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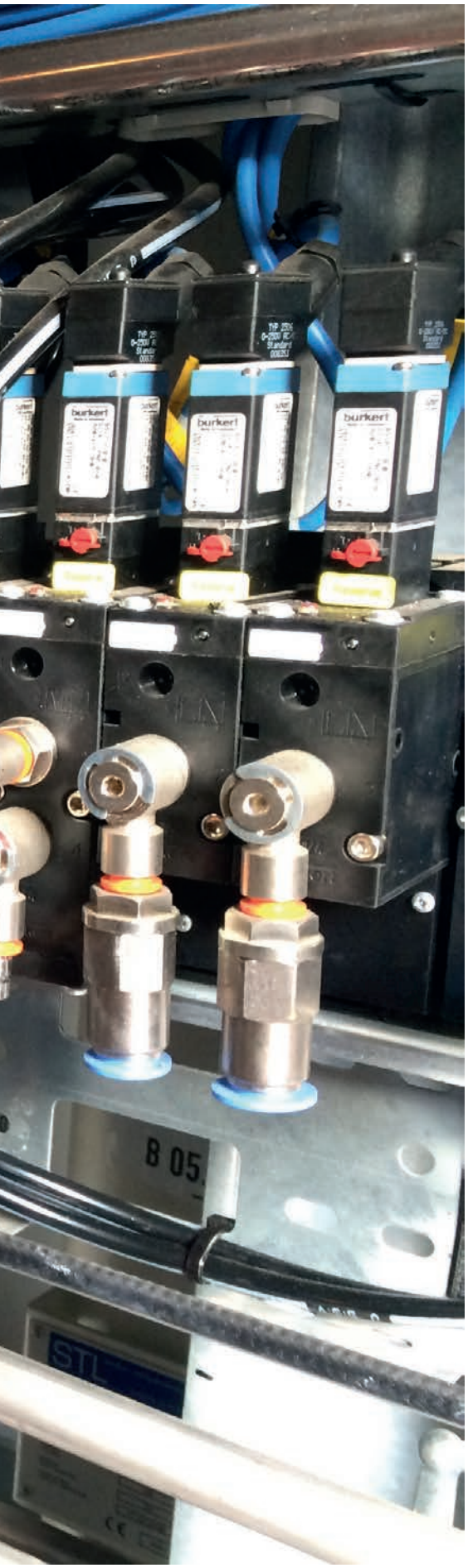


National Grid is at the forefront of a new and exciting initiative that will allow household waste to be converted into renewable, low carbon gas. David Pickering, BioSNG Project Manager for National Grid's Gas Distribution Innovation Team, explains

In partnership with Advanced Plasma Power and Progressive Energy, National Grid believes it has identified a way to give consumers access to secure, low-cost, renewable energy through a pioneering process that will see household waste being converted into bio-substitute natural gas (BioSNG).

Once it has been produced close to the sources of the waste feedstock, BioSNG can be transported using the existing gas network, directly to consumers' homes for heating or to filling stations to be compressed to fuel buses or trucks.

This ambition has moved a step closer to being realised, following the recent completion of a pilot BioSNG plant in Swindon, where the production process will be optimised. Construction of a commercial plant will begin in July this year that will produce significant quantities of BioSNG from 2017 onwards.

WHY CONVERT WASTE INTO GAS?

Currently, gas dominates UK heat supply, with 83 per cent of the UK's buildings heated by gas. Heat demand is highly variable, with peak daily demand more than five times greater than the lowest demand day. The existing gas infrastructure is ideally suited to handle seasonal and daily variations in heat demand. Alternatives to gas such as electric heat pumps will make a contribution, but huge investment would be required in generation, infrastructure and appliances if they were to completely replace gas for heating.

In transport, the electrification of vehicles has a key role to play. However, this needs to be complemented by low carbon fuels that can provide the energy dense storage required by the heavy goods vehicle and bus sector. The use of compressed natural gas can offer carbon, noise and emissions benefits in the short term, and its popularity is increasing exponentially, in both domestic and international markets.

However, the UK will become increasingly reliant on imports for its gas supply, raising concerns over security of supply and exposure to the price volatility of world markets. In addition, meeting the UK's commitment to an 80 per cent reduction in greenhouse gas emissions by 2050 requires a major reduction in the use of fossil fuels. Gas produced from waste, the UK's largest sustainable energy source, provides a low carbon fuel, generated from a low cost and native feedstock. Once the technology has matured, the cost of the gas it produces should fall below fossil gas prices.

Renewable gas in the form of biomethane from anaerobic digestion is already making a contribution, with around 50 plants injecting into the gas network. However, the types of waste that can be treated in this way are limited to food, agricultural waste and sewage. Recent analysis has indicated a maximum potential contribution of 40TWh per annum of renewable gas from anaerobic digestion, using current technologies.

If renewable gas could be made from a wider variety of organic waste materials, such as residual 'black bag' household and commercial waste, availability would increase by around 100TWh per annum, or 30 per cent of current domestic gas demand. The new gasification technology currently being developed by National Grid and its partners offers such a possibility.

