Technology Utilization:
Sustainable Power Generation with CMM Gas

Caterpillar Business Development Manager
Gaseous Low Energy Fuels
Electric Power Division
Outline

• Introduction to Caterpillar.
• CBM, CMM Utilization.
• Project Experiences.
• Why Sustainable Power Generation from CMM?
• Overview of Jincheng CMM cluster.
One powerful future.

11GW Gas Gensets (15 Years Population)

- 2.5GW: 3,800 units
- 3.3GW: 3,200 units
- 710MW: 1,200 units
- 710MW: 1,200 units
- 450MW: 370 units
- 2.5GW: 2,500 units

Transformed by 6 Sigma
One powerful future.

Product Support

• One of the best dealer distribution networks in the world.
• Fast Repair and Reduced Downtime.
  – Critical for Plant Economics.
  – Cannot be Compensated with Higher Efficiency.
• Worldwide Logistics
  – Parts Supply within 24 hours
• Service Contracts
  – Extended Service Agreements
  – Fleet Management
One powerful future.

Coal Mine Methane
One powerful future.

Project Example - North America Compression

Over 1000 Caterpillar Gas Engines in Coal Bed Methane Compression

Coal gas projects account for 7.5% natural gas in USA
Appin & Tower Coal Seam Methane Project

- BHP Appin & Tower coal mines are located in New South Wales. Two hours from Sydney.
- Construction commenced in July 1995
- Full capacity of 94 MW was achieved in September 1996
- Combined engine hours to date of 7,990,000
Caterpillar Coal Mine Methane Solutions

Energy Developments Limited
BHP Billiton’s Appin and Tower Coal Mines
New South Wales, Australia

- 96 megawatts electricity
  - 94 Cat 1,030 kW generator sets
  - 600,000 m³ per day of methane consumed
  - VAM feed to power plant
  - 3.4 M T CO₂ equivalent reduction /year

- 15 years of operation,
  - Over 100,000 operating hours
  - Major overhauls at 60,000 hours
  - Combined engine hours to date of >8,000,000
German Creek Project

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Caterpillar Coal Mine Methane Solutions

German Creek, Australia

- Anglo Mining Company
  Simple Cycle 32 MW (16x G3520C) Power Plant
- NO\textsubscript{X} Limit of 500 mg/Nm\textsuperscript{3}
- 690 V to 22 kV to 66 kV
Caterpillar Coal Mine Methane Solutions

South Park
South Yorkshire, England

- 24 MW (12 X G3520C) Power Plant
  - 2x units at 6 locations
- NO\textsubscript{X} Limit of 500 mg/Nm\textsuperscript{3}
- Parallel to the grid
- Operational November 2005
  - Over 40,000 hours of operation
- Application: Abandoned Coal Mine Methane
- Gas supplied by Anglo coal
- Modular solutions designed for quick installation and location flexibility.
Project Example – 4 MW at Manvers UK
CMM Power Generation Sites in China

2006-2010:, > 250MW installations

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**CMM Power Installations**

- **SRET**: 24xG3520C
- **Shaqu**: 14xG3520C
- **Yangquan Huweigou**: 3xG3520C
- **Jincheng Sihe**: 60xG3520C
- **Jincheng Meiganshi**: 21xG3520C
- **Jincheng Chengzhuang**: 10xG3520C
- **Huainan Pansan**: 2xG3520C
- **Xiyang**: 3xG3520C
- **Malan**: 2xG3520C
Project Overview

- Power plant Capacity: 120 MW
- Power Sold to Electricity Company: 840,000 MWhr/y
- Heat Recovery in Winter: 233,600 GJ
- Carbon Credits: 2.5 MMTCE to the World Bank’s Prototype Carbon Fund

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Project Scope

• 120 MW of 24/7 Continuous Electric Power and Steam Generation
  – Divided into 4 power houses of 30 MW Each
  – 60 x CAT 1.8 MW G3520C CMM Gas Engines
  – 16.5 Tons/hr of Superheated Steam Generation at 2.5 MPa and 400°C
  – 4 x 3 MW Steam Turbines and/or 10 MW of Hot Water for Winter Heating
  – 10.5 kV, 50 Hz Operation
  – Standard Grid Parallel
  – Full Load System Thermal Efficiency of 80%
Technology Selection Criteria

• Gas pressure requirement
  – High speed Engines 1 – 2 MW require 300-1000 mbar
  – Medium Speed Engines 3 – 6 MW range need 2 – 3 bar
  – Turbines (6 MW and above) need around 25 bar
    • Higher pressure requires more complex compression equipment.
    • More power needed just to boost compression.
    • Wasted Energy consumption affects overall efficiencies.
    • More safety concerns.
Caterpillar Gas Engines

• Key Technology Strengths
  – Robust core components based on more than 50 years of gas engine production experience
  – Reliable and prove design
  – Stable performance (±1% deviation in kW)
  – High efficiency (40 + %) in balance with high uptime and low Owning & Operating Cost.
  – Low emission (250/500 mg/Nm 3)
  – Tolerant to ambient changes
  – Tolerant to fuel changes
Jincheng CMM Power Generation Updates

- A total of three CMM power plants: 1) 120MW, 2) 42MW, and 3) 20MW in three locations with 91 x G3520C CMM units
- In 2010, three CMM power plants generated a total of 1.28B eKW-hr at an average of 89% availability
- In 2010, 45 out of the 91 x G3520C units has undergone scheduled Top End Overhaul.
- The customer is satisfied with the overall performance of the G3520C CMM generator sets.
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Thank You!