

# GREBE

Generating Renewable Energy  
Business Enterprise



Advice Notes on Biomass Technology Economics for the NPA Region



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## The GREBE Project

### What is GREBE?

GREBE (Generating Renewable Energy Business Enterprise) is a €1.77m, 3-year (2015-2018) transnational project to support the renewable energy sector. It is co-funded by the EU's Northern Periphery & Arctic (NPA) Programme. It focuses on the challenges of peripheral and arctic regions as places for doing business, and helps develop renewable energy business opportunities in areas with extreme conditions.

The project partnership includes the eight partners from six countries, Western Development Commission (Ireland), Action Renewables (Northern Ireland), Fermanagh & Omagh District Council (Northern Ireland), Environmental Research Institute (Scotland), LUKE (Finland), Karelia University of Applied Sciences (Finland), Narvik Science Park (Norway) and Innovation Iceland (Iceland).

### Why is GREBE happening?

Renewable Energy entrepreneurs working in the NPA area face challenges including a lack of critical mass, dispersed settlements, poor accessibility, vulnerability to climate change effects and limited networking opportunities.

GREBE will equip SMEs and start-ups with the skills and confidence to overcome these challenges and use place based natural assets for RE to best sustainable effect. The renewable energy sector contributes to sustainable regional and rural development and has potential for growth.

### What does GREBE do?

GREBE supports renewable energy start-ups and SMEs:

- To grow their business, to provide local jobs, and meet energy demands of local communities.
- By supporting diversification of the technological capacity of SMEs and start-ups so that they can exploit the natural conditions of their locations.
- By providing RE tailored, expert guidance and mentoring to give SMEs and start-ups the knowledge and expertise to grow and expand their businesses.
- By providing a platform for transnational sharing of knowledge to demonstrate the full potential of the RE sector by showcasing innovations on RE technology and strengthening accessibility to expertise and business support available locally and in other NPA regions.
- To connect with other renewable energy businesses to develop new opportunities locally, regionally and transnationally through the Virtual Energy Ideas Hub.

- By conducting research on the processes operating in the sector to improve understanding of the sector's needs and make the case for public policy to support the sector.

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The Advice Note aim to provide introductory material for entrepreneurs, startups and SME's, considering entering into the renewable energy sphere, based in any of the NPA regions, which are partners to GREBE. The scope of the Advice Note covers regional, renewable energy (RE), technology information, from Ireland, Northern Ireland, Scotland, Iceland, Finland and Norway. Different partner regions have different level of deployment of the various RE technologies covered by the Advice Notes; thus, the level of information will vary depending on the level of deployment for each technology. For example, Biomass CHP is not deployed on a large scale in Iceland; however, it is widely deployed in Finland, Ireland, Northern Ireland and Scotland.

The focus of the Advice notes is to provide regional partner information on some of the main economic characteristics, sited as imperative, when making an informed choice, regarding which RE technology may be the optimal choice for the business:

- Costs and economics associated with the relevant technology
- Support schemes available, relevant to the technology
- Government allowance/exemptions, relevant to the technology
- Funding available for capital costs of the relevant technology
- List of the relevant to the technology suppliers/developers, with focus on local/regional suppliers/developers and the products and services they offer.

The technologies that are covered in the Advice Note are the following:

