CHANGEWORKS

Low Carbon Heating Models:

A discussion document to inform ‘off the gas grid’ property owner-occupiers, landlords and tenant in advance of a consultation

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Introduction

Changeworks are leading a project focused on the just transition to low carbon heat in Scotland. The project aim is to

> *Identify and advocate for targeted investment in just heat decarbonisation approaches that are replicable, scalable and have broad stakeholder and community buy in.*

The project focus is rural and remote off-gas areas where current rates of fuel poverty are high. There is a concern that those already vulnerable and in or at risk of fuel poverty could be impacted by the switch in technologies and face an unfair burden, for example due to additional costs imposed or lack of access due to affordability.

The project will consult with owner-occupiers and landlords and tenants from the private and socially rented sectors as well as wider stakeholders. This discussion paper outlines four potential models to enable a just and fair transition to low carbon heating and provides a brief background on relevant low carbon heating technologies. The document is designed to inform stakeholders and prompt discussion around the suitability of the four models.

The discussions and stakeholder input arising from this paper will inform a campaign to generate awareness and acceptance of the different ways consumers can participate in the heat transition. Ultimately our aim is to influence Scottish Government and ensure that the means by which consumers in off-gas areas transition to low carbon heat are fair and just.

Low carbon heating technologies

Building fabric upgrades

Improving the energy efficiency of homes through measures such as wall insulation will ensure the maximum impact of low carbon heating solutions. A fabric first approach is crucial to a just transition as it addresses one of the drivers of fuel poverty, creates comfortable living environments whilst reducing heat demand and subsequently carbon emissions.

Opportunities	Challenges
Suitable for any archetype	High capital costs
Increased comfort	Some property types hard to treat
Reduce ongoing heating costs	Quality risk due to complexity

Electrification

A large chunk of the decarbonisation of heat will be delivered through electrification, enabled by the expansion of renewable electricity generation. Electric heating will be delivered in people's homes through technologies such as heat pumps and resistive electric heating (including storage heaters). There are three key challenges for the electrification of heat:

- managing the peak energy demand for winter heating
- grid infrastructure able to cope with the demand down to the local level
- the readiness of consumers to adopt new heating technologies.

Increased electrification of heat will require energy storage to manage the peaks and troughs in renewable electricity generation. This will include large scale storage such as hydro

systems and large-scale battery storage alongside building-scale batteries and thermal storage (including storage heaters, hot water tanks and phase change materials).

Resistive Heating	
Opportunities	**Challenges**
Low maintenance	High running costs
Grid flexibility from storage heaters	
Heat Pumps	
Opportunities	**Challenges**
Low maintenance	High upfront capital costs
Low running costs	Quality risk due to immature market
Also provide cooling	Require user engagement and education

Biofuels

Although their overall role will be limited in the transition to low carbon heat, biomass and other biofuels will provide domestic heating in off-gas properties where electric heating is unsuitable. Biomass boilers provide hot water and central heating.

Opportunities	Challenges
Low fuel costs if biomass is sourced locally	Dependent on good management of feedstock
Security of supply from local sources	Air quality impacts
	Require manual loading and clearing of boiler

Heat networks

In areas where heat density is high enough (e.g. villages, towns or new build developments), heat networks may be an appropriate way of delivering low carbon heat. Heat networks can use a range of low carbon heat sources including commercial-scale biomass boilers or geothermal energy as well as electricity and heat pumps.

Opportunities	Challenges
Lower costs for consumers	Operational responsibilities
Suitable for any archetype	Quality risk
Long-life systems	Require adequate heat demand

Hydrogen

Hydrogen has potential as a low carbon heating fuel, utilising the existing gas network though the actual role it ultimately plays in heat decarbonisation may be very limited. As this project is focused on off-gas areas however, hydrogen is out of scope.

A just and fair transition

The transition to low carbon heating must ensure that no-one is left behind or disenfranchised. Acceptance from stakeholders will require solutions that feel fair and just.

Those who are likely to be the most at risk of being left behind are those considered ‘vulnerable’. Poor health and disability are associated with high levels of fuel poverty and unemployment. Low-income households will be disproportionately affected by electrification of heat as they have little capital to invest, are less likely to take financial risks and may pay more than those with the ability to pay up front due to fees associated with money lending.

Other issues to consider are digital exclusion, either due to infrastructure or capabilities and geographical differences in services such as supply chain and maintenance. Building fabric, dwelling type and tenure will also impact the equity of the transition. ‘Hard to treat’ properties, such as pre-1919 stone built cottages are more expensive to retrofit. People in multi-occupancy buildings may face barriers associated with shared ownership, space constraints and split-incentives between landlords and tenants.

