GREBE

Northern Periphery and Arctic Programme 2014–2020

EUROPEAN UNION
Investing in your future
European Regional Development Fund

Claremorris Energy Co-operative
Anaerobic Digestion

Introduction

Claremorris and Western District Energy Co-operative is a community enterprise focused on the development and commercialization of renewable energy technologies. The group's focus is to develop financially viable renewable energy projects through education programmes with key competencies in district heating, solar, biogas, and Micro grid applications. The Co-Op also aims to educate the community on the benefits of community ownership, and renewable energy, on what it is and its impacts.

The AD Demonstration unit (trailer) for biogas with support from Gas Networks Ireland to overcome the lack of understanding of anaerobic digestion and the elements which contribute to development of biogas solutions.

The Co-Op developed a mobile demonstration unit for biogas with support from the Renewable Gas Forum Group / Gas Networks Ireland to educate the public on the benefits of biogas. One of the barriers to entry for this technology is that landowners and local residents' interests often oppose AD projects believing it may impact on land values, businesses or cause smells and so want to restrict the development of anaerobic digestion plants. The development of this demonstration unit allows communities to ask good questions about technologies and to gain an understanding of how AD operates.

As a result of the demonstration stand at the National Ploughing Championships in 2015, the Co-Op has been invited to demonstrate the unit to 27 different groups.
The co-op has developed the original anaerobic digestion demonstration unit to include CO_2 extraction, iodine, biogas compression and storage, and consider how CO_2 emissions might be addressed. It highlights a means of addressing CO_2 emissions from agriculture.

Case Study Approach

The data on the market access of renewable energy technologies were collected both from the case studies in different renewable energy technology projects and from the secondary sources. To collect specific project data, a template was established with following subsections:

- **Technology description and a project summary**
  - Innovative characteristics
  - Technology readiness level
  - Available product / service supports from the manufacturer
  - Any standard procedures / requirements for integrating the technology into existing electricity networks, buildings and/or mainstream energy appliances / systems
- **Commercialisation of the technology**
  - Is the technology already a commercial solution?
  - Are there re-sellers of the technology, or is the technology available only from the manufacturer?
  - Identified main market area
- **Cooperation partners and networks**
  - Description of the roles of the co-operation partners and networks in the RE technology project.
  - How have they supported the market access of the technology?
- **Assessment of the technical and economic risks**
  - What kind of procedures have been made for assessing the technical and economic risks of the project
  - Who is bearing the risk of the investment (manufacturer, client, shared between them)?
  - Is the public sector involved in risk sharing? (e.g. co-financing, or platform for technology demonstration)
- **Drivers and barriers in the RE technology project**
  - Main drivers in carrying out the RE technology project
  - Barriers, and how they have been overcome (such as price of energy, availability of resource, specific expertise, policy enabling the technology)
- **Funding and support mechanisms**
  - The financial support received by the project: amount/support rate, type and purpose of the support, agency providing the support, significance of the support for the project
  - Types of soft support/advisories received during the project: the use of soft supports (advisory, training, mentoring etc.) during the technology development or implementation, and how successful these have been
- **Monitoring the performance**
  - How are the technical/non-technical aspects of the RE technology case monitored?
  - Information on the design, installation requirements and procedures, operational performance, and costs/financial arrangements
- **Conditions for the technology transfer & adaptation in different partner regions**
  - What are the main requirements/preconditions for transferring the technology and applying it in other partner regions?
  - Description of the main drivers and barriers for the technology transfer (such as. Energy price, resource needs, certain support etc.)
- **Project results**
  - Benefits & lessons learnt
  - Post- project benefits

Technology Description

The biogas demonstration unit incorporates the overall primary Biogas production in trailer 1 (Unit 1) with a treatment and compression demonstration element. The innovation demonstrates: (1) CO_2 extraction (2) How the biogas is compressed and stored (3) How CO2 emissions might be addressed

CO_2 extraction

To get rid of the Carbon Dioxide (CO_2) the digester biogas is diffused through a water (or limewater) spray tower. This action dissolves the CO_2 in the water, which is then collected at the bottom of that tower and then sprayed down a second column to release the carbon dioxide gas from the water, which is then vented to the next stage of capture. The water is then recycled back to pick up another load of carbon dioxide.

