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THWING & OCTON PARISH COUNCIL RENEWABLE ENERGY FEASIBILITY STUDY

FINAL RCEF REPORT

Provided by:	Luiza Potter Haussen, Senior Consultant
	Oliver Cowburn, Consultant
Reviewed by:	Helen Troup, Principal Consultant
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CONTENTS

EXECUTIVE SUMMARY

Avieco was commissioned by Thwing and Octon Parish Council to conduct a renewable energy feasibility study for the parish.

This Project is supported by the BEIS funded Rural Community Energy Fund (RCEF) which is managed by the North East Yorkshire and Humber Energy Hub and administered by Tees Valley Combined Authority.

This report outlines the technical, financial and governance feasibility of renewable energy technologies for heat and power, within Thwing and Octon parish.

Our priority heating recommendations are:

- Individual air source heat pumps (ASHP) and ground source heat pumps (GSHP) – for residents, heat pump type will depend on whether they have available land to install GSHP heat collectors and/or personal preference
- Biomass boiler systems for farms during peak heating demand periods

Our priority power recommendations are:

- Individual rooftop solar PV systems

Our priority street lighting recommendations are:

- 13 solar powered LED smart streetlights

We propose that the recommended renewable energy systems should be owned and operated by the residents within the parish. It is important to note that this method of governance will require active participation of relevant parties, principally during procurement, installation and commissioning of equipment. The Parish Council should support residents as necessary and act as a knowledge hub for engaged residents of Thwing and Octon.

The results of the renewable energy feasibility study provide evidence of the difficulties of decarbonising for rural off-gas grid communities like Thwing and Octon Parish Council and that more support is needed. We hope that this report can be used to engage policy makers, funders, and others for further support.

Avieco Ltd
3rd Floor, 105-107 Farringdon Road
London, EC1R 3BU
hello@avieco.com | www.avieco.com | +44 20 7048 0450
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OVERVIEW

Thwing and Octon Parish Council has identified an opportunity to explore renewable energy systems in the Thwing and Octon parish to benefit residents. The Parish Council has recently undertaken a community plan process in which they received strong community support for the idea of implementing renewable energy in the parish.

The Parish Council has been awarded a Rural Community Energy Fund (RCEF) grant for the purposes of a feasibility study. Avieco is assisting the Parish Council with specialist support to assess the potential for renewable energy schemes within the parish and identify which schemes to progress.

The kick-off meeting for this project took place on 13th March 2020. After a break caused by the Covid-19 pandemic, works restarted on 28th September 2020, with a technical site visit.

After a community consultation event on 10th October 2020, the community elected the preferred options for renewable energy implementation in the parish:

- Heat: individual heat pump domestic systems
- Heat: small scale heat network
- Power: ground mounted, centralised solar farm
- Power: individual rooftop solar
- Street lighting: solar-powered streetlights

We have included several additional technologies to ensure we have covered as many potential solutions as possible; these include biomass, solar thermal, full scale heat network and wind.

Thwing and Octon need a robust feasibility assessment of these opportunities to identify which are viable, at what scale, and how to progress potential schemes to deployment. This feasibility study report presents the assessment of the main renewable energy technologies that can be implemented in the area, with a rationale for any deemed not suitable for technical, financial or governance reasons.

We have analysed the options mentioned above and present their feasibility in this report. The feasibility study follows RCEF format requirements and will enable Thwing and Octon Parish Council to make an informed decision on the next steps for the project.

For ease of understanding, and to support the Parish Council in using this report to engage their residents, funder partners, and other stakeholders, we have included the write-up of the technical, financial and governance analyses as an appendix, following.

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London, EC1R 3BU
hello@avieco.com | www.avieco.com | +44 20 7048 0450
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SITE DETAILS

Thwing and Octon parish consists of two small villages located on the eastern end of the Yorkshire Wolds, in the East Riding of Yorkshire. Although the majority of residents live within these villages, a number of properties are dispersed around the 4,024-acre parish. Outside of the developed areas, the parish predominantly consists of agricultural land, see **Figure 1**. It is important to note that the parish is an off-gas grid community.

FIGURE 1: SITE MAP OF THWING AND OCTON PARISH INCLUDING PARISH BOUNDARY

CONTEXT

In 2015, the Paris Agreement, the world's first legally binding global climate change agreement, was adopted, with the objective to limit global warming to 1.5°C – 175 entities signed the agreement on the first date it was open for signature. With an increasing number of countries around the world pledging Net Zero targets, the UK joined them in 2019 as the first major economy to make the pledge with the target of 2050. To reach this legally binding target, all parties need to take action, from individuals, to businesses and communities.

The UK Government are currently creating our Net Zero roadmap and enshrining much of the routes there in law, with incentives to support the transition. Particularly of interest for residents is the plans to phase out fossil fuel heating systems in new and existing homes off the gas grid through the 2020s. The sale of wet wood and house coal will be phased out from 2021 to 2023, to make way for other solid fuels which produce less harmful particulates, such as dry wood or biomass pellets. Additionally, the government have pledged to ban all fossil fuel boiler installations in both existing and new build homes by 2025 – this will include coal, oil, and LPG systems. To clarify, this does not mean if you have an existing system, you must stop using it by that date, but that when it comes to replacement no new high carbon installations will be acceptable.

The Parish Council have recognised these trends and have acted ahead of time to commission a feasibility study to help understand what can be done within the parish and to provide the residents with a guide to the available renewable energy solutions.

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London, EC1R 3BU
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IMPLEMENTATION ROADMAP & SCHEDULING

In this renewable energy feasibility study, we have identified technically and economically feasible renewable energy systems for Thwing and Octon parish. To help realise these systems, we have outlined the next steps for the Parish Council and the residents to put these opportunities into practice.

Avieco's implementation roadmap enables action in the immediate, short, medium, and long term to realise renewable energy systems, for the benefit of the Parish Council, and the wider community.

The Parish Council should use this report as evidence of the support gap experienced by many off-gas grid communities within the UK which has prevented many of community wide renewable energy solutions to not be feasible at this time. The correct funding support mechanisms could make some community wide solutions viable.

PARISH COUNCIL NEXT STEPS

IMMEDIATE (<3 MONTHS)

- Council to review this report and its recommendations
- Share the summary report and discuss the findings with the wider community
- Decide on whether to progress with the parish street lighting replacements

SHORT TERM (3-6 MONTHS)

- Engage with suppliers and operators, through formal tendering process, as required – a minimum of 3 supplier quotes should be sourced to ensure value to money
- Liaise and agree with ERYC the alterations to the street lighting throughout the parish
- Undertake detailed site assessments for streetlights with a technology supplier
- Seek project funding routes (Council budget, grants, loans, government incentives etc)

MEDIUM TERM (6-9 MONTHS)

- Secure funding – include costing for street lighting upgrades in Council budget and/or apply for grant(s)/loan(s), as appropriate
- Procure equipment and confirm works programme
- Install system(s); scheduled to cause least possible disruption to homeowners, tenants, and community

LONG TERM (>9 MONTHS)

- Monitor performance of streetlights
- Review performance against success criteria and prioritise future installations
- Communicate with residents – highlighting benefits of the technologies to community
- Ongoing maintenance regimes and future works: solar PV inverter upgrade and battery replacement, if not covered by extended warranty (to be advised by installers); solar PV cleaning if desired

Promote the scheme(s) and the benefit to the sites and the wider community and support/advice on future renewable energy schemes across other Parish Councils.

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London, EC1R 3BU
hello@avieco.com | www.avieco.com | +44 20 7048 0450
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CONCLUSION

Our renewable energy feasibility study for Thwing and Octon Parish Council included community engagement, an energy consumption profile analysis, a technical and financial assessment considering a wide range of heat and power technologies and an operation and governance review.

Based on this analysis, our priority recommendations are:

Our priority heating recommendations are:

- Individual air source heat pumps (ASHP) and ground source heat pumps (GSHP) – for residents, heat pump type will depend on whether they have available land to install GSHP heat collectors and/or personal preference
- Biomass boiler systems for farms during peak heating demand periods

Our priority power recommendations are:

- Individual rooftop solar PV systems

Our priority street lighting recommendations are:

- 13 solar powered LED smart streetlights

We assessed a variety of technologies including air source heat pump, ground source heat pump, biomass boiler, solar thermal, heat network, solar powered streetlights, solar PV and small-scale wind.

The community engagement guided our later technical sections and helped us understand the importance of this project to the residents. We conducted a voting process, where 20 residents cast their vote on preferred technologies, which defined the priorities for the feasibility study. Additionally, we circulated questionnaires to the community on their energy usage, 33 of which were returned – this step in the engagement process ensured that we had real parish data in order to calculate their typical energy consumption and understand the array of heating sources used.

We considered a range of factors in the analyses including planning permission, system size, site suitability, generation profile, grid capacity, DNO connection cost, technology cost, operation and maintenance cost and financial incentives, to name a few. Considering these elements and more we conclude that individual air and ground source heat pumps and biomass boilers for farms during peak demand are the most feasible heating options for the parish, whilst rooftop solar PV Is the preferred power option. Additionally, solar powered streetlights, although only provides a moderate financial case, would provide many benefits to the parish including reduced running costs, greater visibility whilst reducing light pollution and cutting associated carbon emissions.

Finally, we assessed the suitable operation and governance structures for a renewable energy project within the parish – considering the technology recommendations, we believe that the residents (and farmers) to each own and operate their systems which allows them to reap all the benefits.

The technologies presented within this report deliver a number of benefits important to Thwing and Octon Parish. First of all, they will help to cut carbon emissions within the parish which in turn supports the government's decarbonisation targets and reduces the UK's pollution levels. All recommended technologies will also reduce running costs and energy pricing volatility, whilst bringing energy independence to the residents. Renewable energy projects have the ability to bring communities together towards a common purpose and we hope that this report will provide the Parish Council with a strong tool to leverage more support for off gas grid communities.

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APPENDIX A – FULL REPORT AND ANALYSES

COMMUNITY ENGAGEMENT & BENEFIT

Thwing & Octon have a close community of residents, and therefore their engagement with this project was very important. With this in mind, we have put together a community engagement plan, which identified the main stakeholders and events to be held over the course of the project. The plan is included in this report as **Appendix B**.

Our analysis shows that a significant number of residents support decarbonisation initiatives in the parish through renewable heat and power. A previous Parish Council survey also showed that residents see value in implementing renewable energy in the community. 20 people participated and voted for their preferred technologies during the community events in October, and the results of this vote defined the priorities for the feasibility study. This report evidence that a simple "invest-to-save" business model for the community is not viable, so in the absence of other support mechanisms, grants are necessary to support this small, rural community to decarbonise their energy systems.

To properly understand the community's interest in implementing renewable energy within the parish, we undertook several community engagement activities throughout the project, including:

- **Regular meetings with the Parish Council:** from the beginning of the project, the Parish Council and Avieco met regularly to discuss technology selection and community involvement
- **Advertising for the project:** We designed two leaflets and website for the scheme, so the residents can be informed of events and news regarding the scheme
  - **Website:** https://www.thwing-octon-renewables.co.uk/
- **Launch event:** On Saturday, 10th of October, Avieco facilitated a four-session in-person community event, where we presented the aims of the project and put the proposed technologies to a vote. This interaction with the residents and their votes were crucial to determine the priorities for the feasibility study, as not all of the initially preferred solutions were found to be viable due to the community size and the available funding opportunities
  - A recording of this event can be found on the project's website.
  - The presentation for this event can be found on **Appendix C,** and
- **Energy demand survey:** With the support of the Parish Council, we surveyed the community to understand the local energy consumption of homes and businesses

Copies of the publicity material and press releases are included as **Appendix D, E** and **F**, and a copy of the survey results in **Appendix G**. A brief analysis of the survey responses is also included as **Appendix H.**

Changes to delivery schedule

The community engagement plan included in our appendix was developed with the Parish Council, and continually assessed for suitability as the public health situation evolved during the course of the project. Covid-19 has massively impacted the timeline of the project and the planned engagement activities. The kick-off meeting happened two weeks before the first lockdown in England and most of the planned activities following were postponed.

We sought to hold virtual events where possible, but the necessity for in-person events delayed the project significantly. With the support of the Parish Council, we were able to conduct an in-person

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3rd Floor, 105-107 Farringdon Road
London, EC1R 3BU
hello@avieco.com | www.avieco.com | +44 20 7048 0450
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community event safely and respecting the government guidelines for social distancing, and following this were able to resume the work.

Importance of the project for Thwing and Octon

Like many communities off the gas grid, Thwing and Octon have a challenging path to decarbonising their village and need to find the right way to get support from the government and their communities. This project was important to highlight the challenges involved in finding the correct low carbon technologies to be implemented and the funding routes available for them.

The results of the renewable energy feasibility study show that small-scale individual heat and power solutions are the most viable options for the parish's residents. Community-scale options were found to be technically viable but not financially viable, which provides a strong case for the need for more funding support for off-gas grid communities in the UK.

Implementing renewable energy in Thwing and Octon will bring financial and non-financial benefits for the community in the short and long-term. Individual heat solutions can bring good financial returns by capturing the Renewable Heat Incentive and lowering heat costs, and individual power solutions bring low carbon electricity usage to the community, albeit with lower financial returns. Solar-powered streetlights will reduce bills for the parish, improve visibility with better light quality and reduce light pollution due to the dimming technology, where the lamps are only activated by movement. Community-wide benefits of implementing renewable energy solutions in the resident's homes include improving air quality by reducing the usage of fossil fuels and future proofing the community by complying with the UK's decarbonisation targets.

Taking action now and using the available subsidies for renewable heat is important to guarantee that the community will have support to execute these measures and won't have to incur even higher costs in the future.

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TECHNICAL ASSESSMENT

The technical assessment includes an analysis of the feasibility of a range of renewable energy technologies, including heat and power. This section outlines our technology selection criteria, the parish's energy consumption profile, a shortlist of technology opportunities and our recommendations based on the technology assessment.

TECHNICAL SUMMARY AND RECOMMENDATIONS

The recommended renewable energy solutions brought forward from the technical assessment which we will incorporate into the financial assessment include:

Heat solutions:

- Individual air source heat pumps
- Ground source heat pumps - Individual and multi-property
- Biomass boilers for seasonal peak heat demand

Power solutions:

- 109 kWp ground mounted solar PV option for Thwing
- 19 kWp ground mounted solar PV option for Octon
- 2,371 kWp ground mounted solar PV option filling the entire north Thwing solar farm area
- 2,729 kWp ground mounted solar PV option filling the entire solar farm area south of the parish
- 2 kWp individual rooftop solar PV for homes
- 0.75 kWp individual horizontal axis wind turbine for homes

Street lighting solutions:

- Solar powered street lighting to replace 13 of the existing lamps in the parish

These solutions are deemed the most suitable, considering local energy usage profiles, planning regulations, DNO restrictions, geography, and resident preferences. Each technology's financial and business case will be further explored in the financial assessment section.

