

International Poplar Commission

Environmental Applications of Poplar and Willow Working Party

18th-20th May 2006, Northern Ireland

Site visit notes

THURSDAY 18TH MAY

Rural Generation

Rural Generation Limited was formed in 1996 to commercialise the Department of Agriculture's Research and Development project on the gasification of willows chip. Over the previous decade, the Department has been developing a concept of growing willows, harvesting them every three years and generating heat and electricity using a gasifier linked to a diesel engine. The company has since expanded and diversified and currently supply willow cuttings and planting, willow harvesting, design and installation of irrigation systems for dirty water, injection of sewage sludge into willows. Rural Generation also supply, install and commission wood chip and wood pellet boilers and are agents for Farm 2000, KWB, RIKA and Dell Point, as well as act as consultants on all of the above technologies.

Wood gasification and power generation



The gasifier comprises a 9m³ hopper to hold wood chip.. This feeds a downdraft gasifier which is connected to an Iveco diesel engine. The system operates in batch mode, typically running for 12-14 hours per day producing 95kWe and 200kWth, exporting the electricity to the National Grid and using the heat to dry cereals on the 420ha farm. During the winter, heat is also used to dry willow wood chip to be used in the gasifier.

The cost of the gasifier is £1300 per kW. This includes containers, hoppers, control system, electricity generation system, safety systems, heat exchangers on the engine exhaust and the engine cooling system, and all installation and commissioning. It does not include structural modifications to accommodate the CHP unit, compressed air supply, fuel storage silo, or grid connection costs.

Sewage sludge recycling

In October 2004, Rural Generation won the contract to take sewage sludge cake from Culmore Sewage Treatment Works. This involves recycling 7,200 tonnes of sewage cake on an annual basis. This is approximately 600 tonnes per month. A driver takes a tractor and specialist trailer into the sewage treatment plant. He loads the trailer with approximately 10 tonnes of sewage cake and covers the trailer with tarpaulin. The tractor and trailer are then driven to the willow field (all willow fields owned by Brook Hall Estate are within a 10 mile radius of Culmore Sewage Treatment Works). The trailer tips the sludge directly into a bin auger which then takes the sludge to the sludge injector trailer, the injector trailer is towed behind a

tractor through the field where it cuts a slot in the ground, between the newly harvested/planted willow and screw augers the sludge into the trench. Discs on the trailer then fold the soil over the sludge, completely covering sludge such that none is visible above ground.

Wastewater management

The Department of agriculture and Rural Development (DARD) and Rural Generation Limited operated a trial site at Culmore Sewage Treatment Works in L'derry from 1998 to 2004, when, due to construction work at the treatment works, it was required that this site be cleared. This work was originally set up under the auspices of a EU Fair 5 Scheme with the following objectives:

- To measure the biomass production of willow coppice, irrigated with wastewater.
- To evaluate the efficiency of the coppice in removing nutrients and pollutants from the wastewater /soil system.
- To calculate the contribution of the wastewater to the overall nutrient and water requirement of the coppice.
- To assess the environmental, social, sanitary, economic and legal implications of using a bio-filtration system

The results indicate that there is a trend towards greater biomass yields as wastewater irrigation rates are increased. There is also an increased bio-diversity compared to agricultural grassland and under controlled conditions there is no detectable level of nitrate, phosphate or heavy metals detectable in the ground water below the irrigation treatment. The project final report can be found at the following website: <http://www.sweco.se/upload/bwcwslut.pdf>

Commercialising R&D

Rural Generation are also involved in a new project which is part funded through the EU LIFE Environment Programme. This project – Water Renew – is designed to bring to commercial adoption, the technology for wastewater management using fast growing tree species, developed through projects such as that previously conducted at Culmore.

