



nationalgrid

2022 Low carbon heating strategy summary

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2022 Low carbon heating strategy summary

This strategy sets out how NGED will help achieve the government's 2050 net zero target for the decarbonisation of heating, connecting customers to a wide array of low carbon heating technologies, as well as exploring the possible impact on the local grid.

It outlines NGED's commitment to enable customers to connect to the network at a time and place to suit them. The strategy also explains how innovation projects and new business initiatives are key to delivering its vision for a network that is flexible, resilient and ready ahead of need, by turning project learning into 'business as usual' activities.

It touches on technologies not yet widely seen in UK homes, including thermal storage, combined heat and power, and solar district heating plants which are likely to play a role in the future of the UK's domestic heating.

Challenges include the age of the UK's housing stock, which means that many homes have low energy efficiency ratings, and the length of time it will take to transform heating habits.

1. Introduction

1.1. High level government objectives

NGED activities to decarbonise heat are in line with the government's Future Homes Standard, Ten Point Plan for a Green Industrial Revolution, Energy White Paper on net zero, Clean Growth Strategy and Heat and Buildings Strategy.

Future Homes Std.

assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1040925/Future_Buildings_Standard_response.pdf

Ten Point Plan for a Green Industrial Revolution

gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution

Energy White Paper on net zero

gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future

Clean Growth Strategy

assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf

Heat and Buildings Strategy

gov.uk/government/publications/heat-and-buildings-strategy



2. Low carbon heating methods

2.1. Heat pumps

A heat pump is a device that uses a small amount of energy to move heat from one location to another. It is an energy efficient heating method.

Research has found that it costs around £1,005 a year to run a detached house of four people using a gas boiler. This rises to £1,615 for an oil-fired boiler. In comparison, a ground source heat pump would cost £744. (All prices are based on pricing before the April 2022 price increase).

2.2. Heat pump installation

It is NGED's role to ensure that the network is ready to meet all heating requirements. Because heat pump infrastructure requires higher volumes of energy, NGED is factoring this additional load into its new infrastructure.

For retrofit installations, it may be necessary to upgrade and reconfigure existing cables, particularly where service cables were historically looped and shared between two properties. This looped service will be removed at no cost to the customer.

Where clusters of heat pumps may cause constraints, work is already underway to install larger cable assets on new build substations and in areas where proactive uprating of cables is needed.

2.3. Heat pumps and building design

Energy efficiency is assessed by Energy Performance Certificate (EPC) rating, with A representing the best performing homes and G the worst.

Low carbon heating systems will be integral to the Future Homes Standard, with heat pumps expected to become the primary heating technology for new homes. To be cost efficient, heat pumps need to be in a house with an EPC rating of C or above.

2.4. Thermal storage

Thermal storage is needed for heat sources which provide heat at certain times but where there is an almost constant need to heat the space. A heat pump is a typical example of this as it cannot provide 'space heating' and domestic hot water at the same time. This is why a thermal store is necessary, storing heat effectively until it is needed.

2.5. District heating or heat network systems

District heating uses a network of pipes to deliver heat from a centralised heat source, across a local area.

NGED believes that it will be relatively easy to accommodate heat networks on its network as the input energy is provided at one central point rather than by individual homes. Heat networks may also include generation which will offer balancing services to the wider grid.

NGED is already working with councils in Bristol and Cardiff on district heating projects and will monitor these new systems to see how they impact on the network with a view to enabling the decarbonisation of heat in all its forms.

Where local authorities have a heat network – or plan to create one – NGED has forecasted lower heat pump uptake in these areas and higher energy demand for industrial and commercial use.

District heat networks provide about 2% of the overall UK heat demand but government research suggests this could rise to 20% by 2030 and 43% by 2050.

Low carbon and renewable energy sources for heat networks can significantly lower carbon emissions from heat.

2.6. Electric radiators with thermal storage

The internal electrical elements of these radiators are encased in fireclay heat plates. When the element heats, it transfers the heat to the fireclay and then to the surface of the radiator. The radiators continuously generate and conserve heat within the core of the heater, sensing temperature changes and reacting immediately.

Because they heat up quickly, these radiators use less electricity and come with lower costs, as long as there is good insulation.

