UCG – THE ACCEPTABLE FACE OF COAL MINING?

Peter Dryburgh – Regional Director, Scotland
• We are a multi-disciplinary consultancy providing expertise in mining, minerals, engineering and the environment

• Key facts
  • Independent and wholly owned by 16 Directors
  • 25% business outside UK, 75% Business inside UK
  • 30-35% of business mining/minerals related
  • We have worked on coal projects on all continents
  • Long history in the coal industry (founded 1837)
  • 350 staff in 9 Offices in UK
  • Offices in Moscow & Kazakhstan
• Member of the UCG Partnership
• Produced much of UK Government UCG documentation
• Worked on UCG projects in the UK, Europe and China
• Our interest in UCG is a business one
  • Provide consulting services for clients old and new
  • Extension of our existing and historic coal mining work
  • Potential for use of currently unmineable coal reserves
  • Potential to store CO2
  • To expand our business
Coal has been the fastest growing global fuel for much of the past decade. Continued expansion of coal mining is problematic and gives rise to 2 questions:

- Is there an alternative to conventional underground mining that will enable the energy to be realised without large scale mine development?
- Is there a method to access the world’s remaining coal resources which are too deep for conventional underground mining to reach?

Underground Coal Gasification (UCG) offers the potential to solve both of these problems.
World Consumption
Million tonnes oil equivalent

World primary energy consumption fell by 1.1% in 2009, the first decline since 1982. Consumption was weaker than average in all regions. While oil remains the leading fuel (accounting for 34.8% of global primary energy consumption), it continues to lose market share. Coal’s share of global energy consumption was the highest since 1970.
THE ROLE AND IMPORTANCE OF COAL

- Remaining Resources

- UCG gives access to some of 85% of coal reserves too deep for mining
- Ability to produce fuel, power or chemicals
CAN RENEWABLES CAN FILL THE GAP?
- What currently supplies our electricity?

Even if renewables are 50% by 2050 we still need 50% from somewhere else.
• Partial Oxidation of a coal seam in-situ
• Pairs of boreholes are drilled and a connection is made between them
• Oxidant (air/O₂ plus steam) pumped down one hole
• Coal is ignited and product gas flows up the second hole
• Product is ‘syngas’ a mixture of CO, H₂, CH₄ and CO₂
UNDERGROUND COAL GASIFICATION (UCG)
- It is not CBM

Coal Bed Methane (CBM)
• Drills holes into unmined coal seams
• Fractures the coal using oilfield techniques
• Pumps groundwater, often saline, to reduce hydrostatic pressure releasing adsorbed methane from the coal cleats.
• Recovers 2-5% of the contained energy in the seam

UCG
• Drills holes into unmined coal seams
• Establishes linkages between the two holes
• Does not pump out groundwater unless for local control as high hydrostatic pressures are important
• Recovers 40 – 50% of the contained energy in the seam
What are the products'?

- There are many alternatives – commercial decision what is best

Diagram:
- Gasification -> Syngas
  - Power generation
  - City gas/ domestic
  - Industrial heating (steam)
  - Hydrogen
  - Synthetic Natural gas (SNG)
  - Gas to Liquid (Fischer Tropsch)
  - Methanol/ derivatives
  - Other chemical feedstock

Source: www.bgenergy.co.uk
CURRENT STATUS OF UCG AS A COMMERCIAL TECHNOLOGY
What is the current status of UCG?
Depends who you are talking to

Cautious View
Despite 50 years of trials no commercial UCG project has been demonstrated. There has been a great deal of recent progress with pilot projects showing considerable promise and the current pilots could result in commercial operations within five to seven years, providing greatly increased confidence in the technology.

Gordon Couch, IEA Clean Coal Centre- October 2009
Bullish View
Carbon Energy’s Managing Director, Andrew Dash said “Confirmation of the gas composition results, and linking this to the recent resources upgrades, demonstrates that Carbon Energy now has the potential to become a major contributor to Queensland’s growing energy industry and a possible new entrant into the developing LNG industry and domestic gas industries.”

Carbon Energy ASX Announcement - March 2009
History of Trials

- 1912 Co. Durham UK First Test
- 1930’s Intensive Soviet Development
- 1950/60’s Early European Trials
- 1970/80’s US Programme - 6 Major Trials
- 1980’s European Studies and First Trial
- Early 1990’s First US commercial designs
- Mid to late 1990’s El Tremedal, Spain European Trial
- Start of DTI UCG Initiative (1999-2005)
- 2000 on - Rise of Australian commercial projects
History of Trials

Depth is good?
Several companies have become active in Australia and have successfully floated on the ASX.

