a global supplier of DeNOx catalysts for flue gas treatment

– Lurgi Lentjes North America (Columbia, Maryland), a specialized engineering company focused on air quality control technologies and engineering services

Gasification

– Allied Syngas Corporation (Wayne, Pennsylvania), commercializing the BGL gasification technology in North America

Recycling

– Puralube, Inc. (Wayne, Pennsylvania), an environmental technology company engaged in re-refining used lubricating oils into high quality base oils

– Aura Metallurgie GmbH (Helbra, Germany), an environmental technology company engaged in recovering specialty metals from certain industrial wastes
Introduction – Allied Syngas Corporation (ASC)

• Allied Syngas Corporation (ASC) is located in Wayne, PA
• Exclusive licensee to commercialize the British Gas/Lurgi (BGL) gasification process in North America
• Business model to provide syngas “over-the-fence” for a variety of industrial and electric refueling applications
• ASC’s standard gasification module is the “BGL 1000”
  – Producing a nominal 1,000 MMBtu/hr gasifier of clean medium Btu syngas
  – Consuming a nominal 1,000 tons per day of coal
BGL Gasifier Design

- Extensive development history
- Proven design
- High process efficiency
Development of the BGL Gasifier

- R&D investment £150 million ($US 500 million - 2005)
  - Pilot plant - Midlands 1958 - 1964
    - 100 TPD (3 foot dia.)
  - Development plant - Westfield 1975 - 1983
    - 350 TPD (6 foot dia.)
  - Demonstration plant - Westfield 1986 - 1990
    - 500 TPD (8 foot dia.)

- 1st Commercial plant- Schwarze Pumpe 2000 - 2005
  - BGL 1000 (12 foot dia.)
BGL Gasification - Development

• A “slagging” version of the existing Lurgi Gasifier was jointly developed with British Gas to:
  – improve specific reactor throughput
  – increase fines content acceptable in feed
  – reduce steam consumption and consequent gas condensate production
  – recycle tars/oils to extinction
  – increase CO/H₂-yields
  – produce non-leachable vitreous slag rather than dry ash

• The BGL development process achieved these goals
Gasification Phase Diagram  (Coal: Illinois #6  Dry Feed)

Adapted from NETL’s Gasification Overview for Platts IGCC Symposium
Gary Stiegel, 6-02-05
Proven Design

- Extension of the proven Lurgi gasifier
  - Lock hoppers
  - Distributor
  - Quench cooler

- Modifications from Lurgi design
  - Steam and oxygen injection
  - Refractory liner
  - Slag removal
  - Ability to recycle tars to extinction

- Modifications have been proven at Westfield and SVZ
Simple Gasifier Design

• Manufactured from carbon steel plate

• 12 foot vessel

• Refractory lined vessel

• High temperatures restricted to hearth

• 1000 °F and lower syngas exit temperature
Lurgi Fixed/Moving Bed Gasifiers

**Lurgi - Pressure Gasifier**
(North Dakota/Sasol type)

- Feed
- Feed Lock
- Ash Grate (rotating)
- Steam/Oxygen
- Ash Lock
- Wash Cooler
- Crude Gas
- Gas Offtake
- Ash

**BGL Gasifier**
(ASC/SVZ type)

- Feed
- Feed Lock
- Stirrer (for caking coals only)
- Steam, Oxygen and Tar
- Slag Quench
- Slag Lock
- Slag
- Gas Offtake
- Wash Cooler
- Crude Gas
BGL Process Efficiency (typical)

- High coal to syngas conversion efficiency: 88 to 92% (cold gas efficiency)

- Low oxygen consumption: 0.5 to 0.6 pounds of oxygen per pound of coal

- Low steam/water usage: 0.3 to 0.4 pounds of steam/water per pound of coal

- Low CO₂ content in syngas: 3 to 5%

- Medium Btu syngas: ~350 Btu/SCF
BGL Fuel Flexibility

- British Coals
- US Coals
- Opportunity Fuels
BGL British Coals

- Frances
- Rossington
- Gedling Manton
- Hucknall
- Comrie
- Killoch
- Manvers
- Markham
- Main
- Lynemouth
BGL US Coals

- Pittsburgh #8
- Ohio #9
- Illinois #5 and #6
- Belle Ayr (PRB)

- Coal Fines
  - Pelletized or briquetted coal
  - Pulverized coal
  - Coal/water slurry
BGL Opportunity Fuels

- Petroleum Coke
- Lignite
- Tar
- Biomass
- RDF
Commercial Co-gasification of Waste and Coal for the Production of Methanol and Electricity at SVZ

Overall Plant Configuration
### BGL – SVZ: Feedstocks

#### Waste / Coal Mixtures treated and gasified at SVZ

<table>
<thead>
<tr>
<th>(% by weight)</th>
<th>Typical Range</th>
<th>Operational</th>
<th>(Current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF-Pellets</td>
<td>30 - 50</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Agglomerated Plastic Waste</td>
<td>20 - 30</td>
<td>30</td>
<td>45</td>
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<tr>
<td>Compacted Shredder Light Fraction</td>
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<tr>
<td>Briquetted Industrial Sludge</td>
<td>5 - 10</td>
<td>25</td>
<td>10</td>
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<tr>
<td>Briquetted Sewage Sludge</td>
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<tr>
<td>Shredded Wood Waste</td>
<td>0 - 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard Coal/Lignite</td>
<td>20 - 25</td>
<td>19/6</td>
<td>12.5/7.5</td>
</tr>
</tbody>
</table>

- RDF-pellets
- Agglomerated Plastic Waste
- Shredded Wood Waste
BGL – SVZ Schwarze Pumpe

Gasification Building
BGL 1000 Gasifier at SVZ in Schwarze Pumpe

Gasifier Overall Dimensions

- Inside diameter: 12.0 ft
- Outside diameter: 16.0 ft
- Height: approx. 40.0 ft

58 m (190 ft)
5 m
20 m (66 ft)
0 m
BGL Fuel Flexibility

- Washed or unwashed bituminous coals
- Non caking to strongly caking coals
- Ash: 0.5 to 21% wt; silica ratio 45 to 85
- Moisture: 3 to 28% wt
- Sulfur: 0.5 to 5.6% wt
- Chlorine: up to 0.6% wt
- Size: 2.0 x 0.25 inch
- Coals can be changed while operating

✔ Essentially all US coals can be used.