Can we continue to rely on other nations to provide our gas?

- In 2015 the UK will spend £7 Billion importing natural gas from foreign suppliers.
- We increase our reliance on gas from foreign markets, which can be volatile and uncertain.
- We jeopardise the ability of our domestic industries to remain competitive.
- We export our environmental liability to countries where we have limited, if any, control over environmental standards, health and safety practices or the ethical treatment of workforces at the point of production.

The UK Gas Market

- We rely on gas to heat our homes, provide heat for industries from baking to brick making, to make fertilizer to grow our food, to generate electricity and to create a huge range of products and everyday items.
- In 2004, the UK was a net exporter of natural gas. In 2015, we expect to import more than 50% of the gas we require.
- In 2015, we will spend £7 billion importing natural gas to plug this gap between North Sea production and what we use as a nation.
- Gas has a key role to play in supporting renewables during the gradual transition to a decarbonised electricity generating sector. It is not just about electricity and the use of gas in UK is expected to stay stable or increase until beyond 2050.
- As North Sea production continues to decline it is inevitable that gas imports from the likes of Angola, Qatar, Mozambique, Russia and Norway will continue to increase if we don’t develop our own gas resources.

The Reasons for Promoting a UK Supply of Gas

- Gas is central to our quality of life and in the UK. We have abundant sources of gas that we could develop in a safe and environmentally responsible manner if we choose.
- Coal is the UK’s most abundant hydrocarbon resource with more than 17 billion tonnes of coal suitable for Underground Coal Gasification (UCG) identified in the UK and its coastal waters. Most of these resources are no longer economically viable for extraction by traditional methods given the structural decline in our local coal mining industry. A well engineered and regulated UCG industry in the UK would convert this coal in-situ to a range of valuable industrial gases supporting industry and energy generation for decades to come.
- A new UCG industry in the UK would create employment opportunities and utilise skills and supply chains already established in the UK and especially Scotland. Diverting money away from importing gas will mean investing in the UK, its economy and people.
- Using UCG will also enhance the UK’s ability to service its own domestic and industrial demand for gas increasing security and surety of supply.
- Cluff Natural Resources recognises the strengths of a diversified energy portfolio that includes wind, nuclear, natural gas, solar and hydropower. Adding UCG to this mix will bring significant benefits by ensuring businesses have access to an additional reliable and competitive source of energy and feedstock for manufacturing.
What is Underground Coal Gasification (UCG)?

UCG is a process which converts coal deposits underground, into a range of useful industrial gases. The gasification process requires the introduction of oxygen and water to coals deep underground and applying a source of heat to initiate the chemical reaction. Once established the reaction is self-sustaining provided the supply of oxygen is maintained. The process does not burn the coal, as this would destroy the valuable syngas product. Only a small volume of coal is involved at any one time as the hot reaction front moves slowly through the coal, producing the gases, which then flow to the surface through a production well for capture and use. After each section of coal has been gasified, what remains is char and ash. The process is carefully monitored at all stages, using real-time information on oxygen and water injection rates, along with the composition and volume of gases being produced. The captured gas is known as ‘syngas’ and is made up of a mixture of methane, hydrogen, carbon monoxide and carbon dioxide. Syngas is a particularly valuable petrochemical feedstock for industry.

Development of UCG technology and evidence base

1886
Concept of underground coal gasification first proposed by Sir William Siemens at the British Chemical Society

1930s
First reported field trials

1950s
First large scale projects including the UK’s first UCG project

1980s
State funded research and development in EU and US

UK Research and Development

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<td>Heriot-Watt University</td>
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The Right Geology

Previous UCG projects have demonstrated the importance of site selection in mitigating the potential impacts. The most important factor is depth of coal; deeper is better for a range of chemical and geomechanical reasons.

- The target coals are approximately 1000m below the surface and a short distance offshore.
- Significant thickness of low permeability rocks separating the target coal seam from surface. This prevents near surface waters and air from directly interacting with the gasification process.
- The deep coal is accessible from onshore locations using a very similar well design to other successful projects.
- Formation water in and adjacent to the target coal is highly saline and contains elevated concentrations of a range of naturally occurring contaminants which makes it unsuitable for abstraction for agricultural or industrial supply.

