Akin

Untapped Potential

The Opportunity in Biomethane Production

Introduction

Biomethane is indistinguishable from natural gas and can be deployed as a drop-in renewable replacement to natural gas without the need for adaptation of network infrastructure or end-user equipment.

The scale of opportunity in biogas and biomethane production is gaining increasing attention from key energy stakeholders. At the end of 2022, Shell announced a €2 billion investment in the much-coveted Nature Energy, and BP further enhanced its aspirations in this field through the $3.3 billion acquisition of Archaea Energy. The potential has been identified and others will surely follow.

Whilst feedstock availability may limit the extent to which biomethane can completely replace natural gas at current consumption rates, it is clear that the scale of the opportunity is largely untapped[1].

The scale of opportunity in biogas and biomethane production is gaining increasing attention from key energy stakeholders

Biogas and Biomethane Production in 2018 Against the Sustainable Potential Today

(Million Tonnes of Oil Equivalent, Mtoe)

- Biomethane Potential 730 Mtoe
- Biogas Potential 570 Mtoe
- Actual Production 35 Mtoe

Source: Global EV Outlook 2022

In this article we outline the nature of the opportunity, issues to be considered by investors and policy-makers and the longer-term potential for biomethane in the energy transition mix.

The focus of this article is on biomethane produced from the upgrading of biogas generated from organic feedstock and an anaerobic digestion process. We have not considered in any detail the direct combustion of biogas for power or production of biogas from landfill extraction, wastewater treatment or solid biomass, all of which are also likely to have an important role in the deployment of renewable gas in the years to come.

The Case for Biomethane

A Substitute for Natural Gas

Biomethane offers an immediate like-for-like replacement for natural gas without the need for capital investment to upgrade or modify transportation, storage or network infrastructure or end-user equipment and technologies. Put simply, we already have the critical infrastructure and an established use-case.

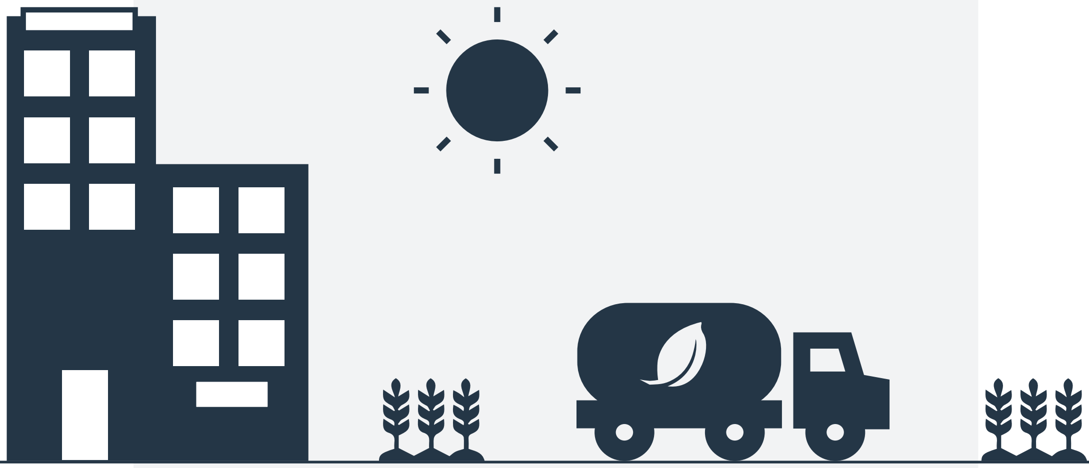
In 2022, the European Biogas Association estimated that the levelised costs to produce biomethane could be up to 30% lower than the price of natural gas[2], so it offers an immediate cost advantage to counter energy price increases seen recently. The extent to which biomethane will likely remain cheaper than natural gas beyond the short-term is not clear but technological improvements, the scaling of production capacities and government support schemes are likely to continue to create downward pricing pressures.

Biomethane production would seem to be an ideal running mate for clean hydrogen in the decarbonisation of the gas grid and the hard-to-electrify sectors (e.g. steel production, heavy haulage and shipping) and a sensible hedge against the rollout of clean hydrogen, particular as the market and use cases for clean hydrogen are developed.