### ➤ **Biomass**

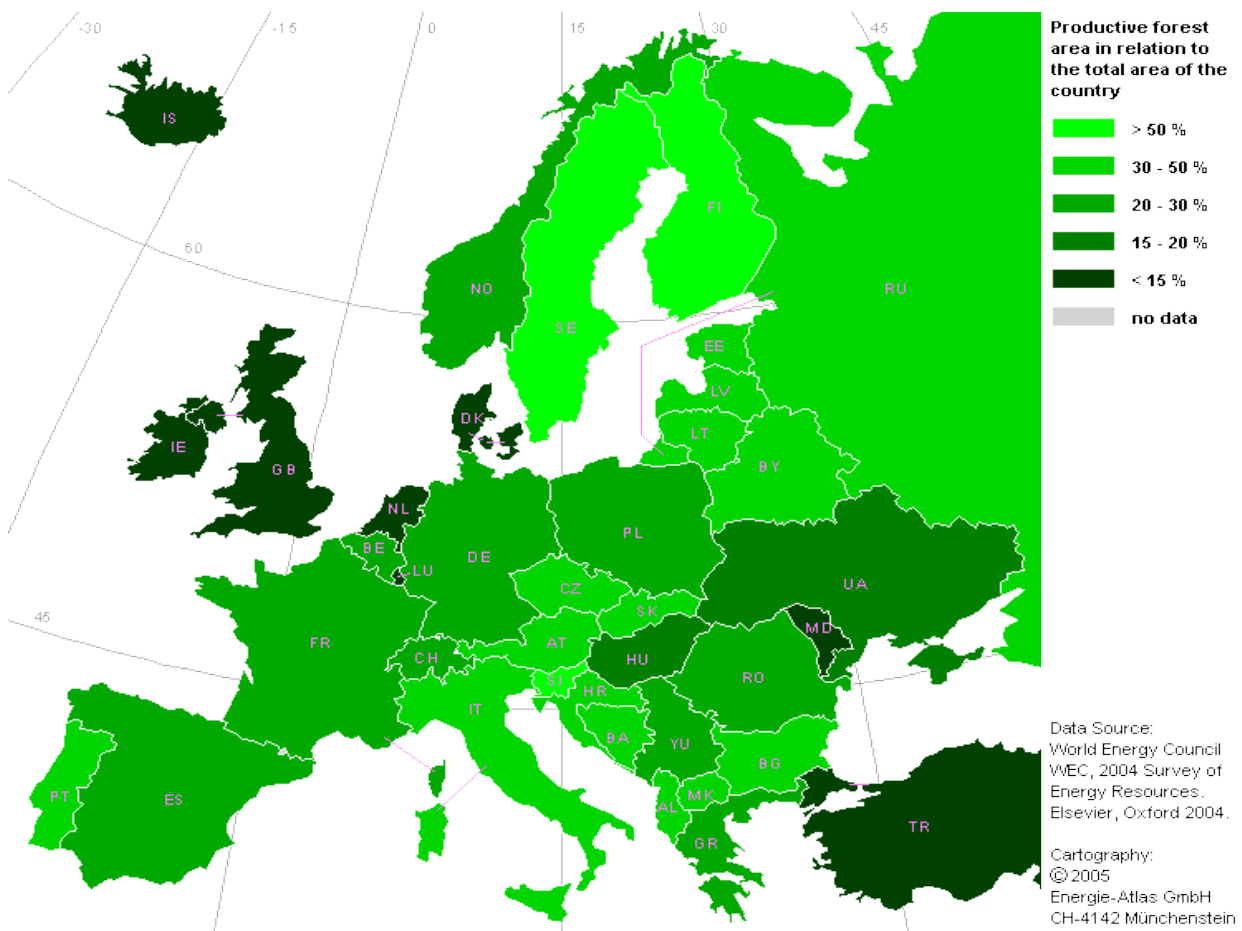
- *Wind*
- *Solar PV*
- *Small – scale hydro*
- *AD*
- *Geothermal*
- *Air source heat pump*
- *Ground source heat pump*
- *Energy storage*
  - *Electric (batteries)*
  - *Thermal (heat storage)*
  - *Chemical (hydrogen – fuel cell and electrolysis)*

The selection of RE technology will also be determined by the balance of energy demand of the business, the prospect to exploit local natural resources and the existing supply network. Assessing the energy mix assists in determining which RE technology is right for the business. Those matters will be discussed in depth in the Renewable Energy Resource Assessment Toolkit.