Legacy of Existing Data

Central Scotland has a long history of coal mining, hydrocarbon exploration and hydrocarbon refining. This has resulted in a significant amount of relevant data which we can use to inform the site selection process and the commercial, technical and environmental modelling for the UCG project. This includes:

- Historic 2D and 3D seismic surveys to delineate structural setting;
- Hundreds of boreholes with detailed geological descriptions;
- Highly detailed mine plans and abandonment plans;
- Large volume of coal quality data;
- Large volume of groundwater quality data, including deep samples from target coals;
- Well established regional air quality baseline and monitoring network; and
- Heriot-Watt University evaluation of the potential of the Firth of Forth to host a UCG demonstration project. This publically available report is titled ‘The Coal Mine of the 21st Century – Feasibility of UCG in the Firth of Forth’ and was funded by the Department of Trade and Industry (DTI) and Scottish and Southern Energy (SSE) and first published in 2006.

The legacy data allows our geologists and engineers to carefully evaluate the ability of the sub-surface to successfully host a UCG project including critical permeability and geomechanical properties of overlying rock formations and large scale structures including faulting.

Brownfield Industrial Setting

Existing heavy industry around Grangemouth and Longannet has resulted in a number of potentially suitable industrial brownfield sites which are remote from residential areas.

- The sites have established heavy vehicle transport infrastructure and other potential impacts such as light and noise are set within an existing industrial context.
- The industrial history of the area means there is a pool of skilled staff including chemical and process engineers, instrument technicians, pipelayers and coded welders which would be required during construction and operation should the project progress.
- In addition, there is also a full service supply chain in area. This includes local engineering and fabrication, laboratories, water treatment, catering and accommodation as well as drilling support services supplied from the oil and gas industry in Aberdeen.

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A Five Phase Project—Outline Activities

1) Long Lead Items and Baseline Establishment
   - Place orders for specialist equipment with long lead times.
   - Work to discharge planning conditions and gain other required permits.
   - Continue to monitor baseline conditions for aspects such as surface water, groundwater and air quality.
   - Undertake minor enabling works to make the site suitable for operations.

2) Project Mobilisation
   - The site would be cleared and working platforms formed from a combination of engineered aggregate fill and cement footings to support drilling operations and surface test equipment.
   - The drill rig and ancillary equipment would be transported to site and installed on prepared pads.
   - This is likely to be a peak period for HGV movements. However, like most construction projects, this would predominantly be undertaken during normal working hours (07:00 to 19:00).

3) Drilling Operations
   - Depending on monitoring well requirements, which would be agreed with SEPA, between 2 and 4 directional wells may be drilled from the site.
   - Drilling activities would be carried out on a 24 hour / 7 day a week basis for between 6 and 9 months depending on the final number of wells to be drilled.
   - This phase will result in relatively low levels of activity with a small number of HGV movements per day delivering fuel, water and consumables and removing waste and drilling mud.
   - Once the wells are completed the drilling rig and ancillary equipment would be removed from the site.

4) Gasification and Production Test
   - A modified well test spread comprising a number of modular units, liquid oxygen and nitrogen storage vessels, water tankage, high temperature flame/thermal oxidiser and ancillary equipment would be installed on site over a period of 2 to 4 weeks and plumbed together.
   - Once the surface equipment has been tested and commissioned the gasification process would be initiated.
   - Once initiated, it is expected the gasification test would run for a maximum of 200 days during which a number of specific operational programmes would be completed including a controlled shutdown and restart process.
   - All gaseous products produced during the test would be disposed of via a high temperature flame or thermal oxidiser.
   - All water produced by the test would be captured in a storage tank and removed by tanker to an appropriate and licenced disposal facility.
   - A wide range of real-time monitoring facilities relating to both surface and subsurface processes would be operated throughout the test period.
   - On completion of the test, the oxygen supply would be shut off terminating the gasification process.

5) Decommissioning and Monitoring
   - Once the gasifier has stopped producing steam, the majority of surface equipment would be removed from site. It is likely that only wellheads and welfare facilities would remain on site.
   - There would be periodic visits to site to check and record readings from installed monitoring equipment.
   - This monitoring period would be agreed with SEPA and could extend to 12 months or more.
   - Should commercial operations be considered, then the site and wells may be safely and securely maintained for future operations (this would need further planning, permissions and consent).
   - Alternatively, should the site not be used for future operations then the boreholes would be cemented up to seal the well, wellheads removed, casing cut below ground level and the site returned to its current owner.