Biomethane can therefore offer a near-term solution to energy security issues for countries reliant on natural gas imports. To illustrate this:

The Danish Energy Agency has forecast that through various support regimes, its entire gas grid could be supplied by biomethane in 2034.

The European Union (EU) has set the ambitious biomethane production target of 35 billion cubic meters annually by 2030, following the launch of the Biomethane Industrial Partnership as part of the RePower EU package.

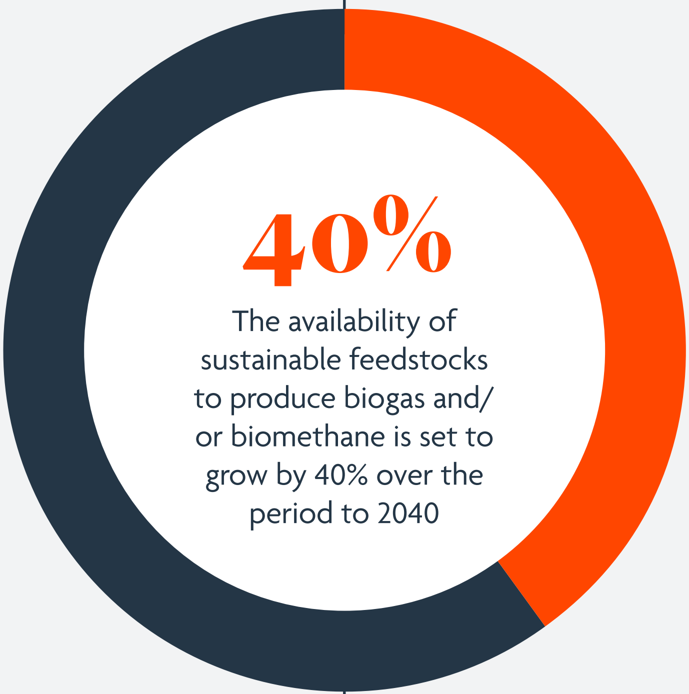


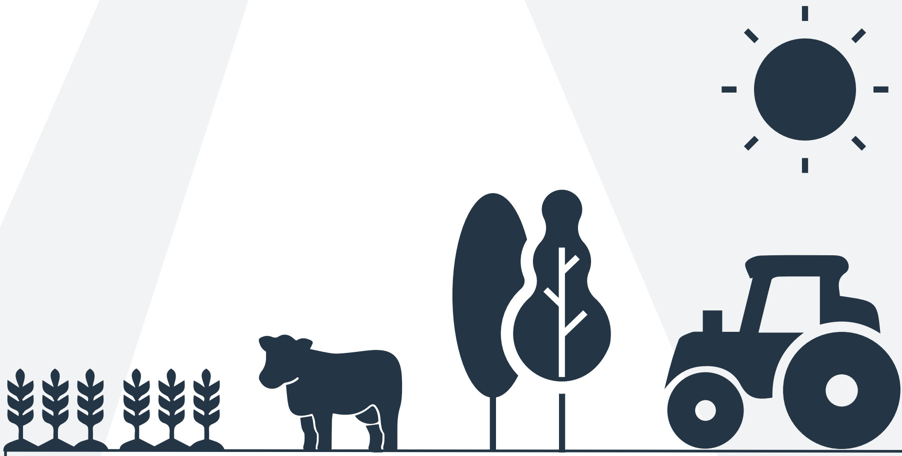
Sustainable Use of Organic Waste

The feedstock required for anaerobic digestion includes crop residues, animal manure and the organic fraction of municipal waste. If not treated through anaerobic digestion, each will release methane into the atmosphere during the natural decomposition process and will remain a waste disposal problem. In employing anaerobic digestion, the methane is captured, isolated and utilised in a closed environment.

The availability of sustainable feedstocks to produce biogas and/or biomethane is set to grow by 40% over the period to 2040.

The microorganisms used in the anaerobic digestion process convert organically bound nitrogen into a more accessible form for uptake by crops. The by-product of the process—'digestate'—may therefore be used as a sustainable high quality fertilizer, building organic carbon in agricultural soil, eradicating the waste problem and capturing the very essence of the circular economy. The use of digestate as a green fertilizer also has the benefit of reducing reliance on the import of other fertilizers that rely on energy and carbon intensive production processes.