# Biomass Economics Across the NPA



Below is a map showing the productive forest potential in relation to the total area of the country. Biomass is the world's fourth largest energy source, contributing to nearly 14% of the world's primary energy demand.<sup>1</sup>



<sup>1</sup><http://www.geni.org/globalenergy/library/renewable-energy-resources/world/europe/bio-europe/indexbig.shtml>

The economics of a biomass system are governed by the capital cost, the biomass fuel cost, the offset fuel costs and the incentives available. The capital cost of a biomass boiler is dependent upon the size, fuel type used and level of automation of the system. The main parameters governing Biomass economics include<sup>2</sup>:

- Capital costs (CAPEX) – consists of costs for the system (62% to 77% of the CAPEX), Type and size of biomass boiler; heat distribution systems (such as pipe work, heat store size); fuel store and feed system; level of automation; buildings to house the system; works to improve or enable access for fuel delivery vehicles.
- Operational cost (OPEX) –The range is from 1% to 6% of the initial CAPEX per year and they consist of labour, scheduled maintenance, routine component/equipment replacement insurance and other variables. Biomass fuel costs and electricity – running costs of associated pumps, fans, and motors will be higher than for traditional boilers.
- Capacity factor - Electricity production and heat production. Tend to be very efficient, over 80%.
- Cost of electricity can be relatively low if local feedstock is available at low cost (no transportation).
- Biomass boiler lifetime - lifespan between 20 and 25 years.

The most common fuel is wood, which can be supplied in three forms; logs, chips and compressed wood pellets. However, biomass energy also includes energy crops, food waste streams, agricultural residues, industrial wastes and residues which can be used for heating in certain, specific circumstances. A range of biomass boilers are available, in sizes to suit homes, small businesses, community buildings through to large hospitals and industrial processes. A reliable feedstock supply chain is vital for the economic viability of a biomass boiler system. Fuel costs are central when considering the levelled cost of electricity, since ongoing running costs far outweigh capital investment. Thus, it is imperative before considering investment in a biomass boiler system to ensure that the right fuel can be sourced locally.

Economic benefits of biomass include relatively inexpensive resources; locally distributed energy sources provide constancy and reliability, price stability and generation of employment opportunities in rural communities. Risks included price volatility and availability of feedstock.

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<sup>2</sup> Renewable Energy: Technology, and Environment Economics, 2007.

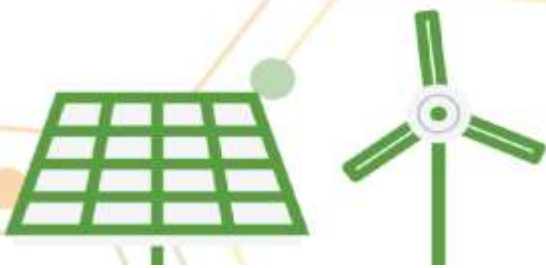


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## Scotland



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## Costs and economics

The most common types of fuel choices are logs, chips and pellets. A 100kW system will use approximately 160 oven-dried tonnes of woodchip fuel per year.

Average Fuel cost depending on the choice of fuel is represented in the table below:

Typical Properties	Logs	Chips	Pellets
<b>Moisture content when used (varies with species of wood)</b>	20-25% (if air dry)	20-30% (if air dry)	5-12%
<b>Energy content</b>	3-4MWh/tonne	2.5-3.5MWh/tonne	4.8-5MWh/tonne
<b>Financial</b>			
<b>Typical price</b>	£30-£100/tonne	£40-£80/tonne	£140/tonne(bulk) £220-£300/tonne (bags)
<b>Typical energy cost</b>	£8-£25/MWh	£10-£22/MWh	£34-£59/MWh
<b>Practicalities</b>			
<b>Suitable boilers</b>	10-80kW	30-10,000kW	8-500kW
<b>Storage facility requirements</b>	Covered area. Typically 2 years seasoning of green wood	Bin, bunker or silo; typically several weeks to a month supply for small scale	Vented room or flexible tanks; typically 3 months supply
<b>Handling</b>	Manual; forwarder, log processors for larger volumes	Front loaders, tippers; automated fuel feed	Bags - manual; tanker supplies use blowers; fuel feed automatic
<b>Transport</b>	Volume of 6 tonnes of stacked hardwood - 12.5m <sup>3</sup> and softwood 15m <sup>3</sup> at 30% moisture content	A 20m <sup>3</sup> agricultural trailer will contain about 3.5-5 tonnes of woodchip at 25% moisture content	A 20m <sup>3</sup> trailer/lorry will contain about 12-13 tonnes of wood pellets

Table 1 – Average Fuel Cost for logs, chips and pellets.