Introducing the Project

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**Project Objectives**

Cluff Natural Resources is in the early stages of planning a UCG production test in the Firth of Forth which will be used to demonstrate the commercial viability of a larger scale commercial project. The Project is currently in an advanced engineering feasibility stage but the location of the project is currently conceptual with a number of potential sites available in the Firth of Forth area. Once a site location is confirmed, there will be future consultation with local communities. For the purposes of this exhibition, we have assumed the wells will be drilled and surface facilities will be located on a site within the Grangemouth industrial complex.

**Construction Phase Surface Equipment:**
- Standard construction equipment for earthworks and foundations
- Standard onshore drilling rig (approximately 20m high)
- Drilling mud and waste storage
- Pipe string deliveries and storage
- Concrete storage/silos

**Operational Phase Surface Equipment:**
- Oxygen storage and cabling tubing unit
- Nitrogen storage
- Concrete pads for wellheads
- Production well gas abatement and thermal oxidiser or high temperature flare
- Storage tanks for clean and produced water
- Control, monitoring and laboratory facilities
- Surface parking

**Project Duration:**
- maximum 36 months on site (+ longer term monitoring)

**Surface Site Area:**
- maximum 6 hectares

**Monitoring Phase Surface Equipment:**
- Installed monitoring equipment, pressure, temperature, flow measurements and micro seismic monitoring equipment.

**Indicative Project Details**
- Construction traffic during drilling is expected to peak at 40 HGVs a day. Normal working average is expected be 10-12 HGVs.
- The project would be a 24hr operation during drilling and operation.

**The Gasification and Production Test Profile - Maximum of 200 days**
- Commissioning test - 60 days
- Ignition and build up phase - 10 days
- Gasification on air - 20 days
- Gasification on enriched air - 20 days
- Gasification on oxygen - 20 days
- Test shut down and reignition - 10 days
- Continuous production test on oxygen at full output - 40 days
- Shut down and decommissioning - 20 days

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The Project will meet the requirements of a wide range of legislation and regulations throughout construction, operation and decommissioning including those set out below.

**Planning/Construction**

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Assessing the Effects of the Project

One of the regulatory processes which oversees the development of projects such as this, is that of Environmental Impact Assessment, or EIA. Cluff Natural Resources is committed to a robust assessment of the potential effects of the Project during construction, operation and decommissioning. It is undertaking an EIA of its proposals, in accordance with The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011.

It is currently expected that the following aspects will be assessed in detail where required and publically reported through the EIA process, before any Local Planning Authority decisions are made on the Project.

**Air Quality and GHG Emissions**
- **Receptor:** Local residents and atmosphere
  - Maximise distance from receptors.
  - Implement standard construction management techniques (e.g. water bowers on exposed surfaces).
  - Gas won from gasification to be treated in thermal oxidiser/high temperature flare prior to vent to atmosphere as predominantly carbon dioxide and water.
  - All air quality emissions would comply with regulatory thresholds.

**Traffic**
- **Receptor:** Other road users
  - Implement a Construction Traffic Management Plan which will identify appropriate routes, ensure appropriate delivery times and ensure clear signage.

**Water**
- **Receptor:** Ground and surface water
  - Drill in accordance with best practice guidance. Isolate activity from usable groundwater.
  - No direct discharges from site to Firth of Forth - all process waters to be removed for commercial treatment.
  - Well casing will be a bespoke design for the location and agreed with Regulators (SEPA and HSE).

**Public Health**
- **Receptor:** Human health
  - The use of a thermal oxidiser/high temperature flare will minimise the risk of emissions to air.
  - Any harmful substances will be stored in closed bunded containers.
  - Groundwater around the gasifier is isolated from public water supplies and is not used or suitable for human consumption.

**Biodiversity**
- **Receptor:** Species and habitat
  - Select a brownfield site previously developed within an existing industrial setting.
  - Minimise impact from noise and plant to surrounding designated bird habitat.