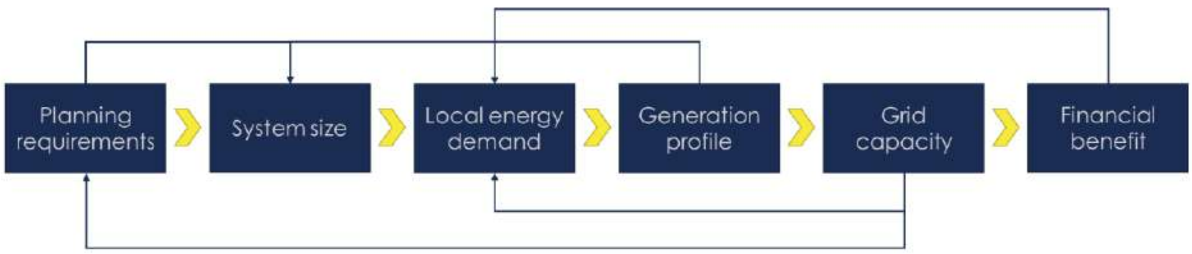
TECHNOLOGY SELECTION CRITERIA

There are many factors to consider when assessing the viability of renewable energy systems, and in order to select the most suitable solutions for the parish, Avieco and the Parish Council have agreed on the following:

Technical suitability

Any onsite renewable system should be matched to the energy needs of the site and the network capabilities, as well as be attractive to the residents. At the community engagement event, residents in Thwing & Octon showed preference for individual heating solutions and centralised solar.

There are multiple factors that affect sizing decisions for renewable generation systems; our approach accounts for these by iterating the technical capacity, local demand, grid capacity and business case to arrive at the optimal size based on all these factors.



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Planning regimes

Determining whether planning permission is required is a crucial step in a feasibility project. In general, local planning authorities supportive of renewable and low carbon development and should particularly back community-led initiatives. Hence, for the majority of properties we did not identify any regulatory constraints that might restrict the usage of renewable energy systems such as rooftop or ground mounted solar PV systems. However, 5 of the 33 questionnaire responses stated that their home or business building was listed, and so permissions to install solar technology will be required. For Grade II listed buildings, this does not mean that renewable technologies such as solar panels or ASHPs will not be possible but listed building consent and planning permission will have to be acquired. This step cannot be completed as early on as the feasibility study but is necessary for the project implementation stage and can be done through the government website or by requesting the forms directly to the local Council offices.

We understand that some of the large-scale technologies might have planning restrictions for the Thwing and Octon area. To confirm this, we have consulted the planning regulations to ensure that any of the recommended technologies are possible to be implemented.

In March 2020 we contacted Owen Robinson, Principal Planning Policy Officer at East Riding Yorkshire Council, who informed us that Thwing and Octon lies within an 'area of significant constraint', meaning that an onshore wind development "should not be considered acceptable" (see **Appendix I**). This has been confirmed in the latest National Planning Policy Framework (NPPF) February 2019[1]. For this reason, planning permission at this time will be not be possible and wind energy should be de-prioritised.

The Prime Minister, on 18th November 2020 presented a Ten Point Plan for a Green Industrial Revolution which is intended to set the UK on a path to Net Zero carbon emissions. However, no mention of funding and planning policy changes for onshore wind were made.

Grid connections for renewable electricity generation

Decentralised power generation assets such as solar and wind power require a connection to the National Grid with the necessary permits that ensure the safety of the network. Factors affecting a grid connection are the strength of the local grid, the number of other connections in the pipeline, the size of the system to be connected and how much electricity would be used onsite vs exported. It is unusual for a connection to be technically impossible, but the fees levied by the distribution network operator may make the connection prohibitively expensive.

Northern Powergrid, the local Distribution Network Operator (DNO) for the Thwing and Octon region, make some of this information publicly available, including high level connection costs and a generation capacity map. We have also liaised with Northern Powergrid to confirm the reliability of the online information.

Financial performance

A positive business case is necessary to install any renewable energy technology at any site. However, the financial performance of different technologies will vary with local conditions. At this stage, we recommend progressing systems with positive Net Present Value (NPV) over the technology lifetime.

There may also be criteria from the funding source, e.g. project payback period and return on investment. These criteria have been analysed in the following financial assessment section, where

1 NPPF Feb 2019 revised (page 45, subsection 154) [link to page]

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3rd Floor, 105-107 Farringdon Road
London, EC1R 3BU
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we will also identify any further constraints linked to financial performance that may exclude a technology or influence design decisions.

Environmental impact

Renewable energy projects help reduce greenhouse gas emissions – contributing to the UK's legally binding emissions reduction target. We recommend prioritising technologies based on cost of carbon saved (£/CO_2e), should multiple technologies prove viable.

Renewables energy systems can have some negative environmental impacts – i.e. glare from solar panels or visual impact from wind turbines. This is expressed as a qualitative and/or relative measure to allow the Thwing and Octon community to prioritise schemes accordingly.

Summary of technology selection criteria

Criteria	Threshold	Notes
Technical Suitability		
Meets energy needs of the community	Optimised – ideally 100% of annual demand	For solar PV, the aim is to meet 100% of total daytime electricity usage in order to avoid exports to the network and large-scale battery use.
Meets energy needs of the local electricity network	Low or no impact on the local electricity network	Considerations include available capacity within the local grid for additional generation technologies and further works to the local infrastructure
Planning requirements	Permitted development preferred	Wind energy unlikely to be permitted, based on advice from Local Planning Authority Solar PV complies with local planning requirements, but sizing depends on DNO network availability
Financial performance	Positive NPV over lifetime	Assessment to follow in financial analysis
Environmental performance		
Emissions reductions	Ranked by £/CO_2e saved	Assessment to follow in financial analysis
Environmental impact	Ranked by degree of disruption	Assessment in implementation roadmap

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ENERGY CONSUMPTION PROFILES

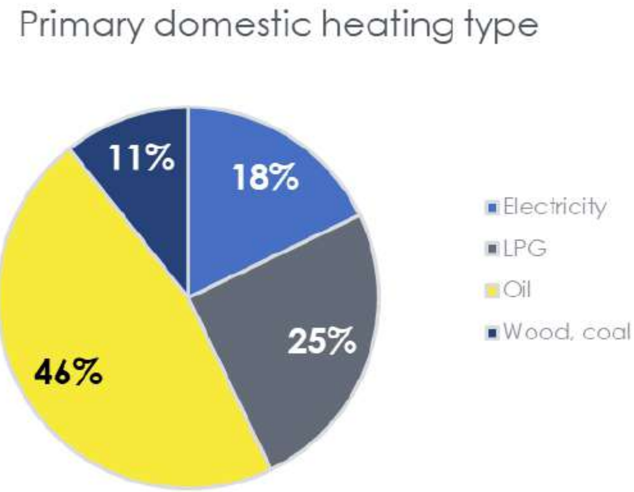
An initial consumption profile has been developed to establish the energy requirements of the Thwing and Octon parish residents. This will enable identification of the best solutions, both technically and economically, for the parish.

DOMESTIC ENERGY CONSUMPTION

The electricity and heat consumption profiles of domestic residents have been calculated from a sample of 28 questionnaire responses and extrapolated to the 88 households in the Thwing and Octon parish Plan (2017). In the absence of metered data from the parish residents, we have assumed that electrical consumption is constant throughout the year and heat consumption follows the heating degree days (HDD) in a given year.

User	Electricity Consumption (MWh/year)	Heat Consumption (MWh/year)
Domestic	355	2,016

Oil is the main heating sources used in the parish, with an estimated 64% of households using wood and/or coal as a secondary heating source. Only one household uses a thermodynamic water heater and wood and coal only.



We found that heating costs the residents almost two thirds more than electricity, with an average heating bill of approximately £1,560 per household, compared to an average electricity bill of £930 per household. We also found that carbon emissions from heat were 5 times higher at around 375 tCO2e (tonnes of carbon dioxide equivalent) when compared to electricity at 99 tCO2e.

Annual energy usage for heat and electricity are displayed in the graph below. In the absence of a detailed consumption breakdown, the consumption profile for electricity has been assumed to be constant as electricity consumption is less influenced by seasonal variations. We understand individual usage will vary and electricity consumption can be affected by a range of factors such as whether a resident works from home or whether they have electric heating systems, but in the absence of more granular data, we have assumed steady usage throughout the year.

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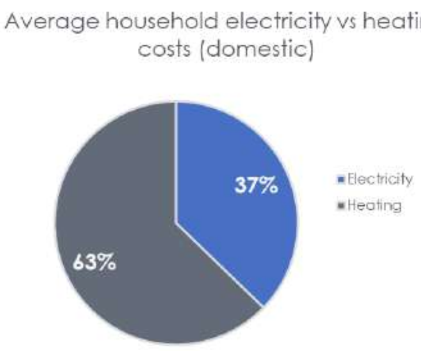
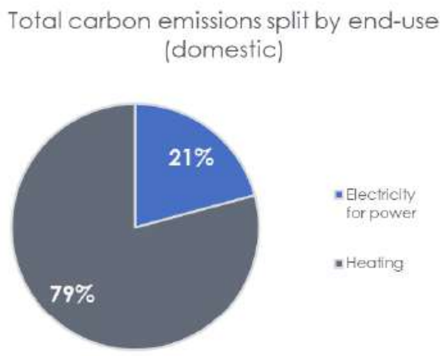
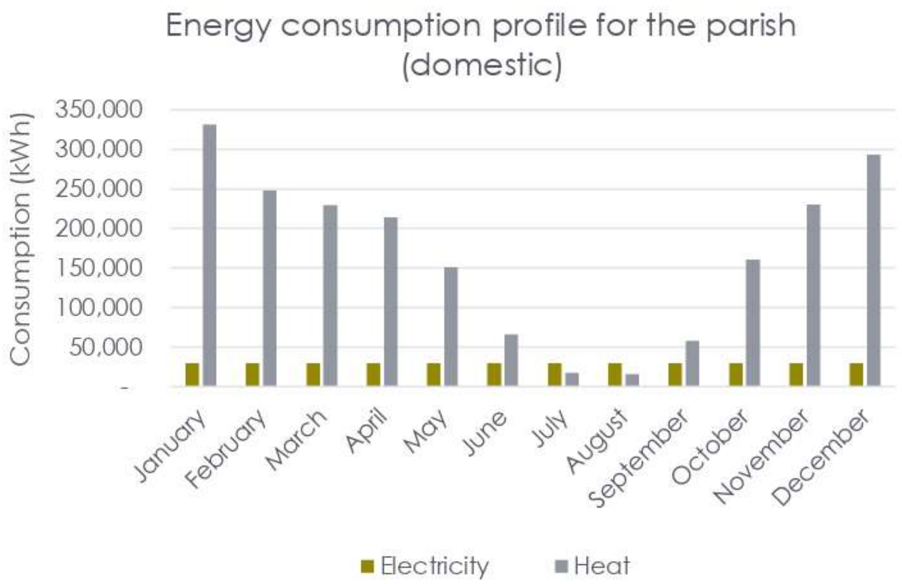




Heating degree days (HDD) have been used to estimate the monthly heat demand. The results show a typical annual consumption profile, with peak demand in the winter months providing heat to the parish. The profile below shows the demand for heat and power for the whole parish:



NON-DOMESTIC ENERGY CONSUMPTION

For non-domestic users, 4 questionnaires were returned, all of which were farms, with two supplying the appropriate data for electricity consumption and one for heating. The graphs below show results based on the information collected, so at the technology implementation stage, an individual study needs to be done for each farm. Farm energy consumption can vary significantly depending on a range of factors such as size or type of farm (i.e. arable or pastoral).

User	Electricity Consumption (MWh/year)	Heat Consumption (MWh/year)
Individual farm	5	24

Similarly to domestic consumption, annual heat costs are higher for farms than electricity – costing around £1,255 p.a., compared to electricity which cost around £700 p.a. Heat also emits more

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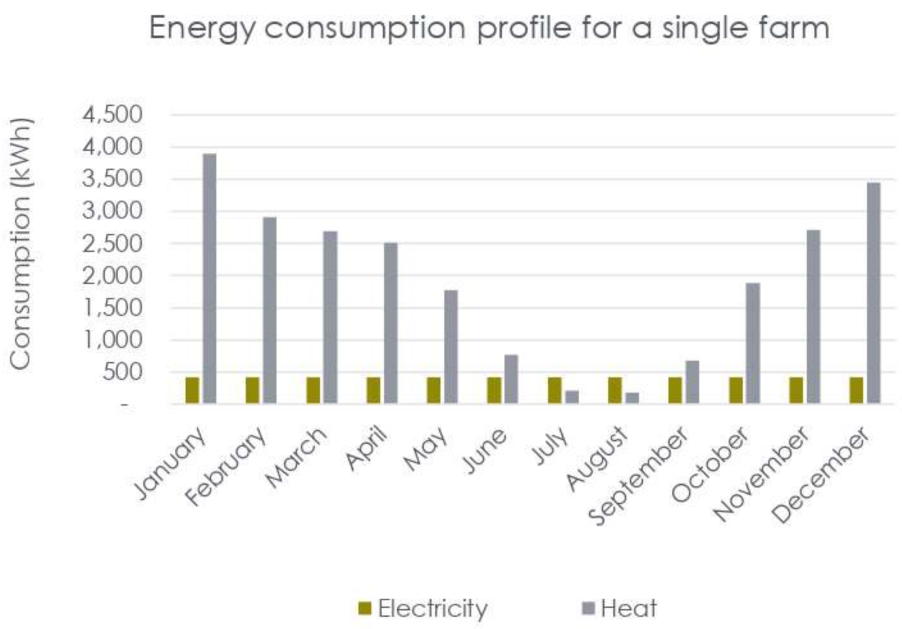
greenhouse gases – approximately 5.8 tCO_2e (tonnes of carbon dioxide equivalent) as compared to 1.4 tCO_2e for electricity.

The divide between the farm's electricity and heat monthly consumption profile are displayed below. Both display the same trend as the domestic energy profiles – more granular data may show a variation between the two profiles.



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TECHNOLOGY SHORTLIST, PLANNING AND PERMITTING

We have analysed the technical feasibility of the five preferred options that resulted from the community engagement event and included several options to ensure we have covered all potential solutions for the parish.

In this section, we present an overview of different technologies, and in the next section we will present a technical, financial and business case analysis of the recommended solutions for Thwing and Octon.

HEAT SOLUTIONS

AIR SOURCE HEAT PUMPS

Description of Technology

Heat pumps are a highly efficient way to heat buildings. They draw in heat from the environment (typically the ground, air, or water), and use electricity to raise the temperature to a suitable level for space heating and hot water. Typically for each kWh of electricity consumed, 2.5-4 kWh heat is supplied – the average ratio of heat delivered to the total electrical energy supplied over the year is known as the Seasonal Performance Factor (SPF). They work like fridges in reverse. Heat pumps deliver lower temperatures than boilers, so they work well with underfloor heating or radiators with a larger surface area.

Air source heat pumps (ASHP) absorb heat from the outside air and repurposed it inside the building for heating. Therefore, an ASHP requires external space either on the side or roof of the building for the compressor and fan beds.

ASHP systems have a life expectancy of approximately 20 years.

This technology is well established and widely used in the UK. Installations also attract financial incentives from central government in the form of the Renewable Heat Incentive. However, achieving the non-domestic RHI scheme deadline by the March 2021 will not be viable for multi-property parish systems and so we expect that the scheme will only be available to domestic users – the domestic RHI ends on 31st March 2022.

Advantages	Disadvantages
Low carbon energy source	External equipment which can produce low noise levels
Minimal maintenance requirements	Heating controls are significantly different to radiators/boiler systems
Straightforward to install	Delivers low-temperature heat which may not be compatible with existing heating systems
No additional fuels required	

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Suitability for Thwing and Octon

ASHPs are well suited to individual domestic properties as they require little space for the equipment and have a relatively low capital cost.

