SUSTAINABLE ENERGY IRELAND
Renewable Energy Information Office

BIOMASS RESOURCE PACK

A comprehensive information pack on biomass technology including:

- A "Best of Biomass" resource CD on all biomass covering anaerobic digestion, landfill gas recovery, liquid biofuels and wood energy. Includes case studies and overviews of each biomass area. Easily searchable web format.
- A compilation CD from the SEI/COFORD Wood Energy conferences 2002-2004 and Study Tours 2001-2003. A wealth of information from experts on wood fuel development. Easily searchable web format.
- Wood Fuels Basic Information Pack – a publication from the BENET Bioenergy Network, Finland – covering all aspects of wood fuel production and combustion. (Retail value €45)
- Biomass Co-firing and Combustion-IEA publication on combustion technology and fuel supply chains, for biomass-to- energy applications ranging in size from domestic to industrial scale. (Retail value €45)
- Wood Pellet Production Study-full colour printed copy of a study conducted by SEI REIO on wood pellet production in Ireland. Full overview of pellet production technology.
- Wood Energy Revue magazine from the European Institute for Wood Energy (ITEBE). Latest issue on developments in wood energy and market reviews.

The resource pack is available online at www.sei.ie/reio/reiobookshop.html
Cost: €75

CHP PERFORMANCE TEST VALUES - 17.08.2004

PERFORMANCE VALUES:

Boiler Efficiency	88%
Electrical Efficiency	21.13%
Average Electrical Output	2175 kWe/hr

EMISSIONS VALUES:

	Measured Values	Licence Values
Dust	12mg/Nm³	50mg/Nm³
Co	92mg/Nm³	200mg/Nm³
NO_2	214mg/Nm³	500mg/Nm³
Reference	O_2 = 6% in dry flue gas	

PLANT AVAILABILITY:

Steam Availability	99%
Electrical Generation	97%

PROJECT PARTNERS
SWS Group www.sws.ie , Email: energy@sws.ie
Wartsila Biopower www.wartsila.com
Grainger Sawmills info@graingersawmills.ie

GLOSSARY & FACTS

Power is measured in:

1,000 watt (W) = 1 kilowatt (kW)

1,000 kW = 1 Megawatt (MW)

1,000,000 kW = 1 Gigawatt (GW)

Energy is obtained by multiplying time by power. Energy is measured in:

1,000 kilowatt hours (kWh) = 1 megawatt hour (MWh)

1,000,000 kWh = 1 Gigawatt hour (GWh)

The average household uses 5 MWh per year for its domestic electricity requirements.

ENERGY VALUE

FUEL	MEASURING UNIT	MWH
Light Fuel Oil	Tonne	11.806
Wood chips	m³ of bulk wood	0.80
Sawdust	m³ of bulk wood	0.60
Softwood bark	m³ of bulk wood	0.60

Contact SEI REIO for an information pack on bioenergy including presentations, case studies and handbooks on bioenergy or to discuss your individual project needs.

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Sustainable Energy Ireland promotes and assists the development of sustainable energy. SEI is funded by the Irish Government under the National Development Plan 2000-2006 with programmes part financed by the European Union.

NDP NATIONAL DEVELOPMENT PLAN
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DEVELOPMENT OF IRELAND'S FIRST BIOMASS CHP PLANT

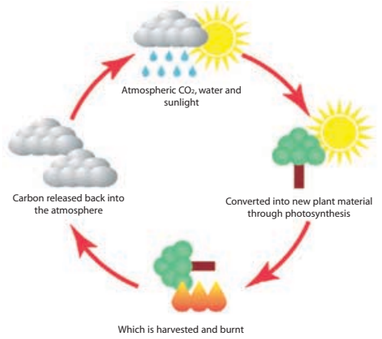
Location:	Grainger Sawmills Ltd, Enniskeane, West Cork
Project Start Date:	May 2003
Commission Date:	May 2004
Owner:	Independent Biomass Systems (SWS Group and Grainger Sawmills)
Tech. Specification:	Electrical output 1.8MWe Thermal output 7.88MWth
Project Capital Cost:	€6.2m

Grainger's Sawmill CHP Plant

Biomass is organic material, either raw or processed, within an intrinsic energy content that allows conversion to electricity or heat.

