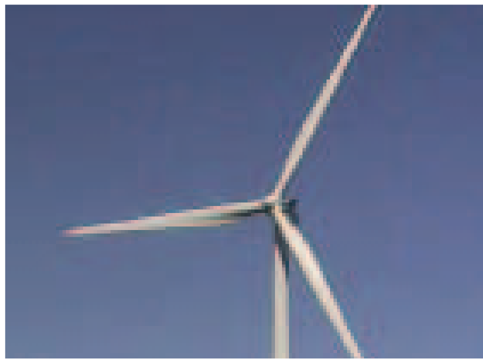
cafre
College of Agriculture, Food & Rural Enterprise

Practical On-farm Renewable Energy



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

afbi Agri-Food and Biosciences Institute

Action Renewables
the future of energy, today

Foreword

As CAFRE Director, I wish to extend a warm welcome to all our visitors to the Practical On-farm Renewable Energy event held at our Greenmount Campus. The day is designed to give practical information about renewable energy options for farmers and the rural sector.

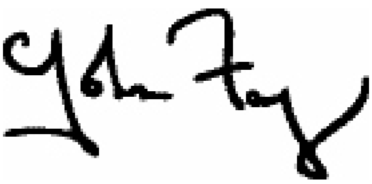
There are many factors at the present time that influence us to consider renewable energy options. On the wider scale we need to tackle global warming by reducing the level of greenhouse gases in the earth's atmosphere. At a national level we need to improve our energy security by reducing our dependence on imported fossil fuels. At an individual farm level, an investment in renewable energy can both reduce the high cost of energy inputs and provide an additional source of income for the business. It also will give the green image to our production which is of increasing importance in the market-place.

I trust that today will provide you with useful information on how to benefit from renewable energy technologies in your business.

Finally, I wish to express my sincere appreciation to the organising committee, comprising staff from across DARD, AFBI, UFU and Action Renewables.

I hope you have an informative and beneficial day.

John Fay



CAFRE Director

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Implementing the DARD Renewable Energy Action Plan

Joyce Rutherford, Climate Change and Renewable Energy Branch, DARD

Agriculture is the main indigenous industry here and forms the backbone of our Rural Economy. However, meeting the demand for a high quality food supply against a background of climate change and the need to make a reduction in our greenhouse gas emissions presents a major challenge for the farming community.

The promotion of renewable energy within the agricultural and forestry sectors can contribute to meeting these challenges and plays an important role in the developing DARD policy framework on climate change.

It is widely recognised that the land based sector can make a valuable contribution to the development of renewable energy whilst benefiting by exploiting the opportunities that the production and utilisation of renewable energy offers.

Acknowledging the rapid evolution of renewable energy policy, particularly the ambitious targets set within the Strategic Energy Framework, the Department are keen to assist with the creation of a favourable environment that will enable the agricultural and forestry sectors to exploit these opportunities.

To meet this objective, DARD published a revised Renewable Energy Action Plan during 2010. Fifteen practical actions are currently being implemented and delivered into the sector. These specific and focused actions strive to ensure that the support and services provided are appropriately targeted to enable farmers, landowners and rural communities to capitalise on the opportunities presented through the development of renewable energy.

This streamlined and focused Action Plan is available for download at
http://www.dardni.gov.uk/publications_dard-renewable-energy-action-plan-2010

Continued research and development is essential to the future success of the agriculture and forestry sectors in contributing to the growth of renewable energy. A dedicated programme of renewable energy research focusing on biomass crops, anaerobic digestion, economics of renewable energy, research into bioenergy technologies and carbon footprinting of renewable energy is currently underway at the Agri- Food Biosciences Institute.

However, it is equally important that the roll out of the findings of that research through knowledge exchange and technology transfer activities is delivered efficiently to the sector

The College of Agriculture, Food and Rural Enterprise (CAFRE) is committed to ensuring the sector is equipped with the necessary understanding, skills, access to appropriate information, knowledge and training to enable effective operation within a renewable energy environment.

Looking ahead, DARD are keen to ensure that the agricultural community are represented in the renewable energy arena. We will work with our stakeholder base and take their views as policy evolves in this area.

The actions within the Renewable Energy Action Plan will continue to be implemented over the coming months and work proceeds with other government departments and their agencies to ensure that activities are coordinated and as broadly aligned as possible to benefit the development of renewable energy within the agriculture and forestry sectors.

For further information please contact Joyce Rutherford at (028) 9052 4215 or joyce.rutherford@dardni.gov.uk

Cafre renewable energy training programme

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

Courses on the following subjects are available

- Energy efficiency on the farm
- Introducing renewable energy
- Energy from wind
- Solar hot water
- Short rotation coppice willow production
- Heat from biomass
- Anaerobic digestion
- Micro-hydro

If you are interested in attending one of the courses please contact David Trimble on 028 9442 6682 or e-mail david.trimble@dardni.gov.uk

UFU makes significant progress in renewable energy

Christopher Osborne, Rural Enterprise Policy Officer, UFU

The UFU welcomes the opportunity to be involved in the renewables event at CAFRE. This article sets out the role and progress of our organization in working to achieve a sustainable renewable energy sector in Northern Ireland and to realize opportunities for farmers/landowners within it.

Farming has a dual role to play in the renewables sector; growing and supplying bioenergy feed-stocks and in the generation of renewable energy, through on-farm technologies (both for consumption on-farm and also potentially to be exported onto the grid.) Aside from the provision of feed-stocks, the NI land-base is a key provider of wind energy; either from the accommodation of large-scale onshore wind turbines or micro-generation-level wind power.

The Rural Enterprise Committee was established in 2006 to co-ordinate UFU policy for the renewable sector, and in-turn lobby Government for viable opportunities for farmers to benefit from renewable energy projects.

In August 2007, the UFU called for co-ordinated Government policy towards establishing a sustainable and effective renewable sector in Northern Ireland. Two key departments, DETI and DARD have made significant advances in establishing such a policy;

Through the **Bioenergy Action Plan**, DETI has set out how to make the most of the resources we have at our disposal. The **Strategic Energy Framework (SEF)** is the overriding document and the latest revised version is due to released by DETI in October 2010. The key policy goals of the SEF are; competitiveness, security of supply, sustainability and infrastructure.

The UFU wishes to acknowledge DARD's efforts which assisted the agricultural/forestry sectors to exploit the opportunities which the uptake of renewable energy has to offer. In the last 3 years £9m has been committed and also during this time, DARD Minister Michelle Gildernew announced the establishment of an **Agricultural Stakeholder Forum on Renewable Energy (ASFRE)**. UFU sat on this forum as a key stakeholder and the publication led to the revised **Renewable Energy Action Plan** and subsequent **Biomass Processing Challenge Fund.**

Interest in renewable technologies has been significantly boosted by moves by DETI on 1st April 2010 to introduce enhanced NI Renewable Obligation Certificates (NIROCs) for specific areas;

All existing technologies	2x NIROCs	Under 50kW
Wind	4 x NIROCs	up to 250kW
Hydro	4 x NIROCs 3 x NIROCs 2 x NIROCs	up to 20kW 20kW-250kW 250kW - 1MW
PV	4 x NIROCs 2x NIROCs	up to 50kW 50kW - 5MW
Anaerobic Digestion (AD)*	2xNIROCs 2xNIROCs	Up to 500kW 500kW - 5MW

• Note: DETI have recently issued a consultation document which proposes increasing the NIROCs awarded for AD to 4 NIROCs for up to 500kW plants and 3 NIROCs for 500kW - 5MW plants.

With such a vast array of opportunities available for the farming industry, it is crucial that Northern Ireland farmers are given as much information as possible. In the past renewables were seen as an alternative to traditional farming practices. However, this has changed and now the UFU would view such opportunities as a diversification opportunity which could work alongside traditional farming.

With the Anaeorobic Digestion plant at their Hillsborough site, AFBI has established itself as a leading renewables research centre. This is alongside the research and development carried out into crops such as Short Rotation Coppice Willow and Miscanthus. For those farmers interested in becoming involved in renewable energy ventures, CAFRE provides a key role, with advice and training on a wide range of renewable technologies.