Overview of identified models

The current journey to installing low carbon heating is fragmented and can be challenging to navigate as a consumer. Generally, an individual household contracts an installer to provide and fit a new heating system, pays a supplier for their energy usage, and pays an engineer for any maintenance. The four models identified provide a more straightforward customer journey to roll-out low carbon heating systems at scale to support a just and fair transition:

1. Collective purchase
2. Payment plan
3. Community asset ownership
4. Third party ownership

The models were developed based on desk-based research. We reviewed examples of low carbon heating projects across Europe, and different types of business models. The models were designed around how the upfront and running costs are paid, how these costs can be minimised (e.g., through bulk purchase) and how to improve the consumer journey. The models seek to achieve a just transition through:

- sharing costs where possible
- encouraging community or area-based projects
- remove or reducing upfront cost barriers
- meeting competing priorities (e.g. between tenants and landlords)

The models were not developed for specific heating technologies and we envisage that all models could be used for the installation of any form of low carbon heating technology. All four models assume that a fabric first approach will be followed. Each model could be supplemented and supported through a grants programme and financial incentives, but we have not included these as standalone models.

The description of each model also includes case studies and vignettes. The case studies of existing projects demonstrate how the models could be put into practice. The vignettes are fictional and aim to illustrate how different actors may benefit from each model.

1. Collective Purchase

The cost of heating and fabric upgrades is reduced through bulk purchasing, as many off-gas communities already do with bulk purchasing heating oil. Heating and fabric upgrade are purchased through reverse auctions or a tender process. As in the case study below, group buying can work well as an area-based scheme to improve uptake and buy-in from residents.

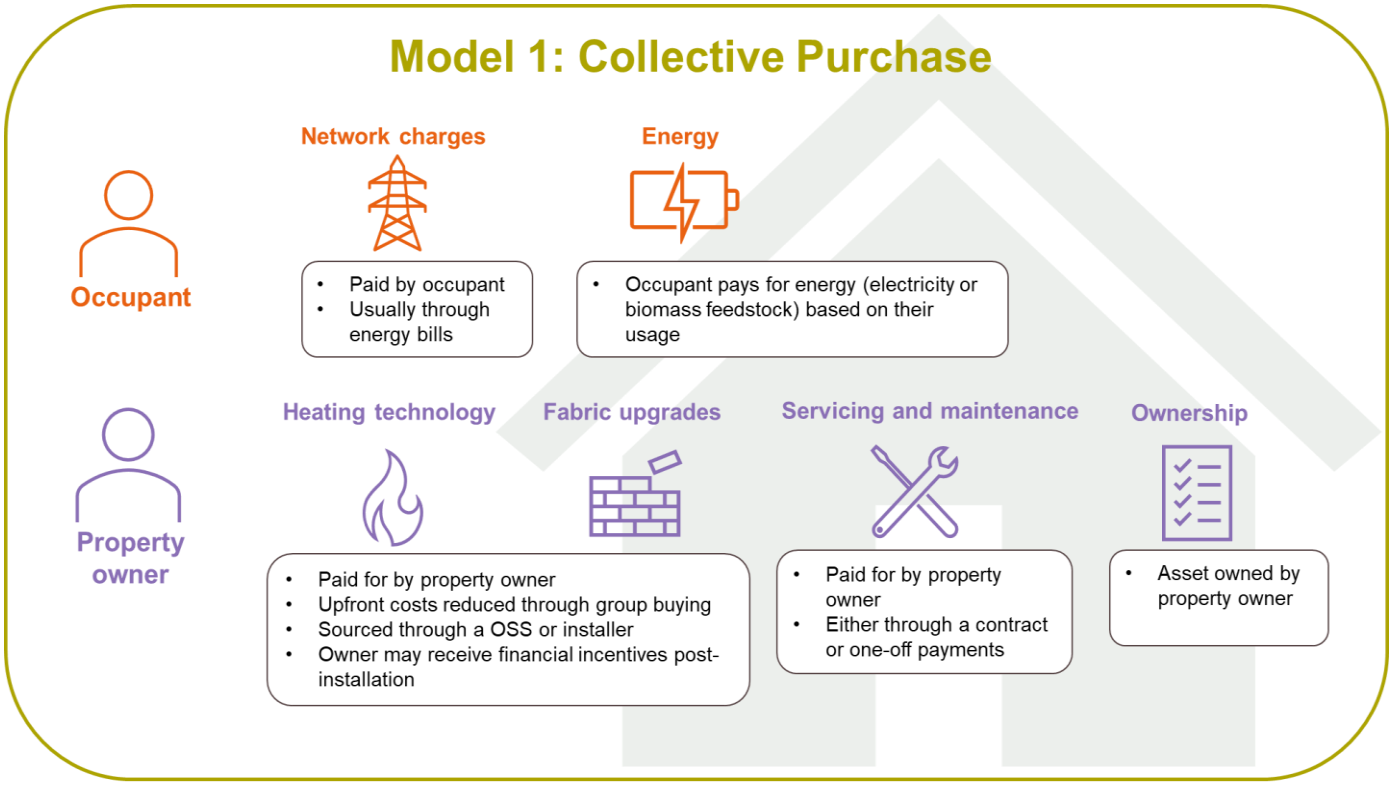
- Property owners pay directly for a new heating system and fabric upgrades.
- Occupants pay for the relevant energy source (electricity / biomass) and network costs.
- Property owners pay for any servicing and maintenance. This may be provided by the installer as an ongoing contract, or separately.

