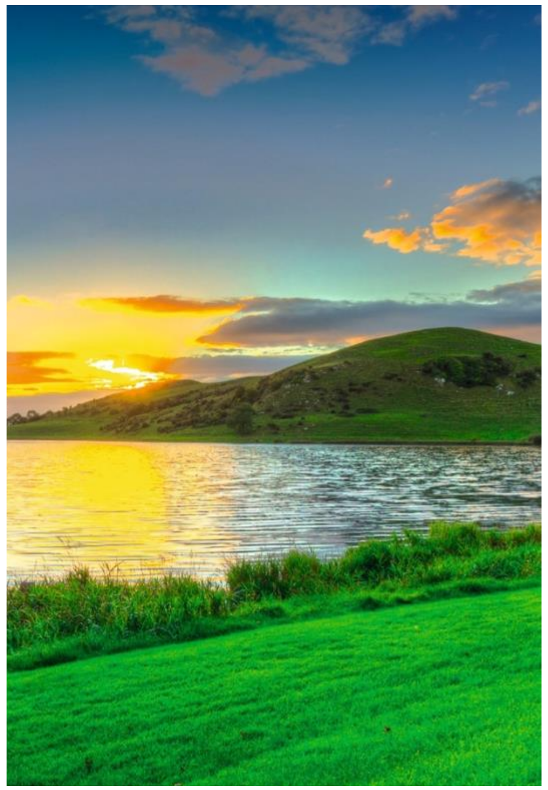
Investigate the Availability of Sustainable Feedstocks and Potential Anaerobic Digestion Plant Locations in the Northwest to Supply a Satellite Gas Network in Sligo Town



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The SLEA clg was established in January 2022 to benefit the communities of County Sligo and County Leitrim through the promotion of sustainability through energy efficiency and supporting reductions in CO2 emissions to communities, businesses and homeowners. SLEA clg works with public & private sector partners and local communities to increase collaboration in sustainability projects and pioneering innovation.

The SLEA clg is the legal entity that administers National and EU project funding on behalf of Sligo (SEC) Sustainable Energy Community. Sligo SEC represents a collaboration of large energy users and employers including ATU - Sligo, Plan Energy, Abbvie, Sligo CoCo, Abbott and HSE Northwest.

The Sligo Green Gas Network (SGGN) project involves the collaboration of the Sligo SEC members and other key stakeholders including Gas Networks Ireland (GNI), IDA, Aurivo, Jennings O'Donovan, Sligo Chamber of Commerce, Lough Gill Distillery, Teagasc, Renewable Gas Forum of Ireland (RGFI), Western Development Commission (WDC) and Northern and Western Regional Assembly (NWRA).

Additional thanks go to the individuals and organisations who have given their time to be interviewed and contribute to this Phase 2 study including Fergal McLoughlin, Christopher Kitchin (Lough Gill Distillery), Abbott, AbbVie and James Russell (BioCore).

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1 Introduction

Rowan Engineering Consultants Ltd (Rowan) have been appointed by the Sligo Leitrim Energy Agency CLG, to investigate the availability of sustainable feedstocks and potential Anaerobic Digestion (AD) plant locations in the Northwest to supply Biomethane to a Satellite Gas Distribution Network in Sligo Town.

Biomethane is a renewable gas made from biological feedstocks including food waste and agricultural feedstocks (such as animal manures, grass, grass silage, etc.), through a process known as Anaerobic Digestion (AD). The anaerobic digestion process produces Biogas from feedstocks, through the breaking down of organic material by micro-organisms in large oxygen-free tanks. A by-product of this process is known as digestate, which can be used as an organic fertiliser. The Biogas can then be 'cleaned' or upgraded to Biomethane which is structurally identical to Natural Gas and can therefore be used as a direct substitute.

The study outlines a detailed regulatory, technical and commercial analysis of the proposed solution including risk assessment considerations and also outlines the key factors for successful project development.

The analysis of the feasibility is undertaken in three major tasks:

1. The identification of potential feedstocks, and their availability and suitability for anaerobic digestion for biomethane production in the Northwest,
2. The feasibility and likely siting of such a facility or facilities, and
3. The overall feasibility of the project including a) technology review and b) financial feasibility.

This final report summarises the outputs of the above tasks.

2 Background

Previous to this report the Sligo Leitrim Energy Agency CLG commissioned a Preliminary Front End Engineering Design (FEED) report (Phase 1) which determined the feasibility for a Satellite Gas Distribution Network in Sligo Town and environs to supply potential customers with an annual thermal energy demand of approximately 50GWh and the potential configuration for a satellite pipeline network. The FEED report is available through the SLEA.

This Phase 2 report outlines the feasibility and potential project viability for anaerobic digestion development to provide biomethane to supply the proposed Sligo Gas Network with the required 50GWh annual thermal energy demand as requested in the scope of the project.

SLEA commissioned Rowan to conduct a feasibility study to outline a detailed regulatory, technical and commercial analysis of the proposed solution including risk assessment considerations and outline the key factors for successful project development.

Rowan conducted an analysis of potential feedstocks in the area, their distribution and availability and potential feedstock combinations for the production of the biogas.

Rowan then conducted an assessment of potential siting locations for an AD plant, a review of Anaerobic Digestion technology and equipment and a financial feasibility assessment.

Based on the above assessments, Rowan then assessed the project for feasibility and viability for Anaerobic Digestion to supply gas to the proposed Sligo Town pipeline network.

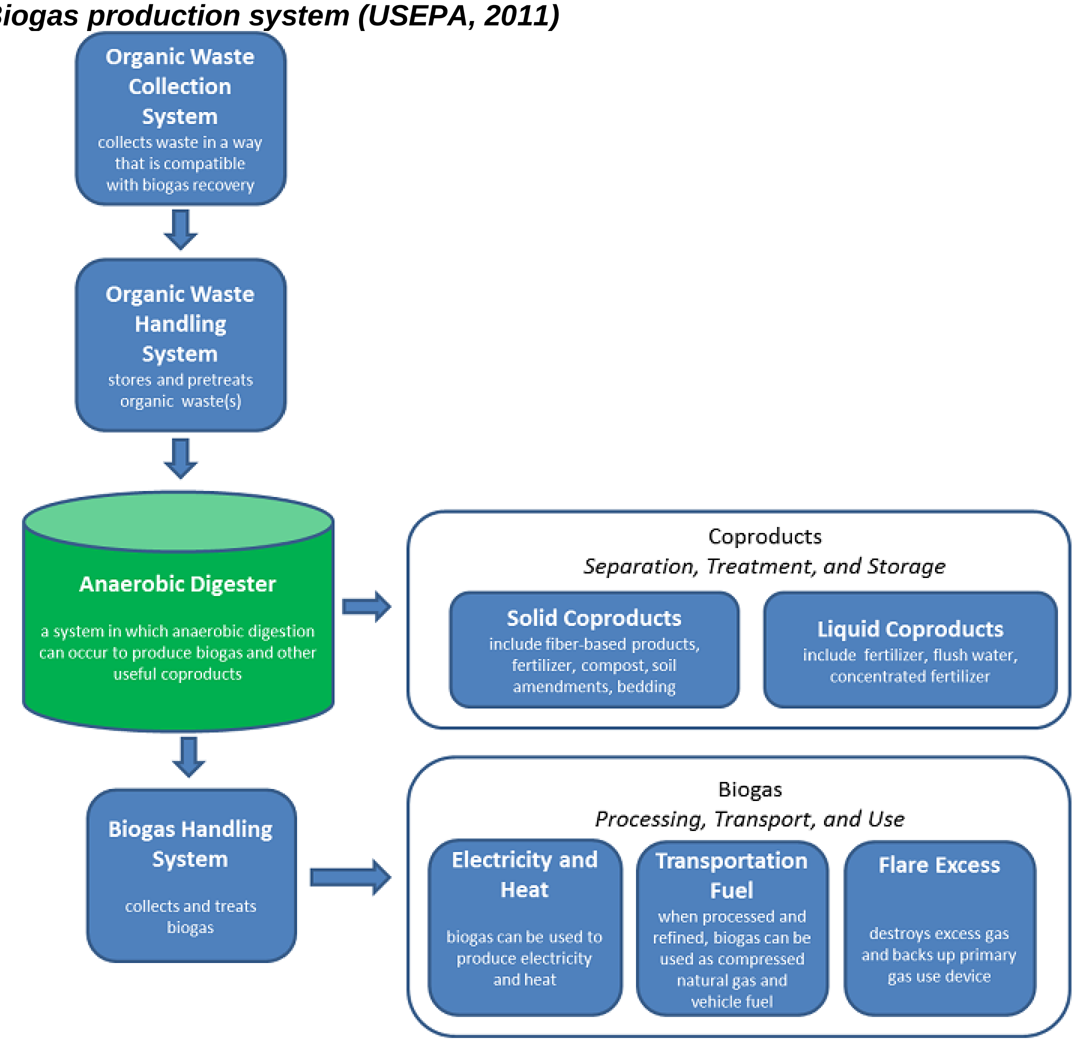
3 Project Overview

This report is based on the review of available data, interviews with potential biomethane customers, feedstock suppliers and other AD facility operators in the region.

Anaerobic Digestion plants typically require a variety of feedstocks to maintain a balance for the effective operations of the digester and the subsequent production of biogas. Whilst it is possible to run AD facilities solely on biomass feedstock (for example grass silage, beats, mangals etc), the FEED study clearly identifies that in order for the AD plant to be viable and meet current Irish guidelines (CRE, 2018[1], DECC 2021[2] and RAE, 2022[3]) it should include a mix of feedstocks including waste materials from various industries and sectors.

Placing of the AD facility should maximise feedstock availability but also be close to biogas demand or hubs to charge the network to prevent excessive transport and operational costs. A simple outline of the AD process and the potential outputs / by-products of the AD facility is presented in Figure 1-1 below.

