Llywodraeth Cymru
Welsh Government

Welsh Government 2023

Heat Strategy for Wales

Draft for consultation

The path to net zero heat in Wales
by 2050 across all sectors

Contents

Ministerial Introduction

The climate and nature emergencies are not the next global crisis - they are already upon us. Our plan is for a better, fairer, and greener future for us all. In March 2021 the Senedd formally committed Wales to achieving net zero emissions by 2050.

Heat accounts for approximately 50% of the total energy use in Wales. Our success in decarbonising heat is coupled with our success in achieving our pathway to net zero.

Our homes are among the oldest and least energy efficient in Europe. Wales also faces the challenge of a significant number of properties off the gas grid. Consequently, the scale of change required is far greater than elsewhere in the UK and in many places in Europe. We also have a large number of owner-occupier households but many are owned by those on low to middle incomes who may not have the necessary resources for the scale of investment needed to decarbonise their heating processes.

Wales also has a large number of micro-businesses and SMEs. For many a key barrier to decarbonising their heat will be a lack of expertise or finances to invest in low carbon solutions. Larger businesses are also not necessarily incentivised to invest currently given the way the current electricity price is determined. While there is undoubtedly a commitment from businesses to support net zero ambitions, for many the financial case for the required investment is not strong.

This Strategy supports our aspiration for a net zero public sector by 2030 and it supports the decarbonisation of our homes, our industry and our businesses by 2050. This is a Strategy for the long-term reflecting the scale of the challenges and the need for a range of interventions to achieve our ambitions.

We have identified the key enabling actions to implement the long-term changes needed. We need to build awareness and confidence in new technologies, we need to upskill the labour force to ensure we have trained engineers to install new solutions. We also need to develop supply chains so we have the capability and units available at an affordable price whilst recognising the economic benefit in Wales.

Urgent action from the UK Government is needed. In particular, we need reform in the way electricity prices are determined, decoupling the price of electricity from the price of gas and ensure the prices customers pay reflect the cost of generation. We need further reform that rebalances energy costs and supports the financial case to invest in low carbon heat.

The market and consumers across Wales will need to engage in the transformational change needed. But we won't leave it to the market and consumers alone; we have identified the need for targeted support for households, businesses, industry, and public sectors. Alongside this support, the Strategy identifies the need to take action to phase out the use of fossil fuels in our heating processes and proposes actions necessary to transition to low carbon solutions.

Delivering this Strategy will require sustained action by government but the Welsh Government alone does not have the resources to fund everything that is necessary. That is why we are calling on support from industry, civic society and the third sector to help deliver the action needed. In line with the resources we have available, we are committed to setting out detailed action plans to support implementation, whilst also demonstrating how our actions support a just transition.

Our vision is for is that clean, affordable heat will be available to all. To deliver this we must recognise the opportunity of the transition and will secure our future well-being with a sustainable low-carbon economy.

Julie James MS, Minister for Climate Change

Heat in Wales

Heat in our lives

Heat is a vital component of modern society in Wales. We need it to keep our homes and workplaces comfortable, provide us with hot water, and cook our meals. The use of heat across industries globally is critical to the supply chain of all products used in everyday life.

The extent to which heat is integrated into our lives makes the provision of secure and affordable heat paramount. Heat is vital to the safety and comfort of Welsh residents and the competitiveness of our industry and businesses.

Our lives are supported by heat and therefore sensitive to changes in how it is produced and managed. Yet, change is required.

This Strategy will guide our approach to decarbonising space heating and hot water for our buildings in Wales, our higher demand industrial heat, and how our energy networks will be transformed to support a low carbon future.