The partners in this project are WRc plc (lead contractor), Queens University, Belfast, DARD and Cranfield University. WRc has established four demonstration sites across England and is still in negotiation to establish two more. Cranfield University has developed an intensively monitored experimental site at its own sewage treatment works. A new site is being developed at the Culmore works which is demonstrating both poplar and willow as a final polishing system for sewage effluent, which should give the project a total of eight sites at which to demonstrate the technology and gather information for the development of a computer based site design model. The project will run until December 2008.

Rural Generation has also developed willow wastewater treatment facilities at the Earl of Desmond Hotel in Tralee, Ireland where all the wastewater arising from the hotel, which is open between April and October, is applied to 4 ha of willow coppice following partial treatment in aeration tanks. New systems are currently under development for sewage treatment and industrial wastewater treatment.



Location of the site visits			
1	Rural Generation at Brook Hall	4	ABFI at Loughgall
2	Culmore sewage treatment works	5	Slieve Donard Hotel
3	Camphill	6	Grey Abbey
		7	Mount Stewart

FRIDAY 19TH MAY

Camphill Community

Camphill is the name given to the movement of intentional therapeutic communities founded by Dr Karl König, an eminent Viennese paediatrician. Along with a group of people he established, in 1940, the first community with children with special needs in Camphill House near Aberdeen, Scotland.

A Camphill community is created by a group of people who live, learn and work together according to Christian ideals and deriving inspiration from the philosophy of Rudolf Steiner. The co-workers and those with special needs who come to communities live together in an atmosphere of mutual respect.

There are over 90 communities in some 20 countries of the world. 47 of the communities are in the UK and the Republic of Ireland. Some communities are in, or on the outskirts of, towns or cities. Others are in the country.

People with special needs, co-workers (unpaid workers) and their families live and work together in extended family settings or in supported independent accommodation.

Everyone in Camphill contributes to the life of the community according to his or her ability to do so. This may mean helping with household chores, teaching, administrative work, therapies, working in the gardens, on the farms and estates, or in a workshop. Everyone takes part in the varied cultural and social life of the community and in the on-going education programmes run in each community.

Some communities are residential schools for pupils from three to eighteen years of age. Others are further education and training centres for young adults up to age 25. There are many adult communities where everyone works either in the community itself or in local formal or voluntary employment. Many young people and adults attend local college courses on a part-time basis. There is one community in the UK for older people where the pace of life is geared to their needs.

The schools provide a holistic and fully integrated approach to the care, education and medical treatment of pupils. The programme draws on classroom, practical and artistic activities, medical therapies and home life to foster the unique qualities and potential of each pupil. The curriculum offered is adapted from the Waldorf Curriculum developed by Rudolf Steiner.

All the communities are voluntary, charitable organisations whose daily running costs are met in general through individual fees or benefits from a variety of central and local government sources. In adult communities, fee income is sometimes supplemented by income generated from the sale of produce or craft items. Fund raising is of vital importance to capital development.

Camphill Community Clanabogan lies on a property of 70 acres (30 hectares) in the beautiful rolling countryside of Co. Tyrone, 4 miles (6 km) from the town Omagh. It began in 1984 and now 80 people live there in 6 households, some large, some small. In this therapeutic community, adults who have difficulties arising from mental and emotional disability live and work together with co-workers and their children.

Agriculture and horticulture are very important activities in the community and provide healthy and meaningful work as well as enhancing people's awareness of the

environment, the seasons and the land on which they live. Milk and milk products, meat, grain, vegetables and fruit are produced naturally without chemical fertilisers or pesticides, following the approach of biodynamic agriculture. With additional rented land, 115 acres (46 hectares) are farmed. The farm is Demeter certified, guaranteeing safe, holistic methods

Sustainable Development through Renewable Energy

Omagh College of Further Education is situated in the west of County Tyrone. The wider catchment area of the college is largely rural. Employment within the area is largely agricultural and small rural based businesses. With this in mind the college's management team has implemented a development programme in conjunction with employers and representatives from community groups and local government. The initial aim of the project was to support activities which would stimulate rural diversification and innovative energy applications in the local area.

