cafre
College of Agriculture,
Food & Rural Enterprise

Practical On-farm Renewable Energy

2012/2013

DARD
Department of Agriculture and Rural Development
www.dardni.gov.uk

afbi
Agri-Food and Biosciences Institute

Ulster Farmers' Union

Foreword

As CAFRE Director I would like to warmly welcome you once again to the Practical On-Farm Renewable Energy event. The aim of the day is to provide practical information about renewable energy options for farmers, growers and the rural sector.

Renewable energy technologies can play a key role in improving efficiency on farms, horticultural, equine and rural enterprises and in improving the competitiveness and sustainability of businesses. An appropriate investment in renewable energy technology will cut the cost of energy inputs and provide opportunities for additional income streams. A further benefit is that the food produced will have a lower carbon footprint and this green image gives it an advantage in the marketplace.

I sincerely hope that today's event will provide you with the information that will enable you to benefit from renewable energy technology in your own business.

Finally I wish to express my appreciation to the planning committee, made up of staff from across CAFRE, DARD, AFBI and the UFU.

I hope you have an informative and worthwhile day.

John Fay
CAFRE Director

Contents

Efficient farming cuts Greenhouse Gases

Peter Scott, Climate Change and Renewable Energy Branch, DARD

"Climate change presents a challenge to agriculture worldwide – the need to produce more food and non-food products whilst reducing the impact on the local and global environment.

We must jointly accept our responsibility to future generations and reduce the net greenhouse gas (GHG) emissions from agricultural production alongside other sectors of the economy while managing the increasing demand for food, water and energy in the face of a changing climate."

Michelle O'Neill, Minister of Department Of Agriculture and Rural Development

The agriculture and forestry sectors are committed to playing their part in carbon reduction and contributing to meeting targets for reductions in emissions.

Key principles

- Production efficiency gains should be the focus of activity – we are seeking to improve the resource efficiency of production and reduce emissions per unit of commodity output, whilst providing flexibility to meet future market demands.
- The agricultural GHG inventory should accurately reflect progressive changes in local farming practices, such as improvements to livestock diets, nutrient management and manure management.
- Recognition should be given to all other GHG costs and benefits associated with the industry, such as the contribution of on-farm renewable energy and the storage of carbon in grass, soils and plants.
- To capture existing good practice, and provide a potentially more cost-effective way of addressing the climate change challenge than regulation.
- To proceed on the basis of voluntary actions involving good practice.

Legislation

Climate Change is a devolved issue; it is influenced by EU and UK policies and legislation.

EU and UK targets under Climate Change Act 2008

The EU has enacted legislation to reduce emissions by 20% by 2020 (taking 1990 as the base), while the UK has set the legally binding target of reducing emissions by 34% by 2020 and at least 80% by 2050.

Since the launch of Efficient Farming cuts Greenhouse Gases in December 2011, three stakeholder sub groups chaired by industry heads have been established to look at the way the various agricultural sectors can work together to reduce GHG emissions without the requirement for further legislative regulations.

Existing mechanisms have been shown to improve efficiency. Further steps are still needed to assess their impact on GHGs and ensure additional uptake of measures that will contribute to further reductions.

Agricultural GHGs have reduced since 1990. By working in partnership to meet the GHG challenge we can map our own future, decrease our carbon intensity and grow production in a sustainable way to meet increasing demands for food and energy.

DARD recognises the efforts made by the industry in reducing emissions and will continue to carry out further research to enhance efficiencies and develop methods to help reduce GHGs and improve agricultural practices.

Copies of the Efficient Farming cuts Greenhouse Gases can be seen on www.dardni.gov.uk/efficient-farming-cuts-greenhouse-gases-2.pdf

For further information contact Julianne Bailie on (028) 9052 4130 or email: julianne.bailie@dardni.gov.uk

Barriers to the installation of small scale renewables

Chris Osborne, Senior Policy Officer, UFU

The knowledge base and expertise of Northern Ireland landowners in the renewables field has developed rapidly over the last couple of years. Yet despite this increasing level of knowledge and enthusiasm, the uptake has been tempered by barriers, which continue to exist in the Northern Ireland small-scale renewables sector.

Significant progress has been made by the Ulster Farmers Union in reducing and tackling these barriers. Yet, many barriers persist to land owners wishing to establish small-scale renewable projects and these are proving difficult to resolve.

Investment on grid infrastructure and integration of small scale renewables

The Utility Regulator has turned down proposed expenditure by NIE on strengthening the 11kV network for the period 2012-2017 (also known as RP5). This could have a detrimental effect on the future integration of small-scale renewables onto the electricity grid in Northern Ireland. Without NIE being able to adequately invest in the grid, the task of integrating small-scale renewables onto the grid will be increasingly difficult. The UFU has recently lobbied the Utility Regulator on RP5 and asked that sufficient funding is made available for the necessary capital expenditure.

Grid connection

Whilst there has been progress made by NIE in easing the grid connection process in terms of communications and technical support, there are still many instances where there are problems, which are out of their control. The UFU is pressing for a resolution to a number of these issues:

SCADA

SCADA stands for Supervisory Control and Data Acquisition. This system monitors and controls a wind turbine remotely and is required when connecting a wind turbine of 100kW capacity or more. Should a fault be detected on a turbine by NIE, in the interests of security of supply as well as public safety, it may be necessary to reduce the speed of a turbine or in extreme cases, turn the turbines off altogether. The problem is that SCADA is an additional cost when it comes to grid connection, with added uncertainty in relation to how much the final cost might be.

Time delays

Time delays continue to be one of the biggest barriers with grid connection. Delays will often cost the developer money in terms of time lost. Yet sometimes it is not necessarily attributable to an individual, rather it results from a breakdown in communication between a variety of the stakeholders and parties involved. It is essential that the developers/landowners provide all the information that is asked of them.

Earthing problems

Earthing ensures the electricity supply will disconnect under fault conditions by providing a path for the fault current to flow to earth. In the simplest possible terms, consider a household appliance such as a fridge. Should it develop a fault, the fault current would flow to earth through the protective (earthing) conductors. A protective device in the consumer unit would detect the fault and isolate/disconnect the electrical supply to the fridge.

In the context of farming and siteing a wind turbine the earthing depends on soil resistivity. Soil resistivity is established by measuring the conductivity of a volume of soil. The resulting soil resistivity is expressed in ohm-metre (Ωm). It is a critical factor in design of systems that rely on passing current through the earth's surface. Soil resistivity levels are dependant upon moisture content, temperature and geological/mineral content. Soils made up of gravel, sand or stone have the highest soil resistivity.

The message from the NIE is that there are actions which can be taken in order to minimise earthing issues on highly resistant land when renewable generation units are present;

- Measure soil resistivity at an early stage and identify likely problems.
- Identify proximity of sensitive locations (cattle sheds, outbuildings, dwelling houses etc).
- Generator location (at least 100m away from above buildings).
- Substation location (avoid proximity to above buildings).
- Dedicated NIE substation to supply the generator at least 100m away from above buildings.

Planning

Backlog of planning applications

The UFU analysed the number of small-scale wind turbine applications in April and July 2012. On 5 April, there were 790 wind turbine applications awaiting a decision, rising to 844 on 10 July. The UFU has met with the the Environment Minister to discuss this backlog and to address our operational concerns.

While this is a frustrating situation the developer/landowner should make sure that they submit a full and detailed planning application to minimise this waiting period.

Microwave links

When installing small to medium-sized wind turbines, problems are often encountered due to invisible barriers known as fixed-link transmission corridors or "microwave links". These are the signals created by communications lines, and not necessarily those created by mobile phone providers. Rather these fixed transmission corridors across farmers land and property are operated by bodies including the PSNI, NIE, utility companies, BT, mobile phone companies and other statutory bodies.

Third-party companies acting on behalf of the utility companies are objecting to the proposed small-scale turbines and since the links are invisible, they offer no visual impact and many farmers and landowners are actually unaware that signals are being transmitted across their land. Land owners are advised to engage with the third parties and seek justification for the objection.

Permitted development for microgeneration

In January 2001, the Planning Service consulted on Permitted Development for Microgeneration. Since then the UFU have been lobbying for progress in implementing the findings from the Consultation process. GB has a permitted development of 465 square metres while in NI it is only 300 square metres. In our response, we called for parity with GB and we will continue to press for this to be introduced.

Belfast International Airport

Landowners within a 30 mile radius of Belfast International Airport are having applications for wind turbines stalled by objections from the airport authority. The UFU also raised this with the Environment Minister Alex Attwood in July who agreed to look into these objections.

Banks and financing

There continues to be a gap in capital funding for many on-farm renewable projects, between the credit offered by high street banks and that of venture capitalists. The UFU are therefore calling on high street banks to listen to landowners when they seek funding and to consider each individual project on its merits. Alternative options are beginning to appear. However, we would urge caution when considering options and advise that landowners do extensive research before making a decision. One example of an alternative could be the PwC option.

Unforeseen bills and financial implications

There is confusion regarding the taxation implications of on-farm renewable projects. Questions have been raised as far as Capital Gains and Inheritance Tax are concerned, namely do the exemptions apply for what is deemed as "agricultural use". The UFU is lobbying HMRC for clarity on all the taxation implications for on-farm renewables projects. In addition, landowners should consider potential rating implications for AD plants if they utilise certain non-agricultural feedstocks.

Saturation of the market – leasing site for turbines

Northern Ireland is awash with companies seeking to lease sites for wind turbines and many landowners are unsure as to what is involved and what constitutes a good business proposal. The concerns are that many of these companies are "site traders" and many agreements will never be completed. The UFU is concerned that landowners are setting their expectations too high and we have issued advice, telling landowners to manage their expectations and to tread carefully before committing to an agreement.

Broad message of advice

In a broad message, as far as renewable technologies are concerned, the UFU are urging members to compile structured business plans and make sure they are fully aware of the advantages and disadvantages of their chosen technology.

For further information contact Christopher Osborne on (028) 9037 0222 or email: christopher@ufuhq.com

CAFRE renewable energy training workshops

Renewable energy team, CAFRE, Greenmount Campus

CAFRE runs a series of workshops on energy efficiency and renewable energy technologies at venues throughout Northern Ireland. These workshops aim to provide participants with an introduction to the technologies, the issues to take into account when considering their adoption, the economics and the payback periods.

Workshops are available on the following subjects:

- Energy efficiency on the farm
- Introducing renewable energy
- Energy from wind
- Solar power
- Biomass production
- Heat from biomass
- Anaerobic digestion on the farm
- Micro-hydro
- Heat pumps
- Business planning
- Rainwater harvesting

Details of the programme are available at www.dardni.gov.uk/ruralni/renewables

For further information contact David Trimble on (028) 9442 6682 or email: david.trimble@dardni.gov.uk

Renewable Energy Technologies

Energy efficiency on the farm

David Trimble, Renewable Energy Technologist, CAFRE

What is energy efficiency?

This is the first step you should take to reduce your energy bills. Before you consider any form of renewable energy you should try to identify the savings that can be made by doing things differently. Once these savings have been made then the renewable energy options can be considered.

A simple example

At its simplest, energy efficiency can mean replacing one old light bulb with a new low energy bulb. The financial savings are both immediate and very significant:

Action: Replace a 100W bulb with a 20W low energy bulb

Savings:

- The bulb is used on average 4 hours a day (1460 hours/year)
- The 100W bulb uses 1460 x 0.1 = 146kWh/year
- The 20W bulb uses 1460 x 0.02 = 29.2kWh/year
- The saving in electricity = 116.8kWh
- At 16.68 pence/kWh the financial saving = **£19.48 each year**

What can be done on each type of farm?

In each enterprise there are key areas where savings can be made, often without any financial investment being necessary.

1. For every type of farm it is essential to **check your tariff**. Electricity supply companies offer different deals and within a company there usually will be a tariff with a cheap rate at night-time. Up to one in six of the dairy farmers taking part in the CAFRE electricity benchmarking exercise were on the wrong tariff. This was a major over expenditure for dairy farmers, giving a loss of at least £8 per cow each year.

Increasingly, larger farm businesses should negotiate the price they pay for their electricity with the supply companies.

2. Lighting can be the "Achilles heal" in your energy costs. This is especially true when lighting is used for several hours each day. Install low energy bulbs and make appropriate use of timers, sensors and proximity switches.

3. In a pig unit, insulation of houses and draft proofing are critical issues.

4. In mushroom units, the hot water distribution system needs to be well insulated. The target should be to use proprietary district heating pipe-work to minimise heat losses.

5. Fuel efficiency on tractors and harvesters will be improved by using the electronic engine management system correctly.

What's new in energy saving on the farm?

In the past year **voltage optimisation devices** have been actively promoted for energy saving on the farm. These have the potential to cut electricity bills and give a financial return. However, a number of points should be noted:

1. They work with electrical equipment that is "voltage dependent." This is an electrical device whose power consumption varies with the voltage being supplied to it. Examples of voltage dependent equipment include:

- Tungsten filament lamps.
- Fluorescent lamps with ballast i.e. switch start. (The more modern electronically controlled fluorescent lamps without the starter motor are not voltage dependent).
- Electric motors without variable speed drives. Many of the electric motors used on farms are voltage dependent because they are relatively small sized, operate much of the time at partial loads and tend to be over-sized for their application.

2. Before investing in a voltage optimisation device, farms should be surveyed to determine the voltage drop between the incoming supply point and the electrical equipment being supplied. The size of this "voltage drop" along with the type of equipment on the farm will influence the investment decision. It may well be more economic to replace voltage dependent lighting with newer high efficiency bulbs or install variable speed drive motors in some instances.

