Global Development of Underground Coal Gasification

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Outline of Presentation

• Introduction to UCG Association
• Benefits of UCG
• The Global Growth of the UCG Industry
• UCG in SA
• Conclusions
Underground Coal gasification

- UCG is a method of converting un-worked coal, whilst still in the ground, into a combustible gas suitable for industrial heating, power generation, and the manufacture of hydrogen, diesel fuel or chemical feedstock.

- Operating at depths of up to 2000m UCG can be applied on shore and off, making it possible to access vast quantities of the world’s otherwise unrecoverable coal.

- The technology has progressed greatly, due to advances in techniques the sharing of knowledge and by bringing all in UCG together.

- Much of this work has been lead
The UCG Association

- The professional body for the Underground Coal Gasification Industry
- Not for Profit – Member Subscriptions
- Provide Information to governments and regulators. – for the formation of regulatory & environmental frameworks, licensing criteria.
- Encourage collaborative research – to provide timely data and identify gaps in recorded information.
- Establishing industry recognised and accredited Training - to provide the next generation of skilled UCG operators.
- Encourage the formation of an industry best practice - to ensure safe operations and environmental and public safety.
- Over 280 members, representing more than 70 organisations and 28 nations: Argentina, Australia, Belgium, Botswana, Brazil, Bulgaria, Canada, Chile, China, Colombia, Germany, Hungary, India, Indonesia, Ireland, Japan, Kazakhstan, Netherlands, Norway, Poland, Russia, Slovakia, South Africa, Ukraine, UK, USA, Vietnam.
More UCGA Members
And Now even More Members!
We are Members of

- American Coal Council
- Brazilian Coal Association
- Energy Institute
- EU – Coal Working Groups – India, China, South Africa
- Fossil Fuel Foundation of Africa
- Gasification Technologies Council
- Global Carbon Capture and Storage Institute
- Global Round Table on Climate Change
- Westminster Energy Forum
- World Coal Association
- UN Expert Group Resource Classification
Strategic Relationships

Punch Above our Weight

- United Nations Expert Group on Resource Classification
- World Coal Association - communications
- Fossil Fuel Foundation of Africa – running training courses/events
- Gasification Technologies Council, USA – now highlight UCG
- Increase activity with Governments, Decision makers
- Several consultation documents for Government
- Increased membership significantly
- Continue building links with others - Geological Societies, Universities, NGO, Energy Associations, Environmental Groups - globally.
- IEA CCC – International UCG Workshops
- 2\textsuperscript{nd}, Banff, Canada
1st IEA CCC UCG Workshop

- The first event, held in July 2011 in South Africa.
- Result of discussions between Eskom, FFF, UCGA, IEA CCC.
- The main aim of the workshop was to bring together local and international UCG experts to discuss current developments.
- Two days of discussions, site visit to Majuba
Why UCG Now?

To fully appreciate the benefits of any new technology one needs to discuss this in the context of the global energy and environmental challenge.

**Global Energy Challenge**

- *Energy Security*
- *Sustainable Supply*
- *Energy Poverty*
- *Climate Change*

UCG addresses all of these issues.
Benefits of UCG

As the gasification of coal takes place underground many of the advantages of UCG are obvious:

- No one works underground - Less Surface Impact –
- No coal to the surface = Lower Fugitive Dust - Noise - Visual Impact
- Syngas can be piped directly to the end-user, reducing rail / road infrastructure
- Cheaper and easier site remediation on project completion
UCG – Lower emissions

Leaves coal ash and other process wastes deep underground,
• Particulates – 50% lower than surface equivalents and stay underground where they belong
• Mercury, Sulphur greatly reduced and easier to handle
• Reduced methane emissions - gas recovered, rather than lost in the atmosphere
• Offers reduced environmental management and costs
• Process affords opportunities to use coal more effectively
• Not just any Coal
• UCG is very site specific – depth, coal quality, thickness of seam, surrounding strata,
Site selection, Site Selection, Site Selection

- *The most important aspect to a successful UCG project.*
- Site selection determines not only whether a location is suitable for UCG but ensures that environmental impacts, such as subsidence or groundwater issues do not happen!
- Coal quality and properties - swell, moisture, volatile
- Thickness of the seam, its angle, its depth
- The makeup and thickness of the surrounding rock – overburden – not suitable, subsidence.
- Distance from major geological faults, rivers, lakes, aquifers, mines.
- Infrastructure - highways, populated areas.
- If a suitable site is located, there also has to be the political will to facilitate UCG.
- Many suitable sites in Africa
Operating a UCG power plant system at high pressure allows the full, higher-heating value of coal to be utilized, recovering the latent heat of vaporisation. UCG operates at up to 80-85% efficiency - the amount of the syngas recovered at the surface is about 80-85% of the original heating value of the coal feedstock.

Enables the CO2 in the flue gas to be captured in a supercritical state available for Enhanced Oil Recovery (EOR) Enhanced Coal Bed Methane (ECBM) - Carbon Capture Utilisation and Storage (CCUS) opportunities.
UCG – Water Supply

- UCG may not require an external water source to operate.
- A major environmental advantage.
- World population tripled – but use of renewable water resources has grown six-fold.
- As the resource becomes scarce, tensions among different users intensifies.
- 260 river basins are shared by two or more countries.
- One of the Millenium Development Goals is to halve, by 2015, the proportion of people without sustainable access to safe drinking water and sanitation.
- Expected 40% -50% population increase by 2050 - coupled with industrialisation and urbanisation - demand for water will have serious environmental consequences.
- www.worldwatercouncil.org
UCG – Sustainable development

A quarter of the world's population - about 1.5 billion live without electric power

Direct Link:
Access to Energy
Human Development
Life Expectancy

The poorest nations - least choices of indigenous energy sources.

