

IEA Bioenergy

Task 29 of the IEA Bioenergy
Implementing Agreement -
Socio-Economic Drivers in
Implementing Bioenergy Projects

CASE STUDY

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Camphill Community Ballytobin, Co. Kilkenny, Ireland

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Executive Summary

This case study describes the anaerobic digestion (AD or ‘biogas’) plant at the Camphill Community Ballytobin in Co. Kilkenny, in the south-east of the Republic of Ireland. The plant is one of the first three farm-based biogas plants in the country, and is the first “centralised” biogas plant. The Community set up a company called BEOFS (Bio-energy and Organic Fertiliser Services) to research, design, build and operate the AD Plant. The plant commenced operation in late 1999, and has two digesters – one horizontal steel digester, and one vertical concrete digester. The total digester volume is 600 m³. About 21 wet tonnes of agricultural slurries and organic residues are supplied to the plant per day. A gate fee is obtained by the Community for organic residues received. The biogas is used in three boilers (two of 85 kW_{th} and one of 220 kW_{th}) to heat the digesters and to supply heat to houses, a school, workshops and a large hall. The fibre from the digestate can be separated and composted for on-site use and for sale. The separated digestate is delivered to the three farms that also supply slurry to the plant. The total capital cost of the system was €800,000. The project provides full-time employment for five people, thus providing important social benefits. The use of the biogas for heating within the Community avoids expenditure of up to €25,000 per year on heating fuel, and displaces at least 360 tonnes of carbon dioxide from fossil fuel use per year.

The development of the project involved a considerable number of stakeholders. Technology transfer from Germany was an important factor in the decision-making process. The project has received support from the EU Horizon and Altener programmes, the Department of Agriculture and Food, the local LEADER company and FÁS (the training and employment authority). By far the most significant barrier encountered by the project developers has been the difficulty in obtaining a Power Purchase Agreement that would allow the connection of a Combined Heat and Power plant at the site. The Camphill philosophy of care for people and the environment and the development of sustainable economics was a guiding force in the development of the biogas plant. The project has significantly increased the awareness of, and interest in, renewable energy locally and nationally. The success of the operation has inspired the establishment of another company called ecobeo limited to develop further biogas plants and other green technologies.

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- Mr. Christoph Eusterbrock and the other members of Camphill Community Ballytobin.
- Mr. Pearse Buckley, Sustainable Energy Ireland.
- The Task 29 Leader, Associate Leader and Country Representatives.

Background to IEA Bioenergy and Task 29

IEA Bioenergy was set up in 1978 by the International Energy Agency (IEA) with the aim of improving cooperation and information exchange between countries that have national programmes in bioenergy research, development and deployment. The government of each member country designates a contracting party to IEA Bioenergy. The contracting party for the Republic of Ireland is Sustainable Energy Ireland (SEI). The work of IEA Bioenergy is carried out through a series of Tasks, each having a defined work programme (IEA Bioenergy, 2004). Task 29 is on Socio-Economic Drivers in Implementing Bioenergy Projects, with the Task Leader being Dr. Julije Domac of the Energy Institute “Hrvoje Požar”, Croatia and Mr. Keith Richards of TV Energy Ltd., United Kingdom as Associate Task Leader. Tipperary Institute was contracted by SEI in 2003 as the Country Representative for Ireland on Task 29. Task 29 also includes participation from Austria, Canada, Japan, Norway and Sweden. For further details on Task 29 see the Further Information section.

Introduction to Case Studies

In its role as Country Representative, Tipperary Institute proposed to SEI that a number of case studies of bioenergy projects in the Republic of Ireland be undertaken. The Case Study reports are written primarily for those who are interested in developing bioenergy projects in Ireland. The reports describe the contexts of the projects examined and provide an outline description of the bioenergy systems involved. The main purposes of the case studies are to document the drivers in implementing the projects, record the barriers encountered by the project developers, list the impacts of the projects and identify the stakeholders. It is hoped that the case studies will improve the understanding of bioenergy project development in Ireland, and thus assist in the construction of additional projects which maximise bioenergy’s social, economic and environmental benefits.

