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Northern Ireland Assembly

Research Paper 49/10 **January 2010**

RENEWABLE ENERGY PROJECTS IN EUROPE

This paper was commissioned by the Committee for Enterprise, Trade and Investment to identify potential Renewable Energy Projects in Europe which may be of interest in any future visit to the European Union structures in Brussels. It examines Renewable Energy projects in and around Brussels up to a distance of approximately 200 miles and includes projects in Belgium, France, Germany and the Netherlands.

SUMMARY OF KEY POINTS

Background

This paper was commissioned to assist the Committee for Enterprise, Trade and Investment in deciding if there are any renewable energy projects Members wish to visit. It provides information on renewable energy projects in the EU nations that border Belgium, up to 200 miles from Brussels. The countries discussed are: Belgium, Germany, France and the Netherlands. The support provided by EU member states for Microgeneration will also be briefly discussed. The table below provides a brief summary of the renewable energy projects discussed in the paper:

Project Title	**Location**	**Description**	**Resource**	**Outputs**	**Cost**
Wartsilia Biopower	Amel, Belgium	Commercial modular combined heat and power biomass plant	Wood residue	5.3 MW plant	€25 million
Nike's European Distribution Centre	Laakdal, Belgium	2 million square metre building that operates solely on green energy	Wind, Solar Power	22 million KWs, equivalent to the electricity needs of 8,000 households	Unavailable
Lille Biogas Fuel Plant	Lille, France	Biogas fuel plant used to provide fuel for cities public transport	100,000 tons of kitchen and garden waste	5.2 million normal cubic metres of gas – supplies 127 buses with fuel for a year. 34,000 tons of compost	€2 million on new buses and refuelling infrastructure. No cost available for plant construction.
Soultz Geothermal Plant	Soultz, France	A geothermal plant that uses Hot Dry Rocks 5 km below the surface to heat water and generate power	Water, granite deposits	1.5MW	€26,033,300
The Blue Tower Project	Herten, Germany	Turn key RE plant that can use a variety of biofuels	Woody biomass, manure, sewerage sludge and plastic waste	13 MW capacity, able to generate around 37,500 MWh per year (enough for 12,000 households) and 150 M^3 of Hydrogen per hour	€24.6 million but can vary depending on size of plant required – a 30MW capacity plant would cost around €40 million.
Moerdijik Chicken Litter Plant	Moerdijik, the Netherlands	One of the largest chicken litter fuelled plants in the world	440,000tons a year of chicken litter, 1/3 of the waste generated in the Netherlands	36.5 MW capacity, 270 million KWh a year. Equivalent to the electricity needs of 90,000 households	€150 million
Wetsus Blue Energy	Harlingen, the Netherlands	Osmotic Plant – uses the osmotic principle to generate electricity via a semi permeable membrane that separates a tank of fresh water and salt water	Fresh water and salt water	Several kilowatts of power – however this is a test unit only, the size of 3 washing machines.	Unavailable – however there are plans in development for a full scale 200MW plant that is estimated to cost €600 million and will be the size of 2 football pitches.

Support for Microgeneration in Europe

France and Germany have two of the most advanced systems in place to support Microgeneration.

France has recently introduced legislation to ensure buildings are as energy efficient as possible with the intention of buildings eventually generating more power than they use, with the remainder sold into the grid.

Germany has developed a renewable energies industry via its support for microgeneration, with the country becoming one of the leading makers of solar and photovoltaic panels. This emphasis on developing RE technology has spawned a €12 billion industry that employs over 150,000 people.

CONTENTS

1 Background

This paper was commissioned to assist the Committee for Enterprise, Trade and Investment in deciding if there are any renewable energy projects Members wish to visit. It provides information on renewable energy projects in the EU nations that border Belgium, up to 200 miles from Brussels. Also discussed are any significant projects which may be of interest. The countries discussed are: Belgium, Germany, France and the Netherlands.

1.1 Europe – General Overview

Electricity generation in the EU is mostly driven by fossil fuels. Figure 1 below provides a breakdown of the sources of electricity generation across the 27 EU member states in 2006[1].

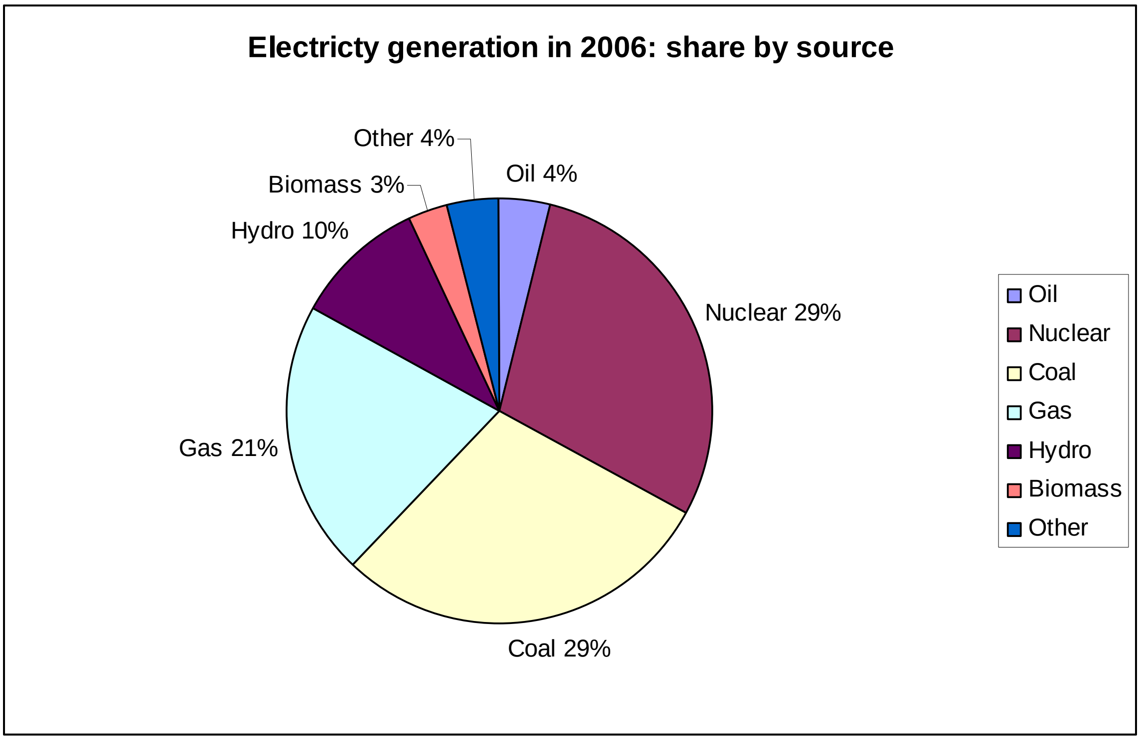

Figure 1: Electricity Generation in Europe by Source (2006)

As can be seen, 83% of the electricity generated is via fossil and nuclear fuels, with a further 10% generated by Hydro power and 7% through other renewables.

