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Mitsubishi Electric Guide to Heat in Buildings Strategies around the UK

Information Guide 80

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Mitsubishi Electric Guide to Heat in Buildings Strategies around the UK

Proposals for decarbonising heat in England, Wales, Scotland and Northern Ireland

This is an independent guide produced by Mitsubishi Electric to enhance the knowledge of its customers and provide a view of the key issues facing our industry today.

This guide accompanies a series of seminars, all of which are CPD certified.

Contents

Introduction - The focus on heat in buildings

The UK must decarbonise space heating and hot water production in all buildings to meet its 2050 Net Zero greenhouse gas emissions target. It is a critical objective set by the UK government and the Climate Change Committee (CCC).

The CCC noted in 2022[1]:
"We cannot reach Net Zero if we continue to use gas for heat. Changing how we heat our homes and buildings is essential."

The main objective is to shift the UK from relying on fossil fuels such as natural gas for space heating and hot water provision in all buildings. This means using low-carbon technologies, particularly those that efficiently use our growing supply of renewably-generated electricity.

England & Wales, along with Scotland and Northern Ireland, are on the same journey, though each nation is proposing slightly different approaches. Cities and regions across the UK are also considering how to make the necessary changes to heating systems to decarbonise, while supporting householders and businesses through the transition.

This CPD Guide will look at the proposals coming out of government across the UK, and touch on some of the ways strategies are being implemented to encourage a change in our 'heating habits' in new and existing buildings.

Background - UK Heat & Buildings Strategy

In 2019, the UK government became the first major economy in the world to set an objective of achieving net zero greenhouse gas emissions by 2050 - and to enshrine that goal in law.

Net Zero 2050 requires changes across the UK economy, from transport to agriculture to manufacturing. However, one of the essential aspects is decarbonising our buildings. There are around 30 million buildings in the UK which are responsible for 30% of national emissions. And 79% of building emissions result from heating (used for space heating or hot water production).

In October 2021, the UK Heat and Buildings Strategy[2] was published to outline how the UK might tackle this challenge. The Strategy document highlights several crucial points about the future of heat in UK buildings.

First, to meet the UK net zero greenhouse gas emissions target by 2050, virtually all heat in buildings will need to be decarbonised. This means completely moving away from burning fossil fuels for heating over the next two decades.

Second, the decarbonisation of heating is closely linked to building energy efficiency and better energy performance. The UK cannot simply transition current heat needs from gas to electric heating, as this would place too much strain on the grid and hinder the transition to renewable generation. We must decrease the heating requirements of buildings to reduce national energy use.

The Strategy document highlights a 'fabric first' approach to improving building performance to **"ensure the transition to low-carbon heating is cost-effective and resilient"**. Delivery of this approach in new buildings can be seen in the recent updates to Part L of the Building Regulations, which require higher insulation standards for new homes.

Finally, the technologies named explicitly in the Strategy document are heat pumps and heat networks. The government notes that a decision on the role of hydrogen for heat at scale would be taken "by 2026".

While England, Scotland, Wales and Northern Ireland are on the same path to achieving net zero, and all countries recognise decarbonised heat as a major step to success, there are different policies and strategies in these areas.

The following sections of this guide consider some of the main strategies in place or being considered around the UK to highlight some interesting regional approaches to tackling the challenge.

England

In England, the UK Heat in Buildings Strategy 'fabric first' approach is reflected in the updated Building Regulations Part L (2021)[3]. These upgraded the required fabric performance for new-build dwellings and non-dwellings to improve energy efficiency and lower the required space heating consumption.

In addition, the 2021 regulations updated the carbon factors for fuels such as gas and electricity (with SAP 10.2 in dwellings). This change means that the use of fossil fuels such as gas for heating becomes less attractive in new buildings, encouraging wider application of energy efficient, electric heat pumps.

Another important change in the regulations for homes is that wet heating systems must be designed to operate with 55ºC as the maximum system temperature. This applies whether a wet heating system is installed in a new home or fully replaced in an existing dwelling. The requirements are intended to encourage the take-up of heat pump-based systems.

In non-dwellings, Part L requires that consideration is given to the use of 'high efficiency comfort heating and cooling systems' for a building. Suggested technologies include district or block heating and cooling, cogeneration or heat pumps. (For full information on Part L, see the Mitsubishi Electric Guide to the Updated Building Regulations 2021)[4].