ASHPs are straightforward to install and can be placed on either a flat roof or alongside the property to be heated. When operating, ASHPs make some noise, and so care should be taken to not place them directly outside a bedroom window. A standard domestic ASHP will produce around ~40-50 dB, which is similar to a refrigerator or light rain.

FIGURE 2: EXAMPLE OF A DOMESTIC SIZED AIR SOURCE HEAT PUMP

Heat pumps are compatible with 'wet' central heating systems, like many systems in the parish, however, heat pumps deliver lower flow temperatures, circa 50°C, as opposed to oil which is closer to 80°C. In the case that a household has radiators with a small surface area, new radiators may need to be installed that have either 50% or even 100% more surface area to ensure a comfortable ambient temperature. An installer will need to survey your existing systems to provide the best possible solution for each household. Underfloor heating is another option for central heating retrofit, but this comes down to personal preference.

Hybrid heating systems are available and allow you to combine an oil or LPG boiler with a heat pump, either as a "top up" in the coldest conditions, or using the heat pump to "pre-heat" the system before passing through a fuelled boiler. However, heat pumps have the ability to meet 100% of a household's heating needs, and our later analysis includes this scenario. Hybrid systems will deliver less carbon savings than a fully electrified, heat pump solution.

GROUND SOURCE HEAT PUMPS

Description of Technology

As with air source heat pumps, ground source heat pumps extract heat from the environment and use electricity to raise the temperature. For GSHPs, each kWh of electricity can deliver 3-4 kWh heat.

A ground source heat pump (GSHP) system needs land available to lay heat collectors in the ground – either laterally in trenches, or vertically in boreholes (see **Figure 3**).

The internal components of a GSHP (the heat pump itself) have a life expectancy of approximately 20 years, and the ground loop has a life expectancy of up to 60 years.

This technology is well established and widely used in the UK. Installations also attract financial incentives from central government in the form of the Renewable Heat Incentive. Similar scheme timing restricts apply, as above.

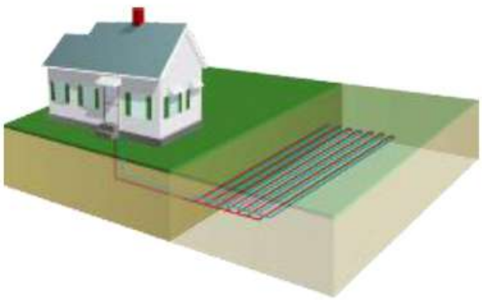

FIGURE 3: DOMESTIC SCALE HORIZONTAL GSHP BOREHOLE INSTALLATION

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Advantages	Disadvantages
Low carbon energy source	Groundworks can be expensive
Minimal maintenance requirements	Requires substantial ground space
Long operational lifespan	Heating controls are significantly different to radiators/boiler systems
No additional fuels required	Delivers low-temperature heat which may not be compatible with existing heating systems

Suitability for Thwing and Octon

GSHPs are suited to both individual domestic properties and larger scale heat networks. Prospect of installation depends on available area to host the horizontal or vertical heat collectors. For individual systems within the parish, heat collectors can be installed in gardens, whereas a larger space in an adjacent field or area of land will be required to host a larger multiple property system.

Heat pumps are compatible with 'wet' central heating systems, like many systems in the parish, however, heat pumps deliver lower flow temperatures, circa 50°C, as opposed to oil which is closer to 80°C. In the case that a household has radiators with a small surface area, new radiators may need to be installed that have either 50% or even 100% more surface area to ensure a comfortable ambient temperature. An installer will need to survey your existing systems to provide the best possible solution for each household. Underfloor heating is another option for central heating retrofit, but this comes down to personal preference.

Hybrid heating systems are available and allow you to combine an oil or LPG boiler with a heat pump, either as "top up" in the coldest conditions, or using the heat pump to "pre-heat" the system before passing through a fuelled boiler. Heat pumps can meet 100% of a household's heating needs, and our later analysis includes this. Hybrid systems will deliver less carbon savings that a fully electrified, heat pump solution.

Shared multiple dwelling heat pump systems are available. These systems incorporate individual heat pumps in each property, which is connected to the same central heat source. A typical heat source for the multiple dwelling heat pump could be ground source heat pumps such as slinkies or boreholes – these are sized to be able to supply the combined peak heat demand of each property within the system (i.e. supply 100% of the required demand). Additionally, these systems are almost maintenance free and do not require planning permission.

The ground conditions below Thwing and Octon are anticipated to be well suited to ground source heat pumps. Well-bedded chalk is expected to be encountered below the superficial deposits at a depth of between 0.4-1.0 mbgl (meters below ground level) and to have a thickness of between 160-220 m[2]. Chalk typically has a good thermal conductivity of around 1.78-2.57 Wm-1K-1[3]. Moreover, the groundwater table below site is projected to be a minimum of 45 mbgl[4] and to have a reasonable flow as below the site is a principal aquifer[5]. These factors make GSHP a good technical solution for the parish.

[2] British Geological Survey [link to page]
[3] Journal of Engineering Geology and Hydrogeology [link to page]
[4] British Geological Survey [link to page]
[5] British Geological Survey Geoindex Onshore [link to page]

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BIOMASS BOILERS

Description of Technology

Biomass for burning as a fuel includes wood, energy crops, agricultural crop residues, wood manufacturing by-products and farm animal litter. Burning biomass releases carbon dioxide to the atmosphere, however, this is principally offset by the carbon absorbed in the original growth of the biomass, resulting in low net carbon emissions over the lifecycle of the system. Biomass boilers can typically be divided into pellet boilers and stoves, and range in size from small domestic units of a few kilowatts to commercial units of megawatt size.

Biomass boilers have a life expectancy of 20 to 30 years.

Installations also attract financial incentives from central government in the form of the Renewable Heat Incentive. However, achieving the non-domestic RHI scheme deadline by March 2021 will not be viable for multi-property parish systems and so we expect that the scheme will only be available to domestic users – the domestic RHI ends on 31st March 2022.

Advantages	Disadvantages
Renewable source of energy	High maintenance system
Low volatility of fuel price	Regular fuel deliveries required
Significantly reduced carbon emissions compared to gas or electric heating system	Space required for fuel storage – conditions must be thoroughly considered
Delivers high temperature heat which will be more readily compatible with existing systems	

Suitability for Thwing and Octon

A biomass boiler could be a suitable replacement for existing oil and LPG heating systems within the parish, however, this option would be more suited to farms and other users with access to regular feedstocks to fuel the boiler. We anticipate straw and grain will be the preferred and most readily available feedstock in the parish due to the existing agricultural activities.

SOLAR THERMAL

Description of Technology

The principle behind both types of solar panel (solar PV and solar thermal) is similar. The key difference is that the thermal panels use energy from the sun to heat water via a sealed system. Like solar PV, solar thermal panels are typically roof-mounted systems, built to absorb the sun's energy. A heat transfer system converts this energy to heat water. The hot water is stored in a hot water cylinder ready for use as required on demand. Solar thermal systems work alongside conventional water heaters such as a conventional boiler or immersion heater.

FIGURE 4: EXAMPLE OF AN EVACUATED TUBE SOLAR THERMAL SYSTEM

There are two main types of solar collector. Flat plate collectors are dark, box like structures which contain a series of pipes running horizontally and vertically inside

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them. Evacuated tube systems are a series of glass tubes (as shown in **Figure 4**).

Solar thermal systems have a life expectancy of 25 to 30 years.

Advantages	Disadvantages
Low carbon energy source	Hot water supply determined by weather conditions
Minimal maintenance requirements	Often not suitable for central heating in winter
Long operational lifespan	Potentially visually disruptive
No additional fuels required	Relatively high capital cost
Familiar technology	

Suitability for Thwing and Octon

Solar thermal is able to provide significant hot water demand in the summer and does not require an additional fuel or electricity input from the users. To this end, solar thermal could be a suitable complimentary heating system for individual domestic properties in the parish, but an additional heating system would be required in the winter months to ensure central heating making it a less favourable technology.

HEAT NETWORK

Description of Technology

A heat network is a distribution system of insulated pipes which transfers heat from a central source and delivers it to the end-user. Heat networks vary in scale and are becoming a popular solution, particularly in built-up inner-city areas where heat demand is high. Heat networks can be supplied by a diverse range of heat sources ranging from ground source heat pumps to biomass boilers to heat recovery from an energy from waste plant.

Advantages	Disadvantages
Low carbon energy source	Groundworks can be expensive
Minimal maintenance requirements	Large heat source required
Long operational lifespan	Requires substantial space for an energy centre and groundworks
Future proofing – a long term heating strategy	Disruptions on streets and gardens for the pipework installation
Easily extendable by adding pipework and increasing the energy source	

Suitability for Thwing and Octon

We have assessed the viability of a heat network for Thwing and Octon Parish Council. A decentralised community heat network would remove the village's need for the polluting and expensive heating solutions such as oil or LPG to heat their homes.

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FIGURE 5: THWING AND OCTON HEAT NETWORK AND CONNECTION BETWEEN THE TWO VILLAGES

A heat network has been assessed for both villages, Thwing and Octon, along with a pipeline connection between the two villages, as can be seen in Figure 5, which shows the area considered for the heat network, not the pipeline design itself. The length of the network for Thwing and Octon is 1,745 m and 415 m, respectively. Properties outside the boundaries on Figure 5 have not been included for the heat network analysis, as it would not be cost-effective to connect them.

The table below outlines the assumptions used in the assessment.

Site	No. of domestic properties	% of domestic heat requirement
Thwing	65	73.9%
Octon	11	12.1%
Total	**76**	**86.0%**

The table below is divided into three heat network scenarios: Thwing alone, Octon alone and the two villages combined with a network connection. The table contains key viability data for each scenario.

Site name	Thwing	Octon	Thwing and Octon connected network
Heat network length (m)	1,745	415	3,535*
MWh heat demand (domestic)	1,489	252	1,741
Linear heat density (MWh/m)**	0.85	0.61	0.49

* total heat network length figure of 3,535 m includes the distance between the two villages

** Linear heat density of a heat network is the total heat demand, divided by the total length of pipe

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The results of the study show that technically a heat network solution for Thwing and Octon is not a viable option. According to CIBSE heat network code of practice[6], route sections with a linear density below 3 MWh/m are considered not viable. Thwing, which has highest density of the two villages at 0.85 MWh/m, is still short of the required technically viable linear heat density. Normally, more built-up areas with a linear heat density greater than 3 MWh/m are considered for heat network projects. Heat networks with heat density lower than the recommended threshold will not deliver a heat in a reliable and consistent way.

Small-scale heat networks

An alternative solution may be to implement smaller scale 'mini' heat networks for more isolated clusters of properties throughout the parish. For example, Octon is spaced out into several small groups of properties which could each have their own heat network, which would reduce long distance connection costs and unfavourable linear heat densities.

Shared multiple dwelling heat pump systems are available. These systems incorporate individual heat pumps in each property, which is connected to the same central heat source. A typical heat source for the multiple dwelling heat pump could be ground source heat pumps such as slinkies or boreholes – these are sized to be able to supply the combined peak heat demand of each property within the system (i.e. supply 100% of the required demand). Additionally, these systems are almost maintenance free and do not require planning permission.

[6] CIBSE heat network code of practice [link to page]

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POWER SOLUTIONS

SOLAR-POWERED STREET LIGHTING

Description of technology

Standalone solar PV powered LED lights are the leading solution to high-efficiency, renewables-integrated streetlights and are widely used in the UK. These units have no connection to the grid and instead generate their electricity from individual solar PV panels located on top of the unit – the PV technology works in the same fashion as described above in the previous PV subsection.

Each street light system has a battery incorporated into the unit which allows it to store the electricity produced in the day and release it during the night when it is required. Through the highly efficient LED bulbs and smart infrared sensors (which dim the lights when not in use and brighten them when pedestrians and cars pass), the built-in batteries that can run for up to a week without sunlight before full discharge.

Advantages	Disadvantages
Low carbon energy source	Snow and dust can accumulate on the panels, reducing electricity production
Minimal maintenance requirements	Relatively high capital cost
Long LED operational lifespan (>50,000 hrs)	Risk of theft
No external fuels or connections required	
Well established technology	
Smart sensors dimming lights when not in use – reduced light pollution	
White light for greater visibility	
Battery lifespan = 5 to 7 years	

Suitability to the area

There is a good case to replace the existing streetlights with solar powered streetlights due to their environmental and efficiency benefits, ease of installation, greater visibility and reduction in all night light pollution. Also, running costs will be significantly reduced as the parish will no longer need to pay for electricity to keep the lights on.

The maps shown in **Figure 6** and **Figure 7** below show the location of all the streetlights within the parish. Blue arrows are lamp posts and red ones are combined lamp and telephone posts.

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FIGURE 6: STREET LIGHTING IN THWING

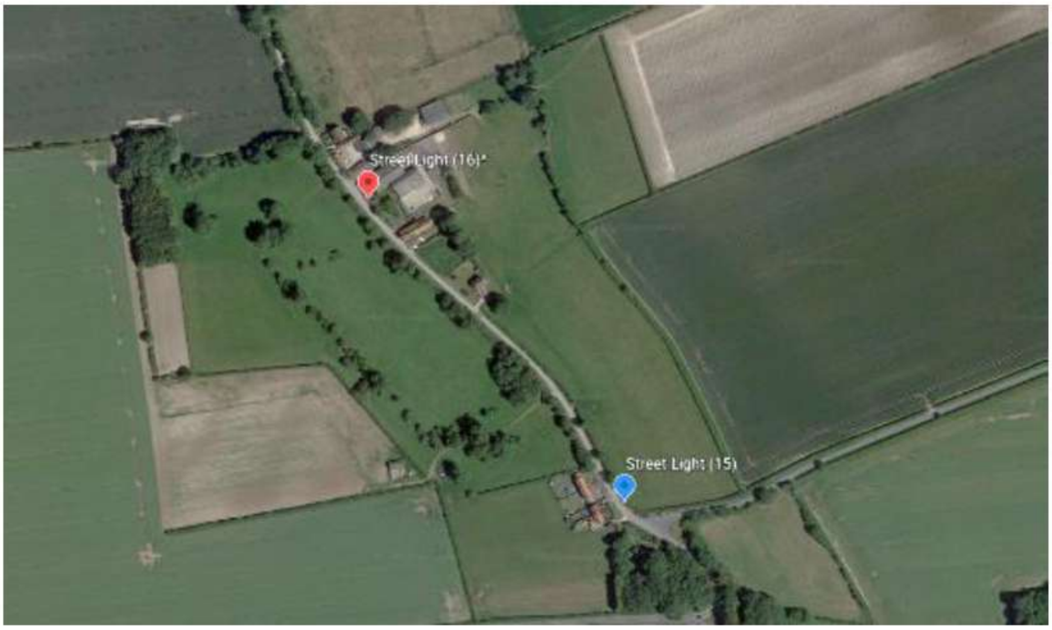

FIGURE 7: STREET LIGHTING IN OCTON

PV-powered streetlights can be provided in two varieties, one that uses existing poles and one that has a new pole incorporated to it.

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Examples of PV-powered streetlights:

Model 1*: Fixture with embedded solar panel. To be used on existing poles.	 *Solar-powered LED lamp and fixture. source: green world solutions*
Model 2*: Fixture with pole.	  *Fixtures with pole. source: prolectric*

* pictures are examples and final model may vary according to the Parish Council's choice of supplier

SOLAR PHOTOVOLTAICS

Description of technology

Solar photovoltaic (PV) panels capture energy from sunlight and convert it to electricity. Panels can be mounted on building rooftops or installed as stand-alone ground-mounted systems. This technology is well established and widely used in the UK.

