Bio-SNG

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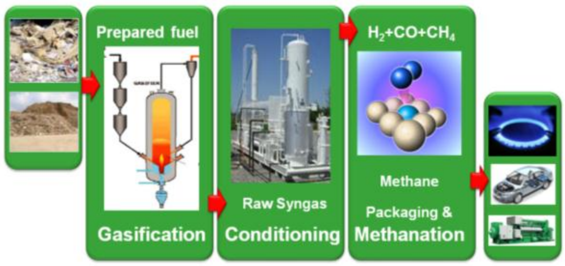
The use of bio-fuels for heating and lighting pre-dates the use of fossil fuels by thousands of years. However, unlike with fossil fuels, a systematic knowledge of the challenges posed by solid bio-fuels is not as widely understood, a fact attributable to the exponential acceleration of fossil fuel usage as global demand increased during the industrial revolution. In the wake of this, producers and users of thermal power are considering the use of biomass in applications in which the use of fossil fuels has been dominant. This includes electricity generation, heating, transport fuels, organic chemicals, synthetic materials, and synthetic natural gas or SNG.

Around 40 per cent of the UK's primary energy consumption is supplied by natural gas, making gas the UK's largest single energy source, with an extensive infrastructure and expertise base. Biomethane is a clean and relatively low carbon intensity fuel that can utilise the established infrastructure and demand-side technologies (gas boilers for heating and an increasingly wide range of available compressed natural gas – CNG – vehicles).

Biomethane production via thermally-derived synthesis gas (bio-SNG) can be generated from any biomass fuel that can be gasified. Feedstocks for bio-SNG can include more durable material such as woody biomass and wastes that cannot be broken down in traditional anaerobic digester plants. Potentially this includes pure biomasses such as woodchip and energy crops as well as discarded materials such as waste wood, or processed wastes such as Solid Recovered Fuels (SRF). Although anaerobic digestion of organic material has been widely accepted as an important renewable energy technology, the production of Bio-SNG is required to move to higher levels of fossil fuel replacement.



There are significant indigenous and international biomass resources in the form of 'pure' biomass and waste derived fuels. However, there are competing uses for biomass in many industrial sectors including building materials, chemicals, heating, electricity generation, and transport bio-fuels. Therefore, one of the main barriers to bio-SNG is in securing feedstock on contracts of a sufficient term and an appropriate price. As such, it is likely that the development of Bio-SNG facilities will require the developer to go upstream to the supply chain for both grown and waste derived fuels.

However, in principle, the major process operations required to produce Bio-SNG can be identified and assembled from existing technology suppliers. Although this does not guarantee that a Bio-SNG development would be free from technical risk, it does suggest that no fundamental process development would be required to create a viable Bio-SNG platform.

NEPIC (North East Process Industry Cluster) has recently published on its website the Feasibility Study that NEPIC, National Grid and Centrica commissioned to review the use of Bio-SNG delivered via the gas grid as a way to decarbonise road transport and heat. The report was co-produced by Progressive Energy and CNG Services Ltd.

The report provides a critical appraisal of the opportunity surrounding Bio-SNG. As well as a financial assessment, a detailed analysis is made of the issues arising from biomass sourcing, the technology options and applicability for injection into the UK grid. The data used demonstrate the full lifecycle carbon dioxide savings and that Bio-SNG is a very cost effective route for decarbonisation compared with other renewable energy sources. It provides proposals for implementation pathways, specifically how a Bio-SNG demonstration could be established in the northeast.

The northeast is seen as an attractive location for the development of a Bio-SNG project. It has a long history of chemical and processing industries and therefore has the necessary gas and services infrastructure and transport links as well as the people and skills base. The industrial backdrop of the northeast can accommodate the kind of processing plant under consideration, with a range of suitable and available sites. Changes to, and closure of, existing industries means that new facilities that offer employment and regeneration are welcomed.

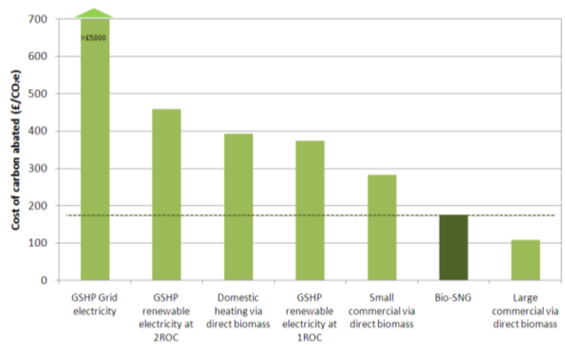
The study analyses two representative scales of facility at 50MWth and 300MWth input that would produce approximately 230GWh and 1400GWh of Bio-SNG per annum respectively. This is equivalent to sufficient gas for approximately 15 to 100,000 households or 25,000 to 150,000 passenger vehicles. Three of the larger facilities would supply 1% of the UK domestic gas market.