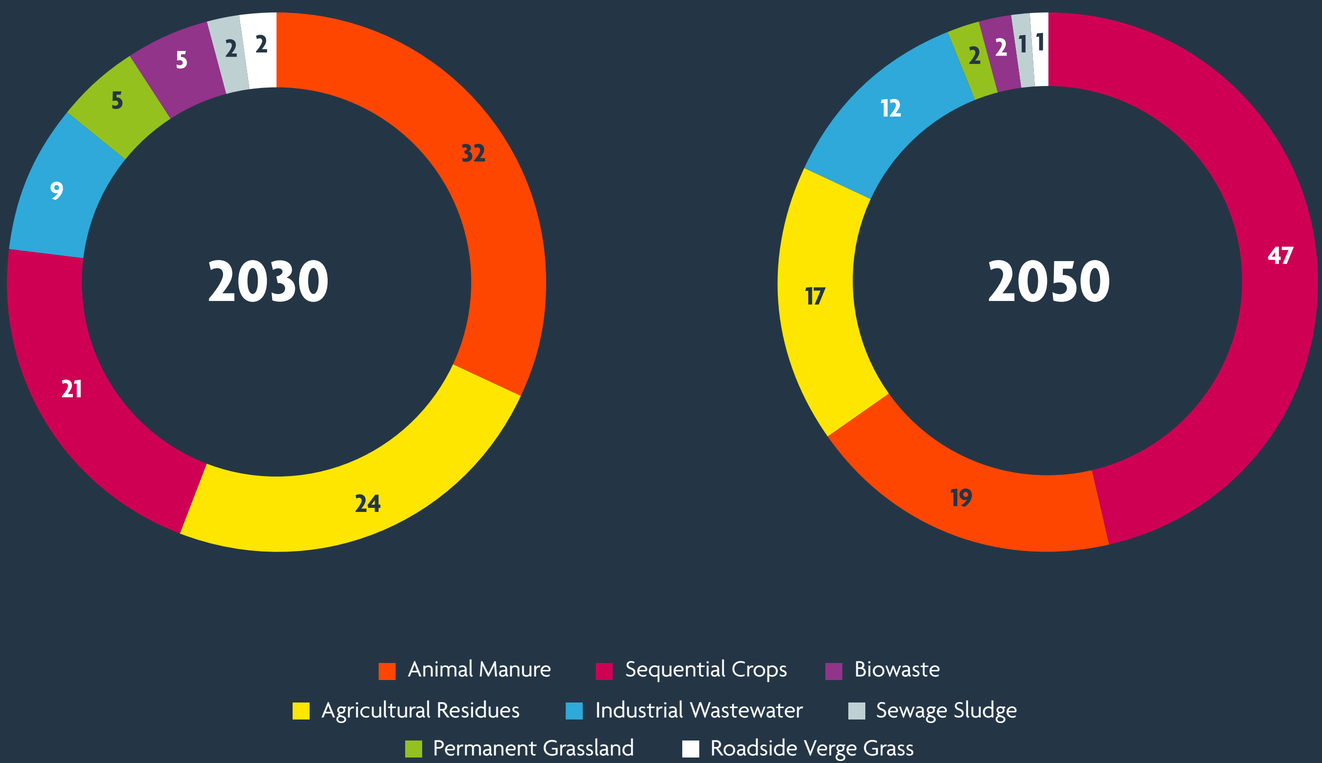




The use of intermediate crops to produce biogas, such as catch crops or cover crops, is also gaining interest. The use of these crops on fallow land or abandoned land is thought to have a positive impact on soil organic carbon. At the same time, there is a policy to move away from the use of energy crops (i.e. crops that are produced for energy production only) given concerns around land use and the impact on food production. Interestingly, the Danish government has recently relaxed proposed legislative limits on the use of energy crops in the sector in light of the recent energy crisis.

Anaerobic Digestion Potential in 2030 and 2050, Per Feedstock

Total of All Countries (%)



Source: Gas for Climate

Reducing Greenhouse Gas Emissions

200%

In replacing the use of fossil fuels with the use of biomethane, greenhouse gas emissions savings of over 200% could be achieved, depending on the feedstock and technologies used.

