Shell Gasification & Clean Coal Energy

Shell Coal Gasification – Leading Technology Across Multiple Applications

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Definitions and cautionary note

Reserves: Our use of the term “reserves” in this presentation means SEC proved oil and gas reserves and SEC proven mining reserves.

Resources: Our use of the term “resources” in this presentation includes quantities of oil and gas not yet classified as SEC proved oil and gas reserves or SEC proven mining reserves. Resources are consistent with the Society of Petroleum Engineers 2P and 2C definitions and includes Oil Sands.

Organic: Our use of the term Organic includes SEC proved oil and gas reserves and SEC proven mining reserves excluding changes resulting from acquisitions, divestments and year-end pricing impact.

Identified Items: This presentation refers to Identified Items which have been excluded from CCS earnings and EPS calculations. Please see page 4 of the Quarterly Results Announcement for a listing of those items.

To facilitate a better understanding of underlying business performance, the financial results are also presented on an estimated current cost of supplies (CCS) basis as applied for the Oil Products and Chemicals segment earnings. Earnings on an estimated current cost of supplies basis provides useful information concerning the effect of changes in the cost of supplies on Royal Dutch Shell’s results of operations and is a measure to manage the performance of the Oil Products and Chemicals segments but is not a measure of financial performance under IFRS.

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The term “Shell interest” is used for convenience to indicate the direct and/or indirect (for example, through our 34% shareholding in Woodside Petroleum Ltd.) ownership interest held by Shell in a venture, partnership or company, after exclusion of all third-party interest.

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Our drivers for winning in the market

- Scale up potential
- Wide range of coal qualities
- Expanded number of vendors
- Highest efficiency levels
- Investment in technology and people
Kowepo IGCC Project

- The customer: Korea Western Power Co. Ltd
- The project: Taean IGCC #1 Power Plant
- The plant: 300 MW IGCC – single SCGP gasifier
- The location: Taean, Republic of Korea
- Shell’s scope: Gasification & Gas Treatment
- Project FEED near completion – start up target date is 2013

Photo courtesy of Kowepo
Shell coal gasification selected based on:
• highest total integrated IGCC efficiency – 42%
• proven track record and reliability at large scale
• integrated lineup – SCGP + Shell Paques Gas Treating
Shell-Paques - aims to boost efficiency

- Applicable to natural gas, synthesis gas, acid gas
- Simple integrated process – little operator attendance – low energy consumption
- Pressure range 1-80 Bar - Less than 4 ppmv H2S can be achieved in the gas stream
- Intent is reducing project cost and enhancing efficiency
- Over 80 licensed units

Diagram:

Gas with H$_2$S → Scrubber → Gas without H$_2$S

Air → Biological Sulfide oxidizer → Air out, S$^0$
Shell Gasification authorised vendor base growing

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<th>1990's (Buggenum)</th>
<th>Operations Today</th>
<th>Projects Tomorrow</th>
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- Authorized equipment vendors expanded over SCGP technology deployment
- As technology track record grows, more authorized vendors coming to us
- Enables more competition than a single source, while maintaining quality standards
Shell clean coal energy related patent activity

R&D investment areas 2009
- Technology advancement; capex reduction, smart integration of multiple technologies, thermal efficiency improvement, and thus CO₂ reduction
- Materially invested in a plant at full commercial scale
- 50/50 JV with Sinopec
Our gasification teams support and share best practices

- Shell gasification excellence centres
- Dedicated bilingual experts in all locations
- Gasification Centers of excellence: Amsterdam Technology centre; Bangalore Design centre; Beijing Service centre; Gummersbach Gasification equipment design centre.
Shell and Essent: low CO\textsubscript{2} power plant

Project details
• 450-1000 megawatt low-CO\textsubscript{2} IGCC
• Location is Rotterdam area, Holland
• Integrated part of scope (H\textsubscript{2}/syngas, utilities)

Why are we doing this?
• Demonstrate CCS chain leadership (cost and technology)
• Take our responsibility in reaching the EU CO\textsubscript{2} emission reduction targets
• Use coal in a sustainable way to meet future energy demand
Shell Gasification: on an ever-increasing scale

In Operation
- 1,370,000 (10)
- 198,000 (3)

Total syngas volume in Nm3 syngas/hr
+ Number of gasifiers (in yellow)
Q2 2009

Construction
- 471,000 (3)
- 71,500 (1)
- 407,000 (3)

Design
- 1,694,507 (8)
- 169,167 (2)
- 550,000 (4)

Legend:
- 50,000–100,000 Nm3 syngas/hr
- 100,000–150,000 Nm3 syngas/hr
- 150,000–250,000 Nm3 syngas/hr
Vast experience in all elements of CO$_2$ storage

**Underground Gas Storage in Europe**
- Storage (and retrieval) of industrial gas in depleted gas fields
- Balancing N.W Europe gas market

**CO$_2$-EOR operations in Denver Unit, USA**
- Tertiary oil recovery using CO$_2$ in USA (Texas), pioneered by Shell in 1970
- Large scale CO$_2$ compression, transport & injection

**Sour Gas Injection in Harweel/Birba, Oman**
- Almost 100 BCF of sour gas injected at pressures over 7,000 psi
- Multiphase transportation over 69 km
IGCC + 90% CCS today

IGCC LHV Efficiency: 36.4% based on in house study

El Cerrejon coal with CGE ~82%, MHI701F4, Selexol, Sour Shift
**IGCC + 90% CCS tomorrow**

4.5-5% LHV efficiency improvement potential for Future IGCC + CCS
Based on application of new technology
This widens the efficiency gap with post combustion CCS solutions

El Cerrejon coal: New IGCC technology
Meeting tomorrow’s energy challenge TODAY