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Case Study: Green Gas DPB, Czech Republic
Integrated, large scale Mine Gas Management

Methane to Markets Partnership Expo, Beijing, China
30 October – 1 November 2007

Climate Mitigation with Methane
45 years experience in an emerging industry

Green Gas International

- Established end 2005 in partnership with G.A.S.
  - Acquired G.A.S. Energietechnologie, Germany and Hofstetter, Switzerland in December 2006
  - Partnership with MEGTEC Systems for VAM applications
  - Merged with OKD, DPB, a.s., Czech Republic in May 2007
- Fully integrated Methane Management capabilities supported by 450 employees
  - Coal mine gas fired capacity of 120 MW_{el} installed
  - Coal mine gas sales via pipeline of 75 million CH_4 m^3/a

G.A.S. Technology for Green Energy
HOFSTETTER
MEGTEC
OKD, DPB, a.s.

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Green Gas DPB, Czech Republic Key Figures

- Mine gas production: 75 million m^3/a (100% CH_4)
- Different sources of mine gas
  - CMM from 5 active coal mine complexes
  - AMM from 10 shafts and 4 wells
  - Carboniferous gas from 59 wells
- Operation of >200 km pipeline
- Mine gas sales to end users and production of electricity and heat
- Technical services for mining activities
  - Geological, gas drainage and gas reserves evaluation services
  - In-mine and surface drilling services

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Mine Gas Production

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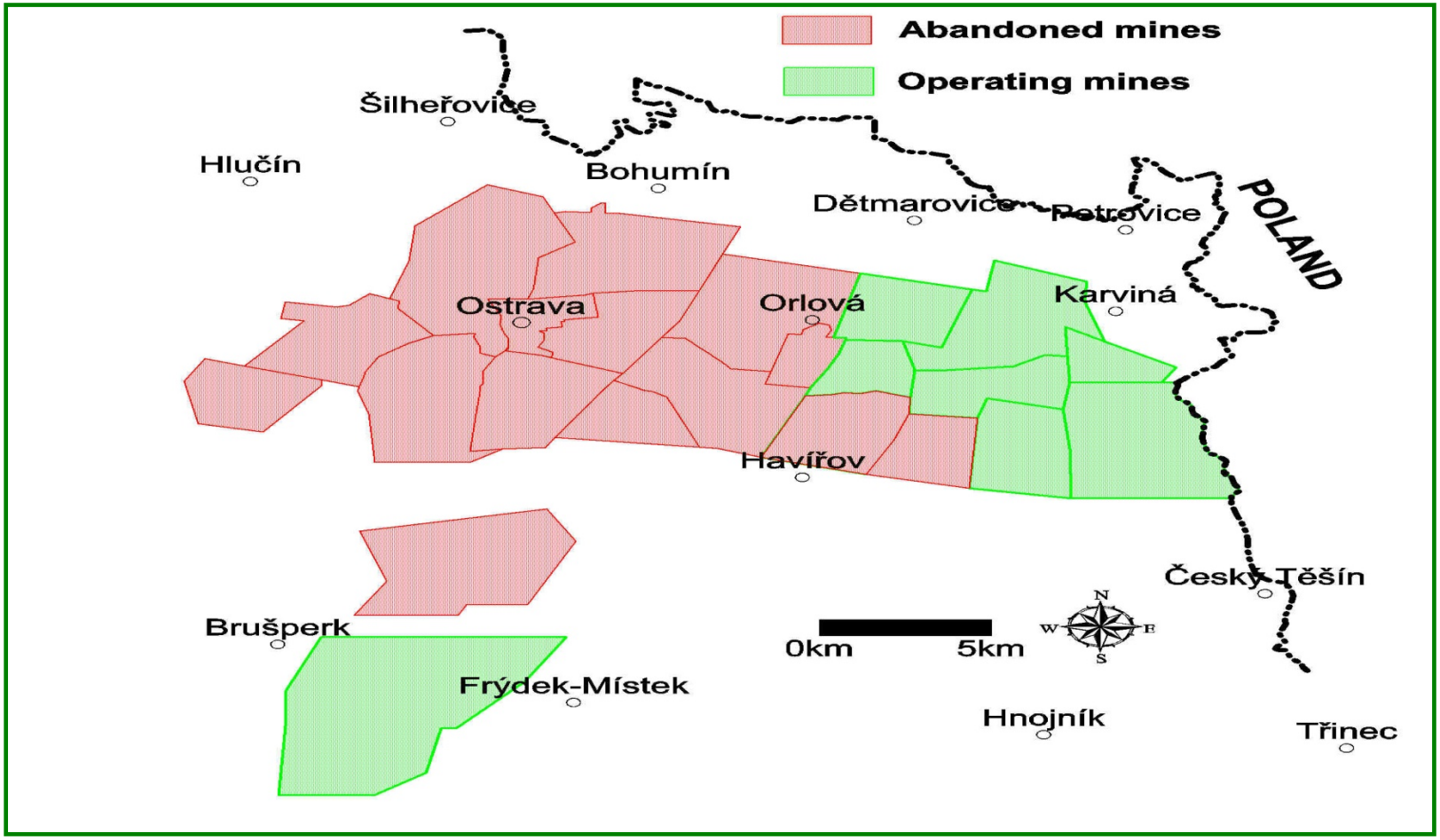
Mining Licenses in Ostrava-Karvina