Suitable technologies: individual (heat pumps / biomass boilers) but not communal

Suitable tenures: owner-occupied, private and social rental sectors

Group buying can be self-organised on a community scale, or through a third-party intermediary or one-stop shop (OSS) which supports the selection of appropriate upgrades and provides additional services such as quality assurance, customer service, robust procurement, and contract management. Alternatively, owners could collectively purchase upgrades through installers relying on robust consumer protection mechanisms.

This model can be combined with grant funding and / or financial incentives to reduce the initial upfront costs for the heating system and fabric upgrades.



Case Study: West Linton group buying scheme

Organisation: Changeworks

Location: West Linton and District

Context: An off-gas village (and surrounding area) in the Scottish Borders. The village has a strong sense of community and a large number of 'self funding' households.

Technologies: Large number of properties with the potential for ASHP to be installed to replace current oil/solid fuel heating systems. Suitable fabric upgrades are also recommended where necessary.

How: The project was initiated and led by Changeworks. West Linton was identified based on suitable building archetypes and local demand. Changeworks held meetings and a focus group with members of the community prior to confirming the project location.

Changeworks developed a customer journey using Home Energy Scotland (HES), produced a procurement model and brought partners on board. HES held a public meeting in West Linton to launch the project and raise awareness, followed by a marketing campaign. Changeworks are procuring installers and heat pumps, as well as providing quality control on the design and costs from the installer, communications and messaging, monitoring, household support and quality control of installations.

Progress: 51 residents have signed up through HES, 32 of whom have received quotations with eight ready to arrange installation dates. Word of mouth and local social media groups have been the best forms of promotion, along with Changeworks and HES presence at village events.

Vignettes

> We got a discount because we're buying as a collective. People in the village do this already with our oil buying group, so it was great to join together and get a discounted quote for an air source heat pump. The support following the installation has been good.
>
> They inspected the installation and had to call the installers back to change a few things. But that's given us peace of mind because we know that everything has been checked and is working as it should.
>
> **Owner occupier**

> The payments from the incentive scheme plus our ability to bulk purchase meant that we could replace old storage heaters with ASHP instead of quantum storage heaters. The money we get back through the incentives has brought the cost right down and allowed us to make a business case. And tenants are much happier with heat pumps than the storage heaters.
>
> Because we buy heat pumps at scale there could be opportunities for owners to purchase at the same time and get a better price.
>
> **Social housing provider**

2. Payment Plan

This model removes the barrier of high upfront costs. Occupants pay for energy use and network charges, and property owners for servicing. Upfront costs for heating and fabric upgrades are spread over time. Some payment methods transfer the cost from the property owner to the tenant in the case of rented properties. Third-party involvement is primarily to provide finance, however there is scope for finance providers to mediate between contractors, giving consumers a stronger voice and additional protection.

- Payments made either by owner or occupant. When paid in full, assets are owned by the property owner.
- Occupants pay for the relevant energy source (electricity / biomass) and network costs.
- Servicing and maintenance may be included in payment plans or paid for separately by owner.