The potential for generating electricity through solar panels is determined by the amount of sunlight falling upon that location. The orientation of the installation relative to the due south (for the northern hemisphere) and the distance from the equator, both determine the energy production per kWp installed (called the "Kk value").

Kk values for Thwing and Octon are 967 kWh/kWp – which means that for every kWp of solar panels installed, 967 kWh are generated per year.

Advantages	Disadvantages
Low carbon energy source	Electricity supply determined by weather
Minimal maintenance requirements	Potentially visually disruptive
Long operational lifespan	Relatively high capital cost
No additional fuels required	Larger installations require planning permission
Familiar technology	

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Suitability to the area

Solar PV installations are quick and easy to install on the ground and on rooftops, making it a good solution for the parish. Ground-mounted solar PV installations can often be easily extended if the electricity demand increases.

We have sized all systems presented in the next section based on the "consumption profile" section, which took data from a survey made by Avieco and the Parish Council in September, regarding residents' energy consumption.

WIND TURBINES

Description of technology

Wind turbines capture kinetic energy from airflows and convert it to electricity. Turbines sizes range from small 10's of watts systems which power street signs and LED lights to large utility scale mega-watt systems which can power whole villages. This technology is well established and widely used in the UK, however, currently the highly restrictive planning regime for large onshore turbines prevents most new installations being approved.

The potential for generating electricity through a wind turbine is determined by the wind moving through the swept area of the turbine. Two external variables effect the output of a turbine including air density (kg/m^2) and prevailing wind speed (m/s), and wind speeds vary depending on location, height in the air column and obstructions such as buildings, trees or hills. Wind is an intermittent energy source and cannot dispatch electricity on demand, therefore it is often combined with other energy sources and storage.

Advantages	Disadvantages
Low carbon energy source	Electricity supply determined by weather
Minimal maintenance requirements	Potentially visually disruptive
Long operational lifespan	Relatively high capital cost
No additional fuels required	Larger installations require planning permission
Favourable weather conditions for location	

Suitability to the area

The East Riding of Yorkshire is well suited to wind energy due to favourable wind conditions, but planning constraints need to be considered.

In general, local planning authorities are supportive of renewable and low carbon development and should particularly back community-led initiatives. However, in England, onshore wind is effectively prohibited by the current planning policy. The current guidance to local planning authorities states that unless the area has previously been identified as suitable for wind energy in the development plan, then a development "should not be considered acceptable".

In the case of Thwing and Octon, the area has been indicated as an 'area of significant constraint', as shown in **Figure 8**, and therefore is highly unlikely to receive planning permission for large-scale onshore wind development.

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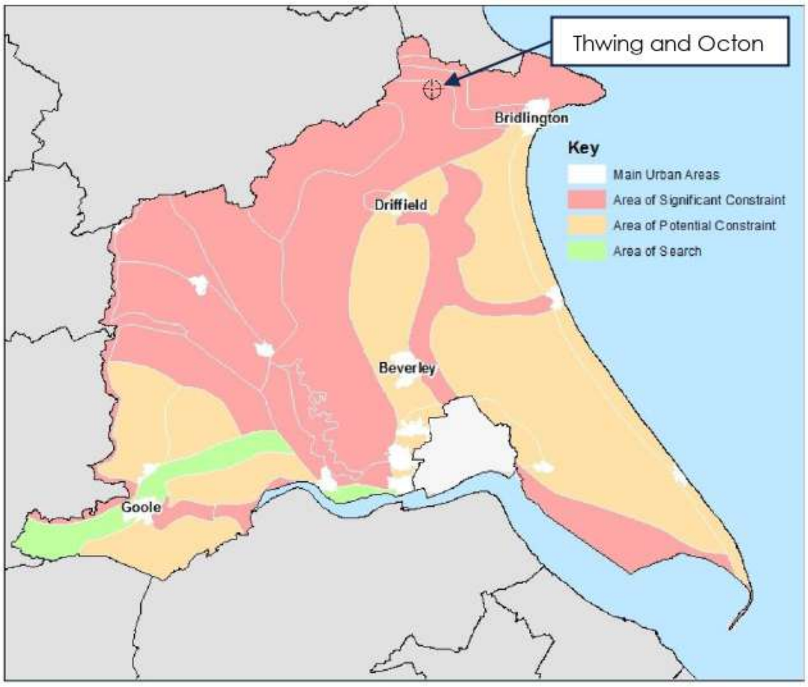

FIGURE 8: POTENTIAL AREAS FOR WIND ENERGY DEVELOPMENT

However, small-scale wind for individuals is not restricted by the same planning conditions and are permitted development. The Thwing and Octon area has mean wind speeds of around 5.0 m/s at 10 magl (meters above ground level), as shown in figure. However, for domestic wind turbines, planning conditions restrict the height of standalone units at 11.1 magl and building mounted units must not exceed 3 m above the highest part of the roof or exceed an overall height of 15 magl.

We have sized all systems presented in the next section based on the "consumption profile" section, which took data from a survey made by Avieco and the Parish Council in September, regarding residents' energy consumption.

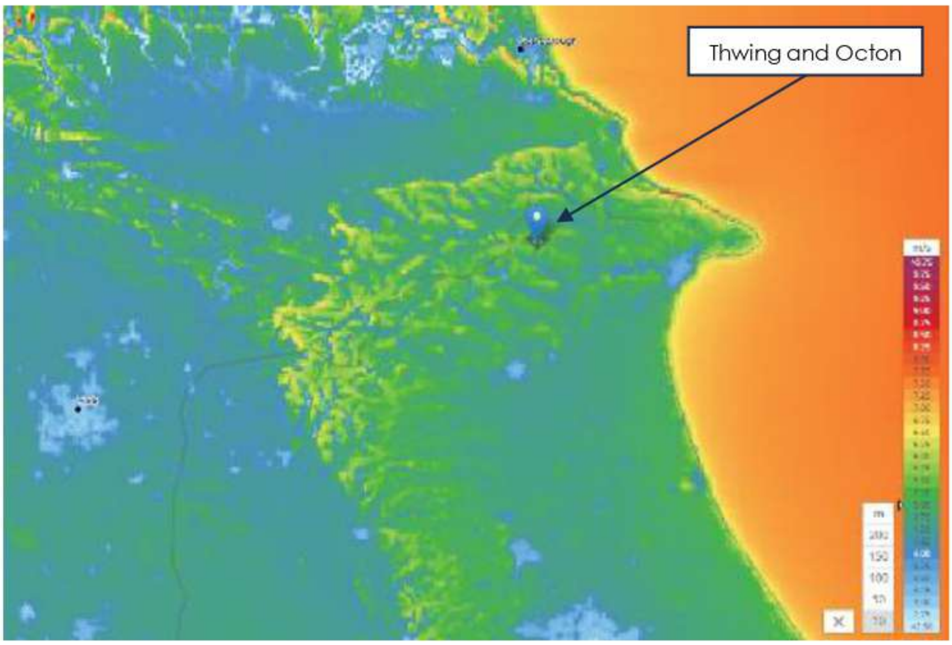

FIGURE 9: AVERAGE WIND SPEEDS AT 10 METERS ABOVE GROUND LEVEL

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DETAILED TECHNICAL ASSESSMENT

Out of the shortlisted technologies assessed in the previous sections, we have analysed in more depth air source heat pumps, ground source heat pumps (individual and small-scale network),biomass boilers, solar powered streetlights, solar PV (rooftop and ground mounted) and small-scale wind in the following stages. These are presented in the sections below, where we analyse further the technical feasibility of each technology. The discarded solutions have not been considered in the financial assessment due to their unfavourable technical characteristics for the area, as indicated in their description. Some of the solutions presented in the detail technical assessment below may be discarded in the financial assessment.

A detailed technical assessment of solutions for renewable heat and power implementation in Thwing and Octon are shown below.

HEAT SOLUTIONS

AIR SOURCE HEAT PUMPS (INDIVIDUAL)

This technology is best suited to individual households who wish to install a low carbon heat at their home. ASHPs are a tried and tested technology in the UK with a relatively low capital cost and would be ideal for residents who wish to take part in the parish's decarbonisation objectives.

The requirements and the exact location of each ASHP collector can be confirmed by each household. The recommended ASHP sizes for the residents are indicated below to show the range of sizes that may be required.

Heat pumps' efficiency are classified by their Seasonal Performance Factor (SPF). SPF is a measure of the operating performance of an electric heat pump heating system over a year. It is the ratio of the heat delivered to the total electrical energy supplied over the year.

Summary

	Individual household example	Individual household (possible range)
Total heat demand (kWh/yr)	22,909	1,523 – 69,154
Total electricity demand of ASHP* (kWh/yr)	8.548	568 – 25,804
Size of ASHP system (kW)	7	4 – 12
Estimated size of ASHP collector, w x d x h (m)	1.05 x 0.48 x 1.02	0.80 x 0.33 x 0.66 - 1.05 x 0.48 x 1.02**
Total heat generated (kWh/yr)	22,910	1,523 – 69,154

* coefficient of performance assumes average ASHP seasonal performance factor

** sizes may vary depending on demand and manufacturer

Percentage of total annual heating generated for one household: 100%

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GROUND SOURCE HEAT PUMPS (INDIVIDUAL & SMALL GROUP)

GSHPs are a scalable technology, which would be well suited to individual households or small scale 'mini' heat networks for clusters of properties throughout the parish.

Figure 10: GSHP supplying a small cluster of domestic properties (source: Kensa Heat Pumps)

In comparison to an individual heat pump, a small multiple dwelling heat network is classed as a non-domestic development under the Renewable Heat Incentive (RHI), meaning that the scheme would close to new applicants from April 2021. Although, individual households will still be able to apply for the domestic RHI which has been extended until March 2022. Following the closure of the RHI, the government has proposed a 'Clean Heat Grant' which is currently under review following a consultation which ran from 28 April to 7 July 2020; at the time of writing, we are awaiting further details.

The exact location of each GSHP collector will vary depending on available space – typical locations include private gardens, Parish Council land and/or leased private farmland. Both of the analysed GSHP scenarios are indicated below.

Summary

	Individual household	Multiple household cluster (4 properties)
Total heat demand (kWh/yr)	22,909	1,523 – 69,154
Total electricity demand of GSHP* (kWh/yr)	7,390	491 – 22,308
Total size of GSHP system (kW)	6 (4-12)	24 (±6)
Estimated size of GSHP, w x d x h (m)	0.61 x 0.60 x 0.59 – 0.60 x 0.58 x 1.15**	
Estimated area for GSHP collector (m²)	~250 – 750	~1,000 – 2,000
Total heat generated (kWh/yr)	22,910	1,523 – 69,154

* coefficient of performance assumes average GSHP seasonal performance factor

** sizes may vary depending on demand and manufacturer

Percentage of total annual heating generated for one household: 100%

BIOMASS BOILERS (INDIVIDUAL – FARMS)

Biomass is best suited to individual farms across the parish due to the availability of biomass feedstocks to many farmers and is less suited to domestic users due to the complexities around procuring, storing, and using the feedstocks. In particular, biomass would be most suited to the peak energy demand of farms and could be used to supply heat in periods of high demand such as peak harvest season, or grain drying season, for example. The heating system could be used in tandem with other heating technologies such as an ASHP or a GSHP.

The requirements and the exact location can be confirmed by each user and fit to their required end-use. Based on data gathered in the community survey, we have simulated the usage of biomass boilers for peak demand on a farm to produce an indicative scenario. In addition, some common feedstock calorific values have been presented.

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Summary

	Individual farm
Total heat demand (kWh/yr)	23,666 (±)*
Total peak demand (kWh/yr)	3,890 (±)*
Total size of biomass system (kW)	8 (±)*
Net calorific value of wheat straw (kWh/kg)	4.6 – 5.6
Net calorific value of logging residue (kWh/kg)	5.1 – 5.7
Net calorific value of chicken manure (kWh/kg)	2.5 – 3.75
Total heat generated (kWh/yr)	3,890

* example scenario for a single farm, each farm's requirements will vary

Percentage of total annual heating demand generated by biomass: 25%

Percentage of peak heating demand generated by biomass: 100%

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POWER SOLUTIONS

SOLAR-POWERED STREET LIGHTING

The parish has 16 streetlights, 13 of which are parish owned and can be replaced with solar-powered models. The other three lamps are the responsibility of the District Council, and have been excluded from this analysis. The lamps are of mixed specification including 6 sodium-vapour (70W), 5 LED (18W) and 2 PLT compact fluorescent lamp (26W).

There are two retrofit options, one to use the current poles and attach a new fixture, which is more cost-effective, and one to replace the whole pole and fixture for a new one. Both present the same light quality and battery life. However, the cheaper retrofit option may only be available to 9 out of the 13 streetlights in the parish – 4 are attached to telephone poles and will, therefore, require a full installation including new light columns. We will assess the economic feasibility of this in the Financial Assessment section of this report.

Current consumption of streetlights (estimated): kWh 2,462/year

Electricity consumption requirements from the grid: 0 kWh - all solar powered and off-grid

SOLAR PHOTOVOLTAIC: GROUND MOUNTED – SCENARIO 1

This scenario presents a large solar installation solution in the parish.

Given the distance between Thwing and Octon, our assessment is that separate installations for each village are the best solution, as shown below. We recommend that the solar PV installations are as close as possible to the homes they will supply energy for, given that connection costs are expensive and can suppress the project's financial returns.

Thwing

During the site visit in September, we visited a number of potential sites available for solar PV installation. The site shown in yellow in the figure below represents the best option due to its proximity to the village and grid connection for the existing solar PV installation, which could facilitate the new installation connection. The centralised solar PV plant would be connected to each household via a private wire, which would need to be installed for this solution – these are expensive. Any electricity not used would then be exported to the grid, sold at the export price.

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FIGURE 11: SUGGESTED LAND FOR SOLAR PV INSTALLATION NORTH OF THWING (MARKED IN YELLOW)

Octon

In order to supply the daytime electrical demand for Octon, a 19 kWp installation would suffice. A long connection would make the project of such a small installation financially unviable, so a small land parcel close to the houses is recommended if a centralised option is preferred.

The land parcels surveyed during the site visit are not close enough for a viable connection, so we recommend that a local land parcel is found, or that Octon opts for rooftop solar in each home, as presented in the solar PV rooftops section. A piece of Parish Council land was presented as an option, as shown in **Figure 12** below, but it is not suitable for a solar installation due to the distance to properties; additionally, the ground conditions are not suitable because it was formerly used as a quarry.

FIGURE 12: PARISH COUNCIL LAND NEAR TO OCTON

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Summary

	Thwing	Octon
Total electricity demand (kWh/yr)	262,000	44,000
Size of PV system (kWp)	109	19
Estimated size of PV system (m^2)	770	130
Total generation (kWh/yr)	104,886	17,750

Total electricity generated by the ground-mounted PV system: 122,624 kWh per year

Percentage of the parish total annual electricity consumption generated by solar PV: 40%

This scenario does not consider the use of battery storage, it is designed to supply the villages with electricity during the day and sell any excess electricity produced to the grid, sold at export price. For this reason, PV is sized for 40% of total electricity demand - which is typically the daytime usage. Oversizing the PV installation will cause more electricity to be exported to the grid at export price, which is very low comparing to retail prices.