2.7. Combined heat and power (CHP)

In CHP, space heating and domestic hot water heating are produced at the same time. This heating method has been used at an industrial and community level since the 1970s but, as a micro CHP system, is increasingly seen as an economically viable solution for individual buildings.

The micro CHP provides heat and hot water like a conventional gas boiler but also provides some of the building's electricity needs.

Unlike a standard boiler, a micro CHP can generate electricity while heating water.

2.8. Solar thermal

This widely recognised technology uses heat from the sun to provide hot water and heating to residential buildings.

Some systems combine photo voltaic systems into the solar heating.

2.9. Waste heat recovery

Industrial waste heat is generated in industrial processes and is lost, wasted and dumped into the environment.

However, this waste heat can be recovered using various heat recovery technologies to provide a valuable energy source.

For instance, the owner of the waste heat could offer the heat to their local district heat network.

2.10. Hydrogen

Hydrogen can play a part in plans to reduce carbon emissions by making low carbon use of the existing gas network.

NGED's interest in hydrogen is in the power that will be needed to produce the gas, as the centralised power demand will have a different impact on the network compared to a demand for electrical energy from each individual customer.

There are several 'colours' of hydrogen which each relate to how it is produced. Green hydrogen is the only variety produced in a climate neutral way and could play a vital role in efforts to reach net zero by 2050.

3. Forecasting and data

The current number of heat pumps across NGED's four licence areas matches forecasts from the RIIO-ED1 Business Plan.

By 2050, our Distribution Future Energy Scenarios (DFES) show the following numbers are expected:

This includes the following sub-technologies:

- district heating
- domestic - hybrid
- domestic - hybrid and thermal storage
- domestic - non-hybrid ASHP
- domestic - non-hybrid ASHP and thermal storage
- domestic - non-hybrid GSHP
- domestic - non-hybrid GSHP and thermal storage.

Licence area	Steady progression	System transformation	Consumer transformation	Leading the way
East Midlands	920,571	1,380,012	2,978,525	2,730,408
South Wales	385,505	518,969	1,084,943	936,560
South West	611,029	807,882	1,656,676	1,490,390
West Midlands	816,791	1,177,847	2,511,640	2,209,022
Grand total	2,733,896	3,884,710	8,231,784	7,366,380

3. Forecasting and data

3.1. Developing DFES

NGED has been producing DFES since 2016 to predict the likely impact of heat pumps and other new technologies.

The scenarios use a 'bottom up' approach to calculate future energy use, taking into account the potential growth of distributed generation, growth in electricity demand and electricity storage.

3.2. Heat pump growth factors

Legislation will be key to driving a growth in heat pump numbers.

The government's Future Homes Standard will make low carbon heating integral to new homes, with heat pumps expected to be the main heating technology for new homes.

For customers, the main barrier will be price. Lower running costs are not yet balancing out the upfront costs of investing in a heat pump.

Despite these barriers, the latest FES project a greater increase in heat pumps than previous FES, reflecting the government's commitment to a low carbon economy.

3.3. Forecasting local growth and pinpointing upgrades

NGED is working with Sero and POBL Housing Association on a project involving 250 new build homes which will be fitted with a complete suite of low carbon technologies, including electric vehicle chargers, solar panels, battery storage and heat pumps.

Findings from this project will help to devise a new forecasting tool to identify where proactive reinforcement might be needed to prepare local networks for LCT connections, particularly heat pumps and EVs.



4. Planning and capacity availability

The size and type of heat pump varies according to building size. Smaller heat pumps are more likely to be in homes where the EPC is A, B or C. Larger heat pumps are expected to be in buildings where the EPC is D or lower.

Larger installations may require properties to be upgraded to a three phase supply. These larger installations and district heating systems may also call for new transformers and substations which will have implications for costs and timescales.

4.1. The application process

The existing paper application process is a manual process which is labour intensive, NGED are fine tuning their on line application process, which will make the whole process electronic and much quicker and easier to use for the installer and customer.

4.2. Planning and design changes

NGED is committed to future proofing the network by ensuring the capacity is available to meet demand. Customers installing LCT's are required to notify NGED; this boosts the efficiency of future network planning and helps to keep bills down for everyone.

