Rural Community Energy Fund (RCEF)

Stage 1 Feasibility Report

Thurlestone Community Renewable Energy Feasibility Study:

Appendix 2: Biomass Technical Study

Submitted by:

Devon Association for Renewable Energy

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Contents

1. Introduction

This technical overview builds on previous work, local knowledge and an initial site visit to examine the potential heat demand and heat main routes[1] for two biomass heat networks in Thurlestone:

- Southern network –-Connecting church rooms, church and hotel.
- Northern network – Connecting parish hall, primary school and care home.

During the community engagement process DARE were approached by a resident of "The Mead" a large estate of private dwellings in Thurlestone. During the first phase of construction of the estate there had been a communal oil tank and connecting pipework to a number of houses and the resident was interested in seeing if there could be any future potential for a district heating scheme at the site. "The Mead" was visited as part of the initial site assessment process, however the properties within the area are set on individual large plots, creating the need for very long district heat main pipework networks, this would lead to substantial heat losses across the system and in addition a location for a centralised plant room could not be established at the time of the site visit."

The work consisted of two elements:

1. Assessment of heat demand
2. Assessment of heat network routes

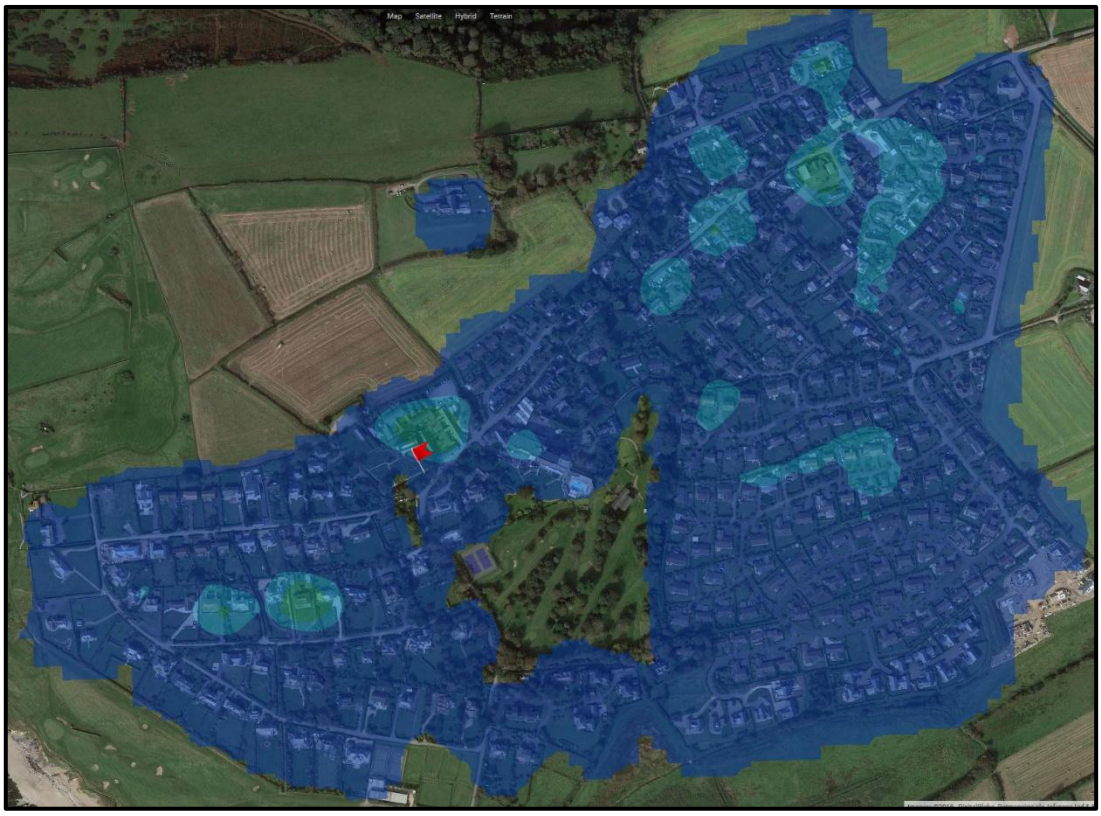
The next sections address these elements in turn. They are followed by conclusions and recommendations.