For further information contact David Trimble on (028) 9442 6682 or email: david.trimble@dardni.gov.uk

Solar water heating on the farm

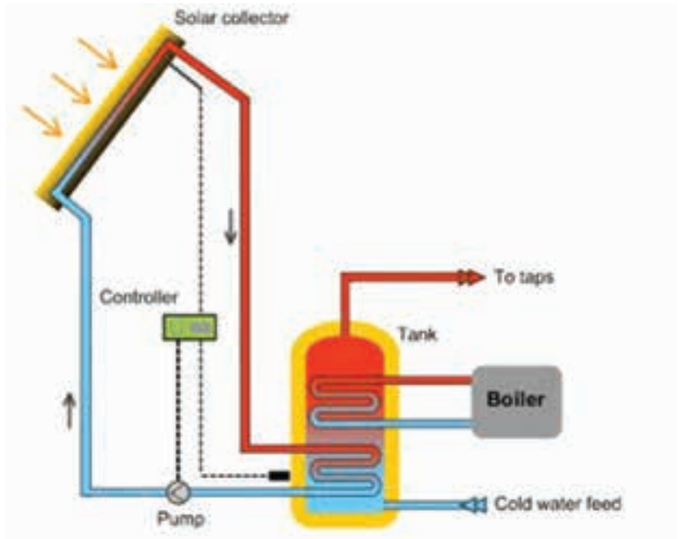
David Trimble, Renewable Energy Technologist, CAFRE

Solar water heating systems are becoming more common in Britain and Ireland due to increasing energy prices. In the agricultural sector they have more relevance in the the high energy using enterprises. For example a dairy cow uses around 350 kiloWatt hours (kWh) of electricity per year of which around 40% is used for heating water.

In the past two years at least 35 farms have installed solar hot water systems in their business. Most of these are dairy farms that have received funding from either the Farm Modernisation Scheme or Northern Ireland Electricity (now PowerNI).

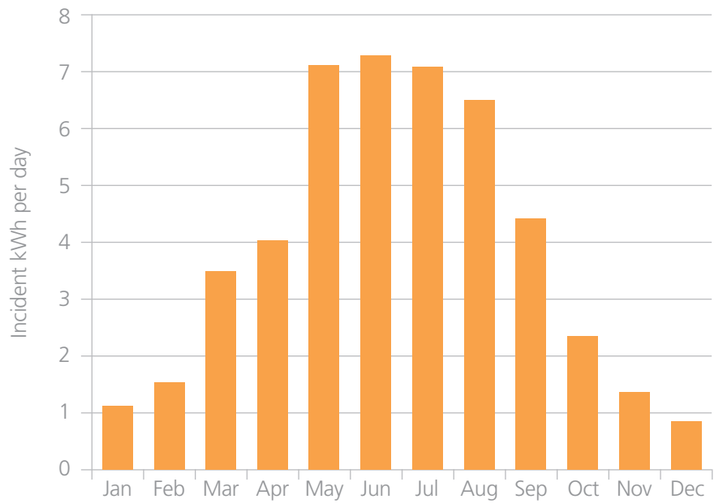
Are there a range of possible systems for farm use?

The most common system in use here is a pressurised indirect primary circuit. In this system the hot fluid from the solar collectors is pumped through a heat exchanger in the boiler to pre-heat the water. It is a sealed system i.e. the fluid in the system does not come in direct contact with the hot water supply.



Lower cost options are available and include thermo-siphon systems. In these the collector is integrated with the storage tank in a prefabricated unit and the heat transfer fluid circulates without pumping due to the differing densities of hot and cold water.

Systems are designed to give a high proportion of the hot water requirements in the summer months, make a significant contribution in the spring and autumn and provide some input during the winter. This reflects the annual distribution pattern of solar radiation illustrated in the figure below. The system is designed to give the best economic balance between the initial set-up cost and the year round output. Well designed systems normally provide no more than 50% of the annual hot water requirements.



Annual distribution pattern of solar radiation in kWh per m^2

What about running costs and maintenance?

Solar heating systems have a long life with low maintenance.

A recent survey by the DTI (UK) of 700 systems installed over the past 30 years showed that the majority of the systems had no significant problems and work reliably for 20-25 years or more.

Experience with the system installed in the Greenmount dairy unit indicates that solar tubes need a degree of maintenance and therefore need to be positioned in an accessible location.

For fuller details on the options available in a solar hot water system see www.dardni.gov.uk/ruralni/renewables

On-farm solar systems

Solar controls and heat distribution system

On the dairy farm of Denis Minford, the solar system consists of 20 vacuum tubes and heats both the plant wash water and the bulk tank wash water. The heat goes preferentially to the plant wash tank and thereafter to the bulk tank wash water. This system allows the maximum benefit from the solar power on a sunny day during long summer days.

On the dairy farm of Denis Blelock the solar collector consists of 30 solar tubes totalling about 5 square metres. The solar fluid supplies heat to the plant wash water by flowing through the heat exchange coil in the bottom of the water tank for the plant wash. On good summer days the water was raised to 80°C.

Solar tubes mounted on the dairy roof

Should I install solar on my farm?

1. For any process requiring energy the first step is to cut costs by improving the efficiency of the existing system. Use of solar should only be considered after achieving the maximum benefit from energy efficiency measures such as the timing of use, insulation and monitoring and control systems.

2. A solar hot water system will reduce the carbon footprint of the farm, typically by two tonnes of CO_2 each year.

3. The payback on the system is influenced by a number of factors. These include obtaining grant aid for the initial set-up, potential tax write-off on the investment, increasing energy prices and perhaps most importantly obtaining the proposed Renewable Heat Incentive payments (see separate article).

4. The suitability of a farm for a solar hot water installation depends on having an area to mount the collectors facing southward, at an angle of around 35° to the horizontal and without any shading from buildings or trees. This area needs to be close to the hot water tank.

For further information contact David Trimble on (028) 9442 6682
or email: david.trimble@dardni.gov.uk

Short Rotation Coppice (SRC) willow for bioremediation of effluents and biosoilids

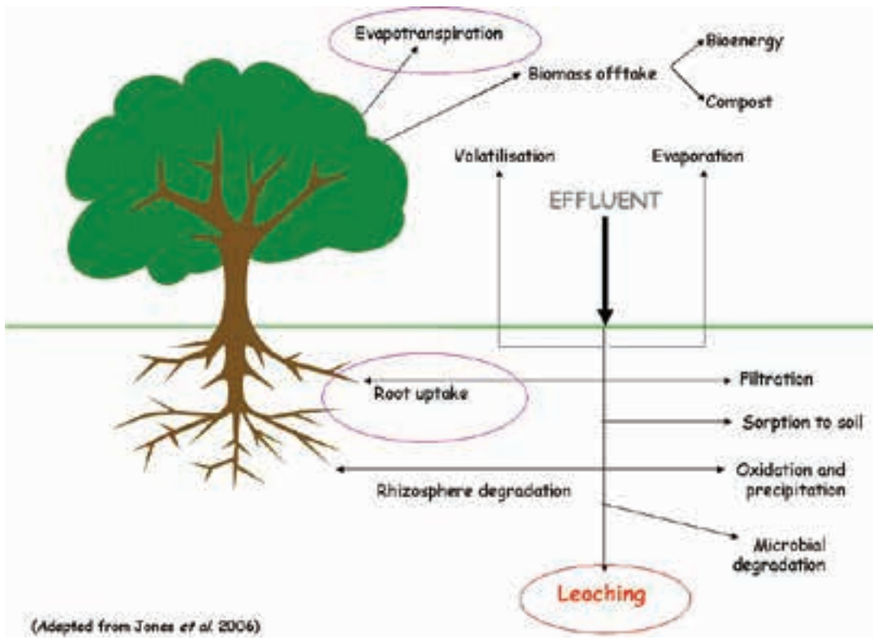
Alistair R. McCracken, Chris Johnston and Greg Forbes,
Applied Plant Science & Biometrics Division, AFBI

SRC willow is grown as a source of biomass fuel for generation of renewable heat. Using the most productive Salix spp. genotypes yields of 10-12 tonnes of dry matter/ha/yr are obtained.

Willow is a fast growing plant with a very high **evapotranspiration** rate. This combination of evaporation and transpiration means that willow takes up large volumes of water from the soil and at the same time absorbs the soluble nutrients such as nitrogen and phosphorus and many others. Willow is therefore ideally suited as a candidate for the **bioremediation** of effluents or biosolids. This is the use of biological agents, including green plants, to remove or neutralize contaminants in polluted soil or water. This can potentially give an additional income stream for the grower, helping to ensure the economic viability of growing SRC willow. AFBI have been investigating the use of SRC willow as a bioremediation crop for several years and based on their results there are now a number of commercial projects using a variety of effluents.

How does it work?

When an effluent rich in nutrients is applied to the surface it will percolate through the soil. During the percolation, nutrients will be absorbed by the soil, utilised by plant micro-flora or taken up by growing green plants – the process driven by evapotranspiration (Figure 1).



A major concern when irrigating a crop with a high nutrient effluent is the potential for leaching of nutrients (in particular nitrogen - N) eventually leading to contamination of the groundwater. Hence any crop irrigation system needs to be managed in such a way to avoid leaching. This will necessitate matching crop requirement with the amount of nutrients applied. If the effluent has a high phosphorus content then over time there will be a slow build up of P in the soil.

Effluent application

It would be normal not to apply any effluent in the establishment year with irrigation commencing after cutback at the start of the second year. By this time the plants will have developed a strong fibrous root system which is important for an efficient bioremediation process. The effluent is applied to the surface through surface laid irrigation pipes (Figure 2).

A B C

Figure 2. A: Irrigation pipes in freshly coppiced willow plantation. B: effluent outlet point. C: Feeder pipes from effluent storage tank.

The volume of effluent applied will depend on its nutrient content as well as on soil conditions. Each irrigation system will incorporate a soil moisture probe giving a feed back to the irrigation system so that following heavy rain the irrigation will be stopped. This is to reduce the build up of surface water and the associated risk of surface run-off from the site.

Linwoods Case Study

Linwoods has been in business for over 30 years and manufactures a range of premium bakery, fresh dairy and healthy super food products. Based in County Armagh they deliver bakery and dairy produce to over 1600 customers daily and distribute their healthy super food range throughout Ireland, UK, Spain and Holland.

Challenge

As a result of their manufacturing and food processing the firm produces around 26,000 cubic meters of effluent annually. In the past this effluent was tankered to the local waste water treatment works (WWTW) for disposal. This involved at least 3,000 round trips to the WWTW which was 11km from the factory amounting to an annual journey of 66,000km with the associated economic and carbon cost. There was also an additional cost at the treatment works for receiving and further treating the effluent prior to discharge. WWTWs are very energy demanding, resulting in more carbon dioxide being produced.

Solution

In close proximity to the factory a neighbouring farmer planted a total of approximately 13ha of SRC willow in 2006 and 2007. A large storage tank was built close to the willow plantation, irrigation pipes were laid between the double rows and irrigation of the effluent commenced in 2008. A willow irrigation system will be best at handling the hydraulic loading when the weather is warmer and brighter (with a little wind). The scaling of an irrigation system is therefore important to also take account of the lower evapo-transpiration rates experienced during the cooler autumn and winter months; taking account of environmental safety. The 13ha is sufficient to handle the total volume of effluent being produced annually.

Storage tank at willow site

Pipe & irrigation point on newly harvested willow

Issues and regulation

Before any effluent can be discharged to the land, a Consent for Discharge must be obtained from the Northern Ireland Environment Agency (NIEA). Their regulatory requirements will include monitoring of the 'Conditions of Discharge', 'Conditions for Application', 'Other General Conditions' and 'Quality Conditions of the Waterway'. In the case of Linwoods, a nearby stream is sampled and chemically analysed monthly upstream and downstream. Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) as well as other indicators such at nitrate, phosphate and dissolved O_2 levels are assessed. Throughout the duration of this project (commenced March 2008) there has been no evidence of the leaching of nutrients or surface run-off of nutrients to the stream. This concurs with current research.

The willow has been harvested 2010 and 2012 and as the irrigation pipes are laid within the double rows there is no need to lift them before harvesting. There can be some slight damage occasionally to the pipe-work as a result but this is very easily and inexpensively rectified.

Environmental and financial benefits

An added economic benefit to the farmer in this case is a gate fee paid per cubic meter of effluent received. This payment also represents a cost saving for Linwoods compared to the cost otherwise paid to NI Water at their treatment works in Armagh (Mogden formula) and the cost of effluent transportation to the treatment works. The wood chip is also dried at site and sold at the current market value making the project very worthwhile in terms of revenues.

In addition to the very significant cost savings, there are major environmental benefits in terms of reductions to Green House Gas (GHG) emissions. These have been roughly calculated as:

- Transport (66,000km) - **17t** CO_2/yr (400g/Km)
- Effluent treatment - **3t** CO_2/yr
- Production of wood chip at site - **180t** CO_2/yr
  13ha (10t/ha/yr) (wood chip = 500,000kWh)

Total Carbon savings of approximately **200t/yr.**

ANSWER (Agricultural Need for Sustainable Willow Effluent Recycling)

The ANSWER project is part-financed by the European Union's European Regional Development Fund through INTERREG IVA Cross-border Programme, managed by the Special EU Programmes Body and is a cross border (Northern and Southern Ireland) co-operation between seven partners. The partners are the Agri-food & Biosciences Institute, NI Water, South West College, Teagasc, Donegal County Council, Monaghan County Council and ITSligo. One of the aims of the project is to establish commercial scale SRC willow plantations (up to 14ha) which are irrigated with municipal effluent. In addition there are a number of post-graduate students studying the basic science of using plants for bioremediation, whilst one partner is using GIS technology to map the potential opportunities for the future.