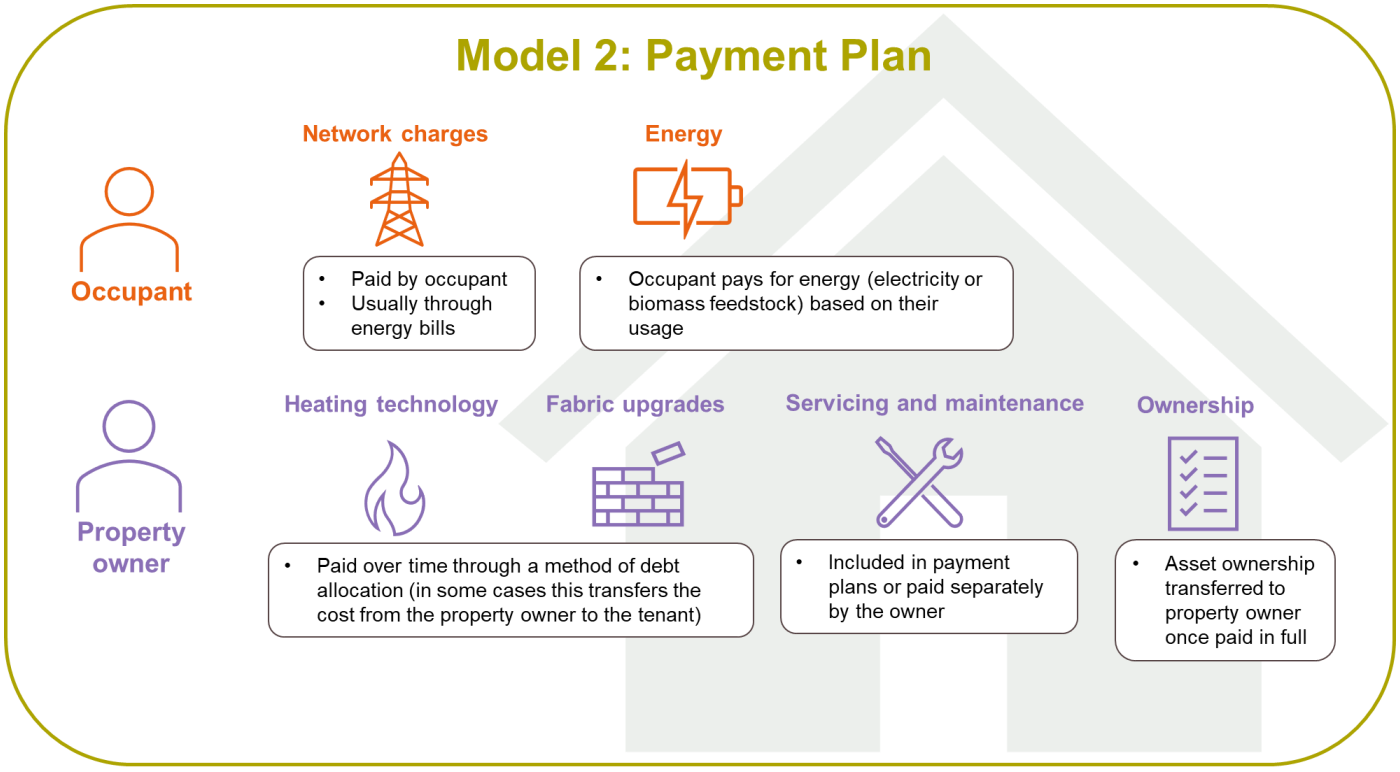
Suitable technologies: individual (heat pumps / biomass boilers) but not communal

Suitable tenures: owner-occupied, private and social rental sectors

This model can be delivered through loans such as the existing HEEPs loan, or other mechanisms such as:

Comfort as a service: a 'heat plan' which bundles a new heating system, servicing, maintenance and an agreed amount of energy (heat and/or power) for a fixed monthly price. Similar to mobile phones, heat plans can be pay-as-you-go or a fixed price contract.

Green leases: loans which seek to bridge the divide between landlord and tenant by splitting costs and benefits between the two.



On bill payments: payments can be linked to the meter or property owner rather than the original purchaser.

Property Assessed Clean Energy (PACE): repayments are made as part of property taxes and based on the equity of the property. Common in the US and being trialled in Europe.

Salary sacrifice: similar to schemes such as Childcare Vouchers and Cycle to Work.

Equity release: a route for older owner-occupiers or PRS landlords with high-equity properties to unlock equity in their property for investment.

Equity loan: owners can borrow against the equity in their property.

Case Study: RenOnBill Pilot

Organisation: Residential building energy renovation with on-bill financing (RenOnBill)

Location: Germany, Lithuania, Italy, and Spain

Context: Pilots in four countries to inform the scale up of on-bill payments if replicated within the EU.