Figure 1-1 Biogas production system (USEPA, 2011)



[1] http://www.cre.ie/web/wp-content/uploads/2018/03/Guidelines-for-Anaerobic-Digestion-in-Ireland_Final.pdf
[2] https://assets.gov.ie/86647/dcf554a4-0fb7-4d9c-9714-0b1fbe7dbc1a.pdf
[3] https://www.mywaste.ie/wp-content/uploads/2023/05/SRWMO-National-Waste-Management-Plan-for-a-Circular-Economy-Executive-Summary-AW-Onscreen.pdf

The Phase 1 (FEED) report assessed the feasibility of a satellite gas network in the Sligo Town area. The FEED report identified sufficient energy demand from Sligo town's largest energy users to justify the proposed project idea and a potential concept plan for a satellite gas grid.

Now, Phase 2 of the Sligo Green Gas Network (SGGN) project will identify potential renewable gas sources to supply such a grid. This report is the feasibility for utilisation of Anaerobic Digestion as the source of methane (biomethane) for the provision of renewable gas to the Sligo Town area. This renewable gas supply has significant potential benefits to local businesses and communities in the area. The determination of biomethane as a potential energy source was made before the current energy crisis in Europe. If anything, this has focused the project further, along with a government interest in anaerobic digestion as a potential industry and market in the renewable energy sector.

The Phase 2 Feasibility Assessment for Anaerobic Digestion as a source of biogas/biomethane for Sligo is based on a four-stage assessment and evaluation process:

1) Availability of suitable feedstocks,
2) Potential location where planning could be achieved,
3) Technical requirements,
4) Financial feasibility of operational plant.

This report represents the final summary report of the feasibility assessment stages for the Phase 2 of the SLEA Sligo Green Gas Network (SGGN) project.

4 Stage 1: Feedstock Feasibility

Production of biogas from AD facilities in Europe has traditionally been focused on the production of gas to drive electricity production onsite. In central Europe, AD is often focused on particular agricultural industries of biocrop grown for the purposes of gas production. Current Irish government policy, under the National Energy and Climate Plan 2021-2030 ("NECP") which sets an indicative target for indigenous biomethane at 1.6 TWh by 2030, has moved to promote biogas as a renewable fuel and a significant component of the measures under Directive 2018/2001/EU ("Renewable Energy Directive (RED) II"). Under the recent Circular Economy and National Waste Strategy, AD is identified as a waste to energy or waste to fuel process. Permitting and planning is also focused on the production of biomethane as a waste process. Agricultural AD plants recently granted planning have been limited in permissions as production of feedstock and reuse of byproducts within the applicant's land stock (farm or co-operative). As such, the feasibility of feedstocks and technology (Stage 3) to ensure the best chance of development concluded the need for a balance of waste material, available high yield materials and a feedstock mix that will produce high gas yield and not require excessive treatment or management.

In addition, the feedstocks had to be from existing material available in the counties. The production of a feedstock specifically for biogas production (i.e., growing biocrop (grass for silage, maize etc) was discounted as it is not in line with current government policy, and in the event of future tariff pricing or grid unit setting by government it is likely that biomethane produced from biocrops would be penalised as per the UK and EU reviews and recommendations (GNI, 2021[4])

Based on these assumptions, Rowan evaluated the potential feedstocks, availability, types and biomethane potential and their locations in the area.

4.1 Stage 1 Review

Rowan have identified a range of potential feedstocks from published literature such as O'Shea, R. 2017. "*Pathways to a renewable gas industry in Ireland*" and Annual Environmental Returns through the Environmental Protection Agency (EPA). A literature review of potential yields (e.g., IEA[5], EU Commission[6] etc) was conducted and this has been peer reviewed by Irish operators.

An analysis of these feedstocks has then been undertaken to identify potential sources of the feedstocks for AD in the vicinity of Sligo town.

The review consisted of three tasks:

- identification of potential feedstock types,
- identification of potential sources of the feedstocks, and
- evaluation of the gas yield of the feedstock and any additional considerations or processing required.

The biomethane yield from each feedstock type has been taken from various published sources but focused on research conducted in Ireland for Irish feedstock potentials e.g. O'Shea, R. 2017. "*Pathways to a renewable gas industry in Ireland*" and reporting from TEAGASC and CRÉ.

[4] https://www.gasnetworks.ie/biomethane-sustainability-report-2021.pdf
[5] IEA, Average biogas production yield by tonne of feedstock type, IEA, Paris https://www.iea.org/data-and-statistics/charts/average-biogas-production-yield-by-tonne-of-feedstock-type
[6] https://www.europeanbiogas.eu/wp-content/uploads/2022/07/GfC_national-biomethane-potentials_070722.pdf

Each feedstock will need to be tested for its biomethane yield in order to accurately evaluate the business opportunity and their suitability for AD. This feasibility study evaluates their potential availability and distribution within the Sligo Town area.

4.2 Stage 1 Results

Analysis of the data sources was undertaken to establish the amount and type of available feedstock within the Sligo Leitrim region. This also included Mayo, Roscommon and south Donegal.

Feedstock sources within the immediate vicinity of Sligo town were initially assessed. The catchment area of existing AD facilities and their potential impact on feedstock availability was also considered. The other key factor to be considered was the viable transportation distance of each feedstock type, particularly feedstock with high moisture content or low biomethane yield.

Where possible a waste transport limit of approximately 250km was considered. The basis of this is the approximate return range of an HGV or similar operating on biomethane or electric battery. The return range of a conventional diesel-powered HGV is approximately double that of the biomethane/electric alternative but is limited by driving hours to a similar distance in a single event.

Based on the assessment, a blend of agricultural high yield biogas producing feedstocks would need to be mixed with waste streams to fulfil the AD plant requirements. Likely high gas production sources included animal slurry, paunch, and excess silage. The potential slurry availability was based on the numbers of animals per Electoral District, as reported through TEAGASC and the Department of Agriculture in the Teagasc National Farm Survey (NFS) and reported statistics. The availability was based on information from farming organisations (IFA, ICOS, TEAGASC, DAFM) and the Sligo Green Gas Network (SGGN) project stakeholder committee on the likely availability of slurry and periods of livestock in sheds as well as the limits and demands for spreading. Biocrops were not considered, but excess or onsite produced silage was a significant consideration. Assessment of the current availability, as well as near future changes in the EU Agricultural Policies and the changes to farm payment schemes (e.g., AEOS, GLAS and the Organic Farming Schemes) mean that it is likely that grass cut, and excess silage would be available in the area in potentially significant quantities.

These would need to be mixed with non-agricultural feedstocks such as wastes from the food industry (retail, catering and food production (including dairy and abattoir), sludges (from wastewater treatment plants) (WWTPs) and other organic wastes.

Feedstocks were considered based on availability, but also required preparation, storage, pre-treatment or pre-digestion processing etc. that would be required.

4.3 Agricultural sources

Sheep manure was a considered feedstock; however, the majority of sheep are open grazing and not in sheds for significant periods. In order for sheep manure to be practically collected it must be done indoors which is likely to only be for very short periods, if any, of the winter season. Poultry and piggeries in the area were considered but there are low numbers in the region. The nearest poultry farm is in Glenamaddy, Co. Galway. There is one piggery in Ballymote Co. Sligo with two more piggeries in Roosky, Co. Roscommon and Castlebar, Co Mayo which are approximately 70km and 80km away respectively. The most likely agricultural source was from cattle slurry collected from overwintering sheds and grass silage. No other biomass sources (corn stalk, straw etc) were considered of sufficient quantity in the area.

Figure 2-1 presents the annual theoretical quantity of cattle slurry available in counties Sligo and Leitrim. The largest quantities of cattle slurry in Co. Sligo are in the west (40-50km away) and south of the county. The largest quantities of cattle slurry in Co. Leitrim are in the south of the county, over 70km from Sligo town.

Figure 2-1 Theoretical cattle slurry quantities from each ED in Sligo and Leitrim