Average LCOE- The economics of a biomass system are governed by the capital cost, the biomass fuel cost, the offset fuel costs and the incentives available. An automatically fed pellet boiler costs



between £10,000 and £19,000 plus the boiler installation cost, delivery and fuel. While smaller domestic biomass boiler cost ranges from £5,000, an ordinary commercial installation aimed to heat two or more buildings can cost approximately £20,000.

- The LCOE for Scotland - £108 £/MWh. The OPEX of many wood-fired boilers is competitive with fossil fuels but CAPEX is much higher.
- Average CAPEX -The capital cost of a biomass boiler is dependent upon the size, fuel type used and level of automation of the system. By combining the predevelopment, construction and infrastructure costs total capital costs for a commercial setting in Scotland are estimated around £200- £450/kW installed maximum output for a complete turnkey system (up to 2MWth in size)<sup>3</sup>.
- Average OPEX- Average operating cost will be from 1% to 6% of the capital costs. Availability of fuel from local supply chain and minimization of transport requirement will bring the OPEX costs down.

The introduction of the RHI enhances the viability of biomass projects. Since the introduction in November 2011 of the RHI, in the 18 months since its introduction, 1,421 boilers have been installed and approved under the RHI. This represents over 90% of all of the renewable heat installation supported. The market continues to grow at a rate of 200 to 300 installations per month in the UK; of these, between 40 and 60 are in Scotland. Biomass it's a popular choice because of the ease of replacing oil and gas boilers in an existing system and the low cost of the fuel.

## Support Schemes

Renewable Heat Incentive<sup>4</sup> - Tariffs can be found below for installations with an accreditation date on or after 1<sup>st</sup> of July 2017.

Technology	Eligible Sizes	Eligible Tariff (pence per kWh)
Small commercial biomass	Less than 200 kWth	Tier 1 2.71
	Less than 200 kWth	Tier 2 0.71

<sup>3</sup> Carbon Trust 2012

<sup>4</sup> <https://www.gov.uk/domestic-renewable-heat-incentive>

<b>Medium commercial biomass</b>	200 kWth and above & less than 1MWth	Tier 1 4.79
	200 kWth and above & less than 1MWth	Tier 2 2.08

In order to be sure that the project meets all of the RHI eligibility requirements check [The Carbon Trust's Biomass Assessment Tool](#) available to help with the economic appraisal:

## Technology suppliers, products and services they offer

Supplier	Product	Services	Contact Information
<b>Biosus Energy</b>	Spanner HKA 35 (electric power - 35 kWel; heat power 79,5 kWth) Spanner HKA 45 (electric power - 45 kWel; heat power 102,2 kWth) Spanner HKA 49 (electric power - 49 kWel; heat power 111,3 kWth)	Installation Maintenance	<a href="mailto:info@biosusenergy.com">info@biosusenergy.com</a> Tel: 01224 918 192
<b>Glendevon Energy</b>	Wood chip boilers Wood Pellet Boilers	Installation Service Maintenance	Glendevon Energy Tullibole Mill Farm Crook of Devon Kinross KY13 0UL Tel: 01577 840579
<b>MCA Renewables</b>	Klover Biomass Boilers WAmflow Wood Pellet Boiler Grant Biomass Boiler	Installation Service Maintenance	12 Mid-Wharf St, Glasgow G4 0LD Tel: 0141 333 0700

<b>HW Energy</b>	Biomass Boiler – pellets and chips.	Installation Service Maintenance	HWEnergy (Highland Wood Energy Ltd) Lochaber Rural Complex Torlundy Fort William PH33 6SQ Tel: 01397 706412
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**The Biomass Suppliers List** - is a list of wood fuel that has proven it meets the eligibility requirements for the Renewable Heat Incentive (RHI) scheme. It allows RHI participants to easily demonstrate to Ofgem that the fuel they are using in their biomass boilers meets the RHI sustainability criteria required to claim their RHI payments. Go to: <https://biomass-suppliers-list.service.gov.uk/>