Technologies: A range of technologies including heat pumps, fabric upgrades and solar PV.

How: Three pre-selected energy companies provide tailored offers using the Energy Renovations Valuation Tool (ERV-Tool), developed as part of the RenOnBill project. The pilots remove the upfront costs of energy efficiency upgrades by using the customer's utility bill as the repayment vehicle. Upfront costs are financed by utility companies (or financial institutions) and paid back by the customer over time through bills. During the payback period the energy savings can offset the cost of the measures installed, allowing the bill to remain unchanged. After the complete repayment of the energy efficiency improvements, the bill will be lower, and ownership will lie with the property owner.

Results: Results from the 2021 pilots will be disseminated at the end of the project in 2022 alongside a holistic replication strategy. This should also reference the potential for low carbon heating conversions to be funded the same way.

Case Study: Energiesprong

Organisation: Energiesprong

Location: Nottingham, UK

Context: An approach to energy efficiency and heating upgrades that sets standards to achieve net zero energy homes. Ten older hard-to-heat social houses in Nottingham were chosen for the first UK pilot.

Technologies: Fabric upgrades, heat pumps, battery and thermal storage.

How: The first Energiesprong UK scheme was conducted in Nottingham for 10 hard-to-heat social houses. Nottingham City Homes and Nottingham City Council procured Melius Homes

Ltd to deliver the retrofits. Based on an initial 3D scan of the homes, new prefabricated outside walls and windows, a solar roof and efficient heating system including ground source heat pumps and battery and thermal storage were installed.

After installation, the occupiers pay a flat rate energy plan for hot water, heating, and electricity, set at the same cost or less than prior expenditure on bills. Energiesprong provide a performance guarantee on energy and indoor climate of at least 30 years. The fees raised under the energy plan are paid to the landlord.

Results: The positive results have led the council to support the Energiesprong scheme for the retrofit of a further 155 homes.

Vignettes

I wanted to upgrade the heating in my property but for me it was too expensive. With the green lease my tenant and I were able to come to an agreement for a small increase in their rent. This contributes towards the repayments for the new heat pump and my tenant benefits from a brand new and efficient heating system.

Private sector landlord with a green lease agreement

With the payment plan it is much easier to work out how much heating I need. In the winter I can just think about how many hours I'll need it on and in which rooms, and I know how much that is going to cost me. It makes it so much easier to budget. Before it was hard to know what the actual cost of my heating was going to be until I got my monthly bill.

