Brightwell-cum-Sotwell

Decarbonised community heating system

RCEF Stage 1 Executive Summary

RCEF Phase 1 Final Report

Brightwell cum Sotwell Parish Council

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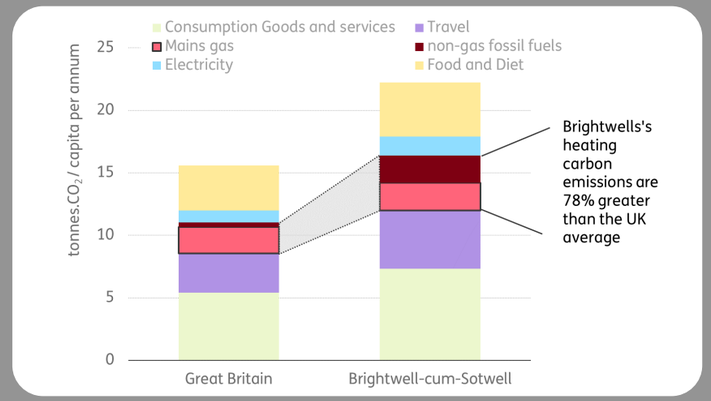
Decarbonising heating in Brightwell-cum-Sotwell - Executive Summary

The Challenge

1 Carbon emissions



- The UK will become a net-zero carbon emission country by 2050, with all levels of society expected to take action
- Brightwell-cum-Sotwell parish has home heating carbon emissions 78% above UK average
- The historic annual heating energy demand within Brightwell is over 15,000 MW.h
- High energy use and high carbon emissions require an efficient renewable heating solution to deliver on net-zero ambitions

2 Energy crisis

- Natural gas is currently trading at over 10x the pre-2021 price on UK markets
- Consumer retail price cap has been capped at £2,500 for typical dual fuel, over 3 times higher than the price cap from 2021
- 2/3 of UK households will be thrown into fuel poverty by new price cap

Complications

1 Complexity

Rural parishes contain homes with a wide range of ages and of different architectural typologies, with varied heating systems and technologies. Any decarbonisation solution must be able to address all buildings within the villages.

2 Uncertainty

Energy price inflation and construction industry inflation are currently high, and the outlook is uncertain. Though government intervention is expected it is currently unknown how this will be approached.

3 Risk

Existing heating systems predominantly rely on gas boilers, an established technology. New technologies will have an element of risk, and consumers require protection.

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Options

1 Do nothing

Benefits

- Residents avoid switching to new technology with potential risks of installation
- By waiting, low-carbon technology prices may potentially decrease (low - medium likelihood)

Costs

- Gas price for winter 2022 is currently 10p/kWh. (Government set price cap average). Consumers are paying 3 times more for heating compared to 2021, and prices are likely to remain high for extended period due to global demands (high likelihood)
- Environmental levies possibly will be added onto gas prices to achieve net zero targets.
- High carbon emissions will continue, contributing to climate breakdown

Rating ✗

2 Wait for hydrogen

Benefits

- Existing gas network and heating systems are viable, new gas compatible boiler would likely be required at similar upfront cost to current boilers

Costs

- High carbon emissions continue until hydrogen availability, contributing to climate breakdown
- Hydrogen system over-all energy efficiency is poor, requiring high system level energy inputs
- Hydrogen has competing uses higher up the industrial value chain, unlikely to be available for home heating within a decade (high likelihood)
- Unit cost of hydrogen is likely to be significantly greater than current gas prices (high likelihood)

Rating ✗

3 Individual heat-pumps

Benefits

- Low-carbon heating system installed today, reducing carbon emissions by over 64%, and zero-carbon within a decade
- If coupled with moderately efficient building fabric/heating system, heating cost savings today (High likelihood)
- Further heating cost savings as electricity prices are decoupled from gas prices (high likelihood)

Costs

- High upfront capital costs of installation - currently costing on average around £12,000 for installation per household
- If installed poorly, or in very inefficient homes, there is a risk of higher heating costs (medium likelihood)
- Risk technology is installed incorrectly and performs poorly (low-medium likelihood)

Rating ?