The EU has a high reliance on fossil fuels such as oil, gas and coal. However, as these stocks began to fail there is increasing concern being raised regarding security of supply, climate change and fuel shortages.

Due to these factors, it has become a central goal of the EU to develop renewable energy sources. This includes the development of an energy strategy with long term plans to increase the use of renewable energy across the EU to 40% of the energy mix.

The EU Energy Strategy has a number of goals:

[1] Eurostat European Commission *Panorama of Energy: Energy Statistics to support EU policies and solutions*, 2009 edition

- Reduce greenhouse gas emissions;
- Address energy security;
- Lower the cost of energy services for customers; and
- Improve economic competitiveness.

The initial deadline for this strategy is set for 2020, with each member state expected to have 20% of their energy supplied by renewable sources. Member states can tailor their approach to meeting this target, a necessity given the varied resources available in each state. For example Northern Ireland and the Republic of Ireland have a massive off shore wind resource, whilst Germany makes much more use of solar panels.

The directives from the EU also include provision for small scale options such as heat pumps, allowing for nations to develop cross sector and cross scale projects in order to meet their renewables obligation.

The EU is also encouraging increased energy interconnectivity between EU nations, with renewable energy tradable across borders.

In order to facilitate the development of Renewable Energy within Europe, the EU provides funding both for increasing energy efficiency and the development of RE projects.

These funding programmes include:

Intelligent Europe: This is the EU's tool for funding action to save energy and encourage the use of renewable energy in Europe. In 2009, the programme's total budget was €65 million and it has to date provided funding to over 400 projects.

The programme is run by the Executive Agency for Competitiveness and Innovation on behalf of the EU Commission. The programmes main aim is to bridge the gap between EU policy and their penetration on the ground.

Any private or public body can apply for funding. The projects need to run for two to three years and have to involve at least three other partner countries. The projects funded include knowledge transfers, process improvement and building market confidence. It does not however, fund Research and Development or hardware investments[2].

Cordis – EU Research Funding: Developed as part of the Seventh Framework Programme public and private bodies can apply for funding in a variety of areas. Eligible bodies include Small to Medium Enterprises, Universities and local, national or regional governmental administrators.

Funding can be applied for through five different blocks with energy considered within the 'Co-operation' section which is the core of FP7. It represents two thirds of the FP7 budget and fosters collaborative research across Europe and other partner countries.

[2] European Commission *Intelligent Europe* http://ec.europa.eu/energy/intelligent/library/newsreview_en.htm (first accessed 07/01/10)

There is additional scope for research into technology development via the ‘Ideas’ strand. It provides funding for “frontier research” and provides funding for research into engineering, science and technology.

1.2 Countries Under Consideration

This paper will discuss the renewable energy projects operating in:

- Belgium;
- France;
- Germany; and
- Netherlands.

Due to the large size of these nations and the travel times involved in visiting sites, the paper will only discuss projects up to 200 miles from Brussels.

2 Belgium

In 2007 oil was the main source of Belgium's energy, providing almost 40% of its heat and electricity. Gas was the next highest contributor to the energy mix with 26.2%.[3]

Renewable Energy only plays a small part in the Belgian energy mix, accounting for only 1.3% of the energy sources in 2002[4]. In 2007[5] this figure had increased to 2.7%, with Biomass providing the vast majority of renewable energy sources at 94.5%.

The remaining 5.5% is made up of hydro power (2.2%) and a combination of wind, solar and tidal power (3.3%).

The section below discusses some of the major renewable energy projects currently in operation in Belgium which may be of interest to the Committee.

2.1 Biomass

Wartsila Biopower

Project: Wartsila Biopower has developed a commercial modular combined heat and power (otherwise known as a cogeneration plant) plant that uses biomass as fuel.

Two of these plants have been built in Amel, Wallonia (Southern Belgium) as part of a joint project between Wartsilia and Renogen, an independent power company. The plants have been added as part of Amel's status as the "first sustainable industrial area" in the Wallonia region.

The plants are highly automated, enabling unmanned operation reducing costs. The biopower plant operates on a closed steam feed water cycle from the hot water system. Superheated steam is generated in a water-tube boiler and supplied to a steam turbine driving an alternator[6]. The water is then heated by steam extracted from the turbine and used to deliver hot water to neighbouring factories.

Inputs: The biomass used to fuel the plant is uncontaminated wood residue from local forest product companies.

Outputs: The plant generates 5.3 MW in power, with an electrical output of 3.29 MWe and a thermal output of 10 MWth for district heating. It supplies hot water to two factories in the Ardennes region with the electricity sold into the grid.

Benefits: As stated by Yves Crits, the CEO of Renogen: "Wärtsilä's modular approach brings several benefits to us. The site work is minimised and delivery time is short, in addition the plant can grow with the growth of heat demand on the industrial estate"

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[3] International Energy Agency, *Renewables Information 2009*
[4] Eurostat 2009 *Panorama of Energy: Energy statistics to support EU policies and solutions*
[5] International Energy Agency, *Renewables Information 2009*
[6] Wartsillia Technical Journal, January 2007 *Wartsilia Biopower plants in the Ardennes, Belgium*
http://www.wartsila.com/Wartsila/global/docs/en/about_us/in_detail/1_2007/wartsila_biopwer_plants.pdf (first accessed 14/12/09)

The fuel makes use of a waste product to generate energy and additional profits via the selling of heat and power to neighbouring companies.