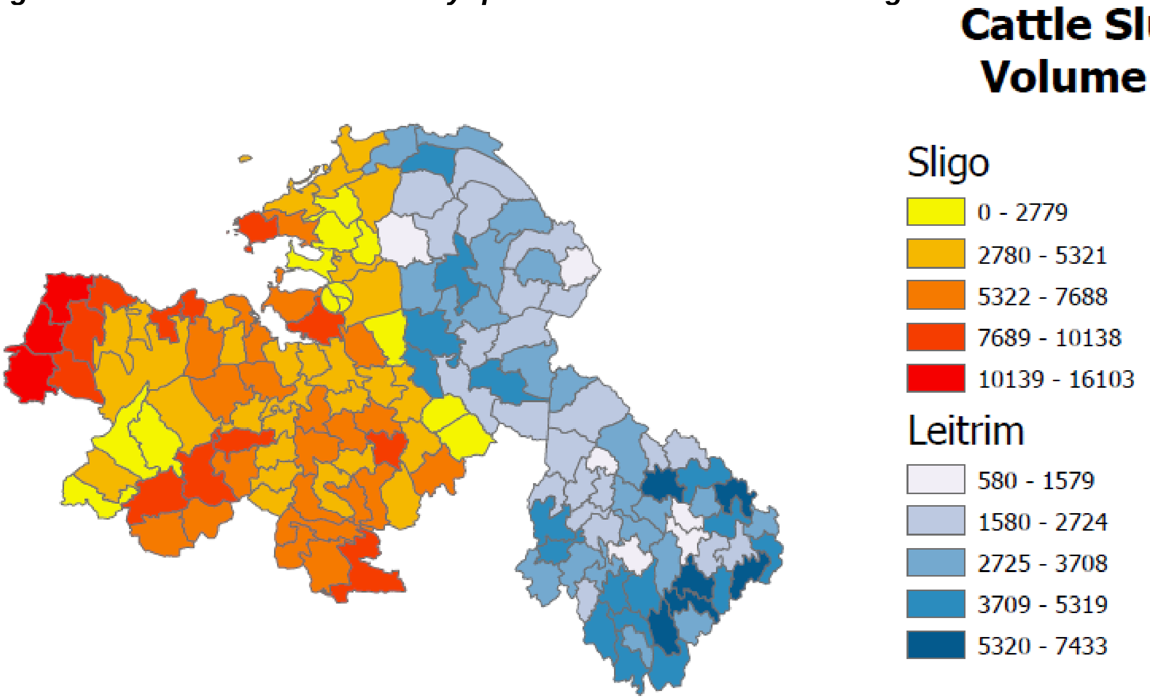
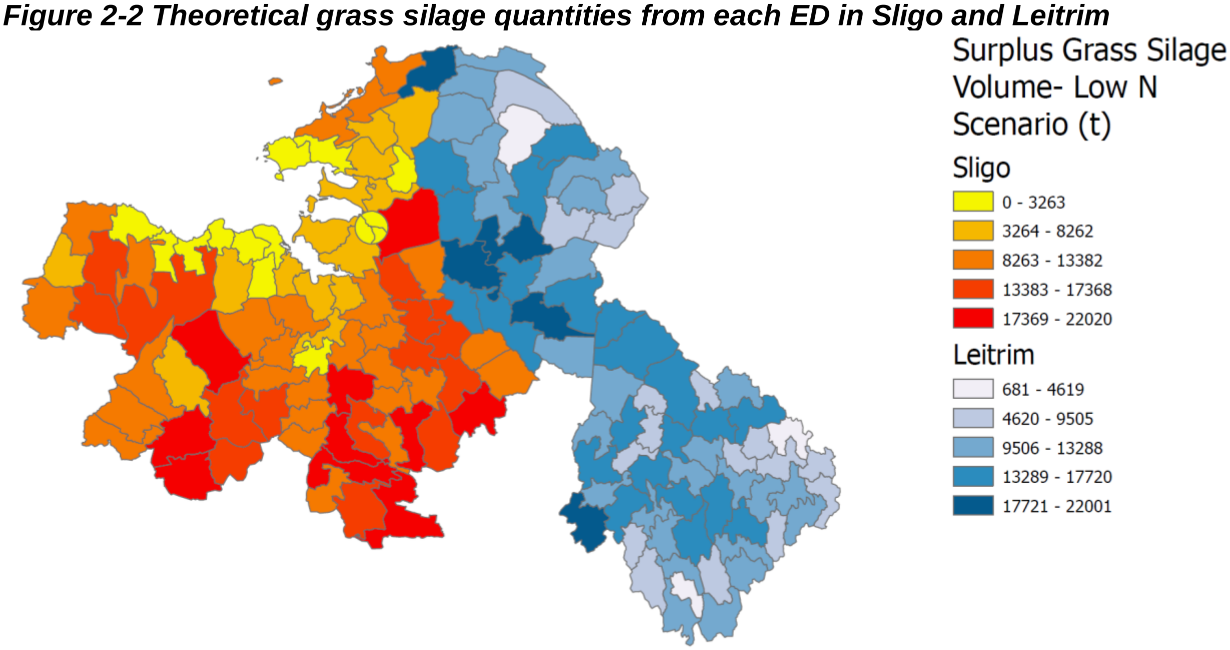


Figure 2-2 presents the annual theoretical quantity of surplus grass silage available in counties Sligo and Leitrim. The largest quantities of grass silage in Co. Sligo are spread quite evenly across the east, south and west of the county. The largest quantities of grass silage in Co. Leitrim are in the west of the county.

Figure 2-2 Theoretical grass silage quantities from each ED in Sligo and Leitrim



The total theroetical surplus quantity of grass silage in Co. Sligo is 818,795 tonnes, with 911,617 tonnes theoretically available in Co. Leitrim. “*The use of surplus grass for the production of grass silage as a feedstock for anaerobic digestion does not alter land use and leverages the existing knowledge that farmers have in relation to the production of grass silage. Additionally, if farmers wish to stop supplying grass silage and increase dairy or beef production, the land previously used for silage production can be immediately used for beef or dairy production.”* (O’Shea 2021)

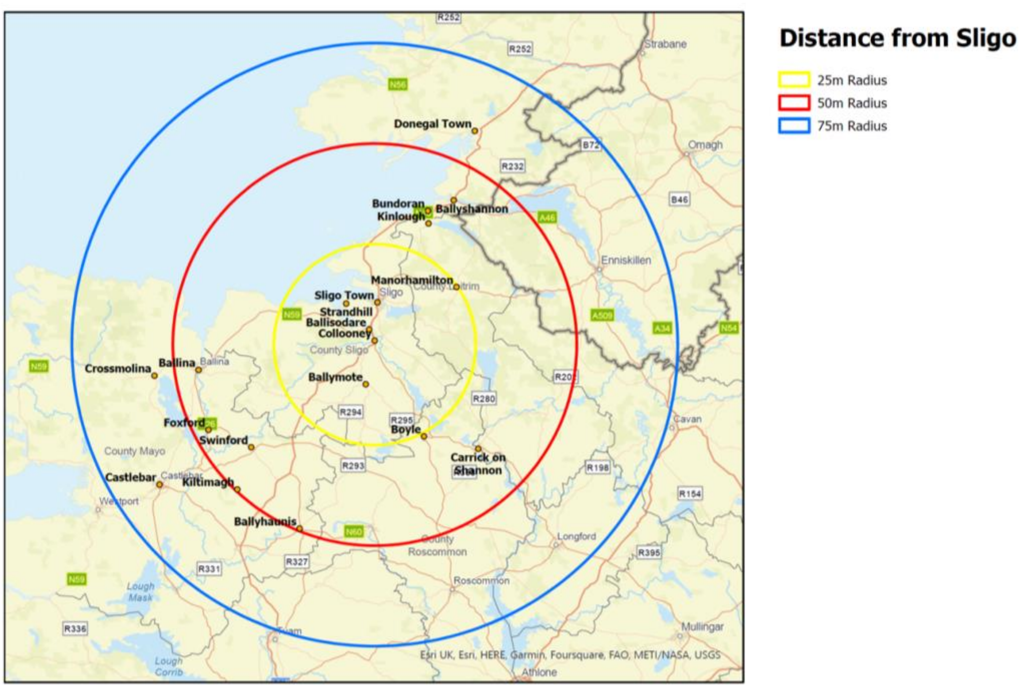
The total surplus grass silage from Co. Sligo could produce 87,494,545m^3 of biomethane or 867,654MWh of thermal energy per annum. The total theroetical quantity of grass silage from Co. Leitrim could produce 98,885,883m^3 of biomethane or 980,618MWh of thermal energy per annum. The distribution of surplus grass silage in Figure 2-3 suggests that this potential feedstock is ideally situated to supply an AD plant near Sligo town.

4.4 Non-agricultural sources

The report also identified a number of suitable non-agricultural feedstocks. The potential for feedstock from non-agricultural sources is less apparent with more consideration and processing for lower gas yields than the potential from agricultural sources. However, this material will be important to provide a holistic waste management option for the region while also providing benefits in terms of GHG reductions and energy security. Acceptance of waste material is in line with current government policy, it also can provide potential gate fee income to support the operational costs of the AD facility.

Possible sources include food waste and brown bins, waste materials from the brewing and distilling industries, food processing and waste water treatment sludges etc. The brown bin (household segregated organic waste) and food waste are concentrated in poplation centres, and most of the other sources and facilities are located in or adjacent to major urban areas (Figure 2-3) which provide the workforce, transport, associated suppliers etc.

Figure 2-3 Main urban areas (over 1000 population) and distance from Sligo



4.5 Stage 1 Conclusions

One or more AD Facilities will be required with a blend of feedstocks. As the proposed output is biogas rather than prioritising electricity production, meaning that transport is a key consideration as there will be incoming and outgoing material and products of substantial volume this will need to be considered in the financial operations.

A mix of feedstocks including agricultural sources for high biogas production and organic waste streams will need to be considered for project viability and national policy adherence. Biocrop only facilities are currently not acceptable under Irish government policy.

5 Stage 2: Environmental Assessment

The environmental analysis is evaluating more than just the environmental considerations of the siting of a potential AD facility. The topics and factors considered and the potential impacts or constraints assessment methodology (considering both the risk of negative impacts but also potential positive or preferencial location needs) has been taken from the international best practices for Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA).

The evaluated topics of these include general aspects of the Sligo Leitrim area, the environmental considerations (under the main themes of EIA namely air, water, soils, ecology etc).The categories include protected areas, Coillte forestry, amentities and tourism, cultural heritage and urbam environments as well as scenic areas and routes. The data was aggessed mainly through government sources, nationally and regionally avialable data and from informaiton kindly supplied by the Sligo County Council GIS department.

In addition to potential negative constraints that would impede development or planning a number of positive constraints were also considered such as acccess to transport networks and proximety to biogas customers, proximety to suitable feedstocks, proximety to the proposed SGGN gas network injection points (determined from the SGGN FEED study) and proximety to potential major gas users etc.

In addition, as required under best practice the socio-economic considerations have also been considered such as transport (road network and access), material assets, potential impacts to other users etc. These include general data such as demographics, vehicle ownership etc.

5.1 Stage 2 – Data acquisition

Several data sources have been considered in the development of this report. A three-tiered approach (Massey, 2012; RPS 2012, DG Eng, 2017) was applied to the collation of the data to maximise the information that could be collated within the project timeline to maximise the analysis.

There are three main data types considered, firstly general context in terms of the area, elevation, physical constraints such as national borders and coastlines and transport networks. Secondly, there are the potential types of feedstocks. Thirdly there are the potential constraints to the siting of a plant due to existing development, sensitive environment etc.

The majority of the data acquisition came from available data from Government departments (directly via gov.ie and their own websites) and data supplied by Sligo County Council GIS team from the County Development Plan data to support this project.

This data has been collected from a number of sources on AD development and operation, including guidelines and research papers. Finally, the sources of potential feedstocks are evaluated, this data is from known industries with waste or by-products suitable for biogas generation, licenced facilities that produce suitable waste or by-products or from surrogate data of potential sources, for example population data and household waste generation.

As the data is received it is categorised broadly by general, environmental and socioeconomic aspects and then by theme. The initial stage of categorisation also involved a review of the data received, its coverage, quality and currency along with identifying if further data acquisition was required for gap filling. The next step involved an assessment of the completeness of the dataset along with categorisation of the data by theme.

