KBR’s Transport Gasifier (TRIG™): Market Projection and Project Updates

Ron Gualy
Vice President Technology, Coal Monetization
Coal will remain as one of the major energy sources worldwide in the next 20 years.

Robust consumption and production growth worldwide for coal in 2010.

2010 Consumption Growth Rate by Fuel

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>7.6%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>7.4%</td>
</tr>
<tr>
<td>Oil</td>
<td>3.1%</td>
</tr>
<tr>
<td>Hydroelectric</td>
<td>5.3%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>2%</td>
</tr>
</tbody>
</table>

Source: BP Statistical Review of World Energy 2011
Global Fossil Fuel Reserves

Reserves-to-Production Ratios (Years)

- Oil: 46 years
- Natural Gas: 59 years
- Coal: 118 years

Source: BP Statistical Review of World Energy 2011

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Energy Sources

Coal

A low cost energy source

A stable and secure feedstock option

Fuel Prices History and Projection

Source: Annual Energy Outlook 2011, EIA
CERA
USA and World Coal Pricing

- Low rank coal prices are lower and provide a better cost per unit of energy than higher rank coals.

- A parallel can be drawn between the utilization of low rank coal vs. high rank with the heavy crude oil and sweet crude oil exploitation and production.

- The feedstock differential with a manageable investment cost is the key business opportunity to utilize low rank coal.

(Data Source: EIA)

![Coal Price by Type in US](chart1.png)

![World Prices for Various Bituminous Coals](chart2.png)
Worldwide Coal Availability

- **USA**: 237 Billion Tonnes, Low Rank ~55%
- **Australia**: 76 Billion Tonnes, Low Rank ~51%
- **China**: 115 Billion Tonnes, Low Rank ~46%
- **Russia**: 157 Billion Tonnes, Low Rank 69%
- **Africa**: 32 Billion Tonnes, Mostly High Ash
- **India**: 61 Billion Tonnes, Mostly High Ash
- **Indonesia**: ~21 Billion Tonnes, Low Rank ~89%
- **Australia**: 76 Billion Tonnes, Low Rank ~51%

Total Proved Coal Reserves ~ 900 Billion Tonnes, Low Rank + High Ash > 50%

Source:
- BP Statistical Review of World Energy 2011
- Indonesia Geological Agency 2010

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Most low rank coals are not tradable in the traditional coal markets due to impurities and other characteristics.

TRIG™ unlocks the value of low cost, low rank lignite, high ash and high moisture coal.

Huge potential in markets such as China, India, Australia, and Indonesia.

Low Rank Coal as Percentage of Total Coal Reserves:
- China: 46%
- United States: 55%
- Australia: 51%
- Indonesia: 89%

Source:
BP Statistical Review of World Energy 2011
Indonesia Geological Agency 2010
TRIG™ Projects Worldwide

UND TRIG™ Pilot Plant
Grand Forks, ND USA [1990s]

Mississippi Gasification Project
Kemper County, MS USA [2014]

PSDF TRIG™ Demo Unit
Wilsonville, AL USA [1990s]

Boyuan TRIG™
Sunite, Inner Mongolia, China [2013]

Jindal Steel & Power
TRIG™ for DRI
Angul, India

TRIG™ Pilot Plant
South Korea [2011]

Dongguan TRIG™ IGCC
Guangdong, China [2012]
## SK Innovation TRIG™ Pilot Plant

**Commissioned Early 2011**

<table>
<thead>
<tr>
<th>Location</th>
<th>Daejeon, South Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>3 MTPD TRIG™ Gasifier</td>
</tr>
</tbody>
</table>
| Use            | • Technology Development  
                  • Feedstock Evaluation Studies |
| Project Progress | Pilot Plant Commissioned Early 2011  
                      Shakedown Runs Completed |
**Beijing Guoneng Yinhui Clean Energy Engineering Co., Ltd.**

**Dongguan IGCC Retrofit Project**

**2012 Start-up**
Plant owned and operated by Dongguan Tian Ming Electric Power Co., Ltd (TMEP)

<table>
<thead>
<tr>
<th>Location</th>
<th>Dongguan, China</th>
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</thead>
<tbody>
<tr>
<td>Design Capacity</td>
<td>120 MW IGCC</td>
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</tbody>
</table>
| KBR & Southern Work Scope | • Basic Engineering  
| | • Proprietary Equipment  
| | • Start-up Services  |
| Project Progress | • Basic and Detailed Design Review Completed  
| | • 90% Equipment purchased  
| | • Lead equipment in fabrication  
| | • Site construction in progress  |
Berun Holding Group 100 KTA Glycol Project

Fall 2013 Start-up
First oxygen-blown TRIG™ gasifier

<table>
<thead>
<tr>
<th>Location</th>
<th>Inner Mongolia, China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Feedstock</td>
<td>High ash lignite feedstock from adjacent mine</td>
</tr>
<tr>
<td>Design Capacity</td>
<td>35,000 Nm³/hr Syngas</td>
</tr>
<tr>
<td>Product Use</td>
<td>Feedstock to 100 KTA Grassroots Ethylene Glycol Plant</td>
</tr>
</tbody>
</table>
| KBR Work Scope  | • Basic Engineering  
                   • Proprietary Equipment  
                   • Start-up Services |
| Project Progress| Basic Engineering and Detailed Engineering of TRIG™ Gasifier issued |

Project Updates
### Project Updates

**Kemper County IGCC Project**

#### 2014 Start-up

Plant owned and operated by Mississippi Power Company (MPC) and the Southeast Mississippi Electric Power Authority (SMEPA)

<table>
<thead>
<tr>
<th><strong>Location</strong></th>
<th>Kemper County, Mississippi</th>
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<tbody>
<tr>
<td><strong>Design Feedstock</strong></td>
<td>Lignite feedstock from adjacent mine</td>
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<tr>
<td><strong>Design Capacity</strong></td>
<td>582 MW IGCC</td>
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<tr>
<td><strong>Design Highlight</strong></td>
<td>65% Carbon Capture</td>
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<tr>
<td><strong>Project Progress</strong></td>
<td>Construction in progress</td>
</tr>
</tbody>
</table>
New Gasifier Contract by Jindal Steel & Power Ltd. for Direct Reduction of Iron Project

<table>
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<tr>
<th>Location</th>
<th>Angul, India</th>
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<tbody>
<tr>
<td>Design Feedstock</td>
<td>Angul High Ash Coal (~40% Ash Content)</td>
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<tr>
<td>Design Capacity</td>
<td>360,000 Nm³/hr Syngas (3 x 120,000 Nm³/hr syngas gasifier)</td>
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<tr>
<td>Product Use</td>
<td>Reducing Gas for Direct Reduction of Iron (DRI)</td>
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</tbody>
</table>
| KBR Work Scope | • Licensing  
• Basic Engineering  
• Technical Services  
• Proprietary Equipment |
KBR TRIG™ an Efficient & Reliable Choice

<table>
<thead>
<tr>
<th>Technology</th>
<th>Studies</th>
<th>Engineering</th>
<th>Procurement</th>
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<tr>
<td>Own or Licensed</td>
<td>Scoping</td>
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<td>FEED</td>
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Delivery of the Total Plant

KBR provides the Full Spectrum of Services