Challenges ahead

The UFU Rural Enterprise Committee has identified key barriers which, unless addressed could stifle development of the sector;

- **Continued financial support for on-farm renewable technology** - another Biomass Processing Challenge Fund.
- **Need to assess whether financial Incentives for electricity and heat generation are required** (NIROCs or Feed-In Tariffs).
- **Energy Act** - The primary legislation is not in place in the Northern Ireland Assembly to introduce an Energy Act. Without an Energy Act, NI could lag behind other neighbouring regions and countries in terms of sectoral competitiveness.
- **Grid Connection** - in many cases, the success of a project is reliant upon being connected quickly and efficiently to the grid. Good communication between the grid operators and project applicants is essential at all stages of the process.
- **Cross Departmental Co-ordination** - Whilst the UFU can acknowledge that DETI is leading the Bioenergy Inter Departmental Group, bringing together DETI, DARD, DRD, DFP, DOE and Invest NI, this does not detract from the importance of cross departmental co-ordination. Co-ordination is essential if the following barriers are to be properly addressed;
- **Planning** - PPS18 can be acknowledged as a step in the right direction, but it must be translated and applied fairly to all renewable projects in a timely manner.
- **Public procurement drive for renewables from biomass** - This is essential to create the market, helping supply chains to be established, and raising awareness of the role agriculture can play in meeting sustainable targets, while crucially securing new income streams for rural communities. The Bioenergy Action Plan identified Public Procurement as a driver and the UFU will be seeking that this is pursued and implemented.
- **Raise awareness and understanding of the potential for renewable energy among farmers/landowners in order to enhance uptake** - it is noted that the establishment of both an Anaerobic Digestion Portal as well as today's event are further steps in the right direction, but the UFU wishes to see this impetus continue at a pace.

For further information contact christopher@ufuhq.com

Renewable Energy Technologies

Energy efficiency on the farm

David Trimble, Renewable Energy Technologist, CAFRE

What is energy efficiency?

This is the first step you take to reduce your energy bills. You carry out an energy audit on your unit to identify any savings that can be made by doing things differently. Once these savings have been made then the renewable energy options can be considered.

Over the past three years the College has carried out energy audits on a wide range of agricultural businesses. In almost every case these audits of farm enterprises or horticultural units have identified ways in which money can be saved and energy used more efficiently.

A simple example

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

Action: Replace a 100 W bulb with a 20 W 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 14.87 pence / kWh the financial saving = £17.37 each year

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

Dairying

- Check your tariff. Up to one in five of the farmers taking part in the CAFRE electricity benchmarking exercise were on the wrong tariff. This is a loss of around £10 per cow each year.
- Have a suitably sized plate cooler with a time delay on the water solenoid. This will save 60% on your milk cooling costs.
- Save on water heating by good insulation of water heaters and associated pipe-work. An uninsulated tank will lose 50% of its heat in 17 hours, compared to just 5% losses with good insulation.

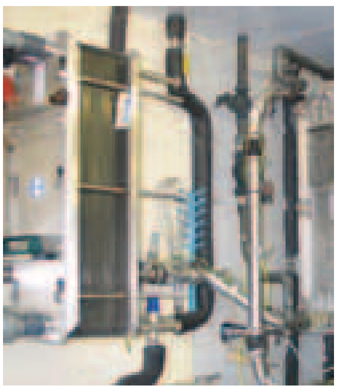


Plate coolers cut the cost of cooling milk

- Watch those lights. Make the best use of low energy bulbs and appropriate use of timers, sensors and proximity switches.
- Large units of over 200 cows should consider installing vacuum on demand pumps and heat recovery systems to capture waste heat from the milk cooling condensers.

Pigs

- Check your tariff. Larger units can negotiate the price with the electricity supply companies
- Have a good control system for heating and air movement
- Savings with low energy lighting can be very significant
- Insulation and draft proofing are critical

Mushrooms

CAFRE carried out energy audits on a number of mushroom units in June 2008. The main areas identified for action are:

- Insulation of the hot water distribution pipe-work
- Change the tariff to benefit from the cheaper night rate
- More efficient air movement by the removal of unnecessary louvres and increasing the size of air inlets
- Installing low energy lighting
- Installing and managing an integrated environmental control system

Beef and Sheep

Beef and sheep enterprises have a relatively low usage of electricity. The main efficiency measure is the installation of high efficiency light bulbs in sheds and work areas.

Field work and arable

Fuel efficiency on tractors and harvesters can be improved in several ways:

- Regular maintenance. Excessive dust on radiators can waste as much as 5% of the fuel
- Maintain the correct tyre pressure - 20% under-inflation can reduce fuel efficiency by up to 30%
- Use the electronic engine management technology. This improves fuel efficiency by giving a rapid response to changing load demand.

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

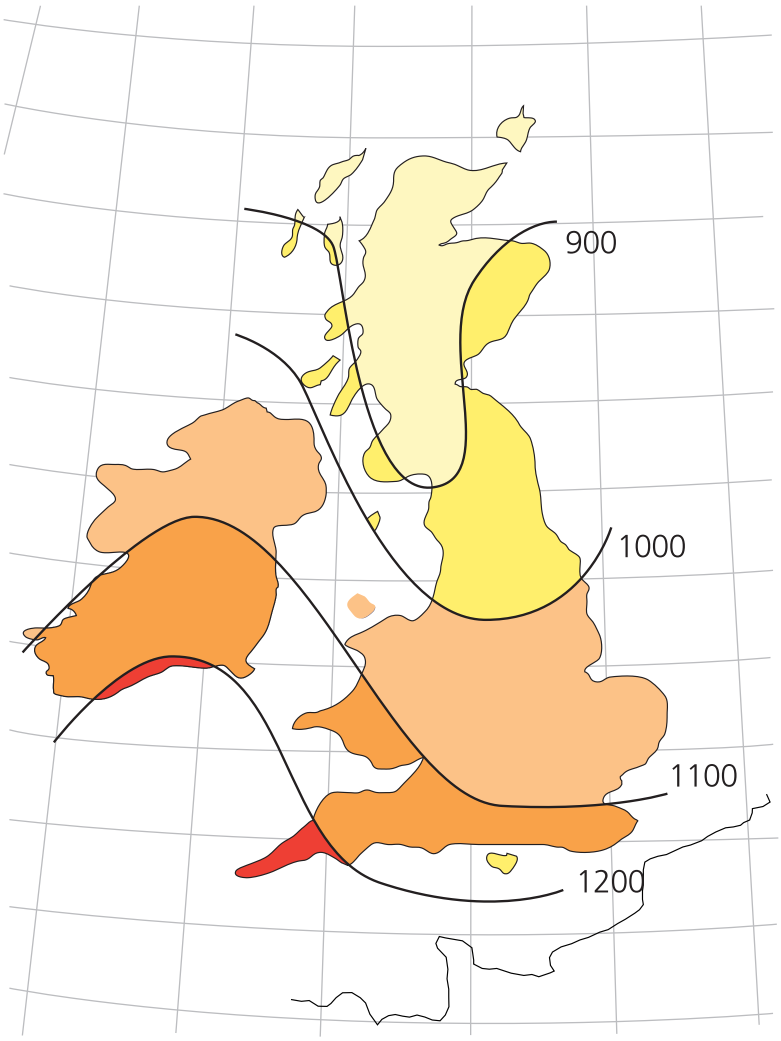
Solar water heating on the farm

David Trimble, Renewable Energy Technologist, CAFRE

In the UK solar systems are primarily used for heating water rather than for generating electricity. They have most application in the high energy use agricultural sectors. For example a dairy cow uses 350 kiloWatt hours (kWh) of electricity per year of which around 40% is used for heating water

Northern Ireland has less direct sunlight than many parts of Europe. The combination of direct and diffuse sunlight which can be harnessed for use is between 1,000 and 1,100kWh per square meter each year.

UK solar irradiation annual total kWh/m²



1. What is a solar hot water system?

A solar water hot water system has three main components:

a. Solar collectors.

These "collect" as much heat as possible from the sun's radiation, retain the heat against loss to the surrounding environment and transmit the heat as efficiently as possible to the hot water storage system.

The collector ideally should face due south, although the annual energy collection will only vary by a maximum of 10% when the surface is anywhere between 30° to the south east or south west.

There are two main types of collector:

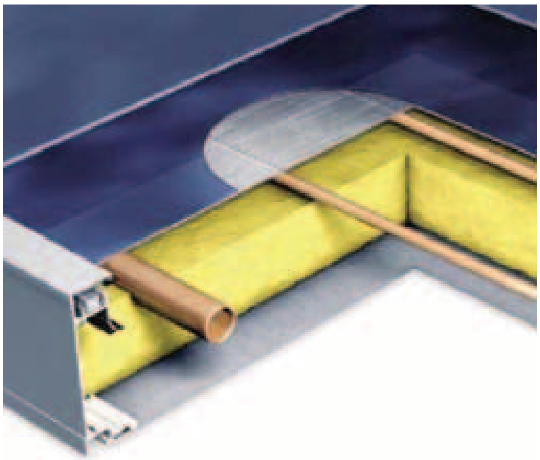
i. Flat plates

Flat plate collectors have three components:

(i) A transparent collector cover. This needs to have a high transmission of visible and near infra - red radiation to capture the maximum amount of solar radiation and a minimum transmission of infra-red radiation to minimise heat radiation back from the absorber to the atmosphere.

