Introduction to Underground Coal Gasification

A Clean, Safe, Indigenous Energy Supply

presented by
Julie Lauder, CEO
UCG Association
Outline of Presentation

• Introduction to Underground Coal Gasification Association
• What is Underground Coal Gasification
• Development of UCG Technology
• The Potential for UCG & Commercial Opportunities.
• Strategic Issues and Economics.
• The growth of the UCG Industry.
• Benefits of UCG
• Conclusions
The UCG Association

• The professional body for the Underground Coal Gasification Industry
• Promote the commercial, social and environmental benefits of UCG technology - security of supply, indigenous resource, employment opportunities
• Knowledge Sharing and Skills Training
• Through dedicated UCG training courses, seminars and conferences - building the next generation of UCG specialists
• Governments, Decision makers, Environmental Groups and the Media
• Licensing, Regulatory Bodies
• Strong Links with Academia
• Public and independent information service on UCG
• UCGA is globally recognised as the centre of excellence and information for all
What is Underground Coal Gasification?

• Underground Coal Gasification is the process of gasifying coal whilst in situ
• It is not a new technology but one that has evolved
• In recent years it has undergone a transformation due to technical advances, specific research and the sharing of knowledge and information.
• Much of the recent development in UCG has been spearheaded by the UCG Association
Basic UCG Technology

The UCG process takes place underground, generally below 1,200 feet (365 metres) The setting provides both the feedstock source as well as pressures comparable to that in an above-ground gasifier. Two wells are drilled on either side of an underground coal seam. One well is used to inject air or oxygen (and sometimes steam) into the coal seam to initiate the gasification reactions. The second well is used to collect the synthesis gas (syngas) that is formed from the gasification reactions and to pipe it to the surface for additional processing and use.
Basic UCG Technology

UCG reactions are managed by controlling the rate of oxygen or air that is injected into the coal seam through the injection well. The process can be halted by stopping the injection of the oxygen or air.

After the coal is converted to syngas in a particular location, the remaining cavity (which will contain the left over ash or slag from the coal) may be flooded with saline water and the wells are capped.

Growing interest in using these cavities to store carbon dioxide that could be captured from the above-ground syngas processing.
Basic UCG Technology

• A pair of wells can last 8-10 years. The resulting high quality Syngas can be processed to provide fuels for power generation, diesel fuels, jet fuels and hydrogen. Once a particular section of a coal seam is exhausted, new wells are drilled to initiate the gasification reaction in a different section of the coal seam.
Why UCG Now?

- Offers many benefits over traditional coal extraction methods, *environmental, social and financial*
- Addresses security of supply issues – *indigenous resource*
- UCG is now being recognised globally as a viable and economic method for accessing deep otherwise unrecoverable coal reserves, *on and offshore*,
- Europe, huge potential, untapped coal, densely populated areas
- Given the current energy scenario UCG has the potential to play a significant role in the future energy mix for many,
Development of Modern UCG Technology
Many UCG trials and studies undertaken all over the world - important data - enabling the technology to develop

UCG is a multi disciplined technology: Geologists, Hydrologists, Chemical Engineers, Gas Processors, Modellers, Well and Plant Design, Drillers

The greatest advances have been achieved by linking with others - Oil and Gas industry
Milestones of UCG Development in Europe

- 1912 Co. Durham UK First Test
- 1930’s Intensive Soviet Development
- 1948 Bois-la Dame, Belgium
- 1950/60’s Early European Trials – inc.
- 1955 Newman Spinney – Ntl Coal Board
- 1980’s European Studies and First Trial
- Mid to late 1990’s El Tremedal, Spain European Trial
- Firth of Forth Feasibility Study
Global UCG Developments

Soviet Union (1950-1970’s)
• Soviets tested a variety of configurations in 6 or more sites
• At least two commercial schemes, Siberia and Uzbekistan, one still operating.

United States (1970-1990)
• 31 tests involving DOE, Gulf, Texas A&M, GRI, ARCO – Moveable injection developed, CRIP
• Rocky Mountain Trial, 14,000 tons of coal 93 days
• Oxygen Fired (270-328 BTU/ft³)

Australia (1990 - 2009)
• Chinchilla – still in operation – recently launched by Linc as worlds first commercial UCG and GTL plant.
• Bloodwood Creek, 100 day flaring now going commercial.