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Ostrava-Karvina Coal Mines

• **Mining depth**	**480 - 1,200 m**
• **Number of coal seams**	**255**
– **Inherent gas content**	**0.3 - 8 m^3/t**
– **Total seams thickness**	**150 m**
• **Coal Reserves (mineable)**	**440 million t**
• **Coal Production**	**12.5 million t/a**
• **Specific CH_4 emissions**	**5 - 70 m^3/t**
• **Mine gas production**	**70 million m^3 CH_4/a**
– **Mines' own consumption**	**32 million m^3 CH_4/a**
– **Sold to Green Gas DPB**	**38 million m^3 CH_4/a**

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Diversified Mine Gas Supply

1. Buys drained mine gas from operating mines (CMM)
2. Receives drained mine gas in kind by providing in-mine drilling
3. Produces Abandoned Mine Methane (AMM) from wholly owned production licenses from shafts and wells
4. Produces carboniferous gas from sandstone reservoirs charged with mine gas
5. Link to the natural gas grid

Highly reduced risk through diversified supply

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Effective In-Mine Gas Drainage

- Drainage from 5 coal mine complexes
- No major gas explosion for almost 20 years
- Low permeability coal does hardly allow for pre- or in-seam drainage
- Gas capture at source through cross-measure boreholes into the roof (~100 m length, 75 mm diameter)
- Maximisation of drained gas with high methane concentration (>50 Vol.-%)
- Low VAM concentrations (0.1 - 0.3 Vol.-%)