The plant has been designed on a modular basis, with its components put together in a factory and then transported to the power plant site were it is installed. The modular construction has several advantages including consistency of design and if it is found that there is scope for expansion additional modules can be added quickly and efficiently[7].

Costs: The building of the cogeneration plants at Amel cost €25 million euro. This figure was partially supported by financial aid from the Belgium government as part of its programme to encourage the development of renewable energy sources. 4energyinvest, the parent company of Renogen, had costs of €4.2 million for running the site for the year January to December 2008. This included €3 million spent on the biomass fuel for the plant. The remainder consisted of administration and running costs. It must be noted, however, that the company's total revenue was €9.4 million from the sale of green energy. This included €6.3 million from the sale of green certificates, €3 million from the sale of electricity back into the grid, and €100,000 from the sale of heat.

Is it applicable to Northern Ireland?

A similar plant is currently in operation in Fermanagh. Balcas, a wood product supplier, generates a large amount of saw dust and wood waste as part of its timber production. Prior to the construction of the CHP plant, this residue had to be transported to disposal sites.

Balcas completed construction of the CHP plant and began operations in November 2005. The plant produces 50,000 tons of fuel pellets a year, enough to meet the company's energy needs and power for 10,000 homes. The plant generates 2.7MW of electricity and 10 MW of heat for its own use[8].

The construction of the plant cost £9 million. However, it provides an energy saving of half a million pounds each year with additional revenue generated from the selling of surplus wood chips and electricity to the national grid.

CHP plants are easily applicable to Northern Ireland, with significant heat and electricity savings to be made for companies willing to invest in such plants.

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[7] Wartsila Press Release, 25th April 2007 *Another Wärtsilä BioPower plant in the Ardennes, Belgium* http://www.wartsila.com/,en,press,0,tradepressrelease,1CAD77FC-CF70-41D3-945A-414D0FA71E0F,3C92CE5E-52FC-4ED0-A6D9-811780674FF6,,.htm (first accessed 09/12/09)

[8] Balcas website *Biomass Fuel* http://www.balcas.com/articles/chp-.html (first accessed 06/01/10)

2.2 Wind Power

Nike's European Distribution Centre

Project: Nike's European Distribution Centre (EDC) at Laakdal, 60 kilometers from Brussels, is one of the largest such facilities in Europe. The building was designed to maximize energy efficiency and use of green technology and Nike was the first company of its size in Belgium to operate solely on green energy[9].

Inputs: A major part of the building consists of six, 111 meter wind turbines[10]. The turbines have been designed to minimise the use of steel in their construction and to maximize the power generation from the blades. In addition the building itself has several unique design features including a site orientation to maximize daylight, sunscreens to control heat within the building, ground cooling tubes to replace air conditioning and draft reduction systems to preserve heat in winter.

Outputs: The 1.5 MW wind turbines generate 22 million KW hours a year, equivalent to the annual electricity needs of approximately 8,000 European households. The electricity generated by the turbines is sufficient to power the 2 million square foot building.

Costs: Nike did not finance the capital cost of the wind turbines. Rather, Seeba, Nike's partner organisation in the development, leased the land from Nike and built the turbines. Seeba also maintains the wind farm with the lease payments helping to make the green power purchase agreement cost neutral relative to conventional power contracts.

Benefits: It is one of the largest on-site wind power projects in Europe and makes Nike (the sporting goods manufacturer) into one of the first European Commercial sites of that size that are 100% powered with renewable energy.

In order to gain community support and buy in for the project, Nike organized visits for local community members to operating wind farms so they could see one first hand to better understand the technology and alleviate any fears.

The design of the wind turbines maximize the power generation available and also reduce noise pollution. The frame structure of the turbine itself also reduces the cost of construction due to the use of 60% less steel.

Is it applicable to Northern Ireland?

Many of the concepts used in the construction of the Nike EDC could be applied within Northern Ireland. However, the scale of the project would need to be considered. The EDC is 2 million square feet and few, if any, such buildings exist in Northern Ireland. However, many of the concepts could be reduced in size and applied such as the use of wind turbines to generate power and building orientation in order to maximize the use of daylight.

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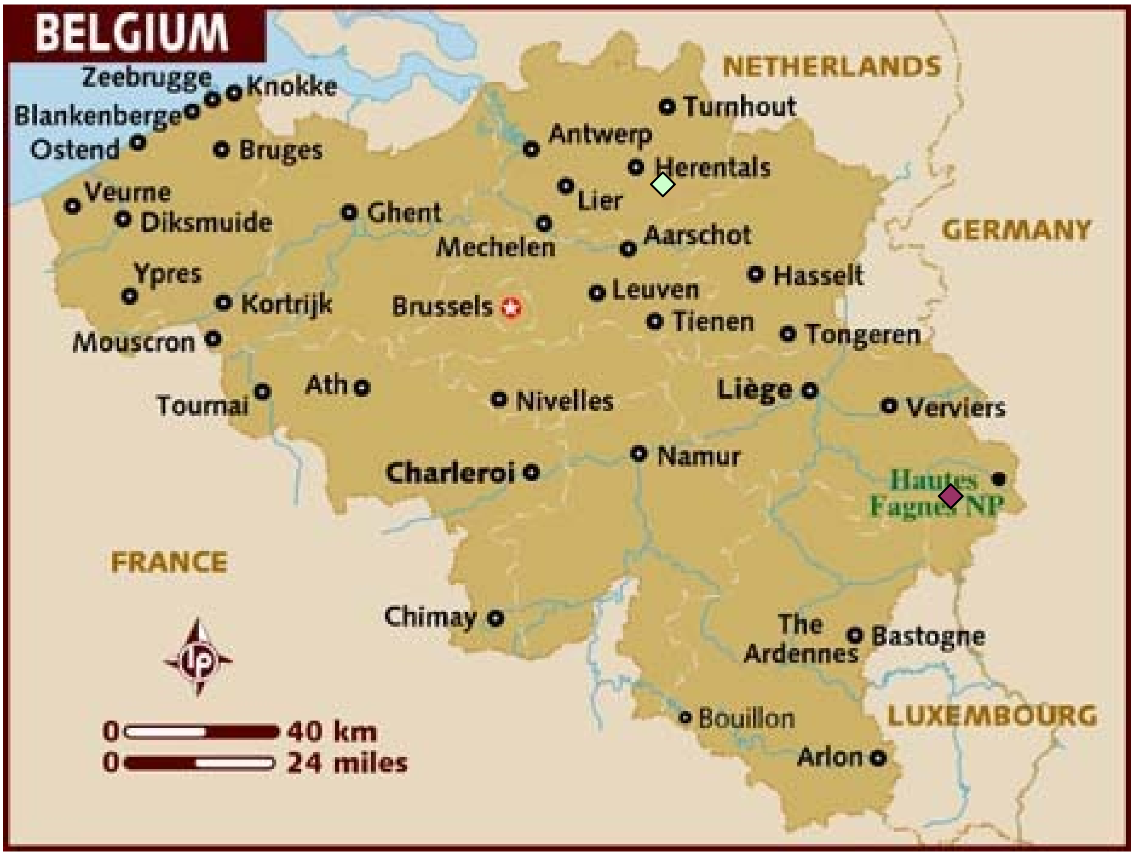
[9] Nikebiz *Nike's Laakdal DC Has 6 Windmills and a New Energy Efficient Design* http://www.nikebiz.com/responsibility/considered_design/features/wind_power.html (first accessed 15/12/09)