SOLAR PHOTOVOLTAICS: GROUND MOUNTED – SCENARIO 2

In this scenario we have sized the solar PV systems to fill the remaining available space at each ground-mounted solar farm in and near the parish, highlighted by the Parish Council as potential land to host a large-scale system. These systems will provide significantly more power than the parish requires but have been included in the study to present the potential benefits or drawbacks of such a system, as requested by the Parish Council.

The two sites highlighted were:

- North Thwing solar farm located off Duke's Lane which connects the village to Wold Newton, as shown in **Figure 11**
- South of the parish solar farm located west of Thwing road near Dotterill Park, as show in **Figure 13**

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FIGURE 13: EXISTING SOLAR FARM SOUTH OF THE PARISH

Summary

	North of Thwing	South of parish
Total electricity demand of parish – domestic (kWh/yr)	355,000	
Size of PV system (kWp)	2,371	2,729
Estimated area required for PV system (m²)	16,600	19,100
Total generation (kWh/yr)	2,609,000	2,614,000
Percentage of domestic parish demand (%)	640	736

Total combined electricity generated by the ground-mounted PV systems: 5,223 MWh per year

Percentage of the parish total annual electricity consumption generated by solar PV: 1,471%

This scenario would allow the parish to meet their daytime electricity demand and provide excess electricity which could be exported back to the grid. We will analysis this opportunity financially in the following section of this report.

SOLAR PHOTOVOLTAICS: ROOFTOP (INDIVIDUAL)

This scenario presents an individual solution for homes, which would use the electricity generated directly from their rooftops during the day. The size of the installations considers average daytime electricity usage for households (taken from the survey) and does not consider battery storage, so any excess electricity produced would be sold to the grid at export price. This solution is suited to all residents with the ability to install solar PV on their roofs, including household in Thwing, Octon and the remainder of the parish.

Small solar installations have a simplified process of approval from the DNO and are quick and easy to install on the roof. They can be extended if the resident wishes to include a battery in the future to utilise the generated energy in the night-time as well. For the same reasons stated in the ground-mounted solution, the PV installation is sized to daytime usage only.

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Summary

	Average parish household
Total electricity demand (kWh/year)	4,000
Size of PV system (kWp)	2
Estimated area required for PV system (m²)	14
Total generation (kWh/year)	1,916

Percentage of the average home's total annual electricity consumption generated by solar PV: 47%

SMALL SCALE WIND (INDIVIDUAL)

This scenario considers an individual solution for homes which would use the electricity generated from small scale wind turbines either mounted on their roofs or mounted on masts from the ground. The size of the installation considers the electricity usage for households (taken from the survey) and the maximum number of small-scale turbines we believe an average household could reasonably install on their property.

For this scenario we have modelled the LE-600 horizontal axis wind turbine (HAWT) which includes a small inbuilt battery storage to account for wind variability, however, technical models for wind turbines are dependent on the specification of the turbine itself which varies between manufacturers[7]. Note that although this model has a peak output of 750 W, in reality this is much lower for typical average wind speeds. Taking the mean wind speed (5.0 m/s) within Thwing and Octon, we have used the HAWT's power curve to calculate the mean power output of 75 W. We recommend monitoring wind speed at the site for 6-12 months in advance of commencing installation.

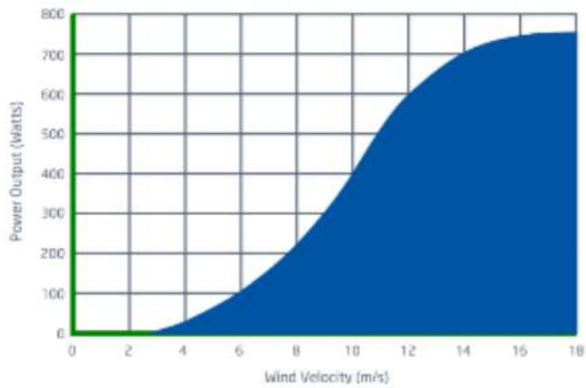

FIGURE 14: POWER CURVE SHOWING POWER OUTPUT DEPENDENCE ON WIND SPEED

Summary

	Average parish household
Total electricity demand (kWh/yr)	4,000
Size of wind system (kWp)	0.75
Estimated number of HAWT	1*
Wind speed at 10m above ground level in the parish (m/s)	5.0
Estimated area required for system (m²)	1.54**
Total generation (kWh/yr)	657

* One (1) HAWT has been included to show the potential energy supply and savings (more units can be added at the discretion of each household)

[7] LE-600 horizontal axis wind turbine [link to page]

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** the rotor diameter of the LE-600 is 1.54 m^2, however, if a resident wishes to install more than one turbine these must be spaced apart appropriately to avoid turbulence. The general rule of thumb is that the turbines should be spaced 7 rotor diameters apart

Percentage of the average home's total annual electricity consumption generated by wind: 16%

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FINANCIAL ASSESSMENT

The financial assessment includes an analysis of the financial performance of the technologies deemed technically viable in the technical assessment and details on the financial landscape effecting the implementation of the renewable energy systems. This section contains a financial performance summary, financial dependencies, and potential funding routes for the Parish Council to explore.

FINANCIAL SUMMARY AND RECOMMENDATIONS

Based on our assessment and outputs presented below, there is a clear business case for renewable energy technologies in Thwing and Octon. Rationale for these recommendations is shown in the next section.

Heat

Based on the financial study, we recommend that for residents' heating, individual ASHP or GSHP systems are installed. Note that for GSHP, land to position the heat collectors is required (such as a garden) and approximately 0.025 to 0.075 ha (250 to 750 m^2)(dependant on the heat demand of the property) would be needed for a system sized to supply a single property's yearly heating demand. Note that the small-scale group network GSHP system does not perform well financially due to the multi-property being counted as non-domestic and therefore not eligible for the RHI after March 2021.

For farms, peak heating requirements during grain drying season, we recommend biomass boilers which provide a reasonable financial performance. We have sized the system to fit the data provided from the community data collection, however, the scale of farm operations can vary considerably, and each system size may vary.

Power

For power, the financially preferable option we recommend is individual property rooftop solar PV systems as they provide the best return on investment, a positive NPV (net present value) and a good payback period of around 12 years. Financially, a ground-mounted private wire system is not feasible as the associated capital costs for connecting each house individually are too high, considering the distances.

Another option for parish residents is small-scale individual wind, however, the technology has a relatively low power output and does not present a strong financial case due to the long payback period (17.6 years) and a low return on investment (ROI). However, if a resident is willing to accept the less favourable financial case, a small-scale wind turbine could be installed on their land to complement other solutions such as solar PV.

Solar PV and wind systems can be combined to provide electricity during the day and night; we note that the business case of each will remain the same when the systems are combined.

Street lighting

Finally, solar powered street lighting provides a moderate financial case, as the units will incur a considerable upfront capital cost yet a significant reduction in running costs.

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Our priority heating recommendations are:

- Individual ASHP and GSHP (dependant on available space for heat collectors) – for residents, heat pump type will depend on whether they have available land to install GSHP heat collectors and/or personal preference
- Biomass boiler systems for farms during peak heating demand periods

Our priority power recommendations are:

- Individual rooftop solar PV systems

Our priority street lighting recommendations are:

- 13 solar powered LED smart streetlights

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FINANCIAL PERFORMANCE SUMMARY

We have modelled the financial performance of each technology opportunity not ruled out in the technical assessment and used a number of metrics to compare them including cost of carbon saving (£/tCO_2e), payback period (years), return on investment (£) and net present value (£).

FINANCIAL PERFORMANCE: HEAT SOLUTIONS

Technology appraisals for:	**Thwing and Octon Parish Council**			
	Domestic			***Non-domestic (farr***
	Air source heat pump *(individual)*	Ground source heat pump *(individual)*	Ground source heat pump *(group network)*	Biomass boiler for peaking *(individual)*
Generation statistics				
System size (kW)	7	6	24	8
Carbon saved (tCO_2e/yr)	5	5	18	1
Annual electricity generation (MWh)	-	-	-	-
Annual heat generation (MWh)	28	27	109	6
Proportion of total electricity provided	0%	0%	0%	0%
Proportion of total heat demand provided	122%	119%	119%	25%
Initial Incremental Cost	£ 3,550	£ 5,250	£ 21,000	£ 4,525
Annual O&M cost	£ 142	£ 120	£ 480	£ 136
Annual fuel costs / savings	£ 1,329	£ 1,329	£ 5,315	£ 338
Annual electricity costs	£ 1,190	£ 1,227	£ 4,907	£ -
Annual financial incentive (RHI)	£ 2,437	£ 2,449	£ -	£ -
Cost of carbon saving (£/tCO2e)	30	47	47	136
Financial metrics				
Investment	£ 3,550	£ 5,250	£ 21,000	£ 4,525
Simple Payback Years (SPB)	1.33	1.97	32.65	11.03
Simple Return on Investment (ROI)	75%	51%	3%	9%
Average ROI over study period	10%	5%	-9%	8%
Net Present Value (NPV) - over study period	£ 8,737	£ 6,849	£ (24,256)	£ (189)
Internal Rate of Return (IRR) - over study period	75%	48%	0%	10%
Study period	25	25	25	25

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FINANCIAL PERFORMANCE: POWER SOLUTIONS

Technology appraisals for:	Thwing & Octon Parish Council						
	Domestic				***Non-domestic (utility-scale)***		***Street lighting***
	Ground mounted solar PV *(Thwing network)*	Ground mounted solar PV *(Octon network)*	Rooftop solar PV *(individual)*	Small-scale wind (HAWT) *(individual)*	Ground mounted solar PV *(North Thwing solar farm)*	Ground mounted solar PV *(South of parish solar farm)*	Solar powered street lights *(for 13 lamps)*
Generation statistics							
System size (kW)	109	19	2	1	2371	2729	0.13
Carbon saved (tCO_2e/yr)	27	4	0.5	0.2	575	662	0.6
Annual electricity generation (MWh)	105	18	1.9	0.7	2,272	2,614	2.5
Annual heat generation (MWh)	-	-	-	-	-	-	-
Proportion of total electricity provided	40%	40%	47%	16%	640%	736%	100%
Proportion of total heat demand provided	0%	0%	0%	0%	0%	0%	0%
Initial Incremental Cost	£ 491,756	£ 290,010	£ 2,800	£ 1,685	£ 2,836,241	£ 3,229,099	£ 22,651
Annual O&M cost	£ 668	£ 113	£ 51	£ -	£ 14,466	£ 16,644	£ 58
Annual fuel costs / savings	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Annual electricity costs / savings	£ 14,600	£ 2,471	£ 267	£ 91	£ 49,416	£ 49,416	£ 876
Annual financial incentive (RHI / FiT) + Export	£ -	£ -	£ -	£ -	£ 105,426	£ 124,243	£ -
Cost of carbon saving (£/tCO2e)	£ 617	£ 2,151	£ 192	£ 338	£ 164	£ 163	£ 1,211
Financial metrics							
Investment	£ 491,750	£ 290,000	£ 2,800	£ 1,700	£ 2,836,250	£ 3,229,100	£ 22,650
Simple Payback Years (SPB)	33.72	117.49	12.34	17.62	19.60	19.97	27.21
Simple Return on Investment (ROI)	3%	1%	8%	6%	5%	5%	4%
Average ROI over study period	3%	-2%	15%	8%	5%	5%	1%
Net Present Value (NPV) - over study period	£ (280,065)	£ (254,186)	£ 637	£ (313)	£ (1,025,814)	£ (1,223,411)	£ (13,576)
Internal Rate of Return (IRR) - over study period	4%	-3%	12%	8%	6%	6%	2%
Study period	30	30	30	30	30	30	30

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QUANTIFYING THE BUSINESS CASE

We have used a range of financial inputs from industry standards, supplier quotes from other project work, and connection costs sourced from Northern Powergrid. These are itemised in **Appendix J**.

CORPORATE POWER PURCHASE AGREEMENT (PPA)

We have explored the possibility for Thwing and Octon to enter a corporate power purchase agreement (PPA). This is a contractual agreement between two parties - the end-user looking to consume electricity and the renewable energy generator. The user directly purchases the electricity from the generator at a long-term fixed tariff.

Typically, a PPA is between a renewable energy generator and a single entity, for the case of Thwing and Octon, as the consumers would be individual households throughout the parish, this would require a complex agreement to bill each household effectively for the electricity they use.

Corporate PPAs require the end-users to consume a specific quantity of energy before the agreement becomes financially viable for the renewable energy generator – 5,000 MWh per annum is standard. Thwing and Octon parish's demand is too low to be considered for a corporate PPA as the domestic annual consumption is approximately 335 MWh, as shown within the Energy Consumption Profiles section.

FINANCIAL DEPENDENCIES

GOVERNMENT INCENTIVES

HEAT

Renewable Heat Incentive (RHI)

For renewable heat generation systems, including ASHP and GSHP, the Renewable Heat Incentive (RHI) provides £ per kWh produced, which provides an important income for these technologies. There are two versions of the incentive, domestic and non-domestic. The application deadline for the domestic version of the incentive is 31 March 2022 and the recommended individual ASHP and GSHP systems will be eligible. Thwing and Octon will need to commission the system and register before this deadline, or secure a tariff guarantee before then, which requires planning permission and financial close. However, for the non-domestic RHI, the deadline is 31 March 2021, and any multi-dwelling system would be counted as non-domestic, including a multi-property GSHP. Hence, we have included domestic RHI payments in our financial study but excluded for any systems classified as non-domestic as the timescales would be unachievable.

Clean Heat Grant

The Clean Heat Grant is a government proposed scheme set to replace the RHI in April 2022. The government ran a consultation from 28 April to 7 July 2020 which is now currently under review; however, it is expected that the scheme will deliver grants towards low-carbon heating technologies such as heat pumps for both households and businesses.

Green Homes Grant

The Green Homes Grant (not to be confused with the Clean Heat Grant) is an existing scheme provided by the government whereby they cover up to two-thirds of the cost of energy efficiency and low carbon heat improvements to domestic properties. The scheme provides a voucher up to a limit of £5,000 to homeowners and includes low-carbon heating measures such as ASHP, GSHP, solar thermal and biomass boilers. For low income households, 100% of the costs are covered up to £10,000. It is available to domestic properties only and this includes homeowners and landlords. The scheme stipulates that homeowners should use TrustMark registered installers and for low-carbon

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heating improvements, they must be MCS certified[8] (see **Appendix K**). Vouchers can be claimed in tandem with the domestic RHI, however, you must apply for the Green Homes Grant first and then notify Ofgem when applying for the RHI. The vouchers must be redeemed and works completed by 31st March 2022.

POWER

Currently, there are no available financial incentives for power generation technologies. The feed-in-tariff (FiT) programme, a financial incentive for solar and wind technologies, was closed to new entrants on 31st March 2019 and there is currently no indication that a similar scheme will be introduced.

DISTRIBUTION NETWORK OPERATOR COSTS

To be able to connect your generation asset (solar panels) to the network there needs to be an available capacity to accept the electricity. Having contacted the local provider, Northern Powergrid, we were informed that there is available capacity in the area to connect the assets to the grid. **Figure 15** below shows high availability for distributed generation connection in the area.

Figure 15: Availability of the local electricity grid

The connection costs provided by the DNO at this stage are indicative – they are dependent on the location of the plant and the solar PV supplier will be able to provide bespoke solutions and costs when the project details are established. See **Appendix L** for an example of Northern Powergrid's indicative cost calculator.