Effective drainage provides safety and high quality mine gas

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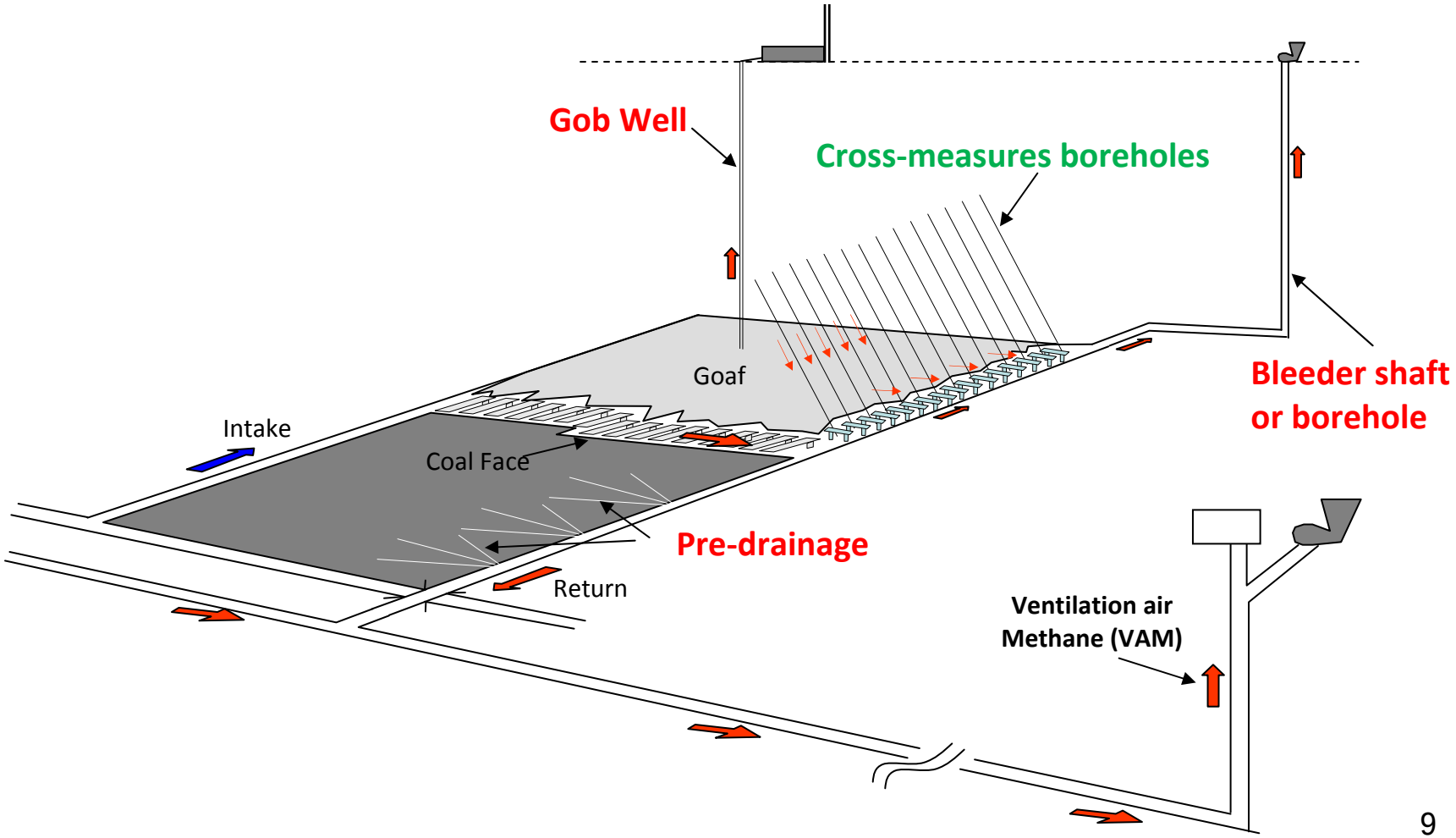
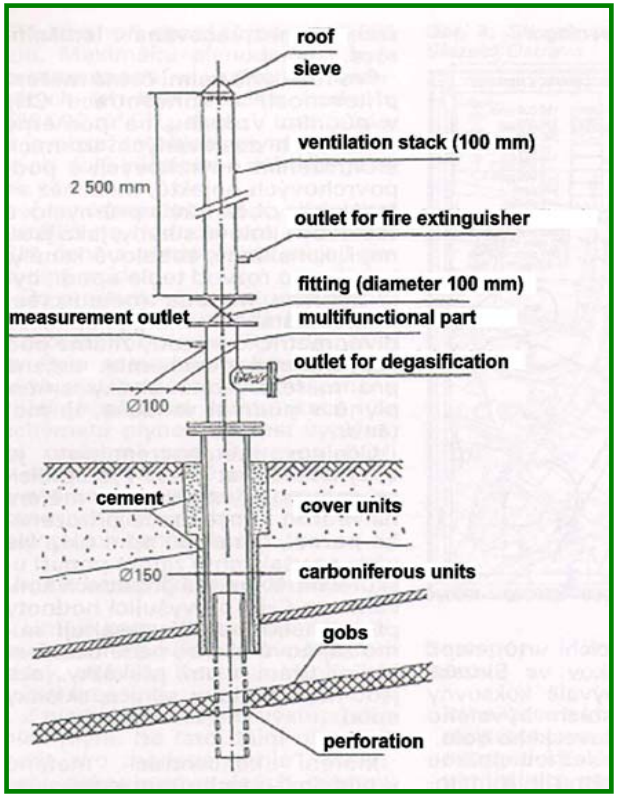
Gas Drainage Methods for a Longwall Face



