Braunton Parish Council

Rural Community Energy Fund

Stage 1 assessment

Renewable Heating

This assessment considers the feasibility for renewable heating systems in the Parish of Braunton.

Headings

Table of figures

Renewable heating systems

There are several types of renewable heating that were considered for community projects in and around Braunton.

Biomass Heating – Using locally sourced or sustainable sources of timber for heating and hot water. In a community project context this technology would be suitable to heat one or more local buildings and create a small district heating scheme, reducing reliance on fossil fuel heating systems. Wood fuel heating systems have lower carbon emissions than conventional fossil fuel systems. However they require much more space for fuel storage and can be very expensive.

Heat pumps – Air, ground and water source heat pumps utilise stored solar radiation in the air, ground or water and operate in a similar way to a fridge running in reverse. They are best at producing lower temperatures for specifically designed and energy efficient buildings. Unless linked to a new build project or retro fitted to a very energy efficient building, heat pumps are unsuitable for a community energy project.

Combined heat and power (CHP) systems – These systems generate heat and power simultaneously from the same energy source. These are most commonly gas CHP systems. There have been attempts to market biomass CHP units, but none are currently low risk enough for a community energy project. CHP systems work best at sites where there are large heat and electrical demands, such as swimming pools.

The most effective way of looking to identify suitable sites for renewable heating systems it to find buildings with high heating demand, and preferably off the mains gas network.

Most of Braunton has mains gas network and there are few community or business buildings that are not connected to it. Mains gas is a fossil fuel which is currently cheap. Biomass systems do not offer sufficient savings to be viable when competing with mains gas.

The Parish offices and hall have a mains gas boiler and so would not be suitable for renewable heating. The cost savings are currently not significant enough to ensure financial viability.

Commercial buildings with high heating demand include Perrigo and Tesco. These buildings are on the gas network and therefore renewable heating systems are currently not financially viable.

Biomass heating systems

Biomass includes a range of potentially combustible organic matter, either waste based or purpose grown, and either processed into a clean, uniform fuel stock (e.g. wood chips or pellets), or essentially non-processed (e.g. logs and carpentry waste). The main types of wood fuels used in boiler systems are logs, chip and pellet.

Figure 1 wood fuel types

Wood fuel is low carbon – when wood is burnt it emits the same amount of CO_2 into the atmosphere as absorbed during the life cycle of the growing plant. It is important to recognise that it is not carbon neutral because there are emissions from transportation and processing. However, the emissions are significantly lower than for fossil fuel heating systems, especially if the fuel is obtained from local woodland. There are also economic and ecological benefits if local timber is used.

Each of the three main types of wood biomass fuels has its own strengths and weaknesses when used for boiler heating systems. **Logs** are the least processed of the fuels but require the most manual handling. Log boiler systems are suited to rural properties and farms that already use seasoned log fuel and are prepared to process and handle the logs for the boiler system.

Pellet fuel is a low carbon but is the most processed and transported of the wood fuel types. **Wood chip** could be sourced more locally and would be cheaper per unit of heat delivered than pellet fuel. Wood chip heating systems do require more space for fuel storage and handling but have lower carbon emissions, more local benefits and are significantly cheaper per kWh of heat delivered.

Two of the main considerations for wood fuel are the moisture content, and its volume. All wood fuel will have some moisture content – the lower the moisture content the greater efficiency of combustion and the cheaper it is to transport (as less water is transported). The water vapour from the wet wood can condense in the chimney, forming creosote which runs down the insides of the flue. This can build up over time and cause issues in the boiler system.

Wood pellets generally have a guaranteed moisture content because they tend to fall apart when damp, leading to significant problems for the boilers feed mechanism. Likewise, a reputable local supplier of wood chip should also be able to provide fuel with low moisture levels. Using wood fuel with too high a moisture content will greatly reduce the lifetime of the boiler unit.

Wood fuel requires a lot more storage space than fossil fuels, and this can be an issue on some sites. Compared to oil, wood pellets will require three times, and wood chips ten times, the storage volume to heat the same building. The transport of low density materials is also a major consideration, and will greatly affect the cost of the fuel.

To be economic, the supply of wood fuel should be as local as possible. It is possible to source local wood chip, but not local pellets. Wood chip will come from wood that is of low value and not usable for other things, therefore it is not diverting wood from other uses but making use of wood usually dumped in to roadways on forest tracks, used for mulch etc.