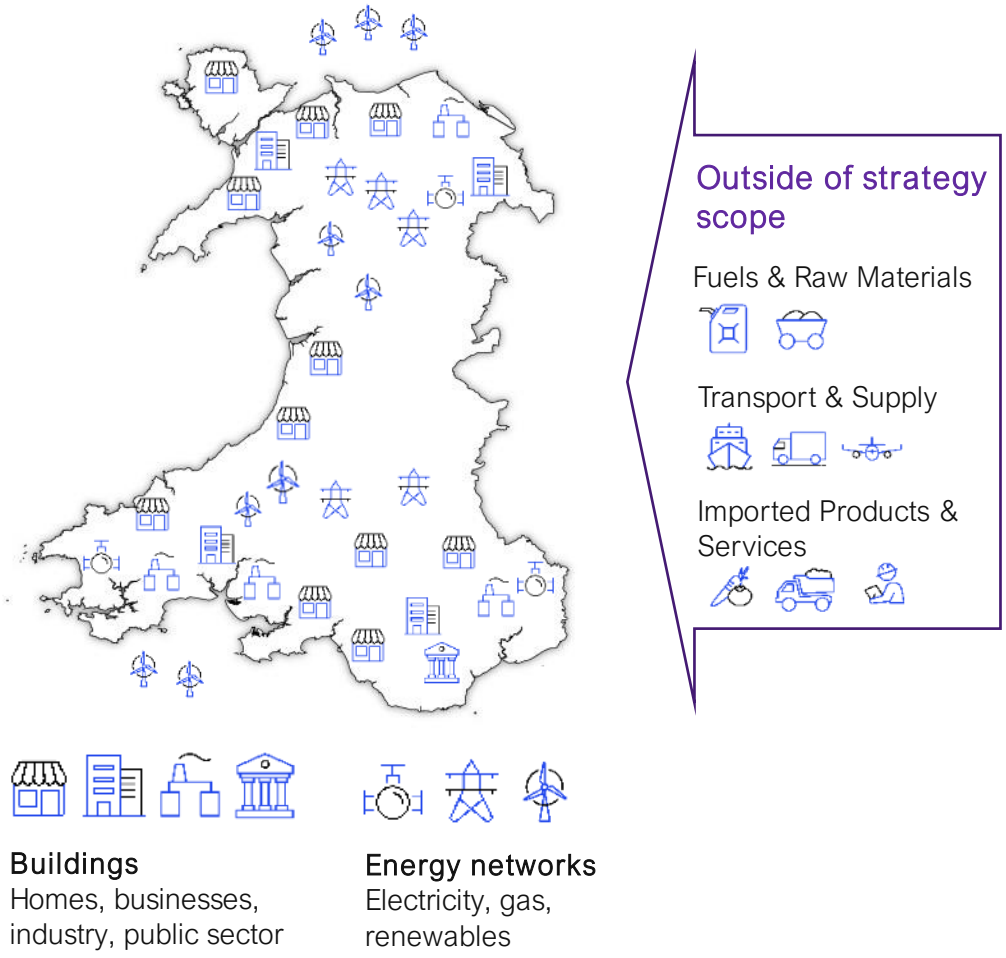

Figure 1: Heat is used across Wales and impacts all aspects of our lives

The change required

The production and management of heat across our buildings and industry account for over 50% of the total energy demand in Wales (Figure 3), three-quarters of which comes from the combustion of fossil fuels[1]. Our industrial users currently account for the majority of heat emissions, followed by emissions from heating our homes.

The environmental impacts of human-induced climate change require us to change our approach to energy. Crucially, we need to reduce our demand and be more efficient in our use of energy. We must also transition away from fossil fuels towards low carbon energy sources. Affordable and secure heat must now also be clean heat.

At the same time, energy crises have demonstrated our exposure to global events and energy markets, with volatile prices affecting people and businesses across Wales. The most recent energy crisis is estimated to have put 45% of Welsh households at risk of fuel poverty[2], with the negative impacts disproportionately affecting those most vulnerable in society.

Delivering *clean, affordable, and secure* heat is intrinsically linked to positive outcomes for people and businesses across Wales. However, meeting this energy trilemma requires systematic changes to the way we deliver and consume heat.

The transition to low carbon heat will need people to engage, technology solutions across the energy system, and enabling actions to support delivery.