For the purposes of the demonstration unit, it is not necessary to eliminate all Carbon Dioxide from the methane, but CO_2 has no intrinsic fuel value. The process is visual and demonstrated through clear tubes. This educates on what is scrubbing, how we potentially can remove CO_2 and where it can be channelled. The CO_2 percentage can vary considerably from week to week of normal operation, particularly where differing feedstock constituents are used from time to time. The scrubber system allows a fairly free flow of gas to minimise pressure losses in the gas system since the operating pressures are so low to start with that little reduction can be tolerated before the whole thing stops flowing.

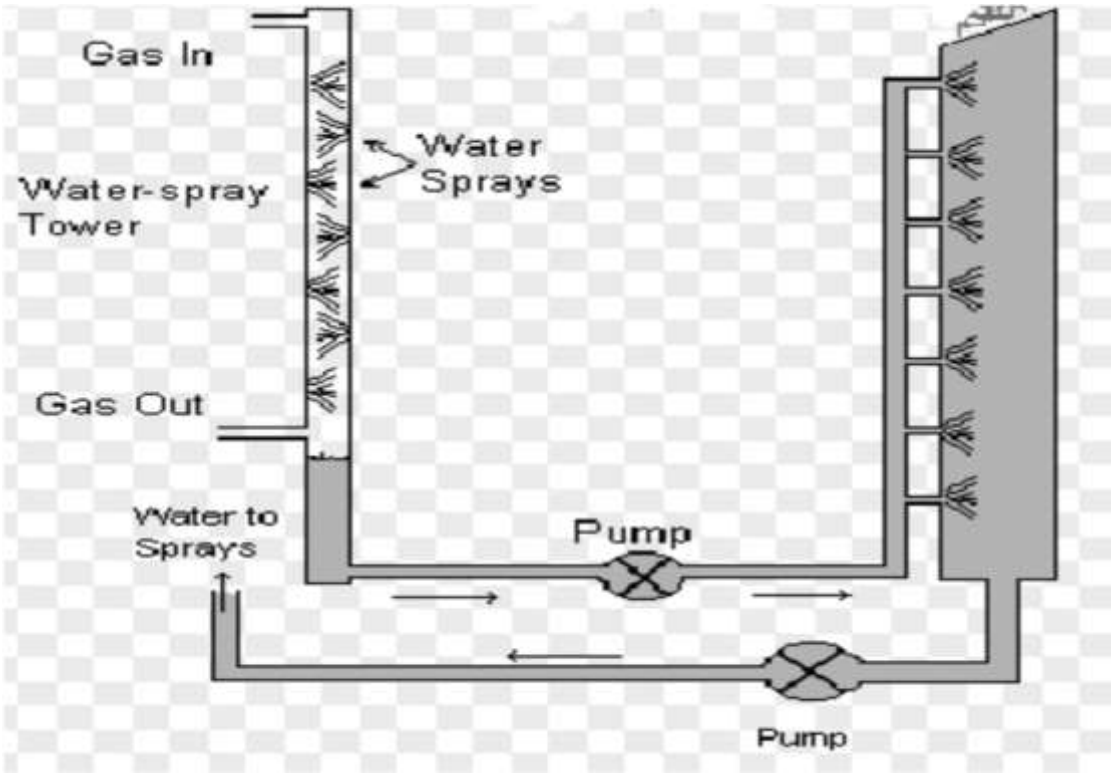

Figure 1Illustration on the CO_2 capturing water-spray tower/scrubber.[1]

[1] Western Development Commission. Grebe case study pictures. 2016

How the biogas is compressed and stored (including Hydrogen Sulphide extraction)

The scrubbed gas passes through a reducer and safety valve into a receiver tank. Based on a predefined gas pressure the gas is then passed through a gas meter into the gas filter. The main culprit Hydrogen Sulphide, or 'Rotten Egg' gas is removed as the gas is passed through metal filings.
It then enters the compressor whereby the compressed gas will be stored in gas cylinders. Throughout the design, safety valves are included while the compressor itself will have some element of heat recovery. This heat is then directed back to the AD tank to support the temperature control in the AD unit. The compressor is capable of compressing over 5m^3 per hour of gas with a power consumption of 2.2kW.

