The CCG® Technology of CHOREN

Entrained flow carbon gasification concepts of CHOREN Industries

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Introduction – CHOREN Industries
CCG – CHOREN’s Clean Carbon Gasification
Gasification Applications
Technological options
CHOREN Fact Sheet

- **C**-Carbon, **H**-Hydrogen, **O**-Oxygen, **REN**-Renewable → **CHOREN**

- Private Company in partnership with Shell, Daimler and Volkswagen (minority shareholders)

- Based in Germany in **Freiberg, Saxony** with offices in **Hamburg, Beijing, Houston**

- Founded **1990** by **Dr. Bodo Wolf** and 3 employees from DBI

- 1997 company focuses on **gasification as core competence** (SynGas Producer) and builds pilot plant

- CHOREN Industries GmbH founded in 2000. Today over **280 employees**

- **Capital employed > € 200m**
CHOREN Group Structure *

Subsidiary companies

- CHOREN Industries GmbH
- CHOREN Biomass GmbH
- CHOREN Components GmbH
- CHOREN Technologies GmbH
- CHOREN Export GmbH
- CHOREN USA LLC
- CHOREN Fuel Freiberg GmbH & Co. KG

Project Companies

- Others are being planned
- Others are being planned
- Others are being planned

* simplified version
After German Reunification former DBI know-how employees accumulate around Dr. Bodo Wolf including leading engineering competence of gas conglomerate ‘Schwarze Pumpe’ (GSP)

Research targets the improvement in development of the GSP gasifier for sludge and organic waste drying

R&D work leads to improved coal gasification system and development of proprietary Carbo-V® biomass gasification system

Component manufacturing for 3rd parties (e.g. vessel and component fabrication for Sustec/Future Energy, today SIEMENS)

2007 First CCG project in China, 2*400 MW coal gasifiers for repowering project in Ammonia facility commissioning in 2010
CHOREN’s 400 MWth CCG Technology

Dry-feed entrained coal gasifier for high efficiency

Advantages:
- Entrained Flow Coal Gasifier
- Slagging gasifier: protective slag layer
- High ash content flexibility
- High quality synthesis gas, no condensates
- Dry dust gasifier advantages

Technical Specs:
- Up to 1,500 t/d per unit
- 40 bar (580 psig)
- Up to 93 % CO + H₂
- **Up to 35 % ash content**
- Ash melting points of 1,400 °C or higher with fluxing agents
- Burner lifetime up to 4 years (yearly inspections)
- Cooling screen lifetime up to 10 years

First Project Awarded:
- China – Ammonia reformer repowering 2 x 400 MW CCG gasifiers awarded in 2007
Developments in dust-gasification under pressure Basis

- specific and detailed analysis of the 20 years of operational experience in dust-/slurry-gasification in Gaskombinat Schwarze Pumpe, Germany

Development trends:

- flexible use of different coal qualities with the aim to use coals rich in ash and halogen
- gasification process for integration in electricity production (IGCC) as well as in XtL-production
- gasification under high operating pressure = synthesis units operated > 30 bar
Developments in dust-gasification under pressure

Dust dosing - FLUSOMET®

- use of high density flow transport with a dust load of 400 kg/m³ carrier gas
- exactly adjustable dosing of fine-grained, powdery material
- mass flow control of cohesive and not cohesive dusts
- control range of 180 – 48,000 kg/h per control range
- multiple dosing out of a dosing tank with a different capacity per line
Developments in dust-gasification under pressure

Multiple Burners – Pilot burner

Basic outline

- Flame monitoring
- Electrical ignition
- Flushing gas
- Burning gas
- Cooling water inlet
- Cooling water outlet
- Oxygen + steam

Diagram showing the components of the pilot burner with labels for each part.
Developments in dust-gasification under pressure

Multiple Burners – Coal burner
## Developments in dust-gasification under pressure

### Multiple burners

1. 1 pilot burner
   - electrical ignition burner
   - flame monitoring
   - gas burner

2. 2 – 4 dusty coal burner

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*combination:*

1. dusty coal burner
2. fuel oil burner
3. fuel oil burner
4. pilot burner (electrical ignition burner, flame monitoring, gas burner)

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- Multiple feedstock
- Production safety
- Wide range of operation load
- Even distribution of feedstock
- Quicker conversion
Developments in dust-gasification under pressure
Quenching system