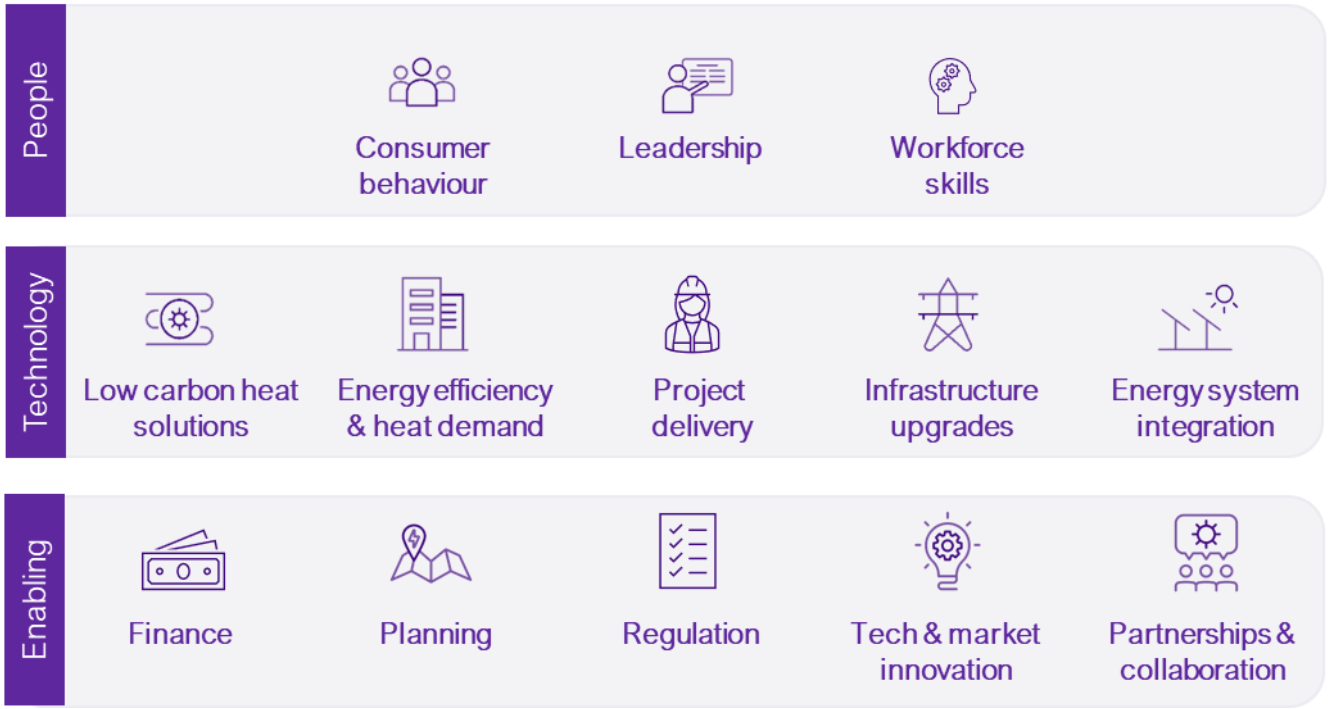

Figure 2: Involvement across people, technology, and enabling areas for a low carbon heat transition

Affordable warmth

Wales has some of the lowest energy efficiency ratings in Europe. Improving the performance of our homes will lead to lower energy bills and healthier, more comfortable households.

Resilient businesses

Wales' role in the industrial revolution had a global impact, and our industrial base provides a platform to lead modernisation towards a globally recognised low carbon industrial hub.

Green jobs & growth

Employment opportunities for our existing workforce and the ability to attract new talent, boosting our local economy.

Cleaner air

Cleaner air across our towns and cities, improving health outcomes for our communities.

Energy security

Reducing reliance on imported fossil fuels with local and secure generation which also reduces price volatility.

Net zero: an opportunity

Wales has a legislated target to reduce greenhouse gas (GHG) emissions to net zero by 2050. This means that the amount of GHG emissions produced across all activities in Wales will need to be balanced by emissions that we remove from the environment. On the route to net zero, Wales has interim decarbonisation targets for 2030 (63% reduction) and 2040 (89% reduction), and a series of 5-year carbon budgets.[3] We met the 2020 target (23% reduction).

The decarbonisation of heat is the greatest challenge that Wales faces in reaching net zero, and our success in decarbonising heat is coupled with our success in achieving our net zero and interim targets.

We are starting to make progress. The total renewable heat capacity in Wales is 686MW, providing 2.3TWh of mostly biomass heat. This equates to 4% of the ~53.4TWh of heat energy use per year in Wales.[4]

There must also be a drive towards improving the thermal performance of existing buildings in order to reduce the demand for heating; the two go hand in hand. This presents both a challenge and opportunity for those with responsibility for buildings. Construction and building maintenance supply chains are key in developing innovative solutions towards the retrofit of buildings.

The challenge is great, but the opportunity is greater still – transforming heat is an essential aspect of modernising Wales and achieving better outcomes for our people, our businesses, and our environment.

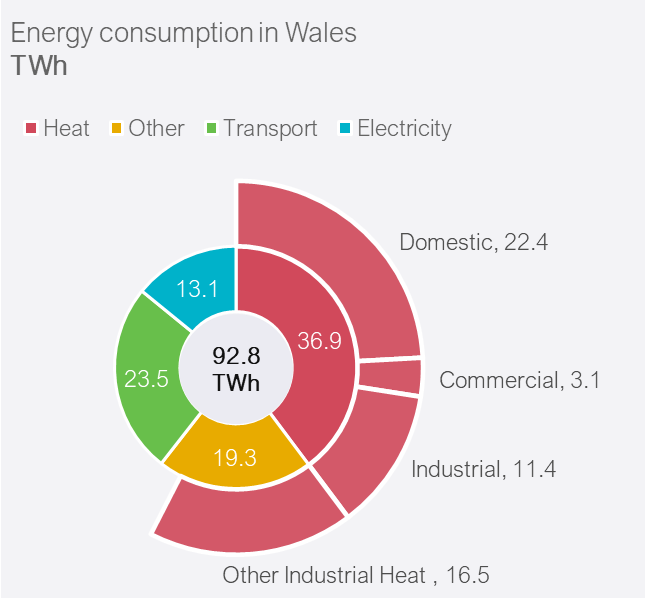

Figure 3: Annual energy consumption in Wales for 2019[1]

Policy context

Our commitment to net zero carbon emissions is legally binding. In parallel, the Well-being of Future Generations Act places obligations on Welsh Government to maximise its contribution to goals which include developing 'a prosperous Wales' and a 'low carbon economy'.