(ii) An absorber plate from which heat can be removed by a heat transfer fluid.

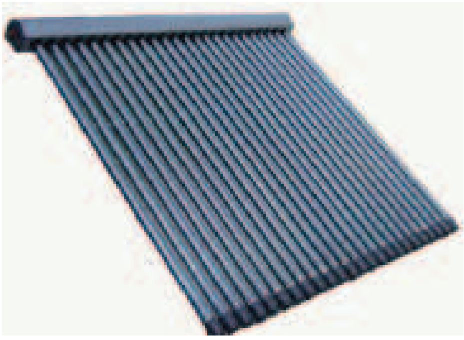
(iii) Substantial insulation to minimise heat loss back into the atmosphere.



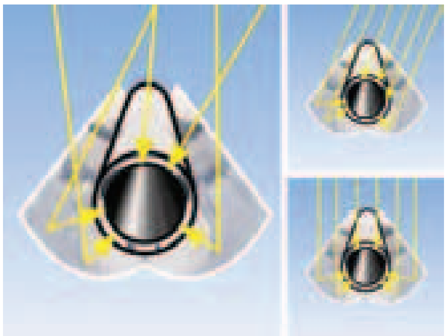
Cross section of a plate collector showing the pipe work attached to the absorber plate

ii. Evacuated tubes

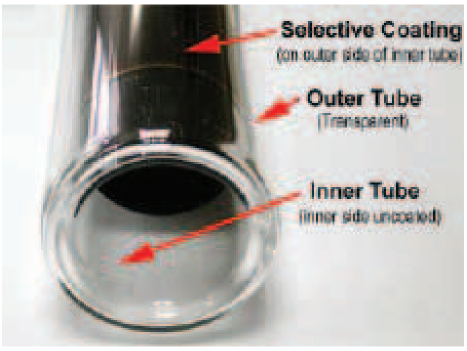
These are glass tubes evacuated similarly to thermos flasks, to reduce the heat losses from convection and thermal conduction. The absorber can be a thin strip of coated metal running the length of the tube or a coating on the outer surface of an inner glass tube. In this case a reflector is necessary to make use of the absorber area away from the sun. These reflectors are frequently used as concentrators and the entire unit of tubes and reflectors is referred to as a Compound Parabolic Concentrator (CPC).



An array of evacuated tubes



The operation of a parabolic concentrator in a CPC system



Evacuated tube of the type in the Greenmount dairy unit

Evacuated tube systems are more expensive per square metre of collector area than flat plate systems. However they would be expected to perform better in cold, changeable and windy conditions. This is particularly the case when the system operates at higher temperatures. Typically a dairy plant cleaning system requires water at 85°C whereas domestic heating systems use water at 60°C.

b. A heat transfer system.

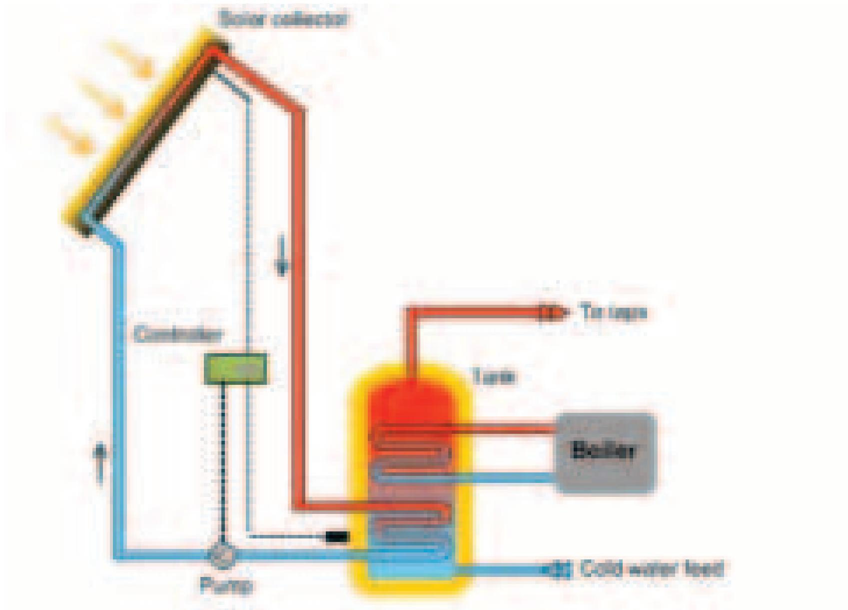
This consists of insulated pipe-work containing the heat transfer fluid, a water pump, a heat exchange system, measurement equipment and a control system. The heat transfer fluid has a high proportion of antifreeze for frost protection.

c. Hot water storage.

The water heated by the solar system during the day needs to be stored for later use. The storage vessel can contain the electric water heater where the pre-heated water has the temperature raised further as necessary.

2. Are there a range of possible systems for farm use?

The most common system is a pressurised indirect primary circuit. In this system the hot water 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.

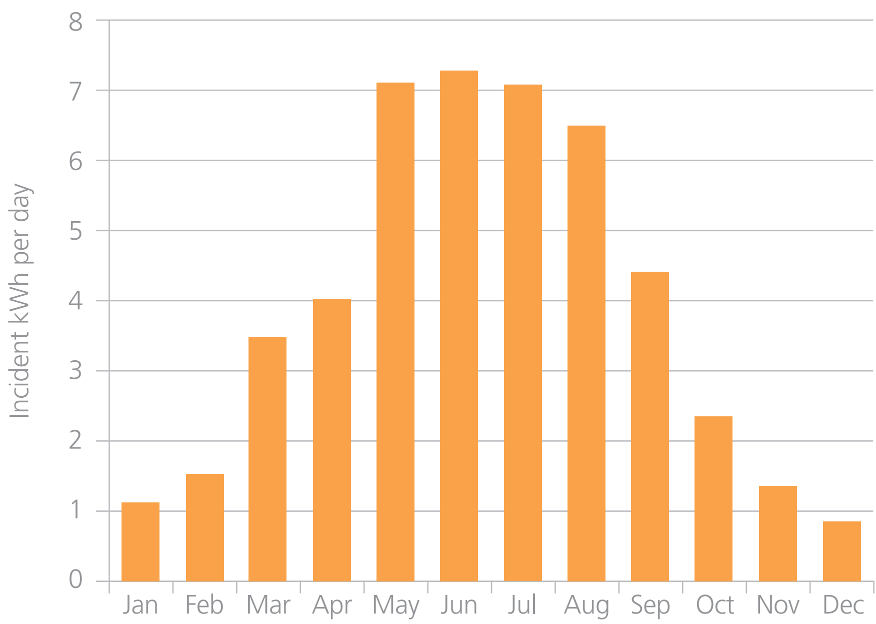


Lower cost options are available and include thermo-siphon systems. In these the collector is integrated with the storage tank in a prefabricated unit and the heat transfer fluid circulates without pumping due to the differing densities of hot and cold water.

3. What is the annual output of a system?

Systems are designed to deliver a high proportion of the requirements in the summer months, make a significant contribution in the spring and autumn and some input during the winter. 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



4. 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.

Action Renewables in a study in 2007 reported that it took £12 a year to run the pump for a domestic system. This will be greater for a farm scale system but overall will not be a significant cost.

5. What is the payback time on the investment?

Payback periods on domestic systems are around twelve years. This is a modest return on capital, however there are a number of factors that will shorten the payback period:

- A farm system used 365 days a year will be more efficient than a domestic system
- Increasing energy prices
- Grant assistance such as the Farm Modernisation Grant
- Tax write-off on the investment

6. Is planning necessary?

The Carbon Trust recommends that a business should contact their planning authority for advice before proceeding with a solar installation.

7. Should I install solar?

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.

Providing hot plant wash water for the Greenmount dairy unit prior to the solar system being installed required 48 kWh per day. During the summer months of 2010 the average daily electricity usage was:

	(kWh)
May	6.5
June	7.2
July	11.4
August	10.7
September	12.9

This was a daily average use of 9.7 kWh, just 20% of that prior to the solar system being installed.