- flash-quenching at slag drain
- main raw gas outlet in quenching zone
- innovative injector system
- intelligent separation of gas & solid matter
- optimal use of vessel volume
Developments in dust-gasification under pressure

CHOREN’s Focus

1. Reactor design for 300 – 500 MW_{th}

2. Dust fluidisation and dust dosing with FLUSOMET® (own patent)

3. Burner and burner system design concerning part load, safety design

4. Re-design of the quenching system
C Grinding
70 t/h
90 % 65 μm
100 % 200 μm

Gasification
40 bar
Thermal efficiency η 76 %
100,000 Nm³/h (dry)

ASU

Gas washing & cooling
95 % CO+H₂
5 % N₂
100,000 Nm³/h

H₂O Treatment

Gas for pilot burner
1,000 Nm³/h

Steam
2 t/h

O₂
30,000 Nm³/h 45 bar

N₂
16,000 Nm³/h 50 bar

Fresh water
80 Nm³/h

Slag 12 t/h
C content. < 1 %

Water exit
20 Nm³/h

Sludge
1.5 t/h

Synthesis

O₂
30,000 Nm³/h 45 bar

N₂
16,000 Nm³/h 50 bar

Fresh water
80 Nm³/h
Synthesis Gas Derived Products

Synthesis Gas
\[ \text{H}_2 \text{+ CO + CO}_2 \]

- **Sequestration**
  - Food grade CO\(_2\)
  - NH\(_3\)
  - Ammonia
  - CO\(_2\)
  - Carbon dioxide

- **Chemicals**
  - NH\(_4\)NO\(_3\)
  - Ammonium nitrate
  - HNO\(_3\)
  - Nitric acid
  - NH\(_3\)
  - Ammonia
  - H\(_2\)O\(_2\)
  - Hydrogen peroxide
  - H\(_2\)
  - Hydrogen
  - CO
  - Carbon monoxide
  - HCOOH
  - Formic acid
  - Cl\(_2\)CO
  - Phosgene

- **Synthesis Gas Products**
  - H\(_2\)N-(C=O)-NH\(_2\)
    - Urea
  - NH\(_4\)NO\(_3\)
  - L\(_2\)
    - Liquid Hydrogen
  - CGH\(_2\)
    - Compressed Gaseous Hydrogen
  - H\(_2\)C=CH-CH\(_3\)
    - Propylene
  - H\(_2\)C=CH\(_2\)
    - Ethylene
  - CH\(_4\)
    - Synthetic methane
  - SNG
  - (+CH\(_2\))\(_n\)
    - Hydrocarbons
  - LCO\(_2\)
    - Food grade CO\(_2\)
  - R-H\(_2\)C-CH\(_2\)-CHO
    - Aldehydes
  - R-H\(_2\)C=CH\(_2\)
    - Hydroformylation
  - H\(_3\)C-O-CH\(_3\)
    - Dimethylether
    - DME
  - H\(_3\)C=O
    - Formaldehyde
  - H\(_2\)C=OH
    - Methyl chloride
  - H\(_3\)C-OH
    - Methanol
  - H\(_3\)C-COOH
    - Acetic acid
  - H\(_3\)C-CO-O-CH\(_2\)CH\(_3\)
    - Ethyl acetate
  - H\(_3\)C-CO-O-CO-CH\(_3\)
    - Acetic acid anhydrate
  - LPG
  - MTBE
  - Kero
  - Diesel
  - Light Wax
  - SynLubes
  - Heavy Wax
  - Naphtha
  - Thermal Heat
  - Gas turbine
  - IGCC
  - Electric Power
Synthesis Gas Derived Products

Synthesis Gas
\( \text{H}_2 + \text{CO} + \text{CO}_2 \)

