Context

British Coal and Peel Energy are seeking approval for the construction of a 27 MW power station at the North Selby Mine site, comprising a 5MW biogas plant and a 22 MW gasification plant.

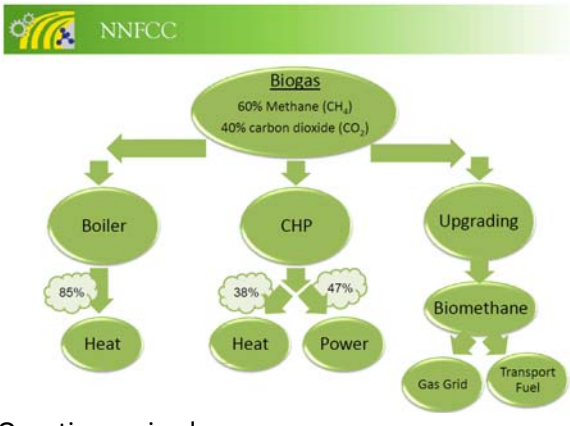
British Coal's objective is the enhancement of and realisation of the land and property assets at North Selby Mine, as part of a wider strategy to de-lever its balance sheet and restore profitability.

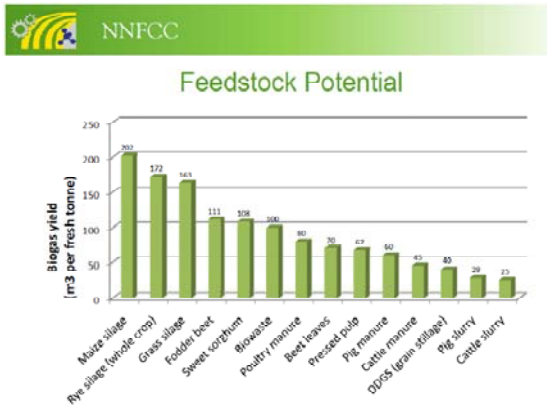
Notes on biogas

Biogas power involves the digestion of a feedstock suspended in water, by a variety of bacteria present in the feedstock or introduced separately, and in the absence of oxygen. The bacteria produce a mixture of methane (natural gas) and carbon dioxide, which can be burned in a generator engine to produce electricity. The generator's exhaust heat can be used to raise steam or heat water for nearby applications.

The biogas unit proposed for the North Selby Mine site is large by industry standards. In Germany, the world's leader in biogas power generation, 70% of sites generate less than 0.5 MWe and the average size is approximately 0.35 MWe[1].

NNFCC quote yield data for biogas from biowaste at around 100 m3 per tonne waste. One cubic metre of 60% methane biogas contains approximately 6 kWh of combustion energy. NNFCC also indicate that a typical large scale CHP plant produce 1.7 kWh electricity and capture 2.0 kWh heat per cubic metre of biogas[2]. The balance of about 2 kWh combustion heat per m3 biogas is lost, or used in the process.





Questions raised:

- **Why so big?** Most existing biogas sites are co-located with their primary feedstock source and sized accordingly: Small units of less than 500 kWe on agricultural sites and alongside small food processors, large units generating over 500 kWe at sewage works and landfill sites. This is because significant logistics costs would make most biogas projects uneconomic, and uncompetitive with other renewable energy options. A large scale site

[1] http://ageconsearch.umn.edu/bitstream/53334/8/6_final_Moeller%20IAAE09.pdf
[2] http://www.biogas-info.co.uk/

reduces the flexibility for small scale process development trials in collaboration with academic or other external groups. It is also less representative of the EU's small scale agricultural biogas base into which any newly developed technologies could be deployed.

- **How much feedstock?** Assuming 8500 full load hours p.a., 5MWe produces 42.5 GWhe p.a., and according to NNFCC's CHP figures would require 25 million cubic metres of 60% methane biogas. This, in turn, would require 250 kt of 'biowaste' (NNFCC terminology) – considerably more than the 50 kt p.a. indicated as biogas feedstock in the planning document.