One of the biggest challenges in England is persuading householders to switch from gas central heating to alternatives such as heat pumps. The English Housing Survey Energy Report (2020-21)[5] notes that 20.7 million dwellings in England, or 88% of the total, rely on gas for heating and hot water.

The survey also noted that heat pumps are currently found in only 1% of English dwellings, which is around 114,000 homes. Of these, 68% were owner-occupied; 16% were operated by housing associations; and 11% were owned by local authorities.

The UK government has a Help to Heat programme[6] which has set aside £12 billion for delivery through several schemes. One of these is the Boiler Upgrade Scheme which provided grants to property owners to install low carbon heating systems such as heat pumps. Some of this funding is also available across the rest of the UK.

For non-dwellings in England, the future of heating systems is likely to be further influenced by the Future Building Standard, which the government intends to introduce in 2025. In its summary of responses to industry feedback[7] the government emphasises that it expects the Standard to **"produce highly efficient new non-domestic buildings which will use low-carbon heat and have the best fabric standards possible."**

However, it is important to note that, across England, several regions and cities are already using their planning powers to drive the uptake of low-carbon heating technologies in non-dwellings.

One example is the 2020 London Plan[8] which focuses on low-carbon heating options for all buildings across the capital, including district heating and the use of local secondary heat sources in conjunction with a heat pump. In particular, the Plan requires that major development proposals with the Heat Network Priority Areas in London should have a communal low-temperature heating system.

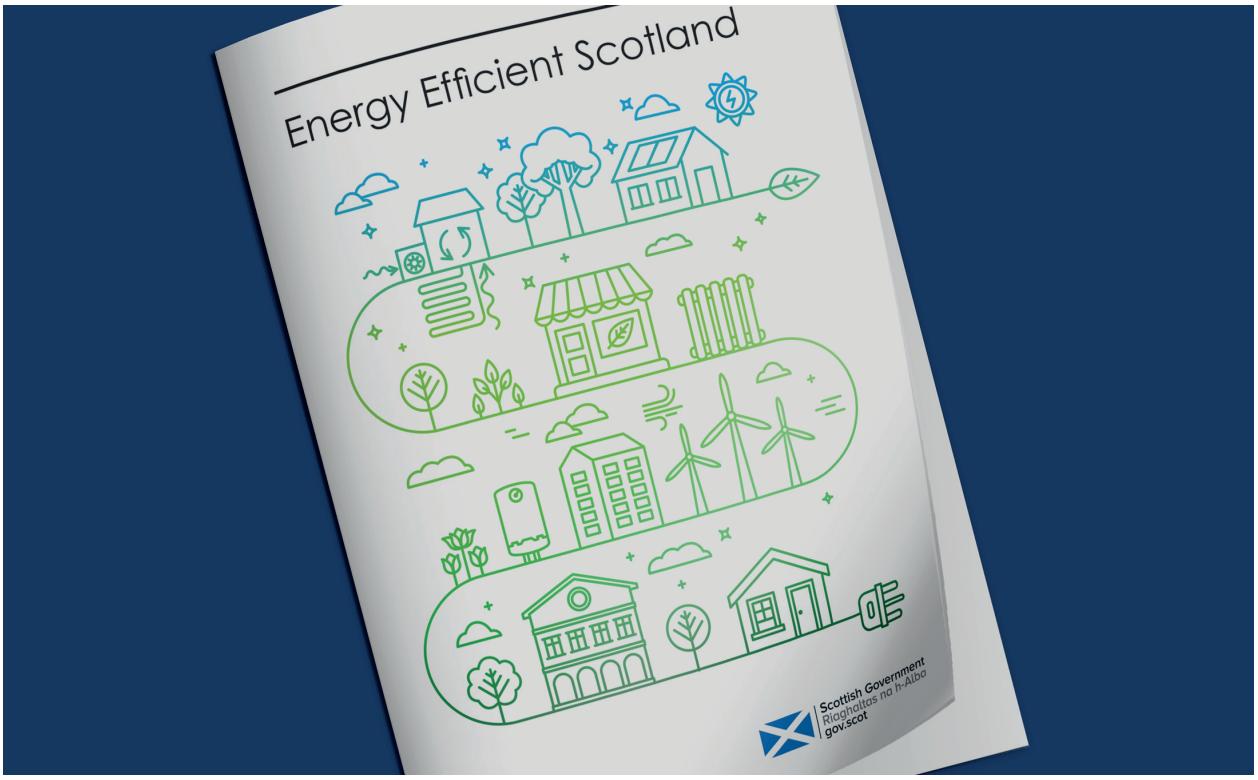
Scotland

Scotland introduced its Heat in Buildings Strategy[9] document in October 2021. It clarifies the country's vision for the 'future of heat in buildings'. The Strategy document updates two previous publications (Energy Efficient Scotland Routemap and Heat Policy Statement).