These themes were developed based on the structure of an Environmental Impact Assessment as outlined under Irish environmental law and the associated guidance from the EPA etc. For completeness the assessment will include environmental and socio-economic assessment factors (ESIA). These categories will be applied to the datasets.

An inventory of the layers as categorised was compiled and with the project team a series of constraints weightings were developed.

5.2 Weighted Constraints Analysis

Based on the information provided, Rowan used the major themes of the Planning and Environmental Impact Assessment Process to categorise potential environmental sensitivities and constraints as well as generating data or surrogate datasets to evaluate the best potential locations for siting. Unfortunately, whilst significant information was available for Sligo, there was limited GIS data for Leitrim. The early assessment showed that transport was likely to be a significant constraining factor to the delivery of product (gas) to the grid in Sligo and therefore locating the facility in Leitrim was not assessed.

5.2.1 Physical Environment

The physical environmental constraints of the Sligo Town area, and the wider Sligo-Leitrim region were assessed as part of the analysis. Sligo and Leitrim have several mountainous areas, lakes and rivers which provide physical barriers to transport and movement of goods and services.

Siting of a facility should be cognisant of the topography for suitable siting and facilities. The assessment also considered suitable geology and related factors such as groundwater and aquifer protection.

5.2.2 Environmental constraints

The environmental constraints followed the principles and the themes of the required information for planning and Environmental Impact Assessment reporting, from guidance of international standards and national guidelines, such as the EPA guidance May 2022[7] and the Themes included Land, Soils & Geology, Landscape and Visual, Water including Hydrology & Hydrogeology, Air Quality, Noise & Climate Ecology and Biodiversity (including protected sites and Habitats Directive considerations), Material Assets and Existing Infrastructure, Roads, Traffic & Transportation, Waste and Archaeology and Architectural Heritage. Data was provided from Sligo County Council GIS system and national sources of information from data.gov.ie where many government departments publish national data coverage relevant to assessment.

5.2.3 Socio-economic constraints

As part of the assessment the socioeconomic conditions of the area were considered. These included existing development (both in terms of constraints and proximity to potential customers for the biogas), transport networks and access to both feedstock and the proposed satellite gas grid and potential siting constraints and benefits such as tax and rural incentive areas, areas of existing industrial commercial park developments. The results from the first stage of the project which mapped the availability of feedstocks in the area were also used as positive constraints to the socio-economic analysis.

[7] EPA, May 2022 Guidelines on the information to be contained in Environmental Impact Assessment Reports, Environmental Protection Agency

5.2.4 Weighting and spatial analysis

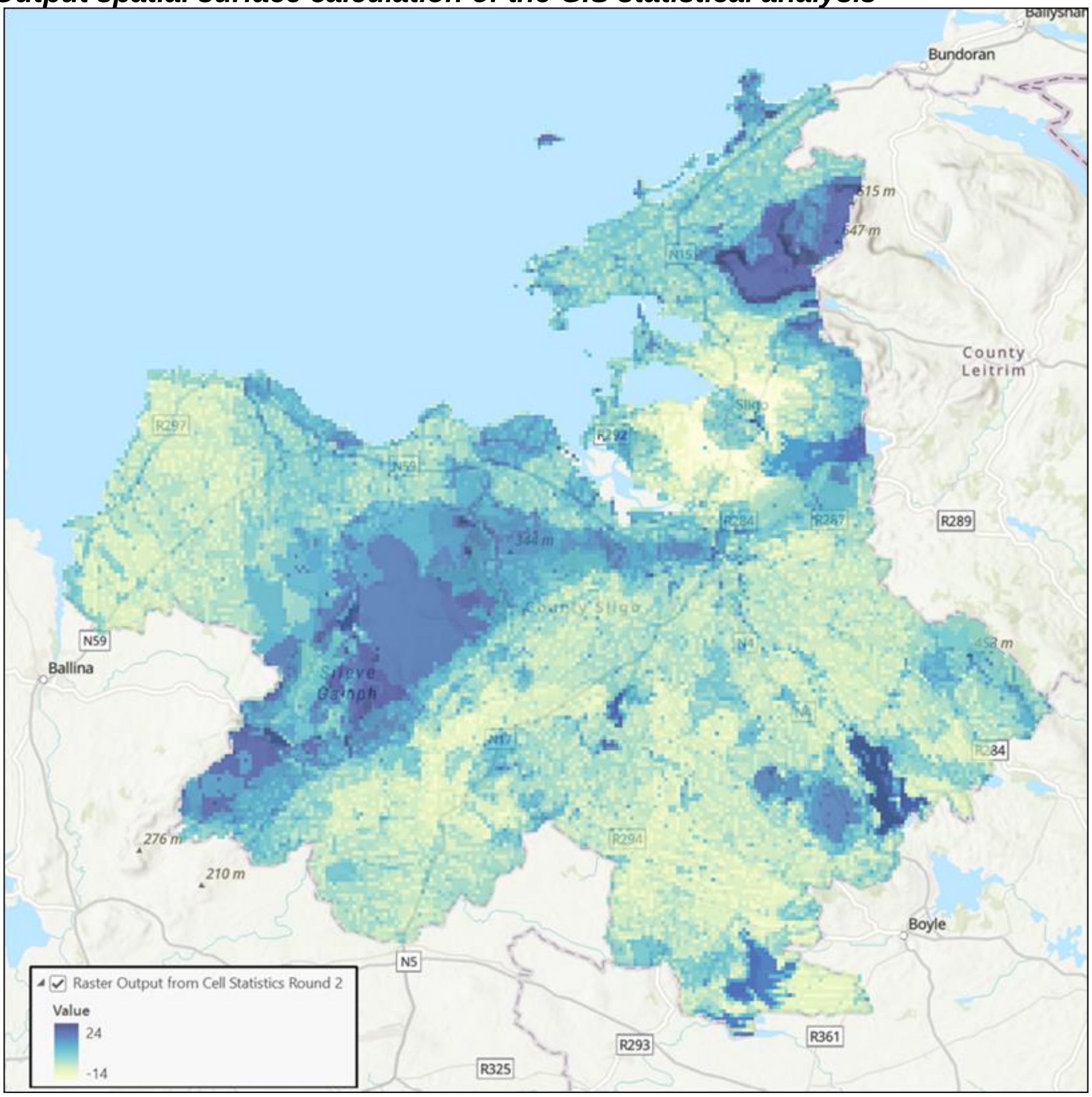
The analysis was based on the weighting of the constraints on a 7-point scale. Each set of information was weighted from +3 to -3 dependent on the level of potential interaction with the project. For ease of analysis the weighting was inverted with negative constraints such as protected areas receiving a score of 3 and less constraints receiving a lower score. Positive constraints such as close proximity to transport networks were give a -3 score and graded accordingly by the level of constraint.

Each set of information was analysed and weighted accordingly. Through the analysis Rowan created several layers such as distance buffering from the proposed gas grid injection points, roads etc.

The entire study areas were then analysed on a 500m grid. Spatial statistical tools in the GIS were used to calculate the summed value of each cell based on all the information from the data. Where layers had no areas of weighting a 0 score was recorded.

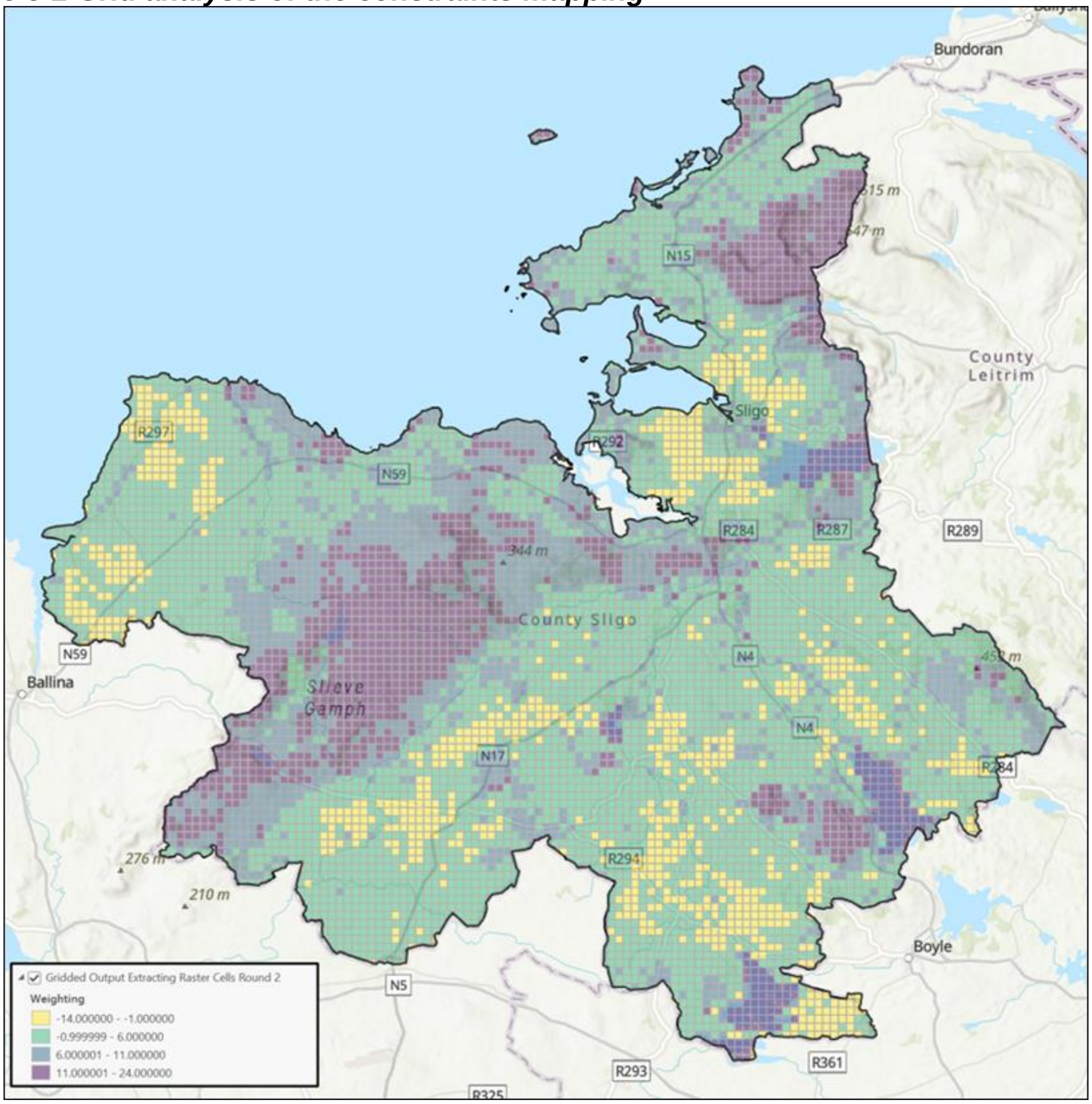
The overall analysis created a calculated surface or raster of values from -14 (ideal location) to +24 (likely unsuitable location) for development.

