

## SUBMISSION FROM CLUFF NATURAL RESOURCES

### **Key recommendations by Cluff Natural Resources Plc to the Scottish Parliament EETC inquiry to improve Scotland's Security of Energy supply**

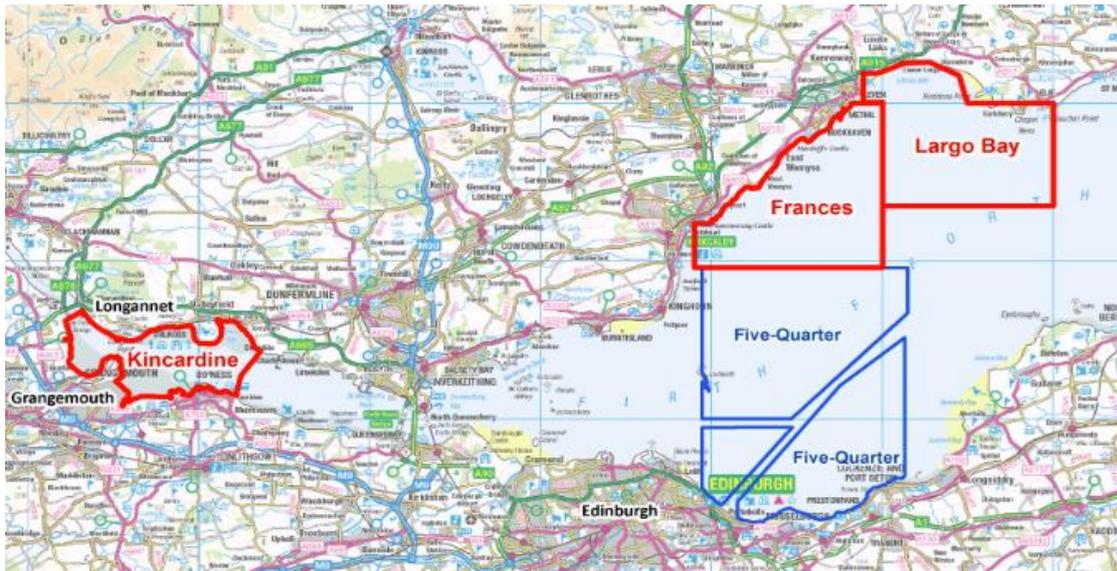
Cluff Natural Resources Plc (CNR) believes Deep Offshore Underground Coal Gasification (UCG) can, with the right support, evolve into a major clean energy contributor to Scotland's energy future. The company holds three offshore UCG licences, issued by the Coal Authority, at Kincardine, Largo Bay and at Frances, near East Wemyss, in the Firth of Forth. CNR is at the forefront of the development of this indigenous energy process in the UK. CNR has spent four years assembling a portfolio of Deep Offshore UCG licences in the UK, whilst raising the profile of UCG by explaining the outstanding potential benefits available from the process to the UK energy sector, policymakers, energy intensive industry and regulators.

Deep UCG is the gasification of coal seams at a depth of approximately 600m and below. Environmental impact at this depth is minimal compared with conventional coal extraction, natural gas, coal bed methane and surface gasification. UCG with CCS is a clean and safe process, comparable with renewables that will enable billions of tonnes of so-called 'stranded' Scottish offshore coal to be exploited to boost energy security and affordability. The capital costs for production are highly competitive and gas turbines can operate on UCG gas with higher efficiencies than modern coal-fired plant. There are minimal exploration risks as the presence, quality and suitability of the coal have already been established from the comprehensive coal mining database that is available.

#### **The Firth of Forth**

The Firth of Forth was identified by the UK Department for Trade and Industry in 2006 as the best site for UCG in the UK to create what it called, "*The Coalmine of the 21st Century*".<sup>1</sup>

CNR holds the UCG licence for this location known as the 'Kincardine Project Area', which lies alongside the Longannet Power Station to the north and Grangemouth to the south. Scottish Power have announced the likely closure of Longannet next year. The map below shows the Company's Kincardine Project Area, located in the Firth of Forth consisting of a licence area of 3,687 hectares, along with its other two licences:



## Overview of the Kincardine Licence

Last year CNR announced an initial JORC resource estimate of 335 million tonnes of coal within the Kincardine Licence, of which 247 million tonnes is measured and indicated. This initial resource estimate is a key step towards building the UK's first deep offshore UCG demonstration project. But importantly there is also potential for operating Longannet or a new power station in conjunction with new UCG operations (covered later in this submission). Two coal seams alone identified 43 million tonnes of coal in place ('CIP') meeting CNR's initial key coal quality criteria for a fully commercial UCG project alongside Longannet or Grangemouth.

## Environmental and production advantages of UCG vs Conventional Coal Mining

The current coal fired plants will all be closed over the next 5-8 years, but fossil fuel, i.e. gas or coal will be required to balance the growing renewable load in the UK for the foreseeable future. Gas supply from the North Sea is diminishing rapidly, and imports, already around 50% of UK demand (and predicted by DECC to rise to 75% by 2030) will have to increase significantly. On the other hand, coal is plentiful, particularly offshore in the Firth of Forth and the other parts of the UK, and if used with CCS could supply all of Scotland's needs for decades.