NGED has already increased the cable size for all new underground cables, as well as increasing the size of ground mounted transformers at some substations, to accommodate the anticipated growth in LCT's.

Where houses are connected by a looped service cable, this will be removed by NGED from homes wanting to connect LCT's.

4.3. Technical changes to enable heat pumps

When installing a heat pump, customers or installers complete an application process for connection of items above 32A per phase to NGED's low voltage system.

This information is used to determine if the network is suitable to connect the heat pump (or EV) infrastructure needed.

Issues such as thermal capacity and the network's susceptibility to voltage fluctuations, flicker and harmonic voltage distortion are all taken into account.

4.4. Power quality

A heat pump and EV charger database created by the ENA helps to speed up the installation process by enabling DNO's to find details of heat pumps which have already been assessed for compliance with the relevant British Standards. All heat pumps on the database have been assessed for their effects on harmonics and power quality.

The DNO must then carry out a thermal or load assessment of the local network.



5. Providing information to customers

NGED's 2021 'Guide on Heat Pumps and DNO Engagement with Local Authorities or Building Owners' provides detailed advice for local authorities and customers considering installing heat pumps.

To offer further support to customers, NGED will continue to review and update the number and content of guides for customers considering heat pump options for their homes or businesses.

Customers will also find it easier to access data to inform their connection decisions by using NGED's network capacity map which has now been consolidated into a single map to create a single source of visual data.

5.1. Connections surgeries

Local authorities and house builders can request a one-to-one connection surgery with a local NGED planning team. This means they will be able to discuss plans for low carbon heating or heat pump installations and how the electricity network can be updated to accommodate their future plans.

Visit the web page to request a connections surgery:

nationalgrid.co.uk/connections-landing/changing-your-connection



6. Stakeholder engagement

NGED prides itself on an excellent track record of stakeholder engagement. Since 2010, this has included engaging stakeholders on the subject of LCT's and ensuring that NGED can support a growing number of heat pumps.

6.1. Engagement with local authorities

Local authorities often take the lead on installing and retro fitting heat pumps. In 2022, NGED will publish an updated heat pump guide to help local authorities with their plans.

NGED will also engage directly with all 130 local authorities across its region during 2022 to discuss their local energy plans.

As well as outlining energy forecasts for the local authority area, NGED will also note local authorities' future energy plans so these can be factored into its future energy scenarios.

6.2. Engagement with Housing Associations

NGED's engagement with POBL Housing Association and Sero Homes, to install a full suite of low carbon technologies, has been mentioned earlier in this document.

6.3. Engagement for planning design

NGED has changed the standard house service cable which supplies all properties to a three phase cable, making it easier for customers to connect LCTs.

6.4. Engagement with UK government

NGED works closely with BEIS and other parties on stakeholder engagement to help deliver the government's Clean Growth strategy and Future Homes strategy, which deals with the decarbonisation of heat and transport.

One of NGED's aims is to see all new buildings incorporate a complete suite of LCTs as part of a more holistic approach.

6.5. Engagement with Welsh government

NGED's projects in association with Pobl and Sero homes have been delivered in partnership with the Welsh government. NGED is also following the Welsh government's plans for decarbonisation alongside those of the UK government.

6.6. Engagement with 'go ultra low cities'

NGED is working with three go ultra low cities – Bristol, Milton Keynes and Nottingham/Derby – to help them deliver their targets.