During its growth, the organic feedstock on which biogas and biomethane production relies captures CO_2 from the atmosphere through photosynthesis. This CO_2 is returned to the atmosphere during combustion of the renewable gas and is then captured again by newly growing biomass. The combustion of renewable gasses does not increase CO_2 in the atmosphere but instead makes it circulate in shorter cycles. Importantly, whilst the production and use of renewable gasses is carbon neutral in its own right, the process displaces the use of fossil fuels which are not part of the natural carbon cycle and are entirely additive to the level of carbon in the atmosphere.

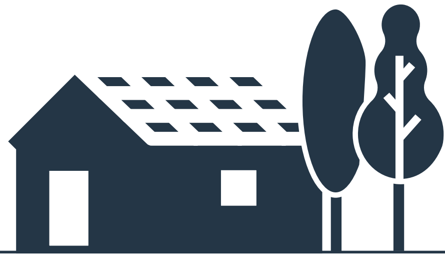
The upgrading of biogas to biomethane also produces a highly concentrated CO_2 stream. This CO_2 can be sequestered or used to achieve a permanent removal of carbon from the atmosphere. The market and use case for this CO_2 remains undeveloped, so there remains further potential to enhance greenhouse gas emissions reductions.

In replacing the use of fossil fuels with the use of biomethane, greenhouse gas emissions savings of over 200% could be achieved, depending on the feedstock and technologies used[3].

It is important to recognise also that biogas and biomethane may be stored and combusted in a combined heat and power (CHP) facility or gas fired power station to offer a source of dispatchable power. This may therefore offer a net zero emissions energy storage and grid balancing solution to support the deployment of (and help manage the intermittency associated with) renewable power generation.

1

2



Feedstock Supply

Contrary to the approach taken conventionally on fuel supply arrangements in other sectors, biogas/biomethane projects will not typically have a single or a small number of long-term supply contracts with financially robust suppliers. Instead, for larger centralised facilities we are more likely to see hundreds of individual farmer agreements organised under cooperative arrangements along with a small number of larger supply contracts with, for example, supermarkets (i.e. for food waste) and municipal waste authorities (i.e. for the organic fraction of municipal waste (e.g. garden waste)).

Whilst the contractual supply terms will be important, the nature and the number of the counterparties to these arrangements will typically mean that any enforcement of terms will be challenging. It will be important therefore for due diligence to be focussed on establishing the commercial and practical drivers that will underpin supply. The assessment of feedstock availability is therefore focussed on (i) the volumes of available feedstock proximate to the facility, (ii) competition for alternative treatment/disposal of those volumes and (iii) the risk that volume assumptions may be undermined by changing circumstances.

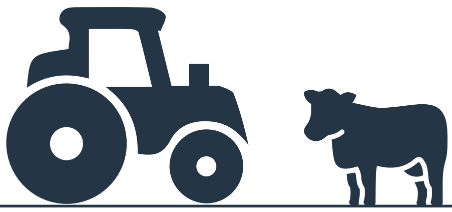
Location of the Facility

Ideally, the developer will look to locate the facility in an area where there is an abundance of feedstock readily available close by and with limited need to upgrade local transport infrastructure. The location of the facility can create a de facto monopoly over local feedstock supply as transportation costs became a natural barrier to movement to an alternative facility. The position in this regard will be very much reliant on the local planning regime. It would be usual for the local planning and zoning regime to limit the development of new facilities within a given radius of existing operational plants. This is certainly the position we have seen adopted in core European markets as local municipalities seek to encourage capital investment and at the same time avoid the risk of complaints that may come from an oversupply of facilities (e.g. traffic movements and odour).

1,023

Europe reached a total of 1,023 biomethane production facilities by the end of October 2021

Manure with low dry matter content will typically have a lower biogas yield when compared to crop residues, food, garden and industrial waste. It will be important therefore for the facility to tap into multiple sources of feedstock within the vicinity of the facility to optimise performance from both a waste throughput and gas yield perspective. There is undoubtedly increased competition for 'industrial' sources of feedstock. This is where longer-term supply contracts with larger entities may be appropriate and where longer-term planning and strategy is required.



3

Competition for Alternative Treatment/Disposal

The cost/benefit to the feedstock supplier of alternative means of disposal will be a key consideration. In most jurisdictions there will be an increased cost to the alternative treatment or landfilling of waste, often supplemented by the application of taxes. Provided the project model supports a cost/benefit to the supplier (including transportation and storage) that is more favourable than that offered from alternative treatment options, the risk of supply being undermined in this way should be capable of mitigation.