8. Checklist for solar installations

- Orientation of collectors to the sun - between south-east and south-west.
- Angle of collectors to the horizontal - between 40° and 45° to the horizontal
- No shading
- Space for a hot water storage tank
- Area of collectors - 1 sq meter will heat 45 litres to 60°C

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

Short Rotation Coppice (SRC) willow

Dr Alistair McCracken, Applied Plant Science and Biometrics Division, AFBI

Short Rotation Coppice (SRC) is the practice of planting woody crops at high density, which are harvested every 2 - 3 years. While there are a number of candidate crops, willow is particularly well suited to Irish climatic conditions. Willow produces vigorous juvenile growth when it is coppiced, i.e. cut back to ground level. The coppiced stools that remain after harvest re-sprout to form multiple stems and can give dry matter yields in excess of 10 t/ha/yr depending on the site and the climate.

Site selection

Soils: Willow will grow in most agricultural soils with a pH of 5.5 - 7.0. Medium to heavy clay soils with good aeration and moisture retention are ideal although it must be possible to cultivate to a depth of 25cm to enable mechanical planting. Light sandy soils may have a problem with moisture retention and heavily organic soils should be avoided because of difficulties with initial weed control.

Water: Willow is a water demanding crop and needs soils with good water retention. Optimum growth is achieved with annual rainfall of 900 - 1,100 mm. Willow will thrive in wet soils but will not tolerate water logged anaerobic soils. However, soil moisture and structure may have implications for harvesting machinery.

Elevation: The production site should be less than 100m above sea level and have slopes of less that 13%.

Access: It is essential to have hard access to the plantation, particularly for the movement of harvesting machinery in the winter. The root systems of the willow will support the harvesters during cutting, but hard access is vital for the removal of cut willow from the site.

Area: A minimum area of two hectare blocks is recommended. Smaller blocks make it difficult for planting and harvesting. Furthermore it is expensive to rabbit fence small areas if required.

Location: SRC willow will blend into the landscape in most situations. However as it can grow to a height of 5 - 6m by harvest this needs to be taken into consideration. Neighbours will need to be consulted.

Site preparation

SRC willow will potentially be in the ground for a minimum of twenty years so thorough and careful site preparation is essential.

Initial treatment: In September there should be an application of herbicide (4.0 - 5.0 l/ha) while vegetation is still actively growing. If the site has excessively heavy vegetation it should be cut and removed. Allow sufficient time for regrowth to allow herbicide uptake. On grassland and set-aside sites an application of 3.0 l/ha. Dursban will be needed for leatherjacket control. A minimum of ten days after treatment the site should be ploughed. Ploughing should be to a depth of at least 25 cm.

Seed bed: If the site is suitable it can be ploughed and power harrowed in mid-March, six weeks before planting. Any germinating seed can then be sprayed off using 2.0 l/ha Glyphosate. If the site has a heavy clay soil it will be necessary to power harrow as close to planting as possible. Additionally it may be necessary to lift large stones which have the potential to interfere with the planting machinery.

Rabbit and hare fencing: Rabbits and hares can cause significant economic losses, especially during establishment. If there is a rabbit and hare population then the crop needs to be protected using an appropriate rabbit fence.

Planting

Planting material: There are two willow breeding programmes in Europe developing new improved varieties for SRC production. The Swedish programme is controlled by Svalof Weibull AB. Commercially available varieties from the Swedish Programme include; Tora, Sven, Torhild, Tordis, Olof, Gudrun and Inger. The European Breeding Programme which is now based at Rothamsted Research in England has released varieties including Nimrod, Resolution, Discovery, Endeavour, Beagle and Terra Nova.

It is important to note that all of these varieties are protected by Plant Breeders' Rights which means that it is illegal to produce propagation material for self-use or sale. However it is permitted to produce small numbers for gapping up of established crops, from material produced at cutback. Cuttings will therefore have to be obtained from a specialist grower or supplier and will be supplied in the form of one-year old rods for mechanical planting.

Mixtures: For reasons of disease management it is vitally important that a mixture of varieties is planted. The mixture should contain at least six components of which at least two should come from either the Swedish or the European Breeding programmes. The importance of using genotype mixtures cannot be overemphasised. Mixtures will reduce the impact of any disease or insect attack; they will reduce the disease pressure on individual components and will ensure the long term viability of the plantation. Use of mixtures also increases yield.

Timing: Planting should take place from early spring (February/March) to late May depending on weather conditions. Cuttings are planted in double rows (0.75 m apart and 1.5 m between double rows). A spacing of 0.5 m between plants within rows will give a planting density of approximately 18,000 plants/ha. There are a number of types of planting machines but the industry standard has become the Step Planter®. In ideal conditions and large fields a planting rate of 6 - 8 ha/day can be achieved. In most situations there will be an establishment rate of in excess of 90% giving a final plant density of at least 15,000 plants/ha. Where possible the rows should be planted in parallel with the long axis of the field.

Harvesting

The crop is best harvested during the winter, December - February when there are no leaves on the plant. Two approaches are used for harvesting:

Direct chip harvesting. The crop is cut and chipped in a single pass, and blown into trailers for removal. The moisture content of fresh wood at harvest is around 50% and so will require immediate artificial drying, which is normally carried out in a ventilated grain drying floor. Heated air (6 - 10°C above ambient) is used to increase its water holding capacity. It is necessary to reduce the moisture content of the chip to less than 20% and this can normally be achieved in 3 - 6 weeks.

Whole stem harvesting. The 'Stemster' harvester cuts the entire rod which can then be stacked, preferably on a hard surface. The rods will dry naturally to around 30% moisture when they can be chipped for use in boilers. This method avoids the need for specialist drying equipment used in the direct harvesting. However, whole stem harvesting requires collection of the rods and their removal to the standing area. Higher power requirements are needed for chipping the drier rods and the chip produced tends to have a wider particle size.

End use

Wood chip for heat: Willow wood chip is a high volume low density fuel so it is very important from an economic perspective that the production site is close to where the chip will be utilised – normally no more than 20 miles. The simplest and most convenient method of energy recovery is combustion to produce heat. A wide range of boilers are available at a range of outputs to match many requirements. At the present initial stages of the development of the industry it is essential to have established possible end use for the wood chip before planting.

Wood chip energy: In energy terms SRC willow dry matter has an energy content of approximately 19 MJ/kg or 45% of the energy in an equivalent volume of light fuel oil. This gives a mean annual production equivalent to 3300 - 5700 litres of oil/ha/yr. It is normally considered that willow wood chip is carbon neutral, having absorbed the same amount of carbon during growth as is released during burning. Additionally, there are significant carbon savings through the displacement of heating oil. It is estimated that 3,300 litres of domestic heating oil produces 8,355 Kg CO_2. Burning wood chip will reduce the net CO_2 emissions by an estimated 90%.

Expressed another way, wood produces 7 Kg CO_2 per GJ compared to heating oil which produces 79 Kg CO_2 per GJ. Furthermore, biomass does not contain many of the other noxious chemicals that are released when fossil fuels are burnt e.g. sulphur, which can cause major environmental problems.

Bioremediation (Biofiltration)

SRC willow has the potential for the bioremediation or biofiltration of both solid and liquid effluent wastes. Willow can take up large volumes of water and is efficient in the utilisation of nitrogen, and to a lesser extent phosphorous. The use of a plantation for the treatment of sewage sludges and effluents could significantly improve the economics of growing SRC willow. However caution is required when considering bioremediation:

- It is essential to have a full soil analysis to determine whether or not the site is suitable to receive the sludge / effluent.
- A full analysis of the sludge / effluent is required in order to ensure that its application complies with all waste treatment legislation such as the Nitrates Directive and the Safe Sludge Matrix.
- Sludge will have to be pre-treated before application in order to bring about a pathogen kill.
- Approval must be obtained from the Department of the Environment before any waste material can be applied to the land.
- Sites where sludge / effluent is being applied need to be carefully monitored.

For further information contact Alistair McCracken at (028) 9025 5244 or alistair.mccracken@afbini.gov.uk

Heat from biomass

Dr Lindsay Easson, Environment and Renewable Energy Centre, AFBI Hillsborough

Biomass which has been grown and harvested must be delivered within defined quality standards if it is to be efficiently utilized by biomass boilers to deliver heat. Important quality characteristics are:-

- Moisture content
- Chip size
- Ash content
- Chlorine content
- Bulk density

Each boiler works within the quality constraints that the manufacturer sets, although even when operating within these limits the performance of a boiler may vary. Studies have shown, for example, that as the moisture content of the fuel increases, net heat output declines, boiler efficiency declines, gaseous outputs increase and the boiler needs more frequent servicing.