6.7. Engagement with local enterprise partnerships and electricity supply areas

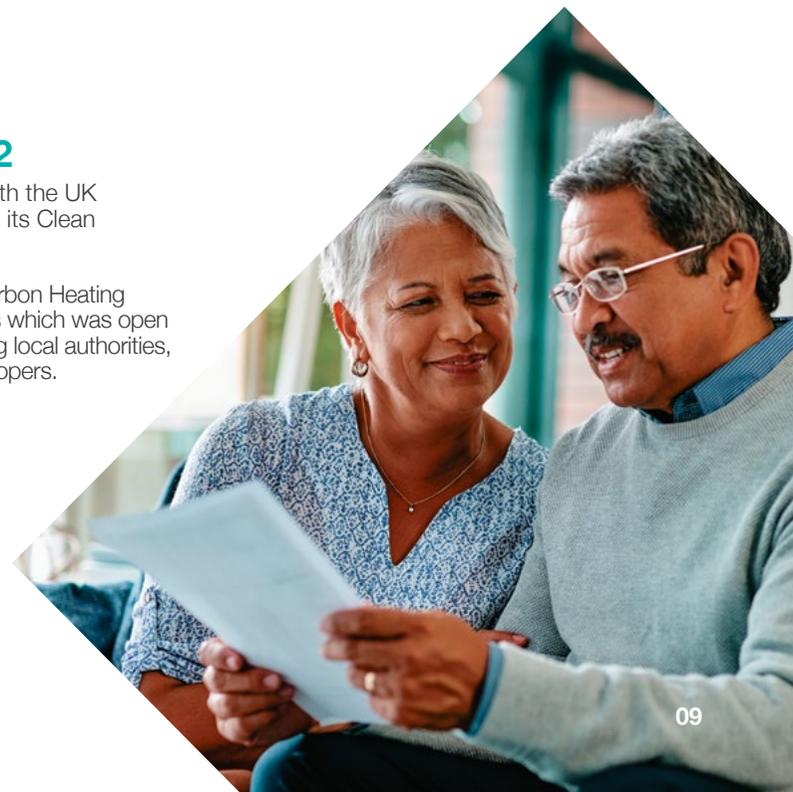
NGED engages with customers in each of its four Electricity Supply Areas to understand their planned projects and ensure these are fed into NGED's investment strategies. This enables NGED to build a 'bottom up' picture of demand, generation and storage growth and to factor this into future energy scenarios.

The data gathered is also shared with Local Enterprise Partnerships, local authorities and other stakeholders.

6.8. Stakeholder engagement plans for 2022

NGED continues to engage with the UK government through BEIS and its Clean Heat team.

NGED also held its first Low Carbon Heating Workshop in the West Midlands which was open to all interested parties, including local authorities, housing associations and developers.



7. Plans to support heat pumps

The pattern of energy use is changing, as the UK moves toward its net zero targets.

7.1. Profiling and modelling

Homes with heat pumps will be more energy efficient, creating the need for new energy demand profiles.

These will be generated using heat pump profiles from the Tonyrefail project which creates profiles for 'space heating' (SH - the heating of the home) and domestic hot water (DHW) that can then be applied to calculate typical demand for similar properties. Profiles like this will enable NGED to target its network investment as effectively as possible.

NGED may also generate retrofit heat pump profiles which will be useful when upgrading existing networks.

Consistent demand profiles are essential when planning changes to the electricity network. These take into account factors such as user behaviour, including times of peak energy use, and the EPC of a building, as these can significantly impact the energy performance of a building.

NGED will revisit and revise the methods it uses to design housing networks, taking into account new use cases, to ensure that heat pumps can be accommodated in the most efficient and economical way.

Where the existing network is not suited to heat pump installation, NGED will use innovative solutions, where necessary, to allow faster and efficient connections. Examples may include upgrading overhead lines to three phase in rural communities, allowing a village to make the switch to heat pumps and EVs.

7.2. Releasing existing network capacity

There is already some extra capacity available at certain points on the existing network which can be released.

7.3. New homes

Increased demand from LCT's could require larger capacity service cable (this is the cable that runs from the street to an individual property). These are being trialled in NGED's Superfast Electricity project.

Following consultation with customers, NGED has already changed its standard service cable to a three phase hybrid cable to facilitate the connection of LCTs.

7.4. Existing homes

A large section of NGED's network was built in the 1950s – 70s when demand for electricity was very different to today.

While most new homes, built since the 1990s, can accommodate a normal domestic demand, an assessment must be carried out if customers are looking to connect a heat pump or other LCT. NGED is working with the ENA to make this assessment and the whole application process as simple as possible.

The ENA LCT group is working on two projects – the first is a smartphone app which allows customers to take a photograph of the cut-out and send it to their DNO to see if the device is fit for purpose; the second will allow customers and installers to easily identify the capacity of a service cable.

Where a property is connected via a looped service, NGED will remove the loop and small service cables and replace these free of charge.

7.5. Clustering

Heat pumps which are installed in homes with an EPC rating of C or above may help to shift load on the network.