There is a range of strategies and policies that will affect heat decarbonisation in Wales – Figure 4 sets out our legislation, strategies, and ambitions driving action.

Many of the policy areas that impact heat in Wales are overseen by the UK Government. The Climate Change Committee (CCC) has stated that we cannot meet our net zero target in Wales without the right policy and financial commitments from Westminster. In fact, the CCC assessed that of the changes needed in Wales by 2050, only 40%[5] can be influenced by powers mostly or partially devolved to Wales (see Appendix B: Devolved powers).

Devolved powers related to heat in Wales include the ability to provide support and funding schemes to help deliver low carbon heat. However, the regulation, market pricing mechanisms, and the significant scale of funding are non-devolved.

Acknowledging this, this Strategy includes policy levers that call on the UK Government to take action, whilst also making use of the powers that are devolved to position Wales as a forerunner for clean, secure, and affordable heat in the future.

Figure 4: Relevant Welsh legislation and strategies behind the Heat Strategy for Wales

Technology context

Reaching net zero will require both reducing the amount of heat energy we use, and ensuring that heat generation is low carbon, secure, and affordable. This transition will require a variety of solutions across different sectors and heat demand requirements.

For homes and commercial buildings, heat pumps will be a core solution for many. Findings from domestic demonstrations across the UK show that there is no property type or architectural era that is unsuitable for a heat pump.

Whilst heat pump solutions are technically feasible, insulation improvements and opportunities to lower temperatures with heat emitter upgrades will help optimise cost and carbon performance. This strategy strongly supports a 'whole building' approach as part of designing the low carbon heat solution.

Tried-and-tested solutions already exist for higher temperature requirements. With high-temperature and cascaded heat pumps now on the market, the perceived barriers of insulation or heat emitter upgrades being 'essential' no longer stand.

For large industrial sites requiring very high temperatures, such as steam, solutions are available. Again, the first step will be to review the temperature required, and reduce, or de-steam if possible. If steam is required, even now it is possible to raise steam from a heat pump solution. Fuel-switching solutions including direct electric boilers and biogas are available, and hydrogen solutions are increasingly being developed.

Many of the technologies we need to achieve net zero are available and their integration and deployment are supported in this Strategy, alongside novel and emerging solutions such as smart appliances and smart local energy systems – with accompanying tariffs and incentives.