8 MCS certified, TrustMark registered suppliers search tool [link to page]

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Indicative costs for solar PV installations, as provided by Northern Powergrid:

System size	Cost
Up to 3.68 kWp (typical domestic rooftop)	£0
3.68 to 189 kWp	£10,050
190 to 999 kWp	£72,942
Above 1000 kWp	£227,670

We conducted a financial performance sensitivity analysis where we removed DNO connection costs for the ground mounted solar PV scenarios to account for the potential reduction or removal of fees due to the existing solar farms on the two prospective sites highlighted by the Council. We found that the removal of connection costs had nominal effect on the financial return with payback periods between 18 to 113 years. Without connection costs a large-scale ground mounted solar PV system is still not viable for the parish at this time due to the high upfront capital costs and lack of financial incentive support from the Government.

For the proposed street lighting, connection to the grid will not be necessary, as the units will be standalone installations with the ability to produce their own electricity.

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FUNDING SOURCES

Having quantified the anticipated capital requirements, we have also researched suitable funding sources for the parish. The recommended funds are summarised below. We note that some funding routes are only available to certain legal entities (e.g. Community Interest Company) – this may affect what legal structure is chosen to commercialise this scheme, if any.

Recommended funding sources

Funder	Joseph Rowntree Charitable Trust	Aviva	Co-operative & Community Finance	NatWest Group
Fund Type	Grant	Grant	Loan	Project Finance
Interest rate	N/A	N/A	Variable (6–10%)	Variable
Fund name	Sustainability Futures Fund	Aviva Community Fund	Bank Loan	Climate and sustainable Finance
Description and details	The Joseph Rowntree Charitable Trust recognises that climate change caused by human activity creates social inequality. Funding priorities includes engaging people individually and collectively in sustainable growth and ways of living.	Projects must fall within one of the two key areas: financial capability and inclusion and/or community resilience. Funds must go towards developing a new approach, product or technology and implementing a new initiative or scheme.	Provide funding to organisations that are owned and democratically controlled by their members, who are usually either employees, customers, or members of a community.	Financing of innovative low carbon generation and energy efficiency projects for clients who aim to mitigate their emissions.
Required legal structure	Your organisation must be governed by an unpaid board, not for profit and your organisation's formal purposes fall within the list of charitable purposes recognised within English law.	Must be UK registered charity, a registered community interest company or a registered community benefit society and have an active board of trustees or directors.	Lend to employee or community-owned social enterprises, including co-operatives, community businesses, development trusts and businesses developed from the charitable and voluntary sector. All must have an appropriate form of employee or community	No specific legal structure required.

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			ownership and must be democratically controlled by their members.	
URL	https://www.jrct.org.uk/sustainable-future	https://www.avivacommunityfund.co.uk/	https://coopfinance.coop/	https://www.natwestgroup.com/
Grant available	Up to £100,000	Up to £50,000	£10,000 to £75,000, up to £150,000 for special cases	No funding limit
Potential project element	Energy generation technology & street lighting	Street lighting & street lighting	Energy generation technology & street lighting	Energy generation technology & street lighting

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OPERATION & GOVERNANCE

To realise the benefits of any community energy project, the governance and operation of the scheme must be considered. There are a range of governance models used by community energy groups, and each have advantages and disadvantages. The suitability of any given governance model and legal structure must be assessed against the Parish Council's requirements and the schemes in view.

We have considered a range of legal structures suitable for a renewable energy project in Thwing and Octon. These are outlined below and ranked in order of preference.

Legal Structure	Rank	Description	Advantages	Disadvantages
Each site owns and operates	**1**	All renewable energy technologies are installed on private land – this structure is suited to individual scale systems.	Direct connection between scheme and individuals, giving freedom to operate e.g. with regard to grants and distributing other benefits. Host sites retain the financial benefit directly. Each site can procure systems independently, accordingly to site-specific requirements. Grants available for domestic heat solutions until April 2022.	All risk and responsibility borne by hosts. Some homeowners may not have the required space for the installations.
ESCo (Energy Service Company)	**2**	ESCos design, implement and manage energy systems for host sites. This would alleviate all the responsibility but reduce the community benefit.	Minimal involvement from host sites. Guaranteed service levels from the supplier.	Reduced benefit to the community. Scheme may be too small to be of interest to third party.

RECOMMENDED GOVERNANCE MODEL

Each site owns and operates the systems

The recommended model for the scheme(s) detailed above is for the residents (and farmers) to each own and operate the respective systems, receiving all the benefit and bearing all the costs and risk. This model is endorsed as the recommended technologies are individual household solutions and would be the most straightforward to implement considering the complexities of community wide buy-in. This method of governance would provide members with involvement in the scheme if desired, without the administrative burden for the Parish Council.

It is important to note that this method of governance will require active participation of relevant parties, principally during the procurement, installation and commissioning of the equipment.

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APPENDIX B: COMMUNITY ENGAGEMENT PLAN

Community engagement plan identifying key stakeholders to be held over the project.

THWING & OCTON PARISH COUNCIL COMMUNITY ENGAGEMENT PLAN

Provided by: Luiza Potter Haussen

Date: 02 July 2020

Version: v1.0

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THWING AND OCTON PARISH COUNCIL

RENEWABLE ENERGY FEASIBILITY STUDY
COMMUNITY ENGAGEMENT PLAN

This document shows a suggested approach for a community engagement plan to support renewable energy implementation in Thwing and Octon Parish.

Objectives:

- To identify the main stakeholder groups and their levels of influence on the project
- To understand the community's expectations for the implementation of renewable energy in Thwing and Octon Parish, and ensure buy-in from enough people to guarantee project viability
- To identify any serious objections from the community towards any technology

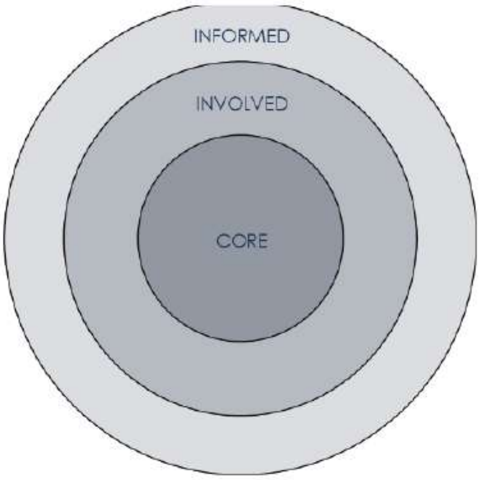
Deliverables after the implementation of the plan will be:

- Structured surveys targeted to each main stakeholder group identified in this plan
- A plan for each of the chosen communication channels

1. **Stakeholder analysis**: Who should we focus on?

Based on our current understanding of the parish and the stakeholders, we have identified and categorised six main stakeholder groups relevant to this stage of the project.

Levels of participation:



CORE – Final decision makers. Will develop the solutions and make sure the services are delivered

INVOLVED – Will be regularly informed and consulted about the project developments

INFORMED – Will receive regular updates on the project. Should communicate with their representative in the working group for any contributions they wish to make

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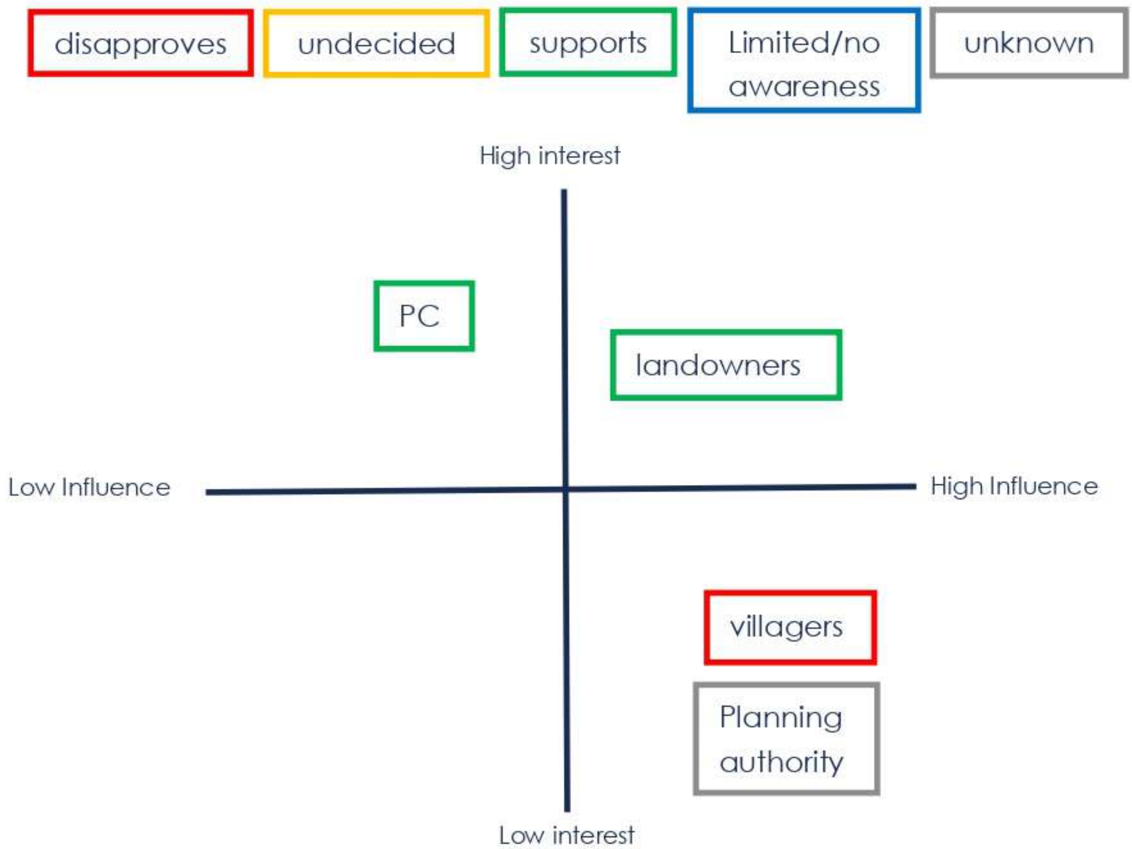
Stakeholders	Level of participation
Working group – PC representatives, Avieco, representatives of each group.	Core
Parish Council	Involved
Villagers	Informed
Landowners	Informed
Planning Authority	Involved

Example (preliminary information, to be verified):



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2. **Stakeholder engagement**: What do they need to support the project?
Example (preliminary information, to be verified):

Who?	Parish Council	Villagers	Landowners	Planning Authority
Needs?	Respond to climate emergency Reduce carbon emissions?	Understand disruptions and costs, lower costs	Understand disruptions and opportunities Lower costs	Receive project documentation
Concerns?	Project perception with population	Increase in costs Disruption to everyday life	Decision on land use	
What do we need from them?	Agreement to approaches and reviews	Annual energy spend and consumption	Annual energy spend and consumption Land available	Planning requirements for wind/solar
Potential actions	Fortnightly call and interim reports	Energy use survey by post Informative communication Consultation on participation	Video call workshop Consultation on participation	Consultation

2.1. After deciding on the potential actions for each group and prioritising actions for the ones in the high interest/high power quads (but involving all groups), we can agree on which actions to develop first.

3. Engagement strategies

As we have different types of stakeholders on the village, more than one solution is necessary, and one solution will not be fit for all. Thus, we propose different channels:

- **Digital communication**: Use existing and new channels to do consultations and send fortnightly updates to the community
  - **Create a Facebook group** for the project and put targeted ads to engage the community to join the group and see notifications. Targeted ads can be set for people in a specific geography, they don't necessarily need to be on the existing Parish Council group.
  - **Create a dedicated information webpage on the Parish Council's website** with the full information on the project and a 'sign up' function for informative newsletters and updates. A link for the villager's survey will also be accessible from the webpage. *Obs: Avieco will need admin access to the website to create the page. We will aim to build it ourselves but it's possible we'll need support from Parish Council's IT. Avieco will support all text and structure for the website. TBC when the details on the website architecture are confirmed.*
- **Physical communication**:
  - **Direct mail by post** – aiming to reach those who do not use or have access to the internet. The leaflets will be developed by Avieco with inputs from the Parish Council. For GDPR reasons, the delivery will have to be handled by the Parish Council.
- **Online meetings**
  - **Workshops** - discussion sessions by Zoom or Teams, with smaller groups of main stakeholders to clarify any preferences, questions and objections to the project.

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We propose starting this with the landowners, since their active involvement is necessary at this stage to define which lands can be used.

- **Surveys**
  - Structured questionnaires to collect supporting data necessary for the feasibility study. These will be done by post or in a digital channel for those who access the internet. Distribution of the physical leaflets will be the responsibility of the Parish Council for GDPR reasons.

4. **Work group**

Include representatives of each stakeholder group

Parish Council	Sandra Morrison Edward Peacock Gavin Coe Andrew Frost
Villagers	*Parish Council to provide contacts if any representatives are needed*
Landowners	*Parish Council to provide contacts*
Planning Authority	Informed only – names TBC
Avieco	Helen Troup Luiza Haussen Oliver Cowburn

5. **Potential solutions – renewable energy**

Based on the outcomes of the survey made for the Parish Plan for 2017, there is a considerable interest from the Thwing and Octon Community in implementing renewable energy sources in the area.

The main areas of interest according to the survey were solar PV, wind turbines and local arrangements with power suppliers.

For the purposes of this feasibility study, the main technologies that will be considered are:

- Large-scale solar PV
- Community solar PV on rooftops
- Individual solar PV on rooftops + battery
- Efficient street lighting with built-in renewable supply

5.1. Heating

We will include questions about heating usage on the questionnaire to assess current technologies used and the villagers' disposition to switch to renewable heating sources.

For the purposes of this feasibility study, the main technologies that will be considered are:

- Solar thermal panels
- Ground source heat pump
- Biomass boilers
- Air source heat pumps

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6. Timelines

Date start	Date finish	Responsible	Action
23/03/20	27/03/20	PC	Review community engagement plan and send back to Avieco with any relevant comments
06/07/20	07/07/20	Avieco	Perform the stakeholder analysis and define which communication strategies will be used for each stakeholder group
06/07/20	10/07/20	Avieco	Produce the deliverables defined in the stakeholder analysis phase Send out all communication to stakeholders
13/07/20	24/07/20	PC/community	Review deliverables, fill in surveys, have discussions and gather all documents resulting from the consultation
20/07/20	24/07/20	Avieco	Digital surveys and interactions
27/07/20	29/07/20	PC	Return all physical communication to Avieco
29/07/20	31/07/20	Avieco	Analyse the consultation results and include it on the feasibility study.

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APPENDIX C: LAUNCH EVENT PRESENTATION

Community launch event presentation, delivered by Avieco – see facing page and following.

LOW CARBON THWING & OCTON

Public event presentation – 10th October 2020

Presented by: Helen Troup

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AGENDA

1. INTRODUCTIONS
2. BACKGROUND TO THE PROJECT
3. AIMS & OBJECTIVES
4. BENEFITS & CHALLENGES
5. POTENTIAL LOCATIONS
6. NEXT STEPS
7. HOW YOU CAN HELP
8. Q&A

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THWING & OCTON PARISH COUNCIL HAS SECURED A GRANT TO EXPLORE RENEWABLE ENERGY FOR THE COMMUNITY

This project is supported by the Department for Business, Energy & Industrial Strategy (BEIS) funded Rural Community Energy Fund (RCEF) which is managed by the North East Yorkshire and Humber Energy Hub and administered by Tees Valley Combined Authority.