[10] Government of Flanders Investment and Trade *The Logistics of Industry in Flanders* August 2008 http://www.investinflanders.com/library/attachments/publications/ac26d121-1b8b-4ff8-b32a-66e1777d2e62/LogisticsFlanders.pdf (first accessed 07/12/09)

Project Locations



Key[11]

◇ Nike's European Distribution Centre

◆ Wartsila Biopower

Please note, all project locations are approximate only.

[11] Maps Source: The Lonely Planet http://www.lonelyplanet.com/maps/europe (first accessed 06/01/10)

3. France

France currently relies heavily on nuclear power to supply much of its energy needs, accounting for 78% of electricity production. Over recent decades, natural gas has begun to play a larger role in the energy mix, replacing a number of coal fired plants.

In terms of renewable energy sources, biomass and wind hold the most significant portion of the French energy mix. However, this is relatively small, providing only 1.2% of the total in 2006.

In 2007 renewable energy contributed 6.7% of France's energy mix. Biomass was the largest renewable source, with 68.7% and Hydro the next largest at 28.1%. The remaining 3.1% was made up of geothermal, wind, solar and tide energy[12].

3.1 Biomass:

Lille Biogas Fuel Plant

Project: Lille, a town close to the border with Belgium in the Nord pas de Calais region of France has built the countries first biogas fuel plant. The plant was developed to generate biomethane to power the town's fleet of public buses (over 100)[13].

Lille is a participant in the Biogasmax programme, a project that supports the innovative production of biogas in transportation in order to reduce CO2 emissions from petrol and gas. It also has the goal to increase transport fuel security of supply by increasing Europe's energy autonomy.

The biogas plant receives 100,000 tons of municipal organic waste per year. This 'green' waste (which mostly consists of kitchen and garden waste) is placed in tanks where it ferments and creates biogas and compost.

The biogas is then concentrated into biomethane fuel and piped to the nearest bus depot to be used to power buses.

Inputs: 100,000 tons of kitchen and garden organic waste, gathered from the Lille municipal area. Roughly 650,000 of Lille's 1.1 million residents contribute to the waste which includes everything from grass clippings to tissue paper.

Outputs: 5.2 million normal cubic meters of gas (refers to uncompressed gas at normal atmospheric pressure). This has a 55-65% methane content. The biomethane currently supplies 127 buses with fuel for the year. In addition, there are plans to expand the project to encompass refuse collection vehicles and other municipal authority vehicles.

In addition, 34,000 tons of compost is created each year which is supplied to farms throughout the region[14].

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[12] International Energy Agency, *Renewables Information 2009*

[13] The Bio-Nett Project *Bio Methane in Lille - A Case Study* http://www.bio-nett.org/Bio-methane-in-Lille-Case-Study.pdf

[14] La Vie Verte Young, Denise 20/09/07 *Lille's Bus Fleet to Run on Biogas Generated from Household Waste* http://lavieverte.wordpress.com/2007/09/20/lilles-bus-fleet-to-run-on-biogas-generated-from-household-waste/

Costs: Lille has invested €2 million in the biomethane system of the city, mainly on the new buses and refuelling infrastructure.

Benefits: The scheme had two main goals when it was started; a need for the treatment of organic wastes and to use the excess biogases and a drive to reduce the pollutant emissions from the transport system.

Both of these goals have been met. Consultations with the general public and transport operators have found that carbon and sulphite emissions are drastically reduced from the buses. A survey conducted on the general public found that the smell from the buses was also reduced in comparison to the previously used diesel buses.

Is it applicable to Northern Ireland?

There are currently no large scale projects in Northern Ireland that use Anaerobic Digestion to produce biogas. However, there are a number of smaller microgeneration projects based on farms that make use of animal waste to generate biomethane and electricity.

The Agri-Food and Biosciences Institute (AFBI) is installing an on-farm anaerobic digester to test the process. Data gathered from this research project will provide much needed information for the farming industry in terms of best practice and design. The plant will include a CHP plant and will use cow slurry as its main fuel source[15].

3.2 Geothermal

Soultz Geothermal Project

Project: Soultz is one of the first geothermal projects to be developed in France. Based near the German border, the Soultz geothermal project uses Hot Dry Rocks (HDR) 5 kilometres below the surface to heat water and generate power[16].

The project has been developed by the EU, with direct support from a number of countries including France, Italy, Germany, Switzerland and the UK with the costs shared between the appropriate ministries and the EU Commission.

Soultz sits over a large granite deposit that contains natural fractures and water deposits. This makes it ideal for the production of geothermal power.