2. Heat demand assessment

The initial heat demand assessment consisted of a desktop review of the national heat map GIS data for the village. National heat map data should be treated with caution. It is indicative of general energy consumption, but its accuracy is limited for rural post codes such as Thurlestone, which covers large areas. Figure 1 shows the pattern of heat demand for Thurlestone, which was generally confirmed in later site visits. The figure shows "hot spots" as light blue areas, covering the parish hall, school and areas close to the hotel.

[1] This study assesses the technical challenges regarding heat main routes; Appendix 1 addresses ownership issues.

Figure 1: Thurlestone National Heat Map Image showing "hot spots" over the parish hall school and hotel[2]



Site visits were then undertaken to establish site-specific heat demand within each network, and suitability for accepting networked heat.

2.1 Southern network heat demand

Site visits established that the church, church rooms and hotel could all accept heat in theory and that operators were interested in exploring the possibility in principle. The lack of a wet heating system for the village shop means that there would be significant cost associated with that site being upgraded to use networked heat.

In addition, a significant proportion of the shop's heat comes from waste heat from the chiller cabinets, meaning that energy demand from the heat main would be too low to justify the cost of connection. The site was therefore deemed unsuitable.

It should be noted that the cost of connecting to a heat network is not inconsiderable, in addition to the ground works. The cost of a domestic heat interface unit, is comparable to that of a gas boiler, which it is intended to replace.

Regarding the Thurlestone Hotel, a meeting with the manager revealed the existing biomass installation (installed January 2014) supplies a large part of the on-site demand, due in part to the very high quality demand management system. Only 14% of the site's annual demand is met by fossil fuels. Given the high cost of connecting the heat main, which would need to cross a road to the hotel, a connection to the proposed network would not be financially viable.

Table 1 shows the heat demand for the remaining sites, together with their heating type.

[2] From here. Copyright DigitalGlobe, Getmapping plc, Infoterra Ltd and Bluesky.

Table 1: Southern route potential heat demand and heating systems

Site	Annual energy consumption	Wet heating system
Church rooms	11,000 kWh/y	Yes
Church	24,000 kWh/y	Yes

The neighbouring domestic properties at the Church Farm estate were asked if they would be interested in their properties being part of a community heat network. None of the properties responded positively. In addition many of the properties within the Church Farm estate are second homes and, as such, their energy use profiles would not be beneficial to a district heating scheme in terms of heat sales.

2.2 Northern network heat demand

The initial proposal for the Northern network included the Thurlestone Court Care Home. Contact was made with the owner, after which it became clear that they were unable to provide the long-term commitment required on the part of a heat purchaser. The parish hall and school remained as potential partners, and their heat demand and heating systems are show in Table 2.

Table 2: Northern route potential heat demand and heating systems

Site	Heating demand	Wet heating system
Parish hall	16,500 to 22,000 kWh/y	Yes
School	90,000 kWh/y	Yes

The neighbouring domestic properties in the Northern network area were asked if they would be interested in their properties being part of a community heat network. None of the properties responded positively. In addition the owner of the property through the garden of which a heat main would have to pass, in the Northern network route B option, had expressed that they did not wish to be part of a community heat network.

3. Heat network configurations

The potential heat network routes were initially mapped using desktop software, and then reviewed by site survey. The results are shown here for each network.

3.1 Southern network heat main route

Four potential heat main routes were assessed, as follows:

- Southern Network A: Based on the biomass installation being sited at the hotel, feeding a network including the church and church rooms (271 metres).
- Southern Network B. Same as for network route A, but with the biomass installation being sited on the church car park.
- Southern Network C: Routing the heat main across the field to the north of the village, allowing it to cross the main road rather than run along it (413 metres, a considerable undertaking).
- Southern Network D: The final iteration, with the biomass installation on the church car park and serving only the church rooms and church (91 metres). This route, while shorter, would require very careful digging across a church yard and connection with two existing oil fuelled wet heating systems. Working within the curtilage of a listed building and a burial ground would make this an expensive option, despite its short length.

These variations are shown in the next four figures.