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Case Study Name and Location

Camphill Community Ballytobin
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People Involved in Case Study

- Mr. Mark Dwan, Director Bio-energy and Organic Fertiliser Services (BEOFS) and Camphill Communities
- Mr. Les Andrew Arthur, Plant Manager
- Mr. Christoph Eusterbrock, Director BEOFS
- Mr. Patrick Lydon, Director BEOFS and Camphill Communities

1. Description of Case Study Context

The Camphill movement was founded in 1940. A Camphill Community involves voluntary co-workers and people with special needs living as a community in a particular location. Members of the community have a cultural life, a community life and an economic life, based on the three guiding principles of Camphill (Association of Camphill Communities, 1997). There are over 90 Camphill communities in 20 countries across the world, with 47 in the United Kingdom and Ireland (Association of Camphill Communities in Great Britain, 2004). Ballytobin, near Callan in Co. Kilkenny, was established in 1979 as a therapeutic farm for children with multiple disabilities and disturbances (see Figures 1 and 2).

There are now 85 people living in the Community, including children and adults with special needs, and co-workers. The 8 hectare site includes a primary school, a number of houses, workshops, a community hall, a garden and an organic (bio-dynamic) farm (Camphill Communities of Ireland, 2001). A large hall named Castalia was opened in 2002, and hosts events in which the public participate, thus contributing to Camphill's aim for integration with the wider community.

Figure 1 Mr. Christoph Eusterbrock of Camphill Community Ballytobin gives a tour of the Community to a delegation from Task 29.



Figure 2 Home in Camphill Community Ballytobin.



Plans for an anaerobic digestion (or “biogas”) plant at Ballytobin began in 1995. The Camphill Community set up Bio-energy and Organic Fertiliser Services (BEOFS) to research, design, construct and operate an overall system, including the biogas plant, heating boilers and a community heating system. Construction commenced in 1996 (see Figure 3) and the plant was officially opened in December 1999 by a member of the Dáil (Irish Parliament) and the Chairperson of Kilkenny County Council, the local authority for the area. The plant is one of the first three farm-based anaerobic digestion plants in the Republic of Ireland (Guest, 1999), and is described as the country’s first “centralised” biogas plant, as it involves a number of biomass suppliers (Camphill Communities of Ireland, 2001) (see Figure 4).

Figure 3 The first digester under construction.



Figure 4 Slurry is delivered to the biogas plant, by Mr. Les Andrew Arthur and Mr. Dick Dunne, two of the five people employed on the plant.



A woodland site was purchased beside the Community for the construction of the biogas plant. A number of oak trees were felled in the development of the biogas plant - these were then used in the construction of the Community's beautiful hall, Castalia (see Figures 5 and 6).

Figures 5 & 6 The Community's hall Castalia.



2. The Bioenergy System

The system consists of the following principal components:

- Biomass reception and storage,
- A 150 m³ horizontal plug-flow anaerobic digester and a 450 m³ continuously stirred anaerobic digester operating in series (see Figure 7),
- 90 m³ biogas storage above the continuously stirred anaerobic digester,
- Substrate, biogas, digestate and heating water pumping systems,
- Fibre separator (screw press),
- Biomass storage and composting shed, with materials handling equipment,
- Digestate storage,
- Three biogas boilers (two of 85 kiloWatts thermal output and one of 220 kW_{th}) and community heating (“district heating”) system,
- A flare to burn off excess biogas production installed in 2004,
- Tractor and slurry spreading tank,
- Storage tanks on three local farms.

Figure 7 The plug-flow digester (right of picture) and the continuously stirred digester with biogas storage (left of picture).