For further information contact Chris Johnston on (028) 9268 2484
or by email: chris.johnston@afbini.gov.uk

Heat from biomass

Alistair McCracken, Chris Johnston and Greg Forbes, Agri-Food & Biosciences Institute, Newforge Lane and Hillsborough

Specifically grown energy crops such as Short Rotation Coppice (SRC) willow along with other woody material including forest brash, round wood and pellets are valuable sources of biomass for heat production. Miscanthus (elephant grass) can be grown successfully in cool damp climates producing relatively high yields. However, for a variety of reasons miscanthus is currently not being used extensively as a fuel for combustion.

In Great Britain almost all of the woody biomass is being used in large scale co-firing facilities for electricity production or to feed dedicated biomass electricity generation stations. In these types of situation, wood chip quality is less critical. In contrast, in Northern Ireland, woody biomass is being used to fuel small to medium scale boilers (100-500kW) for heat only. There are now several locations in Northern Ireland including leisure centres, council offices, conference centres and schools which are heated with wood chip. In these cases the quality of the wood chip is critical to the performance of the boiler.

Wood chip quality

Moisture content: The most important quality characteristic of wood chip is moisture content. When wood is harvested, e.g. SRC willow, the moisture content is normally above 50%. Wood chip at this level of moisture cannot be safely stored. It will very rapidly start to degrade, the internal temperature will rise and in the worst case spontaneous combustion and explosions can occur. Hence freshly harvested wood chip will have to be artificially dried. This can be a difficult and expensive process, especially when carried out during cold damp weather. Trials carried out at AFBI, Hillsborough during 2010 showed that when the ambient temperature fell below 10°C drying costs became prohibitively expensive. The target is to reduce the moisture content to below 20% when the chip can be stored safely and the maximum energy returns achieved when combusted. As the moisture content of the wood increases the net heat output declines, boiler efficiency is less, gaseous emissions are greater and the boiler needs more frequent servicing.

Uniformity: the optimum chip size may be determined by the particular boiler being used. Uniformity can be improved by grading the chip to remove fines (dust) and also oversized material which may in turn cause problems with the boiler auger feed mechanisms.

Fuel performance: When SRC willow wood chip, chipped forest brash, chipped round wood spruce and miscanthus were combusted in an AFBI trial, all performed well with heat outputs of between 3.5 and 4kW/Kg dry fuel. The ash content was lowest from wood pellets (0.22%) and spruce (0.4%), intermediate from willow (1.2% and highest from miscanthus 1.9%). Currently some questions have been raised about the level of particulates and/or NOx emissions when burning willow wood chip. Trials are currently being conducted at AFBI Hillsborough to assess any potential risks.

Case Study - Mount Stewart, historic house and gardens, Newtownards, Co. Down

Aim:	By 2020 The National Trust in Northern Ireland intend to meet 50% of their energy requirements for heat and electricity from renewable sources (compared to 2009 levels).
Requirement:	Sustainably heat and provide hot water for the house while moving to a low carbon renewable energy base.
Solution:	KWB 240kW boiler and accumulator tank housed in the existing boiler room with 3 tonnes wood chip store.
Fuel:	Wood chip.
Carbon saving:	180 tonnes CO_2/year.
Payback estimate:	Within two years (inclusive of grant aid from DECC's low carbon buildings programme and Power NI).
Contract type:	ESCO – local biomass supply.

Mount Stewart
(National Trust Property, Ards Peninsula)

In March 2010, the heating of Mount Stewart House was changed from oil to woodchip. The traditional heating system was an oil-fired boiler burning approximately 66,000 litres of oil per year (approx £40,000/year). Since then this property has been fuelled by a local farmer (Mr. John Martin) using SRC willow wood chip via an Energy Services Contract managed and maintained by Rural Generation Ltd of L/Derry.

Aim

The National Trust in Northern Ireland has set itself a tough target to reduce its reliance on fossil fuels. In association with other energy saving and renewable energy strategies and technologies, a number of biomass boilers have been installed across the National Trust Estate with the resulting associated decommissioning of their largest oil boilers.

Design and installation

The old boiler-room was partly refurbished and the old oil tank removed. In this space a fuel bunker for the woodchip fuel store was constructed and a 240kW KWB Powerfire wood chip boiler and 4000 litre buffer tank were installed. This represents the Trust's largest renewable energy installation in Northern Ireland. Wood chip was selected as an appropriate technology for this site for several reasons including economics, environment and community but also because there were existing buildings which provided adequate space for the boiler and a suitable logistics for fuel delivery and storage.

Fuel delivery and supply chain

The supplier (Rural Generation Ltd) takes responsibility for the operation and maintenance of the boiler plant. This includes provision of wood fuel which is undertaken by a local farmer (Mr John Martin) who grows and processes (dries/grades) 15ha of SRC willow about a mile away. This wood chip is delivered to the fuel bunker as required at a rate of 5 to 20 tonnes per month depending on the heat need. The total wood fuel usage is between 130 and 150 tonnes per year.

Performance and finances

Prior to the installation of the biomass heat system, the 66,000 litres of oil used per year would cost £43,000 at current oil prices. Currently Mount Stewart is using approximately 420,000kWh of energy per year (approx £16,000 wood fuel cost) which has saved £24,000 since the biomass heat system was commissioned at the end of March 2011. The installation of the heat system was partly funded by DECC's Low Carbon Buildings Programme Phase 2E (50% – £40k) and Power NI SMART Programme (£5k). The cost saving due to fuel purchases will however realise a payback of just under two years.

Carbon reduction

Wood is considered to be a carbon neutral fuel (ie. any CO_2 released through the burning of the wood is largely offset by that which was absorbed during the original growth of the willow). In practice however there is a small element of fossil fuel required for operations within the fuel production lifecycle. Taking this into consideration it must be realised that these levels are relatively insignificant when examining the carbon emissions saved by displacing fossil fuel. 66,000 litres of oil would emit 170 tonnes CO_2[1] while 420,000 kWh of heat from woodchip represents less than 3 tonnes/year of CO_2[2] (associated delivery of chip largely insignificant). Other factors which should also be taken into consideration are that the willow plantation is sequestering carbon within the soil and is also fertilised by organic wastes produced locally. These processes reduce the green house gas emissions yet further from fertiliser production and other intensive uses of energy employed to process the waste.

Running and future benefits

The heating system is managed by automated telemetry whereby the boiler notifies the service provider with a SMS or email of detail such as whether the ash bucket is full or the diagnostics of the boiler is abnormal in any way.

Other National Trust properties which have moved to biomass heat are Castle Coole and Florence Court Apartments, Ardress House, Crom Visitor Centre, Holiday Cottages and the Giant's Causeway Offices. The longer term strategy of the National Trust is to try to use some of the wood from their own estate and convert several more properties to biomass in the coming year.

For further information contact Alistair McCracken on (028) 9025 5244
or by email: alistair.mccracken@afbini.gov.uk

1. www.nef.org.uk/greencompany/co2calculator
2. www.biomassenergycentre.org.uk/portal/page?_pageid=75,163182&_dad=portal&_schema=PORTAL

Ground Source Heat Pump on a Co. Tyrone farm

Garrett O'Sullivan, Renewable Energy Technologist, CAFRE

Gary Anderson is a pig farmer with a 400 sow unit in Co. Tyrone. Prior to 2003, the heat for farrowing units at his farm was provided by an oil fired boiler and hot water distribution system delivering water at 42°C to the heated pads in the pens. The unit was consuming 26,000 litres of heating oil per year and so the decision was made to install a heat pump.

Heat pumps are a renewable energy technology that extract low grade heat from the ground, water or air and transfer this heat, usually into a water heating system.

In 2003 a 16kW ground source heat pump from Heliostat was installed to provide heat to warm the heated pads in the pig rearing unit. The total installation costs were £13,000.

The operation of the heat pump was monitored in the first year of operation. The consumption of oil was reduced to around 1,500 litres per annum. Therefore, the heat pump had replaced 24,500 litres of oil consumption annually.

The heat pump consumes 150 units of electricity daily giving an annual electricity consumption of 54,750kWh.

The reduction in annual oil costs with oil at 60p per litre equates to £14,700. The increase in electricity cost amounts to £8,157. This is calculated based on an average electricity price of 14.9kWh as this unit operates night and day.

Overall the energy costs for heating the pig pads are reduced by £6,543 per annum.

The overall carbon savings by replacing the oil with electricity amount to 36.6 tonnes of CO_2. This system obtains the greatest savings by being sized to use the maximum amount of heat produced by the heat pump.

A heat pump system typically requires more maintenance than an oil heating system as there are more components in the heat pump system.

The fact that the pig pads require a temperature of 42°C ensures that the heat pump is working at its optimum output and also provides much greater control of the final pad temperature than the previous oil system.

CREAM herd dairy water heater at Greenmount Campus

The CREAM dairy unit at Greenmount Campus consists of a high genetic merit herd of cows managed by students. The dairy washing system was previously supplied with hot water for plant cleaning by an electrically heated immersion tank.

Air Source Heat Pump Unit at Greenmount Campus

A Solmatix 11kW Air Source Heat Pump (ASHP) was installed at the CREAM dairy unit to demonstrate the use of heat pumps in the milking parlour. The unit was commissioned in August 2011. The heat pump pre-heats the water up to 55°C and then the electric immersion raises the temperature to the required 85°C.

The installation of the ASHP unit cost around £6,000 and initial assessments indicate that it will save 30% annually in electricity costs.

What about the economics of heat pumps?

The economics of heat pumps will be influenced by the introduction of the Renewable Heat Incentive (RHI). This scheme will give a payment per kWh of renewable heat produced by a heat pump used in a business setting.

At present the RHI will only apply to Ground Source Heat Pumps and it is anticipated it will be set at 8.4p per kWh produced, for heat pumps under 20kW thermal output. Air Source Heat Pumps are being considered for funding in phase 2 of the RHI in 2013.

Further details of the RHI can be found at www.detini.gov.uk/deti-energy-index/deti-energy-template-menu-5

For domestic dwellings the Renewable Heat premium payment scheme applies. This provides an up-front payment to help with the installation of a heat pump. The payments are:

Air Source Heat Pump	£1,700
Ground Source Heat Pump	£3,500

More details on the Premium Payment can be found at www.detini.gov.uk/deti-energy-index/northern_ireland_renewable_heat_premium_payment_scheme

What to think about when considering using a heat pump?

This is typically a higher cost technology to install than oil heating, so it will be most relevant where:

i. Energy costs are high.

ii. There is a constant demand for heat throughout the year.

Heat pumps typically produce water at temperatures of between 40 and 55°C so they will be most cost effective if final water temperature required is in this range. However, where significant electric immersion heating is employed, a heat pump can still significantly reduce the overall electricity required where it is installed in conjunction with electric immersion heating.

Where ground source heat is being considered the ground availability and soil condition are critical to ensure that the unit removes heat from the ground efficiently and cost effectively. Heat pump installers will assess the suitability of any site being considered for ground source heat systems.

More details on the technology of heat pumps can be found on the RuralNI website at the following link www.dardni.gov.uk/ruralni/index/environment/renewables/heat_pumps

For further information contact Garrett O'Sullivan on (028) 9442 6869
or email: garrett.osullivan@dardni.gov.uk

Solar Photovoltaic (PV) – electrical energy from sunlight

Greg Forbes, Environment and Renewable Energy Centre, AFBI Hillsborough

PVs convert solar radiation to electricity that can be used as an immediate power source, stored for later use or exported to the grid. PV power generation is seen as a clean, green technology that can be easily incorporated into existing or new power supply systems. Referred to as micro-generation, Government led initiatives to increase the uptake of PV include the Northern Ireland Renewable Obligation Certificates (NIROCs). This means that electricity generated from PVs can be used locally or can be sold to earn the producer a guaranteed income over a set number of years.

What are PVs?

PVs are manufactured cells of materials, such as Silicon, that become electrically charged when sunlight falls upon them. In order to yield usable amounts of electricity, cells are set in panels such as the type shown in **Figure 1.**

Figure 1. *a common type of PV panel, 168cm x 80cm, weighing 20kg*

Electrical output is measured in kilowatt hours (kWh) and the panel shown has a rated peak output of only 170 watts (or 0.17kW). To further increase output, panels are often composed as connected strings and arrays that may be fixed in different ways according to the setting or physical constraints.

Stand alone system

Roof mounted
(Courtesy, Horizon Renewables)

PV roof tile
(Courtesy, Redland)

Thin film PV technology

Figure 2. PV panels on different fixings.

Electricity is generated as direct current (DC) and is normally converted to alternate current (AC) via an inverter (Figure 3) and installers would be expected to include supply and installation of these with PV systems. DC can be run directly to batteries for storage and use which can be a very practical solution in isolated areas without mains electricity.

Figure 3. An inverter on the AFBI Hillsborough PV system

When PV systems are set up, installers select the most suitable and efficient type of panels for that location and also align and angle the panels or arrays so that the maximum amount of radiation is captured, thus optimising efficiency and returns. Some systems have manually or mechanically self-adjusting mountings that allow settings to be changed. There are also systems available that automatically "track" the sun as the earth orbits and tilt the panel to the correct angle. Figure 4 (overleaf) shows the GPS controlled tracker at the farm business of Mr John Martin at Waringstown. Though these trackers will add to the expense of the system, they can considerably increase generated output.