The Parish Council took this opportunity to develop a plan to future-proof the Parish from the coming bans on coal and wood for heating, and increasing resilience for electricity price volatility, while contributing to the UK's decarbonisation targets.

The study funded by RCEF will be conducted by Avieco.

Helen Troup

Luiza Haussen

Ollie Cowburn

Background to the project
Renewable energy projects in Thwing & Octon

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WE WILL WORK WITH YOU TO ASSESS OPTIONS FOR RENEWABLE HEAT AND POWER

The project will explore a number of options to decarbonise heat and power:

- **Large-scale ground mounted solar PV**
- **Solar PV on rooftops**
- **A shared heat network supplying homes and businesses with low carbon heat**
- **Efficient, renewably-powered lampposts**
- **Recommendations on low carbon heat for individual homes**

The objective of this project is to identify which technologies will best meet the needs of the village, reducing carbon impacts, moving away from oil and coal, and saving money on energy.

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EACH OPTION HAS BENEFITS AND CHALLENGES: LARGE SCALE SOLAR PV

Benefits:

- Big carbon savings
- Potential for the community to have shared ownership
- Financial return to the host and any community shareholders
- A third party could pay for the installation and offer low-cost power

Challenges:

- Need to identify suitable land parcel to install the solar panels
- Can take a long time to negotiate with the electricity grid, landowners, etc
- Lower financial returns now that the feed-in tariff scheme is closed

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EACH OPTION HAS BENEFITS AND CHALLENGES: ROOFTOP SOLAR PV

Benefits:

- Individual households and businesses get zero-carbon, free electricity
- Easy to install, with limited disruption to you and village life
- Some schemes still offer free installation

Challenges:

- Not all buildings will be suitable
- Lower financial returns now that the feed-in tariff scheme is closed
- Bigger visual impact on the village

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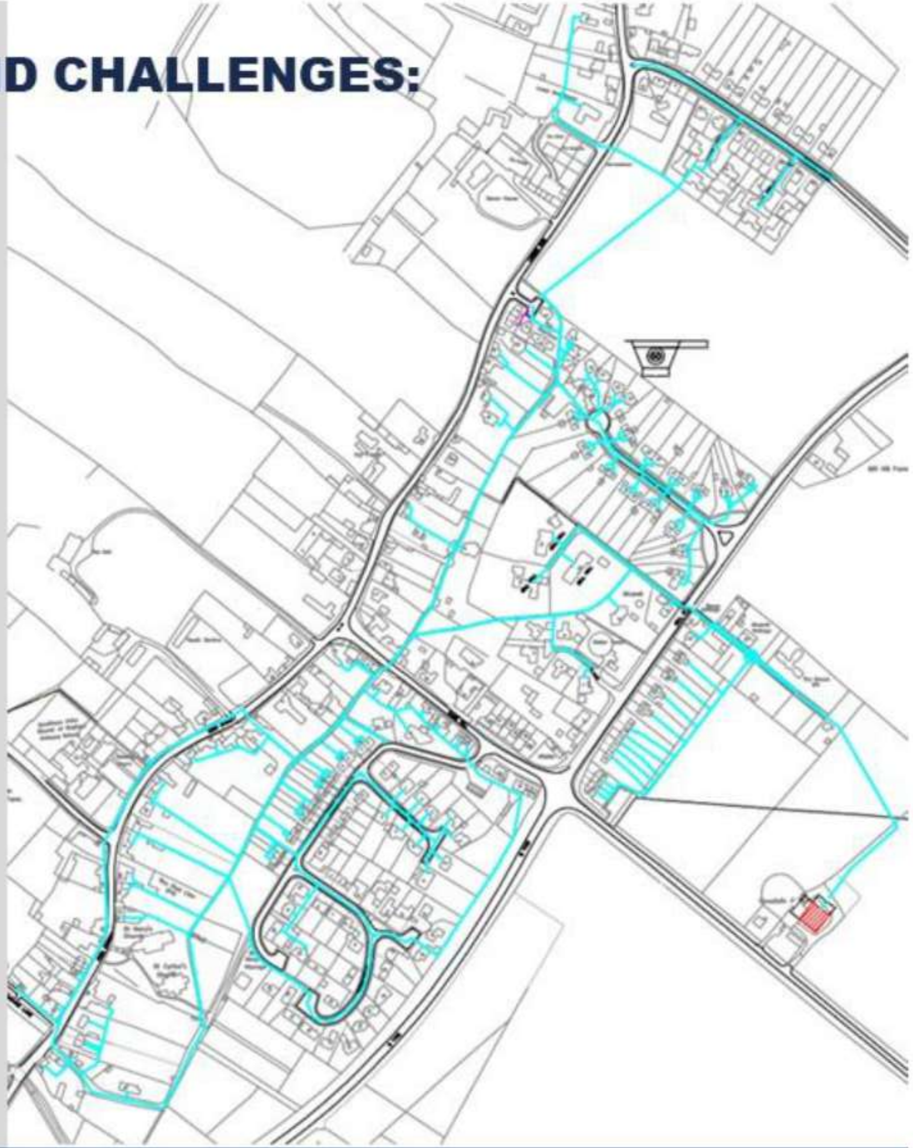
EACH OPTION HAS BENEFITS AND CHALLENGES: HEAT NETWORK

Benefits:

- Get the whole parish off oil and coal with one new heating system
- Big carbon savings
- Cost savings to residents compared to oil
- Can deliver high-temperature heat, so more compatible with your existing heating systems
- Would improve air quality, and reduce vehicle movements in the village

Challenges:

- Long-term infrastructure project – with significant capital cost and complexity
- Laying new pipework will be disruptive to the village
- Needs a sufficiently high heat demand to make this viable



Benefits & challenges of the different options
Renewable energy projects in Thwing & Octon

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EACH OPTION HAS BENEFITS AND CHALLENGES: RENEWABLY-POWERED LAMPPOSTS

Benefits:

- Reduce running costs for street lighting in the parish
- Power streetlighting with zero-carbon electricity
- Extend streetlight lifespan
- Option to add more streetlamps and improve light levels in the parish

Challenges:

- Multiple varieties of streetlamps in the parish
- Need to work with the District Council to progress

Benefits & challenges of the different options
Renewable energy projects in Thwing & Octon

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EACH OPTION HAS BENEFITS AND CHALLENGES: RECOMMENDATIONS FOR YOUR HOME

Benefits:

- Information packs covering a range of options for how to decarbonise your home
- Indicate potential suitable funding streams to support you
- Access wider support e.g. the Green Homes Grant

Challenges:

- Relies on each household and business to make changes
- Lower total carbon savings
- Likely to need to install and/or buy new equipment yourself

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THERE ARE A NUMBER OF POTENTIAL SITES WITHIN THE PARISH FOR LARGER SYSTEMS AND ROOFTOP OPTIONS

Potential locations within the parish

Renewable energy projects in Thwing & Octon

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OVER THE COMING MONTHS, WE WILL DEVELOP & COMPARE THESE OPTIONS FOR YOU & THE PARISH COUNCIL

Next steps
Renewable energy projects in Thwing & Octon

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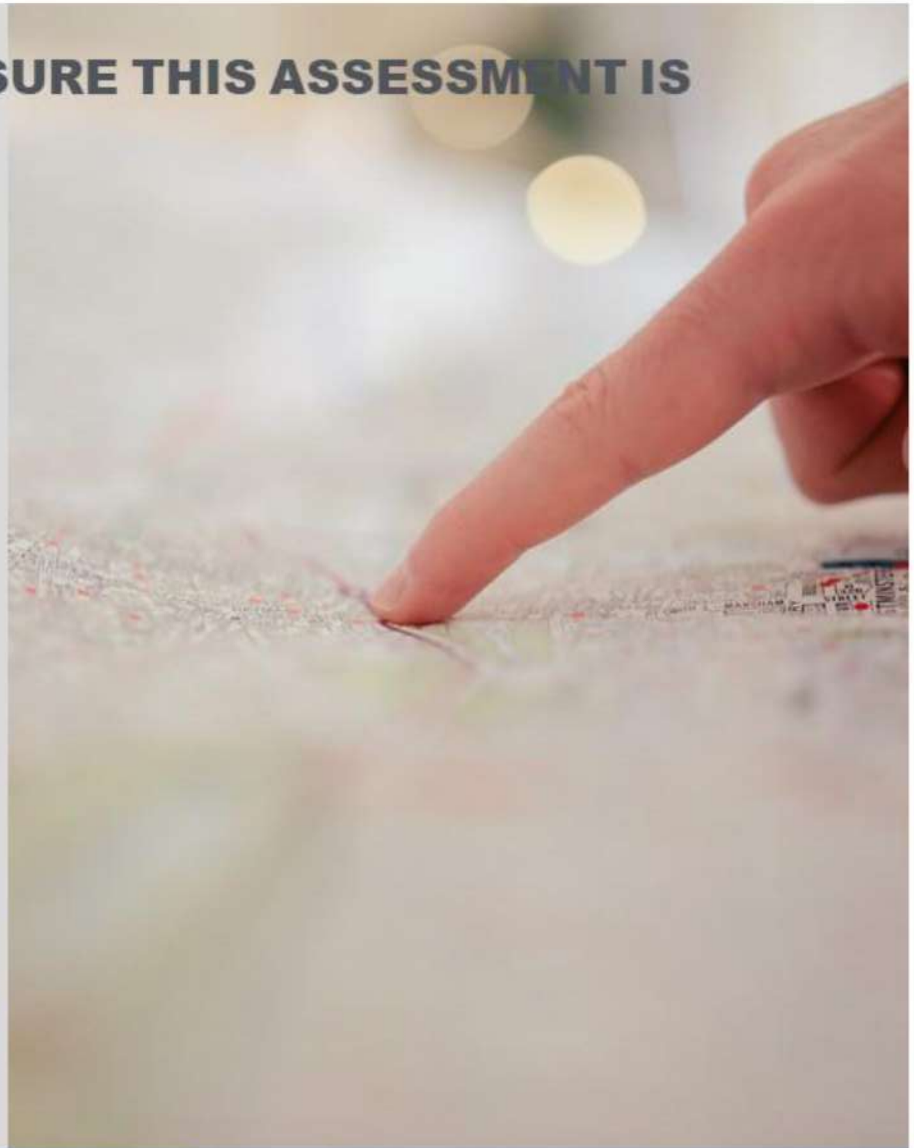
WE NEED YOUR HELP TO MAKE SURE THIS ASSESSMENT IS ACCURATE

- Complete an energy questionnaire, if not already done

- Vote for your favourite projects

- Ask questions, raise concerns



How you can help
Renewable energy projects in Thwing & Octon

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Q&A

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APPENDIX D: COMMUNITY ENGAGEMENT LEAFLET

Community engagement leaflet circulated to parish residents which introduced them to the scheme.

THWING & OCTON PARISH COUNCIL

RENEWABLE ENERGY

FOR THE COMMUNITY

Thwing & Octon Parish Council have successfully applied for a grant to develop a feasibility study to implement renewable energy sources in the Parish.
This project is supported by the BEIS funded Rural Community Energy Fund (RCEF) which is managed by the North East Yorkshire and Humber Energy Hub and administered by Tees Valley Combined Authority

For further information and updates visit: **www. thwing-octon-renewables.co.uk**

The feasibility study will consider:

- Centralised power and heat options - solar PV plants and district heating networks;
- Individual power and heat options - rooftop solar PV panels, solar thermal panels and heat pumps;
- Street lighting - self-sufficient fixtures, with integrated PV panels and LED lamps.

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Luiza Potter Haussen, Senior Consultant
luiza.haussen@avieco.com

THWING & OCTON PARISH COUNCIL

Sandra Morrison, Parish Council Clerk
thwing.clerk@outlook.com

APPENDIX E: COMMUNITY EVENT POSTERS

Posters used to facilitate the voting process during the launch event day which were used to gauge parish appetites on several renewable energy solutions.

LARGE SCALE SOLAR PV

Benefits:

- Big carbon savings
- Potential for the community to have shared ownership
- Financial return to the host and any community shareholders
- A third party could pay for the installation and offer low-cost power

Challenges:

- Need to identify suitable land parcel to install the solar panels
- Can take a long time to negotiate with the electricity grid, landowners, etc
- Lower financial returns now that the feed-in tariff scheme is closed

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ADD A STICKER TO SHOW YOUR SUPPORT FOR THIS OPTION

Renewable energy projects in Thwing & Octon

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HEAT NETWORK ACROSS MULTIPLE HOUSES

Benefits:

- Get the whole parish off oil and coal with one new system
- Big carbon savings
- Cost savings to residents compared to oil
- Can deliver high-temperature heat, so more compatible with your existing heating systems
- Would improve air quality, and reduce vehicle movements in the village

Challenges:

- Long-term infrastructure project – with significant capital cost and complexity
- Laying new pipework will be disruptive to the village
- Needs a sufficiently high heat demand to make this viable

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ADD A STICKER TO SHOW YOUR SUPPORT FOR THIS OPTION

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ROOFTOP SOLAR PV

Benefits:

- Individual households and businesses get zero-carbon, free electricity
- Easy to install, with limited disruption to you and village life
- Some schemes still offer free installation

Challenges:

- Not all buildings will be suitable
- Lower financial returns now that the feed-in tariff scheme is closed
- Bigger visual impact on the village

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ADD A STICKER TO SHOW YOUR SUPPORT FOR THIS OPTION

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RENEWABLY-POWERED LAMPPOSTS

Benefits:

- Reduce running costs for street lighting in the parish
- Power streetlighting with zero-carbon electricity
- Extend streetlight lifespan
- Option to add more streetlamps and improve light levels in the parish

Challenges:

- Multiple varieties of streetlamps in the parish
- Need to work with local District Council to progress

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ADD A STICKER TO SHOW YOUR SUPPORT FOR THIS OPTION

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RECOMMENDATIONS FOR YOUR HOME

Benefits:

- Information packs covering a range of options for how to decarbonise your home
- Indicate potential suitable funding streams to support you
- Access wider support e.g. the Green Homes Grant

Challenges:

- Relies on each household and business to make changes
- Lower total carbon savings
- Likely to need to install and/or buy new equipment yourself

ADD A STICKER TO SHOW YOUR SUPPORT FOR THIS OPTION

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APPENDIX F: PRESS RELEASE

The press release used to introduce the scheme and highlight that the Parish Council had won an RCEF grant to conduct the study.

THWING AND OCTON PARISH COUNCIL WIN GRANT FOR RENEWABLE ENERGY

The Parish Council has acted proactively to prepare for the coming ban on fuels such as oil and wood.

Thwing and Octon Parish Council have won a first Rural Community Energy Fund (RCEF) grant to develop a feasibility study to implement renewable energy sources which will benefit the entire community across both villages.

After a successful collaboration that won them the RCEF grant, the Parish Council chose Avieco, an environmental consultancy, to carry out the feasibility study and support them in the planning and management aspects of the project.

The study will evaluate renewable energy options for power generation, home heating and street lighting, and will consider both centralised options - such as solar PV plants and district heating networks, and individual options – such as rooftop solar PV panels, solar thermal panels and heat pumps.

Thwing and Octon Parish Council have aligned themselves with a growing number of forward-thinking Local Authorities that are choosing to switch to renewable energy and decarbonise their power and heat sources. The move to renewable energy will allow them to protect the community from future price volatility on electricity whilst contributing to the UK's carbon emission reduction targets.