- **Will the site in practice use mine gas?** The proposed generator scale might make more economic sense for the project if British Coal intended to co-feed mine gas alongside the AD biogas. This is not the purpose of the development stated in the planning document, but British Coal actively develop old mines as mine gas sites (e.g. Stillingfleet)

- **What about the smell?** Experience has shown that AD on this scale can be a very smelly business. Smells are emitted from the delivery and storage of feedstock, from the cleaning out of digester vessels, from biogas cleanup (e.g. removal of H_2S) before power generation, and from the generator exhaust.

- **What will the excess heat be used for?** An efficient CHP site at 5MW scale will capture at least 5MW heat – sufficient to meet all domestic heating and hot water for over 2000 homes, and far more than the proposed biorenewable centre is likely to require.

- **Where will the digestate go?** Depending on feedstock, a quarter or more of material delivered will not be digested by microbes in the AD process, and will result in a digestate by-product. Small scale farm digesters spread this on local land as a slurry-like fertilizer. The quantity of digestate from a plant of this scale will most likely require moving out in road tankers, adding to the site traffic. Alternatively it may be used as indicated in the planning document, as "a soil conditioner or land restoration medium" – i.e. piled up on site indefinitely.

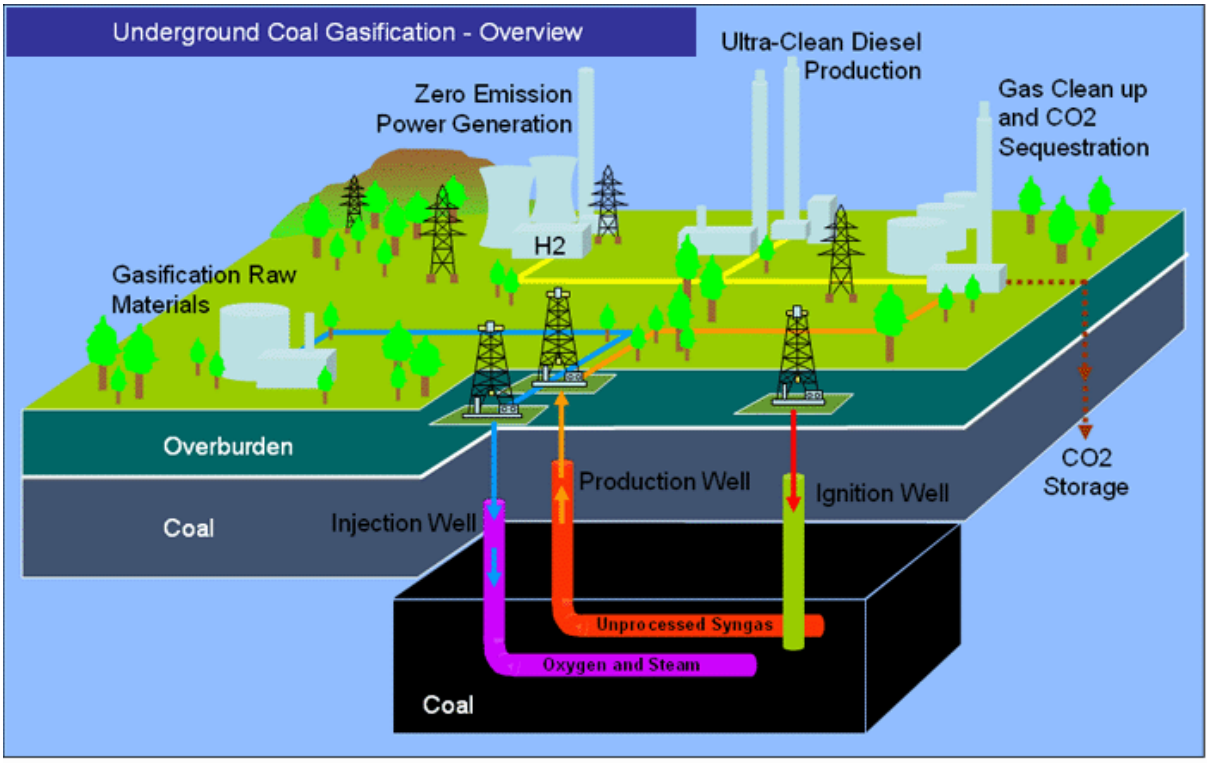
- **Where will the effluent go?** What will happen to washings and other process effluent that cannot be returned to the land as digestate? In the event of process spills, Bridge Dyke and Halfpenny Dyke will deliver the problem directly to Escrick's primary school!