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## Ireland



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# Biomass CHP

## Economics

### Ireland



### Costs and economics

Typical Properties	Chips	Pellets
Moisture content when used (varies with species of wood)	25-35%	5-12%
Energy content	2.5-3.5MWh/tonne	4.8-5MWh/tonne
<b>Financial</b>		
Typical price	€115-125/tonne	>10 tonne: €210/t 3tonne: €230-275/t 1 tonne: € 275/t
Typical energy cost	€3.97/MWh	€5.63-€6.88/MWh
<b>Practicalities</b>		
Suitable boilers	30-10,000kW	8-500kW
Storage facility requirements	Bin, bunker or silo; typically several weeks' to a month supply for small scale	Vented room or flexible tanks; typically 3 months' supply
Handling	Front loaders, tippers; automated fuel feed	Bags - manual; tanker supplies use blowers; fuel feed automatic
Transport	A 20m <sup>3</sup> agricultural trailer will contain about 3.5-5 tonnes of woodchip at 25% moisture content	A 20m <sup>3</sup> trailer/lorry will contain about 12-13 tonnes of wood pellets

### a. Average LCOE for Biomass CHP

There are currently no biomass CHP plants in the North West Region of Ireland and only 2 installed plants in the rest of the country.

Due to lack of installations to date, data relating to LCOE, CAPEX & OPEX is not readily available.

## Support Schemes

RESS (Renewable Energy Support Scheme) proposed tariffs due to come into effect in 2018, subject to State Aid clearance from the European Commission. The tariffs are based on a sliding scale depending on MWh/yr usage.

Tier	Lower Limit (MWh/yr)	Upper Limit (MWh/yr)	Biomass Heating Systems Tariff (c/kWh)
1	0	300	5.66
2	300	1,000	3.02
3	1,000	2,400	0.50
4	2,400	10,000	0.50
5	10,000	50,000	0.37
6	50,000	N/A	0.00

REFIT 3 aimed to incentivize the reallocation of up to 310 MW of grid capacity to renewable energy sources with scope for between 100-170 MW of capacity to potentially be attributed to biomass powered CHP. While now closed to applications, some projects exist in the pipeline with deadline for connections extended to September 2019. REFIT will be replaced by the RESS.

## Government Allowances and/or Exemptions

For certified High Efficiency CHP (HECHP) plants, they may be eligible for relief from electricity tax for electricity produced from high-efficiency environmentally friendly heat and power generation.

## Funding available for Capital Costs

Debt funding up to 85% of the project costs (recent reports suggest 75% is now more likely).

Due to lack of installed capacity (~5.4 MWe spread over 2 CHP plants) there currently doesn't exist a shared ownership or ESCO business model for biomass CHP.

## Technology suppliers, products and services they offer

Supplier	Product	Services	Contact Information
<b>Fingleton White</b>	Ireland's leading designer and developer of industrial CHP.		Tel: +353 57 8665400 <a href="mailto:info@fingleton.ie">info@fingleton.ie</a>
<b>HDS Energy</b>	Designers of Industrial Steam Boilers, Biomass Energy Plants, Combined Heat and Power (CHP) Installations and RDF fueled energy plants.		Tel: +353 (0)46 929 3976 <a href="mailto:info@hds-energy.com">info@hds-energy.com</a>
<b>Crowley Energy</b>	Designers and installers of biomass CHP equipment and ancillary equipment.		Tel :+353 (0)21 4396666 <a href="mailto:sales@crowley.ie">sales@crowley.ie</a>
<b>RACKARD STEAM &amp; BIOMASS SERVICES</b>	Technical and mechanical feasibility studies, design and execution of biomass systems.		Tel: +353-872525458 <a href="mailto:nick@rackard.ie">nick@rackard.ie</a>



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## Finland



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## Costs and economics

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Average market prices of biomass fuels:

- Wood pellets: bulk ton delivered 245 €/t (incl. VAT 24%); big bag 500 kg delivered: 124 € (incl. VAT 24%)
- Woodchips at plant, approximate 20 €/MWh. Biomass -based CHP requires higher fuel quality as heat only production, so the price level is above this average price.