In summary a wood fuel boiler has the potential to:

- Reduce fuel costs markedly over oil/electric heating systems
- Give an excellent return on investment with RHI revenue index linked for 20 years
- Contribute to local supply chains
- Reduce CO_2 emissions
- Increase energy security
- Improve local woodland management and biodiversity
- Provide an opportunity for local investment in a renewable energy project

Wood pellets

Wood pellets are made from compressed sawdust and wood shavings (and also other biomass products such as straw and biomass crops), and can be produced to very uniform specifications – typically short pellets of 6 - 10 mm in diameter, resembling animal feed. These pellets can be produced to a much greater density than wood chip, and hence take up less space. Their uniformity of size and their ability to flow makes wood pellets ideally suited to automated systems.

Generally, biomass boilers are less efficient when fired up for short frequent bursts, they prefer a more sustained on-period; but pellet boilers tend to offer better modulation and control than other fuels. Pellets deliver heat at a cost of approx. 4-5 pence per kWh compared to oil at 5-7 pence (this is an average figure – at the moment oil is much cheaper at around 3 pence a kWh), LPG at 6.5 pence and electric heating at between 7 and 12 pence (depending on type of tariff).

Wood chips

Wood chips are traditional chipped wood, and should be of a fairly uniform size, so as to work well in an automated machine. The benefits of wood chip fuel are its associated low cost, its local availability and the environmental and economic benefits it has. Well prepared wood chip should have moisture a content of 30% or less, and at this level it will constitute a cost effective and efficient fuel, providing heat for around 3-4p/kWh (significantly cheaper than oil, LPG, and comparable to mains gas). If wood chip is too wet it reduces the efficiency of the boiler and dramatically reduces boiler lifetime.

Wood chip boiler systems can be fully automated, like a pellet boiler. However they are only cost effective in larger boiler sizes, generally over 30kW in size. Wood chip also has a much lower energy density per cubic metre (a bucketful of chip is lighter than the same bucket of logs or pellets because of the space between the chips) and so requires a larger storage area or more frequent deliveries, where a lorry/tractor and tipper trailer would need access to a silo.

A well designed and operated biomass boiler burning fuel within the specification of the boiler should not produce any significant smoke, but black smoke may be produced if the fuel is too wet for the boiler. All biomass boilers produce some oxides of nitrogen (NO_x), particularly nitrogen dioxide (NO_2). While NO_x emissions from gas boilers have been reduced significantly in recent years through the use of low NO_x burners which burn at a temperature slightly below that at which NO_x forms, the nature of biomass combustion, and the need to ensure the complete combustion of wood gases, means that combustion takes place at a temperature where atmospheric oxygen and nitrogen can chemically combine. The better the quality of the combustion control system on a biomass boiler, the lower the NO_x emissions will be. In general, biomass boilers produce less NOx than oil boilers. Biomass boilers do not produce any oxides of sulphur (SOx).

The ash produced from biomass boilers is high in potash which makes the ash valuable as a top dressing by farmers or as a component of composts by horticulturalists. If ash cannot be disposed of in this way, or if the quantities are small, it can be disposed of to landfill with other wastes. The boilers produce very little ash as they burn very efficiently as long as the wood chip moisture is correct.

A wood boiler system would be comprised of:

Boiler (the better quality boilers cope better with varying chip moisture content and need less cleaning). The boiler would be sited so that it can be connected to each of the heated buildings. There are several ways of siting a boiler such as a dedicated building housing the boiler and fuel store, timber clad containers dropped on site or modification of an existing building to house the boiler and fuel store.

Wood chip/pellet hopper – this would be a dedicated space for storage of wood chip/pellets. An auger transfers the wood chip/pellet to the boiler. Usually, for boilers of medium size, an agitator arm is used to prevent build-up of the chip in one area of the hopper. A good hopper installed by a competent installer will prevent the chip from absorbing moisture and be well ventilated.

Buffer vessels (also known as thermal stores) – these are large insulated tanks of water that store the heat energy generated by the boiler and ensure any intermittent spikes in demand are met effectively. Chip boilers do not modulate very well and so these buffer vessels are needed to help facilitate smooth, uninterrupted heat supply.

Pumps and controls – it is likely that a new wood chip system will require new controls and pumps. The control system for a good wood chip boiler is as easy to use as that for a conventional fossil fuel boiler and just as automated.