Figure 2: Southern Network heat main route A

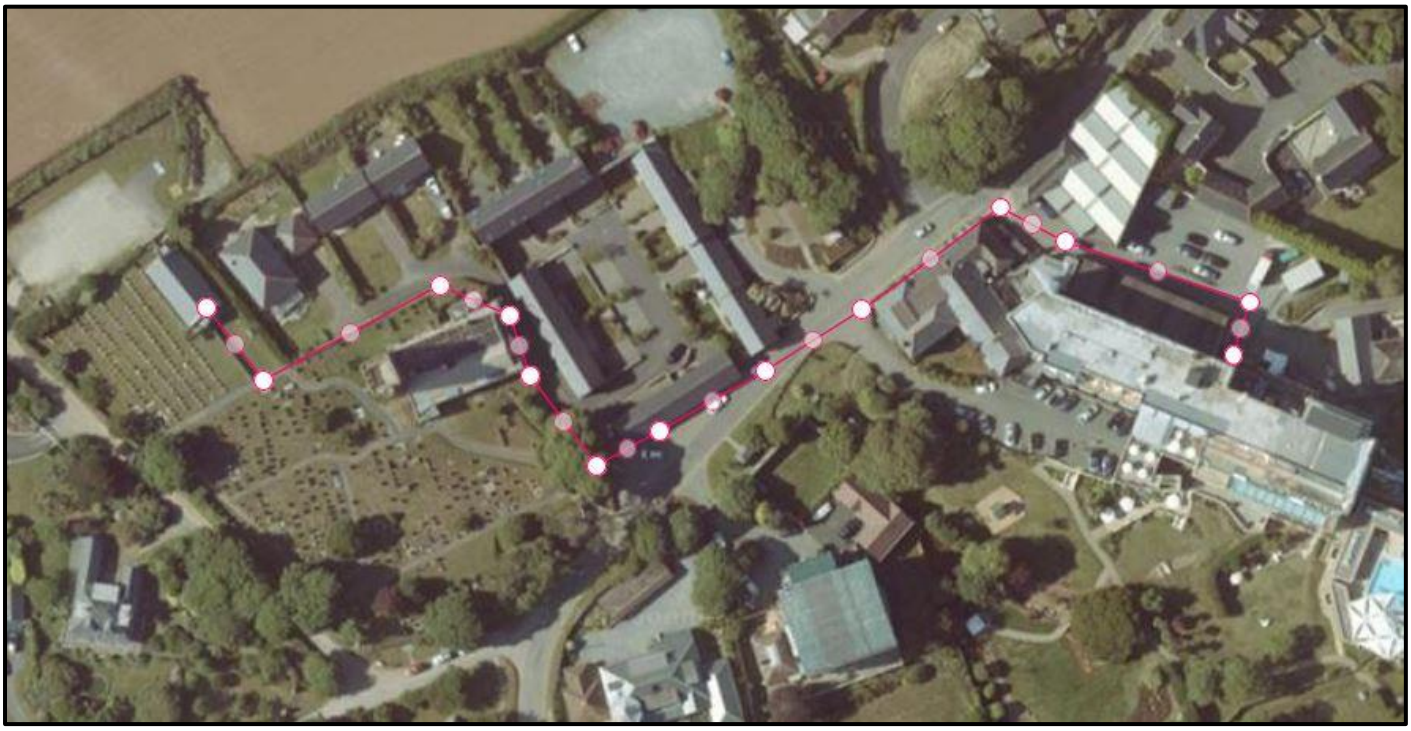