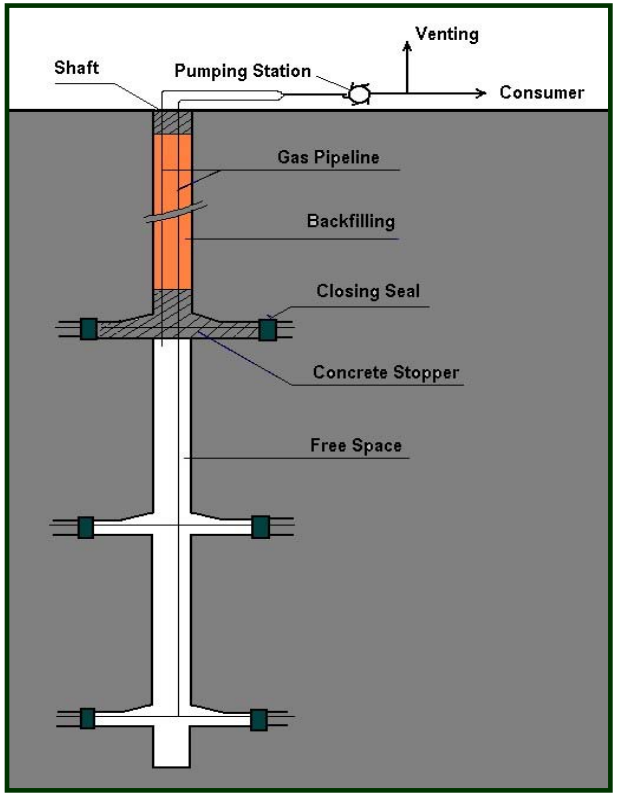
Abandoned Mine Methane (AMM) Production

- 4 production areas (10 abandoned shafts, 4 wells)

AMM well design



AMM abandoned Shaft design



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Mine Gas Distribution and Utilisation

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Pipeline systems

- Mine gas pipeline of 131 km connects supply sources and utilisation options
  - CH_4 concentration ~50+%
  - Distribution of 65 million m^3/a (100% CH_4)
- Carboniferous gas pipeline of 67 km connects 59 wells with industrial gas buyers
  - CH_4 concentration ~ 97%
  - Distribution of 10 million m^3/a (100% CH_4)
- ➢ Harmonisation of quality and quantity fluctuation
- ➢ Can act as storage vessel (~90,000 m^3)