Nearly 80% of known coal reserves are deemed unmineable

Clean Conversion of coal - too deep, poor quality, or uneconomical to access - into energy and products offers huge environmental, social and economic benefits.
UCG – Sustainable development

Applying UCG technology to, stranded, low grade coal seams vastly increases the amount of exploitable global reserves

- Estimates suggest UCG could increase recoverable coal reserves by 300%-400%*
- Coal when applied to UCG becomes the largest sustainable resource base in the world

*Accelerating Development of Underground Coal Gasification, Dr. S Julio Friedmann, Lawrence Livermore National Laboratory, 2007)
UCG - Costs

The economics are attractive: lower Capex and Opex. Plus as UCG is a multidiscipline technology, it offers employment opportunities and potential new revenue streams.

Cost of UCG for Power Generation – UCGA 2010

* Mott MacDonald: "UK Electricity generation costs update" June 2010
Flexible Product Uses of UCG Syngas

Current Energy Market UCG cannot compete natural gas market - price,
Global UCG Development

- **Australia** - Bloodwood Creek site, Carbon Energy
  Chinchilla - Linc, Western Australia - 3 potential sites, Pekira Basin, Liberty Resources, - supplying Marubeni, Amonia & Urea

- **Bulgaria** – EU funded joint research project – Overgas, Aachen University, Leeds University, UCG Engineering

- **Canada**, Swan Hills Synfuels, deepest ever, 1,400 meters, CC for EOR, Laurus Energy Project, others Liberty, Linc, Nordic
  Canada ahead on legislation, environmental frameworks, licensing

- **China** – recent announcement of Inner Mongolia Project, joint UK/China initiative, ENN syngas from pilot project in Walanchabi City, Inner Mongolia, 26 months, gasifying more than 100,000 tons of coal.

- **Chile** - Mulpern Energy/Carbon Energy

- **Colombia** – lack of legislation
Global UCG Development

- **Hungary** - WildHorse Energy, Mescek Hills project, plus two other sites earmarked
- **India** – call 2010 for submissions for UCG projects – did not move forward, ONGC, CIL
- **New Zealand** – Solid Energy project at Huntly, successful, now controlled shut down
- **Pakistan** - Thar Project, Sindh Province
- **South Africa** – Eskom, Majuba UCG project
- Suitable sites identified in Botswana,
- **Turkey** – Carbon Energy
- **UK** - 20 licenses to explore UCG on and off shore
  Five Quarters, £15 mill, explore potential in North Sea
- **USA, Colorado, Wyoming, Montana, Alaska** – Linc, Carbon, Laurus, Ergo and others. **State level** - Montana, Colorado, Indiana, University of Utah, University of Colorado, LLNL, NETL - UCG research, **Clean Air Task Force Report** - recommends 3 UCG pilots
Lack of Regulations holding UCG Back

- Modern UCG is a new industry and therefore new to everyone, the public, the media and also regulators.
- Licensing policies for UCG now being formed, New Zealand, Canada, UK ahead.
- Mining is usually the base reference.
- Important to work with Government to achieve a workable system - UCGA able to assist.
- Regulators may need to deal with competing bids and other users of coal.
- Sometimes difficult for a new industry since others are already licensed.
- In countries, such as Australia, issues over overlapping tenements CBM/UCG, both have value!
- **UCGA believe such disputes be resolved with the objective of optimising overall national resource.**
- 80% Energy from Coal using UCG technology!
Lack of Expertise

Many underestimate the expertise in UCG – especially within SA.

**Eskom**: major experience in modern UCG, above ground facilities, environmental studies, health and safety reports

**Sasol**: Gasification, GTL and CTL

**CDE Processes**: Contracted for CCGT power generation facilities fuelled by UCG syngas for a UK/China consortium, also a Hungarian UCG Project

**Aqua Alpha**: coal seam exploration, vertical or directional production and injection wells for UCG, currently working on a European UCG project.

**MegChem Engineering**: provide engineering solutions for UCG in Australia

**Analytika Holdings**: independent expert geological reports and site identification and evaluation for UCG.

*All of these companies are well known in Europe and Australia and bring modern skills, techniques and practical experience to the UCG industry.*
Status of UCG - Summary

UCG as a Strategic Technology
- Ready for large scale syngas production.
- Take-up could be rapid (2012-2018),
- Syngas products have a rapidly growing global market – coal to liquids, fertilisers, hydrogen, power generation.
- Technology unlocks unmineable coal, increased global stocks
- Offshore and coastal schemes are of growing interest

Technical
- DHD techniques provide the necessary process control in deeper seams.
- Environmental impacts solved with current available technology and site evaluation techniques.
- Increase demonstration projects provides important technical data
- For CO$_2$ capture and storage, UCG offers a range of options for lower cost capture
Conclusion

• Industry will not grow just by the efforts and enthusiasm of operators
• To become more widespread, we need to inform governments across the world of the environmental, social, economic and increased resource benefits UCG affords.
• Key to the commercialisation and growth - collaboration

Join UCGA.
Strength in unity

www.ucgassociation.org
Presentation Ends
Thank you for your attention

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