NGED is using its forecasting methods, along with information from installers, to identify clusters of heat pumps and other LCT's to inform the proactive reinforcement of networks.

7.6. Mitigation of local network constraints

In isolated incidents, clusters of heat pumps may exceed network capacity. To reduce the risk of supply interruptions to customers, heat pumps may allow for flexibility by using energy storage solutions. These would be used as a short term solution while network upgrades were being carried out.



8. Smart solutions and flexibility

8.1. NGED's approach

While heat pumps help to reduce carbon emissions, growing numbers of decarbonised buildings also present challenges when it comes to available generation and network capacity.

Operating heat pumps as part of a smart grid could help to tackle these challenges. During an average winter, large numbers of homes will be able to offer flexibility in a 'demand side response' (DSR) situation, where intermittent renewable generation struggles to keep pace with heat pump demand. It may be more difficult to find sufficient flexibility during an extreme winter.

NGED's Flexible Power brand already uses smart and flexible solutions. It is expected that heat pump flexibility could be provided by aggregators and by using 'time of use' tariffs for customers.

8.2. Domestic flexibility

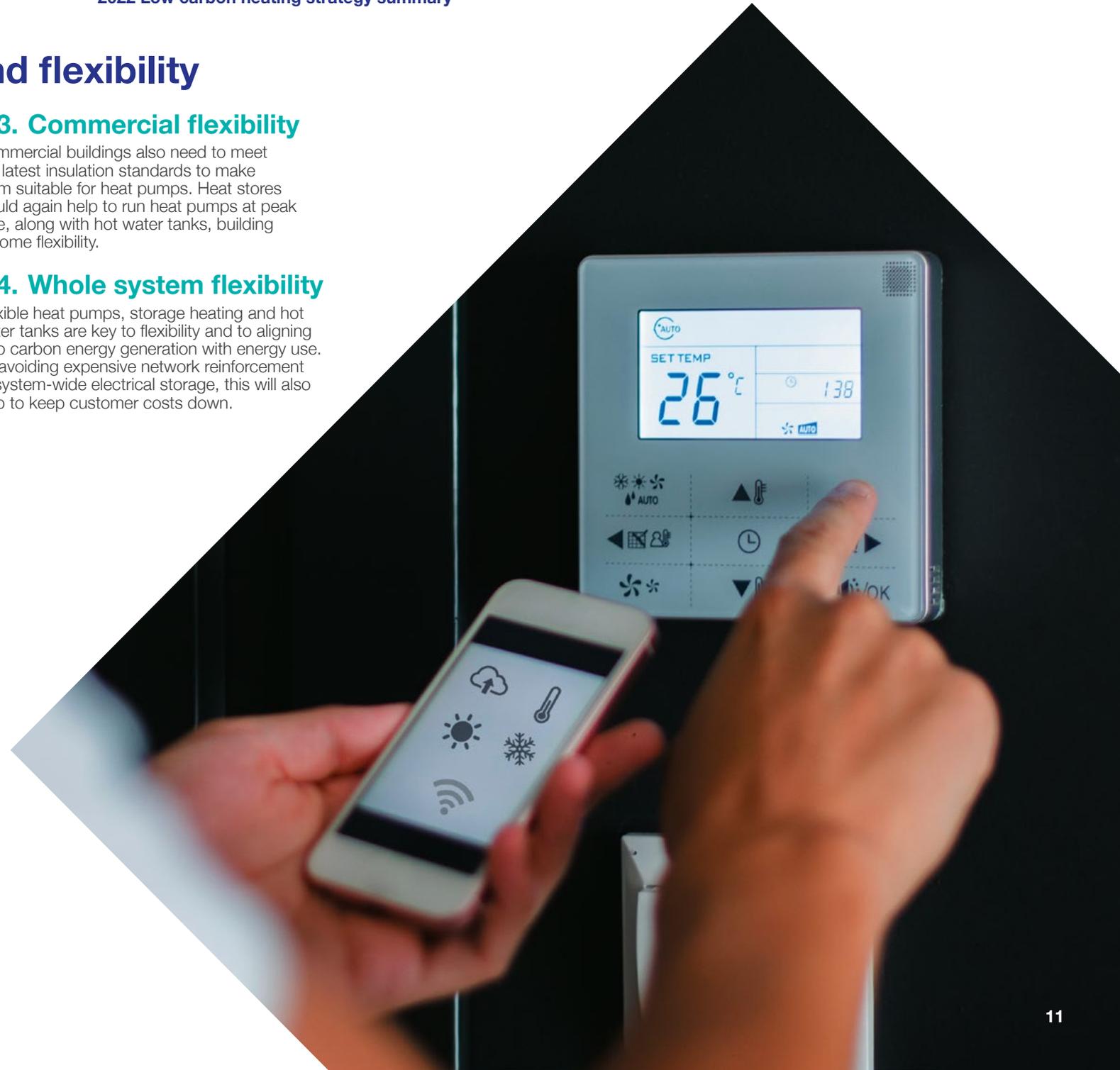
Before heat pumps can realise their full potential, the UK's building stock must meet the latest insulation standards. By introducing a heat store for space heating, it would be possible to run the heat pump at peak times, introducing some flexibility into the housing market.

