Reference
CCC 010217

Date
1st February 2018

Cadent Gas Limited
Ashbrook Court, Prologis Park
Central Boulevard
Coventry CV7 8PE
cadentgas.com

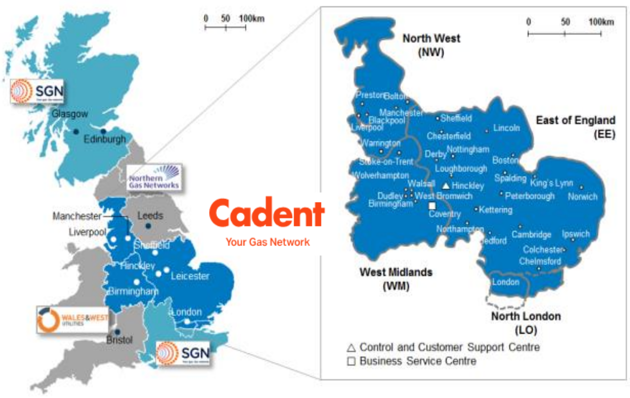
The Committee on Climate Change
7 Holbein Place,
London SW1W 8NR

Cadent
Your Gas Network

Dear Sir,

2018 Bioenergy Review Call for Evidence

Cadent welcomes the publication of the Bioenergy Review Call for Evidence and is pleased to be able to respond. We consider the comments made below to be our high level thoughts and we would welcome the opportunity to engage further with the department in the near future on any issue raised here.



Cadent owns and operates four gas distribution networks in the UK, providing a safe, reliable and efficient network that transports gas to homes, schools, businesses from the District to North London and from the Welsh Borders to the East of England.

We serve 11m customers across this footprint and are the largest gas distribution company in the country. Our size and scale ensures that we are an important position to work collaboratively with the Committee on Climate Change to develop a long-term strategy which will reflect the critical importance of gas and the gas networks as the most cost-effective and efficient pathway for the country's transition to a low-carbon energy system.

Cadent believes that bioenergy, and in particular renewable gas, can make a significant contribution to meeting 2050 climate change targets, in particular when supporting decarbonisation of the heat and transport sectors, which are currently lagging behind the electricity sector. We believe that bioenergy should be focused on where it delivers solutions which cannot readily be serviced in other ways

.
It therefore follows that waste and biomass resources should be strategically directed AWAY from being used for electricity production.

This is because there are sufficient alternative solutions to generate low carbon electricity (wind, solar, nuclear etc), and the gap between supply and demand that such sources leave requires flexible supply technologies. The logistics of biomass means that it is unsuitable for flexible power production, but it is very suitable for conversion to biomethane/BioSNG (and potentially biohydrogen) which delivers excellent carbon savings, with the prospect of bioCCS and the ability to store renewable energy in the gas networks. This will deliver renewable energy into *either* the heat or transport markets, which are otherwise difficult to decarbonise, with the gas networks as an essential element in the chain.

In other words, converting as much waste and biomass as possible into gas provides most degrees of freedom in relation to utilisation.

Maximising the use of waste / biomass resources to produce renewable gas has the following additional advantages:

- The gas networks already have sufficient capacity to distribute energy for heating to over 80% of consumers in Britain, and also to support distribution of gas for heavy transport. If bioenergy resources were to be converted into electricity and this additional electricity needed to be transported to consumers for heating (e.g. utilising heat pumps) this would require a very significant and costly expansion of the electricity networks to supply a heat load that would only be required for relatively short cold periods in the middle of winter. In Cadent's 2015 proposal to Ofgem to build a BioSNG Commercial Demonstration plant, an independent analysis demonstrated that extensive use of BioSNG technology would result in energy system costs in 2050 that were around £4bn per year lower than a scenario where there was no BioSNG in the energy mix.

- Conversion of bioenergy resources to renewable gas, which is then distributed by the existing gas networks, means that consumers are able to access renewable energy for heating using their existing heating appliances and systems, with no requirement for costly and disruptive changes. A recent study has found that consumers are unlikely to replace their heating systems unless it fails or there is a significant financial benefit from doing so[1].

- If bioenergy resources are converted into renewable gas at a relatively small number of production plants, this provides the opportunity to capture and sequester the CO2 that is produced (as the BioSNG production process results in a pure stream of CO2), resulting in negative GHG emissions. By contrast, if bioenergy resources are converted into renewable electricity, the process produces a stream of CO2 that is diluted with nitrogen, meaning that further costly processing would be required to capture the CO2.