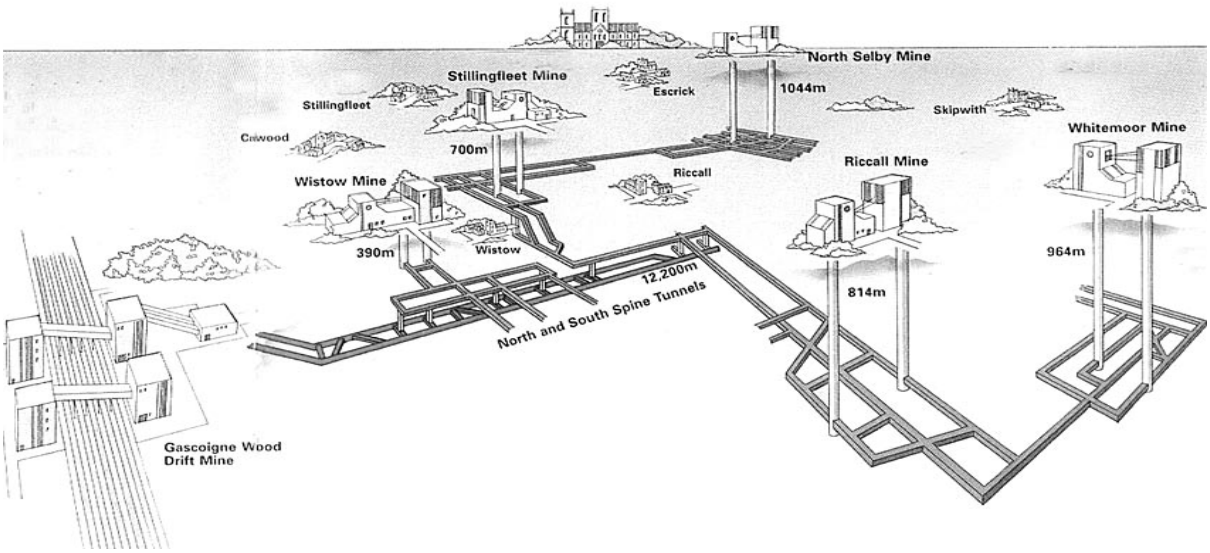
- **Algae ponds and greenhouses?** Feeding biogas-derived CO2 to greenhouses and digestate to algae ponds and has been proposed by some researchers as a way to improve the economic and GHG performance of small biogas sites. The Peel presentation site plans indicate a large area that may be used for this purpose, but the visual impact of this industrial agriculture has not been represented.

Notes on gasification

Peel's proposal to place a 22 MWe gasification unit using unspecified 'advanced technology' raises considerably more questions than the biogas unit – could this be a fore-runner for coal gasification?

British Coal Gasification (not British Coal) is one of several companies now developing techniques to gasify coal underground[3], aiming to increase coal energy recovery from uneconomic/exhausted mining sites. This process involves pumping steam and oxygen into a region of the mine, igniting the coal in situ to generate carbon monoxide and hydrogen, and extracting this for power generation. British Coal has a strong economic incentive to develop this option which would increase the value of reserves in former deep mines of the Selby complex dramatically. British Coal Gasification are actively seeking to venture with British coal resource owners with this objective, whilst Clean Coal Ltd have already secured licences to trial this at five sites in the UK[4].