- **Ammonium nitrate** (\( \text{NH}_4 \text{NO}_3 \))
- **Liquid Hydrogen** (\( \text{LH}_2 \))
- **Compressed Gaseous Hydrogen** (\( \text{CGH}_2 \))
- **Ammonia** (\( \text{NH}_3 \))
- **Hydrogen peroxide** (\( \text{H}_2 \text{O}_2 \))
- **Carbon dioxide** (\( \text{CO}_2 \))
- **Nitric acid** (\( \text{HNO}_3 \))
- **Formaldehyde** (\( \text{H}_2 \text{C}=\text{O} \))
- **Methanol** (\( \text{H}_3 \text{C}-\text{OH} \))
- **Acetic acid** (\( \text{H}_3 \text{C}-\text{COOH} \))
- **Acetic acid anhydrate** (\( \text{HCOOH} \))
- **Hydrogen peroxide** (\( \text{H}_2 \text{O}_2 \))
- **Ethylene** (\( \text{H}_2 \text{C}=\text{CH}_2 \))
- **Polypropylene** (PP)
- **Melamine**
- **Formaldehyde** (\( \text{H}_2 \text{C}=\text{O} \))
- **Methyl chloride** (\( \text{H}_2 \text{C}-\text{Cl} \))
- **Dimethylether** (DME)
- **Melamine resin**
- **Ethanol** (\( \text{H}_3 \text{C}-\text{CH}_2 \text{OH} \))
- **Ethyl acetate**
- **Urea**
- **Ammonium nitrate** (\( \text{NH}_4 \text{NO}_3 \))
- **Compressed Gaseous Hydrogen** (\( \text{CGH}_2 \))
- **Ammonia** (\( \text{NH}_3 \))
- **Hydrogen peroxide** (\( \text{H}_2 \text{O}_2 \))
- **Carbon dioxide** (\( \text{CO}_2 \))
- **Nitric acid** (\( \text{HNO}_3 \))
- **Formaldehyde** (\( \text{H}_2 \text{C}=\text{O} \))
- **Methanol** (\( \text{H}_3 \text{C}-\text{OH} \))
- **Acetic acid** (\( \text{H}_3 \text{C}-\text{COOH} \))
- **Acetic acid anhydrate** (\( \text{HCOOH} \))
- **Polypropylene** (PP)
- **Melamine**
Synthesis Gas Derived Products

Synthesis Gas
\[ \text{H}_2 + \text{CO} + \text{CO}_2 \]

**Chemicals**
- **Formaldehyde** \( \text{CH}_2=\text{O} \)
- **Methanol** \( \text{H}_3\text{C-OH} \)
- **Acetic acid** \( \text{H}_3\text{C-COOH} \)
- **Methyl chloride** \( \text{H}_3\text{C-Cl} \)
- **Dimethylether (DME)** \( \text{H}_3\text{C-O-CH}_3 \)
- **Propylene** \( \text{H}_2\text{C}=\text{CH-CH}_3 \)
- **Acetic acid anhydrate** \( \text{H}_3\text{C-CO-O-CO-CH}_3 \)

**Fuel**
- **MTBE**
- **Ethanol** \( \text{H}_3\text{C-CO-OCH}_2\text{CH}_3 \)
- **Propylene** \( \text{H}_2\text{C}=\text{CH-CH}_3 \)

**Petro-Chemistry**
- **Liquid Hydrogen** \( \text{LH}_2 \)
- **Compressed Gaseous Hydrogen** \( \text{CGH}_2 \)
- **Propylene** \( \text{H}_2\text{C}=\text{CH-CH}_3 \)
- **Acetylene** \( \text{HC}≡\text{CH} \)
- **Ethylene** \( \text{H}_2\text{C}=\text{CH}_2 \)

**Other Products**
- **Ammonia** \( \text{NH}_3 \)
- **Ammonium nitrate** \( \text{NH}_4\text{NO}_3 \)
- **Nitric acid** \( \text{HNO}_3 \)
- **Formic acid** \( \text{HCOOH} \)
- **Phosgene** \( \text{Cl}_2\text{CO} \)
- **Liquid Hydrogen** \( \text{LH}_2 \)
- **Liquid Hydrogen** \( \text{LH}_2 \)
- **Ammonia** \( \text{NH}_3 \)
- **Formaldehyde** \( \text{H}_2\text{N}-(\text{C}=\text{O})-\text{NH}_2 \)
- **Urea**
- **Melamine**
- **Melamine resin**
- **Acetylene** \( \text{HC}≡\text{CH} \)
- **Ethylene** \( \text{H}_2\text{C}=\text{CH}_2 \)
- **Ethanol** \( \text{H}_2\text{C}-\text{CH}_2\text{OH} \)