The Heat in Buildings Strategy sets out several objectives, but specifically states that by 2030 Scotland aims to install zero-emissions heating systems in over 1 million homes. In addition, 50,000 non-domestic buildings will convert to zero-emissions heating systems. Heat pumps and heat networks are identified as the main alternative to fossil fuel heating.

The Strategy raises the important point that while decarbonising heat in buildings is key to reducing the nation's carbon emissions, it must go hand-in-hand with improved building energy efficiency in homes and non-dwellings. It states: **"We need to continue to prioritise improvements to the fabric of our homes and buildings to accelerate our efforts and deliver a very significant reduction in our demand for energy as a society."**

This reflects Scotland's objective of achieving 'good' energy efficiency in all buildings by 2030. Specifically, the goal is that all homes in Scotland will reach a minimum of EPC band C by 2033. This includes existing homes where upgrades will be undertaken **"where feasible and cost-effective"**.



In May 2022, there was an additional proposal for a Bill[10] to introduce new minimum environmental design standards for all new homes. The proposal is to use the Passivhaus standard (or Scottish equivalent) to improve the energy efficiency and thermal performance of new homes. Consultation on this Bill is underway as of November 2022.

An important aspect of the Heat in Buildings Strategy is that the Scottish Parliament committed **"at least £1.8 billion"** to support heat and energy efficiency projects across Scotland with the aim of **"providing a much-needed stimulus to the heat and energy efficiency sector"**.

In July 2022, the Scottish Parliament introduced a consultation paper on a *New Build Heat Standard (NBHS)*[11]. The document sets out proposed regulations in Scotland which will prohibit the use of direct emissions heating (DEH) in new buildings from 2024. A DEH is defined as a heating system which produces greenhouse gas emissions at the point of use. This would include gas and oil-fired boilers, for example.

The proposed NBHS is set in the context of improved energy efficiency standards in updated Building Regulations, which pave the way for low-temperature heating systems. The October 2022 consultation paper on the NBHS contains proposals which would apply to new domestic and non-domestic buildings:

- From 1st April 2024 new buildings applying for a warrant (required under Scottish planning law) will be prohibited from using direct emissions heating systems to meet their **"space and hot water heating and cooling demand"**.

- Instead, the NHBS proposes the use of zero direct emission heating technologies (ZDEH). These are identified as heat pumps and heat networks. (Bioenergy is not considered a ZDEH technology).

While the current focus is on improving the energy performance of dwellings in Scotland, there are also proposals in the pipeline for other buildings. Scotland has approximately 230,000 non-domestic buildings, covering various sizes, ages, designs and uses.

The Scottish government has stated that it wants all non-domestic buildings to meet zero-emission heating requirements by 2045, with public buildings achieving this goal by 2038.

As in England and Wales, all non-domestic buildings in Scotland must have an Energy Performance Certificate (EPC) on sale or rent to a new tenant. In addition, buildings over 1,000m^2 in Scotland must produce an Energy Action Plan at the point of sale or rental.

There are proposals to introduce a new regulatory framework for non-domestic buildings to ensure they are net zero by 2045. Possible future requirements include the reduction of demand for heat through efficiency measures and the installation of zero emissions heating supply.

A sum of £200 million was made available for spending between the end of 2021 and 2026 to support the decarbonisation and increased energy efficiency of existing public sector buildings across Scotland.