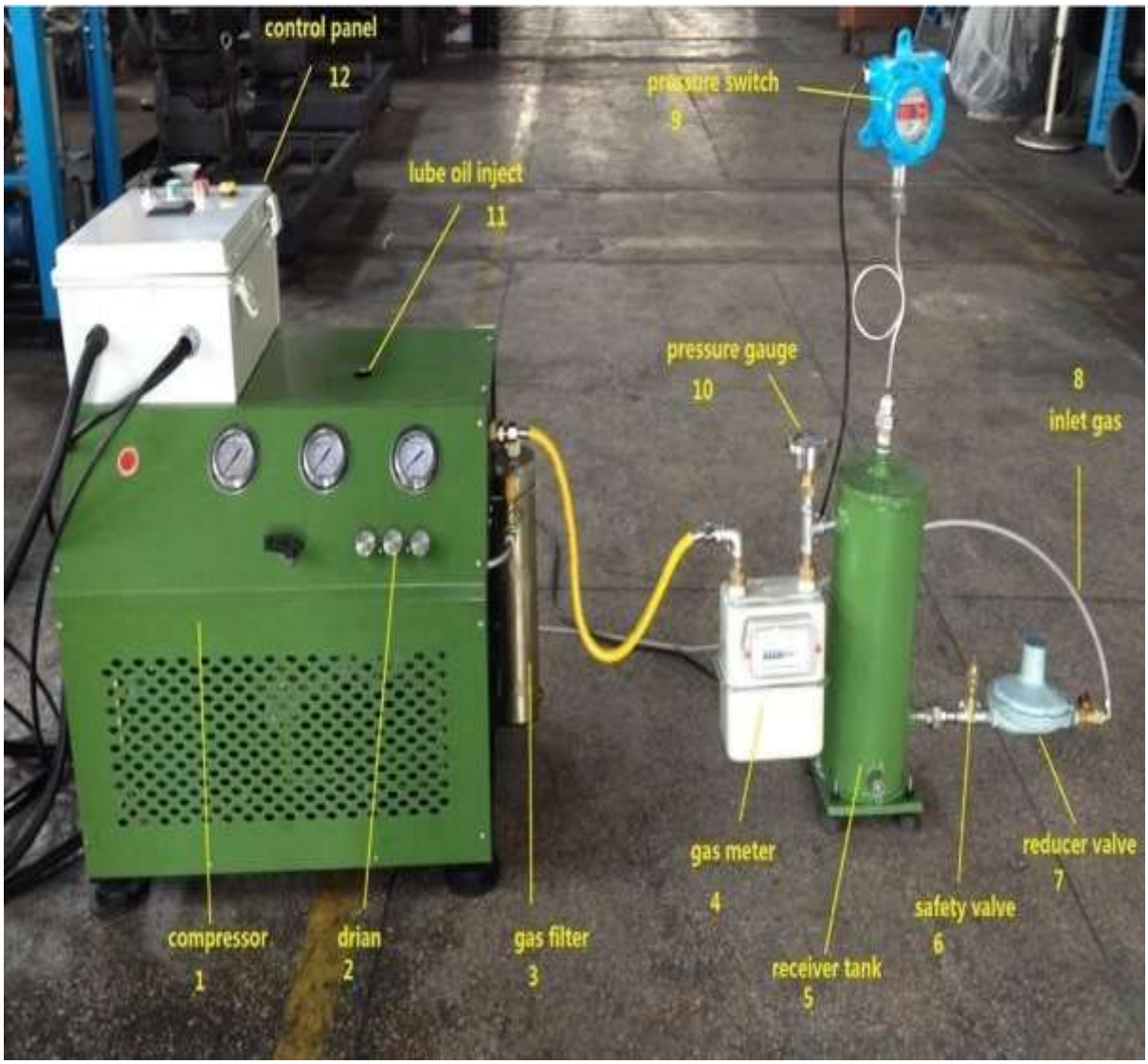

Figure 2. Biogas compressing and filtering.[2]

[2] Western Development Commission. Grebe case study pictures. 2016

How CO2 emissions might be addressed?