- Converting bioenergy resources to renewable gas provides the opportunity to deliver some of the gas into the heavy transport sector, replacing diesel. Heavy transport is recognised as being hard to decarbonise, and the use of gas in heavy transport also provides large benefits in relation to particulate and Nox emissions, which is becoming especially important in urban areas.

[1] http://www.smarternetworks.org/Files/Bridgend_Future_Modelling_%E2%80%93_Phase_2_150910144351.pdf

As requested, in our detailed response below we have answered only those questions in which Cadent has knowledge or expertise. We would be delighted to meet and discuss these points in greater detail with you.

Yours faithfully,
Richard Walsh

Public Affairs Manager
Richard.walsh2@cadentgas.com

Responses to specific call for evidence questions

Q. 12. What are the most credible and up-to-date estimates for global bioenergy resource potential through to 2050, broken down by feedstock type? What key assumptions underpin these estimates? Please provide details of any assessments of global bioenergy resource explicitly tied to sustainability standards (covering GHG emissions, biodiversity, water use, land-use, land-rights, air-quality and other social and environmental issues)

In 2017 Cadent commissioned an independent study to evaluate the potential of renewable gas in the UK to 2050. This work was carried out by Anthesis Consulting Group PLC and E4tech UK Ltd, to update the CCC 2011 scenarios. The report considers all of the potential feedstocks including waste and UK sustainable biomass that can be used for the production of biomethane from anaerobic digestion (AD) and Bio-Substitute Natural Gas (BioSNG). The results for total bioenergy potential in 2050 are broadly similar to those modelled by the CCC in 2011.

This work consists of a Summary Report[2] and a full Technical Report[3]. Sections 3.5 and 3.6 of the Technical Report assess feedstock availability to 2050 for non-waste feedstocks.

The forecasts suggest **a range of 30 - 170TWh/yr** of bioenergy potential from UK non-waste feedstocks by 2050. The report converts this (section 4.2) into a renewable gas potential of 21-127 TWh/a with 97% of this coming from energy crops, short rotation forestry and wood/forestry residues converted to BioSNG and the remaining 3% from biomethane via anaerobic digestion of wet manures and macro-algae.

Commentary is provided for other non-waste feedstocks in the Technical Report, but these are not included in the bioenergy potential scenarios. These feedstocks include imported biomass, including woody biomass and agricultural residues.

Ricardo (2017)[4], quoted in the Technical Report, estimated the total surplus global supply of woody biomass to 2050, which grows as supply chains are established, and assumes that the UK is able to access a certain percentage of this global surplus - decreasing from 10% in 2015 to 2% in 2050 (due to increasing competing national energy supplies). This would amount to around a further 20 million dry tonnes of feedstock potentially available for bioenergy production. This is equivalent to **an additional 100TWh/yr of bioenergy** potential – a renewable gas potential of around an additional 70TWh/yr.

Q.14. What are the most credible and up-to-date estimates for the amount of bioenergy resource that could be produced from UK waste sources through to 2050? Where possible please state any assumptions relating the reduction, reuse and recycling of different future waste streams.

Forecasts in the Anthesis / E4Tech technical report [5]quoted in Cadent's response to Q12 (section 2.4.1) suggest **a range of 65 to 77 TWh/a of bioenergy potential** from waste feedstocks by 2050. The report converts this (section 4.2) into a renewable gas

---

[2] http://cadentgas.com/getattachment/About-us/The-future-role-of-gas/Renewable-gas-potential/Promo-Downloads/Cadent-Bioenergy-Market-Review-SUMMARY-Report-FINAL.pdf
[3] http://cadentgas.com/getattachment/About-us/The-future-role-of-gas/Renewable-gas-potential/Promo-Downloads/Cadent-Bioenergy-Market-Review-TECHNICAL-Report-FINAL.pdf
[4] Ricardo Energy & Environment (2017) *Biomass Feedstock Availability*, Department for Business, Energy & Industrial Strategy, March 2017. Available at: https://www.gov.uk/government/publications/uk-and-global-bioenergy-resource-model
[5] http://cadentgas.com/getattachment/About-us/The-future-role-of-gas/Renewable-gas-potential/Promo-Downloads/Cadent-Bioenergy-Market-Review-TECHNICAL-Report-FINAL.pdf

potential of 47-56 TWh/a, with 83% coming directly from BioSNG using gasification and 17% from biomethane via AD.