Figure 3-1 Output spatial surface calculation of the GIS statistical analysis



The output of the analysis was then applied to the 500m^2 grid to assess the potential for site selection.

Figure 3-2 Grid analysis of the constraints mapping



5.3 Stage 2 Conclusions

As part of the assessment the socioeconomic conditions of the area were considered. These included existing development (both in terms of constraints and proximity to potential customers for the biogas), transport networks and access to both feedstocks and the proposed gas grid and potential siting constraints and benefits such as tax and rural incentive areas, areas of existing industrial commercial park developments.

The analysis identifies a band of suitable locations in proximity to Sligo town to the north and south of the city adjacent to transport networks. These locations would allow for direct connection to the Sligo Satellite Gas Network, a significant advantage to the proposed planning of the project and with potential advantages of limiting the transport requirements for the products.

In addition, on further inspection and refinement, suitable industrial commercial zoned lands and council owned lands were identified in both locations. The key finding is that the town is effectively cut in two by the Garavogue river and bridge restrictions meaning that transport of trucks (biogas or feedstocks) north to south is potentially a significant constraint to planning.

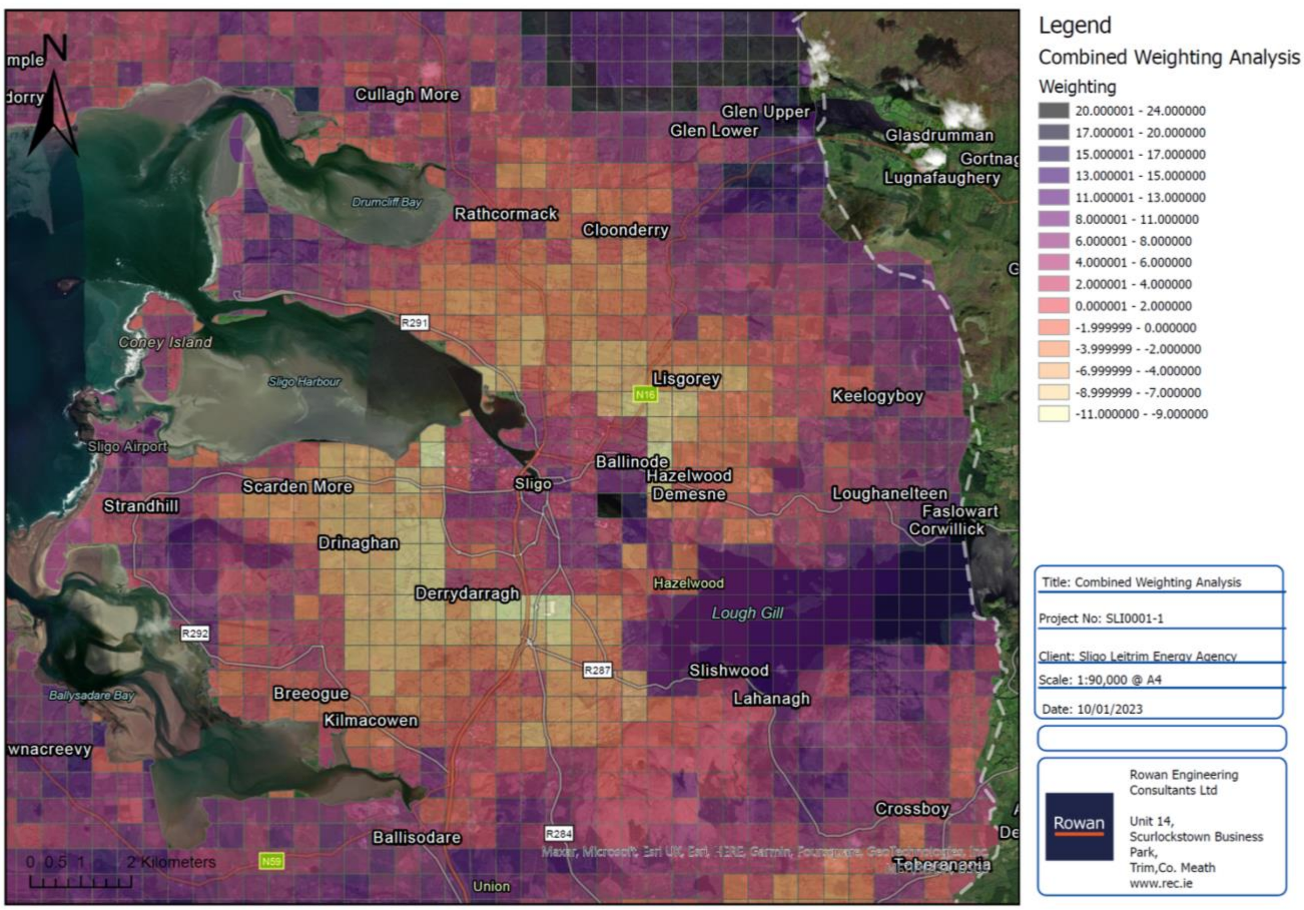
The amount of feedstock and the siting assessment identifies the potential for a 2 AD plant solution to the supply of the satellite gas network, with suitable locations on either side of the city. Further assessment of the potential customers and gas demand in Sligo town and the immediate area identified there is sufficient potential feedstock and biomethane demand to support a solution of more than one facility.

Specifically, a potential location somewhere with access to the N16 in the north of Sligo Town area in the Lisgorey, Drumkinsellagh, Ballytivnan areas. These are near the proposed network injection points and the ATU - Sligo, AbbVie, Sligo University Hospital and Lough Gill Distillery customers.

Also, a suitable location to consider is in the south of Sligo Town which is a primary site area for consideration in the Derrydarragh, Ballyfree, Carraroe townland areas with access to the N4 and proposed gas network injection points in Finisklin Business Park and the IDA Oakfield Business & Technology Park.

In both areas, further investigation confirmed the presence of suitable industrial / commercial zoned lands and council owned lands that maybe suitable for siting such a facility.

Figure 3-3 Mapping of area of interest for potential siting.



These are the most advantageous locations, however the assessment provided data on all areas within Sligo County and therefore the potential of any site can be queried to determine potential issues or benefits related to the planning of a facility at that location. For example, other sites considered could be the redevelopment of brownfield locations identified by the Council, such as historic landfill or quarrying sites that can be repurposed and remediated as part of the development. These sites were specifically identified in the analysis as the potential for contaminated land or existing use and may make them less favourable at this high-level study. However, where such a site may be proposed as part of a two-objective project, to remediate and repurpose an area, there would be additional benefits to the project and community as well as environmental benefits. If such projects or sites were proposed, then the GIS provided can be used to evaluate the other criteria related to suitability for AD development, such as proximity to transport, feedstocks or protected areas etc.

The assessment identified that space is a key issue in the consideration. A 4.5 acre site is suitable for the development of the AD plant at the production capacity proposed and associated facilities such as gas scrubbing and compression.

However, access to a larger site at the outset is key to future proofing the project and allowing for future phases of development, feedstock processing diversification or the addition of additional products from the process. A 12 or 15-acre site would allow for onsite facilities that can provide additional benefits to the project, as well as space for future compression or liquefaction of gas and potential additional feedstock consideration or byproducts.

Onsite slurry storage and silage production is highly recommended, both to keep feedstock prices down, but also to ensure supply and maintenance of the gas production through seasonal variations. Gas production from this storage can be collected and included in the AD process as investigated in the Technology Review.

Onsite digestate and byproduct storage is also advantageous as there are seasonal constraints on some agricultural customers on when these products are in demand.

6 Stage 3: Technology Assessment

Rowan conducted a full review of Anaerobic Digestion technologies and potential solutions. A key finding from the policy review and the feedstock assessment is that the plant will most likely be licenced as a waste facility subject to the associated EPA licencing. The current government policy is that AD is a waste process, the use of a directed biocrop for gas production is not permitted as the primary source, classing it as intensive agriculture for non-food production. (Government Statement on Climate Action, 30th Sept 2021).

As a result any plant that's developed will need to handle a number of waste streams and feedstock types. The technology requirement therefore is likely to need a two stage process to manage the feedstock types.