For understanding the impact of CO_2 extraction and alternative possibilities of capturing the CO_2 gas, the cooperative has investigated and designed a simple mechanism to pass the CO_2 from the scrubber through a series of tubular Micro Algae tubes.

These tubes are arranged in a vertical setup, but also horizontal applications is possible. The vertical standalone tubes are bubble columns. The productivity of microalgae in converting CO_2 into oils far exceeds that of agricultural oleaginous crops without sacrificing arable land.

By illustrating the principle of the operation, a better appreciation of how technologies such as this can capture CO_2 but also support the argument for progressive technologies to support biogas production. Microalgae can not only create clean renewable fuels, but also remediate wastewater and create bio chemicals.

Additional points demonstrate the energy harvested as nontoxic and biodegradable, obtained from a renewable source. Moreover, it can be demonstrated that the water used in the AD process could be passed through the algae tubes and recycle the wastewater while purifying the air.

Again, the purpose of the unit would be to demonstrate the possibilities and further understand the impact of the overall biogas solution. The algae can be used for animal feed, substrate for anaerobic digestion, and the CO_2 capture and for use in the pharmaceutical industry, for instance.

Figure 3. Micro Algae Tubes for CO_2 capture and utilisation. [3]

Carrying on from the first trailer, the ability to demonstrate at all levels the scrubbing and compression of the biogas and highlight the CO_2 capture, enhance agricultural benefits of micro algae generation, heat exchanger on the compressor to circulate hot water back to the AD tank. The second trailer to be adapted to compress larger amounts of Gas where demonstration sites become available. The operation will highlight the possibility of mitigation support strategy to mitigate greenhouse gas emissions and become a substitute for fossil fuels as energy source.

[3] Western Development Commission. Grebe case study pictures. 2016

This RE demonstration project is innovative, as it has ability to demonstrate at all levels the scrubbing and compression of the biogas and highlight the CO_2 capture, enhance agricultural benefits of micro algae generation, heat exchanger on the compressor to circulate hot water back to the AD tank.

TRL and Technology Scale

The technology readiness level of this demonstration unit is 9 because the anaerobic digestion process with cleaning to biogas is at a fully commercial level.

This unit is stepping back at level to demonstrate on a small scale, the effectiveness of this process in different scenarios. The unit for CO_2 extraction was designed in Ireland and manufactured in China.

Cooperation partners and networks

This is a community owned energy co-operative with seven local people as shareholders with experience in community development, business and energy. The co-operative intend to invite new members to participate in the co-operative as the project develops.
Gas Networks Ireland is an important stakeholder in this project, through their financial support and through the expertise available in the organization.

As part of the district heating project in Claremorris, Mayo County Council. is an important partner through the provision of a disused handball alley as a site for the biomass boiler, and in another project of the leachate for the landfill site. Technical support has been provided by University College Cork and Galway – Mayo Institute of Technology, and the Technology Centre for Biorefining and Bioenergy.

Risk assessments and supports received

From the initial project inception in December 2014 to date, just under €100,000 has been spent on the project. This is excluding the voluntary time commitment of the shareholders of the Co-Op or other goodwill and costs taken on personally by the Co-Op members, e.g. transportation of the demonstration unit.

The Renewable Gas Forum Ireland group as part of EU group looked at overall economic analysis of biogas and biomethane. As financial support of 60 000 € was provided by Gas Networks Ireland from their Gas Innovation Groups Innovation Fund, an evaluation and analysis of this project was undertaken in advance of the provision of funding. The aim of the fund is to provide support for research and demonstration and balance the level of funding available for each, based on projects potential to deliver the goals of the fund. This project is a demonstration project, and shows that communities could develop a model on this basis.

The Innovation Fund is intended to promote and accommodate an environment of innovation in the gas industry by engaging with key stakeholders in order to share knowledge and leverage the best use of all resources. It is intended that the Innovation Fund will foster creativity, tailor innovation and consider solutions that meet gas industry needs, embedding innovation in the GNI organisation and the gas industry.