For most boilers the biomass fuel is delivered in a chipped or pelleted form. Generally larger boilers, with greater diameter delivery augers, will be able to handle larger chip sizes. The uniformity of chipped material can be improved by grading to remove both oversized and undersized material. A high proportion of dust can cause particular issues due to the explosion risk from dust laden air.

The most important quality characteristic is the moisture content. Fresh timber or willow at the time of harvest will generally have a moisture content of about 55%. Timber or willow rods left to air dry naturally will reach an equilibrium with ambient conditions within several months resulting in moisture contents below 30%. Artificial drying with warm air ventilation can bring the moisture content to below 15% while wood pellets will generally have a moisture content well below 10%. The lower the moisture content the greater will be the output of heat per kilogram of dry matter. Only relatively large boiler systems (>500kW) are specified to work satisfactorily at moisture contents of above 50%, and even then ignition of the material may be more difficult. Most medium and small scale boilers are specified to perform satisfactorily with biomass fuels below 30% moisture, and prefer material of about 20% moisture.

Achieving uniformly dry woodchip using an on-floor drier can be difficult as the lower layers dry quickly while the top layer initially becomes wetter. If any moulding and compaction occurs in the upper layers the airflow can be restricted reducing the rate of drying. In some cases it may be necessary to remix the material after achieving the desired average moisture content and then allow the whole batch to equilibrate. Due regard must be given to running the drying system only when efficient drying can be achieved, and during very cold spells of weather this may not be possible.

A number of biomass fuels such as miscanthus and grain contain a relatively high amount of chlorine which can give rise to a range of problems including rapid corrosion of the boiler and flue linings, the formation of excessive amounts of clinker in the grate, and the emission of unacceptable dioxins in the flue gases. These issues can be avoided if properly specified boilers are used which have been set up correctly to ensure that sufficiently high combustion temperatures are achieved. In some cases it may also be necessary to add lime to the fuel to counteract the acidity.

In trials being carried out at AFBI Hillsborough using a range of biomass fuels available locally including SRC willow chips, wood pellets, Miscanthus, forest brash and chipped spruce, all the fuels have performed well with heat outputs of between 3.5 and 4 kWh per kg fuel dry matter. The ash content has varied from as low as 0.22% from wood pellets and 0.4% from chipped spruce to 1.2% from SRC willows and 1.9% from Miscanthus.

Correctly set-up biomass boilers can achieve measured heat output efficiencies of close to 90%, and can run in automatic mode with relatively little attention provided the fuel is of consistently high quality. Nevertheless it must be understood that biomass boiler systems do require significantly more management input than would be the case for oil or natural gas fired systems.

For further information contact Lindsay Easson on (028) 9268 2484 or lindsay.easson@afbini.gov.uk

Micro-hydro

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 greater than 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 1800's there were approximately 1200 water powered mills, a proportion of which were hydro turbines. By the early 1900's 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

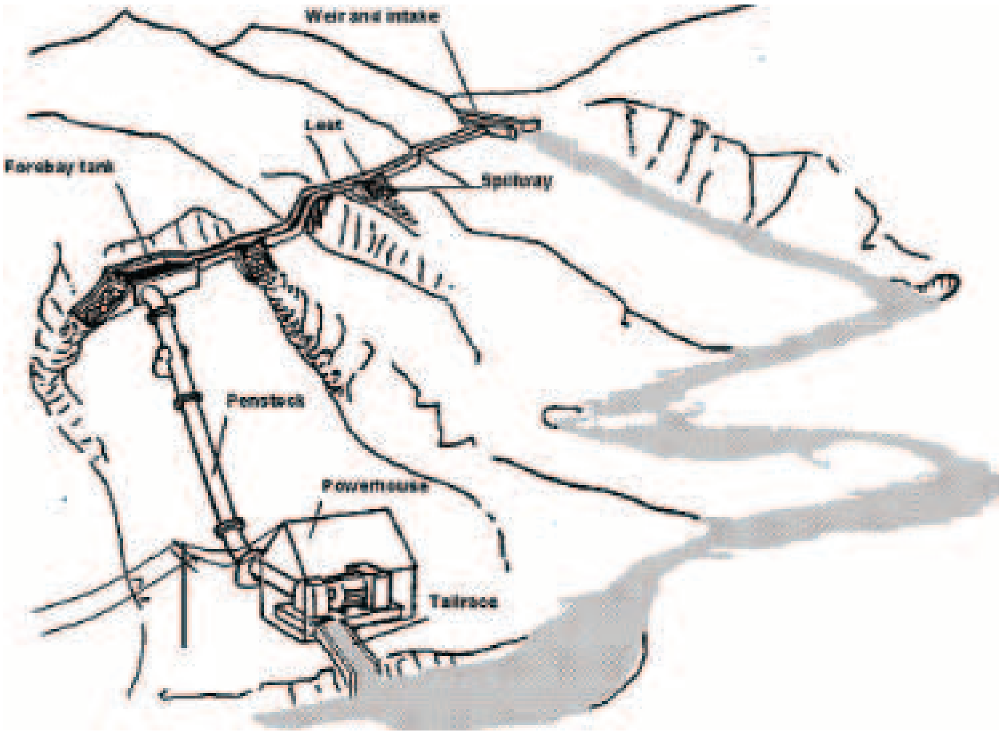
Before embarking on any hydro power generation project it is essential to survey the proposed site to calculate the amount of available hydro power.

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

Hydro facts

- Hydropower is the world's No.1 source of renewable energy. It produces almost 20% of the world's electricity and over 90% of the world's renewable power.
- Less than one third of the world's practical hydro capacity has been developed.
- Hydro beats all other electricity generating technologies with a pay-back ratio of 300 (energy produced/energy to produce) - this is ten times more than oil-fired power stations.
- There are no direct CO_2 emissions from hydro projects.

- Small hydro schemes have minimum visual impact on their surrounding environment.
- Approximately 40% of the UK's renewable energy is provided by hydropower.
- 25 countries depend on hydropower for 90% of their electricity (99.3% in Norway); 12 are 100% reliant on hydro. Hydro produces the bulk of electricity in 65 countries and plays some role in 155. Canada, China and the USA are the three largest generators of hydro electricity. Vietnam has over 2,500 micro-hydro schemes producing electricity for over 200,000 households.
- Hydropower, after 150 years as an electricity generating source, is still one of the most inexpensive ways to generate power.
- Hydro installations can have a useful life of over 100 years - many such plants are in existence worldwide.
- A modern hydro turbine generator can convert over 90% of the energy in the available water into electricity. This is more efficient than any other form of generation.

For further information contact Eoin McCambridge at 07808594557 or eoin70@aol.com

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.

Making energy while the wind blows

Anita Watts, Energy and Enviromental Specialist, Greengage

Northern Ireland has one of the best wind resources in Europe and, as a result, installing a wind turbine here has the potential to provide a good return on investment. This is especially true in light of recent improvements in the financial incentives offered for renewables installation.

However, this doesn't mean that putting up a wind turbine in just any location will deliver a successful project. This article provides guidance on the key factors that need to be taken into consideration.

Wind resource

It may sound obvious, but one of the first things to determine is exactly how windy your site is. The best sites are usually in coastal areas, at the top of rounded hills, on open plains or in gaps in mountains. When a wind project fails to deliver it is more often a fault of the site selection than the technology.

To work effectively, wind turbines need an average wind speed of no less than five metres per second (5m/s). Wind maps can be used to give an initial indication of the wind speed at your site. Visit, for example, www.actionrenewables.org/site/default.asp?catid=4879 or www.decc.gov.uk/en/windspeed/default.aspx)

However, wind maps do not take account of the landscape on a small scale; factors which may have a considerable effect on the wind speed. The wind speeds reported could also be recorded at heights that are greater than most small wind turbines. In short, wind maps will not replace the need to record accurate wind measurements at your site.