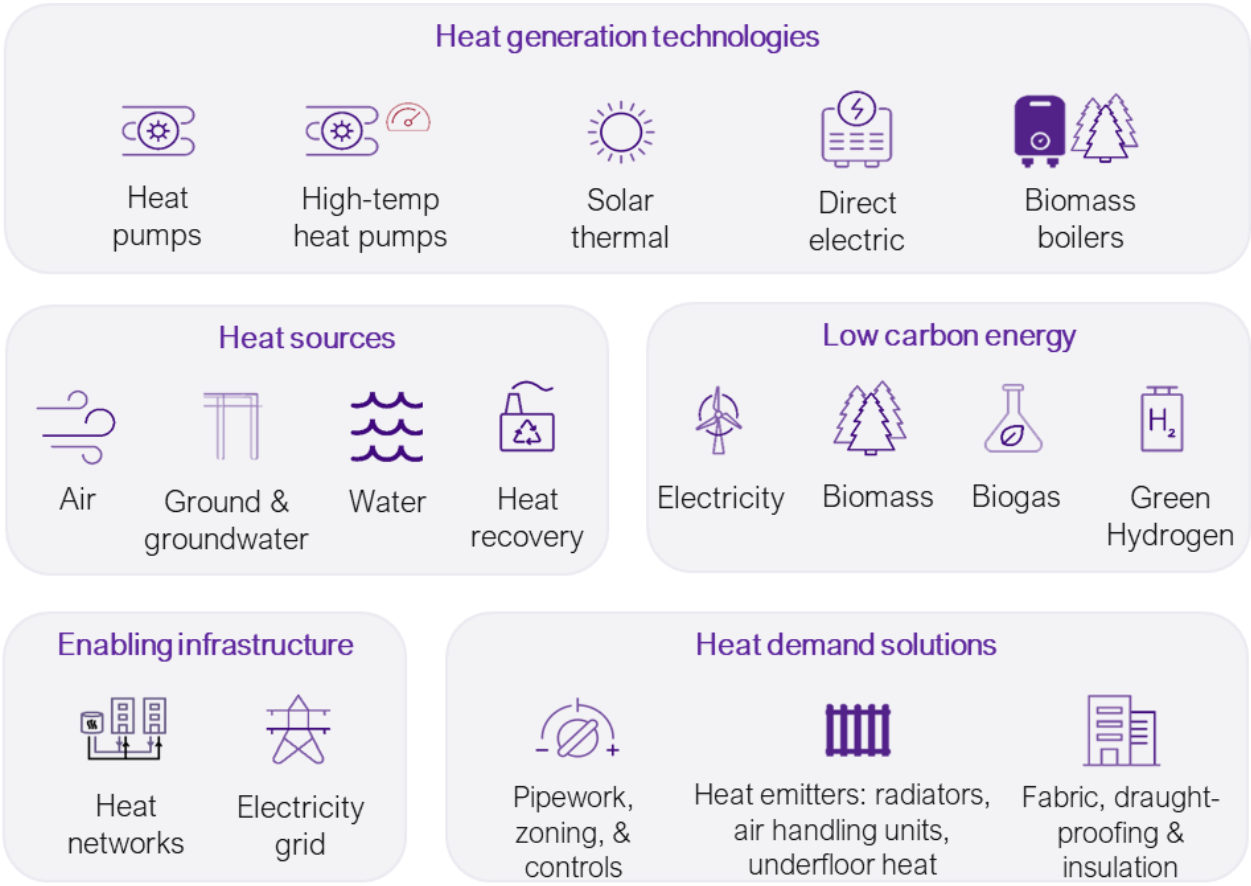

Figure 5: Summary of technological solutions available for a low carbon heat transition

Our approach

Principles of the strategy

To effectively tackle the challenge of heat decarbonisation, our Strategy is guided by five fundamental principles.

These principles have been tested with representative stakeholder groups as the Strategy developed. We recognise the need to continue building consensus on them as the driving ethos in the years to come. This collective approach will be essential to meeting our goals.

Strategy arrangement

The structure of our approach is laid out as follows:

- **Sectors:** splitting the challenge into thematic areas
  - **Objectives:** setting the long-term goals and ambitions for each sector
    - **Policies:** setting the specific interventions to meet each objective

Figure 6: Principles for the Heat Strategy for Wales

Sectors and actors

This Strategy takes a comprehensive approach to address the future of heat, encompassing all sectors, from low-temperature home heating to high-temperature industrial heat. It recognises that low carbon and affordable heat is not only a technical challenge, but also a human one.

To enable a successful transition, we need policies and delivery approaches that engage and empower individuals, communities, and regions. These delivery approaches need to be local, involve people in decision-making, and facilitate collaboration across sectors.

Our vision, objectives, and policy interventions are structured against the following sectors in Figure 6[4]. It is important to note that many policies are interconnected with wider benefits across several sectors.

Welsh Government cannot deliver heat decarbonisation alone. We will support people and organisations from across every sector to make the change they want to see in their communities.

Public sector
Public sector officers, supported by our Welsh Government Energy Service, will lead the way in demonstrating how net zero can be achieved, priming the low carbon heat market.

Businesses
Every business, from the smallest to the largest, will be empowered to make decisions on decarbonising heat with the aim of lower bills and greater resilient over the long-term.

Homes
Every homeowner, social landlord and private landlord will be empowered to make the right choices to decarbonise our homes. A warm home will be affordable for all.

Industry
Industrial businesses will lead the way in the green industrial transition, continuing to invest in energy efficiency and switching to low carbon alternatives.

Infrastructure
Long term, strategic, efficient investment in grid infrastructure will support the growth of renewable heat. Network operators and local planners will work together to deliver local ambitions.

Figure 7: Summary of sectors addressed in this Strategy

A vision for heat in Wales

Clean, affordable heat

In a net zero economy, clean and affordable heat will be accessible to everyone in Wales.

Sustainable energy sources, such as renewable electricity, will be used to produce heat, reducing our dependence on fossil fuels. These sources will be secure and supported by a reliable and smart electricity network.

Our pathway sets out the decarbonisation route to meet our legislated net zero target by 2050.

Our objectives by sector and a timeline of selected key policies are set out in the following sections of the report.

Our Vision:

Clean, affordable heat will be available to all – we will recognise the opportunity of the transition and will secure our future well-being with a sustainable low carbon economy.