Photograph: Green Energy Technology

Figure 4. Rear view of a bi-axial solar tracking (azimuth and elevation) mounting system on the farm of Mr. John Martin, Waringstown.

Do PVs work well in NI?

Though we receive less sunshine than many areas of the British Isles, PV is still considered a viable technology and though Northern Ireland lags behind other UK regions for PV uptake, it is becoming more visible on buildings or as stand-alone installations. Both the duration and intensity of sunlight affect electrical generation. Records of the performance of the AFBI Hillsborough 11.9kWp PV system, (the stand alone installation of the bank of 7 arrays shown in Figure 2) show that even at times of low sunshine and overcast conditions the system still generates electricity very consistently. The graph in Figure 5 displays outputs for comparable periods in consecutive years.

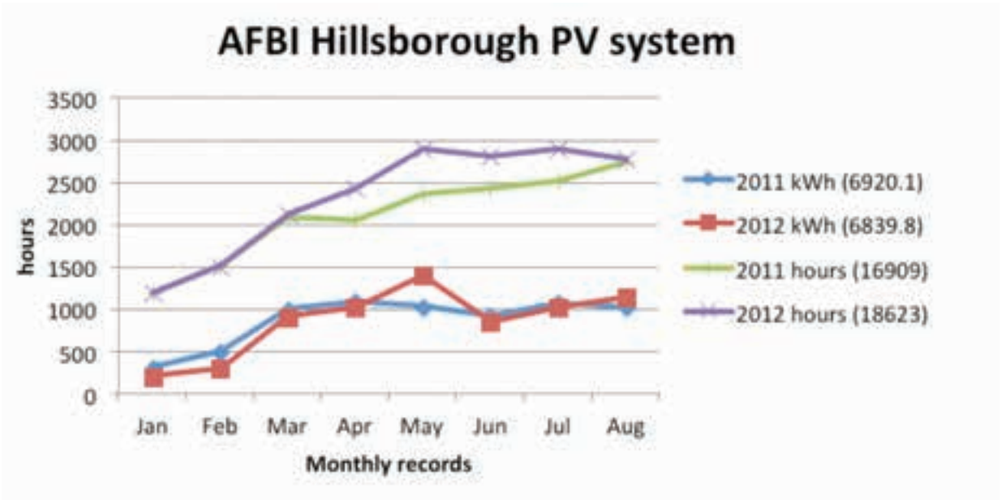


Figure 5. AFBI Hillsborough record of combined total electrical production hours from all 7 arrays in the 11.9kWp system and the gross electrical output (kWh) for the period shown.

This graph demonstrates that, even though in 2012 there were 10.1% more hours of electrical generation than in 2011, the electricity generated was 1.2% less, due to the long overcast periods for most of 2012 (except during May) reducing the levels of sunlight.

Durability of PV systems

These are regarded as very durable, with even prototypes running for over 20 years. There are continuous developments in PV technology, with panels of 250 watt capacity now available. Prices of panels and components have tumbled on the international market and press reports cite costs for installation reduced by often as much as 50% compared to a few years ago.

Certification

It is possible to buy and install PV systems oneself but as the process involves electrical installation and linkage to a mains system with approved metering equipment, professional advice and certification should be sought. However, to qualify for ROCs payments all new schemes must be installed by Microgeneration Certification Scheme (MCS) approved installers. Many companies offer complete turnkey installation with period maintenance and management contracts, but it is important to use only MCS approved installers. Under the aegis of the MCS a list of approved installers is available and can be accessed at:

www.energysavingtrust.org.uk/Media/node_1422/Northern-Ireland-PDFs/Northern-Ireland-MCS-installers

Is planning permission needed?

Though rules for incorporating renewable energy sources such as PVs have had many restrictions removed, certain buildings and locations may still have some in place. Therefore it is advised that an initial consultation with Planning Service should be made before any scheme is advanced.

Details of the current rates for ROCs payable by PowerNI to microgenerators for whom they are agents and to non-agent customers are available with other general details at the weblink below.

www.powerni.co.uk/index.php/saving-energy/renewable-energy/nie-energy-generation-tariff/

For further information contact Greg Forbes on (028) 9268 1546
or email: greg.forbes@afbini.gov.uk

On-farm micro-hydro generation

Eoin McCambridge, Renewable Energy Focus Farmer, Co. Antrim

Why micro-hydro?

In a suitable location small-scale hydropower is one of the most cost-effective and reliable of the renewable energy technologies. It has several advantages over wind, wave and solar power:

- A high efficiency (70-90%), by far the best of all the technologies.
- A high capacity factor i.e. time generating power throughout the year (typically >50% compared with 10% for solar and 30% for wind).
- A high level of predictability, varying with annual rainfall patterns.
- A slow rate of change; the output power varies only gradually from day to day (not from minute to minute).
- It is a long-lasting and robust technology; systems can readily be engineered to last for 50 years or more.
- It is environmentally benign. Micro-hydro is in most cases ‘run-of-river’; in other words any dam or barrage is quite small, usually just a weir, and little or no water is stored.

Hydro principles

The basic principle of hydropower is that water can be piped from a certain level to a lower level, with the resulting water pressure being used to do work. If the water pressure is allowed to move a mechanical component then that movement involves the conversion of the potential energy of the water into mechanical energy. Hydro turbines convert water pressure into mechanical shaft power, which can be used to drive an electricity generator.

History

In Northern Ireland in the late 1800s there were approximately 1200 water powered mills, a proportion of which were hydro turbines. By the early 1900s these were the main source of electricity for rural communities. With the development of the Nation Grid around 1960 and relatively cheap electricity most of these sites became obsolete.

Calculating hydro power

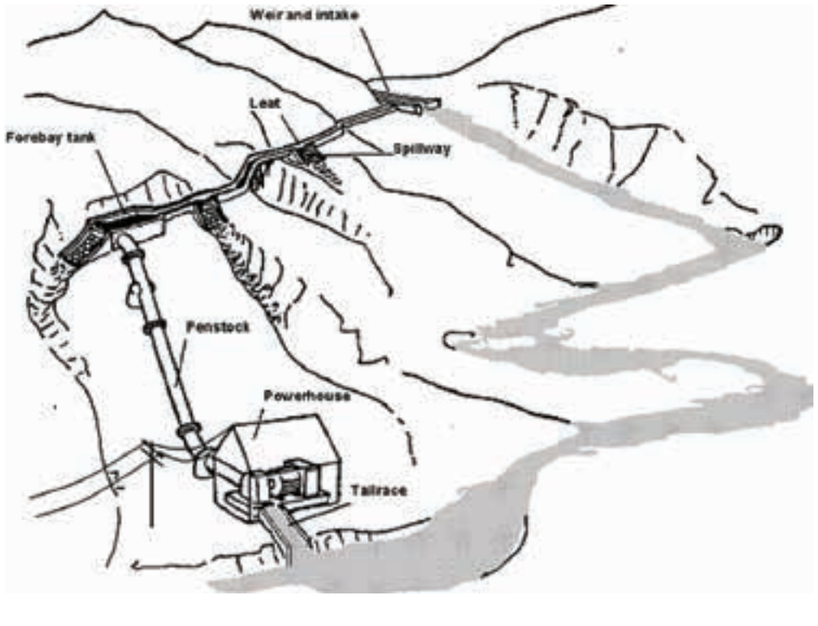
Before embarking on any **hydro power** generation project it is essential to survey the proposed site to calculate the amount of available **hydro power.**

The two vital factors to consider are the **flow** and the **head** of the stream or river.

The **flow** is the volume of water which can be captured and re-directed to turn the **turbine generator.**

The **head** is the distance the water will fall on its way to the generator.

The larger the flow – i.e. the more water there is, and the higher the head – i.e. the higher the distance the water falls – the more energy is available for conversion to electricity. Double the flow and double the power, double the head and double the power again.



A **low head** site has a head of below 10 metres. In this case you need to have a good volume of water flow if you are to generate much electricity. A high head site has a **head** of above 20 metres. In this case you can get away with having a lesser flow of water.

The key equation is the following:

Power = Head x Flow x Gravity

where **power** is measured in watts, **head** in metres, **flow** in litres per second, and **acceleration due to gravity** in metres per second per second. *The acceleration due to gravity is approximately 9.81 metres per second per second i.e. each second an object is falling, its speed increases by 9.81 metres per second (until it reaches its terminal velocity).*

Therefore, it is very simple to calculate how much **hydro power** you can generate.

Example:

Head of 12 metres

Flow of 200 litres per second

Power = 12 x 200 x 9.81 = 23,544 watts or 23.5kW

Types of turbine design

A turbine converts energy in the form of falling water into rotating shaft power. The selection of the best turbine for any particular hydro site depends on the site characteristics, the dominant ones being the head and flow available. Selection also depends on the desired running speed of the generator or other device loading the turbine. Other considerations such as whether the turbine is expected to produce power under part-flow conditions, also play an important role in the selection.

All turbines have a power-speed characteristic. They will tend to run most efficiently at a particular speed, head and flow combination.

A turbine design speed is largely determined by the head under which it operates. Turbines can be classified as high head, medium head or low head machines. Turbines are also divided by their principle way of operating and can be either impulse or reaction turbines. The range of common design types is given in the table below.

	High head	Medium head	Low head
Impulse turbines	Pelton Turgo	Cross-flow Multi-jet Pelton Turgo	Cross-flow
Reaction turbines		Francis	Propeller Kaplan

A Crossflow Turbine installed at the McCambridge Focus Farm just outside Ballycastle

A Pelton Turbine with upper casing removed

Two Archimedes screw water turbines installed side by side, Devon, England

Ballynaglogh hydro case study

Key statistics:

- Gross head = 7.4m
- Net head = 7.2m
- Flow = 500 litres/sec
- Turbine type = WKV Crossflow
- Speed 255rpm
- Output power = 30kW
- 195,000kWh/year.

Ballynaglogh Hydro is located approximately 2 miles east of Ballycastle on the Carey river. This is a spate river with a catchment area of 43 square kilometers with an average annual rain fall of 48 inches.

The water enters the scheme above the weir, flows through a screen and then travels 150 metres down an underground pipe into the turbine.

The turbine is a WKV twin cell operating at a design flow of 500 litres per second on a net head of 7.2 metres and a speed of 255rpm. The construction of the crossflow turbine allows an almost constant efficiency from 100% down to 17% of rated water discharge.

Using this turbine it has a peak power of 30kW and generates on average 195,000kWh of energy per annum, enough to supply 40 average sized homes.

In addition to the financial return the production of this renewable energy will result in a reduction of CO_2 emissions of around 86 tonnes per year.

For further information contact Eoin McCambridge on 07808 594557
or email: eoin70@aol.com

Wind generation on Moorfield Farm

Elliott Bell, Moorfield Farm, Rathfriland

For many generations our family has always maintained that a diverse income is needed in order to help maintain the viability of our farm business. In more recent years we moved away from beef and dairy to focus on arable, sheep, biomass, cut flower production and in 2010 the addition of a Gaia 133 wind turbine.

We had followed with interest the quiet emergence of renewable energy in Northern Ireland throughout the last decade and in 2005 we took the first steps into this new industry by experimenting with a plantation of willows which have been grown and sold through Fane Valley. While we were aware of the environmental benefits this biomass crop presents, we were of course attracted by the alternative income stream this project could potentially bring.

In 2009, I completed a Masters in Rural Development at Queens University with the thesis aiming to study how wind energy could benefit rural communities in Northern Ireland. This thesis provided an excellent platform to research the industry and the technology which was available and perhaps provided the impetus for us to pursue our own project further.

As with biomass, wind energy provides farmers with an opportunity to make a significant contribution to reducing carbon emissions in agriculture but it also allows us to take advantage of a natural energy resource. It is to our benefit that Northern Ireland provides some of the most consistent examples of this resource in the entire continent of Europe. There were however a number of elements which we took into account when assessing the viability of our wind turbine project.

In the first instance it was vital that we found a suitable site. In a sense we were lucky that our own farm sits in excess of 300ft above sea level. To the south west and approximately 150m away from the yard lies an open hill with very few natural obstructions. Having always considered our yard a naturally windy environment we felt that this hill would provide the most suitable site for a wind turbine. While we could and probably should have conducted a full wind speed survey we decided that the historical data available indicating a wind speed of 6m/s corresponded similarly with our own observations.

One limiting factor in our proposals from the start was the fact that we were located less than a mile from the town of Rathfriland and surrounded by the densely populated countryside which is evident throughout South Down. As a result a medium scale turbine was ruled out almost immediately and we took a more realistic approach by assessing the micro turbine market.

Having assessed a number of turbines and spoken with a variety of companies we selected the Gaia 133 11kW turbine. Having first met our suppliers, Silverford Renewables, at Balmoral Show in 2009 we were impressed by the depth of their knowledge and pragmatic approach to wind energy. At the time, the Gaia had only recently been introduced to Northern Ireland but through the information provided by Silverford and through our own research we soon became aware that the turbine had in fact a healthy reliability and performance record which extends for nearly twenty years in Denmark.

Long term reliability was a key factor in choosing the Gaia especially in an industry which seems to churn out new technology on a regular basis. Of equal importance was the fact that the Gaia was designed to achieve maximum performance from moderate wind speeds. The 13m single blade covers a swept area of 133m^2 and travels at a constant speed of 56rpm allowing it to provide consistent performance from 3.5m/s wind speed all the way up to 25m/s. In addition the Gaia was recognised as one of the quietest turbines available which fitted in with our plans to be as considerate with our neighbours as possible.