All of these trials have resulted in the modern development of UCG
Conclusions from the work to date:

- Shallow seams, not suitable because of high gas losses, potential breakthrough to surface and possible contamination of groundwater
- Thin seams, less than 3m thick, will be difficult to exploit economically unless in a multi-seam environment
- Thick seams work well using the CRIP method;
- Lignite and sub bituminous coal are ideal for gasification, as is bituminous coal provided no significant swelling characteristics exist
- Deeper coals - higher pressures in the reactor resulting in higher methane content and resultant higher heat value gas
- CV’s in the range of 12-14 MJ/m³ are recorded when using oxygen feed and may be increased as the process develops at a greater depth
- The CRIP concept has lead to the highest gasification efficiency in terms of oxygen usage and will allow subsidence to be minimised or possibly eliminated, by using wider barrier pillars between panels
Development of Modern UCG via Oil and Gas Technologies

- Exploration using 3D seismic survey, interpretation, core drilling
- Directional and Horizontal drilling, sophisticated Steering Systems for Inseam Drilling, Moveable In-seam Injection, intersections and branching, CRIP
- Advanced completions for moveable injection, hot multi-phase flow and sour gas
- Downstream processing—filtering, washing and acid gas removal
- Gasification process – coal to liquids, fuel cell technology - Fisher Tropsch well known
Development of UCG

• Many technical issues that once hampered the deployment UCG have been overcome
• Environmental Impacts are now fully understood and are manageable with the correct site selection
• Site selection is paramount
• CCS benefits of UCG - Gasification Process - amenable to pre-combustion capture (CHEAPER CO$_2$ SEPARATION)

www.co2sinus.org
Angren, Uzbekistan

- 50 years of Commercial Operation
- Coal, lignite with 11% ash and 30% water.
- Restarted in 1961, 100MW of electrical power is still generated from syngas out of the 600MW that the plant produces.
The Chinchilla UCG Site
Current UCG Technology
Principles of UCG Process Control
-Moveable In-seam Injection

Tested in Field trials with oxygen injection at
• 110m depth \((361\text{ft})\) - Rocky Mountain 1, Wyoming
• 860m depth \((2,822\text{ft})\) - Thulin, Belgium
• 550m depth \((1,804\text{ft})\) – European field trial, Spain
Availability of Sophisticated Steering Systems for Inseam Drilling

- Rotary steerable assemblies, with in-built closed loop control.
- Wide range of on-line geo-logging tools gamma, resistivity, forward scanning, acoustic, etc.
- Electronic telemetry to be surface.
- Active and passive
- Magnetic devices for well intersections.
Carbon Dioxide Capture Advantages of UCG-CCS

Capture Advantages of UCG
(in deep seams)

- Gasification Process - amenable to pre-combustion capture (CHEAPER CO$_2$ SEPARATION)
- High Pressure Process - Smaller Plant & Pressure energy for power (up to 20%) available. (Cost Savings)
- Oxy-fuelled Process - burning gas produces only CO2 and water (CHEAPER SEPARATION)
- H2/methane mixtures can be produced - advantageous in gas turbines.
Environmental Risk Management

- UCG requires management of the environmental emissions risks to air and ground water.
- Active process control to ensure cavity flows are always inward.
- Careful site selection paramount
- Monitoring essential - EU Ground Water Directives.
- Hydrogeological modelling required.
- Deeper coal seams reduce the environmental risk.
- Carbon Capture and Storage
### General Risk Summary

<table>
<thead>
<tr>
<th>Geographical Area</th>
<th>Operation</th>
<th>Risk</th>
<th>Comparative Industry</th>
<th>Operational Risk</th>
<th>Legacy Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulting</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
<td>standard oilfield practice</td>
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<tr>
<td>Coal</td>
<td>coal thinning (uneconomic)</td>
<td>mining</td>
<td>standard mining</td>
<td>mine closure</td>
<td>standard mining practice</td>
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<tr>
<td>Seal</td>
<td>cap rock breach</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
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<td>standard oilfield practice</td>
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#### Well Engineering - Drilling