The total capital investment in the plant was €800,000. During normal operations, the biogas plant is supplied with a mixture of cow / cattle slurry and suitable organic residues. The typical total biomass intake is 21 wet tonnes per day (Dwan, 2004). Organic residues have formed a proportion of the biomass supply to the plant since 2002. Slurry generally provides about two thirds of the plant intake by mass. The slurry is supplied from three farms, all of which are within five kilometres of the plant. Slurry supply reduces by one third during the summer time. The digesters are operated at mesophilic temperatures – about 37° Celsius. The typical retention time in the biogas system is about 30 days.

After digestion, the fibre can be separated from the digestate using a separator manufactured by FAG Germany. After fibre separation, the digestate is returned to storage tanks on the three farms for landspreading. The transport of slurry to the plant, and digestate from the plant, is undertaken by people from the Camphill Community. Biogas production is estimated at 1,000 m³ per day (Dwan, 2004). The biogas is burned in gas boilers to provide hot water for heating the digesters, and for the community heating network. The separated fibre is composted (see Figure 8) and sold in bags or in bulk. Most of the compost is used on site for vegetable production, and also in nearby plant nurseries operated by the Camphill Community.

Figure 8 The composting shed and materials handling equipment.



Organic residues are delivered by waste management companies in vacuum tankers or tipper truck, depending on the solids content (see Figure 9). Residues are only accepted at the plant if they have been deemed in advance to be suitable for digestion, based on analysis data. The waste management companies pay a ‘gate fee’ to Camphill Community per tonne of residue delivered. The biogas plant is classified as a ‘recovery’ operation and has a Waste Permit issued by the local authority, Kilkenny County Council. Regular monitoring of the inputs to, and outputs from, the plant is required.

Figure 9 Articulated truck delivering organic residues to the biogas plant.



Trials are done at the plant to test different biomass substrates. During 2004 testing was done to establish if the plant can be run solely on food residues. Two aspects were examined – the operation of the biogas plant itself, and the value of the digestate from a farming perspective.

The reader is referred to the Further Information section for material on bioenergy resources and policy in Ireland (Sustainable Energy Ireland, 2002).

3. Drivers in Implementing the Bioenergy System

Philosophy: The ethos of Camphill Communities is based on caring for people and for the environment and the development of sustainable economics. As described below, a biogas plant was seen as a mechanism of achieving all of these goals.

Employment: Camphill Communities help people with disabilities to access employment opportunities, within or outside the Community. A major driver for the development of the biogas project was that it would create employment within the wider community. To maximise achievement of this objective a largely “self-build” option was chosen in preference to a turnkey contract.

Commercial: The energy demand of the Community was estimated in 2001 as 150,000 kWh of electricity and 500,000 kWh of heat (Camphill Communities of Ireland, 2001). A plan was developed to build a new hall at Ballytobin for the Community and the general public. The question of how the hall would be heated was raised. A biogas plant emerged as the favoured solution. The plant is economically viable (Dwan, 2004).

Availability of Advice and Support: The idea for the project was proposed initially by Mr. Christoph Eusterbrock, a German national and voluntary co-worker in the community. Germany is a leading country in the implementation of on-farm biogas plants. Christoph had an interest in renewable energy, was familiar with biogas technology, and had access to information through the German Biogas Association and Irish contacts.

A preliminary assessment of the possibility for a biogas plant at Camphill Community Ballytobin illustrated the advantages it would provide. The community were assisted in their assessment by an Advisory Group, which involved accountants and engineers including Mr. Rick McGrath. Visits were made to Germany to view biogas plants and seek advice (see Figure 10).

Figure 10 Mr. Paddy Cunningham helping out by filling bags of compost at a German AD plant during research visits.