The main types of biomass resources include: wood residues (from forestry, construction and wood processing) agricultural by-products (straw, animal manure), sewage sludge, food industry residues and energy crops.

Biomass is carbon neutral. When it is used for energy, no net carbon dioxide is released as it consumed carbon dioxide as a growing plant.



Source: British BioGen, the UK Trade Association for Bioenergy.

SUMMARY

The construction of a biomass CHP plant at Grainger Sawmills, Co. Cork marks the development of the first such installation to be built in Ireland. This demonstration project is a joint venture between two companies - Grainger Sawmills Limited and SWS Group who have come together to develop the project from concept to an operational plant generating green energy (Heat and electricity) from wood by-products such as sawdust, bark, peelings and forest thinnings.

This development means that in addition to having a plentiful supply of hot water at a fixed cost, the sawmill also has a guaranteed market for its low-grade residues, protection from fluctuating energy costs, a new revenue stream from 'green' electricity which is sold to the National Grid and the satisfaction of knowing that it has reduced lorry journeys from the sawmill by an expected 1,500 per year. By investing in a biomass CHP plant the company has added as much value as possible to the timber processed from the mill while keeping the cost base as low as possible and improving environmental performance.

WHY BIOMASS CHP?

Biomass CHP is a very common industrial energy efficient technology used increasingly in industry world-wide. Combined heat and power is the generation of thermal and electrical energy in a single process. CHP installations can typically convert up to 90% of the energy in the fuel into electrical power and useful heat. This compares with conventional power generation, which has a delivered energy efficiency of only around 40%. Biomass CHP uses a renewable source of energy, which is carbon dioxide neutral.

CHP technology can be used to produce process or space heating and hot water for commercial and industrial applications. For energy intensive industries, CHP can make a significant impact on profitability.

For large energy users participating in the Emissions Trading Scheme adopting biomass CHP facilitates increased production and trade in carbon credits.

KEY BENEFITS OF THIS PROJECT FOR IRELAND

- Promotes interest in Biomass CHP in Ireland
- Demonstrates the viability of locally available biomass fuel supply for biomass heat and CHP plants
- Contributes towards EU Energy Policy and Kyoto commitments by bringing Ireland closer to its targets for renewable energy and emission reduction
- Provides employment locally in fuel supply and plant operation and stimulates the economy
- Produces green electricity to power 3000 homes

KEY BENEFITS FOR THE BIOMASS CHP OWNER

- Biomass CHP can reduce energy costs
- Biomass CHP enhances competitiveness as it is a highly efficient energy technology widely used by industry in Europe and elsewhere.
- Biomass CHP can offer security against energy price fluctuations.
- Biomass CHP provides a secure supply of energy for industry.
- Biomass CHP can help your business comply with environmental legislation. It also reduces exposure to Emissions Trading Scheme limits – as biomass is carbon neutral

The plant is designed to:

- Receive store and transfer the fuel from the conveyor to the combustor and burn the fuel in an efficient manner to raise steam
- Discharge the combustion products in an environmentally acceptable manner
- Convert energy in the steam to electrical energy in the turbine/generator
- Provide all the sawmills heat requirements and export electricity to the national grid
- Operate 24 hours a day continuously throughout the year.

OPERATION OF THE CHP PLANT

The CHP plant, designed to burn sawmill co-products, is a Wartsila BioPower 2 Hot Water CHP plant with a Bio Grate bio fuel combustion chamber, steam boiler and steam turbine, as well as an extensive 450 metres long fuel conveyor system for transporting fuel in the form of wood by products from the sawmill. The plant is designed to ensure the sawmill's own thermal requirements in the form of kiln drying capacity are met and electricity produced sold to the national grid. By consuming these products on site rather than transporting them to often distant markets, energy is saved and CO_2 emissions reduced. The use of local bio-fuels increases energy independency and minimises environmental emissions due to the high total efficiency, which may exceed 90%.

Fuel is collected from five different locations at the sawmill. The bark and peelings are crushed in a crusher before feeding into the conveying system. The conveyor system is a completely enclosed belt conveyor line taking the fuel to the covered active fuel storage area. The capacity of the main fuel storage is 600 m3. From the storage the fuel is fed further to the boiler using a drag chain conveyor and stoker screw.

The plant has also an enclosed passive storage area located beside the main storage making it possible to store the additional fuel required for periods when the sawmill is not in operation.

