Underground Coal Gasification in South Africa – the SAUCGA

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Technology Introduction

The vertical well method, as practiced by Eskom:

The CRIP process, as proposed by Africary and Exxaro:

Ref: Science & Technology Review, Lawrence Livermore National Lab, USA, April 2007

Ref: Africary
Why UCG?

Energy Resource
- RSA coal resources quoted at 194.4 Bt (1998, DME Bulletin 113)
- Eskom geological records for coal offers received but considered unminable coal = 45 Bt = potentially 350 GWe
- The remaining coal resources: 194.4 Bt – mined – minable = another 100 Bt?
- Un-exportable coal is an indigenous fuel source that is not $-denominated

SAUCGA Membership Capability
- Eskom has 12y experience with UCG development, and 5y UCG operational experience
- Sasol has 60y+ experience with coal gasification, and gasification product development
- Sasol, Exxaro and Africary are developing UCG projects
- Mining services (exploration, drilling etc.)
- Mining experience

UCG Advantage
- Mining efficiency
- Underground safety
- Lower cost
- Environmental performance
- Synergy between electricity and chemicals production
- Asset/job creation from unminable coal resources
- Broad geographic distribution of unminable coal
- Pre-combustion cleanup possible
Country UCG Progress – Eskom

- **Concept Study** identified UCG potential in Majuba coalfield
- **Site Characterisation** study quantified UCG potential in Majuba coalfield
- First 100kW of UCG electricity generated on Majuba pilot plant
- UCG co-firing equipment test
- External co-firing safety due diligence completed
- Revised pilot plant approval
- UCG pilot gasifier #1 commenced shutdown
- UCG pilot gasifier #2 commissioning & commencement of co-firing dependant on permits and licences

**Timeline:**
- Nov 2002: Technology Scan identified UCG potential
- Dec 2003: Pre-feasibility study confirmed UCG potential in Majuba coalfield
- Jan 2007: UCG pilot plant lit, providing proof-of-concept in the Majuba coalfield
- Apr 2010: UCG Licences signed
- Jun 2010: 15,000 Nm3/h pilot gas treatment plant and 120,000 Nm3/h pipeline to Majuba power station commissioned
- Mar 2013: TBA
Country UCG Progress – Eskom

Highlights and lessons learnt:

- UCG currently cannot yet conform to commercial technical criteria.
- It is important to reassess the UCG developmental goals from time to time, to align with rapidly evolving needs/policies etc.
- Eskom remains focused on its reasons for doing UCG and doing it in a phased, iterative and responsible manner.
- Much work is still to be done at the correct level of detail and methodology, to match current commercial and environmental gatekeeper criteria.
- UCG project development success will depend largely on the technical effort invested into it, and a systematic, largely pragmatic approach to resolve working challenges.
African Carbon Energy ("Africary")

Established in 2007 as a BEE South African mining and minerals solutions company in order to fulfil the need for a diversified commodities technology supplier in Southern Africa.

Has available expertise in mining, exploration, gasification and specifically Underground Coal Gasification (UCG).

In 2009 Africary supported Australian ASX listed Wildhorse Energy with investment, technology and management skills for a UCG Project in Europe.

In 2012 Africary diversified and bought a massive coal resource from BHP Billiton SA that is ideally suited for UCG.

Our business philosophy grew to invest and develop our own UCG to Power project - >50MWe.

African Carbon Energy is a multifaceted resource and technology company and owns several energy related interest in Southern Africa.
TUCG Coal Reserves for UCG project

- The Africary Rights comprise an area of 302km$^2$ and consist of:
  - A northern (7km$^2$) coal resource area
  - A southern (173 km$^2$) coal resource area
  - A western (122 km$^2$) coal resource area
- The coal tonnage in the target area is estimated to be in the region of 20 million tons (gross-in-situ)
- >3Mt measured coal reserve in first target area
- Coal quality:
  - 3.2m coal seam thickness
  - RoV = 0.58 (medium rank)
  - Ash content = 28.5%
  - Low sulphur content < 0.7mass %
  - Good gasification characteristics
  - Low Cl and F content
  - CV = >21MJ/kg
TUCG Key Milestones

- **Base-load Coal IPP Bid Announcement**
  - Q2 2014

- **Base-load Coal IPP Bid Closure**
  - Q4 2014

- **Kick-off Implementation Project**
  - H1 2015

- **Completion of BFS**
  - Q1 2014
  - PROJECT READY for IMPLEMENTATION

- **Base-load Coal IPP Bid Opening; ROD: EIA/EMP Authorisations**
  - Q3 2014

- **PPA Finalisation**
  - Q4 2014 to Q1 2015

- **Complete Commissioning and electricity Production in 2016**
TUCG Plant Overview

Flare System

Water treatment

Engine buildings
Uncertainties/Challenges

- Proving environmental integrity of UCG
- Technology maturity level not confirmed
- UCG considered a nascent technology by funders - it may be difficult to secure funds for future projects
- Alignment of policy and regulation with the pace at which the technology is being developed
Why can UCG play a role in SA?

* Coal will remain an important part of the energy mix for decades to come
  * Cleaner coal options such as UCG need to be evaluated alongside other energy options

* UCG can potentially access coal resources that are not economically mineable using conventional mining technology
  * Potential to more than double recoverable coal resources

* UCG is an in-country energy solution, independent of exchange rate and oil price

* SA is at the forefront of UCG development in the world with a number of active projects
**SAUCGA Proposed Objectives**

An independent association is proposed for the purpose of promoting the development of UCG in Southern Africa in the most appropriate, sustainable and environmentally sound manner whilst recognizing the proprietary interests of participating bodies.

To this purpose, the objectives for this association include:

- To create a recognized, co-ordinated point of engagement with stakeholders;
- To advise, develop, enable, support and guide appropriate policy and regulations;
- To establish a balanced position on the case for UCG in SA, including positive and negative aspects, impacts and opportunities;
- To provide an inclusive, balanced and credible advisory function on UCG using a panel of experts;
- To create academic research focal points;
- To develop skills relevant to UCG; and
- To consider a series of steps leading to a SA UCG Roadmap.
Stakeholders represent the wider community interested in UCG, and includes industry, government, academia, service providers, interest groups, communities, etc.
SAUCGA Proposed Roadmap (add dates)

SA UCG Association operational

Priorities to operationalise SA UCG Association
- Sub-Committees prepare work scopes, schedules and budgets
- Executive Committee
  - Formalises governance and terms of reference for meetings and structures
  - Appoints support entity to create administrative structure
  - Recommends membership fee based on administrative costs and sub-committee scopes
  - Submits to members for approval

SA UCG Association formalized

Potential members and other volunteers
- Finalize charter
- Select Executive Committee and Sub-Committee chairpersons
- Register association
- Secure bridging funding for establishment

Stakeholders’ Meeting
Inform, invite feedback and participation, invite potential members, register stakeholders and interested parties

Preparatory Meetings of Interested Parties

Interim administrative support and hosting provided by Fossil Fuel Foundation
Emerging Issues – the next few months

- UCG contribution to the RSA Energy policy
- Regulatory frameworks governing UCG
- Funding for UCG projects
Invitation to Register as SAUCGA Members

All interested parties are invited to contact the FFF secretariat to register.