Capital expenditures of the biomass boilers are in average as follows:

- Pellet heating systems for households (central heating system): 10 000 – 20 000 €
- Pellet stoves: 1 500 – 5 000 € (heat to air and water circulated)
- Wood stove, water circulated with hybrid heat storage: 12 000 - 15 000 €
- Solar thermal + wood stove with water circulation (hybrid): 15 000 - 20 000 €
- Biomass boilers (woodchips, stoker), starting from 4 000 € (20 kW -)

LCOE of biomass energy depends on the system size, biomass fuel price and system efficiency among others. In average, the DH based on woodchips is about 4-7 c/kWh.

In household scale (own boilers), pellet based heat costs approximately 5 c/kWh, and heat based on wood chips (own production) below that.

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## Support Schemes

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The energy supports for biomass heat: 15 (TEM, Ministry of the Employment and the Economy via TEKES Finnish Funding Agency for Innovation).

The Housing Finance and Development Centre of Finland (ARA) is a governmental agency of the Republic of Finland operating under the supervision of the Ministry of the Environment. ARA provides investment supports for RE in housing associations, approximately 10-15%, depending on the financing.

## Government Allowances and/or Exemptions

N/A

## Funding available for Capital Costs

There are some service providers, who supply heat service, i.e. investment cost is bear by the company supplying the heat.

## Technology suppliers, products and services they offer

### Technology Providers

Supplier	Product	Services	Contact Information
<b>LVI-Bioneerit, Kitee</b>	Pellet and woodchip systems (burners, boilers) (Ariterm), heat accumulators.	Reselling, installing, service support.	<a href="http://www.lvi-bioneerit.fi/">http://www.lvi-bioneerit.fi/</a>
<b>LVI-Myller</b>	Pellet burners/boilers (Janfire), Sonny's multistoker burner, Jäspi boilers.	Reselling, installing, service support.	<a href="https://www.lvi-myller.fi/">https://www.lvi-myller.fi/</a>
<b>Tulikivi</b>	Stoves (soapstone), heat to air, water circulated, pellet stoves, hybrid stoves.	Manufacturing, selling, installing, service support.	<a href="http://www.tulikivi.fi">www.tulikivi.fi</a>
<b>Hankkija</b>	Water circulated stove (Linnatuli), Ala-Talkkari bioburners (stokers).	Reselling.	<a href="https://www.hankkija.fi/">https://www.hankkija.fi/</a>
<b>Ariterm</b>	Bioburners/boilers (for pellets & woodchips).	Reselling representatives.	<a href="http://www.ariterm.fi/">http://www.ariterm.fi/</a>
<b>K-rauta</b>	Jäspi burners/boilers (pellets, woodchips).	Reselling.	<a href="https://www.k-rauta.fi">https://www.k-rauta.fi</a>
<b>Putki-Ykkönen</b>	Jäspi burners/boilers (pellets, woodchips).	Reselling, installing, service support.	<a href="http://www.putkiykkonen.fi/">http://www.putkiykkonen.fi/</a>
<b>LämpöKarelia</b>	Jäspi burners/boilers (pellets, woodchips).	Reselling, installing, service support.	<a href="http://www.lampokarelia.fi/">http://www.lampokarelia.fi/</a>
<b>LVI Putki-Karjala</b>	Jäspi burners/boilers (pellets, woodchips).	Reselling, installing, service support.	<a href="http://www.putki-karjala.fi/">http://www.putki-karjala.fi/</a>