Heat main – this is the flow and return piping that will connect the boiler to the buildings that require heating and hot water. The heat main is designed to minimise heat loss and ensure as much of the heat as possible is transferred from the boiler to where it is needed. Heat main is expensive and even the best heat main loses a significant amount of heat over a distance, therefore it is important to try and keep runs as short as possible and use good quality heat main.

Figure 2 wood chip boiler system

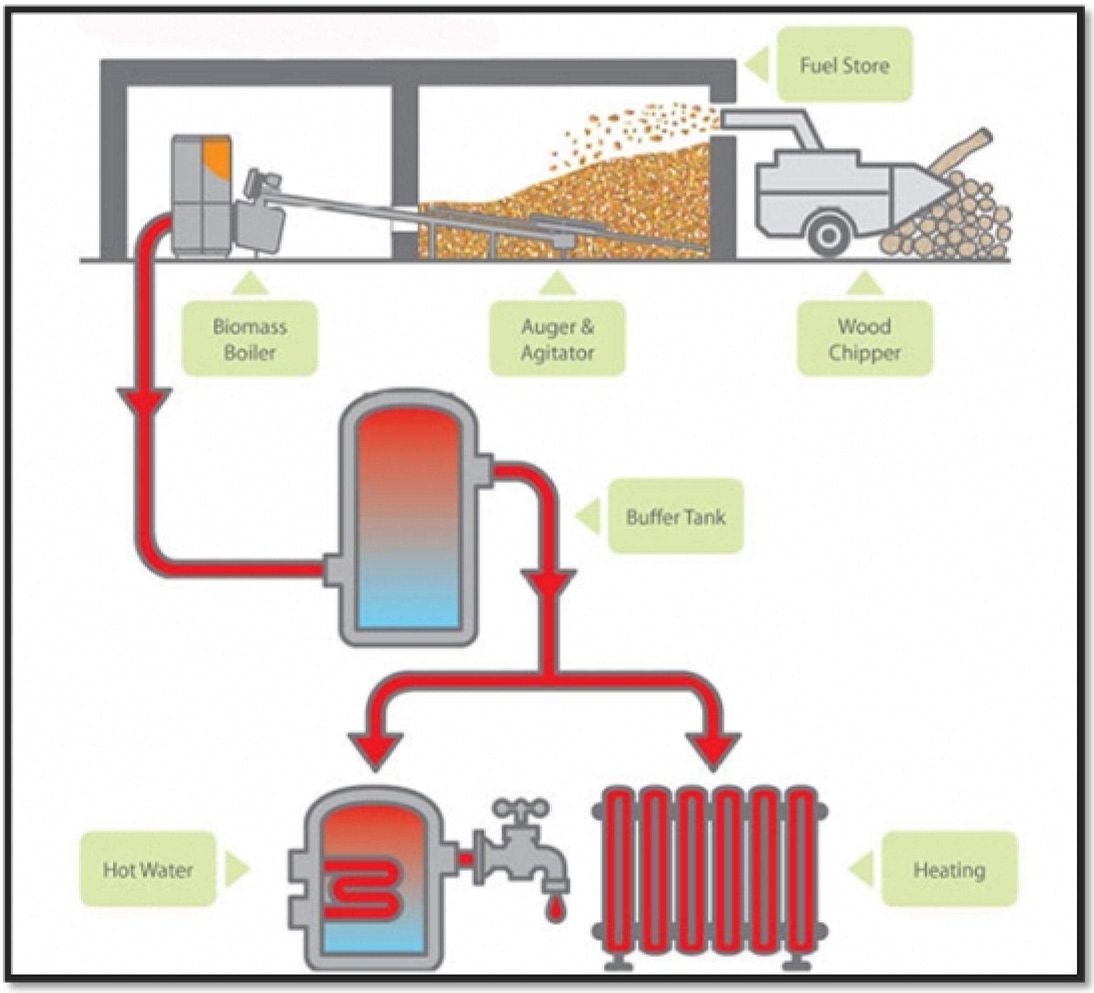

Figure 3 Example of a containerised boiler system - a good option for sites with limited space

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Wood fuel heating in Braunton

Caen Street Car Park

A good opportunity for community renewable heating in Braunton is the area in and around Caen street car park. This area was identified as part of the community engagement work early on in the project. Many of these buildings are off mains gas or have no current heating system at all. The land is owned by the Parish Council and relatively close together.

There is space heating and hot water demand from the buildings around the car park.

