Diverse applications

Feedstocks
- Coal
- Pet coke
- Asphalt
- Heavy Oil
- Vacuum Residue
- Natural Gas

Syngas \((\text{H}_2+\text{CO})\)

- **Power (IGCC)**
  - Greenfield
  - Polygen
  - Refueling
  - Site repowering
- **Refineries**
  - Hydrogen
  - Steam
  - Power
- **Chemicals**
  - Methanol
  - Formaldehyde
  - MTBE
  - Acetic acid
  - Amine
  - DME
  - Urea
  - Ammonia nitrate/sulfate
  - Oxochemicals: Butanol, Ethylhexanol
- **Methanation**
  - Substitute natural gas
- **Coal to liquids**
  - Transportation fuels
Gasification leadership

Over 65 facilities and 145 gasifiers operating worldwide

Experience

• First coal gasification plant in 1978
• First pet coke gasification plant in 1984
• 30 gas turbines operating on syngas ... > 1 million operating hours
• IGCC leader... >3 GW with GE Energy technologies
• 35 projects globally that separate and capture CO₂

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Shenhua Baotou: MTO facility

- China Shenhua Coal to Liquid and Chemical Co. Ltd., Baotou, Inner Mongolia
- 5 GE 900 ft$^3$ gasifiers + 2 spares
- Successful start-up in summer 2010 ...
  PDP delivery May ’07, large bore inspection Oct. ’09
- 1.8MMTPY of methanol per year from syngas (at full production)

Largest coal to olefins plant in the world.
Integrated gasification combined cycle

Five basic systems

Gasification

Syngas Cooling

Syngas clean-up

Air separation system

Combined cycle system

Coal

Slag

O₂

Air/N₂

Heat

Clean fuel

Electricity

CO₂

Sulfur

Hg

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Key IGCC milestones

• Cool Water Demo Plant 1984
  • First Large Scale (120MW) IGCC
  • Demonstrated IGCC technical feasibility

• Polk Tampa Electric 1996
  • Process heat and ASU/GT N2 integration.
  • 250MW - demonstrated IGCC commercial feasibility

• Duke Energy Edwardsport
  • Startup 2012
  • 618MW at 38.4% HHV
  • 3 year construction
  • FOAK IGCC commercial deployment
Global IGCC Deployment

- Frontier Refinery (1996) 40 MW
- Coolwater 2 (1984) 120 MW
- LGTI 2 (1987) 208 MW
- TECO Polk (1996) 250 MW
- Duke Edwardsport 1 618 MW
- ELCOGAS (1998) 300 MW
- Wabash (1996) 250 MW
- Motiva 1 (2000) 180 MW
- Mississippi Power 1 583 MW
- Sarlux (2001) 550 MW
- ENIPower (2006) 250 MW
- Shell Pernis (1997) 120 MW
- SVZ 2 (1996) 70 MW
- STEAG 2 (1972) 163 MW
- SUV Vresova (1996) 350 MW
- GreenGen 2 (2006) 250 MW
- Nuon Buggenum (1995) 253 MW
- ISAB Energy (1999) 521 MW
- API Energia (2001) 280 MW
- ENIPower (2006) 250 MW
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1 Under construction
2 Demonstration plant
3 Discontinued operation

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Experience in CO₂ capture

Proven Gasification
- 68 GE licensed gasification units operating worldwide
  - 21 with solid feedstock

Proven Shift
- 35 GE licensed gasification units operating worldwide using shift reaction to produce H₂
  - 19 with solid feedstock

Proven Capture
- 35 GE licensed units operating worldwide removing CO₂ from shifted syngas
  - 19 with solid feedstock

Proven Turbines
- 30 GE gas turbines operating at 50%+ H₂
- F-class combustion validation up to 90% H₂
Polygeneration

Can provide any combination of:
- Power
- Cleaner CO$_2$ for EOR or sequestration
- Steam (refinery, district heating, EOR)
- H$_2$ for hydrocracking
- Chemicals
- Desalination

Broad feedstock capability
- HFO
- Residuals
- Steam cracker bottoms
- Delayed pet coke

Proven in refinery/petrochemical settings
- Sarlux (power, steam, H$_2$, desalination)
- Exxon Singapore (power, steam, H$_2$)
- Singapore Syngas (CO for acetic acid, H$_2$ for refinery, power, steam)
IGCC and Gasification

Cleaner Coal Solutions