**Sequestration**
- **CO2** Food grade
- **N₂**

**Synthesis Gas Turbine**
- **Electric Power**
- **IGCC**

**Synthetic Methane**
\( (-\text{CH}_2\text{CH}_3)_n \)

**Other Products**
- **Kero**
- **Diesel**
- **LPG**
- **LCO2** Food grade CO2
- **Compressed Gaseous Hydrogen**
- **Liquid Hydrogen**
- **Ammonium nitrate**
- **Nitric acid**
- **Formic acid**
- **Phosgene**
- **Ethylene**
- **Ethanol**
- **Acetic acid anhydrate**

**Petro-Chemistry**
- **Liquid Hydrogen** \( \text{LH}_2 \)
- **Compressed Gaseous Hydrogen** \( \text{CGH}_2 \)
- **Propylene** \( \text{H}_2\text{C}=\text{CH-CH}_3 \)
- **Acetylene** \( \text{HC}≡\text{CH} \)
- **Ethylene** \( \text{H}_2\text{C}=\text{CH}_2 \)
- **Aldehydes**
- **Dimethylether (DME)**
- **Methyl chloride**
- **Formaldehyde**
- **Propylene**
- **Acetic acid**
- **Acetic acid anhydrate**

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- **Ethylene**
- **Ethanol**
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- **Liquid Hydrogen**
- **Ammonium nitrate**
- **Nitric acid**
- **Formic acid**
- **Phosgene**
- **Ethylene**
- **Ethanol**
- **Acetic acid anhydrate**
Synthesis Gas Derived Products