There may be other drivers to use of a particular facility. For instance, we have seen local legislative provisions prohibiting the use of manure as fertilizer unless and until it has been degassed through a local biogas facility. This may lock a farmer into a tolling arrangement with the facility under which the farmer receives an agreed amount of high-quality fertilizer (in the form of degassed digestate) in return for the feedstock supply. Other means of tying a supplier to the facility may include the installation of facilitating infrastructure (e.g. tanking and storage facilities) on the land of the supplier which will be used and maintained whilst the supplier makes feedstock available to the facility.

4

Risk of Volume Assumptions Being Undermined by Changing Circumstances

An assessment will be required with regard to longer-term shifts in waste disposal patterns and behaviours which may impact on assumptions with regard to feedstock supply. For instance, shifts away from livestock farming, a removal of source segregation of food waste or the increased tendency to home compost may all impact on day-one assumptions. Careful analysis will enable the developer to understand the risks and to develop contingencies. Much of the contingency planning is likely to be built around securing volumes of the different feedstock that may be available to the project. Contingency planning of this nature will of course need to be factored into design and plant optimisation and a need for inherent flexibility.

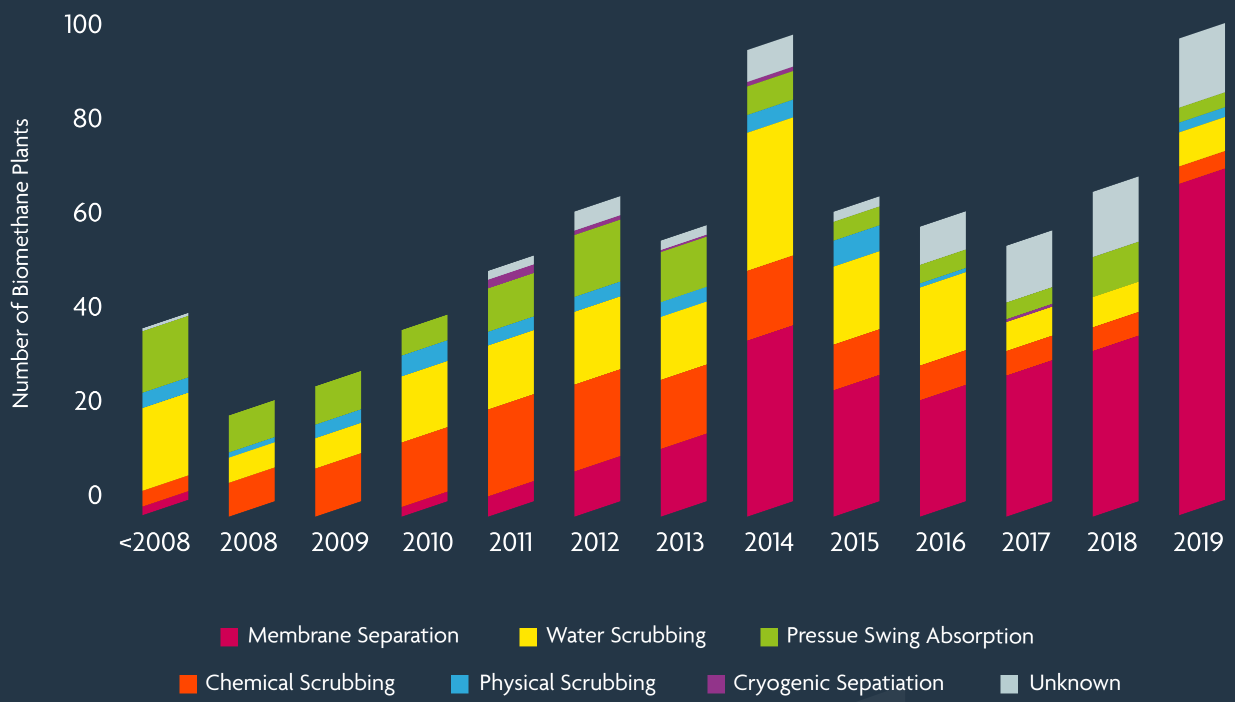
On a shorter-term basis, other aspects of contingency need to be considered. For example, this may include contingent feedstock arrangements following the occurrence of animal disease that may impact directly on feedstock availability. Often insurance options are considered for this type of circumstance.