<table>
<thead>
<tr>
<th>Operation</th>
<th>Risk</th>
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<th>Mitigation</th>
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<tbody>
<tr>
<td>Drilling</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
<td>standard oilfield practice</td>
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<tr>
<td>Directional Drilling</td>
<td>keeping in seam</td>
<td>coal bed methane</td>
<td>time to drill well</td>
<td>standard oilfield</td>
<td>standard oilfield practice</td>
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</table>

#### Well Engineering - Production

<table>
<thead>
<tr>
<th>Operation</th>
<th>Risk</th>
<th>Comparative Industry</th>
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<th>Mitigation</th>
</tr>
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<tbody>
<tr>
<td>Completion</td>
<td>High Pressure-High Temperature (HPHT)</td>
<td>HPHT oil &amp; gas</td>
<td>standard HPHT</td>
<td>standard HPHT</td>
<td>standard HPHT practice</td>
</tr>
</tbody>
</table>

#### Gasification Risk (Underground Coal Gasification - UCG)

<table>
<thead>
<tr>
<th>Operation</th>
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<th>Legacy Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncontrollable fire</td>
<td>unable to control reaction chamber</td>
<td>UCG - Australia, Spain, Russia</td>
<td>achieve control by flooding chamber</td>
<td>minimal risk as chamber is deep, fires unable to be sustained due to lack of oxygen</td>
<td>redundancy: carbon dioxide flood, nitrogen flood, water flood &amp; pressure control</td>
</tr>
<tr>
<td>Explosion</td>
<td>methane build up in drilled section</td>
<td>UCG - Australia, Spain, Russia</td>
<td>ignition of methane</td>
<td>minimal risk as chamber is deep</td>
<td>establish best practices</td>
</tr>
<tr>
<td>High Temperature</td>
<td>reaction rates</td>
<td>UCG and HPHT O&amp;G</td>
<td>equipment failure</td>
<td>chamber monitoring</td>
<td>establish best practices</td>
</tr>
<tr>
<td>Subsidence</td>
<td>collapse of reaction chamber</td>
<td>UCG - Australia, Spain, Russia</td>
<td>unable to continue operations</td>
<td>surface subsidence expression</td>
<td>perform UCG at depths greater than 500m</td>
</tr>
</tbody>
</table>