4 Community solution

Benefits

- Low-carbon heating system installed today, reducing carbon emissions by 60-67%, and zero carbon within a decade
- Heating cost savings (medium likelihood), with higher savings of up to 8% when paired with local renewable power generation (high likelihood)
- Further heating cost savings as electricity decoupled from gas prices (high likelihood)
- Potentially £0 up-front cost for initial scheme customers
- Greater control over energy at the local level

Costs

- Connection costs for residents later in scheme will be higher than a gas boiler, but cheaper than a heat pump (high likelihood)
- Significant community backing required

Rating ✓

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Centralised community solution

1.5 MW Water-source heat pump fed from shallow aquifer beneath Brightwell

2.5 MW Air-source heat pump

5.5 MW Electric Boilers for peak demands

250 m³ Thermal storage

7.4 km total-pipework in roads across Brightwell

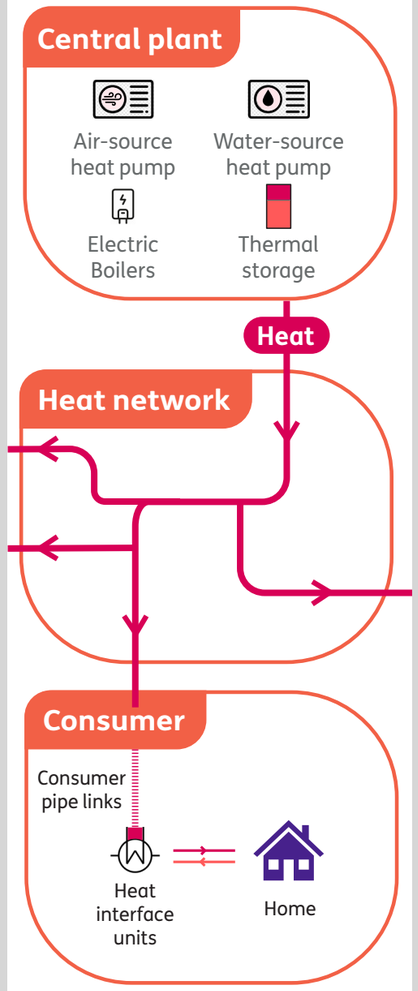
91% efficient heat distribution within network

65ºC flow temperature of water distribution

8.7 km total-pipework in homeowner drives

4s response time for Heat interface unit to deliver 65ºC heat to consumer.

Space saving as Heat interface unit equivalent size to boiler, and no hot water tank necessary



£5.8m Upfront cost for central plant equipment

25 years approximate economic life of industrial scale heat-pumps

£7.3m lifetime cost of plant replacements, in net present value

£5.3m Upfront cost for Brightwell village-wide heat network

100 years approximate economic life of a heat network. This is inter-generational infrastructure.

£3.4m total cost of connection pipework

£2,250 cost for heat interface unit, metering and installation

80% of village households would need to connect for scheme to be viable (405 households)

Benefits

- Resilient, net-zero compatible and efficient system for community
- Low visual and noise impact across community
- Minimal intrusion into homes of customers

Costs

- High upfront capital investment required
- Large amount of community buy in needed
- Disruptive works required in roads to develop network

Financial summary

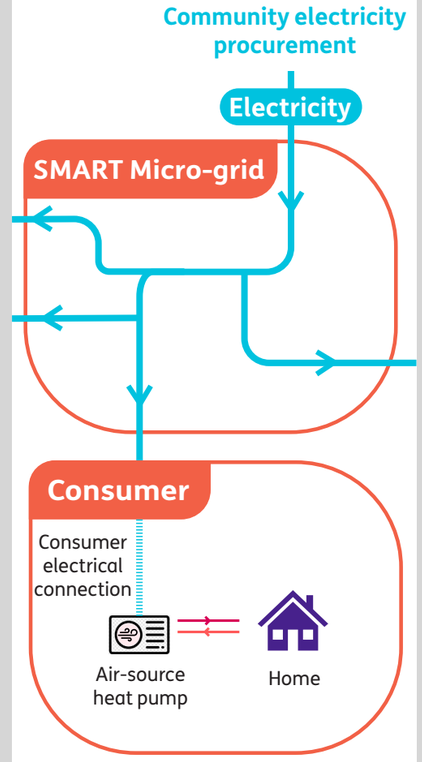
- 2.5% rate of return over 100 years, -4.1% over 30 years finance horizon
- 47 years for straight capital payback