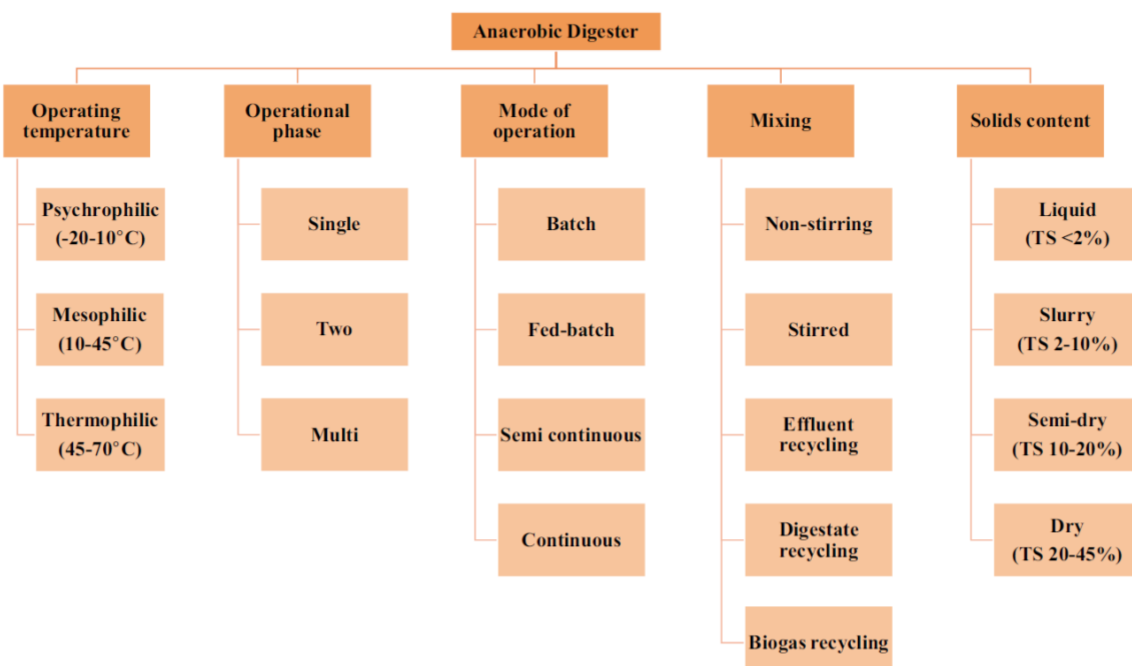
6.1 Anaerobic Digestion process

Anaerobic digestion (AD) is the conversion of feedstock (any organic non-woody material) by micro-organisms in the absence of oxygen into biogas and digestate. It is a natural process and is well understood by mankind, having been harnessed for many years.

Slurry, sludge, food waste and other possible biomass feedstocks are inserted into a large, sealed airless container. In this oxygen-free environment, bacteria will metabolise the materials using processes that produce carbon dioxide and methane or biogas. In most digesters, the contents will be heated to accelerate the process. AD can be applied at a range of scales, depending on the amount and types of biomass available. Systems can range from small farm-based digesters to large centralised anaerobic digesters (CAD) supplied with feedstocks from several sources. The microbial process of AD requires careful management to maximise its potential output.

Figure 4-1 summarises the types of anaerobic digestor systems that are currently commercially available.

Figure 4-1 Types of Anaerobic digestion (Khuntia et al, 2022)



6.2 Technology Selection

The proposed facility will need constant biomethane output to supply a gas grid network utilising a continuous (or semi continuous) production process. It will also need high gas production volume and a two stage process (either two mesophilic temperatures or more suitably a thermophilic and mesophilic digestion stage) to be able to handle a mix of feedstocks and optimise the gas production.

A two-stage process has higher energy demands than a simple digestor set up. Either higher temperature mesophilic, or more likely a two stage process with a thermophilic stage will be used in the plant, meaning that the bioreactor tanks will need to be heated.

The need to accept waste in order to gain planning and permitting means that a variety of feedstocks are considered as a build-up of an operational plant with high gas yields. Certain wastes (such as pre-packaged retail food waste) require significant handling and processing facilities, that may not be suitable in the short term of the project, and may be better considered in a future phase of the project.

In order to provide a future proofed plant with the ability to adapt to policy and feedstock variations in the future, the plant needs to be planned as a two-stage plant, with onsite facilities to accept a number of feedstock types. Onsite storage of some high-volume feedstocks (such as silage and slurry) is recommended to ensure continuity of supply and maintenance of the input materials for dry matter, liquid and solid balance etc.

6.3 Associated Equipment and process

Additional plant and equipment will also be needed to produce high value by-products from the digestion process. Simple anaerobic digestion will produce the gas volumes required, however the material received is a mix of waste and other feedstocks. Without post processing the output is a sludge that is nearly the same volume as the input and has storage and disposal considerations and costs as a waste. The exact configuration of the plant is dependent on the feedstocks to manage, both for the plant and tanks, but also the required supporting infrastructure. Pasteurisation of the incoming feedstocks will be required which requires energy requirements onsite and equipment. Dependant on the feedstocks they may need shredding, maceration, separation and processing to be suitable for digestion.

By refining the output, the plant can produce by-products with market value, namely biosolids which have value as soil matrix or can be used in other industries, and a bio-inert liquid digestate that can be used as a fertiliser, which is preferable to the slurries that were identified as potential feedstocks. This requires post digestion pasteurisation and dewatering, needing space, equipment and energy to operate.

The requirement for the plant to be able to accept a number of feedstock sources, including waste streams means that the incoming material also needs pasteurisation to preserve the bacterial flora of the process. The culture in the anaerobic digestor will be optimised for gas production at thermophilic and mesophilic bacterial communities. These cultures need to be maintained to maximise yield and therefore incoming materials, especially slurries, paunch, food waste and brewery by-products need to be pasteurised as these have bacterial load already.

The output from Stage 2 assessment identified that direct injection of the gas to the proposed satellite gas grid is possible. Alternatively, if the gas is to be transported by road, then gas cleaning and compression will be required.

Biogas from the plant as a raw gas has high levels of CO2 and methane, with the potential for hydrogen sulphide content. Hydrogen sulphide has a strong odour and is poisonous in high concentrations and needs to be scrubbed or removed.

CO_2 levels need to be removed to clean the gas from biogas to biomethane. Biomethane is predominantly methane, and is a direct competitor to natural gas for heat and energy production, boilers, steam turbines etc.

Some anaerobic digestor plants burn the biogas at the plant directly to generate electricity, however, the purpose of this project is to produce biomethane for a gas network and potential customers.

The gas therefore needs to be scrubbed and cleaned and then pressurised for delivery in compressors. The CO_2 extracted has potential as a by-product for food and industrial processes. The compression to truck transport to gas grid is also energy demanding. The gas can be cooled for liquification, however, there is not a need for this additional plant and costs (financial and energy usage) if the gas can be supplied direct to grid, and saves on capex and operational costs.

6.4 Operational costs and energy

A key consideration is the energy requirement (parasitic energy load) of the operation of the AD plant. Whilst the purpose of the plant is to produce biomethane, the operational costs would be impacted by electricity load requirements for plant operations. Therefore, the inclusion of a Combined Heat and Power (CHP) unit onsite is a significant consideration. This unit uses biogas (or biomethane) to run a gas turbine or steam turbine for electrical production onsite. The heat generated from the process is captured and reused to reduce the heating costs for tank operations or pasteurisation and the energy produced is used for powering the plant. Excess electrical energy could be supplied to the grid; however, the balance is to produce the maximum amount of biomethane for grid supply.

The design of the plant to optimise throughput and operations can minimise the costs of onsite feedstock transport and movement and processing and therefore the number of full time staff. Onsite laboratory facilities will monitor the incoming feedstock and bioreactor performance to optimise production. Injection into the grid is preferable and whilst it increases the onsite infrastructure (and therefore cost) it significantly reduces the transport demand of the project.

6.5 Stage 3 Conclusions

Policy drivers as well as variation in available feedstock means that the plant will need to be able to accept several types of waste and feedstocks. The ability to accept different feedstock types supports greater potential longevity of the operation in a changing landscape of politically driven priorities.

The combination of technologies can significantly reduce any waste streams or emissions from the plan and maximise the potential by-products for supply to offset the operational costs of the plan. Additional stages and machinery may mean additional workforce and land take for the site.

Combining these technologies whilst most recently the norm, is not well documented with published data from an operational standpoint to input into the financial model for the potential operational costs and returns. However, from the available information estimates of the capex and running costs as well as by product value can be roughly estimated.

The feedstock is the driver for the technology assessment. Waste acceptance is currently the process by which AD facilities are permitted in Ireland, however, a high yield feedstock will also be required from agricultural sources.

Two stage processes and pasteurisation require higher parasitic energy load on the facility, to offset the operational costs (and protect against energy price fluctuations which are creating the biogas market) an onsite CHP is recommended.

Gas scrubbing is essential to maximise the biogas appeal to the potential future consumer. Where plants convert directly to energy, scrubbing is less essential, but the purpose of this project is not to create electricity, but to deliver biomethane to a local satellite network.

7 Stage 4: Financial Assessment

As part of the tasks of the feasibility study, the financial viability of the proposed AD facility was analysed. This is not a detailed budgetary assessment, which would require detailed design, but an overall evaluation of the proposed infrastructure development and costs, as well as the potential revenues from the facility to assess the project for financial viability.

The financial model is made up of initial capital (purchase or building) costs along with ongoing operational costs and operational revenue.

The purpose of the financial assessment is to consider the feasibility of the project with a high-level assessment to determine if the overall project is financially viable. The estimates are designed to assist the overall business case for the project supporting the financial feasibility which is considered with the other stages of the project.

As a result, the assessment is relatively conservative in the values used. It is not meant as a budgetary exercise for funding application or tendering. The costs of the AD Facility infrastructure for example are based on real world (confidential) examples from the team's experience of tender and contract management for other AD facilities. These figures have been rounded and an uplift (up to 20%) applied to account for variability in costs due to the nature of the site that may be selected / available and to account for current market rates for building products (concrete, steel etc) which are elevated due to the energy market crisis.

Similarly, the revenue (gas price) is a conservative unit value, below the current market peak caused by the recent energy crisis. The lowest EU gas price per kWh in 2020 was 4.99995 cents, therefore a unit price of 5c was used for the initial estimates. At the time of the reporting due to the energy crisis the market value is averaging at 8.499 c per kWh which can be treated as the normal maximum market value and includes government measures and subsidies. Both these are based on natural gas market values in the EU and Ireland.

The assessment has been based on conservative figures throughout and does not include potential policy and capital support mechanisms such as state grants for construction or specific process within the plant (such as CHP) as well as the proposal by Government for preferential gas rates for biogas. These measures or similar may vary or may not be available depending on the timing of the project construction and the nature of the ownership or operation. As a result, these supports have not been included in the model, but are discussed in more detail, later in the report. If these supports are made available, then they will likely improve the financial return period on the plant compared to the financial model values.