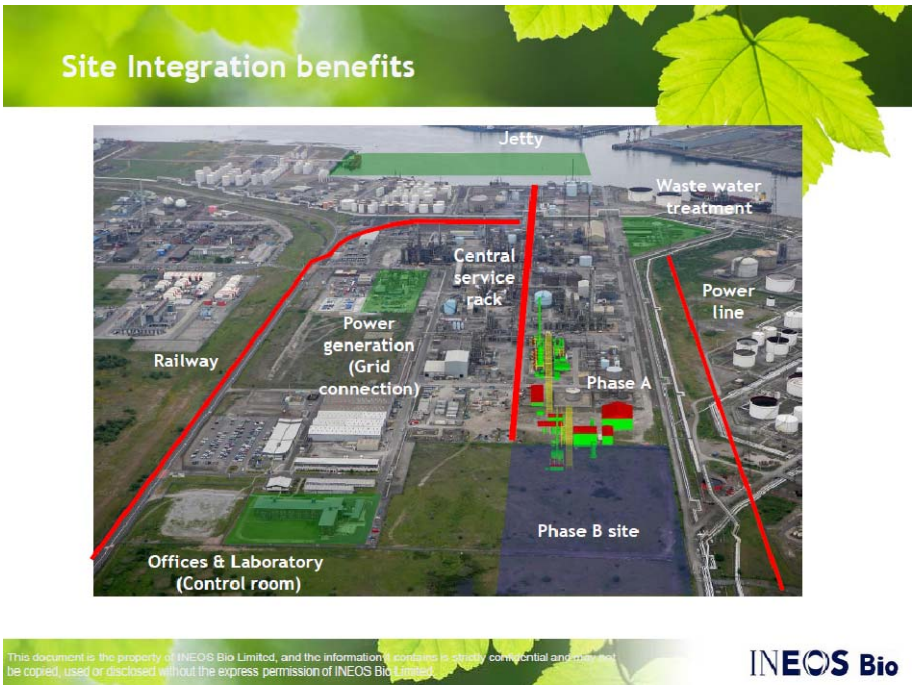
[3] http://www.britishcoalgasification.co.uk/
[4] http://www.guardian.co.uk/environment/2010/mar/04/coal-gasification-ccs

Conventional gasification is mature technology, which involves the partial combustion of carbon-containing organic matter to form 'syngas' – hot carbon monoxide and hydrogen – as a gas engine fuel or as a process intermediary for industrial chemicals manufacture.

The gasification step uses mixed dry feedstock such as domestic waste which would otherwise be difficult to digest biologically - AD and fermentation bugs are often specialised feeders and are easily upset by variable feedstock materials. The output is a homogeneous gas stream which is easily processed or burned for power – however, the usefully omnivorous nature of the process comes at a cost, since much of the energy of the feedstock is converted to heat during gasification. This results in biomass gasification processes generally producing more heat and less power per unit of feedstock energy than biogas AD or fermentation processes. This heat is either captured for use in another process, or wasted.

Although mature, gasification entails such a level of scale process engineering, utility infrastructure integration and risk management that this is generally undertaken within the curtilage of specialised process industrial sites. For example, INEOS have proposed to build a large scale biomass gasification unit processing 125kt p.a. household waste at the Seal Sands industrial complex.

Although smaller in scale than the Peel proposal at North Selby Mine, INEOS provide a strong case for the co-location of such processes on existing industrial sites and *not* in York's green belt.



Advantages of an integrated industrial site location for the INEOS 125 kt waste gasification project:

1) **Process heat integration**. The excess heat of the gasification process is used to create steam for other processes on site.

2) **Transport infrastructure**. Seal Sands has access to a deep water port, a rail terminal as well as direct access to the A1.

3) **Waste water treatment**. Effluent facilities are shared with other Seal Sands businesses.

4) **Power grid connection**. Existing power infrastructure in place for the region's industrial chemical manufacturers.

5) **Expansion options**. Early stage technology needs space to grow – Seal Sands has it.

6) **Carbon sequestration**. In future, CO2 emitting businesses will be at a significant disadvantage if they do not have access to capture and sequestration infrastructure. Seal Sands will have access to a planned CO2 pipeline to storage sites in the North Sea.

7) **Emergency response**. The Seal Sands cluster of businesses benefit from shared emergency response services and infrastructure provided by Sembcorp utilities, and who are able to respond to incidents on the site at a speed and scale proportionate to the risks inherent to many of the chemical process and energy businesses on site.[5]

8) **Security**. For industrial chemical and energy operations, security is paramount since these facilities present a target for malicious action. Security and access control is one of the site's shared services.

9) **Environmental monitoring**. Noise, emissions and other environmental impacts are routinely assessed and controlled for all businesses on the site.

10) **Visual impact**. The site proposed for INEOS Bio's first gasification plant is an existing industrial complex, where large scale chemical and energy businesses have operated safely for the past ~70 years.