These include (their web sites are worth looking at):
- Linc Energy – the oldest and biggest
- Carbon Energy – innovative company
- Cougar Energy
- Liberty Resources

Mostly for fuels/chemicals market; battling with CBM companies for reserves and looking to expand abroad.
What activity are we seeing in the UK?
- Something is stirring ..... 

• 15 CA licence applications – all offshore (nearshore)
  – 3 under the Firth of Forth, Scotland
  – 8 off E coast of England
  – 3 off W coast of England
  – 1 in Swansea Bay, S Wales
• All within the last 18 – 24 months
Industry norms’ will be important in development of UCG

Much needs to be known before UCG is seen as just another (financiable) mining method?

Balance is between

- Companies/ institutions with significant investment in IP and rightly wish to use this for commercial gain
- Sharing information so that others can conduct independent advice AND move the whole technology to a new level of acceptance

You don’t know what you don’t know!

- Financing of UCG projects has been challenging
What are the stages in the UCG process?

- Geology & Reserves
- Directional Drilling/ Panel formation
- Ignition and Gasification modelling
- Gasification Control and Environmental monitoring
- Groundwater modelling
- Subsidence
- Surface treatment and product
- Carbon capture and storage?
- Politics and Public perception
What is the current state of play?

**Geology & Reserves**

- Exploration and geological evaluation for UCG is similar to that for a new underground mine
- Detailed coal quality important
- Reserves are problematic
  - Economic unit is m$^3$ of syngas not tonnes of coal
  - An accepted range of conversion factors needs to be agreed and verified

**Inner Mongolia Sub-Bituminous Basin**
- Depth 400m+
- Thickness 8m
- No overlying seams
- No faults
What is the current state of play?

Panel Formation and Percentage Recovery of Reserve

- There are several drilling methods
  - Vertical
  - Vertical with ‘drive by’
  - CRIP
  - Double lateral (passive CRIP)
- Practical ‘mining’ layouts for each method need developed
- Using this layout a realistic ‘mining recovery’ needs to be assessed.
  - Quoted figure of 70% looks optimistic
  - Recovery potential from multiple seams
What is the current state of play?
- **UCG Designs**

1. Vertical wells linked by hydraulic fractures and/or reverse combustion

2. Vertical wells linked by an in-seam borehole

Source: CSIRO
What is the current state of play?

- **UCG Designs**

3. Using Controlled Retraction Injection Point (CRIP) with a vertical well

4. Using CRIP with parallel in-seam wells (Knife Edge CRIP)

5. In steeply dipping seams

Source: CSIRO, 2006
What is the current state of play?
- **Double lateral at Bloodwood Creek**
What is the current state of play?
- **View to Scale**

Linc Energy
What is the current state of play?
- **Drilling techniques**

Mitchell Energy
What is the current state of play?

*Ignition and Modelling*

- **Ignition**
  - Various methods – propane, electrical, pyrophoric compounds, hot coke
  - The home of IP in the process?

- **Modelling**
  - Universities and Research establishments in the EU, USA and Australia leading in this
What is the current state of play?
Gasification Control and Environmental Monitoring

• Control of the process is vital to protect the environment and to maintain consistent gas quality
  • Likely to be an IP issue

• Environmental monitoring
  • Track record of satisfactory monitoring essential to creating a UCG industry of significant size
  • Sharing of monitoring strategies & results will help create the track record more quickly benefitting all
What is the current state of play?

**Groundwater Modelling**

- Groundwater contamination potential is a key factor in UCG environmental permitting in all jurisdictions
  - Regulators/public need comfort no contamination will happen
  - Modelling contaminant dispersion will be vital
- The Kingaroy problems could be very important
What is the current state of play?

Subsidence

- Conventional wisdom is that subsidence is similar to an underground mine
- Work needed to confirm this with monitoring of actual operations
- ‘Depth is good’
- Sharing of results will help create this track record more quickly
What is the current state of play?

**Carbon Capture and Storage (CCS)**

- Much talk on CCS potential
  - Is there any substance?
  - Can we store CO$_2$ in a caved rock column?
- More work needed on subsidence
- CO$_2$ is in supercritical phase below 800m so ‘depth is good’
- In EU commercial UCG projects will need a CCS licence

Source: CO2 Sinus Project
What is the current state of play?

Politics and Public Perception

- Politics
  - The acceptable face of coal mining?
  - Problems in overcoming an anti-coal bias in many developed countries
  - Level of knowledge about the fundamentals of energy among policy and opinion makers
- Public Perception
  - NUMBY? Need to engage public early and positively
  - Perception of an underground coal fire
  - We can’t afford an UCG environmental failure!
Conclusion
THANK YOU FOR YOUR ATTENTION