EXECUTIVE SUMMARY

The heating sector in the UK accounts for almost one third of the UK's annual carbon footprint. In 2019, 17% of heating emissions from buildings came from homes.

UK Government policy means that all new homes built from 2025 will be banned from installing gas and oil boilers and will instead need to be heated by low-carbon alternatives. These heating systems are less familiar to property developers and, in many cases, are likely to place higher demands on the electricity distribution network. Residential property developers will therefore need to think more holistically about how to meet the heating energy demands of homes they develop.

The challenge faced is substantial. The electrification of heating will place higher demands on the electricity distribution network, and more complex modelling will be required to ensure the new regulatory requirements are met while managing these demands.

For residential property developers, this will involve not only establishing the most appropriate heating equipment for the location and property types, but also understanding how energy demands can be managed (both overall, and at peak times when demands on the electricity network are highest and/or highest carbon; and for future proofing) through building design (including the installation of superior insulation), the installation of renewable sources of energy, and equipment and systems to support flexibility of demand (such as storage batteries).

In this complex ecosystem, data will be key to working out the best solutions. As one stakeholder put it:

'Data is essential to get this use case off the ground, to support the installation of low carbon technologies, and to reduce [future] demand on electricity networks.'

Icebreaker One's future of domestic heating use case therefore focuses on how Open Energy can support residential property developers, or consultants operating on their behalves, by facilitating and streamlining access to essential data. In this document, we outline the data sets required and potential Data Providers, the challenges of implementation, and the benefits and opportunities this use case presents to stakeholders.

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OVERVIEW

As part of the Modernising Energy Data Access (MEDA) competition in 2020, a core use case was developed to demonstrate the benefits of an Open Energy Search and Access Control. This focused around a local authority looking to understand the impact of retrofitting buildings with low carbon technologies and, potentially, electric vehicle (EV) charging points across a large estate.

As part of our user needs-based approach, Icebreaker One has developed two further use cases. These broaden the exploration of the value of better data access: making energy data more robust, shareable, and easily accessible, and outlining the benefits of the Open Energy approach to stakeholders across the market.

The use cases will be used in several key ways, including to:

- enable the development of Open Energy's products and services
- identify key datasets to prioritise for making available via the Open Energy service
- illustrate the benefits of becoming members of Open Energy through real-life examples.

Goals of Icebreaker One's use cases

1. Outline the benefits to potential Data Consumers and Data Providers of accessing data/making data available via the Open Energy service.
2. Identify and acknowledge barriers to implementation, such that methods for overcoming these barriers can be considered at an early stage.
3. Demonstrate, through example, how the Open Energy service can enable a secure, trusted environment to facilitate the sharing, access and control of energy data according to an Open Energy Standard.
4. Demonstrate the status of the relevant data sets identified:
    a. Are the data sets open?
    b. Are the data sets shared using an existing licensing agreement?
    c. Are the data sets subject to data sharing restrictions, as per Open Energy's sensitivity classes for trusted data sharing, such as access being restricted to specific Data Consumers and/or requiring payment for accessing the data.
5. Demonstrate the ability for an authorised participant to access the Shared Data where all Open Energy's conditions relevant to the data set have been met.

Use case prioritisation process

Step 1: Members of the Open Energy Steering and Advisory Groups, including representatives from government, regulators, consumer bodies, trade associations and industry, identified potential areas of focus for new use cases. Broad areas considered during this process included electricity supply flexibility, electric vehicles (EVs), fuel poverty, heat pumps, smart meter adoption rates, and the transition away from domestic gas boilers/heating.

Step 2: Following a scoping period that included input from Advisory and Steering Group members, Icebreaker One prioritised the future of domestic heating in the UK as the area of focus for the development of our second use case.

Step 3: Following an internal prioritisation process and in consultation with our Advisory Group, Icebreaker One confirmed the problem statement for development into an Open Energy use case (see below).

Step 4: During January and February 2022, the Open Energy programme worked with stakeholders in this priority area to develop and refine the use case, gathering insights on benefits, barriers and the data required. Organisations consulted included the UK Green Building Council, BEAMA (the UK trade association for manufacturers and providers of energy infrastructure technologies and systems), the Royal Institute of British Architects, developers of zero-carbon homes, consultants and representatives from local government.