Highly reduced reliance upon one supply source to fulfill demand

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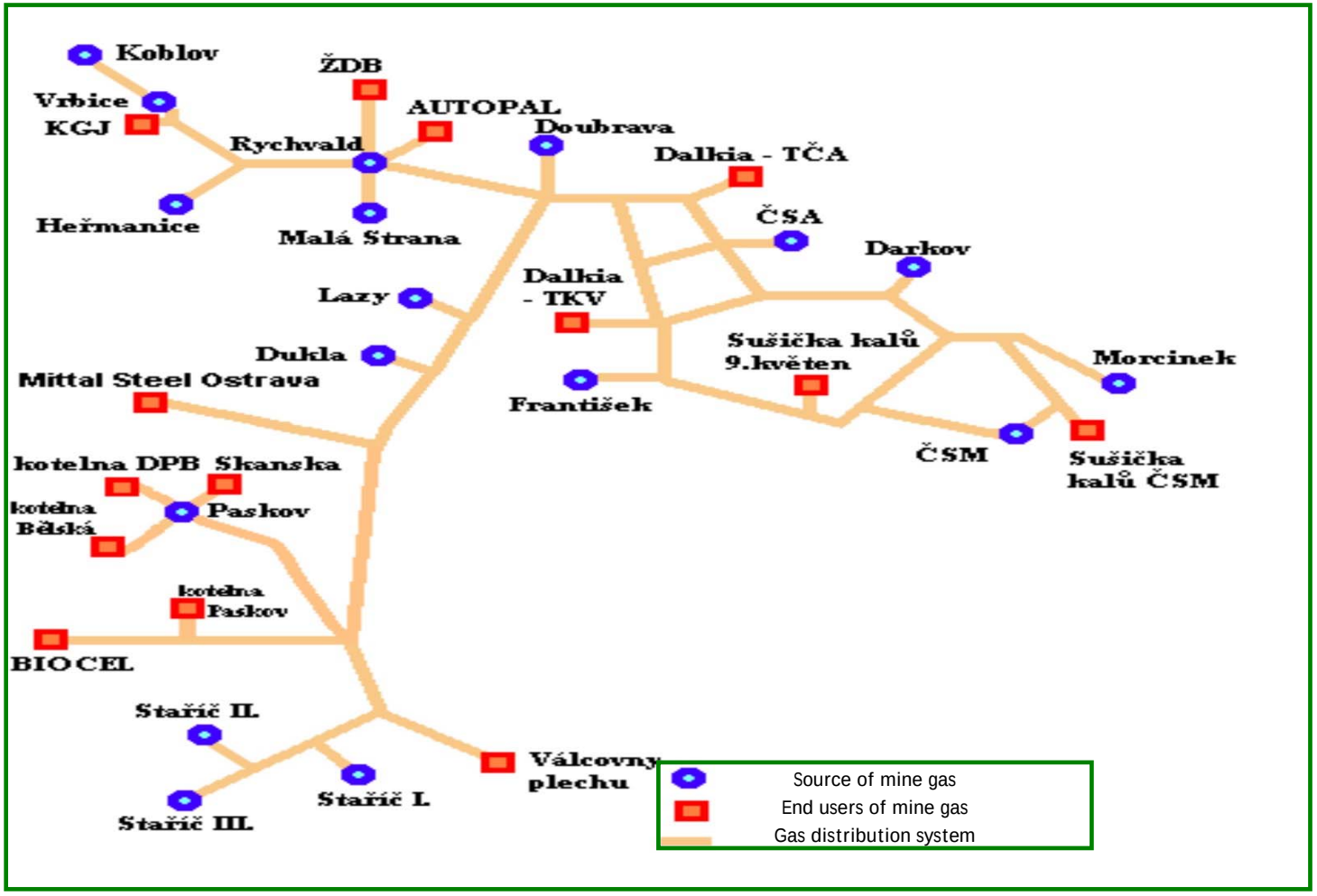
Mine Gas Pipeline



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Diversified Mine Gas Utilisation Options

- 14 mine gas sales contracts in place (industrial customers)
- 9 MW_{el} CHP plants installed
  - Plan to increase to 40+ MW_{el}
  - Heat to be supplied to the mines