#### Environmental Risk

<table>
<thead>
<tr>
<th>Operation</th>
<th>Risk</th>
<th>Comparative Industry</th>
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<th>Legacy Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater contamination</td>
<td>syn gas migration into potable water</td>
<td>land drilling UK</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
<td>standard oilfield practice</td>
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<tr>
<td>Groundwater contamination</td>
<td>drilling mud ingress during drilling</td>
<td>land drilling UK</td>
<td>standard oilfield</td>
<td>standard oilfield</td>
<td>standard oilfield practice</td>
</tr>
<tr>
<td>Operation/Activity</td>
<td>Operation Risk</td>
<td>Consequence</td>
<td>Measures</td>
<td>RISK</td>
<td>Comment</td>
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<tr>
<td><strong>Drilling</strong></td>
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</tr>
<tr>
<td>General</td>
<td>Standard Oilfield Risks</td>
<td>Standard Oilfield</td>
<td>Well examinations</td>
<td>ALARP</td>
<td>HSE Offshore Regs</td>
</tr>
<tr>
<td>Mud System</td>
<td>Mud returns</td>
<td>Entrained C1, C2, C3...gas</td>
<td>ALARP</td>
<td></td>
<td>Mud Gas separators</td>
</tr>
<tr>
<td><strong>Completions</strong></td>
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<tr>
<td>General</td>
<td>Standard Oilfield Risks</td>
<td>Standard Oilfield</td>
<td>Well examinations</td>
<td>ALARP</td>
<td>HSE &amp; HPHT Best Practice</td>
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<tr>
<td>Well Heads</td>
<td>Thermal Expansion</td>
<td>Well head growth: Escape of gas:</td>
<td>HPHT - ALARP</td>
<td></td>
<td>HPHT Best Practice</td>
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<tr>
<td><strong>Pumping</strong></td>
<td></td>
<td></td>
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<tr>
<td>Coil Tubing</td>
<td>Oxygen Pumping: Through coil tubing, coil tubing connectors</td>
<td>Leakage, Corrosion &amp; Fire</td>
<td>ALARP - COMAH</td>
<td></td>
<td>Develop Best Practices</td>
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<tr>
<td></td>
<td>Steam Pumping: Pumping with Oxygen. Connectors</td>
<td>Leakage, Scalding</td>
<td>ALARP - COMAH</td>
<td></td>
<td>SAGD best practice</td>
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<tr>
<td></td>
<td>Reaction initiation materials: Silane $\text{SiH}_4$ and Triethylborane $\left(\text{C}<em>6\text{H}</em>{15}\text{B}\right)$</td>
<td>Highly Volatile, Burning</td>
<td>ALARP - COMAH</td>
<td></td>
<td>Current UCG (Australia) learning.</td>
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<tr>
<td><strong>Production</strong></td>
<td></td>
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<tr>
<td>Syn Gas</td>
<td>Leakage well head (HIC): Suffocation</td>
<td>Severe health hazard</td>
<td>ALARP (Ni and Ti alloys!)</td>
<td></td>
<td>SCC, Hydrogen embrittlement (HIC)</td>
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<tr>
<td>Syn Gas</td>
<td>Explosion, Syngas and injection gas combination</td>
<td>Uncontrolled Gas to surface</td>
<td>ALARP - COMAH</td>
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<td>Modelling</td>
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<td>General Corrosion</td>
<td>Aggressive Gas Species</td>
<td>Pipeline leakage: HS&amp;E</td>
<td>ALARP - COMAH</td>
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<td>Chloride CC, Sulphide CC</td>
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<tr>
<td>General Corrosion</td>
<td>Leakage &amp; Gas Escape</td>
<td>Gas: CO poisonous. CO$_2$ &amp; H$_2$S</td>
<td>ALARP - COMAH</td>
<td></td>
<td>Failure Modes</td>
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<td>General Erosion</td>
<td>Production of fines</td>
<td>Pipeline leakage: HS&amp;E</td>
<td>ALARP - COMAH</td>
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<td>Failure Modes</td>
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<td><strong>Sequestration</strong></td>
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<tr>
<td>CO$_2$ Capture</td>
<td>Chemicals, Leakage</td>
<td>Hazardous Chemical solvents i.e. Amine (MEA): Suffocation</td>
<td>ALARP. Membrane filters</td>
<td></td>
<td>Failure Mode History. Mono-Ethanol Amine</td>
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<td>CO$_2$ Pipelines</td>
<td>Leakage</td>
<td>Suffocation</td>
<td>ALARP</td>
<td></td>
<td>USA - pipeline experience</td>
</tr>
<tr>
<td>CO$_2$ Storage</td>
<td>Leakage</td>
<td>Suffocation</td>
<td>ALARP - COMAH</td>
<td></td>
<td>Norwegian - Sleipner</td>
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</table>
Who are the Potential Stakeholders for UCG?

- Leaseholders of un-mineable coal.
- Suppliers of drilling and completion equipment.
- Oil & Gas production Companies.
- Suppliers of exploration (geophysics) services.
- Plant, safety and equipment engineers.
- Gas Processors
- Power companies and equipment suppliers.
- \( \text{CO}_2 \) capture and storage technologists.
World Coal Resource for UCG

Current global coal reserves stand at around 820 billion tonnes, about 120 years supply. However, nearly 85% of all known coal resources are deemed unmineable, being either too deep or in hard to access locations, such as under the sea.
Coal and Security Issues

- Upturn in coal usage World (20%) China (51%), India (17%) (US 4.4%) in the last 6 years biggest growth of energy source
- On-going clean coal technology developments, (gasification, supercritical plant, mercury, O2 firing, GTL).
- Europe launches sustainable coal programme Oct 06 and sets new targets for Greenhouse gases.
- CO2 capture & storage (CCS) required
- Security of supply vulnerability to Middle East Oil and Russian Gas (Asia, Europe & US).
- Coal-to-Liquid Initiatives China, India, & US
Commercial Opportunities for UCG Syngas
Feedstock Options for UCG Syngas

- Syngas Product
- Iron Reduction
- Synthetic Natural Gas
- Naphtha
- Petrol
- Diesel
- Wax
- Fischer-Tropsch