The aim of the fund is to provide support across research and demonstration and balance the level of funding available for each, based on projects potential to deliver the goals of the fund. The financial support from this fund allowed the demonstration project to proceed.

As the owner and promoter of the project, Claremorris & Western District Energy Co-Op are bearing the risk of the investment. As Gas Networks Ireland is a public body and have provided funding for this demonstration unit, some of the risk has been shared by the public sector.

Drivers and barriers

Claremorris and Western District Energy Co-operative is a community enterprise focused on the development and commercialization of renewable energy technologies. The group's focus is to develop financially viable renewable energy projects through education programmes with key competencies in district heating, solar, biogas, and Micro grid applications. The Co-Op also aims to educate the community on the benefits of community ownership, and renewable energy; on what it is and what are its impacts.

The Co-Op has encountered many barriers during the development of this project. Government policy is focused on wind energy and solid biomass rather than AD. The cost of running this type of renewable energy system is at present a barrier, however the introduction of a renewable heat incentive (RHI), should lower this barrier and make the difference to allowing projects such as this to run. Communities want to own their own energy and have energy security, and policies should be put in place to encourage this.

The sourcing of material can also be a barrier, as farmers currently use material as a fertilizer on their land. Farmers should be encouraged to provide material for anaerobic digestion plants and then to spread the digestate on their lands.

There is a lack of understanding about the anaerobic digestion process and another barrier to entry for this technology is that some landowners and residents do not want anaerobic digestion plants developed near to them.

Conditions for the technology transfer, adaptation and new market deployment

With this demonstration unit, the leadership of a promoter to demonstrate the effectiveness of AD for use in different scenarios is required. Combined with this are the skill and understanding of the technology to overcome the barriers outlined above.

With any project policy support and finance is required to ensure the project is viable and the ability to ensure a strong supply chain of the fuel source is important. As the technology readiness level of this demonstration unit is 9 and the anaerobic digestion process with cleaning to biogas is at a fully commercial level, there are few barriers to the transfer of this unit for use in other peripheral regions.

This unit demonstrates the effectiveness of this process in different scenarios.

Project Results

Benefits

This project shows the ability to generate renewable gas, the commercial and social benefits of biogas scrubbing and compression, the technologies available and how these can capture CO_2 and enhance energy savings.

The first project of the demonstration trailer unit shows the ability to demonstrate at all levels the scrubbing and compression of the biogas and highlight the CO_2 capture, enhance agricultural benefits of micro algae generation, heat exchanger on the compressor to circulate hot water back to the AD tank.

The second trailer demonstrates how large amounts of gas can be compressed. This will allows people to see the technologies in operation and will support the strategies to mitigate greenhouse gas emissions and shows how energy from AD can become a substitute for fossil fuels.

Lessons Learnt

This project was developed by the Claremorris & Western District Energy Co-operative, and one of the lessons learned was the benefits of keeping the group small at the beginning for ease of management of people and other resources. The Co-Op had a charter which was clear, set and understood by all the shareholders and for these reasons progress could be made to get the project underway with structures in place before expanding the Co-Op.

The Co-Op experienced difficulties in cash flow with many members using their own money where necessary. The Co-Op applied for funding to the GIG Innovation Fund in December 2014, and it was in June 2015 by the time this was granted. The demonstration unit needed to be ready for the National Ploughing Championships in September 2015.

There is a general lack of understanding of biogas and anaerobic digestion in the region, and lack acceptance of the technology. There is a need to emphasize local element of the project and local use of the fuel source. The benefits of the project need to be highlighted to ease concern.

The Co-Op recognized the need to have a commercially viable plan for the Co-Op and have administrative staff in place. An important priority of a co-operative is to have a revenue generating project which can support the administrative staff. For this reason, the Co-Op is developing a solar farm, and if successful, will produce an income of c. €200,000 per annum. The Co-Op estimate an income of c. €60,000 p.a. from the district heating network which it is developing.

Post Project Benefits

As a result of the showing the demonstration trailer unit at the National Ploughing Championships in September 2015, interest in the Co-Op has increased locally and new members are becoming involved in renewable energy and are pro-active in their involvement.