Figure 3: Southern Network heat main route B

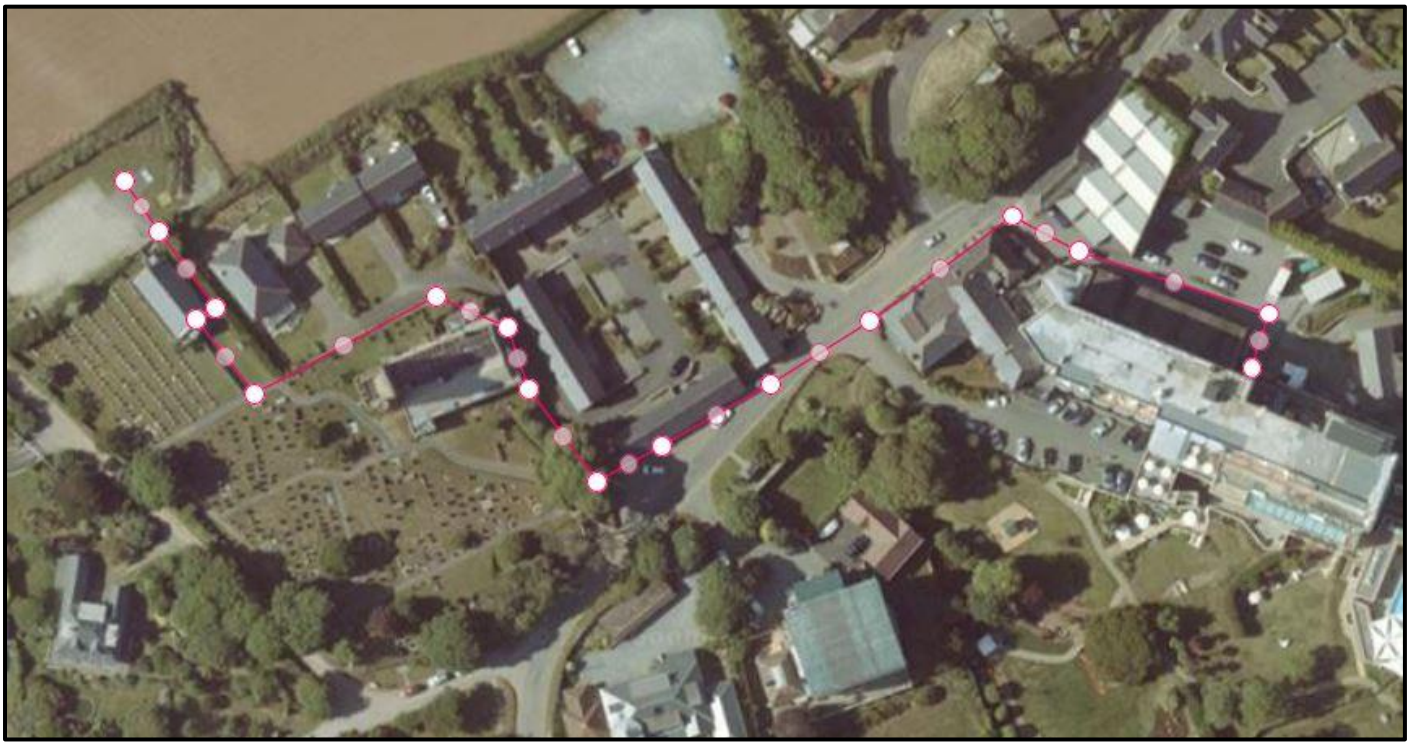


Figure 4: Southern Network