Wales

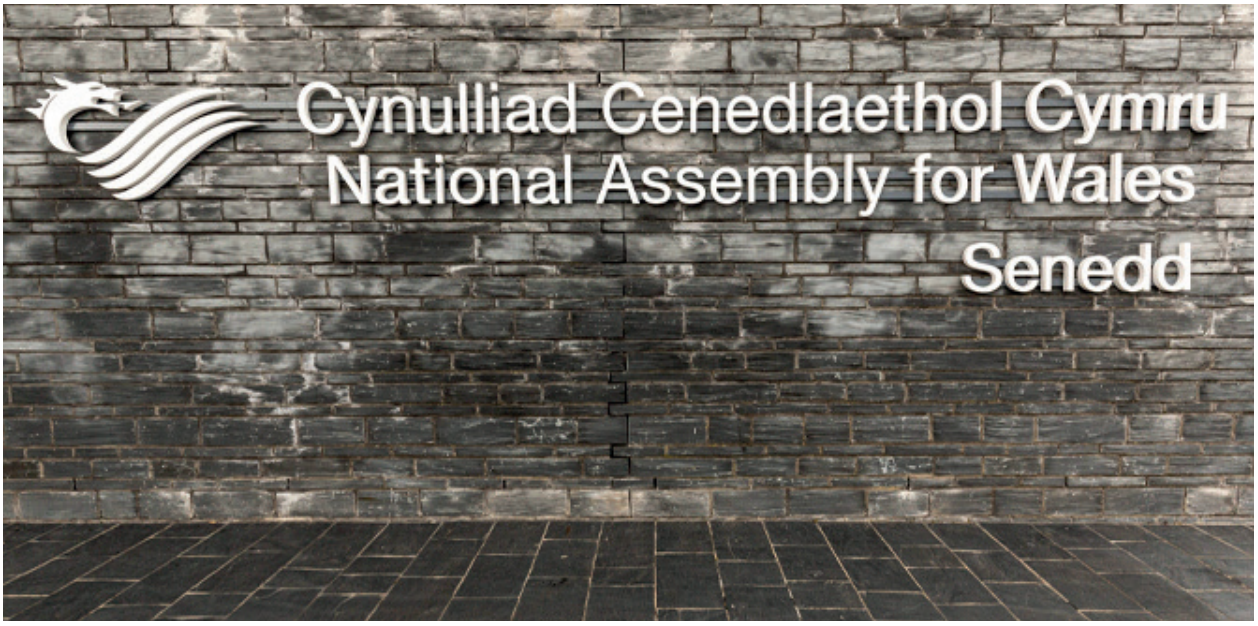
The Welsh Government has set progressively higher targets for greenhouse gas emissions cuts since 2016. Most recently, in February 2021, following the advice of the Climate Change Committee (CCC)[12], Wales set itself the target of achieving net zero emissions by 2050.

There are also interim targets of a 63% emissions cut by 2030; and an 89% reduction by 2040. In addition, the Senedd also agreed to set a 0% international offset limit – which means that the reduction must be achieved entirely by action in Wales[13]. These targets are set out in Regulations, and along with the publication of a third carbon budget for Wales in 2026, these establish plans up to 2030.

One of the main pathways to achieving these emissions reductions is decarbonising buildings. The 2019 *Independent Review on Decarbonising Welsh Homes (Better Homes, Better Wales, Better World)*[14] notes that the 1.4 million homes in Wales are responsible for 27% of all energy consumed and 15% of all demand-side GHG emissions.

One of the Review's recommendations was that the Welsh Government set ambitious housing refurbishment targets to meet its net zero 2050 ambition. The challenge for Wales is that it has some of the UK's oldest and least thermally efficient housing stock. Around 30% of houses were built before 1919, and just 10% of homes in Wales have been built since 2020.

Studies by the Welsh School of Architecture (WSA) showed that the average EPC rating for a dwelling in Wales is band D.



This means that insulation and energy performance improvements must accompany the decarbonisation of heat in buildings. The Review recommended that, by 2050, the Welsh housing stock be retrofitted beyond SAP 90 to achieve an average EPC band A rating (though it recognises that not all properties will be able to accomplish this).

In response to the Independent Review, the Welsh Government set out a proposed *Welsh Housing Quality Standard 2023*, which focuses on improving social housing. Consultation on this document closed in August 2022, and responses are under review.

In addition to a proposed new Standard, the Welsh Government also established the *Optimised Retrofit Programme (ORP)*[15], which was launched in August 2020. It is intended to allow for the testing of approaches to retrofitting across a range of homes.

The ORP takes a **"whole-house, pragmatic approach to decarbonising existing homes"**, which takes into account the fabric of the building, heat production and energy supply and storage in homes. Upgrades which have been trialled include heat pumps, solar panels and intelligent energy systems.