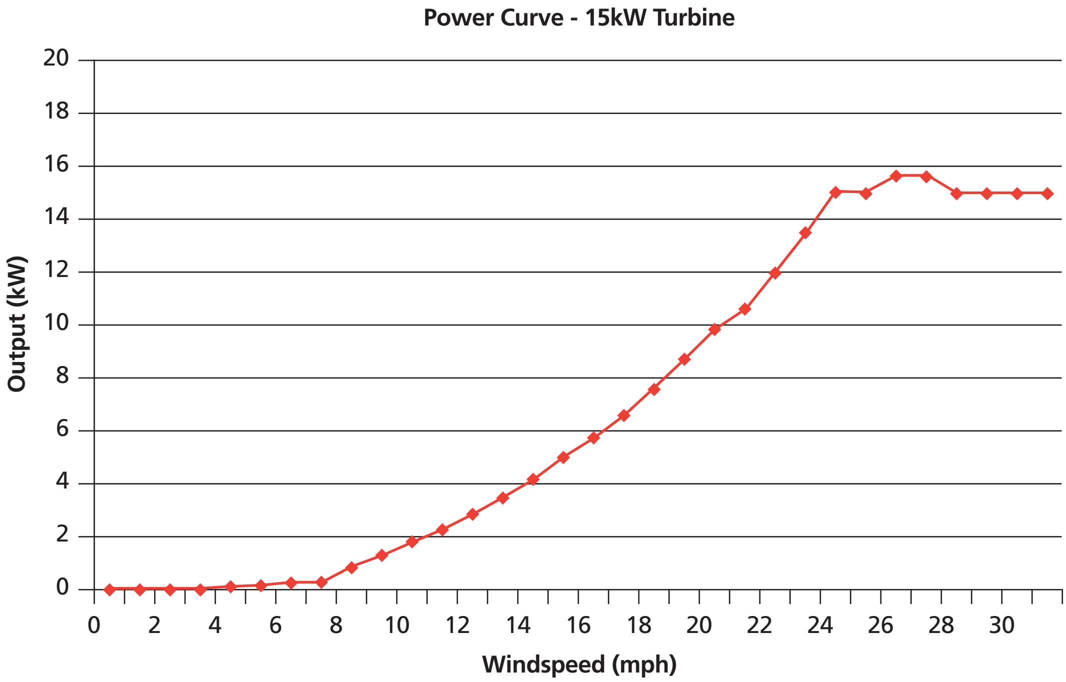
Site selection

Once you have established that you have a good windy site, selecting just the right spot to place your turbine will often be a compromise between a number of factors. Ideally, you are aiming to locate the turbine as close as possible to the point of electricity use but at least 40m from any buildings.

Consideration should also be given to the ease of access to the site. If, for example, a road needs to be built to transport the turbine from a main road, this will have a significant impact on final costs.

Grid connection can also have big cost implications. If the electricity grid is not close to the site and needs extending, or if it needs upgrading to take the amount of electricity generated, then these costs can sometimes make the project prohibitively expensive.

As wind speeds increase with height, it makes sense to put your wind turbine on as tall a tower as you can, within your budget and local planning constraints. It also helps to limit the effects of turbulence, created by the wind passing over obstacles on the ground such as trees or buildings. Turbulence has a significant detrimental effect on the amount of electricity generated, and increases wear and tear on a turbine.



Turbine selection

Once you have selected a suitable site, you now need to select the right turbine. In Northern Ireland we experience a wide variation in wind speeds and it is essential that the turbine can cope with this.

Every turbine has is own power curve graph, which provides information on its performance at different wind speeds. This graph will be a useful part of the process for choosing a turbine that is suited to the wind conditions experienced by your site.

Turbines are given a power rating by the manufacturer. Generally, the larger the turbine's power rating the more electricity it can generate. The size selected will be determined by the demand for energy, project budget, grid strength and planning constraints.

Economics

Developing a sound business case for the project is essential. The financial returns come from combining the savings made from using your own electricity and not buying it all at the tariff price; the income generated from any electricity sold back to the grid; and the Renewable Obligation Certificates (ROCs), which are issued in relation to the amount of renewable electricity generated and have a market value. If the maths adds up, your next harvest could be blowing in the wind.

For further information contact Anita Watts on (028) 4063 0403 or anita@greengagegroup.co.uk

On-farm biogas production

Nigel Moore, Senior Renewable Energy Technologist, CAFRE

What is biogas?

Biogas is a renewable source of energy produced by the action of certain bacteria on organic matter in the absence of oxygen. Growing plants capture energy naturally from sunlight by photosynthesis and store it in the plant. A biogas plant (or anaerobic digester) releases and uses the stored energy from the plants and animal manures.

The process of anaerobic digestion is similar to the digestion process that occurs in the rumen of a cow. In the cow, the energy is utilised for milk production and body maintenance. In the biogas plant, the energy is harvested as biogas and used as a fuel for a biogas engine which produces electricity and heat. Alternatively the biogas could also be fed into a natural gas grid or be used as a vehicle fuel.

On-farm biogas plants

Anaerobic digestion has been used in the sewage treatment industry for many years. In Europe, on-farm biogas plants are common in a number of countries. While many on-farm plants were originally built to digest animal slurries, it was found that digesters running solely on animal slurry did not produce sufficient biogas to be economical. This is hardly surprising when you consider that around 70% of the energy has already been utilised by the animal. The co-digestion of animal manures with green crop silages greatly enhances the biogas yield.

In recent times, the biogas industry has expanded greatly in Europe due to attractive tariffs for producing renewable electricity and the development of co-digestion of slurry with green crop silages such as maize, wholecrop cereal and grass. The table below gives an indication of reported relative gas yields of different feedstuffs in Europe. (AD Portal http://www.biogas-info.co.uk/index.php/biogas-yields)

Feedstock	Dry matter %	Biogas Yield m^3/tonne
Cattle Slurry	10	15 - 25
Maize Silage	33	200 - 220
Grass Silage	28	160 - 200

Research is on-going at AFBI Hillsborough to examine the potential biogas yields from co-digestion under conditions in Northern Ireland.

European biogas plants are commonly fed a ‘diet’ of 70% green crop silage and 30% slurry. It is possible to utilise many other organic wastes in biogas plants but this will involve extra regulation and licensing, and may require extra plant and storage facilities.

In Europe a typical on-farm biogas plant generally consists of a feed intake system, similar to a diet feeder, a slurry intake system, a primary digester, where around 70-80% of the gas will be

produced in a 40 day period, a secondary digester where a further 20 - 30% of the biogas will be collected and a digestate store, similar to a slurry tank.

The gas is collected in the gas store, from where it is piped to the gas engine which generates electricity and heat. Some of these outputs are utilised to maintain the plant and the balance can be exported as electricity to the grid and heat for district heating use or to provide a drying service for grain or woodchip.

The digestate is a good quality fertiliser for land application. Pathogens and weed seeds are killed during digestion, while the nutrient content of the original slurry is maintained. At some biogas plants the digestate is separated with a slurry separator and some of the heat produced by the plant is used to dry the solid fraction. Following pelletisation it can then be sold as a garden or amenity fertiliser.

Key performance factors.

There are a number of key factors affecting the performance of a biogas plant.

Feedstock mixture,

Plant size

Engine efficiency

Engine up-time

Electricity tariff.

It is always advisable to utilise proven technology and a reputable technology supplier when choosing a make of plant. Visit a functioning plant, and talk to the operator. Ask about the performance of the plant and back-up service from the technology suppliers.

The plant size will be related to the availability of feedstock and finance available. It takes roughly the silage from 40ha for each 100kW of electrical output along with the animal slurry.

Aim for an engine with an efficiency of over 40% for electrical output. Lower efficiency engines may be cheaper to purchase but the extra efficiency will normally pay for the extra cost many times over.

Currently two Renewable Obligation Certificates (ROCs) are issued for each MWh of electricity produced from biogas. Recently DETI issued a consultation on proposed changes to ROCs in which it proposed awarding 4 ROCs for each MWh of electricity generated by biogas plants up to 500kW in size and 3 ROCs for plants between 500kW and 5MW. If these proposals become established, then the financial returns from biogas plants will be greatly enhanced. This will no doubt encourage a significant number of farmers to work together to obtain the substantial level of finance required to build on-farm biogas plants in Northern Ireland.

Reliability is key to a profitable plant. At 4 ROCs and an export tariff of 4.5p/kWh, a 300kW plant would have the capacity to generate over £1.00 worth of electricity every minute. Downtime of the biogas engine costs money which cannot be clawed back.

AD Portal

A very useful source of information on biogas production is the AD Portal on the internet at www.biogas-info.co.uk There you will find information on planning permission, feedstocks, regulations, incentives, digestate quality, useful contacts and much more. This has recently been contextualised for Northern Ireland and will continue to be updated as information becomes available.

Meeting the Challenges

Grid connection for small scale renewable generation

Bronagh Lunney, Generation Connections Manager, NIE

From 1st April 2010 the value of the Renewable Obligation Certificate (ROC) received for generating electricity from a number of small scale renewable technologies (less than 250kW) increased from 2 ROCs to 4 ROCs. This is in addition to the price paid by suppliers for electricity produced. The implication of this, along with the increased availability of second hand refurbished wind turbines now coming on to the market, has led to a large increase in queries and applications from customers seeking connection to the distribution network.