This Project is supported by the BEIS funded Rural Community Energy Fund which is managed by the North East Yorkshire and Humber Energy Hub and administered by Tees Valley Combined Authority

About Avieco: Avieco is a market-leading sustainability and environmental consultancy based in London, supporting organisations worldwide to lessen their impacts on the environment and making sustainability part of their growth strategy.

To know more about the project, access www.thwing-octon-renewables.co.uk

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APPENDIX G: RESIDENT SURVEY RESULTS

The resident's survey responses compiled into a spreadsheet – the dataset of responses to the survey is held by the Parish Council.

Respondent reference number	Postcode	Domestic/farm/business	Listed (Y/N)	Only electricity (Y)	Annual elec consumption (kWh)	Electricity costs (£)	Heating systems	Heating costs (£)	Annual heat consumption (kWh)
1	YO253EB	Farm, domestic	N		5,023	£ 768	Oil, elec, wood, coal		
2	YO253HT	Farm, domestic	Y				Oil	£ 1,500	22,642
3	YO253HL	Farm, domestic, business	Y				Biomass		
4	YO253EB	Farm	N		2,900	£ 750	Oil		
5	YO253EB	Domestic	N		5,077	£ 1,254	Oil	£ 890	16,790
6	YO253DX	Domestic	N		3,660	£ 744	Oil, wood, coal	£ 1,959	32,663
7	YO253DS	Domestic	N		2,390	£ 700	LPG, wood, coal	£ 800	21,960
8	YO253DY	Domestic	N		3,053	£ 651	Oil, coal	£ 965	14,563
9	YO253DY	Domestic	N		18,985	£ 2,479	Oil, wood, coal	£ 3,779	59,605
10	YO253DR	Domestic	N	Y	1,253	£ 686	Electricity		0
11	YO253DS	Domestic	N		5,484	£ 967	Wood, coal	£ 800	12,759
12	YO253DY	Domestic	N	Y	1,256	£ 2,507	Electricity, wood, coal	£ 3,307	11,481
13	YO253DS	Domestic	N	Y	3,329	£ 1,202	Electricity, wood, coal	£ 900	11,058
14	YO253DY	Domestic	N		6,210	£ 1,250	Oil, wood	£ 1,750	31,595
15	YO253DY	Domestic	N		1,737	£ 600	LPG	£ 2,951	40,103
16	YO253DY	Domestic	N		4,261	£ 822	Oil, LPG	£ 1,510	24,023
17	YO253DY	Domestic	N		1,150	£ 252	LPG, coal	£ 1,180	18,696
18	YO253EA	Domestic	N		3,696	£ 386	Wood, coal	£ 400	6,380
19	YO253DX	Domestic	N		6,201	£ 960	LPG, wood, coal	£ 1,400	19,956
20	YO253DS	Domestic	N		4,215	£ 696	Oil, wood	£ 650	11,527
21	YO253DS	Domestic	N		2,772	£ 720	Oil, wood, briquettes	£ 850	22,020
22	YO253DS	Domestic	N	Y	1,951	£ 1,020	Electricity, wood, coal	£ 834	7,251
23	YO253DT	Domestic	Y		8,436	£ 1,097	Oil	£ 2,679	50,545
24	YO253EB	Domestic	N		1,782	£ 435	Wood, coal	£ 1,800	28,708
25	YO253DS	Domestic	N		2,744	£ 491	Electricity, wood		
26	YO253DS	Domestic	N		2,745	£ 492	LPG	£ 1,775	27,308
27	YO253DY	Domestic	Y		2,570	£ 420	LPG, electricity	£ 2,000	24,946
28	YO253DT	Domestic	N		5,133	£ 666	Oil	£ 2,642	49,849
29	YO253EB	Domestic	N		2,023	£ 494	Oil, wood	£ 485	13,902
30	YO253BJ	Domestic	Y		2,768	£ 574	Oil, wood, coal	£ 1,180	24,222
31	YO253DR	Domestic	N	Y	2,295	£ 1,920	Electricity	£ 1,920	4,262
32	YO253HJ	Domestic	N		7,018	£ 1,571	Oil, electricity	£ 2,000	30,189
33	YO253EA	Domestic	N		1,600	£ 360	LPG, electricity, wood	£ 1,600	19,692

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APPENDIX H: RESIDENT SURVEY ANALYSIS

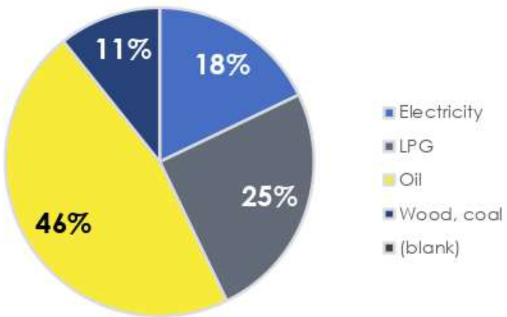
The outline data analysis of the Thwing and Octon resident survey responses.

Primary domestic heating type

Dom/farm/business	Domestic

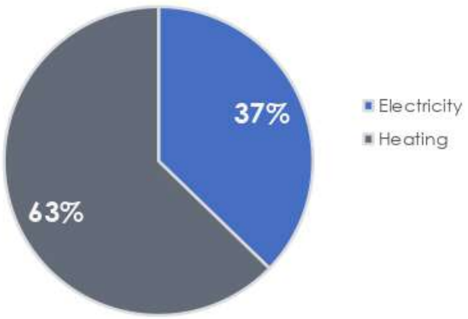
Row Labels	Count of Primary heating
Electricity	5
LPG	7
Oil	13
Wood, coal	3
(blank)	
Grand Total	**28**

Primary domestic heating type



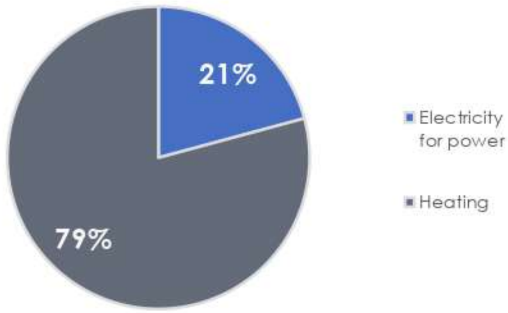
Costs		
Electricity	£	926
Heating	£	1,560
Total domestic electricity (£)	£	81,483
Total domestic heating (£)	£	137,314
Average spend on wood/coal (£)	£	310
Farm individual		
Electricity costs	£	699
Heat costs (oil)	£	1,254

Average household electricity vs heating costs (domestic)



Carbon emissions	
Domestic	
Electricity for power	99 tCO2e
Heating	375 tCO2e
Farm individual	
Electricity for power	1.4 tCO2e
Heating	5.8 tCO2e

Total carbon emissions split by end-use (domestic)



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APPENDIX I: CORRESPONDENCE WITH ERYC

Correspondence with the Principal Planning Policy Officer at East Riding of Yorkshire Council.

Hi Helen

Stephen has passed on your email to me in the Forward Planning team as we are working on a review of the existing Local Plan.

As you note, the current Local Plan reflects the Government's Ministerial Statement but does not currently identify suitable areas for wind development. Since adoption we have prepared an update to our Landscape Character Assessment which can be viewed at the address below (see heading "Landscape Character assessment Update 2018). It incorporates a wind turbine sensitivity and capacity study.
https://www.eastriding.gov.uk/planning-permission-and-building-control/planning-policy-and-the-local-plan/landscape-character-assessment/

The conclusions of the Update were reflected in a 'Options Document' which represented the first formal stage of the Local Plan Review. This document is available to view at the address below. Page 25 of the document sets out the issue and evidence and provided a map showing the spatial conclusions of the Update. The Options we presented were based on these.
https://www.eastriding.gov.uk/planning-permission-and-building-control/planning-policy-and-the-local-plan/east-riding-local-plan-review/

Following consultation, the Council reported on a way forward for a number of the issues set out in the Options Document. The Council resolved to consider developing a policy that would identify the defined 'area of search' and 'area of potential constraint' as being suitable areas for wind energy development (see paragraph 2.32 of the attached file).

Thwing & Octon is located in the "area of significant constraint" according to the LCA Update, which is not likely to be identified as a suitable area through the emerging policy. On that basis, paragraph 154b of the NPPF would need to be considered when looking at proposals outside of the identified areas.

Hope this information helps to guide the Parish Council. If you require any further information, please do not hesitate to contact me.

Kind regards
Owen
Owen Robinson
Principal Planning Policy Officer
Tel: (01482) 391739
Web: www.eastriding.gov.uk
Twitter: www.twitter.com/East_Riding
Facebook: www.facebook.com/eastridingCouncil

EAST RIDING
OF YORKSHIRE COUNCIL

Your East Riding... where everyone matters

APPENDIX J: FINANCIAL INPUTS

Financial inputs from industry standards, supplier quotes from other project work, and connection costs sourced from Northern Powergrid used to quantify the business case.

Input	Value	Source/notes
CAPITAL COSTS		
Heat		
ASHP systems	£500 / kW	AECOM/CIBSE
Horizontal GSHP systems	£875 / kW	GSHP Association typical figures
Power		
Ground-mounted Solar PV systems	£1,250 / kWp	Solar Trade Association typical figures
Rooftop Solar PV systems	£1,400 / kWp	Solar Trade Association typical figures
Distribution network operator connection fees	£10,050 – 227,670	Northern Powergrid; indicative costs (range from 3.68 to >1,000 kWp)
Horizontal axis wind turbine (per single 0.75 kW unit)	£1,685	Leading Edge model (LE-600)
Street lighting system	£1,275 – 1,870 / light	Prolectric Ltd
Street lighting maintenance costs	£4 / year £54 / year	Annualised cost of replacing LEDs at end of life Annualised cost of replacing battery at end of life
Street lighting savings	£876 / year	Annual cost to Thwing & Octon Parish Council for East Riding of Yorkshire Council's maintenance of current streetlamps and power supply (reported by Thwing & Octon Parish Council).
OPERATIONAL COSTS		
Maintenance (ASHP/GSHP)	£20 / kW	Supplier quote (Avieco database)
Maintenance (rooftop solar PV)	£6.10 / kW	Supplier quote (Avieco database)
Maintenance (ground-mounted solar PV)	£1.48 / kW	Supplier quote (Avieco database)
Street lighting maintenance	£58 / yr	Prolectric Ltd
ENERGY SAVINGS		
Cost of electricity	13.92 p/kWh	Northern Powergrid average (2020)

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ENERGY REVENUES		
Export tariff	5.5 p/kWh	Ofgem
OTHER ASSUMPTIONS		
Private wire costs (soft dig)	90 £/m	Lightsource figures
Private wire costs (hard dig)	190 £/m	Lightsource figures
Study period	25 yrs (heat) 30 yrs (power)	Standard; coincides with financial incentive eligibility
Inflation rate	2 %	Standard
Discount rate	10 %	Standard; applied to NPV calculations
ASHP CoP	2.68	Coefficient of performance
GSHP CoP	3.10	Coefficient of performance
Carbon conversion factors (kgCO_2e/kWh)		
UK electricity (scope 2 + transmission)	0.25319	Defra 2020
Heating oil	0.24666	
LPG	0.21448	
Coal	0.34462	
Wood logs	0.01545	

Avieco Ltd
3rd Floor, 105-107 Farringdon Road
London, EC1R 3BU
hello@avieco.com | www.avieco.com | +44 20 7048 0450
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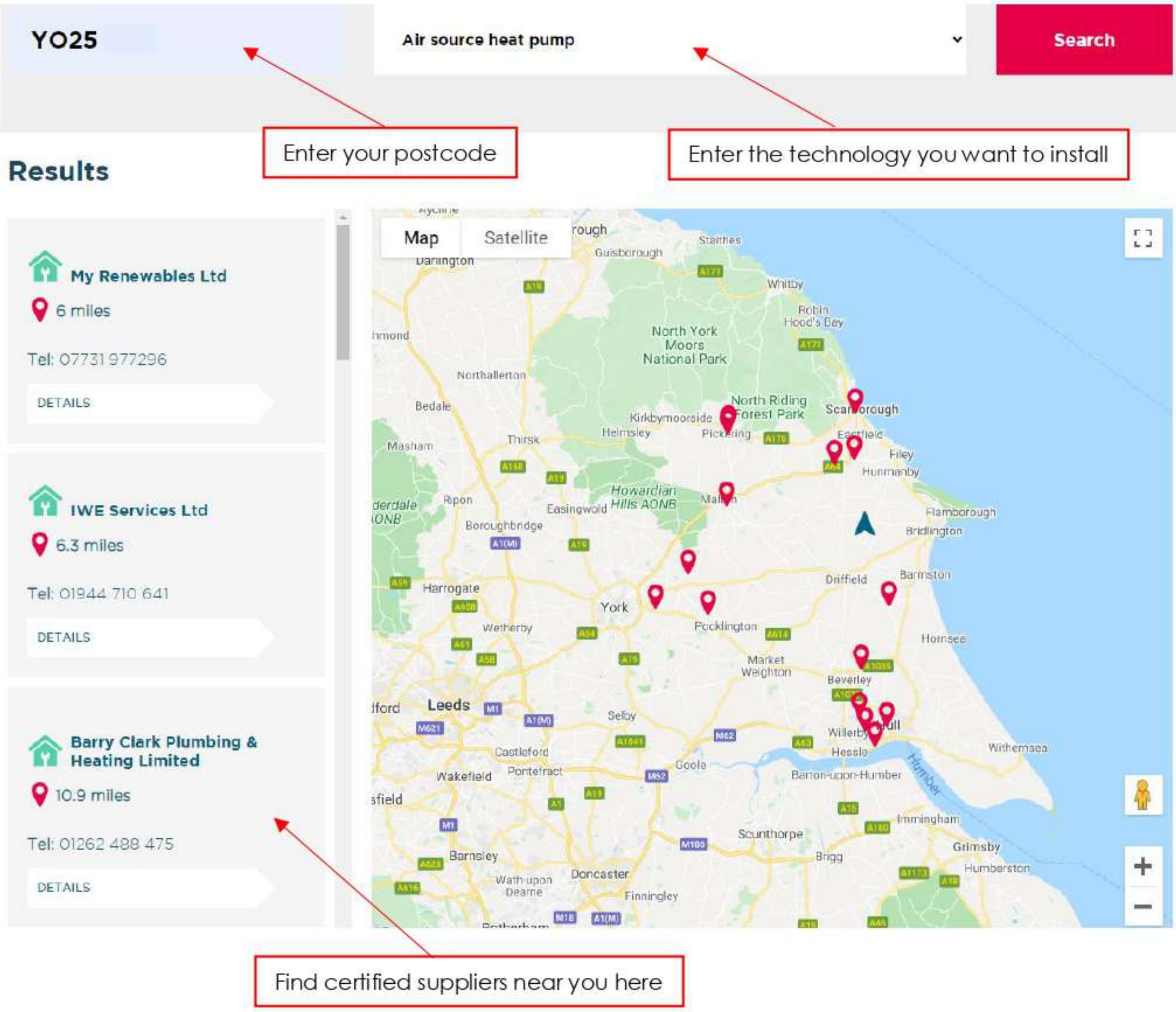
APPENDIX K: SUPPLIER SEARCH TOOL

An example of how to use the Green Homes Grant MCS certified, TrustMark registered search tool.

https://www.simpleenergyadvice.org.uk/installer-search



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APPENDIX L: INDICATIVE SOLAR PV CONNECTION COSTS

An example of indicative solar PV system connection costs provided by Northern Powergrid.

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3rd Floor, 105-107 Farringdon Road
London, EC1R 3BU
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