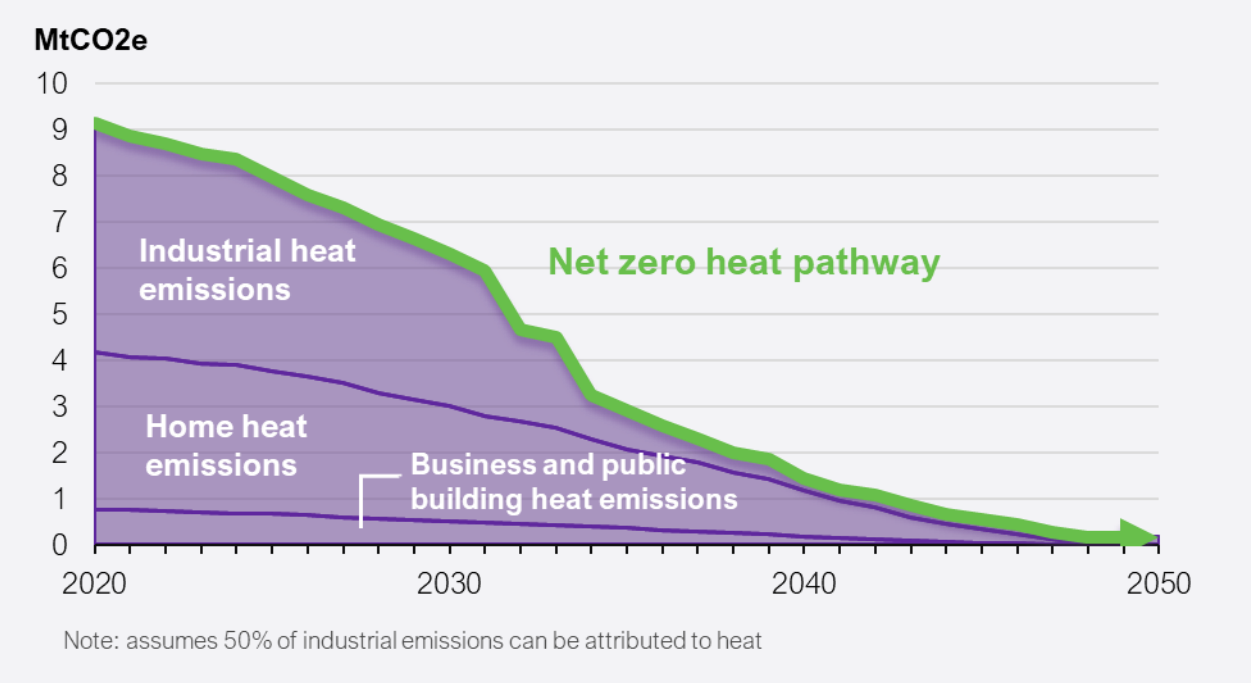

Figure 8 Decarbonisation pathway for heat in Wales, according to the CCC's Balanced Pathway[6]

Objectives across our sectors

Our enabling framework - supporting a just transition

a) Planning processes are transparent, streamlined, and fit for purpose - supporting the efficient rollout of low carbon heat solutions

b) Low carbon heat is understood and supported by heat users in all sectors - collaboration and knowledge sharing have driven demand-side momentum towards net zero heat

c) Our highly-skilled workforce supports local suppliers and manufacturers serving the transition in Wales – new talent, investment, and innovative solutions are drawn into Wales

d) The costs of the transition are fairly distributed across society

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Our energy networks – shaping the future of heat supply

e) Flexible and secure electricity networks have the infrastructure in place to effectively support electrified heat as part of a net zero energy system

f) Heat networks are a reliable and efficient provider of low carbon heat in suitable areas across Wales

g) Wales will have championed zero-carbon hydrogen from renewables at localised hydrogen hubs – hydrogen will be utilised in high-temperature industries, and for other hard to decarbonise solutions

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Our homes – affordable warmth for all

h) A clear regulatory framework will be in place that supports net zero homes across all rented, owner-occupied, and social housing

i) Homes are thermally-efficient and served in the main by heat pumps – a whole building approach has been taken to the transition and homeowners understand how to operate their systems

j) Low carbon heat solutions will be affordable to install and affordable to operate

Our businesses – supporting our local economy to flourish

k) Businesses in Wales will be sustainable and supported by affordable low carbon heat solutions

l) Businesses will have the confidence to invest in the transition to low carbon heat and net zero buildings

m) Our businesses and commercial properties will demonstrate their net zero credentials, building confidence and engagement with consumers

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Our industry - fostering innovation and investment

n) Industry is transitioned, competitive, and sustainable for the long-term following implementation of best available techniques for energy efficiency and low carbon heat

o) Low carbon hydrogen hubs are established and serve high-temperature industrial processes and local users where appropriate