The purpose is to evaluate the financial feasibility and potential return periods on a plant based on the information collated in Stage 1, 2 and 3 and to provide guidance to the SLEA on the likely capital costs, returns, operational costs and the key risks to future revenue. Conservative principles have been applied throughout, and the scenarios considered include for options such as reduce gas output, increased capital costs and increased feedstock costs in the plant operations to fully evaluate the financial viability of the proposed project.

The financial model is made up of initial capital costs, along with ongoing operational costs and operational revenue. Rowan have developed and presented an excel model and repeated the process for several selected scenarios.

The model also includes practical feedstock quantities, parasitic energy requirements and a number of scenarios to compare the impact of certain technology decisions. Every technology option cannot be accounted for in the model because many technology options and decisions have multiple knock-on effects to other technologies either upstream or downstream. Technology selection is dependent on the feedstock mix. A number of feedstock mix options have been evaluated in this study, but for the progression of the project to a detailed design stage, confirmation of the primary sources of feedstock will be required with agreements in principle for the supply or acceptance from specific sources.

7.1 Capex and Investment

Based on the requirements from the Stage 3 Technical review and the information from the environmental siting in Stage 2, an assessment was made of the required onsite equipment, the purchase costs for the land and planning of the plant. Rowan based the estimates on real world examples from similar configuration two stage plants. The total cost estimate includes additional funds for inclusion of silage and slurry storage onsite and the gas scrubbing and compression equipment.

A second scenario was included to calculate the plant costs and returns including an onsite CHP unit to supply power and heat for the operational loads.

The Capex included an allocation for the purchase of 4.5 acres based on commercial land price in the area, however, if a larger site was possible within the budget or through landowner arrangements then this preferable as outlined in the Stage 3 assessment.

7.2 Operational Costs

Operational costs include the staffing of the facility, operational costs, energy usage, feedstock costs, maintenance allowance and parts allowance.

Operational costs include a scenario where electricity demand is needed for the plant operation and the second scenario where a CHP provides this electrical demand, but with the additional parts and maintenance costs for its operation. Onsite costs are included, but transport costs have been kept separate, anticipating that injection to the gas grid is possible and trucking to customer is not required. The CAPEX includes for the post digestion pasteurisation and dewatering of the digestate. This means that the digestate can be used as a by-product with market value and that additional costs do not have to be included for land spreading or digestate sludge disposal. From discussion with AD operators, the current energy crisis means that there is high demand for fertilizer products, and the digestate as a liquid fertiliser has an income value.

7.3 Operational Revenue and Returns

Revenue estimation is based on the gas yield from a mix of feedstocks, identified and qualified for the plant from the Stage 1 assessment. The gas yields from these feedstocks are based on peer reviewed sources and calculations which are detailed in the financial model and report. Based on these gas yields the revenue for the plant is calculated using a conservative 5c / kWh gas costing.

Feedstock prices are based on known values from national reports, TEAGASC and discussion with industry.

Whilst gate fees (a charge per tonne for waste handling and disposal) for the acceptance of waste can provide a valuable revenue stream for the operational costs, the consultant team proposed and the SLEA agreed that these should be a minor element in the plant revenue. The focus is on the production and sale of biomethane. Gate fees are subject to change and market forces. The government has announced a programme to promote the development of more AD in Ireland, this in turn is competition for gate fees and revenue of the plant is limited to this avenue as a significant contributor to the operational revenue.

The assessment showed that a basic scenario level of an AD facility without CHP is commercially viable with a payback of under 11 years based on the conservative estimates.

With a CHP, the additional CAPEX is significantly offset by the reduction in energy costs for operations and the plant has a potential return within 5 years of commissioning.

Both of these scenarios provide significantly better return on investment than other renewable energy infrastructure (solar, wind etc) and as such give a very strong indication that the project is also financially viable.

7.4 Alternative Costing Scenarios

Following a review of the initial financial model outputs, additional scenarios were assessed to ensure the project's viability.

For these assessments the two scenarios (with and without CHP) were fixed, and the variables were applied to assess contingencies in the financial model. As a result to maintain project viability the gas price was also considered. A key factor in the project is to provide customers with a range of gas costs for the biomethane to allow planning and involvement in development. The purpose was to assess project certainty around gas price to customer and account for further contingency on development operational costs and revenue.

Under the two scenarios of the plant with and without CHP, Rowan assessed the following

- Contingency on development (up to a further 15%). The high energy costs are to account for increased costs of materials (steel, concrete etc) due to the energy crisis, or land costs, planning issues etc.

- Contingency on feedstock costs (up to 20%). Unlike the above, the costs of feedstocks (especially the high gas producing agricultural feedstocks slurry and silage) have a potential significant effect on the returns for the facility. Small variations in the cost of silage for example have a significant effect on the profitability of the plant

- Biogas production (up to 15%). The Feasibility assessment used published biogas calculations for the amount of gas produced. The reports identify the need to test the feedstocks for biogas production potential and the possibility of seasonal variation, different dry matter content etc to the published sources. As a result, the scenario includes a reduction in available production from the published figures as a contingency

- Gas price. If all other elements are treated as fixed then in order to improve the returns on the plant the only variable is the cost per unit of the gas produced. Rowan evaluated each scenario against a scale of gas price from 5c (2020 low rate) to 8c (below 2023 market value)

The revenue and assessment is intentionally conservative to ensure the assessment is verifying the financial feasibility of the project. However, it is likely that there may be capital support and incentives that can improve either the revenue or reduce the CAPEX and initial investment costs.

At the moment there is government support for CAPEX towards CHP which use biogas through SEAI grants (e.g Community Energy Grant, Support Scheme for Renewable Heat and SEAI EXEED) as well as potential government funding support for renewable energy projects.

As for the operational costs, there are potential government incentives for biomethane as a renewable energy source which include up to a 30% tax incentive over natural gas. At the moment it is not clear if these would apply to both producer and the customer which would make the product in high demand and allow greater potential unit revenue to the facility.

The grants and incentives are linked to government policy and EU policy which is constantly changing under the current situation. Renewable energy has been proposed as an emergency priority under the European Commission and if upheld could provide access to funding, or streamlining of planning processes for the AD plant(s). However, these are conditional on policy and government funding rounds and the situation when the plant is ready to construct could be different, therefore these have not been included in the financial feasibility assessment in order to judge the project viability without reliance on external funding or benefits.

Figure 5-1 – Summaries of Financial Scenarios and Returns

Financial Scenarios and Returns	Gas at 5c/kWh		Gas a 6c/kWh		Gas a 7c/kWh		Gas a 8c/kWh	
	€32/t silage 5c/kWh gas - no CHP		€32/t silage 6c/kWh gas - no CHP		€32/t silage 7c/kWh gas - no CHP		€32/t silage 8c/kWh gas - no CHP	
Base Scenario - no CHP	Total capital costs	€ 8,595,000	Total capital costs	€8,595,000	Total capital costs	€8,595,000	Total capital costs	€ 8,595,000
	Total operational costs	€ 3,208,546	Total operational costs	€3,251,545	Total operational costs	€3,294,545	Total operational costs	€ 3,337,545
	Total revenue	€ 4,060,643	Total revenue	€4,669,951	Total revenue	€5,279,259	Total revenue	€ 5,888,567
	Simple payback	10.09	Simple payback	6.06	Simple payback	4.33	Simple payback	3.37
	€32/t silage 5c/kWh gas - CHP		€32/t silage 6c/kWh gas - CHP		€32/t silage 7c/kWh gas - CHP		€32/t silage 8c/kWh gas - CHP	
With CHP	Total capital costs	€ 9,945,000	Total capital costs	€9,945,000	Total capital costs	€9,945,000	Total capital costs	€ 9,945,000
	Total operational costs	€ 1,454,064	Total operational costs	€1,454,064	Total operational costs	€1,454,064	Total operational costs	€ 1,454,064
	Total revenue	€ 3,511,631	Total revenue	€4,011,136	Total revenue	€4,510,642	Total revenue	€ 5,010,147
	Simple payback	4.83	Simple payback	3.89	Simple payback	3.25	Simple payback	2.80
	€50/t silage 5c/kWh gas - no CHP		€50/t silage 6c/kWh gas - no CHP		€50/t silage 7c/kWh gas - no CHP		€50/t silage 8c/kWh gas - no CHP	
Increased Feedstock costs	Total capital costs	€ 8,595,000	Total capital costs	€8,595,000	Total capital costs	€8,595,000	Total capital costs	€ 8,595,000
	Total operational costs	€ 3,845,894	Total operational costs	€3,888,894	Total operational costs	€3,931,893	Total operational costs	€ 3,974,893
	Total revenue	€ 4,060,643	Total revenue	€4,669,951	Total revenue	€5,279,259	Total revenue	€ 5,888,567
	Simple payback	40.02	Simple payback	11.00	Simple payback	6.38	Simple payback	4.49
Increased Feedstock costs and CHP	€50/t silage 5c/kWh gas - CHP		€50/t silage 6c/kWh gas - CHP		€50/t silage 7c/kWh gas - CHP		€50/t silage 8c/kWh gas - CHP	
	Total capital costs	€ 9,945,000	Total capital costs	€9,945,000	Total capital costs	€9,945,000	Total capital costs	€ 9,945,000
	Total operational costs	€ 2,091,412	Total operational costs	€2,091,412	Total operational costs	€2,091,412	Total operational costs	€ 2,091,412
	Total revenue	€ 3,511,631	Total revenue	€4,011,136	Total revenue	€4,510,642	Total revenue	€ 5,010,147
	Simple payback	7.00	Simple payback	5.18	Simple payback	4.11	Simple payback	3.41
Higher Feedstock costs	€70/t silage 5c/kWh gas - no CHP		€70/t silage 6c/kWh gas - no CHP		€70/t silage 7c/kWh gas - no CHP		€70/t silage 8c/kWh gas - no CHP	
	Total capital costs	€ 8,595,000	Total capital costs	€8,595,000	Total capital costs	€8,595,000	Total capital costs	€ 8,595,000
	Total operational costs	€ 4,554,059	Total operational costs	€4,597,059	Total operational costs	€4,640,058	Total operational costs	€ 4,683,058
	Total revenue	€ 4,060,643	Total revenue	€4,669,951	Total revenue	€5,279,259	Total revenue	€ 5,888,567
	Not financially viable		Simple payback	117.91	Simple payback	13.45	Simple payback	7.13
Higher Feedstock costs and CHP	€70/t silage 5c/kWh gas - CHP		€70/t silage 6c/kWh gas - CHP		€70/t silage 7c/kWh gas - CHP		€70/t silage 8c/kWh gas - CHP	
	Total capital costs	€ 9,945,000	Total capital costs	€9,945,000	Total capital costs	€9,945,000	Total capital costs	€ 9,945,000
	Total operational costs	€ 2,799,577	Total operational costs	€2,799,577	Total operational costs	€2,799,577	Total operational costs	€ 2,799,577
	Total revenue	€ 3,511,631	Total revenue	€4,011,136	Total revenue	€4,510,642	Total revenue	€ 5,010,147
	Simple payback	13.97	Simple payback	8.21	Simple payback	5.81	Simple payback	4.50
Lower gas yield	€32/t silage 5c/kWh gas - no CHP @ 90% yield		€50/t silage 6c/kWh gas - no CHP @ 90% yield		€70/t silage 7c/kWh gas - no CHP @ 90% yield			
	Total capital costs	€ 8,595,000	Total capital costs	€8,595,000	Total capital costs	€8,595,000		
	Total operational costs	€ 3,208,546	Total operational costs	€3,888,894	Total operational costs	€4,640,058		
	Total revenue	€ 3,755,989	Total revenue	€4,304,366	Total revenue	€4,852,744		
	Simple payback	15.70	Simple payback	20.69	Simple payback	40.41		
Lower gas Yield and CHP	€32/t silage 5c/kWh gas - CHP @ 90% yield		€50/t silage 6c/kWh gas - CHP @ 90% yield		€70/t silage 7c/kWh gas - CHP @ 90% yield			
	Total capital costs	€ 9,945,000	Total capital costs	€9,945,000	Total capital costs	€9,945,000		
	Total operational costs	€ 1,454,064	Total operational costs	€2,091,412	Total operational costs	€2,799,577		
	Total revenue	€ 3,206,977	Total revenue	€3,645,552	Total revenue	€4,084,126		
	Simple payback	5.67	Simple payback	6.40	Simple payback	7.74		