In the autumn of 2009 a planning application was submitted and in the spring of 2010 permission was granted for the project to go ahead in May of that year. Again we were fortunate that as regards grid connection our farm already had the necessary three phase elements and no upgrade was needed for the power lines. At this stage we also applied for the NIE grant scheme which was in existence at the time. Our application was successful and made a contribution of approximately 10% to the payment of the turbine.

The base had been laid for the turbine in late April and on the 14 May construction of the turbine began. Incredibly the construction only took a matter of hours on that cool breezy afternoon and within a couple of weeks the structure was fully commissioned by NIE.

At the stage where we first discussed this project with Silverford the wind speed of 6m/s suggested that the turbine would be capable of producing in the region of 30 megawatts (MW) annually. We used this conservative estimate as the basis for the structuring of our payments for the turbine. With this figure in mind we are hoping that the turbine will pay for itself in approximately eight years and with the correct maintenance the Gaia has already proved in Denmark that it will perform for up to twenty years thus creating further incentive.

On the 1 April each year we submit our performance figures to OFGEM who calculate how many ROCs we are entitled to sell in the online ROC auction. In the first ten months of production from May 2010 until the 31 March 2011 the turbine returned a healthy balance of 28MW corresponding in 112 ROCs being issued by OFGEM. For this class of turbine four ROCs are issued per MW produced. Second year production was outstanding with a total in excess of 36MW leaving us with 144 ROCs to trade in the ROC auction.

One of the primary aims of this project was to take advantage of a natural, renewable resource and to assist with the reduction of our electricity bill. Currently we are using one third of the electricity we produce and exporting the rest to the national grid. In the first 12 months this demonstrated in the region of a 50% reduction in our electricity bill. Currently PowerNI are also providing an export payment for electricity of approximately 6p/kWh, thus adding to the ROC payment already available.

Like any new purchase there has been an occasional glitch in performance with the Gaia, usually an electrical error in the control box and we have also recently replaced a faulty anemometer on the turbine. The Gaia is, however, covered by a five year warranty, which backed up by Silverford's excellent service leaves peace of mind.

Ultimately we have been delighted with the performance of the Gaia 133 turbine. It has delivered the output we had hoped for and has so far met the targets which we put in place when we first began the project. From an environmental point of view the turbine is offsetting in the region of 16 tonnes of Carbon emissions from our farm per annum. This is invaluable information as we market certain varieties of cut-flowers through one of the major multiple retailers. In addition the turbine has been accepted on the landscape by all forms of livestock and wildlife.

In the interim period since the construction of the Gaia we have looked into the possibility of further wind projects as well as ways in which we can utilise more power from the turbine. In particular we hope to convert our grain dryer from diesel to electricity in the coming months, thus removing the need for a tractor to power the dryer and allowing for greater cost savings in the business.

In the last couple of years we have certainly witnessed the benefits of installing renewable technology on our farm and would encourage all farmers and rural dwellers to consider how best they could take advantage of the natural renewable resources in their particular circumstances. There are however several key factors to consider before considering installation and it is of paramount importance that these are assessed before making a conclusive decision.

For further information contact Elliott Bell on (028) 4063 0261
or email: elliottbell32@hotmail.co.uk

Biogas production at BH Energy

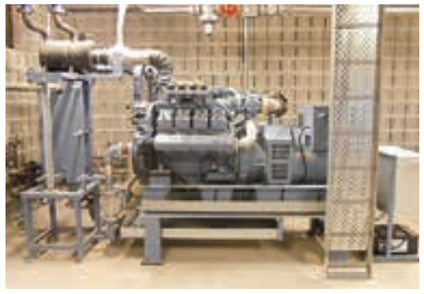
Jim Torney, Ivor Lowry, BH Energy and Nigel Moore, Senior Renewable Energy Technologist, CAFRE

Rising energy costs and the opportunity to diversify their farm business has led Blakiston Houston Estates to develop a biogas plant at their Carrowreagh Farm in Dundonald.

The farm is a 300ha dairy farm with 400 dairy cows and followers. The biogas plant has been constructed beside one of the dairy units to produce electricity and heat from the farm slurry and silages grown on the farm. The plant was commissioned in early 2012 and is generating electricity round the clock.

After extensive research and visits to view operating plants in Europe, the decision was taken to install a 250kW Hochreiter anaerobic digestion plant which could be expanded to 500kW at a later date.

The digester is a concrete ring-in-ring system with a 32m outer ring and a 22m inner ring, 6m deep. A surface mixer in the outer ring ('Mississippi paddle wheel') with below surface mixers keeps the digestate mixed and moving round this outer ring. Slurry is fed in to the outer ring through a reception tank connected to a central pumping station and silage is fed in through a Fliegl feeder on an hourly basis. Digestate flows from the outer to the inner ring as feedstock is added. The floor, wall and lid of the tanks are insulated and the digester is run at a temperature around 42°C. An additional 22m diameter by 6m deep concrete store has been built for digestate storage which incorporates capacity for future expansion of the system.



Gas is collected from the inner and outer rings and fed into a gas store above the control room and the combined heat and power (CHP) plant room. From there the gas is fed into a 250kW Deutz CHP engine installed in the CHP plant room. This engine generates electricity which, in turn, flows through the farm electricity connections, firstly for use on the farm, or if not required, on to the grid.

Power utilised on the farm replaces purchased electricity at full retail rate, while the excess spilled to the grid attracts a wholesale price currently from PowerNI through a power purchase agreement. In addition, all the power generated attracts 4 NIROCs, worth around 17p/kWh.

Heat produced by the CHP unit is utilised to keep the plant at the desired operating temperature of 42°C, and excess heat will be utilised to dry timber for the biomass industry.

A 62m by 26m feedstock silo has been built beside the biogas unit to store and supply non-liquid energy materials – mainly grass, maize and arable silages. Inputs to the system are projected at around 5500 tonnes slurry and 6500 tonnes silage per year with an estimated annual output of about 2,000MWh electricity and 2,250MWh heat from the combined heat and power unit. Around 30% of the heat produced will be required to maintain the plant temperature.

Digestate from the system (estimated at 11000t per annum) is spread back on the land with a potential saving of fertiliser.

Capital grant support towards the cost of the installation was provided through the DARD Biomass Processing Challenge Fund and part financed by the European Regional Development Fund under the European Sustainable Competitiveness Programme for Northern Ireland.

Challenges faced

When installing new technology there are the inevitable frustrations and delays dealing with the authorities to achieve the necessary approvals. Challenges which had to be met and overcome included grid connection with NIE, the issue of waste management licensing even though the feedstocks were solely energy crops and livestock slurry, ROC accreditation, the Power Purchase Agreement and insurance amongst others.

The co-ordination of all the facets of the work from planning through to commissioning was a major challenge, as was the management of cashflow.

Expected benefits

Processing the farm waste through the AD unit will reduce the carbon dioxide and methane emissions from the farm.

The use of fossil fuels on the farm will be reduced directly through reduced import of energy and indirectly through reduced fertiliser use.

The use of the heat to dry timber will add value to the woodchip produced for the biomass industry and excess energy sales will improve the viability of the holding.

The AD unit is integrated with the existing farm business through utilisation of farm slurries and farm produced energy crops, reducing farm energy costs. Existing farm staff and farm equipment are utilised thereby helping to maintain the viability of the farm and employment.

For further information contact Nigel Moore on (028) 9442 6648
or email: nigel.moore@dardni.gov.uk

Issues with Renewable Energy Installations

Grid connection for small scale renewable generation

Michael Atkinson, Head of Generation Connections, NIE

One of the key aspects when considering a renewable energy project is connection to the electricity system or grid. There is an obligation on any developer to contact NIE and enter into an agreement where there is an intention to connect and operate a generator in parallel with the electricity network.

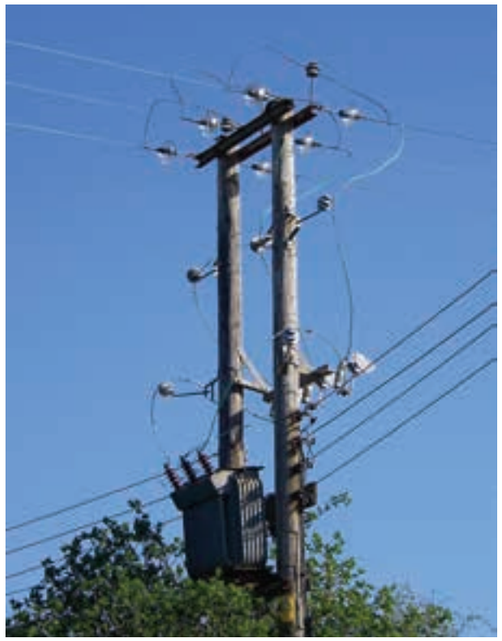
A Network Connection & Capacity Study is offered to customers who have obtained all permissions. This includes planning permission, or equivalent permissions for tidal or hydro generation, at the date of connection application. This study is a full technical appraisal and requires the customer to submit to NIE a formal application (NIE Generator Questionnaire) and the full electrical technical specification of the generator being connected together with the appropriate non-refundable fee.

NIE need to ensure that the required safety and operating conditions will be met by the new generator. The Connection Conditions within the NIE Distribution Code details the technical, design and operational criteria which must be complied with, both by NIE and the customers connected to or seeking connection to the Distribution System. The Distribution Code also sets out the requirements for allowing NIE to both monitor, and if necessary, control the output from the generator.

There are significant technical issues to be considered and studied to design the connection of generators to the network. These include:

- Network design
- Conductor size
- Network voltage
- Thermal issues
- Fault level
- Quality of supply – voltage dip, flicker, voltage imbalance, harmonics.

The Network Connection & Capacity Study provides a quotation outlining the connection costs, the capacity available at the proposed connection point and details of the work required to provide the connection for the requested capacity and technology.



A typical connection will require a new line, transformer and equipment cubicle. Planning permission may be required for the connection. Some connections may require NIE to provide equipment which is not readily available and these items may have a significant order time. So the time to complete the connection process typically can take from 6 months to one year, from acceptance of the offer and payment.

For further information contact the NIE at on 08457 643643 or at www.nie.co.uk/Connections/Generation-connections or contact Michael Atkinson on (028) 9095 4328 or email: michael.atkinson@nie.co.uk

Planning permission for anaerobic digesters

Suzanne Bagnall, Principal Planning Officer, DOE

Currently planning permission is required for all anaerobic digesters. Most planning applications for anaerobic digesters are processed within the local Area Offices. Planning applications for anaerobic digesters should be submitted on a P1 form along with the appropriate maps, drawings and fees.

Specifically, the following information should be submitted:

- A site plan and elevation drawings to determine visual impact.
- Photomontages of the digester, plant, building(s) and chimney stack with a clear indication of building material and finishes.
- Information on grid connection works, including transformer and transmission lines.
- Details of potential noise or emissions to air and an assessment of their impact.
- Details of vehicular access and vehicular movement.
- Landscaping provisions.
- Site management measures during construction phase.
- Model of emissions dispersion.
- Community consultation plans.

Full details are available at www.planningni.gov.uk or by contacting your local Area Office.

Fees

From 11 April 2011, the fee for an application for an anaerobic digester in tanks on an open site is £1,775 for each 0.5 hectare of the site area subject to a maximum of £38,400.

The fee for anaerobic digestion in tanks within a building(s) falls within Category 4 of the Fee Regulations which is:

(a) Where no floor space is to be created by the development, £170;

(b) Where the area of gross floor space to be created by the development does not exceed 40sq.m., £170;

(c) Where the area of the gross floor space to be created by the development exceeds 40sq.m., but does not exceed 75sq.m., £335;

(d) Where the area of the gross floor space to be created by the development exceeds 75sq.m., but does not exceed 3750sq.m., £335 for each 75sq.m., of that area;

(e) Where the area of gross floor space to be created by the development exceeds 3750sq.m., £16,750; and an additional £100 for each 75sq.m. in excess of 3750sq.m., subject to a maximum in total of £250,000.

Material considerations

In considering an application for an anaerobic digester, the Department is required to have regard to the development plan, so far as it is material to the application, and to any other material considerations. Material considerations include any responses from the public and consultees as well as amongst other things relevant policy. In terms of anaerobic digesters the relevant policy includes:

- Planning Policy Statement 18 – Renewable Energy including the 'Best Practice Guide to PPS18' which specifically deals with anaerobic digesters in Section 3;
- Planning Policy Statement 11 – Planning and Waste Management: WM 1 and WM 2; and
- Planning Policy Statement 21 – Sustainable Development in the Countryside: CTY 13 and CTY 14.

Each planning application for an anaerobic digester is assessed on its own merits against the prevailing planning policy and taking into account all material considerations. It is the responsibility of the applicant/agent to submit the necessary information to demonstrate that the proposal complies with the prevailing policy and to enable the Department to determine the application. There may be site specific issues that the applicant/agent may wish to address when submitting any planning application for an anaerobic digester, such as odour issues if there are sensitive receptors in the locality. Additional site specific issues may include:

- Noise
- Air pollution
- Visual impact of the anaerobic digester and associated infrastructure
- Impact of any increase in vehicles to site and along local road network.

Environmental Impact Assessment

Developments that use waste to provide energy may require an Environmental Impact Assessment. Such projects could fall within projects listed in Schedule 2(3) and/or 2(11) of the Planning (Environment Impact Assessment) Regulations (Northern Ireland) 2012.