5

Works Delivery Structure

Whilst projects in this sector have been delivered on a standard turnkey basis, our experience is that it is more usual for biomethane production projects to be delivered on a multi-contract basis. There are a number of reasons behind this, but the key issue is that the upgrading plant is often seen as introducing a degree of technology risk, particularly given the inherent uncertainty in feedstock specification and resulting biogas quality. Furthermore, providers of the upgrading plant technology are generally not in the business of offering a full wrap of construction delivery risk because they either don't have the balance sheet to support it or they have no commercial appetite to offer it.

Newly Installed Biomethane Plants With Respective Upgrading Technology, Per Year



Source: European Biogas Association

Is this fatal to a project finance solution? Whilst it will certainly create increased scrutiny with regard to construction delivery risk, unlike advanced gasification in the waste-to-energy sector, there is no widespread evidence that gas upgrade projects fail. The issue, if anything, will be a risk of delay whilst the feedstock supply and plant are optimised. It will therefore be for funders to establish where this additional cash flow support is likely to come from when required.

Design assumptions will need to account for a wide envelope of feedstock types to enable the facility to operate at the highest possible level of flexibility.

Under a multi-contract solution, steps should be taken to encourage the main contractors to assume risk in interface management and technology integration. Residual interface risks may then be managed by the developer team or through the use of a highly structured engineering, procurement and construction management (EPCm) contract delivery model. Whilst the EPCm contractor will not underwrite project delivery, it will instead typically be a highly skilled and competent professional consultant engineer who will manage and will be incentivised to manage (through a bespoke bonus-malus regime) all aspects of project delivery and interface risk on behalf of the supplier.

If a multi-contract solution is being employed, it will be important for the developer to limit interface risk by packaging the works up into a small number of works and supply packages. For instance, we have seen projects in this space being limited to just two packages:

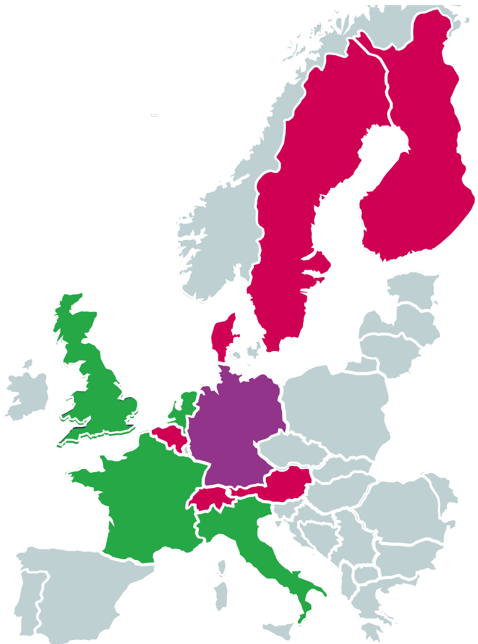
1. a main contractor assuming risk in all civils, on site storage, biodigestors, biogas storage, gas grid connection and all other piping, connections and instrumentation and
2. the gas upgrade contractor supplying and installing the gas upgrade plant.

Line of Sight on the Regulatory Backdrop

To the extent that the project economics rely on revenue support mechanisms, diligence will be required on the degree of certainty that the project will be eligible for and be capable of securing the relevant support. Often this is dictated by compliance with agreed criteria and completion of works within agreed timeframes, so appropriate contractual mechanisms need to be agreed to account for any failure to meet the required terms.

Country Comparisons, Regulatory Support Schemes

Supply-side



Global Support Level for Biomethane Injection
Very Favorable
Favorable
Low Support
Out of Scope

Demand-side

Main Demand-side Support Mechanics
Operational National GO Register for Biomethane

Furthermore, the risk of support being withdrawn must be taken into account. Most developed nations have stable legal systems that provide assurances around potential changes in law that can undermine the availability of assumed subsidy support mechanisms. Grandfathering provisions offer such assurances by ensuring changes in law have prospective and not retrospective effect. This will be a fundamental bankability requirement.