heat main route C

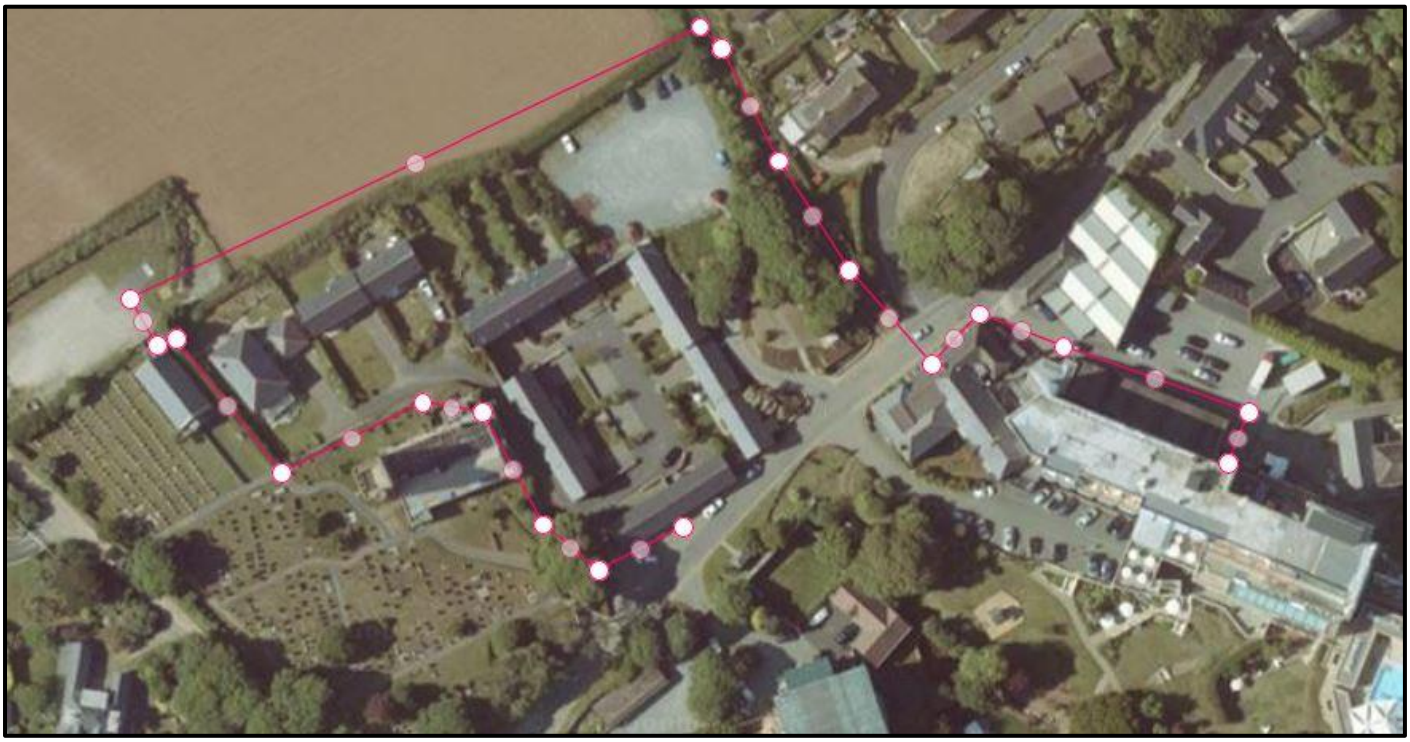
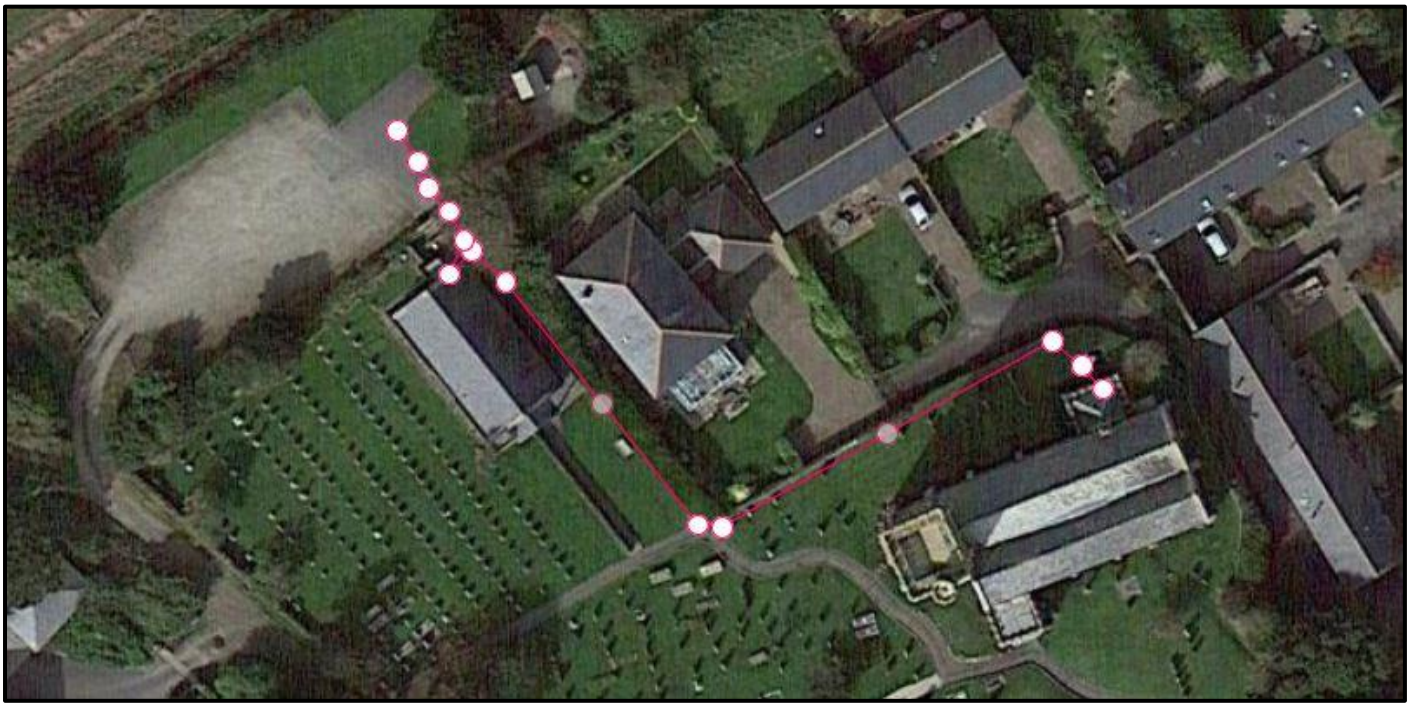