Advice was received from Professor Emer Colleran, Department of Microbiology, National University of Ireland Galway. Prof. Colleran is at the forefront of research and development of anaerobic digestion in the Republic of Ireland. One of the farmers that now supplies cow slurry to the project had an awareness of biogas technology and its value in meeting slurry management challenges, through his attendance at agricultural shows in Europe. Transfer of technologies for anaerobic digestion from Germany to Ireland was also vital in the development of the project – TBW GmbH were a partner with the Community in an international project, and the design and construction of the 450 m³ digester was done by the company Biogas Nord GmbH. Support for the project was also provided by FÁS (the Irish Government's training and employment authority), Teagasc (the national Agriculture and Food Development Authority) and Tipperary Institute (a local third level education and development organisation) (Anon., no date).

Availability of Financial Support: The project has received assistance from the EU Horizon programme, the Department of Agriculture and Food pilot scheme for anaerobic digestion, Barrow-Nore-Suir Rural Development Ltd. (the local LEADER company) and the EU ALTENER programme.

Community linkages: The biogas project provided the opportunity for the Camphill Community Ballytobin to engage in business relationships with three farmers from the local area. This aspect was of particular interest to the local LEADER company in its support of the project. Storage tanks were built on the three local farms, providing economic and practical benefits for those farmers, in addition to the benefits of digestate over untreated slurry.

Environmental Benefits: The environmental advantages of a biogas plant were recognised. These include: replacement of fossil fuel; reduction in artificial fertiliser requirements on farms; reduced odour from slurry spreading; and recycling of nutrients and carbon. By replacing fossil fuel and artificial fertilisers (and their transport), the biogas plant can substantially reduce greenhouse gas emissions.

Local Authority and Commercial Interest: Kilkenny County Council (the local authority) has been supportive of the project. There has been considerable interest from commercial waste management companies, a number of whom now have business relationships with Camphill Community Ballytobin as suppliers of residues for the biogas plant.

4. Barriers Encountered

Policy: By far the most significant and disconcerting barrier encountered by the Camphill Community Ballytobin in the biogas project has been the difficulty in obtaining a Power Purchase Agreement (PPA) under the Alternative Energy Requirement programme (AER), which would allow the connection of the Community's Combined Heat and Power (CHP) plant to the electricity grid (see Figure 11). The CHP plant would maximise the value of the biogas being produced. The AER has been the Irish Government's mechanism for the promotion of electricity production from renewable resources. The Camphill Community have been unable to obtain a PPA under the AER IV, V and VI competitions. An AER PPA is the only option considered possible for electricity sales from the project (Dwan, 2004).

Figure 11 Generator awaiting access to the electricity grid at Camphill Community Ballytobin.



Financial: It proved difficult to get the capital funding required to build the digester. Substantial investment had to be provided from the limited funds of the Camphill Community Ballytobin itself. The Camphill Community real estate was used as collateral for bridging loans, and, as outlined previously, other funding sources were ultimately secured.

Technical: Some of the substrates tested in the biogas plant have proved unsuitable for digestion or have particular operational requirements. On one occasion, the digesters had to be emptied of their contents and the digestion process restarted with a fresh inoculum of micro-organisms – a process which took two months in total.

A gas holder in the form of a gas bag was installed initially, located in a loft above the plug-flow digester. However, there were problems with leaks from the gas bag. Those problems could not be solved satisfactorily, so gas storage is now provided in the covered continuously-stirred digester.

Maintenance work on the stirrer in the plug-flow digester is difficult, as the digester has to be emptied to provide access to the stirrer. In contrast, the stirrer in the continuously-stirred digester can be hoisted out for maintenance, without emptying the digester. The heating system in the continuously-stirred digester also facilitates easier maintenance than that in the plug flow digester. The mild steel construction of the plug flow digester has a limited lifetime of about 15–20 years. The continuously-stirred digester is made of concrete and will have a longer lifetime (Dwan, 2003 and 2004).

The installation of a flare was necessary. BEOFS constructed a custom designed low cost flare (see Figure 12). The purpose of the flare is to burn off excess biogas during periods when production exceeds demand. This situation has become particularly acute due to the absence of a Power Purchase Agreement which would allow the operation of a Combined Heat and Power plant to utilise the total gas production.