Permitted development rights

In support of the ongoing development of the renewable energy sector in Northern Ireland the Minister has proposed a public consultation exercise to consider the introduction of permitted development rights for renewable energy development including anaerobic digesters. The public consultation exercise is likely to take place later this year.

For further information contact your local Area Planning Office or Suzanne Bagnall on (028) 9041 6700 or email: suzanne.bagnall@doeni.gov.uk

Planning permission for wind turbines and solar energy

Suzanne Bagnall, Principal Planning Officer, DOE

Wind turbines

A wind turbine, whether attached to a building or erected on its own independently of a building, requires planning permission.

Planning applications for wind turbines should be submitted on a P1 form along with the appropriate scaled plans and fee. The Department has recently introduced a new planning application form (Form P1W) which must also accompany planning applications for single wind turbine and wind farm developments. Full details are available at the Planning Portal (www.planningni.gov.uk) or from your local Area Planning Office.

Early engagement with consultees

Proposed wind turbines often raise issues of noise and environmental impact, and can cause electromagnetic interference to communications installations. To speed up application processing time, the Department recommends that the applicant engages with certain consultees to address any potential issues prior to submitting a planning application. This early engagement and resolution of problems may help to speed up the processing of your application.

Environmental Impact Assessment

In applications where a development involves the installation of more than two wind turbines, or the hub height of any turbine or height of any other structure for harnessing wind power for energy production exceeds 15 metres, an assessment as to whether an Environmental Statement is required to be submitted shall be made by the Department under Schedule 2 (3) (j) of The Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2012. If you are in doubt as to whether an Environmental Statement is required as part of your application you should contact your local planning office for further information and advice.

Where it is determined that an Environmental Statement is not required, the Department may nonetheless require the applicant to provide additional information to enable it to process the application – e.g. a noise assessment, ecological study or information on interference with emergency fixed links.

Each application will be judged on its own merits and the additional information required will depend on the individual circumstances of each case.

Solar collectors

Solar collectors include solar water heating panels (SWH) and photovoltaic panels (PV). In certain circumstances, planning permission may not be required for the installation of solar collectors on a dwelling-house or a building within the enclosure occupied by a dwelling-house. However, if your dwelling is located within a Conservation Area you should discuss your proposals with your local Planning Office. Full details of the requirements and application fees are available at www.planningni.gov.uk or from your local Area Planning Office.

Where planning permission is required, an application for solar collectors should be submitted on a P1 form with the appropriate plans and fee. The following additional information could also be submitted to speed up the processing of your planning application:

- The design of the module or array.
- Photographs of the existing built environment.
- Detail of the roof mounting arrangement, if applicable.
- Indicative drawings of the module or array in place.
- Connection details to the building or grid if relevant.
- If the application involves a listed building, a photomontage of the proposed collector array could be useful.

Environmental Impact Assessment

Domestic or small-scale systems are not covered by Schedule 1 or 2 of The Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2012 and are therefore not likely to require an Environmental Impact Assessment. In Areas of Outstanding Natural Beauty, conservation areas and on listed buildings, the visual impact and impact of the proposal on the building fabric are amongst the issues that are assessed by the Department.

Material considerations

The range of factors that the DOE take into account in determining any individual application for a single wind turbine or solar collector is, in practice, very wide and can vary from application to application depending on the site and its location. However, in the assessment of all applications, the Department is required to have regard to the development plan, so far as it is material to the application, and to other material considerations.

Material considerations include the relevant planning policy and guidance documents and in particular Planning Policy Statement 18 Renewable Energy (these are available to view on the Planning Portal www.planningni.gov.uk), and comments that relate to planning issues from the general public and statutory consultees. They also include the impact of the proposed development on:

- Public safety; human health; or residential amenity.
- Visual amenity and landscape character.
- Biodiversity, nature conservation or built heritage interests.
- Local natural resources, including air and water quality.
- Public access to the countryside.

Streamlined application process

A planning application for solar panels or a single domestic wind turbine is likely to fall within the Department's streamlined application process, where non-contentious planning applications can be issued without formally bringing them to the Planning Committee of the local District Council unless specifically requested by the local Council. Instead, a decision will issue under the authority of the Area Planning Manager, thus enabling faster decision-making on this type of planning application.

For further information contact your local Area Planning Office or Suzanne Bagnall on (028) 9041 6700 or email: Suzanne.bagnall@doeni.gov.uk

The Northern Ireland Renewables Obligation (NIRO) and Renewables Obligation Certificates (ROCs)

Michael Harris, Renewable Electricity Branch, DETI

The NIRO is the Department of Enterprise, Trade and Investment's (DETI) main policy instrument for incentivising renewable electricity generation.

How does it work?

The Renewables Obligation places a legal requirement on all Northern Ireland licensed electricity suppliers to provide Ofgem (on behalf of the Northern Ireland Authority for Utility Regulation (NIAUR)) with evidence that a specified quantity of the electricity supplied to final consumers can be accounted for by generation from renewable sources. This specified quantity is measured in megawatt hours (MWh).

Evidence of compliance with the Obligation is in the form of Northern Ireland Renewables Obligation Certificates (NIROCs) which are issued free of charge by Ofgem to electricity generators for each MWh of eligible renewables generation.

The NIRO also provides for Renewables Obligation Certificates (ROCs) issued under similar Renewables Obligations in GB (GBROCs) to be used as evidence of compliance and for NIROCs and GBROCs to be mutually tradeable across the UK.

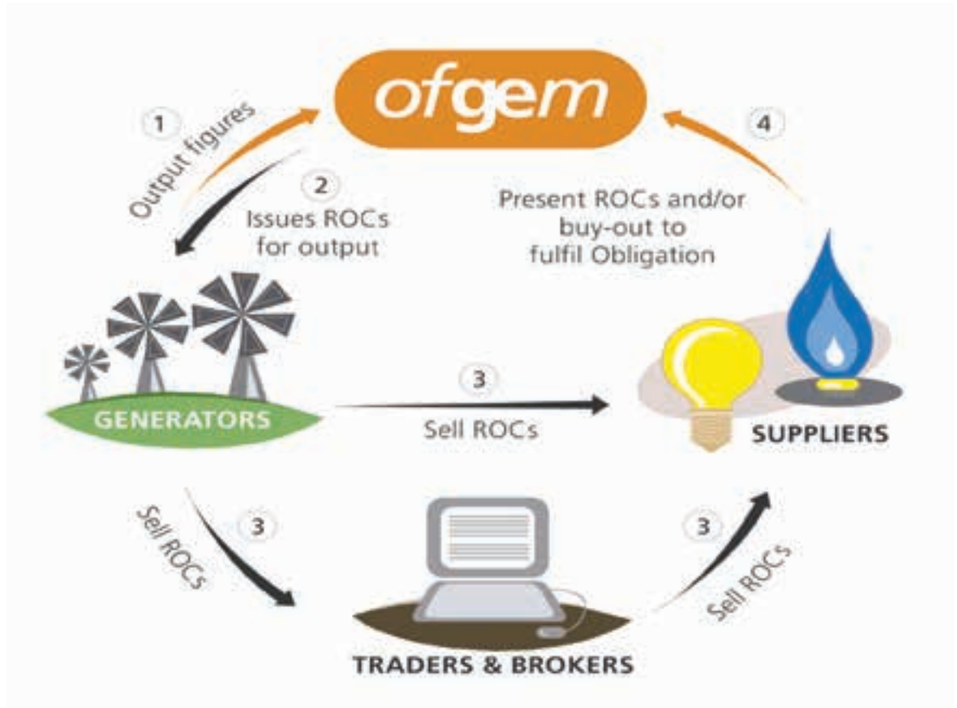
As an alternative to presenting ROCs, suppliers may pay a 'buy-out' fee to Ofgem for each MWh of the specified quantity of electricity that is not covered by presenting ROCs. Suppliers can therefore comply by either presenting ROCs, or paying the buyout (or a combination of the two). At the end of each Obligation period the proceeds from buy-out payments are redistributed among suppliers in proportion to the number of ROCs they produced in satisfaction of their Obligation. With the Obligation set at a level higher than the current level of eligible renewables generation, 'buy-out' fees will always be payable in each Obligation period. This gives ROCs a value and it is this value that provides developers with the financial incentive to invest in renewables capacity. The market value of ROCs (approximately £45) can be expected to be at least the 'buy-out' fee (£40.71 for 2012/13) plus the anticipated Buy-Out Fund redistribution per ROC presented.

The cost of the NIRO is passed on to consumers by suppliers: it does not involve DETI paying grant assistance but instead provides a revenue support based on the amount of electricity generated.

How do you get ROCs?

Generators who want to receive support under the NIRO in order to obtain ROCs must first seek accreditation with Ofgem. Once accredited, generators are issued with ROCs for every MWh of eligible electricity generated. The number of ROCs issued per MWh is determined by the technology used by the generating station, its size and when it first became accredited under the NIRO. Generators can then sell these ROCs directly to electricity suppliers or use the services of an agent. In addition to selling their ROCs, generators can also enter into an agreement with an electricity supplier to export any excess electricity to the grid. ROCs are issued for every MWh generated regardless of whether the electricity is used on site, exported to the grid or a combination of both. Once accredited, generators receive support under the NIRO for 20 years or until 2033, whichever is sooner. (Legislation is currently being drafted to extend the end date of the NIRO to 2037, subject to EU State Aid and NI Assembly approval).

Diagram: How the NIRO works



Source: Ofgem

Changes to ROC banding levels in 2013

A DETI consultation on proposed changes to the NIRO in 2013 was undertaken during 2011/12. When banding was introduced to the NIRO in 2009 it included a provision to review banding levels every four years to ensure that subsidies reflect changes in technology costs. The UK-wide review of banding levels focused on large scale technologies i.e. those with an installed capacity over 5 megawatts (MW). However, it should be noted that the outcome of the NIRO consultation, whilst not proposing changes to small sale renewables in 2013, does indicate that banding levels will be reviewed for the period after April 2014 as part of the work to introduce a small scale Feed-In Tariff (FIT). Any banding changes introduced on 1 April 2013 (or, if necessary, 1 April 2014) will only apply to new generating stations accrediting after this date or any additional capacity added by existing generating stations. Generating stations accredited under the NIRO before 1 April 2013 or 1 April 2014 are 'grandfathered' at the ROC level awarded at the time of accreditation. The NIRO consultation documents and revised ROC banding levels can be accessed on the DETI website at www.detini.gov.uk/deti-energy-index/deti-energy-sustainable/northern_ireland_renewables_obligation.htm

Small scale Feed-in Tariff

The Department is proposing to introduce an Energy Bill to the Northern Ireland Assembly during 2013/14. It is proposed that this Bill will be used to bring in enabling powers for the future introduction of a small-scale feed-in tariff similar to that already in operation in Great Britain since 2010. Under UK-wide Electricity Market Reform measures, the Renewables Obligation will close to new generation from 1 April 2017. Generators already accredited under the NIRO before this date will continue to receive ROCs for the full 20 year duration. It is the Department's intention to introduce a small scale FIT before 2017 to ensure that small scale renewable electricity continues to be incentivised after the NIRO's closure.

The Bill will provide a framework only for small scale FIT powers. This is required to provide DETI with the legislative base to introduce a FIT incentive mechanism in the future. How the new FIT will work, including tariff details will be provided in subsequent secondary legislation and will be subject to extensive public consultation.

The policy consultation on the Energy Bill can be viewed at www.energy.detini.gov.uk

Northern Ireland Renewables Obligation (NIRO) – banding levels

Technology	ROC levels				
	2012/13	2013/14	2014/15	2015/16	2016/17
Anaerobic digestion (≤ 500kW)	4	4	4	4	4
			Banding levels from 2014/15 subject to further review		
Anaerobic digestion (500kW - 5MW)	3	3	3	3	3
			Banding levels from 2014/15 subject to further review		
Anaerobic digestion (above 5MW)	2	2	2	1.9	1.8
Hydro (≤ 20kW)	4	4	4	4	4
			Banding levels from 2014/15 subject to further review		
Hydro (>20kW-250kW)	3	3	3	3	3
			Banding levels from 2014/15 subject to further review		
Hydro (>250kW-1MW)	2	2	2	2	2
			Banding levels from 2014/15 subject to further review		
Hydro (>1MW-5MW)	1	1	1	1	1
			Banding levels from 2014/15 subject to further review		
Hydro (>5MW)	1	0.7	0.7	0.7	0.7
Onshore wind (≤ 250kW)	4	4	4	4	4
			Banding levels from 2014/15 subject to further review		
Onshore wind (>250kW-5MW)	1	1	1	1	1
			Banding levels from 2014/15 subject to further review		
Onshore wind (Above 5MW)	1	0.9	0.9	0.9	0.9
			Banding levels from 2014/15 subject to further review		
Solar Photovoltaic (up to 10kW)	4	4	4	4	4
			Banding levels from 2014/15 subject to further review		
Solar Photovoltaic (>10kW to 50kW)	4	4	4	4	4
			Banding levels from 2014/15 subject to further review		
Solar Photovoltaic (>50kW to 5MW)	2	2	2	2	2
			Banding levels from 2014/15 subject to further review		
Solar Photovoltaic (>5MW)	2	Subject to further consultation			

A complete list of ROC banding levels for all technologies can be found on the DETI website at www.detini.gov.uk/deti-energy-index/deti-energy-sustainable/northern_ireland_renewables_obligation

For further information on:

The NIRO: Department of Enterprise, Trade and Investment (DETI)

Tel: 028 9052 9428

www.detini.gov.uk/deti-energy-index/deti-energy-sustainable/northern_ireland_renewables_obligation

NIRO Accreditation Ofgem

Tel: 020 7901 7310

www.ofgem.gov.uk/Sustainability/Environment/RenewablObl

Marketing Renewable Obligation Certificates

Philip Carson, PowerNI

Following the introduction of banding to the Northern Ireland Renewables Obligation (NIRO) in 2009, Renewable Obligation Certificates (ROCs), and the revenues associated with them have become the key component in the business case of many renewable projects in Northern Ireland. By way of example, with newly installed wind turbines up to 250kW and anaerobic digestion generators up to 500kW receiving 4 ROCs for every MWh of electricity generated, this Government led incentive has had the desired effect in stimulating the market.