Figure 5: Southern Network heat main route D

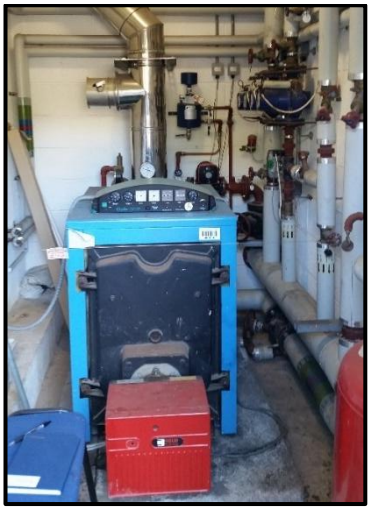


3.2 Northern network heat main route

Three potential heat main routes were assessed, as follows:

- Northern Network A: Based on the biomass installation being sited at the parish hall, feeding a network including the primary school and nursery (which uses a single heating system) and a 28-bed care home. There is sufficient room to locate a containerised biomass installation (including hopper) beside the northwest wall of the parish hall, which would be unobtrusive and provide easy access to the parish hall plant room, and could be fed with blown pellet. The school has a new oil boiler and an easily accessible plant room (see Figure 6) but is managed by NPS (under contract to Devon County Council), which adds complexity.

  Figure 6: Primary School plant room

  This route requires significant road works, which would be prohibitively expensive. During a site visit it was noted that the route ran close to the garage and likely buried petrol tanks, which was a significant potential risk.

- Northern Network B: As for A but excluding the route to the care home (90 metres). The route crosses a road, which increases costs, and wayleave would be required for the garden en route.
- Northern Network C: As for B but travelling along the main road, rather than across a garden, to reach the primary school. This is the preferred route.