ORP Stage 3 is currently running from 2022 to 2025, focusing on **"affordable warmth decarbonisation"**. It offers financial support to local authorities and registered social landlords across Wales. They are invited to apply to the scheme with projects that consider affordability and decarbonisation across their whole stock and to produce a plan for each house undertaking a retrofit. In November 2022, the Welsh Government is also drafting its report on decarbonising the private housing sector (owned and rented)[16].

Northern Ireland

In March 2022, the Northern Ireland Assembly passed the Climate Change Bill, setting the country a target of net zero emissions by 2050. This goes beyond the CCC's earlier recommendation of an 82% reduction.

Northern Ireland therefore faces a significant challenge in achieving its Net Zero objective in a shorter time than the other UK countries. Its first carbon budget period runs from 2023 to 2027, and it will have to tackle issues around energy generation, agriculture, surface transport and buildings.

Another significant hurdle for Northern Ireland is that currently very few homes are connected to a gas grid (about 75% though estimates vary), and around 68% of homes are reliant on oil for heating and hot water. In addition, 72% of the population uses open fires with coal or peat as secondary heat sources[17].

On the building stock, Lord Deben, chair of the CCC, provided several recommendations[18] for Northern Ireland's government:

- All newly-constructed homes should be zero carbon **"as soon as practicable"** with no requirement for later retrofit
- Existing buildings require **"substantial"** improvements in energy efficiency
- By 2028, all heating appliances being installed should be **"zero carbon"** in properties off the gas grid (about 75% of homes in Northern Ireland)
- For properties on the gas grid, all heating appliances should be **"zero carbon"** by 2033

The CCC noted that Northern Ireland must also strengthen its electricity network to achieve these goals and assume that the national gas grid extension will be halted.

Local action on heat decarbonisation

While national and devolved governments set legislation and guidance, we also see local actions on decarbonising heat and improving building efficiency. Local authorities around the UK have adopted their own Net Zero targets, and in some cases, they are putting them into action through local planning laws. Several regions are also either testing or have installed low-carbon technologies such as heat pumps or heat networks.

The West Midlands Combined Authority Area (WMCA), which includes Birmingham, Coventry and Dudley, is targeting Net Zero emissions from the area by 2041. This includes a 69% reduction by 2027. The WMCA published its *Five Year Plan 2021 - 2026*[19], which recommends an 'Accelerated' approach to achieving its goal. In the built environment, this includes retrofitting over one million homes with improved insulation and low-carbon heating systems (mainly air source heat pumps) by 2041.

Similarly, the energy efficiency of over 73,000 commercial buildings will be upgraded by 2031, and low-carbon heating systems in the form of air source heat pumps will be retrofitted into all of them by 2041.

Glasgow is another area which has adopted ambitious targets. The Glasgow Climate Action Plan is focused on achieving Net Zero emissions from the city and surrounding area by 2030. One of the Plan's main steps is to ban gas heating in all new buildings within the city boundary by 2025. Under Scotland's Heat and Buildings Strategy, local authorities must produce Local Heat and Energy Efficiency Strategy (LHEES) documents by 2023. Glasgow developed its LHEES in March 2022, ahead of schedule. It shows how the city and its environs can decarbonise buildings and increase energy efficiency. For example, the Glasgow LHEES identifies 'Opportunity Zones' where renewable heat and energy generation can be piloted or applied at scale. One of these is Glasgow City Centre, highlighted as an excellent location for district heating, with the nearby River Clyde as a potential renewable heat source[20].

The future of decarbonised heat across the UK

There is little doubt that reducing our reliance on fossil fuels for heat in buildings is one of the biggest challenges on the UK's road to Net Zero. The use of natural gas for heating and hot water provision in homes is widespread and has been the established technology for decades.

However, heat pumps and heat networks are also now well-known and widely used, so there is less of a barrier to their adoption. In fact, there are more opportunities than ever to apply heat pumps. The past five years have seen the development of high-temperature heat pumps, which can provide hot water up to 90ºC even for demanding environments such as hotels and hospitals. As local authorities, designers and installers become more involved in applying low-carbon heating, it is vital to bear in mind that there are practical considerations when selecting different technologies. These can differ depending on the application type.

Heat Pumps

The UK government set a target of 600,000 heat pump installations annually by 2030. That is a significant uplift on current levels. The key benefit of heat pumps is that they can provide heating and hot water using electricity from a grid that is increasingly getting its power from renewable sources - and do so very efficiently. Generally speaking, for every 1kW of electrical energy used, a heat pump can produce 3kW of heat energy.