Unlocking this incentive requires a number of steps, the first of which is getting your generating station accredited for ROCs by Ofgem. Monthly meter readings must be submitted to Ofgem and based on these ROCs will be issued in accordance with the technology type, size of the generating station and date of installation. It is worth noting that whilst Ofgem issue ROCs, the price you receive for your ROCs will depend on what structure you have in place under a potential Power Purchase Agreement (PPA).

A common structure is that ROC payments are linked to the buy-out price of a ROC. All electricity suppliers (in GB and NI) have a legal obligation to source a proportion of the energy they supply to end customers from green sources. Evidence is provided in the form of ROCs, hence the demand from suppliers for ROCs. If a supplier does not have enough ROCs to meet all or some of its obligation they can pay a buy-out fee to Ofgem in relation to this element. The buy-out price is set each year in advance of the Obligation Period and is index linked. For 2012/13 (April 12-March 13) the buy-out price is set at £40.71/ROC.

This payment would be made monthly to renewable generators and given the buy-out price is fixed for a 12 month period it gives price stability. This structure also comprises a variable element associated with the redistribution of the income Ofgem receive from suppliers buy-out payments. This payment is made annually in respect of ROCs transferred during the preceding Obligation Period. Another option open to renewable generators is to sell ROCs via the monthly ROC auction. This seeks to improve cash flow as the full value of the ROC is realised up front. However, like any tradable commodity, the market can move up and down. When the Government sets the Renewables Obligation in advance of an Obligation Period the 'headroom' methodology should ensure sufficient demand for ROCs is maintained. Within a given year this can vary month on month as is observable in recent auction results.

There are a number of organisations in the marketplace who are prepared to market your ROCs, either on their own, or in conjunction with power purchase. Power NI have a wealth of experience in assisting renewable generators in Northern Ireland with Ofgem accreditation, acting as an Ofgem agent for over 750 renewable generators under the Power NI micro-generation tariff (for generators up to 50kW). For larger generators Power NI can assist with maximising revenues from your generating station under a more tailored PPA.

For further information contact Philip Carson on (028) 9068 5039
or email: philip.carson@powerni.co.uk

The Northern Ireland Renewable Heat Incentive and Renewable Heat Premium Payment Scheme

Peter Hutchinson, Renewable Heat Branch, DETI

The Department of Enterprise, Trade and Investment (DETI) intends to shortly launch the Northern Ireland Renewable Heat Incentive (RHI), a scheme that will provide financial support for non-domestic renewable heat generators in the first instance. In addition, in May 2012 the DETI Minister launched the Renewable Heat Premium Payment (RHPP) scheme that provides up front capital support for domestic customers switching to renewable heating.

These measures followed on from significant research carried out by DETI, a public consultation on initial proposals (July-October 2011) and the approval of spending of up to £25m in this sector until 2015.

Why is the RHI scheme being introduced?

The primary objective for the Northern Ireland RHI is to increase the uptake of renewable heat to 10% by 2020 (baseline position of 1.7% in 2010). The 10% target for renewable heat equates to 1.6TWh (or an additional 1.3TWh when considering existing levels). This target was included in the Strategic Energy Framework (SEF) and an interim target of 4% renewable heat by 2015 has been included in the Programme for Government.

In addition to achieving the set target, it is expected that the RHI will have a number of other wider benefits in terms of fuel security, lower emissions and 'green jobs'.

Renewable heat technologies are currently unable to compete with existing fossil fuel alternatives given the often higher capital costs and also the lack of understanding and awareness amongst consumers of what are often seen as innovative technologies.

Without the RHI in place Northern Ireland will not achieve either the targets set for renewable heat by the Northern Ireland Executive in the SEF or be able to contribute to the UK target set under the Renewable Energy Directive.

How have the tariffs been designed?

The RHI aims to compensate investors for the additional costs of renewable heat compared to traditional fossil fuel systems. For each technology, we have taken into account all the various types of costs involved (including capital, financing, barrier, fuel and operating) to produce a pence per kWh cost figure – this is known as a levelised cost methodology.

The RHI tariff setting methodology also includes the provision of a rate of return in order to stimulate interest in a developing unknown marketplace and to provide compensation for the financing costs of making the necessary investment in capital projects. In most instances a rate of 12% has been set. Solar thermal receives a lower rate of return as it is a well-known technology, it is relatively easy to install and it will not displace the same level of fossil fuel as the other technologies. In addition solar thermal heat is, at present, more costly per unit of energy than other technologies.

Tariffs are detailed below.

Tariff name	Eligible technologies	Size range (kW)	NI RHI tariff (pence per kWh)	Tariff duration (years)
Biogas injection	Biomethane injection and biogas combustion, except from landfill gas	Biomethane all scales, biogas combustion less than 200kWth	3.0	20 years
Biomass boilers	Solid biomass; Municipal solid waste (inc. CHP)	Less than 20kWth	6.2	20 years
		20kWth and above up to but not including 100kWth	5.9	20 years
		100kWth and above up to but not including 1000kWth	1.5	20 years
GSHP	Including water source heat pumps and deep geothermal	Less than 20kWth	8.4	20 years
		20kWth and above up to but not including 100kWth	4.3	20 years
		100kWth and above	1.3	20 years
Solar Thermal		Below 200kWth	8.5	20 years

Payments will be made on a quarterly basis by the scheme's administrator, Ofgem. Payments will be calculated by multiplying the actual metered heat output of the technology over that quarter with the designated tariff.

Northern Ireland Renewable Heat Premium Payment Scheme (RHPP)

As detailed, the RHI is initially only available to non-domestic customers. In the interim, the DETI Minister has launched the RHPP scheme to help householders afford renewable heat technologies. This is a short term measure prior to the proposed introduction of a Northern Ireland RHI for the domestic sector in 2013.

Since its launch on 24 May the RHPP has offered support to 250 renewable heat installations, 47% of these are solar thermal panels, 30% biomass boilers and the remainder heat pumps.

Financial support provided under the RHPP is detailed below.

Technology	Support per unit
Air Source Heat Pump	£1,700
Biomass boiler	£2,500
Ground Source Heat Pump	£3,500
Solar Thermal	£320

Householders who install renewable heat technologies with the support of a premium payment will remain eligible for any longer term Northern Ireland RHI, should it be introduced to the domestic sector and provided they meet any criteria set by the Northern Ireland RHI. However, at that time, for those receiving premium payments the amount payable under the RHI will be reduced to take account of the RHPP.

Technologies can only be installed in primary places of residence, not second homes or holiday homes, and they must have basic energy efficiency measures in place. This means loft insulation of at least 250mm and cavity wall insulation, where these measures are practical.

The technologies installed must be listed under the Microgeneration Certification Scheme (MCS) or Solar Keymark and be installed by someone registered through the MCS scheme. Further information can be found at: www.microgenerationcertification.org or www.estif.org/solarkeymark

Many domestic renewable heating installations are now classed as permitted development which means planning permission is not needed, but this will depend on the technology you are installing and where you live. Please check with your Local Planning office www.planningni.gov.uk or Building Control Department of your local Council www.buildingcontrol-ni.com before proceeding, to ensure you have all of the correct permissions required.

The next steps

The RHI will be launched following the passage of appropriate legislation; this is scheduled for Autumn 2012. Once launched, the scheme will be administered by Ofgem and those wishing to avail of the scheme or receive further guidance should contact Ofgem in the first instance.

The launch of the RHI is seen as the first phase and DETI has already begun work on issues that need to be assessed and considered as part of phase 2. These issues include:

- Extension of the scheme to the domestic sector (to include those that have availed of RHPP support).
- A specific tariff level for deep geothermal heating (currently treated like ground source heat pumps).
- The introduction of tariffs for Air Source Heat Pumps, Bioliquids; Solar thermal above 200kW.
- Further consideration on the need for support for large biomass installations.
- The need for additional measures to support the development of community or district heating schemes.

In addition, there may be further issues that DETI wish to consider relating to land fill gas, direct air heating and large biogas systems.

At this stage DETI is keen to implement phase 2 in the summer 2013. A public consultation on this matter will be held in early 2013.

Further information on any of these issues can be found at:

www.energy.detini.gov.uk

www.ni.rhi@detini.gov.uk

Or by contacting Peter Hutchinson on (028) 9052 9532 or
by email: peter.hutchinson@detini.gov.uk

The renewable energy supply chain

Gareth Gormley, Senior Rural Enterprise Adviser, DARD

The following case studies demonstrate how groups came together to add value and create sustainable business opportunities within the renewable energy sector.

Ballyhullagh AD Project

The Ballyhullagh group approached the Supply Chain Development Programme with the aim of constructing a 250kW anaerobic digester that will run on slurry and silage that will in turn generate electricity for sale to the National Grid. The group identified this as a means of increasing co-operation between neighbouring farmers and adding value to both silage and slurry. The group has identified the need for a specialist mentor that will work with the group to determine an appropriate structure/partnership depending on the capital investment and time commitments of each member.

To help them decide on what system they are going to purchase and build, they have planned to visit sites in Europe to learn from established and reputable AD manufacturers such as Hochreiter and BD Agro. BD Agro Renewables are part of the Big Dutchman group and have plants in over 100 countries worldwide. They have a reputation for lasting quality and vast experience. Whilst Hochreiter have already established an AD plant in Northern Ireland, the Ballyhullagh AD Group has also expressed an interest in obtaining independent information on AD Plants.

When applying for planning permission, the Strategic Planning Division recommended that the group started a community consultation to assist with the planning approval and avoid objections on the grounds of ‘visual impact’ or ‘noise/air pollution’. To ease this process the group have advertised in papers for local builders to carry out the work as this will create local jobs and lead to a greater liquidity of money in the area. The group are hopeful that the plant should be completed and operational within 12 months of the planning permission being achieved and the funding secured.

The group are currently using the services of a Business Specialist Mentor to advise the group on the options of setting up a company to run the AD plant. When the plant is established the group will require a Marketing Mentor to work with them in order to develop a brand for the digester and assist them with establishing a distribution channel for the product. The Supply Chain Development Programme is in the process of arranging a biogas course that will be delivered by CAFRE with assistance from the National Non Foods Crops Centre (NNFCC) and the group consider that this training will be highly beneficial for their project.

During the groups 24 months on the programme they also intend to create a website and design a company logo. The Ballyhullagh group has identified these two business tools as they will give the company an identity and allow them to promote their business to a bigger audience.

Biomass Energy Northern Ireland (BENI) is a self funded organisation whose members are actively engaged in all aspects of the production, marketing and use of biomass energy in Northern Ireland. Participants in the group are mainly growers of short rotation coppice willow producing woodchip fuel. Additionally, some participants are also involved in harvesting, drying and screening biomass fuel, including material from forest and other sources, ready for use. Individually the growers had difficulty identifying end users for the woodchip produced from their existing crops. In order to collectively develop the potential of a supply chain for biomass fuel, they identified that the group needed the services of professional help and support from suitably qualified experts.

Members of BENI recently made an interesting visit to a Focus farm in Moy, County Tyrone. The farmer installed a Froling Turbomat 150kW boiler in 2007 and is currently saving over £15,000 per year in fuel bills for heating his 12 mushroom houses. After funding the boiler, wood chip store and associated feed system, plus an underground district heating system to the mushroom houses, the farmer estimates that he has achieved full payback in a little over 3 years.

In their action plan the BENI members identified the need for a Marketing Mentor to develop an online newsletter and other promotional materials for the group to communicate with potential users. The group were also granted funding for the services of a Web Designer to create a website for the group. From this, the group could operate effective and fair procurement procedures as well as share information with other group members and strengthen the group's activity. To coincide with the website the group received funding for their members to be trained in the management and administration of website tools used to improve communication and integration within the biomass supply chain.

S I Energy Group

The S I Energy group was created with the idea of providing farmers in the group with the possibility of supplying renewable energy in the form of electricity to the grid from a number of sources including hydro, anaerobic digestion, biomass and heat pumps, depending on the circumstances of their individual farms. One of the main objectives for this group was for the farmers to market diverse sources of on-farm renewable energy collectively and allow the group to grow up to around 40 farmers. After a successful application to the Supply Chain Development Programme, the group submitted their action plan detailing how they planned on developing as a company over a two year period.

As the group has now been together a little over three months the members are still in the process of obtaining all relevant background information on how to become licensed to supply electricity. Already the group have identified that they need the services of a Licensing Specialist Mentor to implement the process of applying for the licence to supply electricity and they have also identified that they will require legal advice to draw up appropriate contracts for all members and subcontractors to the group. The group plans on creating their own website to market and promote their product and also to train each of their members to maintain it and keep it up to date.