Occupant with a pay-as-you-go comfort as a service plan

3. Community Asset Ownership

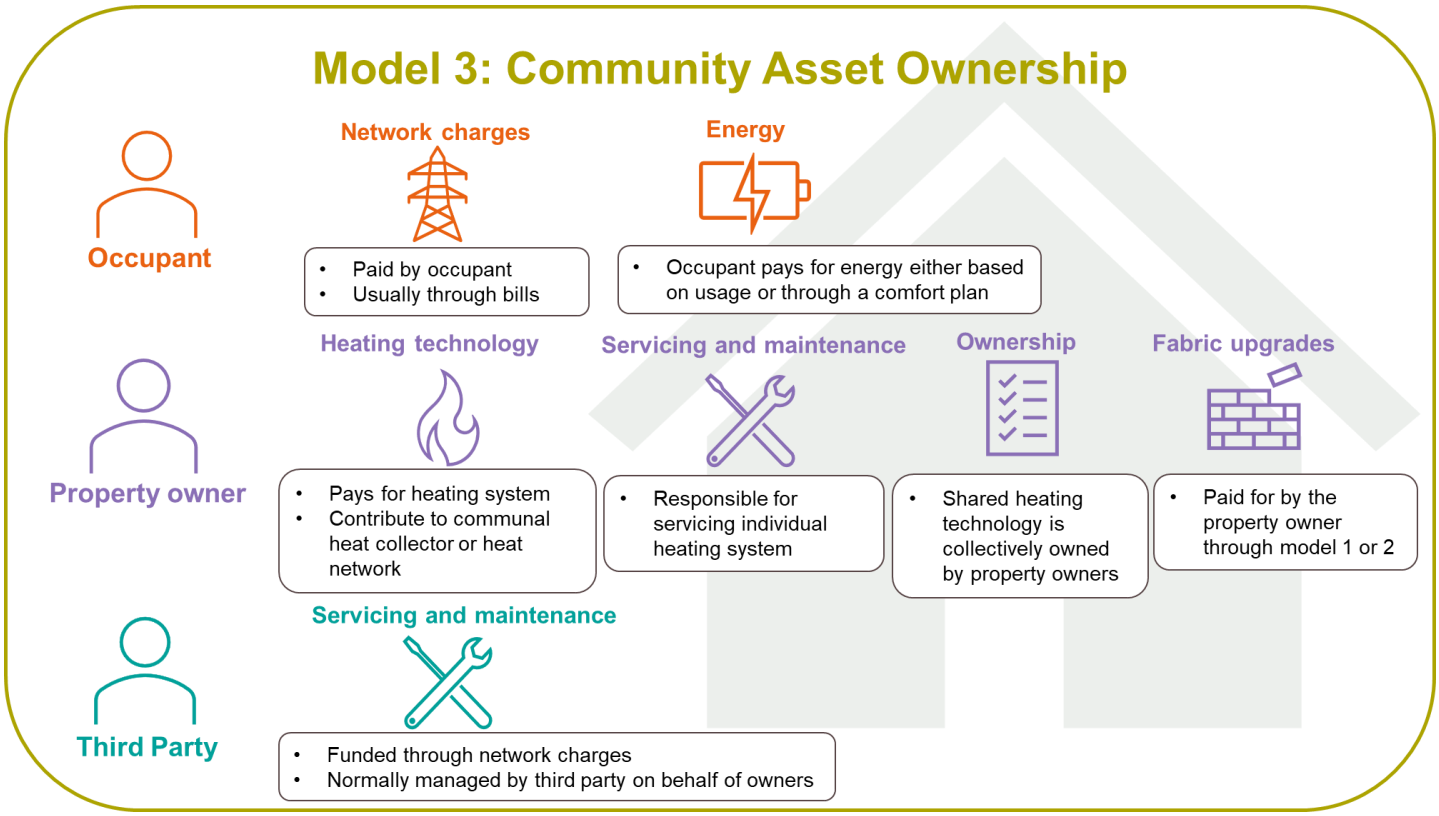
Heating assets are collectively owned by users as is currently the case on metered estates with communal LPG storage tanks. This could include heat networks or shared ground arrays for individual heat pumps. This model could be combined with technical solutions for multi-occupancy buildings such as tenements, on a whole street / village scale, or as small as two semi-detached properties sharing an ASHP.

Community-ownership projects will need large upfront investment (which could be provided through grants or models 1 and 2).

- Property owner pays directly for a new heating system and contributes toward communal heat collector or heat network.
- The householder (owner-occupier or tenant) pays for the relevant energy source as it is needed (electricity or biomass feedstock), network and management charges.
- The communal asset could be managed by owners or through a third party.
- Servicing and maintenance of communal assets is funded through network charges. Property owner remains responsible for servicing of individual heating systems.

Suitable technologies: heat network, microgrid or heat pump ground array

Suitable tenures: owner-occupied and private rental sector



Case Study: Marstal communal heat network

Organisation: Marstal Fjernvarme

Location: Marstal, Denmark

Context: Collectively owned district heating network connected to 1600 consumers on the island town of Marstal

Technologies: The district heating network is supported by solar heat collectors (solar heat is stored in two pit storage systems), wood chips, a heat pump, and the combustion of bio-based oil.

How: As a result of increasing oil prices in Marstal, community members considered an energy transition to reduce heating costs. The original heat network was established in the 1960s and financed by the local residents. Further expansion led to the formation of a consumer-owned co-operative, Marstal Fjernvarme. It is still a not-for-profit company owned by the inhabitants of Marstal. Homeowners buy a share in the network when purchasing a house in Marstal.

Results: 1600 consumers connected to the system with the business model returning potential profits to the cooperative members in the form of lower energy bills.

Case Study: The TWOS project (Two Streets of Solar)

Organisation: Easton Energy Group (EEG)

Location: Bristol

Context: Easton Energy Group is a not-for-profit Community Benefit Society. The project is to develop a private electricity microgrid and community battery in a back alley between two streets in Bristol. Up to 113 homes will have access to the network.

Technologies: Solar PV microgrid with battery storage

How: The original project plan was a community-owned large scale solar installation programme. Following dramatic FiT cuts, the project was scaled back and repackaged into TWOS, to connect solar on neighbouring roofs to form a microgrid. Regen worked with EEG to compare two ways to make the project happen; either creating a physical microgrid or creating a virtual private network (based on the Energy Local Club model). EEG have chosen to build a microgrid with Community Energy Prospector.