Figure 12 Flare at Camphill Community Ballytobin.



A pasteurisation unit is also now necessary due to new legislation on animal by-products coming into effect. The use of energy crops as a landspreading option for the digestate is being explored.

5. Impacts of the Bioenergy System

Technical: The digestate provides farm management benefits to the three farmers involved in the project, as grazing animals can be returned to land which has received digestate sooner than they can onto land that has received untreated slurry. The nutrient content of the digestate is very constant, allowing effective and efficient nutrient management.

The Camphill Community Ballytobin biogas plant has stimulated interest in renewable energy in the region. A ‘bioenergy nucleus’ is already becoming apparent in the area – a short rotation willow coppice plantation has been established by a farmer located near the Community, and three other neighbouring Camphill communities are in the process of installing wood chip district heating systems. A pure plant oil project to meet the vehicle fuel needs of Camphill Community Ballytobin is also under consideration. A culture of eco-technology and skills for sustainability is growing strongly.

Financial: The use of biogas for community heating avoids expenditure of up to €25,000 per year on the purchase of heating fuel (Eusterbrock, 2003 and Dwan, 2004) (see Figure 13). A further income is gained from the treatment and recycling of organic residues and the sale of compost (Dwan, 2004). To capitalise on the experience gained in developing their biogas plant, the Camphill Community Ballytobin have supported the establishment of a company named “ecobeo limited” to develop additional anaerobic digesters in Ireland and other green technologies. The company also wishes to develop and further promote sustainable economics and support non-profit social projects. The Camphill Communities and their projects subscribe to the type of sustainable economic principles as outlined in the website of the Associative Economics Institute (see Further Information).

Figure 13 Two of the gas boilers, and part of the community heating system.



Economic: Five people are employed full-time on the biogas project, with assistance from other members of the Community as required. The wages of these people are met by income from the biogas plant and assistance from FÁS (the Government training and employment authority) (Anon., no date).