Confirmed problem statement

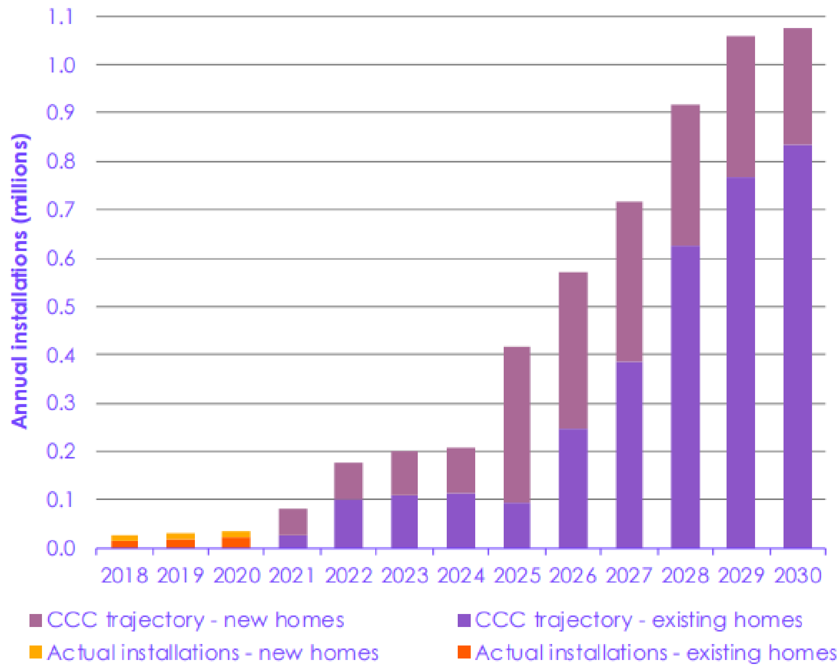
'A new residential housing developer (or a consultant operating on its behalf) wants to know how to reduce grid reliance and minimise grid connection requirements when building and kitting out new housing developments with energy technology (both the heating technologies themselves and renewable/flex resources that could reduce grid reliance) while still being in line with regulatory requirements.

'It needs data to be able to analyse the optimal combination of up-front costs versus reduction in grid connection in terms of the overall cost of development.'

HEATING USE CASE: BACKGROUND AND CONTEXT

The UK has a long way to go to fully decarbonise residential heating by 2050, in line with its target to achieve net zero carbon emissions by this date.

To illustrate the scale of the challenge, the UK government has a target to deliver 600,000 heat pumps a year by 2028, across new and existing properties. However, as the chart below shows, in 2020, the number of annual heat pump installations in homes was just 36,000 (up from 33,000 in 2019), of which 23,000 were retrofit installations (thus 13,000 in new homes). This means that, of the 123,151 new homes built in 2020 according to the National House Building Council, less than 10% had heat pumps installed. This is despite the fact that the ban on gas central heating in new builds comes into force in 2025.



Current heat pump installation rates in homes set against the Climate Change Commission's (CCC) Balanced Pathway. Source: CCC analysis; BSRIA (2021) Heat pumps market analysis 2020: United Kingdom, BSRIA World Market Intelligence. (From the CCC's Progress in reducing emissions: 2021 Report to Parliament)

Heat pumps are, of course, not the only heating technology available (or that might become available) for developers of new residential properties; electric boilers, solar water heating panels and (possibly) hydrogen boilers or local heat networks are also potential solutions. But weighing up the pros and cons of these choices is not straightforward in comparison with simply installing gas central heating, which has been the default choice for most properties to this point.

Not only must the cost and carbon-efficiency of each respective technology be weighed up alongside its suitability for each specific property, but consideration must be given to how the electrification of heating will affect demands on the electricity networks, distribution and energy generation - and thus the likely increased cost of connection to the electricity grid (a key consideration for a property developer looking to manage costs)[1].

It may be possible to mitigate the likely increased demands on the electricity network by, for example, improving the energy-efficiency of the building design, installing on-site renewable generation (such as photovoltaic solar panels) that can supply some of a development's electricity needs and/or by installing on-site storage batteries that can help to manage demand at peak times. The installation of renewable or flexible assets would require consideration at the development design stage, due to space and architectural requirements.