Construction of the covered fuel conveying system

Grainger's CHP Plant

The plant is designed to ensure a highly efficient combustion process of sawmill co-products, with flue gas emissions below the most stringent limits. Electricity is produced in a steam Rankine cycle, which is optimised for generating electricity and thermal energy.

FEATURES OF THE PLANT'S CHP BIOGRATE TECHNOLOGY

- *Based on Patented, rotating conical grate*
- *Combustion area divided into several ring type, rotating zones*
- *Zone controlled primary air inlet for efficient combustion*
- *Three stage combustion air inlet for low NOx emissions*
- *Fuel feeding from the centre bottom*
- *Under grate wet ash removal*

The fuel is fired in a grate steam boiler and the steam is used in an extraction condensing steam turbine for power and heat production. The fuel

The plant is controlled by an automated computerised control (Digital Control System) system to ensure reliable and safe operation. The system interfaces with specific metering points and provides real time data and report generation.

TECHNICAL DETAIL:

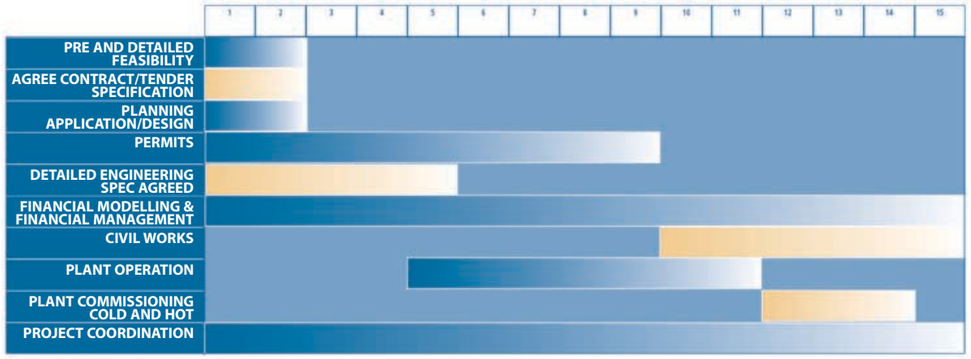
CHP Plant type: Wartsila Biopower 2 producing an average 1.8 MWe and 3.5 MWth

Fuel input: 11.4MW/280kg/m3/20.4m3/hr
Electrical output: 1.83MW or 15.006GWh/per annum
Thermal output: 7.883MWth or 64.64GWh/per annum

Plant Infrastructure:
- Fuel handling and fuel screening
- Fuel storage systems
- Fuel feeding
- Combustion system
- Steam and water system
- Steam turbine and generator set
- Flue gas cleaning system
- Water treatment plant
- Ash removal system

Planning for a Turnkey Plant

The plant was commissioned within an 18 month period from project concept.



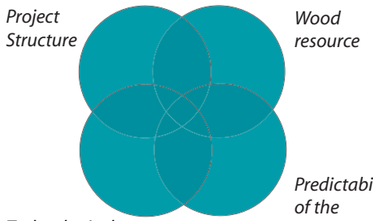
COST CONSIDERATIONS

A National Council for Forest Research and Development (COFORD) report entitled "Maximising the Potential Wood Use for Energy Generation in Ireland" shows that electricity from wood has a cost of less than 7 cent per kWh (assuming wood fuel costs of less than €35 per gross tonne, combustion in a CHP power plant at 5,000 operating hours per annum). This does not include any investment subsidy nor the AER6 price (which is shown for reference only in the graph below).

A Biomass CHP plant has an operating life of up to 25 years and is typically evaluated over a 15-year period. The full financial benefit of the plant will be realised only when it is operated at close to optimum conditions over the whole of its life. Typical investment costs for a Biomass CHP plant are €2000/kW for Fluidised Bubbling Bed (7MWe) and €3500/kW for a grate boiler (1MW).

The economic viability of this project was evaluated by financial modelling and risk assessment of fuel supply, operation and technology.

Key factors of project's strength:



PLANNING CONSIDERATIONS- FEASIBILITY STUDY

A comprehensive feasibility study is critical to planning. In this project technical, economic and environmental considerations were examined to determine whether the project was viable and what route it should take.