However the structural decline of Scotland's and Britain's conventional coal mining industry makes the latter unrealistic with conventional mining. It is considered by CNR that a well regulated indigenous UCG project would have significant environmental benefits when compared to conventional coal fired power generation or the surface gasification of coal with combined cycle power generation (IGCC).

The gasification of coal produces syngas which is a mixture of gases composed mainly of methane, hydrogen, carbon monoxide and carbon dioxide. It can be fired directly with air in boilers to raise steam for power generation or industrial heat, used in combined cycle gas turbines (CCGT) or supplied to the petrochemical, steel or chemicals industry for the manufacture of plastics, liquid fuels and fertilisers. Syngas

can also be decarbonised for UCG-CCS to be an effective low carbon solution to power generation.

Surface footprint for a long term commercial UCG project is much smaller - typically 2 or 3 well pads for a UCG project as opposed to the large footprint required for surface infrastructure or opencast void, solid waste management (i.e. coal tips), coal washing, handling and tailings facilities required to support a conventional mining project. There is no vast restoration requirement post-production unlike with surface mining. The life cycle benefits of UCG over conventional coal, i.e. where mining and transportation overheads are taken into account are significant.

Underground and some surface coal mines have significant issues with fugitive methane emissions, whereas there are negligible fugitive emissions associated with UCG projects. Given the offshore location of the UCG reaction chamber, any subsidence, which will be minimal anyway, will occur offshore and the design will ensure that land-based infrastructure is not affected.

No displacement of environmental liability - indigenous UCG production will be subject to strict UK and EU environmental regulation which will ensure all potential adverse impacts are identified and mitigated against at the project design phase – this is in comparison to the majority of imported fuels which are often produced under regimes with less rigorous environmental controls.

### **Electricity Generation - Role for UCG at Longannet site**

There are no ash lagoons with UCG, and UCG derived syngas is ideally suited to pre-combustion removal of CO<sub>2</sub>. When combined with carbon storage or utilisation technologies, the CO<sub>2</sub> footprint for UCG is equivalent to that of conventional natural gas fired power generation. Best estimates of UCG-CCS are £70/MWh compared with £92/MWh for new nuclear and in excess of £100/MWh for wind.

Mercury, particulate (PM<sub>10</sub>'s), SO<sub>x</sub> and NO<sub>x</sub> emissions from conventional coal fired power stations contribute to 1,600 premature deaths in the UK per year. Oxygen fed UCG to electricity projects produce negligible amounts of these pollutants when compared to traditional coal fired power generation. UCG results in reduced SO<sub>x</sub> emissions to air compared to conventional coal fired power generation. UCG derived syngas is ideally suited to preliminary clean-up, removing sulphur and other impurities pre-combustion. This improves overall emissions performance compared to coal fired power generation and has significant commercial benefits over flue gas clean-up technologies.

### **A new role for Longannet with Scottish UCG?**

The coal-fired steam boilers at Longannet Power Station could be co-fired with UCG syngas in two ways. It could simply replace 20% of the input fuel, which other studies have shown (e.g. ESKOM in South Africa), is effective and would increase the generating efficiency by 3%. However, this is unlikely to be economic with current coal prices at £50/tonne.

The UCG syngas could be used as a re-burn technology to reduce the NO<sub>x</sub> emissions and thereby contribute significantly to meeting the new EU Industrial

Emissions Directive Regulations (Reburn is the firing of a natural gas into the boiler through special ports above the coal flame and can result in a 50% reduction of NOx). Longannet was the location of a successful EU Project (Thermie) with Mitsui Babcock Energy Ltd to test the technology in the 1990's.

New combined cycle gas turbines (CCGT) would be located on the Longannet site and connected to the existing electrical infrastructure. Some or all of these gas turbines would be able to operate on both natural gas and syngas. Examples in Europe where this has been done with surface gasifiers are Puertollano in Spain (600MW) and Buggenum Holland (300MW). The replacement of the 2,300MW coal fired generating capacity at Longannet with a new CCGT plant of 1,000MW would meet Scotland's foreseeable energy requirements without the need for nuclear energy.

The Deep Offshore UCG solution would be to supply the new gas turbines at Longannet with UCG syngas drawn and gasified from the offshore coal in the Firth of Forth. The syngas would be pre-treated with carbon capture to ensure it has the same carbon content as natural gas. The UCG plant would produce a CO<sub>2</sub> stream. UCG could also provide an additional feedstock for the proposed Summit Power IGCC plant at Grangemouth, currently the subject of an R&D feasibility study by the Scottish and UK Governments.

CCGT plants are at least 30% more efficient than conventional coal, and the CO<sub>2</sub> output would have been reduced anyway with the new plant. Total emissions for the proposed new plant would be more than half that of the current Longannet Plant for the same electrical output. (In the future, fuel cells operating on carbon free UCG syngas offer efficiency improvements of 80% - and these are under development at Aberdeen and other Scottish Universities).

CNR maintains that the development of Deep Offshore UCG offers huge potential for Scotland to both diversify and strengthen the balance of its energy portfolio whilst also taking the lead in the development of CCS as well as supporting a new North Sea gas sector. Looking ahead, CCS will also be crucial in delivering Enhanced Oil Recovery to prolong the existing North Sea oil and gas sector.

CNR looks forward to working closely with the Scottish Government and Parliament to take these plans and ambitions forward to strengthen Scottish energy security.