The project enlarged the natural fracture systems in the basement rocks through pumping large quantities of fast flowing water and water with weak quantities of acid through it in order to break down weaker sections of the granite. A multi-well system was then installed through the rocks themselves, linked up to a pumping plant on the surface. Through pumping and lifting, water is forced to migrate through the fracture system. At this depth the rocks can reach temperatures of 200 degrees Celsius, with the heat used for power production.

[15] AFBI *The Potential of On-Farm Anaerobic Digestion for Northern Ireland* http://www.afbini.gov.uk/index/services/services-specialist-advice/renewable-energy/re-anaerobic-digestion-intro.htm

[16] European Deep Geothermal Energy Programme Website http://www.soultz.net/version-en.htm (first accessed 14/12/09)

Figure 2: The Soultz geothermal power plant

The system uses three wells. One pumps water under the earth's surface to a depth of 5 km. Two production wells, as seen in Figure 3 below, deliver the thermal energy to the power plant on the surface.

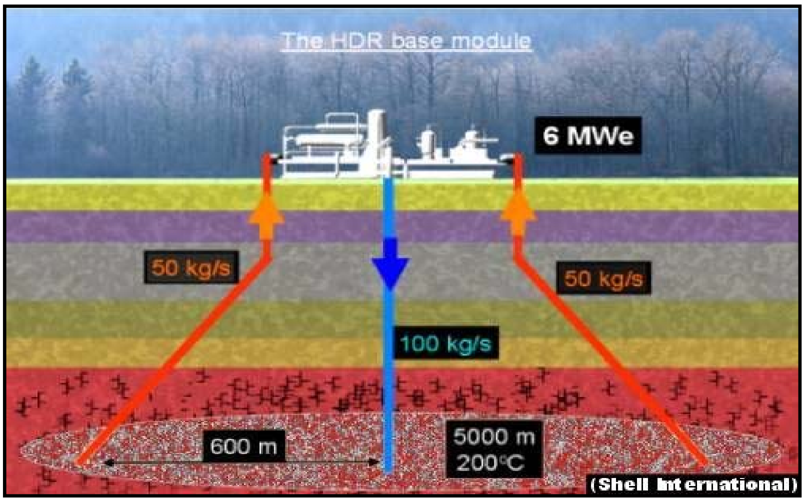

Figure 3: The Soultz geothermal power plant

Inputs: Water is pumped through the well system. However, the power is generated by the pressure of the Earth itself, which at the depth of 5 km creates enormous amounts of heat within the granite deposits. As a result, one square kilometre of granite at this depth can produce 10MW of electric power for 20 years.

Outputs: The power plant is currently producing 1.5 MW of power. However, it must be noted that this is merely a pilot project intended to test the technology rather than to act as a full power generation plant. The plant is currently in its testing and commissioning phase.

Costs: The construction of the geothermal power plant cost €26,033,300 over the period 2004 to 2007[17].

It must be noted, however, that despite twenty years of development work, this technology is still in the development phase and as such is relatively expensive. It can be expected that over time costs will fall and expertise regarding its use will spread.

Benefits: The Soultz geothermal plant is one of the leading geothermal projects on the planet, with the EU taking the lead in many of the technological and process developments[18]. As stated by the Energy Research section of the EU Commission: *"All enhanced geothermal systems research for the past 20 years - world-wide - has been directed at the achievement of the key target parameters (creation of a fracture network, sustainable high-rate circulation at depth, zero fluid-losses), but only the European work has made significant progress in the past decade."*

Whilst only in an early stage of development, the Soultz geothermal plant has developed technology that is applicable to large parts of Europe, including areas within Northern Ireland. The energy produced is clean, sustainable and has multiple uses for both commercial and domestic purposes.

Is it applicable to Northern Ireland?

There are currently no similar projects in Northern Ireland. However, areas of potential geothermal energy have been identified throughout Northern Ireland. A study conducted by Action Renewables and the CSA Group identified four areas with high geothermal potential: Larne, Rathlin, Lough Neagh and the Northwest Basins.

Figure 4 below shows the geothermal hotspots identified in Northern Ireland[19]. There is additional potential within the Mourne Mountains as a result of the high level of granite and radioactive elements that provide a boost to the heating process. However, the research into the Mournes is still at an early stage and further study is necessary before a definite geothermal source can be identified.

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[17] European Renewable Energy Centres Agency *Geothermal Research* http://www.eurec.be/content/view/48/37/1/8/ (first accessed 14/12/09)

[18] EU Commission Research Energy Research *Current Geothermal Energy Research* http://ec.europa.eu/research/energy/nn/nn_rt/nn_rt_geo/article_1136_en.htm (first accessed 14/12/09)

[19] Action Renewables and CSA Group *Defining the Potential of Geothermal Targets* http://www.actionrenewables.org/uploads_documents/DeepGeothermalEnergy.pdf