Meanwhile, property developers must also consider the needs of future residents, who may struggle to get to grips with the way in which new systems operate, maintenance requirements and running costs. According to Policy Connect, as quoted in the Business, Energy and Industrial Strategy Committee's January 2022 report on Decarbonising heat in homes: '...energy

[1] Note: some of this increased cost may be offset by a developer no longer needing to connect their properties to the gas network.

efficiency and low carbon measures can have a complex nature and, especially in the case of new schemes, products and technologies, consumers are likely to have limited understanding of how they work and potential risks.'

Assessing these options and how they interact requires much more complex modelling than has historically been the case in order to build the ideal 'recipe' for development. This modelling will rely on a wide range of data, including electricity network capacity, the availability of local resources (including heat networks and small renewable energy suppliers), energy equipment product specifications, and (importantly) the actual energy consumption and energy-efficiency for different types of property and use (including fully electrified properties). However, this data is not always easy to access, and the construction industry lacks a feedback loop so that those that have built low or zero-carbon homes can share information on real-time energy use and efficiency of properties for the benefit of others.

How can Icebreaker One's Open Energy programme help residential property developers and other stakeholders?

Open Energy will make it easy for stakeholders across the industry to search, access and securely share energy data - which can be open or shared (such as access being restricted to specific Data Consumers and/or requiring payment for accessing the data - as might be the case if data holds commercial value). Its service will enable residential developers (or consultants operating on their behalf) to understand the data available to help them plan the best heating solutions for their development and access it in a more streamlined manner, rather than each stakeholder having to seek out and (where relevant) licence relevant data individually. This will help property developers to:

1. Use the data to analyse options and establish the most cost-effective solution
2. Ensure their properties are sustainably developed in a way that is compliant with regulatory requirements around decarbonisation and keeps demands on the electricity network to a minimum.

DATA REQUIRED TO DELIVER THE USE CASE

Please note: these are the datasets that have been identified during the use case research process as being required to implement the use case in practice. It is not designed to be a comprehensive list of all possible data sets.

Icebreaker One would welcome feedback on this list, including any gaps. Please email openenergy@icebreakerone.org.

Data sets	Potential Data Providers	Access mechanism definition	Rationale for definition	Current access mechanism	Purpose of data set
Primary substation head room available	Distribution Network Operators (DNO)	Ideally open (access routes and level of granularity	Available as CSV files from some DNOs	Varies between DNOs. Requirement	To understand a network's capacity to meet the

		varies by DNO)		to register to enable access for some DNOs. Downloadable .csv files for some DNOs	demands of a new development, plus whether reinforcement will be required
Electricity network constraints	Distribution Network Operators (DNO)	Ideally open (access routes and level of granularity varies by DNO)	Varies by DNO	Varies by DNO	
Current and predicted future cost of standing charges for a grid connection[2]	Distribution Network Operators (DNO)	TBC - information not yet published as a dataset	TBC	TBC	To understand the likely impact on connection costs of different technologies
Low carbon technology product specifications, including storage batteries (price, outputs, carbon emissions etc)[3]	BEAMA (Lexicon data dictionary - currently in development)	Likely open (TBC)	Whether data will be open or subject to restrictions is subject to future discussions	TBC - database not currently available. Product information held by individual manufacturers	To understand the likely cost, energy consumption/ efficiency and carbon credentials of different technologies
Installed low carbon technology performance data	Possibilities include Active Building Centre	TBC - database not currently available.	Currently gathering data on actual equipment performance, eg performance of heat pumps in different temperatures	TBC - database not currently available.	To understand the energy consumption/ efficiency and carbon credentials of different technologies when in use
Energy use for different types of property/ occupancy levels (including those with and without electrified	Centre for Net Zero (founded by Octopus Energy) - dataset based on meter analysis due to be launched March 2022	Likely open (TBC)	Whether data will be open or subject to restrictions is subject to internal discussions	TBC - not currently directly accessible	To understand actual energy demand over time

[2] At present, a developer typically only finds out the cost of connection when they put in their application to a DNO. Data to help them understand how adjusting connection needs might affect the cost of and, potentially, timescales connection would be of value.