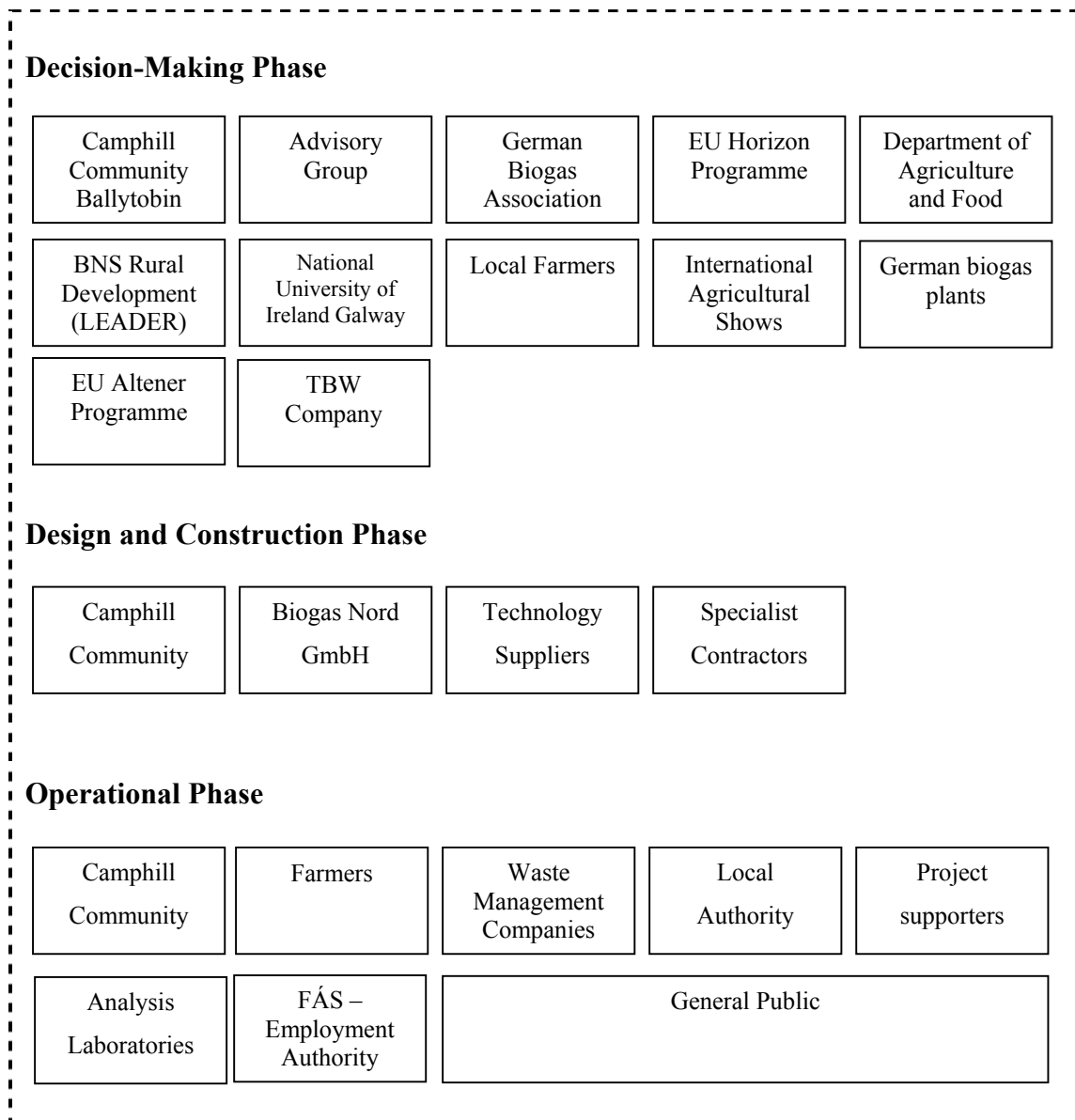
Social: The project is playing an important role in the life of Camphill Community Ballytobin, providing meaningful employment for five people. The biogas plant adds an exciting new element to the Community. The project has resulted in an increase in the skills available in the Community and the wider area. The plant has generated considerable local, national and international interest. Many individuals and groups have visited the plant, including a delegation from Task 29 and students from renewable energy courses operated by a local third level educational institute, the local LEADER company and the area's Energy Agency. The project has been the subject of three TV documentaries, one of which was broadcast on the Discovery channel thereby reaching a global audience.

Environmental: It is estimated that 9.8 TeraJoules (230 tonnes of oil equivalent) of energy per year are produced by the biogas plant. 2.3 TJ are used in digester heating, and 2.0 TJ are lost in flared excess gas. The remaining 5.5 TJ is used for community heating, and displaces at least 360 tonnes of carbon dioxide from fossil fuel use per year (calculation by author based on Dwan, 2004).

6. Stakeholders in the Bioenergy System

There have been a considerable number of individuals and organisations involved in the processes of decision-making, design, construction and operation of the biogas plant. These stakeholders are shown in Figure 14 below.

Figure 14 Stakeholders in the biogas system at Camphill Community Ballytobin, Co. Kilkenny



7. Conclusion

This case study shows how a community of committed people, with the support of individuals and organisations from the public and commercial sectors, can develop a successful project with economic, environmental and social benefits.

The Camphill philosophy was clearly a guiding force in the development of the biogas plant. This ethos is matched by an ability to manage the commercial and technical requirements of the plant. The Community have developed relationships with many stakeholders in the process. The Community looks forward to being able to complete the final phase of the project in the near future, by connecting the Combined Heat and Power plant at the site.

Figure 15 The Biogas Team at Camphill Community Ballytobin.



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