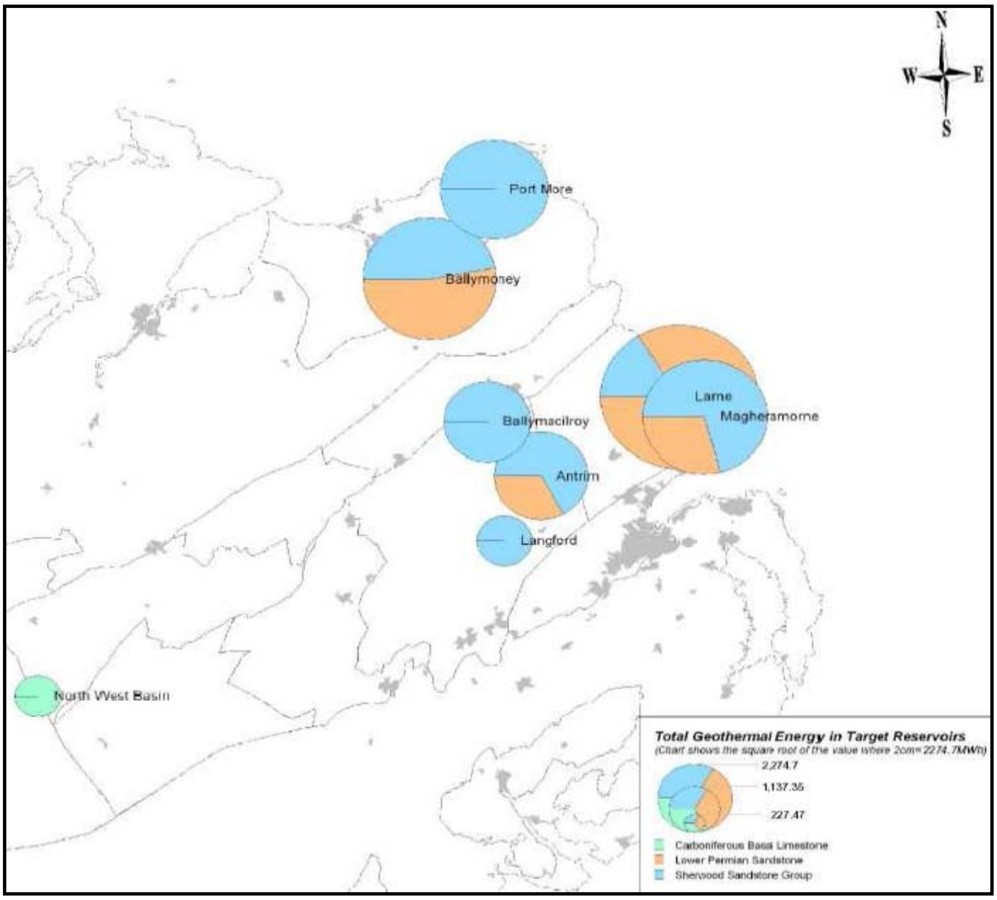

Figure 4: Geothermal hotspots in Northern Ireland

Consultation with the Tellus Project found that one area Northern Ireland and the UK as a whole is lacking is regarding the relevant legislation which allows for private sector investment in the investigation and development of geothermal sources. This legislation is currently in place in a number of other countries allowing for greater development of technology and understanding of the geological structure of the target area. Review of the reserved matters listed in the Northern Ireland Act (1998) highlights that this is not a reserved matter and can be legislated by the Northern Ireland Government. However further research would be required into this area.

Project Locations

Key[20]

◆ Lille Biogas Fuel Plant

◇ Soultz Geothermal Project

Please note, all project locations are approximate only.

[20] Maps Source: The Lonely Planet http://www.lonelyplanet.com/maps/europe (first accessed 06/01/10)

4. Germany

The German energy system is based mainly on fossil fuels. In 2007 renewable energy accounted for 7.9% of the energy mix, with oil, coal and gas accounting for 80.8%. It must be noted that there has been a shift within the energy mix over the last few decades, as Germany becomes less reliant on coal and lignite. Germany has been using more wind, biomass and natural gas in order to make up this shortfall, with small amounts of photovoltaic and biogas also impacting.

Of the renewable energy sources used biomass makes up the significant portion, with 77%, Hydro provides 6.9% of Germany's energy needs and wind, solar, tidal and geothermal sources account for the remaining 16%[21].

By the end of 2006, Germany had 21 GW of installed wind capacity and has become a world leader in the development of biofuels. In order to facilitate the expanding renewable energy market Germany has introduced feed in tariffs in order to encourage their development.

It is expected that Germany will easily reach its renewable targets for 2010, putting it in a good position to meet the 2020 Europe wide targets.

The renewable energy sources with the biggest impact upon Germany's electricity market are: hydro power, biomass, wind and solar photovoltaic.

4.1 Biomass

The Blue Tower project

Project: The Blue Tower Project is located in Herten. The Blue Tower is a demonstration project to test the technology implemented in its design[22]. The plant has been designed to generate both hydrogen and electricity for use by local households. The aim of the plant is to highlight that the technology is ready to be introduced to the commercial renewable energy market. The plant was due to begin operation at the end of 2009.

Inputs: As a turn-key solution provider the Blue Tower is able to take just about any type and mix of waste and use it as fuel. This includes woody biomass, animal manure, sewerage sludge and plastic waste. The local municipalities are in charge of handling and delivering the waste and sewage input material. [23] The current Blue Tower project will be mainly fuelled by grass cuttings from local sources.

Outputs: The primary product of the plant is a hydrogen rich 'syngas' which can be converted to produce electricity and heat or used as a raw material. The 13 megawatt pilot plant will generate around 37,500 MWh of electricity per year and 150 m^3 of hydrogen per hour. The plant will be able to provide electricty for around 12,000 homes. [24]

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[21] International Energy Agency, *Renewables Information 2009*

[22] Renewable Energy Sources 06/03/09 *Foundation stone laid in Herten/Germany for Blue Tower – the technology of the future* http://www.renewable-energy-sources.com/2009/03/06/blue-tower-the-technology-of-the-future

[23] http://www.the-bluetower.com/index.php/Blue-Tower-FAQs/2.-What-Input-Material-does-the-Blue-Tower-run-on.html

[24] http://business.metropoleruhr.de/en/cluster-development/energy/fuel-cells-hydrogen.html

Costs: The Blue Tower project cost a total of €24.6 million. The cost of the Plant for other locations would vary considerably. For example, a plant with 80,000 annual tons of treated waste with a thermal plant capacity of around 30MW could cost around 40 million euro. [25]

Benefits: Blue Tower is an example of multi-feedstock technology. In other words, very different materials can be used, such as garden waste, roadside green cuttings, olive stones and chicken manure. This means that Blue Tower is not dependent on a single feedstock and its cost-efficient availability. Unlike at standard biogas plants, heavily polluting scrap timber, waste oil, paint sludge and rubber can be recycled in an environmentally-friendly manner at the Blue Tower.

The clean product gas created in Blue Tower (Blue Gas) is especially rich in hydrogen, low in tar and practically nitrogen-free. It has many different uses, especially for power generation and recovery of hydrogen. In addition, Blue Gas can also be concentrated to petroleum gas quality and fed into the mains gas network.

The Blue Tower is a stand alone system which can be setup anywhere but will need somewhere between 2-8 acres to operate and store material. [26]

Is it applicable to Northern Ireland?