**Emergency Response**
- **Receptor:** Groundwater
  - Site selection to maximise distance from receptors.
  - Selecting a deep coal seam with surrounding low permeability rock types.
  - Establishing a baseline and integrating ongoing monitoring regime into the project plan.
  - Operating and managing the system at a pressure at which groundwater flows into the chamber.

**Waste**
- **Receptor:** Waste infrastructure
  - Implement a Waste Management Plan to set out how each waste stream will be segregated, stored and disposed of safely in line with regulations.
  - The waste Hierarchy will be observed to maximise reuse and recycling.

**Contaminants at Gasification Chamber**
- **Receptor:** Groundwater
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**Noise**
- **Receptor:** Local residents
  - Maximise distance from receptors during site selection/layout.
  - Use well maintained and low noise equipment.

**Visual Impact**
- **Receptor:** Local residents
  - Select a brownfield site previously developed within an existing industrial setting.

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Introduction

The UCG Production Test for which Cluff Natural Resources is proposing to seek planning permission aims to optimise technological solutions and demonstrate the economic viability of a future commercial scale UCG project. In the success case, Cluff Natural Resources would be required to undertake a range of further engineering, environmental, health and social impact studies before progressing the larger project. A new Environmental Impact Assessment (EIA), planning permission and other regulatory approvals would also be required before Cluff Natural Resources could proceed with any further UCG operations in the Firth of Forth.

Basic Concept

A commercial UCG project in the Firth of Forth would target approximately 43 million tonnes of coal out of the 335 million tonne coal resource previously identified in geological studies. These thicker coals would be gasified at a rate of approximately 1 million tonnes per year, with somewhere between 8 and 10 gasifiers in operation at any one time. This would be subject to further consideration based on the outcome of the production test.

As the coal in one gasifier is consumed over the course of a number of years, a new gasifier would be drilled and brought online to replace it and the expired gasifier sealed. The directional wells to form the gasifiers would be drilled from one or more sites around the Firth of Forth to optimise coal utilisation. Depending on the outcome of the product specification demanded by the eventual customer and engineering feasibility studies there may be some gas treatment on each site or gas may be piped to a central facility for treatment and separation before being exported from the site.

It is anticipated that a commercial development could have a lifespan of 25 years and if efficiencies in production and cost savings can be realised then this could be extended to 50 years or more.

Local Benefits

We believe a future commercial project has the potential to deliver tangible benefits to the local economy and communities within the area, such as:

- A stable project operated from a small number of sites; opportunities for local employment, apprenticeships and development of local supply chains.
- Wide ranging skillsets required – technical, drilling, logistics, financial and support most of which are already available locally.
- Long term source of competitive feedstock for local petrochemical industries – potential for re-basing industry from overseas and protecting existing jobs.
- Increased local revenue – business rates.
- Potential scale-up with additional syngas supplied from Largo and Frances licences – option for primary electricity generation using gas turbines.
- Displace grid quality gas from feedstock to domestic use – equivalent to increasing supply of natural gas.
- Potential for life cycle CO\textsubscript{2} reduction through Carbon Capture and Storage (CCS) and Carbon Capture and Utilisation (CCU).
The Environmental Impact Assessment (EIA) & Public Consultation

Environmental Impact Assessment (EIA) is a process of collecting information, in a systematic way, in order to identify and assess the likely significant environmental effects arising from a proposed development. Public consultation is a key part of this process and an opportunity for people to have their say.

It is currently envisaged that the preliminary findings of the EIA process will be available for public consultation towards the end of 2015. Cluff Natural Resources will host a second round of public exhibitions at this time, to enable members of the public to view the findings and to comment upon these.

In addition, the public will have an opportunity to comment on the outputs of the EIA process, known as the Environmental Statement, once formally submitted to the Local Planning Authority. This is currently scheduled to be submitted in Q1/Q2 2016.

Register Your Feedback

We are here today to seek your views on the Project and to understand your expectations as to what should be assessed in the EIA being undertaken. We would encourage you to fill out the feedback forms provided, so that we can understand and address the issues which you consider relevant and important to you.

Further Information

Should you require further information or wish to leave feedback at a later point, please contact the Project team:

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