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Synthesis Gas
H₂ + CO + CO₂

1. Urea (H₂N-(C=O)-NH₂)
2. Ammonium nitrate (NH₄NO₃)
3. Liquid Hydrogen (LH₂)
4. Compressed Gaseous Hydrogen (CGH₂)
5. Formaldehyde (H₂C=O)
6. Methanol (H₂C-OH)
7. Dimethyl ether (DME)
8. Melamine (H₃C-N=N-NH₂)
9. Propane (H₃C-C≡CH)
10. Ethylene (H₂C=CH₂)
11. Acetylene (HC≡CH)
12. Propylene (H₂C=CH-CH₃)
13. Methane (CH₄)
14. Nitric acid (HNO₃)
15. Ammonia (NH₃)
16. Carbon dioxide (CO₂)
17. Hydrogen peroxide (H₂O₂)
18. Hydrogen (H₂)
19. Carbon monoxide (CO)
20. Formic acid (HCOOH)
21. Methanol (H₂C-OH)
22. Ethanol (H₃C-CO-OH)
23. Acetic acid (H₃C-CO-OH)
24. Acetic acid anhydrate (H₃C-CO-O-CO-CH₃)
25. MTBE (H₃C-CO-O-CH₂CH₃)
26. Ethyl acetate (H₃C-CO-O-CH₂CH₂CH₃)
27. Polyolefin (PE & PP)
28. Polypropylene (PP)
29. Petrochemistry
30. Ammonium nitrate (NH₄NO₃)
31. Ethylene (H₂C=CH₂)
32. Acetylene (HC≡CH)
33. Hydrogen (H₂)
34. Liquid Hydrogen (LH₂)
35. Compressed Gaseous Hydrogen (CGH₂)
36. Formaldehyde (H₂C=O)
37. Methanol (H₂C-OH)
38. Dimethyl ether (DME)
39. Melamine (H₃C-N=N-NH₂)
40. Propane (H₂C=CH-CH₃)
41. Ethylene (H₂C=CH₂)
42. Carbon dioxide (CO₂)
43. Acetylene (HC≡CH)
44. Ethylene (H₂C=CH₂)
45. Methane (CH₄)
46. Nitric acid (HNO₃)
47. Ammonia (NH₃)
48. Carbon dioxide (CO₂)
49. Hydrogen peroxide (H₂O₂)
50. Hydrogen (H₂)
51. Carbon monoxide (CO)
52. Formic acid (HCOOH)
53. Methanol (H₂C-OH)
54. Ethanol (H₃C-CO-OH)
55. Acetic acid (H₃C-CO-OH)
56. Acetic acid anhydrate (H₃C-CO-O-CO-CH₃)
57. MTBE (H₃C-CO-O-CH₂CH₃)
58. Ethyl acetate (H₃C-CO-O-CH₂CH₂CH₃)
59. Polyolefin (PE & PP)
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62. Ammonium nitrate (NH₄NO₃)
63. Ethylene (H₂C=CH₂)
64. Acetylene (HC≡CH)
65. Hydrogen (H₂)
66. Liquid Hydrogen (LH₂)
67. Compressed Gaseous Hydrogen (CGH₂)
68. Formaldehyde (H₂C=O)
69. Methanol (H₂C-OH)
70. Dimethyl ether (DME)
71. Melamine (H₃C-N=N-NH₂)
72. Propane (H₂C=CH-CH₃)
73. Ethylene (H₂C=CH₂)
74. Carbon dioxide (CO₂)
75. Acetylene (HC≡CH)
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77. Methane (CH₄)
78. Nitric acid (HNO₃)
79. Ammonia (NH₃)
80. Carbon dioxide (CO₂)
81. Hydrogen peroxide (H₂O₂)
82. Hydrogen (H₂)
83. Carbon monoxide (CO)
84. Formic acid (HCOOH)
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86. Ethanol (H₃C-CO-OH)
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90. Ethyl acetate (H₃C-CO-O-CH₂CH₂CH₃)
91. Polyolefin (PE & PP)
92. Polypropylene (PP)
93. Petrochemistry
94. Ammonium nitrate (NH₄NO₃)
95. Ethylene (H₂C=CH₂)
96. Acetylene (HC≡CH)
97. Hydrogen (H₂)
98. Liquid Hydrogen (LH₂)
99. Compressed Gaseous Hydrogen (CGH₂)
100. Formaldehyde (H₂C=O)
101. Methanol (H₂C-OH)
102. Dimethyl ether (DME)
103. Melamine (H₃C-N=N-NH₂)
104. Propane (H₂C=CH-CH₃)
105. Ethylene (H₂C=CH₂)
106. Carbon dioxide (CO₂)
107. Acetylene (HC≡CH)
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110. Nitric acid (HNO₃)
111. Ammonia (NH₃)
112. Carbon dioxide (CO₂)
113. Hydrogen peroxide (H₂O₂)
114. Hydrogen (H₂)
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116. Formic acid (HCOOH)
117. Methanol (H₂C-OH)
118. Ethanol (H₃C-CO-OH)
119. Acetic acid (H₃C-CO-OH)
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123. Polyolefin (PE & PP)
124. Polypropylene (PP)
125. Petrochemistry
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127. Ethylene (H₂C=CH₂)
128. Acetylene (HC≡CH)
129. Hydrogen (H₂)
130. Liquid Hydrogen (LH₂)
131. Compressed Gaseous Hydrogen (CGH₂)
132. Formaldehyde (H₂C=O)
133. Methanol (H₂C-OH)
134. Dimethyl ether (DME)
135. Melamine (H₃C-N=N-NH₂)
136. Propane (H₂C=CH-CH₃)
137. Ethylene (H₂C=CH₂)
138. Carbon dioxide (CO₂)
139. Acetylene (HC≡CH)
140. Ethylene (H₂C=CH₂)
141. Methane (CH₄)
142. Nitric acid (HNO₃)
143. Ammonia (NH₃)
144. Carbon dioxide (CO₂)
145. Hydrogen peroxide (H₂O₂)
146. Hydrogen (H₂)
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148. Formic acid (HCOOH)
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150. Ethanol (H₃C-CO-OH)
151. Acetic acid (H₃C-CO-OH)
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153. MTBE (H₃C-CO-O-CH₂CH₃)
154. Ethyl acetate (H₃C-CO-O-CH₂CH₂CH₃)
155. Polyolefin (PE & PP)
156. Polypropylene (PP)
157. Petrochemistry
158. Ammonium nitrate (NH₄NO₃)
159. Ethylene (H₂C=CH₂)
160. Acetylene (HC≡CH)
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162. Liquid Hydrogen (LH₂)
163. Compressed Gaseous Hydrogen (CGH₂)
164. Formaldehyde (H₂C=O)
165. Methanol (H₂C-OH)
166. Dimethyl ether (DME)
167. Melamine (H₃C-N=N-NH₂)
168. Propane (H₂C=CH-CH₃)
169. Ethylene (H₂C=CH₂)
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174. Nitric acid (HNO₃)
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187. Polyolefin (PE & PP)
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196. Formaldehyde (H₂C=O)
197. Methanol (H₂C-OH)
198. Dimethyl ether (DME)
199. Melamine (H₃C-N=N-NH₂)
200. Propane (H₂C=CH-CH₃)
201. Ethylene (H₂C=CH₂)
202. Carbon dioxide (CO₂)
203. Acetylene (HC≡CH)
204. Ethylene (H₂C=CH₂)
205. Methane (CH₄)
206. Nitric acid (HNO₃)
Synthesis Gas Derived Products