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.

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 Connection Conditions within the NIE Distribution Code detail 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.

Operating the network with a greater proportion of "embedded generation" will also be challenging. Recent changes to the Distribution Code have included the request for Supervisory Control and Data Acquisition (SCADA) between the generators above 100kW and the NIE Distribution Control Centre. With this information available, there is additional visibility of the lower voltage network, leading to efficiencies in the local operation of this part of the network into the future.

For further information contact Bronagh Lunney at (028) 6632 1350 or bronagh.lunney@nie.co.uk

Planning permission

Denise Dickson, Operations Team, Planning Service

Wind turbines

Typical domestic or farm scale wind developments can range from building mounted turbines to larger stand alone turbines mounted on towers or masts. A wind turbine, whether attached to a building or erected on its own independently of a building, is considered to be, or of the nature of, plant and machinery. Therefore, planning permission **is required for all wind turbines,** including those on farms.

Planning applications for wind turbines should be submitted on a P1 form along with the appropriate scaled plans and fee. Full details are available at the Planning Service website (www.planningni.gov.uk) or from your local planning office.

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) 1999 as amended by The Planning (Environmental Impact Assessment) (Amendment) Regulations (Northern Ireland) 2008. If you are in doubt as to whether an Environmental Statement is required as part of your application you should contact your local divisional 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 additional information will depend on the individual circumstances of each particular case.

Solar collectors

Solar collectors include solar water heating panels (SWH) and photovoltaic panels (PV). Planning permission **may not be required** for the installation of solar collectors to a dwelling-house or a building within the enclosure occupied by a dwelling-house where they comply with the conditions detailed within Class A, B or D of Part 1 of the Planning (General Development) Order (Northern Ireland) 1993. 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 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) 1999 and are therefore not likely to require an Environmental Impact Assessment. In Areas of Outstanding Natural Beauty (AONBs), 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 Planning Service.

Material considerations

The range of factors that Planning Service 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 Service website 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; and
- 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 Divisional Planning Manager, thus enabling faster decision-making on this type of planning application.

For more information on the above contact Sinead McAvoy at (028) 9041 6700 or sinead.mcavoy@doeni.gov.uk

Anaerobic digesters

Planning permission is required for all anaerobic digesters. All planning applications for anaerobic digesters are processed within the Waste Unit team in Planning Service Headquarters. 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; and
- Community consultation plans.

Full details are available at www.planningni.gov.uk or by contacting the Waste Unit at Planning Service Headquarters.

Fees

From the 4 October 2010, the fee for an application for an anaerobic digester is £1,775 for each 0.5 hectare of the site area subject to a maximum of £38,400.

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 planning policy. In terms of anaerobic digesters the relevant planning 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. Furthermore, additional site specific issues may include:

- Noise;
- Air pollution;
- Visual impact of the anaerobic digester and associated infrastructure; and
- 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) 1999.

Further information and guidance may be obtained from the Waste Unit:

Waste Unit
Special Studies, Millennium House
17-25 Great Victoria street
Belfast, BT2 7BN

Tel: 028 9041 6700
Fax: 028 9041 6802

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

Michael Harris, Sustainable Energy Branch, DETI

The Northern Ireland Renewables Obligation (NIRO) is the Department of Enterprise, Trade and Investment's (DETI) main policy instrument for encouraging the development of new renewables capacity.

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 megawatthours (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.

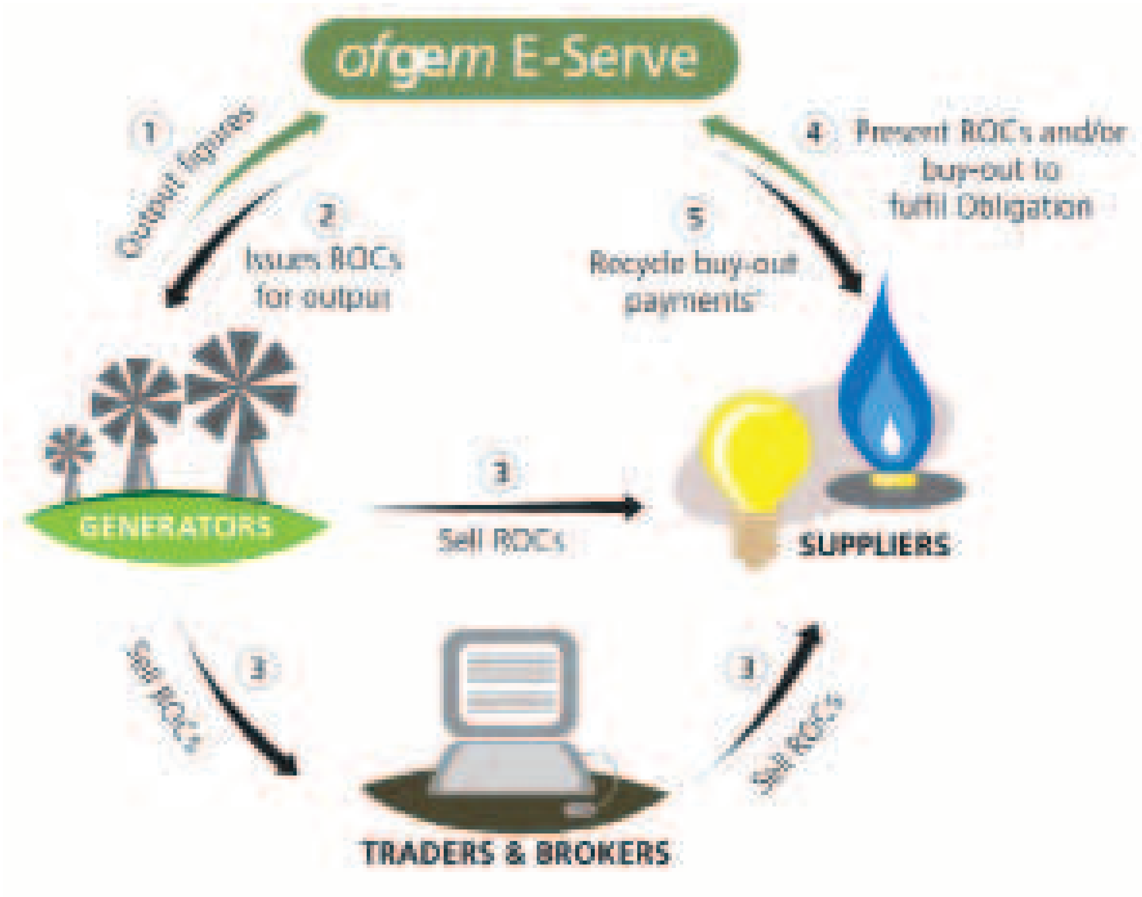
The NIRO also provides for Renewables Obligation Certificates (ROCs) issued under similar Renewables Obligations in GB (GBROCs) to be used as evidence of compliance and for NIROCs and GBROCs to be mutually tradeable across the UK.

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 being 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 £47) can be expected to be at least the 'buy-out' fee (£36.99 for 2010/11) plus the anticipated Buy-Out Fund redistribution proceeds 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 to generators for the electricity they generate after they have set up and are in operation.

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 they generate each month. 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.



Source: Ofgem

A comprehensive list of technologies supported under the NIRO can be found on the DETI website, however the most relevant are replicated in the table below:

Northern Ireland Renewables Obligation (NIRO) - banding table

Generation type	Existing generators (accredited before 1 April 2010) ROC/MWh	New generators accredited from 1 April 2010 ROCs/MWh
Hydro-electric		
<= 20kW	2	4
> 20kW – <= 50kW	2	3
> 50kW – <= 250kW	1	3
> 250kW – <= 1MW	1	2
> 1MW	1	1
Onshore Wind		
- up to 50kW	2	4
- 50kW – 250kW	1	4
- 250kW +	1	1
Solar photovoltaic		
- up to 50kW	2	4
- 50kW +	2	2
Energy from waste with CHP	1	1
Standard gasification	1	1
Standard pyrolysis	1	1
Advanced gasification	2	2
Advanced pyrolysis	2	2
Anaerobic digestion	2	2
Co-firing of biomass	0.5	0.5
Co-firing of energy crops	1	1
Co-firing of biomass with CHP	1	1
Co-firing of energy crops with CHP	1.5	1.5
Dedicated biomass	1.5	1.5
Dedicated energy crops	2	2
Dedicated biomass with CHP	2	2
Dedicated energy crops with CHP	2	2

Note: All microgeneration i.e. up to 50kW receives 2 ROCs/MWh regardless of technology. Exceptions are the changes made to wind, hydro and solar photovoltaic introduced on 1 April 2010

Useful contacts:

Information on the NIRO:
Department of Enterprise, Trade and Investment (DETI)
Tel: 028 9052 9269
www.energy.detini.gov.uk

Accreditation:
Ofgem
Tel: 020 7901 7310
www.ofgem.gov.uk/Sustainability/Environment/RenewablObl

Export tariffs:
NIE Energy
Tel: 028 9068 5010
http://www.nie-yourenergy.co.uk

For further information contact Michael Harris at (028) 9052 9269
or Michael.harris@detini.gov.uk

Marketing Renewable Obligations Certificates (ROCs)

Jonathan Buick, Programme Manager, Action Renewables

To date over 500 businesses in Northern Ireland are embracing renewable technologies to generate electricity. They are experiencing extensive business benefits including lower energy costs and a sustained supply. But organisations in Northern Ireland are not utilising the maximum benefits that can be achieved from Renewable Obligation Certificates (ROCs).