The key assumptions used in developing the forecast model, which drive waste availability to 2050 relate to:

- **Waste arising growth,** which is based on a range of growth rates derived from UK Government population and economic growth estimates. An increase in overall arisings will generally increase the volume of waste available for renewable gas production;

- **Recycling rates,** which are based on the achievement of EU and UK national targets, with additional 'stretch' targets modelled for particular scenarios. Increased recycling rates and diversion to high value markets/applications have the potential to reduce the amount of waste available for renewable gas production;

- **Long-term contracting for residual waste treatment** (for instance for energy recovery), which is assumed not to constrain material from being available for renewable gas production, as all such contracts will expire within the forecast period to 2050; and

- Finally, it is assumed that all **Refuse Derived Fuel** (RDF) currently exported is available for renewable gas production, as again, any long-term contracts will expire before 2050.

The detail behind all the above assumptions is provided in the Technical Report.

Q.23 Gasification has been identified as a potentially important technology for unlocking the full potential of bioenergy to support economy-wide decarbonisation.

a) *What are the likely timescales for commercial deployment of gasification technologies?*
b) *What efficiencies and costs are likely to be achieved? What scope is there for improvement and/or cost reductions over time? Please differentiate between feedstocks where possible/necessary.*
c) *What are the main barriers and uncertainties associated with the development, deployment and use of gasification technologies?*
d) *What risks are associated with gasification technologies and how can these be managed?*
e) *What policies and incentives are required to facilitate commercial deployment?*

Please refer to the detailed answers to these questions provided by Cadent's technical collaboration partner Advanced Plasma Power (APP), with which we agree.

Cadent has been focused on the potential of gasification technologies to produce significant quantities of renewable gas in the form of BioSNG since 2009. Following earlier techno-economic and design studies of BioSNG production, Cadent collaborated with APP, Progressive Energy (PEL), CNG Services and Carbotech to build a pilot BioSNG plant in Swindon, which successfully operated in 2016, demonstrating the technical and economic feasibility of the technology.

Cadent is now a partner with APP, PEL, CNG Services, and Wales & West Utilities in the construction of a Commercial Demonstration BioSNG plant, which is due to deliver BioSNG into the local gas network in summer 2018. This plant will produce 22GWh/yr of BioSNG from 10,000 tonnes/yr of waste wood, or refuse derived fuel, and is intended to operate for a number of years to provide technical and commercial assurance to government and project developers.

The next stage in the roll-out of the BioSNG technology will be the construction of a full-scale BioSNG plant, around ten times larger than the Commercial Demonstrator. The full-scale plant is expected to take in 100,000 tonnes/yr of waste feedstock and to produce 320GWh/yr of BioSNG. An outline design of such a plant has already been produced, and engagement is ongoing with EPC contractors to secure a fixed price turnkey offer to construct it. Following preparatory work on planning, permitting and FEED, it is anticipated that financial close on the plant will be achieved by Q4 2019 and the plant will be brought into operation by late 2021.

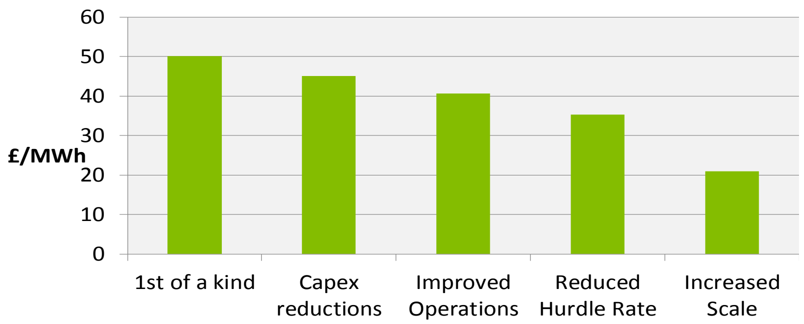
Subject to continuation of a favourable incentive regime, Cadent expects further BioSNG plants to be built throughout the 2020s

Details of the costs and efficiencies of gasification of biomass feedstocks to BioSNG and biohydrogen can be found in reports[6] produced by APP, PEL and Cadent.

The levelised costs for a first of a kind and an 'nth of a kind' BioSNG plant were calculated in the report as follows:

	315GWh/a First of a kind £/MWh	**665GWh/a Nth of a kind £/MWh**
Capex	50	29
Opex	33	25
Gate fee	(33)	(33)
Levelised cost	**50**	**21**

Expected cost reductions are due to economies of scale for larger plants, a lower hurdle return on investment rate required by funders as the technology becomes mature (10%, down from 12%). Further cost reductions will result from a lower risk allowance and higher operating hours per year.