We have seen more recently State Aid questions being asked concerning existing subsidy support regimes that do not appropriately take into account inflated energy prices and so give rise to what are considered 'super' profits for generators/producers. Whilst there is a degree of uncertainty here, it is hoped that any claw back mechanisms that are employed by public bodies are sensible and only capture genuinely unexpected profits so as to maintain projected revenue assumptions. Anything other than this is likely to undermine the attractiveness of the relevant jurisdiction as an investment destination. We have recently seen a tapering approach being suggested in Denmark which, at the outset, appears sensible.

The Inflation Reduction Act in the United States, the RePowerEU Plan in the EU and Green Gas Support Scheme in the United Kingdom have all recently introduced specific financial support for the sector.

This is clearly all very positive. There are other possible areas where local level regulatory and public sector support could facilitate further capital investment in the sector, for instance:

- The development of a planning strategy which optimises the location and number of facilities and therefore encourages capital investment.
- Restrictions on the use of manure as fertilizer unless and until it has been degassed through a bio digester.
- A coordinated domestic and industrial waste disposal regime that directs key feedstock to the facility to encourage capital investment.
- Source segregation and collection of domestic food waste.
- Prohibition on the landfilling of any industrial organic waste.

Operating and Maintenance Arrangements

0.1-0.3%

Where best practices are applied, the range of methane emissions can be low or even negligible (0.1-0.3%)

Source: IEA Bioenergy

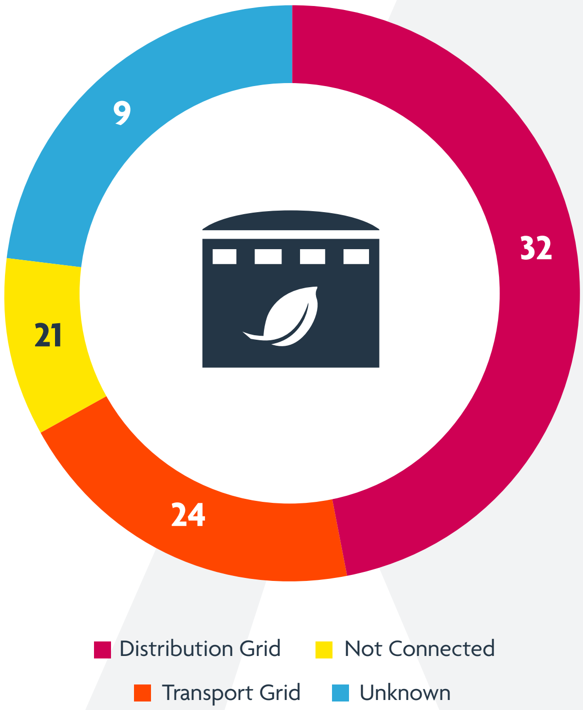
The terms of these arrangements are of fundamental importance. They will need to clearly define the operational services specification, the required standard of performance, key performance indicators and the controls and sanctions available to the developer for non-performance and breach, including provision for operator replacement. The ability to replace the operator will be important as the liability threshold typically accepted by operators will be insufficient to support long-term performance shortfalls.

From a logistics perspective, it would be sensible for the operator to retain responsibility for maintaining plant feedstock volume throughput. Whilst the feedstock contracts would usually be entered into by the developer, the management of the relevant arrangements by the operator would not be unusual. Furthermore, the operator will also typically be required to assume risk in the achievement of an optimised feedstock specification relevant to the facility through the provision of feedstock blending services. These two aspects of feedstock management will go to the heart of throughput and performance requirements set by reference to steady state considerations achieved during facility commissioning and in respect of which the project revenue model will be calibrated.

Feedstock and waste/digestate logistics will need to be optimised to take account of (i) feedstock blending requirements, (ii) the need to limit residence time of feedstock at source (i.e. avoiding excess methane slip and optimising yield) and (iii) the need to limit value chain emissions and transport costs. In this respect, we see value in the use of artificial intelligence (AI) based logistics systems which can optimise transportation routes based on available feedstock (using on site detection systems) and facility requirements, limiting transport costs and emissions. We have experience of electric and renewable gas-powered transportation being used on comparable projects to limit emissions as value chain assessment on overall emissions reductions becomes more relevant.

The biogas and biomethane sectors have come under criticism more recently due to operational failures and a lack of proper maintenance giving rise to methane leakage which undermines the climate credentials of the development. Developers can expect more rigorous scrutiny on design development, maintenance, lifecycle replacements and leakage monitoring as the sector gets built out over the next 10 years.