SYNGAS

- Methanol
- Power Gen
- Hydrogen
- Ammonia
- Chemicals
- Fuel Cells
- IGCC
- Steam & Power
- Ethylene
- Acetic Acid
- Formaldehyde
- DME
- Methyl Acetate
- Polyolefins
- Petrol
Interest in Hydrogen Production

• Once seen as an unwanted by product – Hydrogen is now being looked at as a viable energy source for fuel.
• Meets the environmental challenges of reduced CO2, particulates and other emissions.
• In recent decades, major R&D investment committed to hydrogen and fuel cell technologies.
• Over 400 demonstration projects are in process in the world and are expected to have commercial application in the next 5-10 years
• Governments across the world provide over $4 billion in R&D.
• Japan, US, Canada, Germany have led the way - ongoing programmes to develop a global hydrogen system for the future
Interest in Hydrogen – Research

- In Europe - Hydrogen Fuel Testing Center – 2005
- Collaborative studies with Russia – HYPER, 15 partners from France, Germany, Greece, Italy, the Netherlands, the Russian Federation, the United Kingdom, and the United States.
- €1 billion Fuel Cell and Hydrogen Programme - EU and Industry, plans to make fuel cells and hydrogen one of Europe's leading new strategic energy technologies.
- €470 million FP7 programme - investigate projects use hydrogen as an energy source.
- EU funded project “HUGE” Hydrogen Underground Gasification Europe 2007
- November 2010 - India-UK collaborative research initiative in fuel cells
EU project “HUGE” Geo-Reactors started in 2007 € 3.5M over three years

Determination of the conditions under which Hydrogen will be the main gaseous product
Assessment of opportunities for in-situ CCS
Proof of the concept.
Feasibility study of the demonstration scale of the process.
Integration of UCG technology with CCS and CCT.
US DOE commit $74 million for Hydrogen Fuel Cell Research, December 2010
Interest in Hydrogen Production
- Hydrogen Vehicle Scenario

Stock share of hydrogen fuel cell vehicles in key regions in the most optimistic scenario by 2050 Source: OECD/IEA (2005)
COAL to DIESEL

Synthetic products, as produced by the Fischer-Tropsch processes, whether from gas or coal feedstocks, have unique properties which will ensure a demand for them in the future.

Superior Quality

• Synthetic diesel - one study has estimated that synthetic diesel will result in 40% to 50% reduction in hydrocarbon emissions, 9% reduction in nitrogen oxides, and a 30% reduction in particulate emissions as compared to conventional refinery low sulphur diesel.

• It is therefore seen as a highly desirable fuel from an environmental standpoint – may attract a high premium such as Shell’s PURA fuel.
Significant Growth anticipated in the Coal Sector through Coal to Liquids

Note: “2030 A” represents an energy independence case.
Source: Energy Information Administration, Annual Energy Outlook 2007, and SSEB
Gasification Technology

• Gasification has been reliably used on a commercial scale for more than 50 years in the refining, fertilizer, and chemical industries, and for more than 35 years in the electric power industry.

• There are more than 140 gasification plants operating worldwide. 19 located in the United States

• World gasification capacity is projected to grow by more than 70% by 2015.

• Most of that growth will occur in Asia, with China expected to achieve the most rapid growth
Global Growth of Gasification

WORLD SYNGAS CAPACITY GROWTH
(MEGAWATTS THERMAL EQUIVALENT)

Source: Gasification Technologies Council
GLOBAL SYNGAS OUTPUT BY FEEDSTOCK

- 3% PETCOKE
- 2% BIOMASS/WASTE
- 8% GAS
- 32% PETROLEUM
- 55% COAL

Source: Gasification Technologies Council
Commercialising UCG Regulatory, Economic and Social Issues
Licensing and Regulation

Important to engage at an early stage with those responsible for Licensing and Regulation.
• Save a lot of work as much may already exist that can be applied
• Enable the formation of a Best Practice.
• Regulators can also help in the promotion and formulation of a new technology, inform governments offer access funding.
• Request Research if more data is required.
• Regulator is an enabler

Coal Authority
UK Health and Safety Executive
Environment Agency
Planning Authority
Finance, Legal and Accounting

