Global Coal Solutions with Gasification

DeLome Fair – GM, Gasification Business
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GE is Advancing Gasification Technology for New Regions and Applications
GE’s IGCC solution

**Flexible fuels**
- Coal
- Pet. Coke
- Heavy Oil
- Blends

**Integrated configuration**

**Reliable Products**
- Power
- Steam
- Hydrogen
- CO₂ (for EOR)

- Features GE gasification and syngas power block technology and equipment
- Configured for increased efficiency, availability, and operability
- Low emissions
IGCC success

Successful integration of Gasifier, Power Island and ASU
- Equipment ran in unison on first attempt
- Time-to-maturity reduction on track

IGCC demonstrated at commercial scale
- Plant demonstrated dual train operation
- Full plant demonstration and performance testing soon

Technology enhancements demonstrated
- Higher efficiency (advanced RSC)
- Improved availability (GEN II refractory)
- Increased operability (controls, OTS)

Above statements compared to prior GE Technology
Global coal usage

- **2012**
  - ~75% of coal used for power (total of 1,800 GW: 770 GW China, 330 GW US, 140 GW Western Europe, 140 GW India), and remainder others
  - ~10-15% steel
  - ~5-10% Coal-to-Chemicals and others

- **2020 est.**
  - ~80% of coal used for power (total of 2,300 GW: 1,100 GW China, 270 GW US, 120 GW Western Europe, 260 GW India), and remainder others
  - ~10% steel
  - ~5-10% Coal-to-Chemicals and others

Source: World Coal Association; IEA
Can coal IGCC compete with USCPC?

**USCPC today**
- Higher efficiency – 45% net plant LHV
- Competitive pricing – lower $ without carbon capture
- Criteria pollutant removal improving
- Technology for CO₂ capture not commercial

**To be competitive, coal IGCC must ...**
- Improve efficiency
- Drive costs down
- Solidify sequestration and utilization piece of CCUS

Above references are compared to prior GE technology
Global IGCC outlook

Up to 6 GW in 2013-22

US
- Carbon policy potentially positioning carbon capture

China
- Increased environmental requirements
- Water conservation a must
- Nominal CO₂ price expected
Gasification beyond IGCC
Coal-to-X
Coal-to-X today

Methanol

- Simplest alcohol ... one C atom
- Substitute for gasoline or diesel in automobiles
  - Low pollution, high performance
  - Versatile fuel ... economically attractive

Ammonia

- Basic building block for nearly all fertilizers that contain nitrogen
- Base compound for a variety of chemicals and solvents
Shenhua Baotou Coal to MTO

Location: Baotou, Inner Mongolia, China
Feedstock: Coal
Design Capacity: 352 t/h
Operation Pressure: 65 bar
Gasifier Size: 5 x 900 ft³ Quench
Coal to X - future

**Coal-to-Substitute NG (SNG)**

*Where:* Coal & power demand separate

*When:* NG > $12/MMBTU

*Needed:* Low rank coal capability

**Coal-to-Liquids**

*Where:* Limited availability to traditional fuels

*Needed:* Large projects required for economics
Coal-to-X outlook

Environment
• Improve efficiency
• Eliminate secondary combustion
• Lower water utilization
• Improve waste water quality

Reliability
• Improve Reliability
• Maintain time-to-maturity

Feed & Requirements
• Expand coal envelope – higher moisture and ash
• Transition from \( \text{NH}_3 \), MeOH to SNG, CTL, etc.

Above references are compared to prior GE technology

Chemical polygeneration is potential stepping stone to IGCC
Gasification industry

Conditions and potential

**US**
- Natural Gas abundance
- Policy pressure on Coal Potential
- POx, GTL, IGCC
- Biomass

**Coal**

**EU**
- increased coal use
- Reduced refining
- Power demand low Potential
- Limited

**Refined products**

**China**
- Refinery build out?
- NG constraints Potential
- Coal-to-X
- IGCC/Polygen

**Low Rank Coal**

**S. America**
- Increased Refining Potential
- Petcoke abundance
- Biomass

**ME**
- Deeper Refining Potential
- Heavy Oil / Petcoke
- Limited GTL

**India**
- Refining up
- NG prices high Potential
- Petcoke -> Polygen
- Biomass

**Russia**
- Phase out subsidized NG Potential
- Coal-to-X

**SE Asia**
- Low Rank Coal Potential
- Biomass

**Low Rank Coal**
Installed fleet by the numbers

GE has 155 gasifiers in commercial operation ... the largest fleet in the industry ... with 95 additional gasifiers in development, engineering, or construction at 25 plants ... and a global presence in 15 different countries.
GE Gasification update

High Pressure Quench
• Pressure up to 87 bar
• No syngas compression required for MeOH

Radiant Syngas Cooler
• Proven design in IGCC
• Design for coal-to-chemical industry
• Increases plant efficiency by up to 4%
• Takes advantage of proven full system approach

Extended Slurry
• Provides system-level gasification performance improvement
• Increases plant efficiency on lower rank coals
• Expands coal envelope to include higher moisture coals
• Offers same proven slurry reliability and availability

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imagination at work