To this end, the college set up The Omagh Environmental & Energy Consortium (OEEC) in 2002 with the college as lead partner. This Consortium includes representatives from the Ulster Farmers Union (UFU), the Northern Ireland Agricultural Producers' Association (NIAPA), the Camphill Communities, Omagh District Council and the Department of Agriculture and Rural Development for Northern Ireland (DARDNI). The OEEC then secured almost £200 000 through the Local Strategy Partnership to establish an innovative project

The principle project objectives were to:

- Install a farm-based renewable energy facility, which implements each relevant renewable energy application: wind power, solar energy, photovoltaics, and heating using biomass and ground source heat pump.
- Raise awareness of the need for and applications of renewable energy and provide education to the wider community.

Construction of the renewable energy demonstration facility at Camphill Community commenced in 1999 with the installation of the district heating system to the first of seven buildings, and it has been open to the public since September 2003. This facility is a working demonstration scheme featuring a range of key renewable energy technologies which have been developed and installed on the site, including:

- 20 kW wind turbine for electricity generation
- Ground Source Heat Pump
- Biomass (woodchip) fuelled district heating system
- Solar water heating
- Electricity generation using a photovoltaic array

These systems are all working to meet the energy needs both of the Camphill residential centre and the farming enterprise as well as providing a state of the art demonstration resource for education and research and development into renewable energy applications.

Initially, the wood used for the heating system was all sourced from the farm, but as the system has been expanded it has been necessary to buy-in fuel which comes from a large local sawmill. It is estimated that fuel cost savings of between £13,000 and £20,000 have been achieved compared with oil fired heating.

This project provides the opportunity to develop a regional centre of excellence for research and education in the area of applications of renewable energy technology at

a community and small business level. The project has already gained recognition as follows:

- The project won the prestigious Action Renewables 2004 Award for the Best Community Project in Northern Ireland
- The Beacon Churches Award for Sustainable Community

Reed bed water treatment

The Community originally used septic tanks to treat waste water having no access to mains sewage, but there was always a problem with effluent polluting the waterways, a small stream discharging into the Owenreagh River. With the increase of population and buildings a better solution was needed, hence Iris Water and Design was approached to submit a feasibility study for a system capable of treating waste water for a population of 100 people.

A system of three ponds, cascade and wetland area was chosen from the proposals submitted. After sourcing funding and obtaining the required consent for construction and discharge, the main work was started in September 1993. The upper two ponds are both lined with 500 micron Polytarp between two layers of Fibertex Polyfelt. The whole area was finally covered with aggregate. The third pond is basically lined with puddled clay, with no artificial liner. The final planting of the wetland and marginal areas took place in June 1994.

The system is relatively low on maintenance input. De-sludging on such systems is normally not necessary for a period of 10-20 years. The marginal vegetation needs to be cut back in autumn. The flow through the cascade and reed bed needs a weekly check and flowforms need to be kept free of algal growth. Now, after more than 9 years, the system continues to function well with only minor problems such as an occasional build up of weed or odour, but these things right themselves or can be managed.

The performance of the system has been temporally assessed using water recognised water quality parameters. Strength of sewage entering system:

Nitrate	2.5 mg/l	DO	2.4mg/l
Ammonia	17mg/l	pH	7.6
Nitrites	0.025mg/l	Alkalinity	270mg/l
Sulphate	36mg/l	Chloride	60mg/l

Removal rates for the system are 99.5% reduction in BOD and a 99.5% reduction in suspended solids. Removal rates for nutrients, such as ammonia nitrogen and phosphates are 90% and 83% respectively. Pathogens have been effectively eliminated by the system.

SATURDAY 20TH MAY

SeaGen

Marine Current Turbines (MCT) is to install a 1 MW Seagen tidal current turbine in Northern Ireland's Strangford Lough, which has one of the strongest tidal currents in the UK and Ireland. The project is being supported by a £4.27m grant from the DTI's Technology programme. The turbine will be installed later this year and will be linked to the local grid. Queens University Belfast will manage the monitoring programme. The 5 year pre-commercial pilot project follows sea trials of the DTI supported 300kW SeaFlow which has been running off the north Devon coast at Lynmouth for nearly three years.