One of the groups medium term plans is to develop a database collection tool for monitoring the import and export of electricity. They also plan on participating in several feeder events on AD in conjunction with the Supply Chain Development Programme. In participating, the group will be promoting and educating the farming community on the benefits of becoming a renewable energy supplier using the SIE model. These feeder events will shine a positive light on the group in the latter stages of the project when they are trying to build a portfolio of customers buying the energy directly produced by the group.

At present the group are in the process of obtaining a licence and this is key to kick starting all of the events they have identified in their action plan. Once the licence has been obtained the rest of their plan will be implemented quickly.

Opportunities

Opportunities exist for biomass production, woodchip and pellet manufacture in addition to energy supply, distribution and marketing from anaerobic digestion, wind generation and micro-hydro sources. Farmers and growers need to consider the opportunities to supply the Northern Ireland energy market, what renewable energy systems and technologies are available and how they can overcome the challenges to entering the market.

Contacts

The Northern Ireland Rural Development programme is funded by the European Agricultural Fund for Rural Development (EAFRD) and the Department of Agriculture and Rural Development (DARD).

For further information on the Supply Chain Development programme, contact Gareth Gormley, DARD, on (028) 3025 5912 or the Countryside Agri-Rural Partnership, on 0845 026 7538, or email: supplychain@countrysiderural.co.uk, or visit www.countrysiderural.co.uk

A full list of the revelant Local Action Groups (LAG's), in Northern Ireland is listed below:

Admin Unit Managers

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Renewable energy funding for the agricultural and rural sector

Gareth Gormley, Senior Rural Enterprise Adviser, DARD

There are a range of grants and funding available to support the adoption of renewable energy within the agricultural and rural sector. These are summarised in this article.

The Biomass Processing Challenge Fund (BPCF)

The BPCF is delivered by DARD and the aim of the Fund is to encourage agricultural, horticultural and forestry businesses to install biomass fuelled renewable energy capacity, primarily to aid agricultural activities within the farm or forest business. Under the fund, financial support may be provided to assist with the purchase of a range of biomass fuelled renewable energy technologies such as: heat boilers over 30kW, combined heat and power systems, anaerobic digestion systems or other proven technologies.

A grant rate of up to 40% of capital and installation costs to a maximum of 400,000 euro per project will be made available to fund eligible technologies. If you have any queries regarding the Fund, please contact Climate Change and Renewable Energy Branch on 028 9052 5493 or email bpcf.requests@dardni.gov.uk

NI Rural Development Programme – Axis 3

Please note that this programme is delivered across seven Local Action Groups (LAG's) and all regions may not be open for applications. Contact details for all LAGs are listed opposite.

Measure 3.1 - Farm diversification

A stand-alone renewable energy project can be funded at up to 50% grant aid to a maximum grant level of £50,000 providing the diversification project is for the farm owner or farm family member to become an energy producer and 100% of the output is sold to a third party eg. PowerNI. Under Axis 3, energy cannot be used to reduce the running costs of a farm business and can only be used to supplement the income of the farm family. Renewable energy applications from farm owners or farm family members that are intended to increase the profitability of a new or existing farm diversification business may be accepted. All the energy generated must either be used by the diversified business and/or sold to a third party eg. PowerNI.

Measure 3.2 - 3.6

Private Promoter – a renewable energy project can be funded at up to 50% grant aid to a maximum grant level of £50,000 to increase the profitability of the business.

Social Economy Enterprise – a renewable project can be funded at up to 75% grant aid to a maximum grant level of £170,000 to increase the profitability of the business.

Farm modernisation programme

The farm modernisation programme will provide funding for some on farm energy efficiency equipment at grant rates up to 40% or a maximum of £4,000.

Short Rotation Coppice Scheme (SRC)

The Short Rotation Coppice (SRC) Scheme supports the planting of SRC crops for renewable energy purposes. Applications must be received by the 30 January each year for planting in the following spring. Applicants must also be able to show they can use the crop themselves for energy production or that they have a market for their crop. The maximum grant rate for establishment is £1,000/ha and the minimum grant aided area is 3ha. For more information contact the Scheme Manager on 028 9076 5391 or email: grants.forestservice@dardni.gov.uk

Power NI solar water heating

The Renewable Heat Premium Payment offers households £320 towards the cost of installing a solar water heating system. This is available through Power NI.

Power NI commercial solar water heating scheme

Power NI offers support for commercial solar water heating at the rates below;

	£/sq metre	£/sq metre
	Evacuated tube	Flat plate
Up to 5 sq metre	150	120
5-10 sq metre	120	96
Above 10 sq metre	100	80

Eg. 5sq metre of evacuated tube, the grant is £150 x 5 = £750

7.5sq metre of flat plate, the grant is £120x 7.5 = £720

Power NI solar PV grant

Power NI was offering support to householders who wished to install solar photovoltaics (PV). Funding from the Northern Ireland Sustainable Energy Programme (NISEP) was limited and was withdrawn in late September.

For more information you can download the documents from the Power NI website, www.powerni.co.uk/saving-energy/renewables

For further information contact Gareth Gormley on (028) 3025 5912 or email: gareth.gormley@dardni.gov.uk

Business planning for renewable energy investment

Charlie Kilpatrick, Senior Business Technologist, Greenmount Campus

The current economic climate of inflating input costs and turbulent markets has re-emphasised the need for prudent business management practice, not least efficient financial planning and budgetary control across the agriculture sector.

The principles of business management applied to agriculture are no different from any other type of business, and although the formal aspect of business management is not favoured strongly by many farmers and growers, this is an area that progressive businesses need to focus on in order to succeed.

A farming business, like any other business, must grow in order to survive in the long term. If a business has been examined and profit from the existing assets cannot be further improved, expansion or diversification should be considered.

With the introduction of the Renewable Obligation requirement on all electricity suppliers there is now a demand for the generation of renewable electricity and associated income from Renewable Obligation Certificates. This has created a lot of interest amongst farmers and growers in diversifying the use of their farm resource to invest in various renewable projects. However, in most cases the money has to be borrowed and the project must generate a sustainable surplus to meet new loan repayments, private drawings and taxation.

Business planning

Even if you do not intend to make any changes to your business you should still write a business plan. A good business plan can highlight weaknesses in how you plan and run your business, which can provide helpful insight for later improvements. As well as financial projections for costs and sales, a business plan must include details that take into account the production system and the marketing strategy. A comprehensive business plan is the key requirement for any lender.

Planning the financial aspects of a business can be a considerable challenge, especially in respect of a renewable energy project. Your forecasts should run for at least five years. However, the first forecast for 12 months should have the most detail associated with them.

The foundation for financial planning is an estimation of the costs which will be incurred by a business, and the income which will be generated. It is therefore important to clearly state the assumptions that lie behind the projection of your figures, both in terms of costs and revenues so bank lenders can clearly see the thinking behind the numbers.

For example, a business plan detailing the investment and return for a wind turbine project will require you to accurately estimate:

- Cost of site survey and planning fee.
- Turbine size and cost.
- Efficiency of output given the location/wind speed.
- Cost of grid connection and distance from the connection.
- Value of output in terms of electricity and ROCs value.
- Grant funding if available and timing of payment.
- Cost of maintenance and insurance.
- Repayment of a capital loan at a given Annual Percentage Rate over a number of years.

Financial projections/statements used

Once determined, this data can be translated into financial projections. There are three main financial statements used in business planning and it is important that you have a clear understanding of the function of each. One cannot say one is more important than the other as each has a specific task in the financial planning process.

The Profit and Loss forecast is a statement of sales, costs and profit (or loss) over an accounting period (usually one year). It is calculated using standard conventions such as depreciation that will give an accurate measure of business progress when projected over a number of years. Profit is not cash and should not be confused with a cash surplus. The primary function of the profit and loss budget is to estimate the net profit or loss. A business will pay tax on its net profit, before drawings.

The Cash Flow Budget is a forecast of money going into and out of a business over a specific period of time and can be reflected in the business's monthly bank balance. It differs from profit in that it does not include notional costs such as depreciation but does include all capital payments, private drawings and tax.

Businesses fail more often from lack of cash than lack of profit. While the Profit and Loss budget tells you what you expect to spend and receive, the cash-flow marks the timing.

The Balance sheet is a snapshot of the value of the business this year and last year and the difference between the two years tells you whether you are better off in terms of net asset value.

For further information contact Charlie Kilpatrick on (028) 9442 6654
or email: charlie.kilpatrick@dardni.gov.uk

Financial fodder for farmers

Anne Douglas, Senior Manager, Cavanagh Kelly Chartered Accountants

Trading conditions remain difficult for those in the agri-food sector and looking ahead to 31 January you want to be making sure you are not hit with a large unexpected tax bill which will bring further pressure.

A wet summer has led to disappointing harvests, the early housing of livestock and fears of further increases in feed prices. Add to that the uncertainty about the impact of the proposed common agricultural policy (CAP) reform on farm profitability and low milk prices and, for the farming sector, the winter is looking bleak.

There are however ways to ensure you are managing your tax bill properly and paying only that tax which is due.

Loss relief claims

Where a trader suffers a tax loss due to increased running costs or repairs to farm lands and property, then tax relief can be claimed for that loss. These losses can be offset against other income and capital gains of the same year and the previous 12 months. This may enable those farmers with another profitable business to save tax by offsetting their farming losses against the profit of their other business – or if you are in paid employment, losses may be available to get your tax back!

Alternatively if the farm made a profit and paid tax last year, a loss relief claim could be used to generate a tax refund – a welcome boost to cashflow.

Repairs and maintenance

Another area of interest is the long-standing debate concerning what expenditure qualifies as repair, what is capital and what expenditure qualifies for capital allowances as plant and machinery.

One recent case relating to income tax relief centred upon the resurfacing of a farm driveway. It was found that a new concrete surface being placed over an existing concrete surface was a repair – this meant 100% tax relief against profit in the farm accounts. A 'concrete' result in the farmer's favour on an area which has caused much debate over time.

Average your profits

Averaging of profits is almost unique to the farming sector and can produce beneficial results in certain circumstances. The idea was first introduced in 1977 when new rules were brought in to help farmers because of the fluctuations in their profits caused by weather and the increasing influence of world market prices.

The relief only applies where the profit of one year is 75% or less than that of the other year. Averaging will only help to reduce a farmer's tax bill if the top rate of tax or NIC is different for each of the two years in question. In such cases a tax saving can be achieved.

Go Limited

Whilst Limited Company farms are sometimes few, there can be merit in incorporating the whole farm, part of a farm or having a limited company as one of the partners in your farm partnership (known as a corporate partner) – but only in the right circumstances.

One benefit of this is to achieve a lower rate of tax on profits. Companies pay tax at a flat rate of 20% on the first £300,000; a whole lot sweeter than up to 52% on profits at this level in a sole trade or partnership.

Inheritance Tax (IHT)

The focus of this article is not on IHT reliefs – but farmers should remain mindful of this potential tax minefield. One recent case is of particular relevance and relates to Agricultural Property Relief (APR) which effectively exempts the agricultural value of land and property (including the farmhouse) used in the farming business from IHT on death.

In this case, the farmhouse in question had not been lived in since the farmer became ill and moved into a care home 4 years before his death. As there was no use or occupation of the farmhouse in the final 2 year period prior to death HMRC successfully won their case to refuse the APR claim and the farmhouse was subject the IHT – at a rate of 40%. Forewarned is forearmed – make sure your house is in order.

For further information contact Anne Douglas, based at Cavanagh Kelly's Dungannon office on (028) 8775 2990 or email: anne.douglas@cavanaghkelly.com

Financing renewable projects for land owners

Iain Lees, Corporate Finance, PwC

I receive a large number of enquiries from the farming community where the land owner is asking "how **can** I finance my renewable energy project?" In addressing this, PwC would normally start by adding the question we think the farmer should be asking himself: "how **should** I finance my renewable energy project?"

The key to the "how should I" question is risk. Land owners need to ask themselves "how well do I understand the investment risks and how much risk am I prepared and able to take?"

The prize is well signalled (as is evidenced by AD and wind development companies searching across the Province for available sites to lease), but the risks are also considerable. These include dealing with planning & grid issues, the wholesale electricity price, the value of ROCs, feedstock costs (in the case of AD), technology risk, and hopefully limited disruption risks from NIE.

But every investment carries a level of risk – whether you place cash on deposit in a bank with partial government deposit guarantees, whether you buy government bonds, invest in BT shares or prefer investing in Facebook!

The lowest risk way of leveraging the value of your land is to find a guaranteed rent for providing part of your land to industry players who take the operational, financial and market risks on to their own "balance sheet". At the other extreme, some farmers may be able to raise a loan from a high street bank for the £500,000+ cost of a medium-scale turbine development. The main problem with this is that this loan will have full recourse risk on your land holdings or farm business (we have seen one or two non-recourse loans, but these are only possible where there is also a lot of equity invested in the project). This means you are effectively financing the project.

If we were asked to choose between just those two financing options, our answer would be simple – rent your site to the bidder that will pay the best annual rent, provided they have the credibility to deliver the project and let them take all the risks (they should be better set up for dealing day in, day out with ROC trading, technology selection, Power NI off-takes, etc.).

However, there are a few other ways for farmers/land owners to get more access to the high returns potentially available – but without betting the ranch. There are a few generators/developers who will give the site owner a share of the revenue they earn from the site; others – such as Assured Asset Finance (for small-scale AD) and Green Energy Partners (on small-scale wind) – will finance the site development themselves but then offer the farmer part-ownership in the Joint Venture (JV) structure.

In the end, the right financing structure for you comes down to how much risk you can and should be prepared to take?

(Green Energy Partners are clients of PwC)

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