Siemens Gasification Technology: Improving Plant Economics Through Performance
Agenda

Gasification trends and opportunities

Project update

Technology update

Conclusions
Gasification Trends and Opportunities
Trends in the Global Gasification Market

North America:
- The preference of natural gas (shale gas) to feed chemical plants is giving a negative impact for gasification projects
- Only subsidised projects
- High construction costs
- 2-3 potential new projects

South-America:
- Opportunities for BtL/BtE, e.g. bagasse from sugar plantations of Brazil
- Coal gasification is part of Chile energy master plan
- 1+ potential new project

Western Europe
- Focus on biomass to liquid projects subsidised by European and national programs but moving slow

China
- Large coal reserves, no access to cheap NG/LNG
- High industrial need of chemicals and fuels
- > 30 potential new projects

Arabia/India/Turkey:
- Reliance and Saudi Aramco decided to invest into large refinery based gasification projects
- Worldwide Petcoke production expected to grow with 4% p.a.

Asia / Australia
- High LNG price driver
- Several projects in Korea, Mongolia, Indonesia, Vietnam and Philippines under construction or development
- > 8 potential new projects

Polygeneration, IGCC (with CCS)

Coal to Chemicals

Refinery gasification

Biomass to Energy/Liquids - BtE/BtL
Siemens Gasification Project Landscape

- Siemens Offices
- Operating Units
- Current Projects
- Technology Selected

9 SFG-500 gasifiers shipped/installed for 3 projects
32 SFG-500 gasifier under manufacturing or shipped
Shenhua Ningxia Coal Group’s Ningxia Coal-to-Polypropylene Project (NCPP)

**Coal features**
- Sub-bituminous coal
- Ash content: typ. 10–20 wt%, min.-max. 7–28 wt%
- Moisture: <30 wt%

**Performance features**
- Gasifier operation mode: 4 (in operation) + 1 (standby)
- Dry coal input: 85 t/h per gasifier
- Total syngas output: 540,000 Nm³/h (CO+H₂)
- Methanol output target: 5,000 t/d

[Image of the project site with labels for Air separation units, Power station, Methanol-to-polypropylene, Black water treatment, and Gasification (5xSFG-500)]
NCPP Status

SFG-500 achievements

- longest continuous single gasifier runtime: 109 days
- longest continuous plant runtime (4+1): 183 days
- total achieved plant availability: 92%
- CO + H₂ content (effective syngas): > 92%
- fast start-up / shut-down capabilities: < 2 h
- high fuel flexibility: up to 22 % ash content

Commercial operation and high availability since 2012
In average more than 5,300 t/d methanol production achieved
CPI – 2 billion SNG / Year

Scope of supply

- Basic Engineering (PDP, BEDP)
- 8 x sfg-500 Gasifiers and Feeder Vessels
- 12 Combined Burners (4 spare)
- Operator Training
- Start-up support (Technical Field Assistance)

Project features and updates

- Lowers dependency on Natural Gas imports by using local resources
- Project moved from Yinan to Huocheng keeping SFGT hardware and SNG output unchanged: 2 bio Nm³/a (1st of 3 equal project phases)
- Siemens proprietary equipment localized and manufacturing and shipping of gasifiers, feeder vessels and burners almost completed
- Coal/Ash changed but still sub bituminous coal with <30 wt% moisture
- Final environmental and permission planning ongoing

Customer: CPI – China Power Investment Corp.
Location: Xinjing, China
Plant type: Coal to Natural Gas
Configuration: 8 x SFG-500 Gasifiers
Com. operation: COD 2016
Shenhua Ningxia Coal Group’s 80,000 BBL/d CTL Project

Facts and Figures
- Gasifier manufacturing in China
- 24 x 500 MW SFG gasifiers

Input / Output
- > 2,300 t/h coal input
- > 2,700,000 Nm³/h syngas
- 110 t/h Naphtha
- 352 t/h Diesel
- 42 t/h LPG

Schedule
- PDP finished
- Hardware procurement ongoing
- Construction started
- 2016: Commissioning

Facts and Figures
- Gasifier manufacturing in China
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IGCC Projects

**Summit Power**
Texas Clean Energy Project
- 400 MW\textsubscript{egross}, UREA, CO\textsubscript{2}
- 90% carbon capture
- Siemens scope:
  - SFG-850 gasifier
  - SGCC6-8000H 1x1 power island operating on blend of syngas and natural gas
- Plant Operation and Maintenance services
- Located directly atop Permian Basin and CO\textsubscript{2}/EOR opportunities