Highly reduced reliance upon one gas user to distribute production

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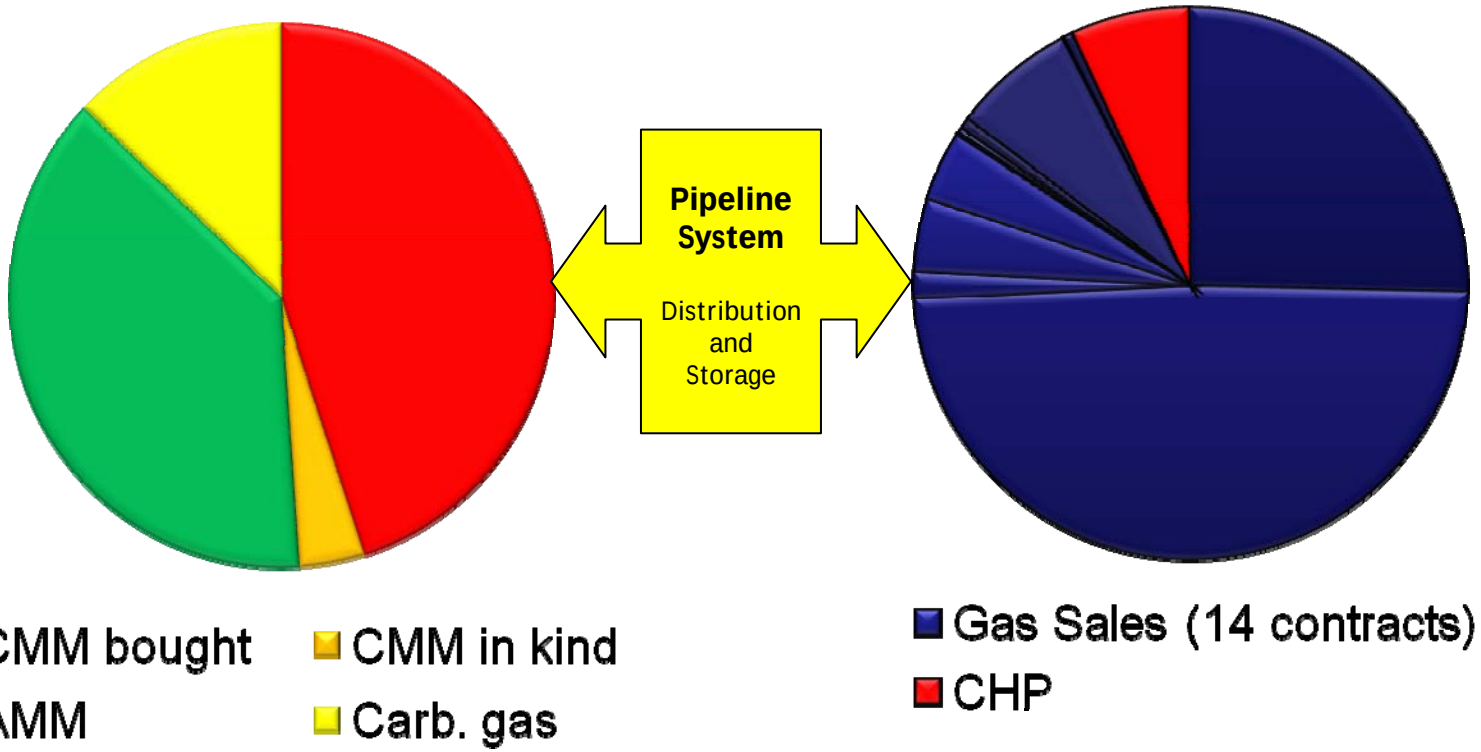
Sources and Uses of Mine Gas 2006

Volume of 75 million m^3/a (100% CH_4)



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Now and the Future …

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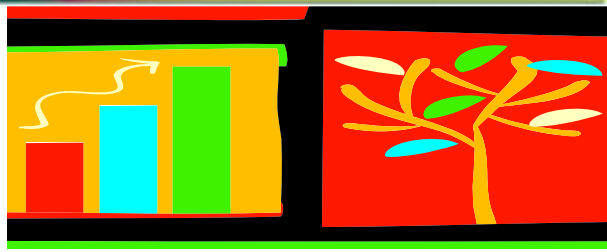
Risk Reduction through holistic approach



- Coal mine gas production and utilisation is a profitable business
- Integration, diversification of supply and demand as crucial as in other businesses
- Portfolio management a critical success factor
- Economies of scale can be achieved
- Collaboration of different parties in one region needed to build a business
- Geographical diversification by offering proven capabilities in the international market place

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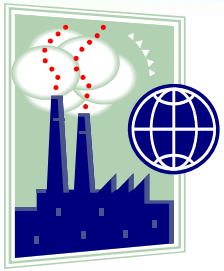
More Energy Efficiency: Conversion to CHP's



- Aggressive roll out to convert existing lower efficiency utilisation to high efficiency option of producing heat and power
- Czech legislation provides for favourable electricity prices for mine gas fired power plants
  - "Green bonus" for AMM: min. price of ~75 €/MWh$_{el}$
  - "Surcharge" for CMM: current price of ~65 €/Mwh$_{el}$
- Heat from CHP plants to substitute heat generated by boilers owned by the mines

Increase of energy efficiency from ~35% to close to 90%

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Case Study Conclusions

- Green Gas DPB achieved
  - Highest safety standard in coal mines and in the region
  - 50 million t CO_2e emission reductions over the past 45 years
  - 900,000 t CO_2e per year of reductions as we move forward
- Profitability and risk management through
  - Diversified mine gas supply
  - Diversified mine gas utilisation
  - Pipeline to facilitate effective diversification
- More energy efficiency through conversion of current uses to higher efficiency applications

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Thank you very much

Green Gas International

"Your partner in integrated mine gas management"