7.5 Stage 4 Financial Assessment Conclusions

The project is financially viable with return periods within 10 years and therefore not only financially feasible but suitable for progression to the next stages of evaluation. Other renewable technologies (wind, solar etc) have substantially longer proposed return periods, meaning that the business and investment case for the project can be built on the model and conclusions.

Based on conservative gas and capex prices – a detailed analysis may reduce the payback period further. Biogas tax incentives and government funding will potentially be available to reduce payback time even further. The inclusion of a CHP requires additional CAPEX at the project start but can potentially reduce the payback time even further (reducing by up to 3 years) by removing the requirement to purchase energy to satisfy the electrical and thermal demand.

Feedstocks are available to provide double the initially identified 50 GWh energy demand without excessive costs. Phased development to operational level with essential infrastructure, but space and planning for additional treatment or feedstock changes to future proof the AD facility. Policy support is required to acquire additional funding, to maximise revenue from products, to drive the proposed satellite gas network forward and, critically, to achieve planning and permitting within a reasonable time frame and without excessive costs.

8 Discussion

From the four stages of the feasibility assessment the project determined that the potential for an Anaerobic Digestion facility to supply a satellite biomethane grid network in Sligo was feasible.

The Stage 1 assessment determined that there is sufficient feedstocks in the immediate area for double the capacity requested in the initial scope. In addition, the national policy and local developments indicated that additional feedstock would be available in the immediate future within the projects development timelines. The assessment noted a mix of feedstocks would be required in relation to operational and planning requirements.

Stage 2 determined that a number of areas in the Sligo region have the potential for an AD facility. A band of suitable sites to the north and south of Sligo town were identified for further investigation, as these sites had a minimal constraints to potential development.

Stage 3 determined that a two stage AD facility would be required as a mix of feedstocks was necessary for planning and operations. Space is a key factor in the siting and viability of the plant. On site processing of digestate to potential by products is a highly recommended process, as is the scrubbing of gas to biomethane and compression onsite. From the outputs of Stage 2, suitable location for the direct injection of biomethane to grid is feasible.

The Stage 4 financial assessment noted that even applying significant contingencies to feedstock prices, CAPEX costs, and gas yields the project is potentially financially viable with attractive return on investment periods. Production of biomethane to a sales price per unit comparable to normal gas market price[8] is possible and accounting for the current energy crisis, the potential gas returns can offset most scenarios of reduced revenue or increased capital or operational costs.

8.1 Key Project Risks and opportunities

The Stages of this feasibility study have reviewed and determined a number of potential opportunities and risks for the development of an AD plant to supply Sligo. The key opportunities and risks identified, include:

- Planning and adherence to current government policy is critical for project approval;
- The need for the plant to be a waste facility for planning and licencing;
- The need for the plant to have the space and capacity to adapt to policy change or feedstock availability;
- Certain feedstocks need space, staffing and equipment to process, and acceptance may need to be via phased development
- A two-stage anaerobic digestor will be required to handle a breath of feedstocks and maintain adaptability
- Gas scrubbing and compression will be required onsite
- An onsite CHP is recommended in the business case for self sufficieny of the plant and increased profitability

[8] 'Normal pricing' determined pre Energy-Crisis prices reviewing from 2018 to current pricing trends)

- Infrastructure to maximise the by-products is a key consideration and avoiding outgoing waste is a signficant factor in the plant operations and financial viability.

- The profitability is highly dependant on the cost of high gas production feedstocks, and there is a need to lock in supply and costs for a significant period early in the business planning process;

- The plant can maintain financial viability even in the event of increased land or capital costs, or poor gas production performance with gas price production below current market levels.

- There is sufficient capacity and feedstocks for more than one plant to supply a grid. There is good indiciation of significantly more potential customer demand in the area than identified in the FEED and sufficient feedstock and capacity for additional plant.

- Sligo has a north-south barrier to development and movement of feedstock and products due to transport.

- The development of a gas network is not guaranteed. The project may need to be viable before the network can be planned. The gas network and sale of gas can only be undertaken by a national registered gas supplier.

These are the key items of concern to project feasibility. A number of other considerations are outlined in each of the reports.

8.2 Next Phase

Under the projects' Phase 3, the potential site will be refined along with a detailed business plan and management plan for the development of the project. Key factors include the negotiation and firming of potential feedstock suppliers, potential siting of the facility and the progression of the steps to the feasibility of the gas grid development.

In addition to these steps, confirmation of the potential gas yield from the feedstocks actually present in the Sligo and Leitrim areas will be need to confirm the calculations and assumptions of the reports provided.

Once the feedstocks mix is better confirmed then the concept plant design can be developed including the processes and equipment for the feedstocks mix identified as most probable.

In addition, SLEA will need to establish the business case for the application for the CAPEX funding and development of contracting and tendering for services.

There are a number of areas which could provide significant benefit to the overall project plan that have not been included in the assessment, such as the availability of council lands or the local authority involvement in the project, the method of contracting (Design, Design and Build or a Design Build Operate contract for gas production). These include decisions on the options for the operator, the project ownership and the interaction with the gas network organisations of the sale and delivery of gas and development of the pipeline network.

9 Conclusion

Overall, there are a variety of suitable feedstocks for AD in the Sligo region. The analysis suggests that there are a number of waste stream products that would be suitable as the base for a feedstock receiving facility with significant quantities of surplus grass silage materials that can be used to balance the inputs to an AD from both counties Sligo and Leitrim equating to 1.7 million tonnes of fresh feedstock per annum. A small fraction of this grass silage could provide significant quantities of biomethane. However, silage is an expensive feedstock and will likely suffer from some variability driven by weather conditions, overall availability and cost or a combination of all three.

There are also large quantities of cattle slurry available in both counties. Most of the 400,000 tonnes of slurry in Sligo could be effectively used in AD. Again, not all of this material will be required, and a relatively small quantity could provide a significant volume of biomethane. There will certainly be some limitations due to transport distances but there appears to be sufficient availability within the surrounding area of Sligo town to make cattle slurry a viable option. Sheep slurry also appears to be available is reasonable quantities and in close proximity to Sligo town to make this material a good option for AD.

Stakeholder engagement will be a key aspect of the project development. All potential suppliers of feedstock will need to contribute. Their insights and expertise as well as their concerns will all have to addressed. Biomethane yields from each feedstock source will also have to be tested to ensure that accurate information is used to develop the overall business model.

Key finding from the first part of the study and report is that a blend or blends of waste and feedstock will be required to provide a long-term viable biogas solution and to address the requirements for the facility to receive waste in line with government policy, which may require additional considerations or processing and produce lower gas volumes and balance these feedstocks with higher gas producing by-products. Policy drivers mean that the plant must be a waste facility, however a mix of feedstocks will need to maintain biogas production.

Key finding from the second part of the study is that location and transport are a significant factor in the siting. The availability of feedstock supply close to major conduits into Sligo is a significant benefit to the project. This has the potential for direct connection to a future gas grid.

The study Identified a number of preferential areas near Sligo; however, the assessment was conducted over the entire county area and there are a number of areas suitable at greater transport distance.

Key findings from the third part of the study are that a two-stage process required to accept a number of feedstock types. Slurry and silage can be considered for storage onsite. In general space is a premium for future proofing of facilities. Onsite CHP is essential for fast profitability and gas scrubbing the biomethane and compression onsite need to be considered. Maximisation of by products and saleable products is a key requirement for profitability and operational costs (biologically inert digestate as liquid fertilizer, Class A biosolids and potting / hydroponic medium, CO_2 to industrial use or preferably food grade scrubbing as a product.

Stage 4 concluded the project is financially viable and potentially with returns suitable for a two-plant solution for the area. Feedstock long term and stable contracted costs are critical to financial viability. Adaptability in the policy landscape is also a requirement for longevity.

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