Not only does this meet the requirements for efficient use of the UK's electrical energy, but it also means that as we produce more electricity from renewables such as offshore wind, the carbon footprint of installed heat pumps continues to reduce. Another important aspect is that heat pumps are applicable in a wide range of applications today, meaning the pace of change needed can be achieved.

There are some important considerations for the use of heat pumps. For domestic installations, it is vital that the dwelling under consideration is suitable for a low-temperature heat pump system. Under Part L 2021, new homes constructed from 2024 must be designed for low-temperature heating systems at 55ºC. Fabric efficiency levels are also higher than under previous regulations.

When retrofitting heat pumps into existing homes, it is, therefore, crucial to consider insulation levels and ensure that these are adequate before replacing an existing gas (or oil) boiler. Householders must also be aware of other requirements for successful applications, such as radiators sized to deliver space heating if an air-to-water system is installed.

In commercial buildings, designing for heat pump applications also means there are essential points to clarify[21], including:

- Volume and temperature requirements
- Peak heat loss at the design condition within the local area (i.e. the maximum heating capacity output when the external ambient is coldest)
- The building's hot water usage profile and if this is steady across the day or if peaks in demand are expected

For example, Mitsubishi Electric recommends that, with its high-temperature Ecodan QAHV heat pump, the sanitary hot water load should be achieved at the lowest required design ambient temperature where the heat pump is located. This is so that the system can be sized to achieve the target hot water temperature efficiently and in a suitable timeframe.

Heat Networks
Heat networks are considered an essential technology for the future of heat in UK buildings. The UK's Heat in Buildings Strategy highlights the development of **"mechanisms to incentivise voluntary connection of existing buildings and reduce the costs"**.

The Heat Network Transformation Programme is the government body working with industry and local authorities to help develop new networks or improve existing ones. This is supported by the Green Heat Network Fund, which provides grants to the public and private sectors (and is the successor to the Heat Network Investment Fund[22])

In the past, heat networks, which supply heat from a central source to multiple buildings, used large gas boilers or combined heat and power (CHP) equipment as the primary heat source. However, this is changing as modern system designers look to use more renewable and recovered sources of heat energy.

This can include local water sources such as rivers and lakes or heat pumps. For example, in London, the Royal Borough of Kensington and Chelsea was awarded funding for a new zero-carbon heat network that uses air source heat pumps to provide heat to over 800 homes and several public buildings and businesses. And Bristol Council was awarded £6.4 million for two heat networks using ground and water source heat pumps, and waste heat from Bristol University's campus.

One modern approach to using low-carbon heat sources is the ambient heat loop. With this method, network temperatures are low, between 10ºC and 30ºC. An ambient energy loop in place of an energy centre (with a gas boiler, for example) pushes energy into the network. Water is pumped around the loop and used as a heat source (taking heat from the system) or a heat sink (adding heat to the system) by heat pumps in each building or apartment on the network.

The important consideration for designers is that the ambient loop approach must focus on balancing the system temperature. Where heat is taken from the loop, it must also be added elsewhere. While this creates its own design challenges, the benefit is that the loop can use heat rejected elsewhere.

For example, the ambient loop runs throughout the building as a heat source or sink in a mixed-use building with apartments over some retail outlets and a gymnasium. Heat pumps in each apartment provide space heating and hot water. A water-source VRF uses the heat network to provide cooling in the shops and gyms. Heat rejected from the VRF can be added to the loop, providing extra heat energy as required and reducing the need for primary energy.

Conclusions

The future of heat in buildings across the UK looks very different from our current approaches. And there is undoubtedly a significant challenge ahead in moving the country away from its reliance on fossil fuels to low-carbon technologies.

One of the most urgent requirements is training. Achieving 600,000 heat pump installations per year by 2028 will require many installers to get the work done – and to be available for regular maintenance of domestic and commercial heat pumps. At Mitsubishi Electric, we are moving forward with our training programmes for installers, but the government must also support skills development in this field.

Designers will also have to re-think their approaches to heating and hot water in buildings. Heat network development requires a perspective beyond a single building. We can maximise the possibilities of ambient loops if we regard heat as an energy source to be moved around buildings, and transformed by heat pump technology for space heating and hot water.

Developments in heating technologies have created exciting options which have also been tried and tested in projects, reducing the uncertainty of outcomes. New thinking can be challenging, but it's needed to take a new direction to a low-carbon future.

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