We believe that the cost reductions in BioSNG production that are likely to be achieved should result in levelised costs that could approach future expected prices of fossil natural gas by the late 2020s. Our expectations of significant reductions in costs as the BioSNG technology matures are supported by the evidence of similar levels of cost reductions experienced by offshore wind technology over the 10-15 year period following initial deployment.

The barriers and risks to the deployment of the BioSNG technology are mainly economic and political. The cost of fuels produced through gasification are currently higher than fossil fuels, therefore long term subsidies or carbon taxes are required for gasification to be economically viable. Unless investors believe that there will be long term support for the technology they will be unwilling to invest in facilities.

Currently the only available subsidy that is sufficient to enable deployment of BioSNG technology is from the DfT Renewable Transport Fuel Certificate scheme. This has the potential to support BioSNG production for use in the heavy transport sector, and thus provide a very helpful incentive to support initial deployment of the technology.

[6] See http://gogreengas.com/downloads/ for the Biohydrogen report and BioSNG Project Close-Down report.

However, this is at present a relatively small-scale market, and unless the market expands it would not support more than one or two full-scale BioSNG plants.

The biomethane tariff in the Renewable Heat Incentive is not at a sufficient level to support deployment of BioSNG, due to the fact that the tariff support for biomethane degresses significantly after the first 40GWh/a of production from a plant. In any event the RHI finishes in 2021, and it would not now be possible to guarantee that a new full scale BioSNG plant could be operational before April 2021.

To enable significant deployment of gasification technology to produce BioSNG it will be essential to achieve political support across government for long term support mechanisms, and in particular that BEIS should recognise BioSNG as an important component of its heat strategy.

Cadent has commissioned work by Ernst & Young to review possible support mechanisms for BioSNG, and this study is expected to report in February 2018. Cadent will makethis report available to the CCC, but we expect it to highlight the possibilities of supporting BioSNG through an extension of contracts for difference to low carbon fuels for heat or transport, or a renewable obligation on gas suppliers (analagous to the RTFO in transport), or by including the investment to build plants in the regulatory asset bases of the gas networks, in addition to traditional tariff support mechanisms.

As noted in our introductory remarks, Cadent believes that in future policies and incentives should be directed towards the use of bioenergy resources to produce renewable gas for heat and transport, and incentives to produce electricity should be phased out. This is because there are lower cost pathways for decarbonising electricity such as wind and solar, and so low carbon fuels are better deployed in producing fuels, where there are few alternatives.

Q.26 There is currently substantial interest in the development of 'advanced' biofuels for use in sectors such as aviation, shipping and/or heavy duty transport.

- a) *What are the most promising technologies/processes for advanced biofuel production up to 2050? Please provide details on each technology/process including advantages/disadvantages, timescales for commercial deployment, feedstock type, fuel type and end-user.*
- b) *What efficiencies and costs are likely to be achieved? What scope is there for improvement and/or cost reductions over time? Please differentiate between technologies/processes.*
- c) *What are likely to be the optimal feedstock types for advanced biofuel technologies?*
- d) *What are likely to be the optimal end-uses of advanced biofuel technologies?*
- e) *What are the main barriers and uncertainties associated with the development, deployment and use of advanced biofuel technologies?*
- f) *What risks are associated with the pursuit of advanced biofuel technologies and how can these be managed?*
- g) *What policies and incentives are required to facilitate commercial deployment of advanced biofuels?*

In common with APP, Cadent's view is that gasification is the most promising technology for advanced biofuel production up to 2050, and that low carbon gas is the most appropriate energy vector that can be produced, in view of its flexibility for use in heating and transport. Gasification can be used to make BioSNG, at an efficiency of around 64% [7] , but it can also be used to make hydrogen at an efficiency of around 73% [8] .

[7] http://gogreengas.com/wp-content/uploads/2015/11/BioSNG-170223-1-Project-Close-Out-Report.pdf
[8] http://gogreengas.com/wp-content/uploads/2015/11/Biohydrogen-Cadent-Project-Report-FINAL-3.pdf

The flexibility of the gasification process to make biohydrogen is a significant advantage. Cadent is currently undertaking several projects to assess the possible use of hydrogen in the gas networks, either as a replacement for natural gas for industrial applications [ref: L-M Clusters] or in a blended mixture (up to 20% hydrogen) with natural gas [ref: Hydeploy]. The working assumption in these projects is that hydrogen would produced by steam reformation of natural gas, but if instead biohydrogen were to be produced from waste / biomass this would lead to even greater negative carbon benefits.

Please see our answer to Q23 above in relation to the barriers, risks, policies and incentives associated with gasification of waste / biomass to low carbon gas.

End.