Advantages of tidal power include its predictability, certainty of 'fuel' supply, and zero carbon emissions. The project includes a comprehensive assessment of the environmental impact of the technology. Recognising the sensitivity of the location, the project team is working with the Environment & Heritage (environmental regulator) and conservation bodies to agree an adaptive and extensive approach to the management and environmental monitoring of *SeaGen's* installation and operation



Marine current turbines work, in principle, much like submerged windmills, but driven by flowing water rather than air. They can be installed at places with high tidal current velocities, or in a few places with fast enough continuous ocean currents, to take out energy from these huge volumes of flowing water. These flows have the major advantage of being an energy resource which is mostly as predictable as the tides that cause them, unlike wind or wave energy which respond to the more random quirks of the weather system.

The technology under development by MCT consists of twin axial flow rotors of 15m to 20m in diameter, each driving a generator via a gearbox much like a hydro-electric turbine or a wind turbine. The twin power units of each system are mounted on wing-like extensions either side of a tubular steel monopile some 3 m in diameter which is set into a hole drilled into the seabed. The design life for the tidal turbines should exceed 20 years and the main monopile support structure can be designed to survive for many decades. The steel pile and other main structural elements in an MCT tidal turbine have cathodic protection and the rotor is constructed from glass and carbon fiber reinforced composite materials which are not significantly effected by contact with seawater.

The patented design of the turbine is able to be installed and maintained without the use of costly underwater operations. A unique feature of MCT's technology is that the turbines and accompanying power units can be raised bodily up the support pile clear above sea-level to permit access for maintenance from small service vessels. This is

an important feature because underwater intervention using divers or remotely operated vehicles (ROVs) is difficult in locations which have the strong currents needed for effective power generation.

The submerged turbines, which will generally be rated at from 750 to 1500 kW per unit (depending on the local flow pattern and peak velocity), will be grouped in arrays or "farms" under the sea, at places with high currents, in much the same way that wind turbines in a wind farm are set out in rows to catch the wind. The main difference is that marine current turbines of a given power rating are smaller, (because water is 800 times denser than air) and they can be packed closer together (because tidal streams are normally bi-directional whereas wind tends to be multi-directional). It is expected that MCT's turbines will generally be installed in batches of about 10 to 20 machines. Many of the potential sites so far investigated are large enough to accommodate many hundreds of turbines.

<http://www.marineturbines.com/home.htm>

Grey Abbey

John Martin is a farmer in the Ards Peninsula who has planted 8.4 ha of SRC willow. His plan was to irrigate the willow with effluent from the local wastewater treatment works, which is just across the road from his farm. However, in the mean time the treatment plant has been upgraded and produces an relatively clean effluent. It has proved difficult to identify another suitable source of effluent and John is currently exploring alternative types and sources of effluent that can be applied.

Mount Stewart

Mount Stewart House is the former home to a fascinating array of political leaders and society figures. There are many stories about the prominent political figures to whom the Londonderry family played host and artefacts include the 22 chairs used at the landmark Congress of Vienna, called to redefine Europe's frontiers after the fall of Napoleon. The house includes world-famous paintings including a huge George Stubbs painting voted one of Britain's 100 Greatest Works of Art.

The famous gardens at Mount Stewart were planted in the 1920s by Edith, Lady Londonderry, and have been nominated a World Heritage Site. The magnificent series of outdoor 'rooms' and parterres contain many rare plants that thrive in the mild climate of the Ards Peninsula. There are dramatic views over Strangford Lough from the Temple of the Winds. The landscaped park was awarded the title: European Garden of Inspiration 2003.

This weekend, Mount Stewart is hosting a *Grand Garden and Craft Fair* which will comprise craft stalls, floral art competition & festival, family entertainment, music, Mount Stewart plant sales and plant swap shop.