The North Selby Mine site has none of these benefits. The planning document states, rather ominously, that "Existing service infrastructure (water supply, sewage, other services) would be upgraded as necessary". The service infrastructure requirements mentioned above imply considerable further development of this green belt site.

The gasification project, in the absence of a local use for around 50MW of steam heat, is an inefficient use of biomass resource. It may be a precursor to experimental development of underground coal gasification in the region.

It is the wrong technology in the wrong place.

A 4 MW biomass gasification unit installed in Italy in 2001 (1/6 of proposed Selby Mine scale)[6]

[5] http://firedirect.net/_archive/_news/2007/0705-1301.htm
[6] http://www.prmenergy.com/?gclid=COXv7b7S2qQCFU1h4wod4WgfJQ

Appendix notes

1) From BNP Paribas doc

A planning condition attached to the planning permission for the mine required the site's restoration to agricultural use The owners, UK Coal Mining Ltd, wish to secure an alternative viable use for the site 1.6 In partnership with Peel Environmental and Science City York, UK Coal are seeking to bring forward proposals for renewable energy generation and associated R&D activities. These proposals have evolved out of a previous scheme which placed greater emphasis on R&D

Proposed Development Overview

4.1 The proposal is for two electricity generating plants with a combined output of up to 27MW, both of which would utilise waste-derived fuels. In addition, the existing office building would require a change of use to R&D, educational and amenity use. The description for planning purposes is as follows:

Use of land and construction of plant for energy from waste generation together with the alteration and re-use of the existing buildings and land to provide an Education and sustainability Research Centre, incorporating.

- *Research and development* offices *and laboratories* (81)
- *Demonstration-scale research facilities for renewables research (sui generis)*
- *Ancillary education and conference facilities (01) and renewables shop* (A 1)
- *Waste processing and fuel preparation (sui generis)*
- *Anaerobic Digestion facility and associated energy generation (sui generis)*
- *Energy from waste (gasification) facility (sui generis)*
- *Car parking and ancillary facilities.*

4.2 It is proposed to co-locate an energy-from-waste (gasification) facility with an anaerobic digestion plant within the existing perimeter mounds.

Gasification Plant

4.3 The gasification plant would use up to 140,000 tonnes of waste per annum. The waste would be non-hazardous and would arise from a combination of municipal, commercial and industrial sources. On average, this would require 32 HGVs entering and leaving the site each day. The plant will export up to 22MW of renewable energy onto the National Grid using the existing grid connection at the Site

4.4 The gasification technology will be housed in a new purpose-built structure. The final provider has not yet been selected, but the process is likely to be based on an "Advanced Technology"

4.5 Waste delivered to the gasification facility will initially be put through a recycling facility process that removes recyclable materials such as metal and glass. The residual waste is shredded within the building, and passed through to the gasification process.

4.6 The gasification process involves heating the waste fuel in an oxygen deficient atmosphere to produce a gas containing hydrogen, carbon monoxide and methane. This gas is then used to generate steam and heat, together with electricity for export into the national grid, with clean emissions to air.

4.7 The plant will be designed as a combined heat and power (CHP) facility, with the heat being used in the proposed Education and Research Centre for Sustainability.

Anaerobic Digestion

4.8 The Anaerobic Digestion plant would be capable of receiving 50,000 tonnes of waste per annum On average this would require deliveries from 12 vehicles per day The facility would receive non-hazardous "green waste" such as agricultural waste, garden waste, food waste, commercial green waste, and paper/card that is too low-grade to recycle

4.9 Waste would be composted in the absence of oxygen to produce a biogas which typically consists of 60% methane, 40% carbon dioxide. This gas would either be stored for use as a fuel off-site or combusted within a gas engine to generate up to 5MW of electricity for export to the grid. Following anaerobic digestion, the composted material would be used as a soil conditioner or land restoration medium.

Research Uses

4.10 With respect to the R&D uses, the intention is to re-use the existing buildings, which provide about 6,250 sqm of floors pace. Existing service infrastructure (water supply, sewage, other services) would be upgraded as necessary.