[3] See https://www.bimhawk.co.uk/pdtTransform.php?pdtid=171 for an example of a product data template for an air source heat pump, that indicates the type of data that would be provided. This template has been developed in collaboration between BEAMA and the Chartered institution of Building Services Engineers. Note: The risk of using technical specifications and datasheets is that in-use performance does not typically match. DNOs may therefore be very cautious about reducing the capacity of the connection below their default level - see challenges, below. Good data sources would be those that use real in-use data, particularly from smart meters, provided this can be properly contextualised and anonymised

heating or energy-efficient measures)	Third-party Data Providers with access to smart meter data[4] and the ability to aggregate and anonymise - possibilities Electralink or n3rgy	Likely shared, but TBC	Whether data will be open or subject to restrictions is subject to future discussions	TBC - not currently directly accessible	
	University of Edinburgh IDEAL Household Energy Dataset (based on energy use in 255 UK homes)	Open	Available here: https://datashare.ed.ac.uk/handle/10283/3647		
Energy efficiency of different types of property	BEIS National Energy Efficiency Data-framework (NEED)[5]	Open	Available here: https://www.gov.uk/government/statistics/national-energy-efficiency-data-framework-need-consumption-data-tables-2021	Publicly available government data	To understand the energy efficiency of different types of property, and build this into design decisions
	Post-occupancy evaluation data (analysis assessing a building's efficiency in use) - as calculated by some architects/utilities consultants[6], but nowhere central. There may be a potential for local authorities to play a key role in publishing this data[7].	N/A - not currently widely generated/ available	Likely shared	N/A - not currently widely generated/ available	
	Energy Performance Certificate (EPC) tables, showing data from certificates lodged on the Energy Performance of Buildings Registers	Open	Available here: https://www.gov.uk/government/statistical-data-sets/live-tables-on-energ	Publicly available government data in Open Document format	

[4] Note: Smart meter data has the potential to be very valuable in terms of measuring actual energy use in properties, but as a number of stakeholders flagged, because it is personal data and therefore subject to strict data protection rules, gaining access to smart meter data can be challenging, expensive and laborious.

[5] This data is currently broken down by property characteristics such as floor area, number of bedrooms and property age. In an ideal world, it would also include breakdowns such as the type of heating installed or the nature of the building fabric.

[6] Sero Homes, for example, is gathering this kind of data for its properties. As yet, the dataset is small, but in the future it is likely to have substantial data around both home energy efficiency and how occupants use their homes (for example, the average temperature people heat their homes at). In principle, this data could be shared at an aggregated, anonymised level – further discussions would be needed to establish if this is possible and the conditions for doing so.

[7] Social landlords have legal targets around reducing carbon emissions and therefore more incentive to measure the success of measures to achieve this.

	since 2008[8]		y-performance-of-buildings-certificates#epcs-for-all-domestic-properties-existing-and-new-dwellings		
Demand for heat energy by buildings	Scotland Heat Map (Scottish Government): shows how much demand there is for heat energy from buildings across Scotland. Heat demand estimates calculated for each building in Scotland and shown at 50m grid square level (NB not broken down by different types of property).	Shared	Available under non-commercial licence: https://www.gov.scot/publications/scotland-heat-map-documents/	Available under non-commercial licence	Assist in identifying opportunities for lowering carbon emissions associated with heat in buildings.
Heat network locations and type	No central database currently available. Future possibilities include government (Office of National Statistics/BEIS) or Heat Trust. In Scotland, the Scottish Government's Scotland Heat Map has this information	TBC	Data not yet available nationwide. Heat Trust has a map of its members' locations, but this represents only a small proportion of UK heat networks: https://www.heattrust.org/existing-members-map. Scottish Government Heat Map has information on Scottish heat networks available under non-commercial licence.	TBC - not currently available. Scottish Government Heat Map has information on Scottish heat networks available under non-commercial licence.	To understand if heat networks are a viable option for a development
Local renewables locations	Ofgem Feed-In Tariff data	Open	Available here: https://www.ofgem.gov.uk/publications/feed-tariff-installation-report-30-june-2021		To understand the role, if any, that local renewable resources could play in meeting a development's electricity

[8] EPCs have limitations in that they may not provide a fully accurate reflection of a home's true energy efficiency in use. However, they still have value provided that their limitations are accounted for.