Results: A feasibility study and community engagement indicated that residents are interested in the project and willingness to host solar modules on their roof was particularly high.

More information

Case Study: Firle low carbon heat network

Organisation: Brighton and Hove Energy Services Co-operative (BHESCo) and the Firle Estate

Location: Firle village, East Sussex

Context: most properties in the village rely on heating oil LPG for heating. BHESCo have been exploring designs for heat networks to power the village with locally sourced, community owned clean energy.

Technologies: GSHPs with shared ground loop for 7 properties

How: BHESCo, in partnership with RetrofitWorks, is pursuing a fabric first approach, improving the energy efficiency of each home. Residents pay a monthly charge through a heat supply agreement with BHESCo. The ownership model is still unconfirmed, but the preferred option is for the system to be collectively owned in part by residents through a special purpose investment vehicle established for this purpose. The network will be managed by BHESCo by entering into a service level agreement with the selected supplier.

Results: Currently consulting residents, after which the installation and management contract will go out to tender to local suppliers.

More information

Vignettes

I see the project as a win-win because it has allowed us to move to low carbon heating and provided financial benefits to the local community. The community heat project provides a small but steady income for the community which supplements our normal fundraising activities.

Owner occupier

Some of the small villages around us had communal oil tanks for their heating systems. We wanted to move away from oil, it's expensive and it's bad for the planet. The idea of a communal underground collector for heat pumps just made sense. It's a small village and there was much less disruption than everyone digging individual holes or trenches for a heat pump.

Tenants in the private rental sector

4. Third Party Ownership

A utility company or an energy service company (local authority, private company, community group or combination) pays the upfront costs to develop the heating system and recoup their costs from users.

This model can also be used for physical or virtual microgrids. Microgrids integrate the provision of heat with energy generation and storage. Networks with microgeneration mitigate grid constraints and can provide security from energy prices rises. Physical grids have the advantage of a strong local identity.

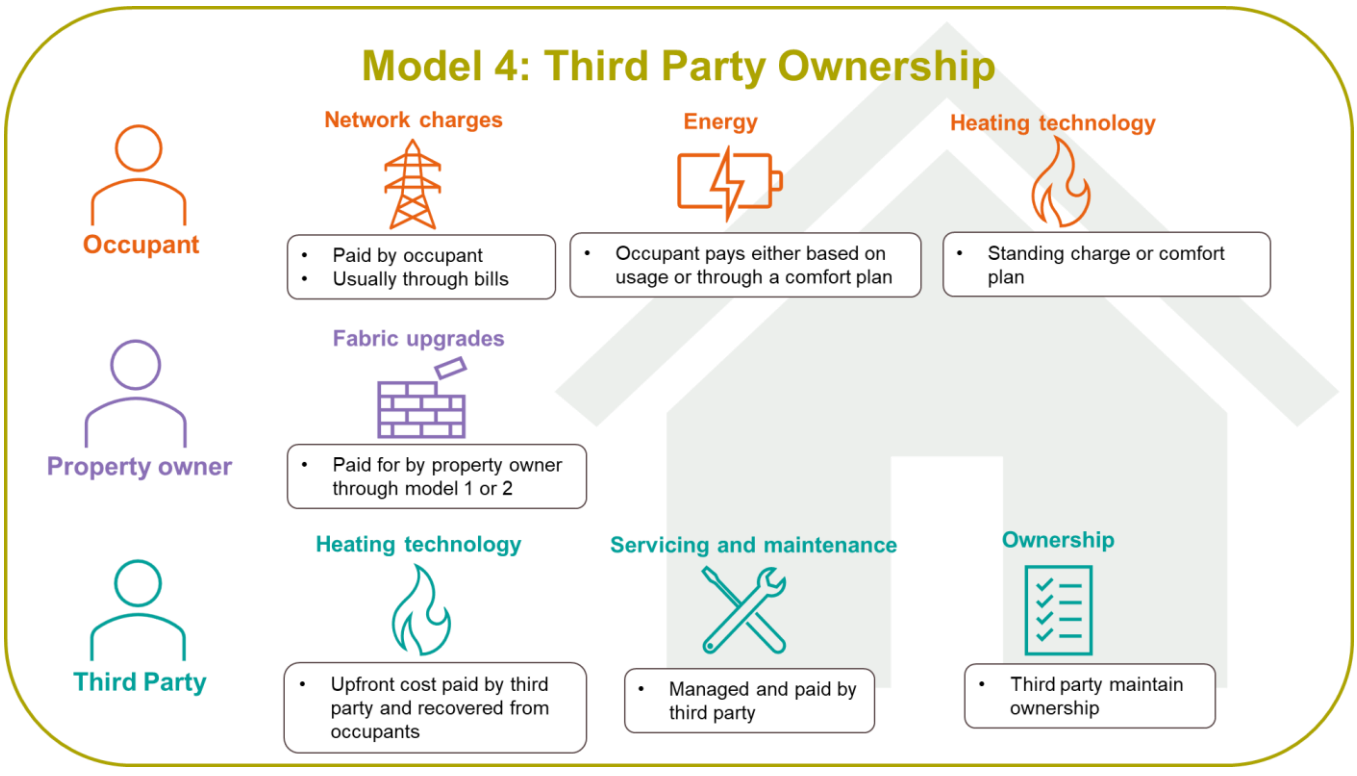
- The third party owns and operates the heating / microgrid infrastructure and are responsible for servicing and maintenance.
- Occupants pay for heat and/or energy, and network charges.
- To recoup investment costs the ESCo / utility company can derive value through access to data, grid balancing, demand aggregation. This may help offset the cost of infrastructure to consumers.