The conclusions of the Feasibility Study are that:

- Bio-SNG offers the possibility of substantial scale renewable methane production
- The major processes required to produce Bio-SNG can be identified and assembled using existing technologies
- The estimated costs of Bio-SNG for a large-scale plant are very competitive with other renewable energy technologies
- Lifecycle CO_2 savings of Bio-SNG compared with fossil fuel alternatives are typically 90% and are similar to those using direct biomass combustion, but with a far more flexible delivery mechanism (the existing gas grid)
- Bio-SNG is significantly more cost-effective per tonne of CO_2 abated than heat pumps or domestic and commercial biomass heating, and more cost-effective than electrical solutions for transport applications

Whilst the study was considering the use of Bio-SNG as a vehicle fuel, it showed that an attractive option might be to use Bio-SNG for domestic heating. For heating, the study shows that the cost per tonne of carbon abated appears to be lower than domestic and commercial biomass boilers and ground source heat pumps. Similarly, for transportation, with the Bio-SNG delivered by the gas grid to customers and then made into CNG for use as a road fuel, the cost per tonne of CO2 abated appears to be significantly lower than the cost for electric vehicles and is a credible option for trucks where the electric option is not practical.

Bio-SNG is therefore a particularly attractive renewable vector as it can be readily utilised in existing applications such as CNG vehicles or efficient condensing gas heating appliances. This compares favourably with the use of other renewable resources, which can impose significant demand-side constraints, which in turn may hinder take-up.



For the northeast bio-SNG project, one approach to reducing technical risk would be the development of a fully scalable demonstration facility. However, even a reasonable scale demonstration facility would not necessarily initiate project finance on the first full scale plant. In light of the report's financial analysis, a project at 300MWth fuelled by SRF could be economically viable. However, the major capital investment for a pilot project is substantial and would not be financeable without a transitional pathway, such as one based on an existing or already proposed syngas platform.

However, the report makes it clear that implementation of Bio-SNG will only take place with the appropriate tax, incentive and legislative environment. It is therefore of critical importance to establish a position that is applicable to Bio-SNG production in its own right as well as in comparison with the situation for other competitive users of biogenic energy resources.

The Renewable Obligation (RO) scheme is well established in the UK to incentivise the use of biogenic resources. In order to facilitate expansion of renewable heat and Bio-SNG in particular, the forthcoming Renewable Heat Incentive (RHI) must be structured so that such projects are commercially attractive compared with electricity production. Without such a scheme, conversion of biomass into Bio-SNG for the purpose of injection into the gas Grid will not happen at any scale using any fuel.

With the current assumed support level under the RHI of £40/MWh, a Bio-SNG Project at 50MWth will not be viable and either some form of capital grant or subsidy enhancement is necessary for a small Bio-SNG Project to operate. However at 300MWth the current support level is sufficient to enable a competitively costed bio-SNG project, particularly if fuelled fully or partially by a waste derived fuel. This indicates that there could be a long term role for Bio-SNG commercially.

In addition to the incentives structures, the regulatory environment must be clear and appropriate, particularly with regard to:

requirements for gas injection, emissions directives, and how the use of waste as a feedstock is treated.

It is clear that the use of new material can only have a limited role, and that the use of waste is vital to maintain the projects commercial integrity. The report's financial analysis postulates that the technical issues relating to Bio-SNG production, particularly from waste, can be overcome. The international Bio-SNG projects currently being developed are based on biomass. One example is a bio-SNG plant that started operation in 1984 in Beulah, North Dakota, USA. With 3GWth input capacity producing 200,000 Nm3/hr CH4 and fuelled by lignite this project is the largest lignite-to-Bio-SNG facility in the world. This site also incorporates a carbon capture and storage (CCS) facility. However, there are a number of international waste-to-syngas projects under development for both GT/ICE power applications as well as bioliquids.

NEPIC, Centrica and National Grid are sharing the details of the study with DECC and the Committee on Climate Change so that the Bio-SNG option can be considered alongside other technologies and the option of a UK demonstration project considered. The results of the study are also highly relevant to the current Defra Review of Waste Policies, as the production of Bio-SNG could help to maximise the contribution that waste management makes to the government's energy goals.

The key advantages of Bio-SNG are: the ability to convert both woody biomass and wastes into bio-SNG; the utilisation of the existing gas grid which allows the highly efficient transfer of energy from the Bio-SNG plant to the consumer; and finally the use of efficient heating appliances such as condensing boilers. With the ever rising need to secure future energy diversity and reduce greenhouse gas emissions it could be a considerable advantage if use could be made of the gas infrastructure and the expertise of the efficient industry that has developed around it by the use of bio-SNG.