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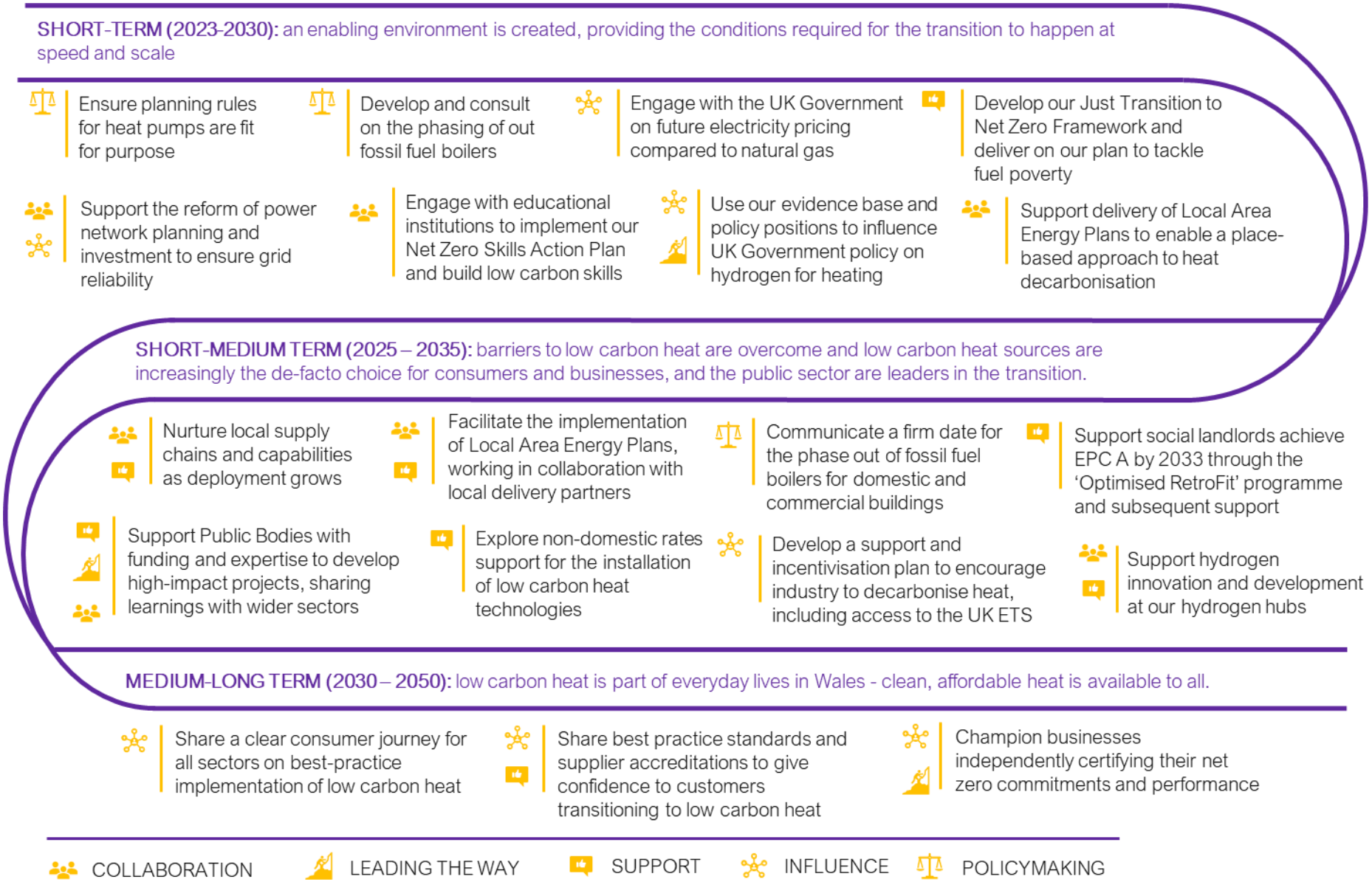
Our public services – leading by example

p) The public sector are leaders in the transition to net zero – working towards net zero by 2030 and supporting delivery on a regional and local basis to recognise the benefit to Wales

q) All public sector buildings will be served by low carbon heat solutions – championing a whole building approach to the transition

Timeline of key policies



Maximising opportunities

Our vision for clean and affordable heat directly links to recognising the opportunity in Wales and securing future well-being.

We recently consulted on a call for evidence for the 'Just Transition to Net Zero'[7] which will inform our decarbonisation pathway.

This Strategy will support the Just Transition towards net zero and make a significant contribution to the achievement of our national Well-being goals[8].

Figure 9: Well-being goals (Welsh Government)

Our Vision:

Clean, affordable heat will be available to all – we will recognise the opportunity of the transition and will secure our future well-being with a sustainable low carbon economy

Fuel poverty

With an estimated 45% of Welsh households at risk of fuel poverty - affordable heat in the future will support well-being of our most vunerable people

Health

The NHS estimates that the treatment of illnesses linked to cold, damp, and hazardous homes costs the UK approximately £1.4 billion per year

Local jobs

Upskilling the workforce to transition to the low carbon jobs of the future

Social infrastructure

Recognising future well-being means an engaged society where communities work together - a just transition where we 'leave no-one behind'

Financial value and investment in Wales

Economic benefits for Wales must be recognised in the transition

Environment

The climate emergency is also a nature emergency. Protecting biodiversity and nature is important to consider in our approach to the low carbon transition

Energy security

Stable and reliable energy from renewable sources is needed - increasing the use of renewables in the UK guards us from international politics impacting energy

Air quality

The combustion of fossil fuels in boiler plants release harmful pollutants into the air, which can lead to various respiratory and cardiovascular diseases

Figure 10: Opportunities and benefits from the transition to low carbon heat [8, 2]

Our enabling framework

Systemic change requires an environment that can deliver systemic action. This will require engagement and increasing momentum for implementation across all sectors – including heat customers, suppliers, funders, and policymakers.