THE BIOSNG PRODUCTION PROCESS

The process is carried out in several stages. Waste materials diverted from landfill as well as other biomass materials act as the feedstock for BioSNG gas generation.

GASIFICATION

The first step in the process is shredding the waste and removing recyclable materials such as metals, followed by drying, to produce refuse

derived fuel (RDF). The RDF is then gasified to produce a syngas that is rich in carbon monoxide and hydrogen and low in tars. The syngas is then cooled in a heat recovery boiler and passed through a number of other stages to remove impurities, such as heavy metals, ammonia and chlorides.

METHANATION

The chemical reaction to produce methane requires the appropriate hydrogen to carbon monoxide ratio. The syngas from the gasifier has an excess of carbon monoxide, so steam is introduced and the gas is passed through an iron catalyst, known as a water gas shift reactor, increasing the hydrogen content. The gas then enters a succession of methanation reactors with nickel-based catalysts. In these reactors, the quantity of catalysts and the gas flow rates are carefully selected to ensure a controlled reaction.

UPGRADING AND DISTRIBUTION

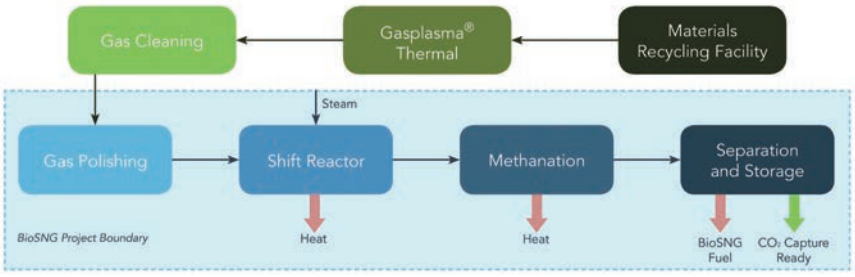
The gas exiting the reactors contains significant quantities of carbon dioxide, which is removed to produce a gas product with a high methane content, meeting Gas Safety Management Regulations. The high purity carbon dioxide is suitable for industrial and food applications or for carbon sequestration.

DEVELOPMENT PROGRAMME

PILOT PLANT

The technology is being showcased at a new pilot plant in Swindon. This test plant has been designed to demonstrate the technical potential of producing BioSNG. It will also act as a test bed to optimise the overall performance of the system and to inform the design and economic viability of subsequent commercial plants. The full end-to-end process will be demonstrated in 2016, and the testing programme will be completed by February 2017.

SCHEMATIC DIAGRAM: BIOSNG DEMONSTRATION PLANT



COMMERCIAL BIOSNG PLANT

The next project will gasify 10,000 tonnes per annum of waste to produce BioSNG for injection into the local gas grid and compressed BioSNG for transport. Construction will begin in 2016, and the plant will produce 22GWh of BioSNG per annum, starting in 2017. By operating continuously under normal commercial conditions, the plant will help to remove the construction, operational and performance risks of the technology, giving confidence to potential developers and investors of larger scale plants.

The project will benefit from a secure source of RDF from the local Swindon Borough Council waste facility, and from income from a local road haulier who will buy the compressed BioSNG for use in its fleet. The BioSNG will also be injected into the local Wales & West Utilities gas distribution network.

The £23 million development has been funded by the Department for Transport, Ofgem's Network Innovation Competition, Advanced Plasma Power and National Grid.

FULL SCALE PLANT

The project partners believe that the first full-scale BioSNG plant could start producing gas in 2019. A large scale facility could use the waste from a city the size of Coventry to meet one quarter of its gas demand, or to fuel the entire bus fleets of Manchester, Liverpool and the West Midlands.

The roll-out of further production facilities beyond 2020 is expected to lead to cost reductions due to economies of scale and a reduced risk premium, which should lead to BioSNG production becoming competitive with fossil gas prices by the middle of the 2020s.

LONG TERM BENEFITS

The substitution of renewable gas for fossil gas will increase the security of the UK's gas supply and lead to significant savings in greenhouse gas emissions. At the forecast rate of roll-out BioSNG plants, 37TWh per annum of BioSNG would be produced by 2030, which would result in annual savings of around 12 million tonnes of CO_2 equivalent.

National Grid's independent study of future energy scenarios has demonstrated that a roll-out of BioSNG is substantially more cost effective than alternative pathways, and will result in savings in overall energy system costs, amounting to approximately £4 billion per annum by 2050.

BioSNG offers the prospect of converting the UK's largest source of renewable carbon to substitute natural gas, delivered via an existing and extensive distribution network to meet heat and transport demand. Ultimately, combined with renewable gas from anaerobic digestion, it could meet 35 per cent of the UK's gas demand and play an essential part in meeting our greenhouse gas emission targets in a cost effective way. ■

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■ **For more information about National Grid's work with BioSNG, visit** *www.nationalgrid.com/BioSNG*