This includes:

- **The medical centre** – Has space heating demand. The building is used Monday to Friday. It has a wet heating system heated by a modern mains gas boiler.
- **Braunton museum** –The building is used Monday to Saturday. It has a wet heating system heated by a modern mains gas boiler unit.
- **Countryside centre** – Currently unheated. Open April to October from Monday to Saturday.
- **Surf Museum** – This building includes the surf museum, Surf England offices and a children's nursery. Heating is currently from electric storage and electric convector heaters.
- **Newsagents** – No heating required.
- **Police station** – Electric heating. Recently sold.

The buildings are of various energy efficiency standards. Most of the buildings have regular visitors throughout the day, which leads to heat being lost from the building as external doors are opened and closed. A system that can cope with this type of heating demand is required. Heat pump technology would not deal well with this regular loss of heat from the building.

Assessments were carried out for all buildings except the medical centre and police station. Several attempts were made to engage with the medical centre, but due to time pressures the manager felt unable to commit to a site visit. The police station was in the process of being sold, and access was not possible.

The current heating demand information for the buildings is:

Figure 4 Caen car park heating data

Building	Heating demand kWh p/a	Cost
Museum	11,000	385
Surf Museum	*	n/a
Countryside Centre	**	n/a

**the building is currently not heated – some heating is provided by electric plug in heaters on colder days, but there is no information on costings.*
***the building is heated from electric storage and convector heaters. There is no heating data.*

The surf museum building has until recently only been used as the museum and offices for Surf England. However now part of the building that was previously unheated will be used in the day by a local nursery group and in the evening as a youth club. Therefore heating demand will increase for the building.

The countryside centre is at present not heated at all and is closed during the colder months. Therefore we have no heating data at all.

The museum is heated by a modern mains gas boiler unit which is efficient and cheap to run. The building is run through the year.

Discounting the medical centre (due to their lack of interest) it would be possible to connect the museum, surf museum and countryside centre to one central wood fired boiler system and create a district heating system. This could utilise local timber supplies and provide cost effective low carbon heating.

The most simple and cost effective system to install would be a wood fuel boiler that heated the countryside centre and surf museum. This configuration would require very little heat main to connect the buildings and a boiler house could be sited near to the surf museum.

Connecting the museum in to a heating system would raise the installation costs significantly due to the increased heat main and requirement to cross a road.

The potential configurations of a wood boiler heating system for the surf museum and countryside centre are shown below. The most suitable option would be a containerised system (Figure 3) that could be dropped on to site by the surf museum building. There is no space internally in either of the buildings to site a system and so it would need to be sited externally.

Figure 5 Surf museum and countryside centre heating system options

The best location for a plant room is at the southern end of the surf museum. This would take up a small area of car park. The location would allow easy delivery of fuel and sufficient space for boiler and fuel store.

Figure 5 shows the potential location of a containerised system (two potential configurations shown) and the heat main link between the buildings.

The boiler would be connected into the surf museum via a short run of insulated heat main. Another small run of heat main would connect in to the countryside centre. Both buildings would need wet heating systems installed (radiators). The museum could also be connected, but this would raise costs and disruption.

Figure 6 Space in between surf museum and countryside centre

The small gap between the surf museum and countryside centre.

It is recommended that one of the automated types of wood fuel boiler are used. The author has experience of a log boiler in a community building and it did not work well. The boiler needs to be manually loaded every day in the colder months. In a community building, with people's roles and responsibilities changing, this does not work smoothly. If the person that usually loads the system is away, or leaves, it can cause disruption issues. It would be better to use a more automated system for these buildings. Fuel can be stored and maintenance is kept to a minimum.

A pellet boiler would offer the most automated system, with fuel delivered in a similar way to heating oil. However this system would not make use of locally sourced fuel. A wood chip boiler would require more maintenance, but would be able to utilise local supply chains.

The suggested wood heating scheme for these buildings is therefore a wood pellet or wood chip boiler dropped on to site in a containerised housing. This could provide the countryside centre and surf museum with heating and hot water.

The exact size of the boiler would depend on what installer and manufacturer was used for any potential installation and how the system was configured. For instance if a larger buffer vessel was used then a smaller boiler could be run harder for more of the time.

There is very little hot water demand for either of the buildings and therefore the majority of the boiler load will be for space heating. A 50 kW boiler, with a suitably sized buffer vessel of 2-3000 litres would be sufficient to provide ample space heating for both buildings.