8.3. Commercial flexibility

Commercial buildings also need to meet the latest insulation standards to make them suitable for heat pumps. Heat stores would again help to run heat pumps at peak time, along with hot water tanks, building in some flexibility.

8.4. Whole system flexibility

Flexible heat pumps, storage heating and hot water tanks are key to flexibility and to aligning zero carbon energy generation with energy use. By avoiding expensive network reinforcement or system-wide electrical storage, this will also help to keep customer costs down.



9. Projects to demonstrate heat pump connections

NGED's balanced portfolio of projects is developed in line with its innovation strategy and supported by regular stakeholder engagement.

9.1. Completed projects

Freedom

This two year project installed 75 smart hybrid heating systems in Bridgend, Wales. The project, delivered in partnership with Wales and West Utilities and PassivSystems, indicated that a hybrid approach to decarbonising heating, including green gas growth, could lead to the total decarbonisation of domestic heat.

Image copyright:
Freedom Project

9.2. Current projects

Parc Eirin superfast electricity for the future

NGED is working with Sero and Pobl homes on a project to fit 250 new homes with a full suite of LCTs. NGED will monitor the estate, including the heat pumps, to generate demand profiles and inform future forecasting. (Progress has been slower than planned due to Covid-19).

9.3. Future projects

Self-assessment

This project is being developed in partnership with the Energy Networks Association and other DNOs to help customers determine if their home is suitable for an LCT connection.



10. Commitments

10.1. Realising benefits

NGED is committed to incorporating project learning into its 'business as usual' activities. This has already led to the adoption of minimum cable designs and a pledge to replace looped LV service cables with individual cables in existing homes.

Ongoing projects are expected to lead to further positive changes. These include:

10.2. Parc Eirin superfast electricity housing for the future

This project will be used to define a typical profile for the space heating of the house and a second for the heating of the hot water. This data will help to enhance future planning for new housing estates.

10.3. Design capacity assumptions

The design model used to plan new networks for housing developments will need to be updated to reflect the impact of LCTs. This will be done using data from innovation projects.

10.4. Network capacity indication

NGED has consolidated its network capacity map into a single map, making it easier for customers to access data that will inform their connection and operation decisions.

This shows the capacity available to support low carbon heating or other LCTs.



11. Targeted commitments 2022

11.1. Realising benefits

The aim is to transform project learning into 'business as usual' activities.

Parc Eirin superfast electricity housing for the future – continued monitoring

As more residents move into these homes, NGED's learning from this project will increase.

Equinox

Equinox is investigating how much flexibility heat pumps can offer to the wider system and how network companies and energy suppliers can work together to offer a fair price to heat pump owners for this flexibility.

This NIC project runs until December 2025 and will look to develop processes and technologies that unlock flexibility from domestic heating, while meeting the needs of all customers, including the fuel poor and vulnerable.

SMITN

This will extract additional value from smart meter data and look at how the quality of data can be improved to make it suitable for digitalisation. Smart meter data could benefit DNOs by improving load estimates for planning, phase identification and identifying unregistered low carbon technologies.

Smart meter early information – future home heating

NGED used an estate of 100 homes to compare the design outcomes of old and new modelling software. This was then checked against the aggregated smart meter data at a substation level with a view to amending LV design policy accordingly.



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