Synthesis Gas: \( \text{H}_2 + \text{CO} + \text{CO}_2 \)
Synthesis Gas Derived Products

H₂N-(C=O)-NH₂ → Urea
NH₄NO₃ → Ammonium nitrate
LH₂ → Liquid Hydrogen
CGH₂ → Compressed Gaseous Hydrogen

NH₃ → Ammonia
H₂O₂ → Hydrogen peroxide
CO₂ → Carbon dioxide

Hydrogen (H₂)

Sequestration

LCO₂ → Food grade CO₂
R-H₂C-CH₂-CHO → Aldehydes

Synthesis Gas
H₂ + CO + CO₂

Chemicals

H₂C=O → Formaldehyde
H₂C-OH → Methanol
H₃C-O-CH₃ → Dimethylether (DME)
H₃C-Cl → Methyl chloride
H₃C=CH-CH₃ → Propylene

Petroleum Chemistry

H₂C=CH-CH₃ → PE & PP (Polyolefine)
H₂C=CH₂ → Ethylene
H₂C=CH 

Acetylene

Hydroformylation

H₂C-CH₂ 

Hydrocarbons

(-CH₂)ₙ

Hydrocarbons

Synthetic methane (SNG)

Naphtha

Kero

Diesel

Light Wax

SynLubes

Heavy Wax

Gas turbine

IGCC

Heat

Electric Power

H₂ + O₂ → Hydrogen peroxide

NH₃ → Ammonia

H₂O → Water

Nitric acid (HNO₃)

Solutions
CHOREN staff - Know-how and background
“DBI & Gaskombinat Schwarze Pumpe”

- Process engineering
- Plant layout
- Construction
- Manufacturing of components
- Commissioning
- + about 20 BETA plant operators
Performance Test and Delivery of Key Equipment
2 x 400 MW\textsubscript{th} China Project · Q1/2009
Biomass Gasification for GHG Footprint Reduction and Energy Security

Exploiting Opportunities of Biomass Availability

Biomass, Recycle Wood, MSW, etc.

Feedstock Mix Carbon Content

Green 100 %

Gas Clean-up

Product Conversion

Product Cycle GHG Emissions

Green Fossil

+CCS?
Coal SynGas Feed (CtX)

Exploiting Opportunities of Coal Availability

coal / pretreated biomass

Two Phase Coal Gasification

Ammonia
Methanol
Electricity
Synthetic Diesel
Synthetic Kerosene
Chemicals
Biomass and Coal: Enabling Energy Security and GHG Emission Reduction

Capitalizing on Economies of Scale by Mixing Biomass and Fossil Feeds
CHOREN Gasification Application Overview

Feedstock Prep and Handling
- Biomass
- Waste
- Coal
- Pet coke / Residuals

Entrained Flow Gasification Carbo-V® and CCG (Coal)

Gas Cleanup

Product Conversion Technologies*
- Synthesis Gas
- Methanol
- Ethylene
- Propylene
- Acetic Acid
- H₂
- DME
- Ammonia
- Ethanol
- Urea
- SNG
- FT-Products
- Power / Steam

Utility Integration

*Non-exhaustive technologies list for clarity
CHOREN’s scope of supply for gasification projects

- PDP for coal sluice and -dosing, gasification, optional gas scrubbing (wet dedusting)
- Detail engineering for specific equipments (e.g. reactor)
- Supply with special equipment
- Technical service whilst construction, assembling and commissioning
- Safter-sales services
Business model and partnerships

CHOREN Technologies GmbH
Technology Development

CHOREN Components GmbH
Engineering & Construction

CHOREN Biomass GmbH
Biomass Logistics

Project SPVs
Project Ownership

BtL
Licensing, FEED packages & Engineering Services

BtE
Component manufacturing

CtC
Biomass trading & consulting

XtX
Ownership and operations of production plant

Strategic Partnerships

Shell
Volkswagen
Daimler
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