	BEIS Renewable Energy Planning Database	Open	Available here: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract		demand
	Scotland Heat Map (Scottish Government)	Shared	Available under non-commercial licence: https://www.gov.scot/publications/scotland-heat-map-documents/	Available under non-commercial licence	
Locations with high solar potential	Regional maps of areas with high solar opportunity - eg London Solar Opportunity map, Bristol City Council solar potential dataset	Open	Typically published by local or regional authorities		To understand the likely potential of installing solar panels in different locations
Weather and climate data by location	Met Office	Open	Published here: https://www.metoffice.gov.uk/research/climate/maps-and-data/data/index		To understand the likely potential of renewables in different locations
Future scenario modelling	National Grid ESO Future Energy Scenarios (FES)[9]	Open	Available here: https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2021/documents	Currently available on National Grid ESO website and via Icebreaker One service	To understand likely roll out of decarbonised heating, renewable and flexible technologies
	DNO Distribution Future Energy Scenarios (DFES)	Open	Each DNO produces 'DFES' using similar assumptions to FES, but at a more granular level, often taking into account	Underlying data published on most DNO websites.	

[9] Main modelling insights currently used to anticipate and plan for future growth. However, individual consultancy firms may have their own, bespoke models based around specific user needs and/or could develop these in the future using data available through Open Energy service.

			local ambitions which may not be reflected in FES.		

BENEFITS OF USE CASE

Individual beneficiaries

- **Residential property developers**
  - With improved access to the data they need, developers will be in a better position to design homes that meet regulatory requirements.
  - Understanding the technologies that will mean lower reliance on the electricity grid should ultimately result in lower connection costs, because they will be able to build in a way that reduces demand on the network through better building design and the installation of renewable/flexible technologies.
  - Without easy access to good quality data to support the decarbonisation of heating, residential property developers may deliver sub-optimal solutions that don't take into account the benefits of building in renewable or flexible assets.

- **DNOs**
  - Better access to more robust data will help provide DNOs with the evidence that they need to establish the real energy demands of electrified property developments that have measures built in to reduce demand (such as on site renewables, improved insulation or flexible technologies).
  - If properties are fitted with technologies that reduce demands on the electricity network, this reduces the risk of capacity overload and/or frees up capacity for other demands (such as EV chargepoint installations).
  - Further, this potentially reduces the grid reinforcement investment required by DNOs.
  - DNOs will be better able to support residential property developers in meeting regulatory requirements.

- **Mechanical and electrical (or utilities) engineers, architects and other consultants**
  - Engineers, architects and other consultants operating on behalf of residential property developers will benefit from access to data to support the advice they give to their clients and inform the design process.
  - Consultants will have the tools they need to provide information and appropriate planning and designs that enable regulatory compliance.

- **Consumers**
  - The Decarbonising heat in homes report recognises that many properties currently being built are not being built to the Future Homes Standard (currently due to be implemented in 2025) and will therefore need to be retrofitted at the expense of homeowners. If better access to data enables property developers to

decarbonise heating systems from the outset prior to 2025, this will reduce the number of new home buyers that need to pay to retrofit their properties.
  - By identifying and installing solutions that keep the initial cost of connection to the network as low as possible, this may potentially result in lower ongoing energy costs for residents (for example, if buildings are more energy-efficient and/or some of their electricity is supplied by on-site solar panels).
  - Greener and more energy-efficient solutions for residents.

- **Other potential beneficiaries**
  - **Local authorities**: as well as being responsible for planning permission in the areas they administer, local authorities build housing in their own rights, and so will benefit from access to data.
  - **Insurance companies**, which need to be able to be clear about their cover (or not) in the eventuality of complex incidents, such as flooding and storm damage to assets that might be installed as a consequence of reducing grid connection requirements.

Systemic benefits

This use case has the potential to streamline and accelerate the decarbonisation of heating in UK homes. This in turn will have a number of systemic benefits, as outlined in the table below:

Environmental	Societal	Innovation	Public spending
Facilitates the decarbonisation of heating in homes, in line with government targets	Increased decarbonisation has positive impacts on public health through reduced air pollution	Additional add-on benefits for innovators developing services to help homeowners understand the best solutions for existing properties.	A reduction in spending on health due to the public health benefits of reduced pollution.
Reduction in pollution from a potentially faster move to zero-carbon heating solutions and, potentially, an increase in renewable consumption and flexibility.	A more secure energy supply, through a reduced reliance on imported gas.		

CHALLENGES OF IMPLEMENTATION

Icebreaker One's use case research has identified a number of challenges that will need to be overcome if the potential of this use case is to be realised, including both logistical and regulatory challenges.