Percentage of Biomethane Plants Connected to the Distribution and Transport Grids in Europe in 2020



Source: European Biogas Association

Offtake Arrangements

The offtake arrangements will underpin the viability of the project from a bankability perspective. Ideally, long-term arrangements with a creditworthy counterparty will be the starting point. There will be a balance to be struck between long-term price and volume stability on one hand and the ability to access enhanced offtake terms on the other. There are a number of solutions in the market which have achieved an appropriate balance in this regard. The extent to which the offtake terms provide for take-or-pay arrangements or volume guarantees will all link into these considerations.

It will be important to establish pre-project development, the terms which the offtaker will impose on the project relating to aspects such as fuel delivery, quality and gas pressure and specification requirements. All such requirements will need to be agreed, understood and reflected on a back-to-back basis within all relevant project contract terms (including front-end engineering design). Likewise, the conditions to the effectiveness of the offtake terms will need to be clear and unambiguous, with the risk and liability for such terms not being achieved or the offtake agreement falling away being captured within the project contract risk allocation. This will all need to be aligned with any subsidy support regime secured by the project.

The location of the facility proximate to possible grid connection points will be a further important consideration. The connection terms and the impact that they will have on capital cost requirements, infrastructure and gas specification and pressure requirements will all need to be factored into design and project planning.

Gas input and output from the grid must be balanced and the terms will need to capture arrangements for when there is low demand within the gas grid but the facility is able to deliver large volumes of biomethane. From a practical perspective, plant operation should be capable of optimisation and on-site gas storage solutions may be considered.

Our Practice and Experience

We act for energy companies, industrials, investors, funders, export credit agencies (ECAs) and governments in the production, storage, transportation, use and regulation of renewable gasses. We advise on the largest and most complex renewable and conventional power projects and have advised on genuine pathfinder first in-kind projects across the energy and infrastructure sectors. We have a full service global offering from project inception and feasibility, front end engineering design (FEED) and final investment decision (FID) achievement, to detailed design, construction, commissioning and operations. Our areas of experience include construction, licencing regulations, supply and power purchase agreement (PPA) terms, offtake arrangements, joint ventures, mergers and acquisitions (M&A), project financing, debt finance, as well as disputes, restructuring and investigations.

Key Contacts for This Piece

Matt Hardwick
Partner

matt.hardwick@akingump.com
London
T+44 20.7661.5533
F+44 20.7012.9601

Daniel Giemajner
Partner

daniel.giemajner@akingump.com
London
T+44 20.7661.5521
F+44 20.7012.9601

Alex Harrison
Partner

alex.harrison@akingump.com
London
T+44 20.7661.5532
F+44 20.7012.9601

Wider Akin Contacts

Ike Emehelu
Partner

iemehelu@akingump.com
New York
T+1 212.872.8182
F+1 212.872.1002

Matt Kapinos
Partner

mkapinos@akingump.com
Houston
T+1 713.250.2117
F+1 713.236.0822

Shaun Lascelles
Partner

shaun.lascelles@akingump.com
London
T+44 20.7012.9839
F+44 20.7012.9601

Simon Rootsey
Partner

simon.rootsey@akingump.com
London
T+44 20.7012.9838
F+44 20.7012.9601

Paul Greening
Partner

paul.greening@akingump.com
Singapore
T+65 6579.9070
F+65 6579.9009

Justin Williams
Partner

williamsj@akingump.com
London
T+44 20.7012.9600
F+44 20.7012.9601

Emily P. Mallen
Partner

emallen@akingump.com
Washington, D.C.
T+1 202.887.4019

Footnotes

1- Together, biogas and biomethane production in 2018 equated to 35 million tonnes of oil equivalent (MOE), whereas the biomethane production potential in the same year was 730 MOE based on sustainable feedstock availability. Furthermore, it is anticipated that the availability of the relevant sustainable feedstock is set to increase by 40% in the period up to 2040. IEA World Energy Outlook Special Report: Outlook for Biogas and Biomethane, prospects for organic growth

2- European Biogas Association

3- European Biogas Association – the contribution of biogas and biomethane industries to medium-term greenhouse gas reduction targets and climate neutrality by 2050 – April 2020