Figure 7: Northern Network route A

Figure 8: Northern Network route B

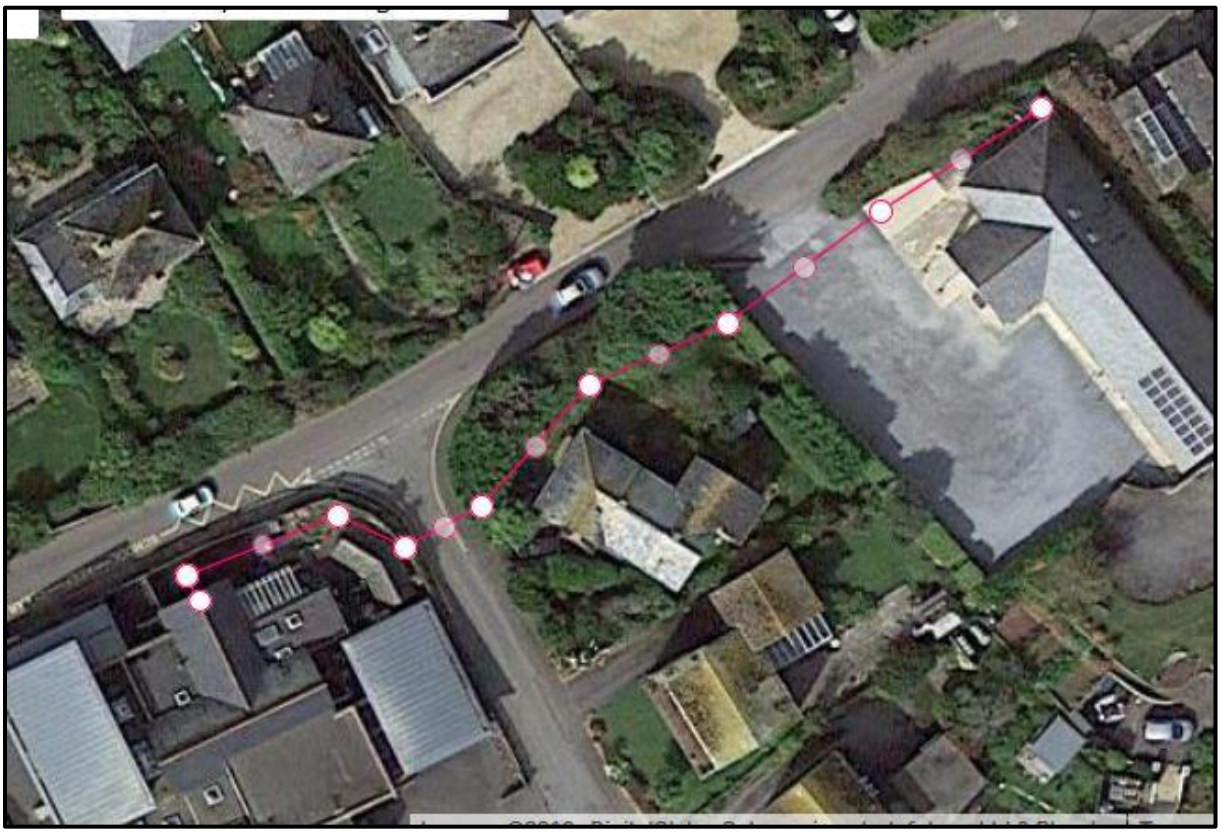


Figure 2: Northern Network route C

4. System specifications and costs

Any biomass heat network size must be specified to take account of heat losses from the heat main. In the case of Thurlestone, the final networks for each installation would have an approximately 90m length of insulated heat main that is buried in the ground (90m flow and 90m return, making 180m of total length of pipe in the ground). This heat main is well insulated, but even so it will lose around 6,000 kWh per year.

Each system will incorporate a thermal store, holding heat to meet peaks in demand at each connected property. These stores will also have thermal losses, as will the heat interface units that connect each property to the heat main.

The boiler must supply enough heat to cover these losses while meeting the connected buildings' heat demand. The lost heat cannot be part of the RHI claim, and must be considered an overhead of the running of the scheme.

Biomass boilers may be fuelled by pellet or chip. Pellet requires a smaller storage space than chip, and it is easier to deliver (because it can be blown through pipes from a lorry). It normally has a more consistent moisture content, which increases efficiency and reduces maintenance costs. For all these reasons, a pellet boiler has been specified for the installations. If chip is considered in the future, then local supply would be very important. This 2012 study provides an overview of the local resource, and options for woodfuel supply hub.

All of these factors are taken into account in the summary of generation, costings and demand shown in Table 3. This table underpins the financial model which forms Appendix 3.

Table 3: Summary of Thurlestone biomass heat network generation, costings and demand.

Site	kWh per year boiler	RHI kWh per year	RHI income at 2.96p/kWh	Pellet cost to supply the heat @ 4.8p/kWh	System Cost	Heat main	Ground [3]works
Northern	125,000 [4]	112,000	£3,315	£6,000	£70,000	£7,000	£15,000[5]
Southern	42,000	35,000	£1,036	£2,016	£35,000	£7,000	£12,000[6]

[3] The ground works will have a huge impact on the overall installation cost, hitting a service in the ground of finding archaeology can add tens of thousands of pounds to the installation costs.
[4] In reality, this could be higher as most of the heat is used at the school and is being pumped through the ground from the village hall, therefore the pipe losses will be greater.
[5] Assuming the pipe can be passed under the road using a "mole", if not road closure and repair would add around £5,000 to £7,000.
[6] Assuming minimal hand digging.

5. Biomass energy cabin locations

The biomass boiler and associated feed hopper for each installation could be modular, housed within an energy cabin such as the one shown in Figure 10.

Figure 10: Biomass Energy Cabin

This is a six metre energy cabin, the same size as would be required for each of the installations in Thurlestone. The next two figures show the potential location of each.

Figure 11: Southern network energy cabin location (in blue)

Figure 12: Northern network energy cabin location (in blue)

Annex: Exeter City Council Nursery Energy Cabin

This annex provides a series of views of the energy cabin installed at Exeter City Council nursery. It is used to heat a greenhouse, and is slightly larger than the ones examined for Thurlestone.

Figure 13: Exterior with boiler end in foreground, showing access door and solar panels

Figure 14: Exterior from fuel hopper end showing access hatch

Figure 15: Fuel hopper end view showing blower lorry loading ports over door

Figure 16: A view inside the fuel store.