Suitable technologies: individual (heat pumps / biomass boilers) and communal (heat network / shared ground arrays for GSHP) and microgrids

Suitable tenures: Social rented, owner-occupied and private rental sector

Methods for third parties to recoup costs from heat users include:

Standing charge: occupants pay per unit for energy or heat used. This could be to the asset owner (heat networks / microgrid) or to an electricity supplier (heat pump with shared array).



Occupants also pay a standing charge which covers the cost of the asset (physical or virtual heat network, or a shared ground array)

Comfort as a service: as outlined in model 2, occupants pay for an agreed heating plan through a contract, rather than for the energy / heat used. This can also take the form of a Home Service charge or all- in rental agreements, which include all utilities, local taxes and other running costs in a single charge.

Case Study: Leicester District Energy Scheme (LDES)

Organisation: ENGIE in partnership with Leicester City Council (LCC) and the University of Leicester

Location: Leicester

Context: Most heat networks in the UK are owned and operated by the project sponsor or through a concession arrangement (project sponsor owns the assets and a third party operates them). LDES is unusual as it is wholly owned by a third party (ENGIE) who are responsible for funding the project. This allows LCC to transfer all technical and performance risks to the third party ESCo.

Technologies: Heat network with CHP and biomass boiler plant

How: LDEC was established with an investment of £14 million by ENGIE as well as using over £1 million of Community Energy Saving Programme (CESP) funding. The project linked four district heating schemes and was then extended to include LCC council homes.

Results: LDEC delivers low carbon heat to 3,000 dwellings on six housing estates, 19 civic buildings and the University of Leicester.

More information

Case Study: Pay-as-you-go heat pumps

Organisation: Danish Energy Agency

Location: Denmark

Context: The scheme is designed to boost replacement rates for oil-fired boilers and is aimed at rural off-gas grid homes or those who cannot connect to a district heat network.

Technologies: Heat pumps

How: A funded pilot programme to create a sustainable market for pay-as-you-go heat pumps with minimal state support. Energy companies are responsible for scrapping the old oil boiler and the installation, ownership, operation and maintenance of the heat pump. They also pay for the electricity used by the heat pump, which creates a financial incentive to operate and maintain the heat pump as efficiently as possible. Homeowners pay for their heating usage, a one-off connection charge, heat consumed and a fixed monthly subscription fee.

Results: Since the pilot finished in 2020 ‘heat pumps on subscription’ has been established. The new business model still relies on a state subsidy paid to the energy company, which must be used to reduce costs for the homeowner.

More information

Vignettes

We have been looking at options to replace the storage heaters in our properties for a long time. For properties in towns and village we looked at heat networks, but the risks associated with being a heat supplier are far too great for the organisation to take on. We also don’t have the expertise. This way our tenants can benefit from a reliable heating system and we are not responsible for supplying their heat.

Housing Association with a third party ESCo heat network

Unfortunately houses in rural areas aren’t worth so much and lending institutions therefore deem it a risky investment to loan money to us to purchase heat pumps. When I had the offer to get a pay-as-you-go heat pump, I readily accepted. I paid a one-off cost of £3,300 and now pay £60 a month plus heating charges. I avoided purchasing a heat pump for over £13,000 and I expect to reduce my total heating expenses by a third. That’s something that makes a difference to our household budget from day one and now our heating is also more environmentally friendly.

Owner occupier using a pay-as-you-go heat pump