Decentralised community solution

7.4 km electrical micro-grid cable required across Brightwell village

Hot water cylinder required alongside local air-source heat pump

External fan unit required to extract heat from air on each property



30% approximate saving over consumer retail price of electricity for bulk purchase (under normal market conditions)

£3m estimated upfront cost for Brightwell village SMART micro-grid

20 years approximate economic life of SMART micro-grid electrical equipment.

£12,000 estimated average cost of individual home heat-pump install

£4.9m total estimated upfront capital cost for 405 heat pump installations

50% of village households would need to connect for scheme to be viable (260 households)

Benefits

- Lower upfront capital costs, and less community buy-in required
- Minimal village wide disruption for system installation
- Air-source systems can be specified to meet specific home needs

Costs

- Each individual home relies on a single heating system
- External fan units required at each home, which could have a noise and visual impact
- Disruptive home installation

Financial summary

- 3.2% rate of return over 100 years, -1.0% over 30 years finance horizon
- 20 years for straight capital payback

Isolated rural properties far from the BcS Village may require individual air-source heat pumps and retrofit solutions.. please see mean report for further details or contact the Parish council

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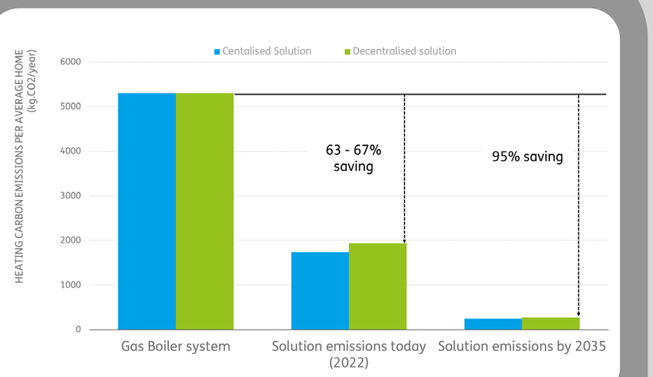
The benefits

1 Carbon emission reductions



2 Consumer savings and protection

Unit heat charge - 8.5p/kWh

Standing Charge - £430/year

- £430/year standing charge covers the on-going maintenance, metering and billing charges (~£150/customer/year) and the major plant replacement cycles.
- The Unit heat charge is initially set tracking average of gas/oil prices. Greater savings may be possible. Detailed financial modelling is required at future project stage.
- Unit charge could de-couple from gas in the case of price spikes. System would be regulated by Ofgem and the Heat Trust, providing consumer protection.

3 Capturing benefits of renewable power generation

Central plant

- Distributed solar generation isn't possible to connect directly to the central plant, due to number of connections and complexity
- Currently no local wind-turbine generation or large photovoltaic plants
- A private wire connection to a nearby solar array or turbine would be highly beneficial to project finances and consumer bills, if one comes available.

Electricity

Local Solar Photovoltaic generation

SMART Micro-grid

- With a SMART grid, distributed solar generation can be fed into the network
- Adding 1.2MW distributed solar generation on top of home roofs across the village of Brightwell could deliver a 4.5% return over 100 years, a 0.8% return over 30 years.
- If solar generation financial benefits entirely distributed to consumers, savings of 8% on heating bills could be delivered

Next steps

1 Support

To take forward a community energy project, the scheme needs to demonstrate significant community support. Please visit:

www.heatingbrightwellsotwell.co.uk/

To register your support and get in touch with Brightwell-cum-Sotwell Parish council!

2 Grant funding

The project is currently at a feasibility stage. More detailed design and financial modelling is needed to take this forwards to an investment ready business case.

Grant funding, supported by the governments heat network development unit, and your district or county council is needed.

3 Sign up

If the project receives grant funding, the most important determinant for capital investment would be a viable consumer base. Get in touch with the council and spread the word to support this scheme!

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