Without funding you will not have a project

• Investors and funders not only need to understand the potential of your technology
• Need to know you have identified your market and that all the required legal, regulatory and social aspects of the technology have been addressed.
• A good legal firm, who understand the needs of energy, ensure you will not get sued
• Accounting firm that are familiar with energy, advise you and ensure your project stays on track and within budget.
• Highlight information gaps - **Syngas index**
Need to Engage with the Public

• There is a need to change the public view of the energy industry
• Create an understanding of the levels of research, development, testing.
• Links to academic research
• Highlight the benefits more than the process.
• To date there is very little literature or information that isn’t technical
• Public Information and Outreach Programme.
• The public are not ill informed of Coal Technology they are not informed at all.
Global Growth of the UCG industry
How fast is the industry growing?

Map Courtesy of Clean Coal Ltd.

UCGA Training Course, London  
21st – 22nd March 2011

Poland: UCG under review.


Belgium: EU trial at Thulin.

USA: Major trials in the 1950s. Substantial interest & new project activity planned in Wyoming, Montana, North Dakota, Cook Inlet, Alaska & other states. Linc, CCL & Laurus.

Spain: EU trial at El Tremedal.

Colombia: UCG project planned.

Chile: UCG project announced by Carbon Energy.

Brazil: Demonstration project planned.

Slovenia: UCG under review.

Czech Republic: UCG under review.

Slovak Republic: MOU signed by CCL.

Hungary: White Coal & Wildhorse Energy project.

Romania: UCG activity under review.

Bulgaria: 2 projects under review.

Turkey: CCL project in Amasra with Hema.

Kazakhstan: UCG trial site identified.


Japan: Research activity.

China: History of Pilots. Academic training of many UCG PhDs. New projects planned- Cougar & CCL. The Ulanchap, Inner Mongolia project is in its 3rd year. Other projects in this region in planning stage with other operators including CGE, Cougar & Guifside.

Bangladesh: UCG activity planned.

Vietnam: 2 projects Red River Delta in planning stage- Linc & CCL.

Indonesia: MOU signed by CCL.


New Zealand: Solid Energy UCG project.

India: Substantial activity planned with 13 companies bidding for leases.

South Africa: Eskom in 2nd stage of UCG project. Others reviewing.

Uzbekistan: Oldest UCG plant in the World (50yrs) in Angren.

Pakistan: Substantial activity planned in Sindh Province.
Global UCG Activity

- MOU’s signed in Canada, India, South Africa, USA, Vietnam, Indonesia, Poland, Turkey and Hungary.
- Research Projects, Bulgaria, UK, USA, China, Germany,
- US DoE launched, funded UCG study programme
- Huge upturn in interest and potential investment - Australia, who are leading the world.
- All coal rich nations have engaged in dialogue and investigation – Licensing, Regulatory, Feasability.
- Increased commercial activity and possibilities in the next few years.
- Need for Trained and skilled Operatives and those with knowledge or services in UCG technology.
Gasification Engineer

• The role of a Coal Gasification Engineer is to aid in the design, construction, and operation of an integrated gasification project.
• During the operation, they oversee the drilling of the injection wells into the identified hydrocarbon (coal) field into which the air or oxygen is forcibly introduced into the targeted coal seam.
• They also oversee the operation of the production wells and pipelines through which the resultant coal gas is brought to the surface and relayed to gas cleaning plants.

• Any possessing these skills are in High demand!
Benefits of UCG
Benefits of UCG

• As a method of exploiting coal, UCG represents a huge environmental improvement over traditional coal mining and surface combustion of coal.

• Access to more coal resources than recoverable by traditional technologies, estimates give recoverable reserves to 600 billion tonnes.

• It is safer and more efficient.

• Biggest advantages of UCG is fuel supply certainty: the supply of syngas is local and continuous.