The Blue Tower project could be located in Northern Ireland as a result of its ability to burn various types of biomass and its intended future commercial availability. The plant has been designed specifically to be located at multiple sites. The only restriction placed upon it is the 2 – 8 acres needed for the plant location and storage of fuel.

[25] http://www.the-bluetower.com/index.php/Blue-Tower-FAQs/23.-How-much-does-the-Blue-Tower-cost.html
[26] http://www.solarmillennium.de/front_content.php?idart=793

Project Locations

Key[27]

◇ The Blue Tower Project

Please note, all project locations are approximate only.

[27] Maps Source: The Lonely Planet http://www.lonelyplanet.com/maps/europe (first accessed 06/01/10)

5. The Netherlands

The Netherland has a large reserve of natural gas and as such a large portion of its energy reserves come from this source. In 2007 gas provided 41% of the Netherlands energy needs. Oil was responsible for 41% and coal for 10.5%. Renewables provides for just 3% in this same period.

Renewables have begun to have a larger effect on the energy mix, with Biomass and wind increasing significantly over the last few years. Biomass accounts for the majority of the renewables, with 86.2%. The remaining 13.8% is made up of Hydro, wind, solar and tidal power.

In order to encourage the development of renewables the Dutch government established premiums for sources such as wind, photovoltaic and biomass.

5.1 Biomass

Moerdijk Chicken Litter Plant

Project: One of the largest chicken litter fuelled plants in the world has been built in Moerdijk, a few miles south of Rotterdam.

The plant began operations in September 2008 and takes advantage of the Netherlands strict land use laws. For example, farmers can only have animals on their land if they have a guaranteed manner of disposal for manure. In addition there are tight controls on the level of phosphates in the ground which must be monitored by the farmer. As such excess manure cannot just be disposed of by adding it to the fields[28].

The plant processes a third of the chicken litter waste generated by poultry farm and creates a carbon neutral fuel via the burning of the methane gas given off by the chicken litter. The chicken litter is provided by a consortium of 629 chicken farmers. In order to offset any potential odours, the litter is transferred in airtight trucks and only released for processing once the trucks have entered an air lock in the fuel processing centre[29].

Inputs: The plant uses 440,000 tons of chicken litter (one third of the waste generate from the Netherlands poultry industry) which is burnt to generate power.

Outputs: The plant has a maximum production capacity of 36.5 Megawatts, generating 270 million kilowatt hours in a year. This equates to providing power for 90,000 households.

Costs: The project cost a total of €150 million to complete and took two years to construct.

Benefits: The plant provides two main benefits. It generates non-fossil fuel energy from a renewable source with a subsequent reduction of 100 kilotons of C02 from the

[28] World Poultry.net *Poultry Litter Plant "Egg of Columbus"* http://www.worldpoultry.net/news/poultry-litter-power-plant-%E2%80%9Cegg-of-columbus%E2%80%9D-2896.html (first accessed 20/12/09)

[29] The BioEnergy Site September 2008 *Biomass Plant Running on Chicken Manure Online* http://www.thebioenergysite.com/news/1629/biomass-plant-running-on-chicken-manure-online (first accessed 20/12/09)

non-use of fossil fuels. In turn, the plant generates the same level of emissions as would have been produced if it had been added to the soil as a fertilizer, thereby it remains carbon neutral.

Prior to the plants construction, the Netherlands had to ship a large portion of the chicken litter to other countries, creating additional monetary and environmental costs.

The construction of the plant has created an annual reduction of 2.5 million auto kilometres, with an emissions reduction of 2,500 tons of C02 and 19 tons of Nitrous Oxide. This equates to fuel savings of 900,000 litres of diesel[30].

In addition, the plant's generation of power is consistent, unlike other sources such as wind, which is reliant on the weather.

Is it applicable to Northern Ireland?

This facility is similar in concept to the chicken litter plant proposed by Rose Energy. The Rose Energy plant is intended to supply 25,000 households with power and if the project were to go ahead, the chicken litter would be supplied by a consortium group, composed of three of the main poultry farmers in Northern Ireland – Moy Park Ltd, O'Kane Poultry Limited and Glenfarm Holdings Limited.

It is worth noting that there has been significant local opposition to the construction of the plant.

5.2 Osmotic Plant

Wetsus Blue Energy

Project: A recently developed technology is using the osmosis process between salt and sweet water to generate electricity[31].

A few projects are currently in existence, with a large scale prototype plant developed in Norway. This plant operates via the osmosis principle. Fresh water and salt water are placed in a large tank, separated by a semi permeable membrane. Fresh water is drawn through the membrane, increasing the pressure on the salt water side. This pressure is comparable, at the Norway plant, to a medium sized waterfall and is high enough to drive a turbine, thereby generating electricity.

Wetsus has developed its own Osmotic plant. However, it operates more like a giant battery than a pump. The Wetsus model uses two membranes which are impermeable to water. They do, however, allow the transition of ions, with positively charged ions generated by the salt water passing into the fresh water and the negatively charged ions passing from fresh water to salt water.

This creates in essence a chemical battery with the passing of the ions between the membranes generating an electrical charge. Wetsus calls the use of this Osmotic principle 'Blue Energy'.

[30] Natural History Museum *P-Recovery in a Poultry Litter Power Plant* http://www.nhm.ac.uk/research-curation/research/projects/phosphate-recovery/Nordwijkerhout/deHaan.doc (first accessed 20/12/09)

[31] New Scientist Ravilious, Kate, 25/02/09 *Salt solution: Cheap power from the river's mouth* http://www.newscientist.com/article/mg20126972.000-salt-solution-cheap-power-from-the-rivers-mouth.html?page=3

The Wetsus team initially developed a small prototype that operated in a lab and generated a 20 watt charge. However, more recently they have begun to test a larger facility based at a salt mine in the Northern Netherlands in order to assess the scaling up of the model. It is intended that the project will be further developed with a full scale plant to be built at the Afsluitdijt Dam in the Central Netherlands.

Inputs: Salty waste water from the mine and fresh water from the local river is piped into the plant, feeding the salt batteries, which are the size of three washing machines.