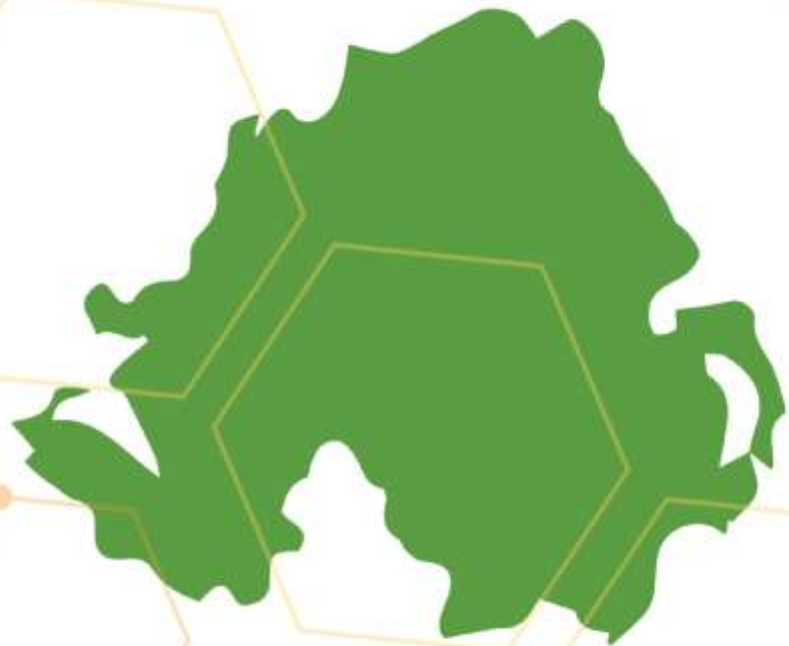


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## Northern Ireland



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## Costs and economics

Commodity (% Moisture Content)	pence/ltr	£/tonne	Net Calorific Value		Pence/kWh (input)	pence/kWh (“on the meter”)
			kWh/tonne	kWh/ltr		
LPG (Domestic)	40			6.6	6.06	7.13
Wood Pellet Bagged		250	4800		5.21	6.13
Firewood (30%)		150	3500		4.29	5.04
Wood Pellet – small blown delivery		220	4800		4.6	5.4
Wood pellet – full load blown delivery		200	4800		4.16	4.89
Wood Chip (20%)		150	4100		3.66	4.30
Wood Chip (30%)		120	3500		3.43	4.03
Wood Chip (40%)		90	2900		3.1	3.65
Wood Chip (50%)		70	2300		3.04	3.58

- Average LCOE - The economics of a biomass system are governed by the capital cost, the biomass fuel cost, the offset fuel costs and the incentives available. The Renewable Heat Incentive for Northern Ireland 6.4p/kWh.
  - Average CAPEX -The capital cost of a biomass boiler is dependent upon the size, fuel type used and level of automation of the system.
  - Average OPEX- Average operating cost is around £235k/MW.

## Support Schemes

RHI – Unfortunately the RHI is no longer available in NI after February 2016.

## Government Allowances and/or Exemptions

As of February 2016 there are no funding options available for biomass instalment. Previous to the closure of the RHI the banks were offering loans for the biomass purchase. However with the closure and the negativity towards the RHI there are no funding options available. The RHI was successful as you were guaranteed an agreed amount for heat per kWh that the boiler produced.

## Technology suppliers, products and services they offer

Supplier	Product	Services	Contact Information
<b>Green Energy Technology LTD</b>	<p><b>Grant Spira</b> wood pellet boiler.</p> <p>The Spira is up to 97.4% efficient, condensing wood pellet boiler. It is MCS accredited.</p> <p>The Spira has a fully automatic cleaning and washing system, not available in the majority of boilers. This system removes the requirement for a weekly clean.</p> <p>The boiler comes with its own 100kg wood pellet hopper, enough pellets for up to one week. This small hopper is filled using widely available bags of pellets.</p> <p>An optional upgrade is available to increase your pellet storage, and enable cheaper bulk purchases; to do this we recommend adding a 2 metre auger and 3.5 tonne wood pellet storage bin.</p> <p>This boiler comes in 26kW and 36kW options. A site visit is required to confirm installation requirements.</p>	<ul style="list-style-type: none"> <li>- Feasibility Study</li> <li>- Advice/Guidance</li> <li>- Design</li> <li>- Biomass Instalment</li> <li>- Support</li> <li>- O &amp; M</li> </ul>	<p><a href="http://www.get-renewables.com/">http://www.get-renewables.com/</a></p> <p>+44 (0) 28 3888 1228</p>



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 GREBEProject

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## Project Partners

GREBE will be operated by eight partner organisations across six regions:



## About GREBE

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