A Renewables Obligation Certificate (ROC) is a green certificate issued to an accredited generator for eligible renewable electricity generated within the United Kingdom and supplied to customers within the United Kingdom. ROCs are issued for each megawatt hour (MWh) of eligible renewable output generated. The current market value is around £47.00, and the number of ROCs issued depends on the generating capacity and type of the technology.

The scheme which issues ROCs and creates a market for them is the Renewables Obligation, which places an obligation on UK suppliers of electricity to source an increasing number of ROCs. Electricity supply companies seek to purchase ROCs to fulfil their obligation, or else they will have to pay a "buy-out fee". This creates a market across the UK in the trade of ROCs. Locally the Northern Ireland Renewables Obligation is designed to incentivise renewable generation into the electricity market here. The scheme was introduced by the Department of Enterprise, Trade and Investment and is administered by the Utility Regulator (whose day to day functions are performed by Ofgem).

Currently Northern Ireland businesses that have installed a renewable technology to create electricity are making significant savings on their energy bills. However, they could use their technology to generate revenue and reduce the payback period significantly by looking further afield and selling their ROCs to licensed electricity suppliers across the UK.

To give a working example; a small business or farm with a 20KW wind turbine, generating 26,200 units of electricity for use in their business each year, will generally save more than 10 pence per unit on their electricity; over £2,000 per year. They will also receive 104 ROCs that can be sold to a licensed electricity supplier and at the current market price this equates to over £5,000. The added revenue will also reduce the company's payback period to six or seven years. Wind turbines up to 250kW can now obtain 4 ROCs per MWh of electricity generated, regardless of whether this electricity is used to offset demand on the business or sold to the grid. Action Renewables is seeing an upsurge in interest in these turbines due to the revenues obtained from selling ROCs, which can provide a return on investment of around 5 years.

Most businesses will automatically think of selling their ROCs in the Northern Ireland market but could receive a higher price for them if they explore all opportunities and examine selling them in the UK mainland. This option becomes increasingly important, the more the generator consumes the output of the turbine onsite. Electricity, unfortunately, can only be sold to supply companies in Northern Ireland, such as ESBIE, Airtricity and NIE Energy, and so these companies will often offer a "package" deal for ROCs and electricity.

Independent guidance can help generators to optimise the returns from their renewable energy technology. Action Renewables Energy Trading Limited can assist organisations in finding the best deal for selling ROCs and electricity and provide guidance through the process.

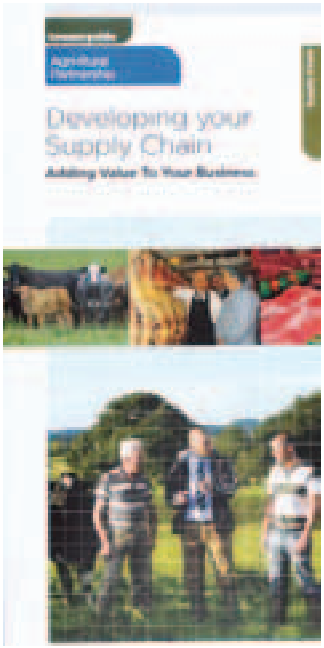
For further information on ROCs please contact Jonathan Buick, Programme Manager, Action Renewables on **028 9073 7862** or email jonathan.buick@actionrenewables.co.uk.

Can you develop a renewable energy supply chain?

Gareth Gormley, Senior Rural Enterprise Adviser, DARD

Awareness events such as 'Practical on-farm Renewable Energy' at Greenmount Campus will stimulate many farmers to consider the production of renewable energy crops on their farm. It may also prompt the question 'Can I work with others to add value and create a sustainable business opportunity within the renewable energy supply chain?'

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



Farmers and growers planning to develop profitable and sustainable renewable energy businesses should create efficient, effective and stable supply chains to be successful in the competitive energy market. When entering a new market, issues often arise surrounding knowledge, planning, legislation and funding. The immediate challenge for farmers is to understand the opportunities for renewable energy crops and the markets for heat and power from these crops.

The Supply Chain Development Programme is designed to provide support for farmers and growers who want to examine how they and potential partners can work collaboratively to improve rewards from their supply chains. The renewable energy sector represents a significant new opportunity. Successful entry to this market will require farmers and growers not only to develop an understanding of the market needs but also to establish relationships with a new group of supply chain partners.

The Supply Chain Development Programme can provide facilitation and financial assistance for farmers wanting to develop their renewable energy business idea.

Participation in the programme can assist the development of supply chain structures that will encourage increased levels of collaboration between farmers and customers in the renewable energy sector.

For more information on the Supply Chain Development Programme you can contact;
Gareth Gormley, DARD, 028 3025 5912; or
Sam Hawkes, Countryside Agri-Rural Partnership, 0845 026 7538.

Renewable energy grants and funding for the agricultural and rural sector

Nicola Chang, New Business Developer, Action Renewables

Farm Modernisation Programme

Tranche 2 of this programme opened for applications on Monday 18th October 2010 and will close on Friday 26th November 2010.

Section 1.57 includes grant aid for solar panel water heating systems with water storage tank. For systems up to 300 litres heating capacity the maximum grant is £1,245. For systems above 300 litres heating capacity the maximum grant is £1,730.

Section 1.59 includes grant aid for single stage plate coolers (maximum £590), twin stage plate coolers (maximum £685), dairy unit heat exchangers (maximum £1,190 for up to 300 litres heat recovery capacity and £1,480 for over 300 litres heat recovery capacity).

Further information about the support available under the Farm Modernisation Programme can be found at www.dardni.gov.uk/index/grants-and-funding

NIE farm solar water heating scheme

Farmers in Northern Ireland can avail from the NIE SMART Programme which offers a grant towards the cost of installing a solar water heating system. This system captures the heat of the sun to heat water on the farm.

Grants detailed below.

1. Less than 300 litres of hot water on farm - £900 or a maximum of 25% is available for a system which provides up to 300 litres of hot water on farm.

2. More than 300 litres of hot water on farm - £1,100 or a maximum of 25% for a system providing over 300 litres of hot water on farm.

NIE provides a range of grant funding for both farm and domestic use. Check their website at www.nieenergy.co.uk to check the grants currently available.

Forestry grant schemes

Short Rotation Coppice Scheme (SRCS)

This scheme will contribute to the cost of establishing approved willow energy crops. The scheme intends to develop the renewable energy market by increasing the amount of short rotation coppice grown for energy use in Northern Ireland. The harvested crop is usually converted into wood chips which can be used as fuel to generate heat and electricity.

Applications must be submitted by 31 January each year to fund planting in the following spring.

For more information contact the Scheme Manager, Birnie Brown on (028) 9037 8502 or at birnie.brown@dardni.gov.uk

Other available grants to households

NIE household grant for solar photovoltaics (PV) and wind

The NIE SMART Programme also provides support for home owners who wish to install solar PV, solar thermal or domestic wind turbines technologies on their premises. This funding is only available for electricity supplies on the domestic tariff.

Photovoltaics - £2000 per kWP or 30% of the relevant eligible costs, which ever is the lesser amount (MAX. £10,000)

Wind - £900 per kWP or 30% of the relevant eligible costs, which ever is the lesser amount (MAX. £4,500)

NIE household solar water heating scheme

The NIE SMART Programme for solar water heating will provide a grant of £400 per system.

For further information contact Nicola Chang at (028) 9073 7861
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