Through this method the plant generates several kilowatts of power. It is not hooked up to the grid, but the main intention of the plant is to assess how Blue Energy could be scaled up.

Outputs: The process results in brackish water which is pumped back out into the local river. As the salt water used would have been released into the river anyway, it does not have any additional impact upon the environment.

Currently, the plant is only producing a small level of electricity. However, larger scale projects would generate greater power, increasing its level of efficiency and effectiveness.

Costs: The cost of Blue Energy, when compared to conventional energy generators is high. It is estimated it would cost around US$600 million to construct a 200 MW plant, which would cover the area of around 2 football pitches. This plant would produce electricity at a retail cost of US$90 per MWh in comparison to fossil fuel plants which generate electricity at a cost of US$50 per MWh.

However, the high cost of constructing the plant and of the electricity generated would fall significantly once the technology is further developed and proven, especially as there would be no fuel costs.

Benefits: The Wetsus Model has a number of benefits. The design is relatively simple, with salt water and fresh water pumped in at one end, passed through a membrane and then released at the other side. There is no pollution and the resource used is almost endlessly renewable.

Unlike the Norway project, Blue Energy could be used in a number of areas, not just river estuaries. Power could be generated at desalinization plants, from industrial processes that generate salt water or at salt mines.

In addition, the Norway model relies upon relatively clean areas of water, as the semi permeable membrane is sensitive to the build up of silt and bacteria. As such, Norway, which has cleaner waters than other European nations, is able to run this type of plant efficiently. However, in other western European countries these conditions do not exist and as a result the membranes would quickly become damaged and require replacement on a regular basis.

The Wetsus model does not allow the passing of water between the semi permeable membranes and as such there is less build up of residue and is therefore more applicable to areas such as Northern Ireland.

Is it applicable to Northern Ireland?

The project could be applied to Northern Ireland. The region has a number of large estuaries and several salt mines which could be exploited for the purposes of generating Blue Energy.

Roelof Schuiling, a geoengineer at Utrecht University in the Netherlands, believes Salinity Power plants are feasible and could have a big impact on global energy stores. For example, a typical wind turbine generates electricity for an average of 3,500 hours per year. A salinity plant could operate close to capacity for more than 7,000 hours per year.

It must be noted however, that like many other types of renewable energy, the Blue Energy project is still at an early stage of development and is yet to be tested for commercial viability. As the technology is still relatively unproven it is also expensive.

Project Location

Key[32]

◆ Moerdijik Chicken Litter Plant

◇ Wetsus Blue Energy

Please note, all project locations are approximate only.

[32] Maps Source: The Lonely Planet http://www.lonelyplanet.com/maps/europe (first accessed 06/01/10)

6. Support for Microgeneration in Europe

Microgeneration refers to small and medium generators of electricity, such as wind turbines, solar panels and biomass boilers that feed power directly to a home or business.

There is no EU wide strategy on microgeneration; rather it falls in with a number of measures related to the EU energy policy. Individual nations have their own polices in place regarding the development of microgeneration. This includes everything from grid access to subsidies for the use of the technology. Of the 27 EU member nations, France and Germany have the most effective support mechanisms in place for microgeneration, with Germany considered a benchmark for other nations.

6.1 France

France has taken a number of measures, including the introduction of a low consumption building standard. This covers all new public and non-residential buildings initially but will be expanded to include all new buildings in the future.

The low consumption building standard includes a government loan of up to €30,000 to allow organisations to introduce microgeneration to buildings. This is important as by 2020 all new buildings will have to generate more energy than they consume, with existing buildings having to be renovated in order to reduce their energy consumption to between 90 – 150 KWh/M2/year[33].

In 2008, it was announced that France intended to vastly increase its use of solar power. As a result the government introduced a high rate Feed in Tariff France. The new tariff category for commercial buildings has a rate of €0.45/kWh. This is intended to aid businesses, factories and farmers to take profitable advantage of their large rooftops. As a measure of the government's seriousness, there will be no limit on the size of commercial rooftop projects that qualify for the tariff.

The overall objective of this increase is to raise the level of solar power capacity to 5,400 MWs by 2020.[34]

6.2 Germany

Germany's Microgeneration strategy played a significant part in developing the nation's renewable energy sector, which employs around 150,000 people and has an annual turnover of €12 billion.

The Market Incentive Programme granted funding to nearly 300,000 applications for solar panels, biomass boilers and heat pumps. This took place in tandem with the "100,000 rooftops" programme which promoted the installation of photovoltaic panels for electricity generation across the country. The programme has the ultimate goal of reaching a 1,000 MW capacity, which when reached will end the programme funding.[35]

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[33] Energy Efficiency News, 10/09/09 *Microgeneration: Sarkozy launches plan to reduce France's Energy Use*

[34] Renewable Energy.com 21/09/09 Gipe, Paul *France Raises Solar Feed-in Tariffs* http://www.renewableenergyworld.com/rea/news/article/2008/11/france-raises-solar-feed-in-tariffs-new-york-seia-calls-for-fits-54119 (first accessed 06/01/10)

[35] DTI *The Need for a Microgeneration Strategy* www.berr.gov.uk/files/file27577.pdf (first accessed 05/01/10)

The German government also spends €1.4 billion per year on the retrofit and energy improvement of buildings through the installation of energy efficient measures.

These investments by the government have helped to establish and drive an industry based around the microgeneration of renewable energy.

Germany also provides a Feed in Tariff (FIT) which subsidises all power production from renewable energy sources such as wind, biomass and solar power. It guarantees a premium price for all power produced by eligible plants.

The FIT is paid for 20 years by the relevant local distribution company into whose grid the green energy is fed. The tariff is fixed for all energy sources except wind power which is higher for the first five years.

The success of the FIT can be seen in the growth in wind power capacity between 2000 and 2003. In 2000 Germany's wind capacity was 4,500, when the FIT was introduced. By the end of 2003 there had been an additional 10,100 MW's installed, totalling 14,600.[36]

[36] The Scottish Government June 2008 Re*view of Energy Efficiency and microgeneration support in Scotland* www.scotland.gov.uk/publications/2008/05/3014073710 (first accessed 06/01/10)