• Syngas products have a rapidly growing market.
Economic Benefits UCG

- Capital and operating costs of are lower than in traditional mining
- Reduced cost of plant installation - No Surface Gasifier
- Plant can be scaled up as required
- Flexible finance options
- Syngas can be piped directly to the end-user, reducing need for rail / road infrastructure
- Lowers the cost of environmental cleanup due to solid waste being confined underground
- CCGT power plants using UCG product gas instead of Natural Gas can achieve much higher outputs.
- Manufacture of chemicals such as ammonia and fertilizers
- Synthesis of liquid fuels at a predicted cost equivalent to US$17/barrel
- Enhanced Oil Recovery (EOR).
Environmental Benefits

• Most notably UCG does not require an external water source to operate, a major environmental advantage over water-intensive coal mining operations and pulverised-coal-fired energy production methods.

• Lower emissions - gasification in UCG is underground, the facilities produce no sulfur oxides or nitrogen oxides, both regulated pollutants, thereby reducing environmental management costs.

• Particulates are generated at half the rate of their surface equivalents and stay underground.
Environmental Benefits

• Lower fugitive dust, noise, visual impact on the surface
• Low risk of surface water pollution
• Reduced methane emissions
• No dirt handling and disposal at mine sites
• No coal washing and fines disposal at mine sites
• Smaller surface footprints at power stations
• No mine water recovery and significant surface hazard liabilities on abandonment
Environmental Benefits

• Reduced Ash Content
• The ash content of UCG syngas is estimated to be approximately 60% less compared to smoke from burning.
• The containment of ash widens the appeal of UCG technology to nations that have abundant low-quality – high ash content coal reserves
• India, China, South Africa, areas of USA such as North Dakota,
Social Benefits

• Due to the absence of traditional mining a number of social benefits are evident.
• Risk of injury or death is eliminated.
• Impact on the environment is greatly reduced, local communities do not face the detrimental impacts (e.g. air pollution and large scale land degradation) that traditional mining brings.
• Local communities can benefit from the creation of associated infrastructure (e.g. roads), subsidised energy, and employee spending in the local economy.
Status of UCG- Summary

UCG as a Strategic Technology

– Ready for use for large scale syngas production.
– UCG feasibility studies & demonstrations underway in Asia, Australia, US, Eastern Europe S Africa and UK.
– Take-up could be rapid (2012-2018),
– UCG in deeper coal resources contributes significantly to world’s security of supply & power requirements.

Technical

– Directional, horizontal inseam drilling and moveable injection (CRIP) provide the necessary process control in deeper seams.
– Environmental impact solved with current technology and site evaluation techniques.
– For CO₂ capture and storage, UCG offers a range of options for lower cost capture and local permanent storage.
– Offshore and coastal schemes are of growing interest.
Challenges of taking a new technology to market

• Identify your potential stakeholders
• Identify your potential market
• Identify information ‘gaps’ in your technology
• Identify gaps legislation and regulations
• Identify who you need to engage with outside of energy sector
• Identify who may not welcome your technology
• Identify what information is required for the different sectors
• Engage with the public and the media

Engage with others who have skills that will be important in the growth of your industry
Fuel poverty statistics

A household is said to be in fuel poverty if it needs to spend more than 10% of its income on fuel to maintain a satisfactory heating regime (usually 21 degrees for the main living area, and 18 degrees for other occupied rooms). **IEA Member Countries - 150 million people in fuel poverty.**

79% of the people in the Third World (the 50 poorest nations) have no access to electricity, despite decades of international development work. In 11 countries, Africa, more than 90% of people go without electricity. In 14 nations worldwide, less than 10% of people have the option to use modern cooking fuels. 2.5 billion people globally subsist on wood or charcoal.

**The total number of individuals without electric power is put at about 1.5 billion, or a quarter of the world's population.**
Concluding remarks

• UCG Technology is entering a new and exciting phase of development - worldwide.
• Most coal rich nations are developing UCG programmes.
• Underground risks are manageable with the right site selection, monitoring and active process control.
• All countries will become increasingly dependent on indigenous coal supplies to help industrial growth in the wake of the global economic crisis
• New projects need to be operated together with regulatory bodies, public consultation – openness
• UCGA strive to ensure all who operate at a commercial level do so responsibly and with a high regard to safety and environment

• *Key to the safe commercialisation and growth of UCG* - collaboration
The past we inherit - the future we make

The UCG Association
At the forefront of the developing UCG Industry

thank you for your attention
Julie Lauder CEO, UCGA

www.ucgassociation.org