**Mississippi Power**
Plant Ratcliffe IGCC Project
- 582 MW\textsubscript{enet}
- ~65% carbon capture (~3 M tons of CO\textsubscript{2}/year)
- Siemens scope:
  - Two SGT6-5000F Gas Turbine Generators
  - Will Operate on high H\textsubscript{2} syngas as the primary fuel and natural gas as the backup/startup fuel
  - Will include capability to extract air for integration with the air-blown gasifier
- Located in Kemper Co., Mississippi

**Huaneng Greengen Co. Ltd.**
Tianjin IGCC Project
- 265 MW\textsubscript{egross}
- In operation, CCS to be included in later phase
- Siemens scope includes one SGT5-2000E gas turbine and auxiliaries
  - Main fuel: Coal-based syngas
  - Secondary fuel: Fuel oil
- Located in Tanggu District, Tianjin, China

**Saudi Aramco**
Jazan IGCC Project
- 4,000 MW\textsubscript{e gross}, 2,400 MW\textsubscript{e net}
- Integrated with Saudi Aramco's Jazan Refinery which will process 400,000 bpd of Arabian Heavy and Arabian Medium crude oil
- Siemens Scope:
  - 5 SGCC6-5000F 2x1 Thermal Islands
  - Main Fuel: Residual-based syngas
  - Secondary fuel: Fuel oil

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Simple and Reliable System for a Wide Range of Different Feedstock

Siemens Fuel Gasification Technology
Latest Developments

Design to Cost
- Reduction of lock hoppers
- Simplified gas cleaning concept
- Optimized plant layout
- Optimized material concept
- Reduction of instrumentation and valves

Lessons learned
- Jet Scrubber instead of first venturi Scrubber
- Improved guide tube design and burner design
- Optimized coal fluidization and coal feeding control
Evolution instead of Revolution

Product Development Process
Systematic implementation of review processes to ensure product performance

SFG-850MW next generation gasifier available
minimize CAPEX and increase performance
New size for improved CAPEX but still transportable fully assembled

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<tr>
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<th>SFG-500</th>
<th>SFG-850</th>
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<tr>
<td><strong>Coal Input, t/d</strong></td>
<td>2,000</td>
<td>3,000</td>
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<td><strong>Operation Pressure, bar(a)</strong></td>
<td>42 – 44</td>
<td>46</td>
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<td><strong>Syngas output, Nm³/h</strong></td>
<td>130,000</td>
<td>210,000</td>
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<td><strong>Dimensions, m (OD x L)</strong></td>
<td>4 x 20</td>
<td>4.8 x 22.4</td>
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<tr>
<td><strong>Weight, t</strong></td>
<td>240</td>
<td>380</td>
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<td><strong>gasifier material</strong></td>
<td>carbon steel (SA 516)</td>
<td>carbon steel (SA 516)</td>
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New flexible Low Steam CO-Shift Concept jointly developed by Siemens/Clariant

- No additional steam
- No condensation
- High flexibility for inlet Steam/Gas ratio

Pre-Shift Catalyst
- Leading to high efficiency and cost reduction

Highly attractive for Methanol and SNG synthesis
Selective Laser Melting and 3D Design
Innovative technology for increased customer value

**Gasification Innovation**
- High-nickel alloy material
- Qualified welding procedure test (TÜV)
- FEM stress calculation for static pressure
- CFD simulation of thermal behavior
- Extremely high material strength
- Manufacture of a water cooled burner
- Hot operation approval (TÜV)
- Customer site test since 04-Aug-2014

**Cost effective and timely solutions for increased customer value**

**Selective Laser Melting Process**

- Metal powder
- Laser

SLM burner tip product
Conclusions

Global demand for gasification is still strong in markets where economics work

• Chemicals / SNG
• Transportation liquids
• IGCC + CCS

Advances in technology will provide more options and improved plant economics

• Innovations in gasification technologies are being developed based on lessons learned leading to better performance and reliability
• Polygeneration plants are helping to improve plant economics

Siemens is leveraging its 155 years of OEM and 50+ years of gasification know-how to develop gasification based solutions for tomorrow
Questions?

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