The following licensing arrangements were part of the planning process:

- Integrated Pollution Control (IPC) Licensing (it was relevant in this case since the company already had an IPC licence so needed to inform the EPA of this change to their energy system. IPC is not necessary for Biomass CHP unless the site is larger than 50MW)
- Planning Permission
- Fire Certificate
- Grid Connection
- Commission for Energy Regulation - licence to generate electricity and construct power plant
- Power Purchase Agreement

TECHNOLOGY CONSIDERATIONS

In order to decide the technology and scale of the plant, the project partners evaluated the following from a technical and financial point of view:

- Current energy needs versus predicted usage
- Steam only or CHP?
- On site electricity or export potential
- Fuel supply, energy value and fuel handling
- Excess energy for integrated pelleting?

The result was that the company decided to proceed with the CHP plant as a first stage of the development with an option to integrate wood pellet production at a later stage.

RESULTS & BENEFITS

This project facilitates the further development and expansion of renewable energy technologies by providing a showcase reference plant for other industries.

LESSONS LEARNED

The critical requirements for this project were the Power Purchase Agreement, the Grid connection and ensuring a long-term fuel contract.

The project developers, IBS identified two key priority areas for the successful uptake of BIOMASS CHP in Ireland. It is their view that once these are in place all the remaining issues for successful project implementation (planning, technical, contracts etc) are achievable:

- Support for investment and financing of projects
- Power Purchase Agreement (PPA)

A long-term PPA at an adequate price and index-linked is important for the financial stability of the project. This project was successful in gaining a PPA under the Alternative Energy Requirement (AER) Programme VI. The maximum bid price under AER VI for Biomass CHP was 7 eurocent per kWh.

The project was supported at both feasibility and capital stage through SEI's Renewable Energy Research Development and Demonstration Programme.

Financing options include 100% capital investment (including bank financing) or third party financing from the equipment supplier or an energy contracting company.

FURTHER DEVELOPMENT

Biomass CHP offers a highly efficient heat and power solution for Irish industry and will serve to develop biomass fuel supply in Ireland.

Industries with a biomass raw material and high energy demands are ideal candidates for biomass CHP. Manufacturing companies in the food and drink, pharma-chem and agri-sectors could consider biomass heating for their process heat requirements. A worthwhile first step would be to conduct a preliminary feasibility study into biomass heat and power.

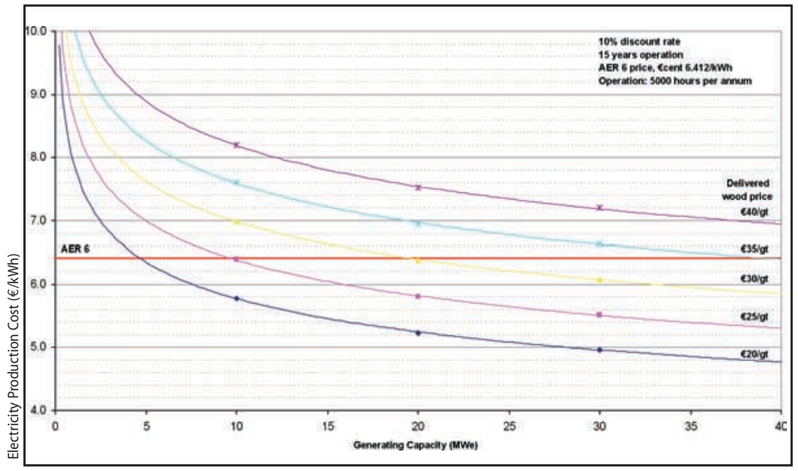
An option for Irish companies in the future would be to outsource their heat or power needs to a biomass energy services company, who would manage fuel supply and plant operation.

MONITORING & CONTROL

The plant's control system allows for real time performance monitoring. The following results from a plant performance test, show that the boiler meets the performance criteria set out in the design specification in terms of overall boiler efficiency, controllability and flue gas emissions.

Start up and operation of the Wartsila boiler has proceeded smoothly. The boiler is the 19th boiler in this size class (under 2 MW) to be delivered by the company. This project benefited from the experiences gained from previous installations as well as the fact that the design for this size of boiler has become standardised.

CHP Plant Electricity Production Costs



Data on typical Biomass CHP investment and power production costs are based on the COFORD Study 'Maximising the potential wood energy generation in Ireland', which is available at www.sei.ie/reio.htm