Some of the challenges are the same as were identified during the research for Open Energy's EV use case, including:

- **Data sets needed for multiple purposes are distributed across a large number of organisations with no unified view or understanding of what exists.** Identifying and gaining access to all of the relevant datasets is a significant endeavour. Whilst this problem could be solved through individual organisations licensing their data to other individual organisations via bespoke bilateral contracts, this is not a practical or scaleable solution. This problem is not dissimilar to that faced by the banking sector for which Open Banking was designed and for which Open Energy has also been developed.

- **Data sets are held in varying formats that will not be interoperable.** This is normal, and is what metadata (the description of a data set, which Open Energy will index) is used to clarify. This allows Data Consumers to know how to parse and interpret data sets according to their needs, while allowing Data Providers to publish them in formats that they find most convenient.

- **Standardised access and licence conditions for sharing are needed.** These, combined with openly-available listings of what datasets are available, will allow data to be more quickly and easily consumed. Access conditions may include, for example, terms around payment or security compliance. Licence conditions may include, for example, terms governing how the data can be used, adapted or redistributed.

Our research has also identified several further challenges that are more specific to this use case.

- **Some data is currently not collected or presented in a usable form.** For example, there is currently no centralised location where energy equipment specifications are published, though BEAMA is working on this. Meanwhile, both the Business, Energy and Industrial Strategy Committee's report on Decarbonising Heat in Homes, and the Climate Change Committee's 2021 progress report to Parliament, highlight a lack of data on the location of low-carbon heat networks and how they operate, including the nature of the heat source. The Climate Change Committee has recommended that the Office for National Statistics works with BEIS to put in place plans to collect and report data annually on low-carbon heat networks.

- **The actual energy performance and efficiency of properties designed to be low or zero-carbon 'in use' will be essential to understand the impact of installing different measures**, but there is limited incentive for many property developers to spend time, effort (and potentially money) measuring and sharing this data. There may be an important role here for social landlords, who have legal targets around reducing carbon emissions and therefore more incentive to measure the success of measures to achieve this.

- **Electricity grid connection requirements are currently calculated using fairly basic assumptions; there is a lag between current benchmarks and future need.** Utilities engineers have a responsibility to ensure that developments have enough supply to meet maximum demand. As a result, when they are working out likely grid connection requirements for a development they will typically do so based on 'worst-case' demand scenarios. These typically assume a conservatively high demand estimate and add a margin on top of this. Connection requirement calculations typically don't take into account, for example, initiatives to reduce demand (for example by designing a home for optimal insulation, or building in flexible assets that can manage demand at peak times).

- **There is work to be done to reassure DNOs that efficient building design, combined with the installation of renewable and flex technologies, can reduce demand on the electricity network.** Even where utilities engineers build such measures into their grid connection requirement calculations, DNOs may not yet accept the validity of such reduced-demand calculations. A key responsibility of a DNO is to minimise the risk that a development will not have an adequate power supply. However, as the UK increasingly electrifies across multiple sectors, and demands on the electricity network increase, the need to build in and take account of measures that will reduce demand will become increasingly important. DNOs and regulators will need evidence, in the form of data, to demonstrate that such reduction in demand is possible.
- **Consumer behaviour is difficult to predict, and developers of new properties won't know the exact future occupancy** (for example, will a two-bedroom property be lived in by a single person or a family of four?). Assumptions need to be made about likely occupancy; better access to aggregated data on actual energy usage by property type, heating type and number of occupants will help with this challenge.

FUTURE DEVELOPMENT

- Ofgem's plans for market-wide reform of how energy settlement works, moving from a system where customers must estimate likely energy demand to a system based on actual half-hourly consumption and export, have the potential to significantly improve the granularity of data available. This information could be combined with National Grid ESO's carbon intensity dashboard data to build in property-management tools that can reduce demand at times when grid carbon intensity is highest.
- While this use case is focused on new-build residential property developers, the data identified will also be of value to stakeholders involved in retrofitting existing properties and/or developing and retrofitting commercial properties.
- A developer installing flexible assets on site may be eventually able to sell flexibility back to the grid, and benefit from this. The markets for this are not yet fully developed, however.

Appendix: Useful links

- HM Government Heat and Buildings Strategy (gov.uk)
- Decarbonising heat in homes: House of Commons Business, Energy and Industrial Strategy Committee report (UK Parliament)
- Low energy efficiency standards cost owners of new homes £234m last year (Guardian)
- Progress in reducing emissions 2021 - Report to Parliament (Centre for Climate Change)