The Co-Op has kept the membership of the group initially limited but will aim to expand from its seven original members to 20 and in the future hope to have 100 members. The district heating and solar projects are developing and the Co-Op hopes to sell power and so can employ people locally, and move towards making the Co-Op a commercial organization.

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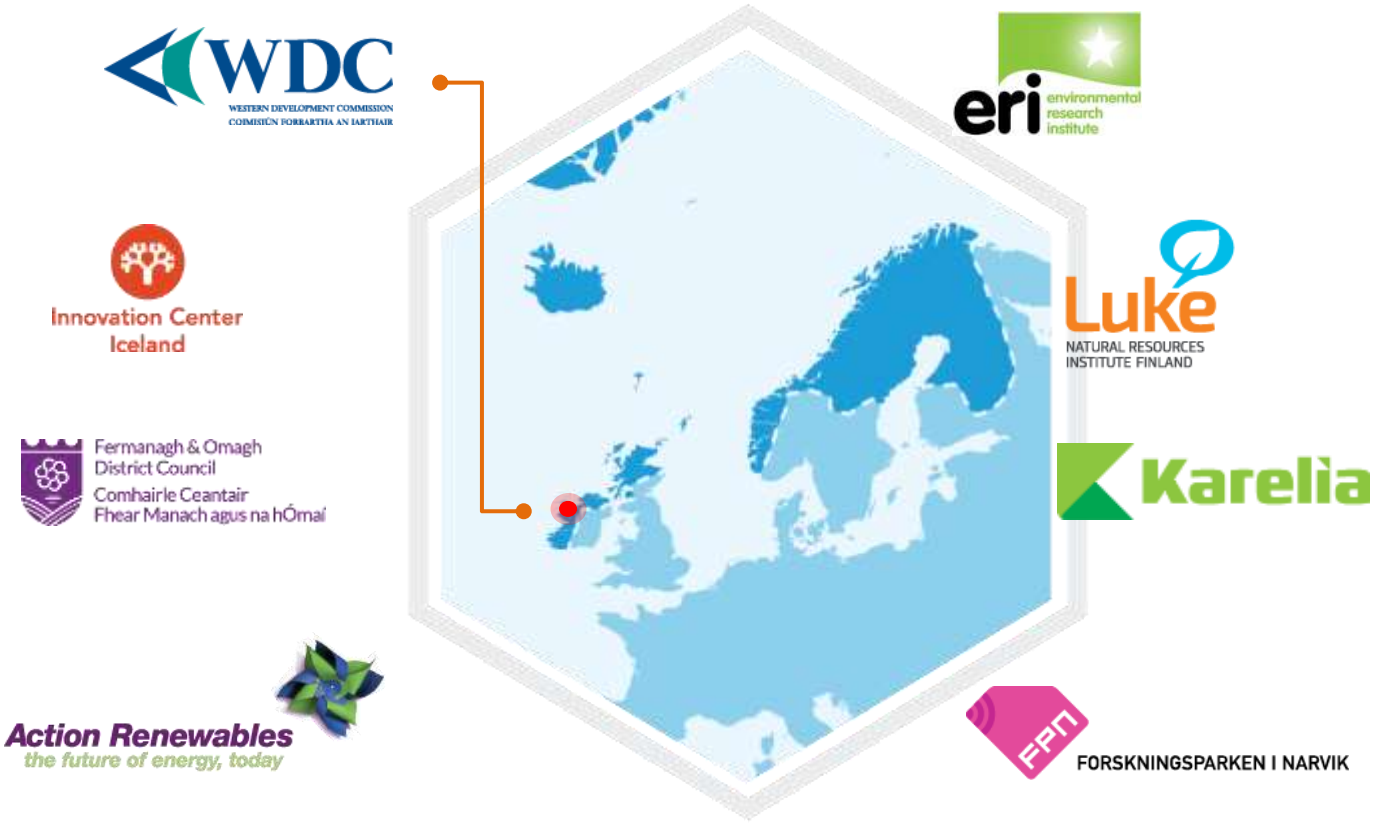
PARTNERS

GREBE will be operated by eight partner organisations across six regions:

WDC



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