Cost savings are difficult to estimate due to the lack of heating data for the building. However if we take a conservative estimate of heating provision based on boiler size and heating hours then the boiler should be delivering approx. 50,000 kWh p/a.

Other Braunton sites

There are few other sites in Braunton with high heat load and that are not mains gas connected.

There are several hotels that will have winter heating demand and high summertime demand for hot water, but these are mains gas connected.

The main high heat users are out of the village. For instance the nearby holiday parks have high base heat loads from swimming pools. If off mains gas these would provide excellent potential for wood fuel heating. Several attempts were made to contact Ruda, but no reply was forthcoming. If contact can be developed with one of these sites then a wood fuel heating system would be a viable community energy project. This would be dependent on a viable RHI.

Woodland Assessments

Assessments of the woodland areas owned by the parish council were also carried out to determine how much timber could be sustainably harvested from them each year.

The Beacon – woodland area

Figure 7 The Beacon woodland area

The Beacon is an area of woodland situated on a hill top above Braunton and owned by the Parish Council. The woodland is not currently managed for timber extraction.

The woodland could be brought into more active management, perhaps by the community through a ‘Logs for Labour’ scheme. A small amount of manual equipment would be needed, and somewhere to season the logs. This could perhaps be on site if on a small enough scale. The scheme would need volunteers to manage the woodland and arrange the seasoning of the timber.

The sustainable yield from the woodland is shown in the tables below (using the Silvanus Trust woodland survey tool).

Summary information

	Hedges	Woodland	
Total volume (measured)		6.9	**m^3**
Total volume (total)		1616.0	**m^3**
Distribution of volume (measured)		100.0	%
Distribution of volume (total)			%
Average height		10.0	**m**
MSY		53.9	**m^3**

Alternative weights and measures - Woodland

Sampled volume	7.7	**t**
Plot area volume	7.7	**t**
Woodland volume	1809.8	**t**
MSY	60.3	**t**
$m^3\ ha^{-1}$	385.1	**t**
MSY $m^3\ ha^{-1}$	12.8	**t**

		Energy density by volume kWh/m3	Total volume (kWh)	MSY (kWh)
Woodland	Wood chips (30% MC)	870	1405887.9	46862.9
	Log wood (stacked - air dry: 20% MC)	1,400-2,000	2747137.3	91571.2
	Wood (solid - oven dry)	2,100-3,200	4282302.3	142743.4

Therefore around 60 tonnes of timber can be sustainably harvested from the Beacon each year. This is a manageable amount of timber for a ‘logs for labour’ scheme. There are many people who run wood burners in the village that would perhaps like to get involved in active management of the woodland in return for seasoned logs.

This would have positive impacts on the biodiversity of the Beacon and also help to offset fossil fuel heating system emissions in the village.

Figure 8 Beacon unmanaged woodland example

The Old Quarry – woodland area

Figure 9 The old quarry woodland area

The old quarry site is a small piece of woodland owned by the PC on the hilly ground to the east of the village. The woodland is on a slope of a hillside, near to residential properties.

The land is not suitable for renewable energy. But there is some scope for woodland management, as an additional piece of land for a 'logs for labour' scheme.

Sustainable yield information is given in the tables below.

Summary information - Comparable results			
	Hedges	Woodland	
Total volume (measured)		6.9	m^3
Total volume (total)		447.0	m^3
Distribution of volume (measured)		100.0	%
Distribution of volume (total)			%
Average height		10.0	m
MSY		14.9	m^3

Alternative weights and measures - Woodland			
Sampled volume		7.7	t
Plot area volume		7.7	t
Woodland volume		500.6	t
MSY		16.7	t
$m^3\ ha^{-1}$		385.1	t
MSY $m^3\ ha^{-1}$		12.8	t

		Energy density by volume kWh/m3	Total volume (kWh)	MSY (kWh)
Woodland	Wood chips (30% MC)	870	388862.6	12962.1
	Log wood (stacked - air dry: 20% MC)	1,400-2,000	759846.5	25328.2
	Wood (solid - oven dry)	2,100-3,200	1184466.6	39482.2

Conclusion

In summary there is at present no scope for a community renewable heating project in Braunton.

However there is the scope to bring community woodland into management which would have a number of benefits for local people.

There are a number of community groups throughout the UK that manage woodland on the ‘log for labour’ model. It would be possible to set up such a group in Braunton. A facility to store harvested timber would be beneficial, as this would allow for central drying and storage of the logs for the community.