4.11 The site has parking capacity for 250 cars, Around 150 people are likely to be based at the site, although many of these would be part time. With visitors attending demonstrations or conferences, site occupancy could reach around 200 people

2) From North Yorks planning report to JCC

The site is in an open countryside location where large scale non-mineral development would not normally be permitted. Principally for this reason, conditions were imposed on all the original shaft site permissions to retain control over the working life of the sites and to secure the eventual removal of all buildings upon the cessation of mining in order to facilitate restoration to agricultural use. The standard condition requiring such restoration reads as follows:

> *"If the use of the two shafts for the purposed of conveying miners and their equipment to work coal from the Barnsley Seam is abandoned or shall cease for a period of not less than twelve months the whole site shall be restored to a condition capable of agricultural production, in accordance with such scheme as may be approved by the County Planning Authority, and any plant, buildings and machinery shall be removed from the site within twelve months of the relevant date being the date of abandonment or termination of the twelve months period above mentioned".*

A planning application for a relaxation of the restoration condition to allow the retention of a range of buildings and infrastructure and the re-use of the retained buildings for business, industrial and storage/distribution uses was submitted in 2000.

3) From http://www.ukcoal.com

The Strategy

Harworth Estates manages a substantial portfolio, comprising in excess of 43,500 acres of land and 250 commercial and residential properties. The Company has identified more than 79 potential development sites through its initiative Project Worth, and has committed to reporting on the progress of this project at half yearly intervals with both formal revaluations of the estate and revisions to its management estimates of worth.

The current development sites identified cover approximately 3,900 acres of principally brownfield regeneration land located from Northumberland to the East Midlands, principally down the A1/M1 corridor with additionally a large site at Bolton on the Manchester orbital motorway. The identified development sites have the potential, with planning consent, to deliver in excess of 31,000 new homes and 32 million sq ft of business space. The majority of the rest of the portfolio is currently either operational land or agricultural land held for income, asset appreciation and future potential for surface mining in accordance with world leading environmental best practice.

Electricity Generation from Methane

From a safety standpoint we need to extract methane from operating mines. Its use as a fuel source both contributes to our operations providing an economic fuel source and reduces the impact on the environment of venting methane, a greenhouse gas with approximately 21 times the environmental impact of CO2. Our methane based electricity generation operations are now treated as part of our deep mine operations.

In 2008, we generated 165,834MWh of electricity (down 9% compared to 2007) from 29 MW of installed capacity from methane extracted at both operating mines and former mine workings effectively self supplying over 60% of our deep mine electricity requirements. Generation from our two non operating mine sites was better than expected with Stillingfleet utilisation being above 95%.

Renewable Energy

The UK Government and European Energy Policy is clearly directed toward increasing the proportion of renewable energy within a sustainable framework of energy mix. Harworth Power has access to a considerable portfolio of sites suitable to the development of renewable energy installations.

Wind projects are commercially attractive, with much synergy to the business. Owning suitable sites is the main catalyst for investigation of projects, but when other aspects of wind schemes are considered such as planning expertise, competences in generation, electrical, civil and mechanical engineering, the commercial benefits increase, and the commercial / engineering risk reduces. There also exists opportunities to support the regeneration and redevelopment of former colliery sites through the provision of clean, green energy.

In the last quarter of 2008 the Group completed a strategic collaboration agreement with Peel Energy, a wholly owned subsidiary of the Group's major shareholder, Peel Holdings. Under the Agreement, Peel Energy will undertake investigative work on 14 existing wind farm opportunities and where appropriate take forward, at their own cost, projects through the planning stages to ultimately identify joint venture wind farm development opportunities. Harworth Estates will additionally work closely with Peel Energy to identify further wind farm opportunities from within the portfolio. The Sustainable Development Commission has also produced an excellent document regarding wind energy which can be found at http://www.sd-commission.org.uk/publications.php?id=234. A pocket sized version of this report is also available and can be requested from Harworth Power by e-mailing enquire@harworthpower.com

4) From UK Coal Chairman's annual statement 2010 (2009 annual report)

We consider our debt levels to be too high and therefore intend to take advantage of the current strong market values for agricultural land to pursue the disposal of a significant proportion of our agricultural estate and to explore joint-venturing the development of a larger part of our brownfield land portfolio with the objective of reducing the absolute levels of bank debt and associated costs.