To deliver a vision of clean, secure, and affordable heat for the future, we need to increase support and readiness across multiple areas – including public support, skills, and infrastructure.

The role of people in a low carbon heat transition is a vital aspect. Support from consumers will help drive policymakers, businesses, and the supply chain to make progress and build momentum.

The change needed is transformational, and the scale is extensive - impacting all sectors in Wales.

We recognise that access to finance is a key barrier to action – financing options for different end users are addressed later in this document.

We have identified four core areas of the enabling framework that need to be in place to support the transition:

Policy: political support and drive to lead the transition – with planning policy, regulation and support that enables delivery.

Public perception: support for a low carbon heat transition - to both invest in and understand low carbon heat solutions.

Skills and supply chain: a local and capable workforce with the skills required to implement and maintain low carbon heat technologies – appropriately scaled-up with retraining and recruitment, together with a supplier market which supports the transition whilst recognising benefits local to Wales – including manufacturing, suppliers, and installer markets.

Energy markets: energy supply and pricing policy and mechanisms that support affordable low carbon heat solutions.

Nesta research into heat pumps and green home upgrades

Recent research[12] shows that, when faced with the full costs, only 25% of homeowners would pursue green home upgrades, even with attractive financial support.

The research recommends that low interest financial support needs to be complemented by clear consumer advice to give homeowners the confidence and ability to make investment decisions.

Once installed, Nesta research[9] shows that satisfaction with heat pumps is high and comparable to gas boilers:

- Compared to their previous heating system, 73% of heat pump owners are as satisfied or more satisfied with their heat pump.
- 67% of heat pump owners said they were satisfied with running costs (vs. 59% of gas boiler owners).

However, work is needed to improve system operability; 22% of heat pump owners were either ‘not very’ or ‘not at all’ confident in using and controlling their heating (vs. 6% for gas boiler owners).

Our enabling framework objectives and policy actions seek to build our readiness to deliver heat decarbonisation across all sectors.

The key policy drivers influencing our enabling framework are:

- Well-being of Future Generations Act sets well-being goals we need to recognise; in particular, the enabling framework will support a prosperous and resilient Wales.
- Just Transition Framework is a recent call for evidence from the Welsh Government on how to recognise a fair and inclusive transition to net zero with the principle of 'leave no-one behind'.
- Prosperity for all: Economic Action Plan sets the plan to futureproof the Welsh economy by building on strong foundations to build industries for the future – with the low carbon transition recognised as an area for economic opportunity.
- Net Zero Skills Action Plan was released this year, including 7 key areas of action to increase net zero skills, including for low carbon heat, in Wales.
- Manufacturing Action Plan for Wales is to be published in 2023 following an update. The Action Plan sets out the need for technological change, skills development, and greater collaboration to support the manufacturing sector of the future in Wales.
- Review of Electricity Market Arrangements consultation is reviewing the pricing mechanisms for electricity across the UK.

Many foundations to meet our policy goals and enable low carbon heat are already in place.

For example, Business Wales and the Development Bank of Wales provide advice and support in running and growing businesses in Wales. And the education system in Wales has a diverse range of adult (post-16) learning that is being utilised to build our workforce capabilities to understand and support the low carbon heat transition (right inset).

However, this Strategy acknowledges that the Welsh Government has limited powers across several of the enabling actions required, including energy markets. With energy prices and supply chains being critical to the vision of clean, affordable heat, Welsh Government has an important leadership role to play in influencing the UK Government.

Current training and learning opportunities in Wales supporting heat decarbonisation

Higher & Further Education

- 9 Universities and 16 colleges provide engineering and wider net zero qualifications.

Apprenticeships

- Supporting learning in businesses of all sizes across 24 sectors, including energy and engineering.

Personal Learning Accounts

- Training individuals in new skills with courses delivered in colleges across Wales. Fully funded training for green skills – including heat pump installer training.

Employability Programmes

- Helping to increase employability with support and guidance for work-related challenges, training, upskilling, and new careers.

Adult and community learning

- Accredited and non-accredited learning to develop new skills and improve health and well-being.

Planning processes are transparent, streamlined, and fit for purpose - supporting the efficient rollout of low carbon heat solutions

The planning approach in Wales is set at a strategic level – with national, regional, and local level 'Plans'. Secondly, it is set at a regulatory level with planning policy and planning permission activities.

Planning Policy Wales provides the key principles for developing local planning policy and taking planning decisions, with further guidance provided in Technical Advice Notes.

The Future Wales National Plan 2040 sets the strategic development plan for Wales. This provides the considerations for planning new developments and infrastructure.

Strategic Development Plans and Local Development Plans set out the regional and local plans for future developments, adding detailed policies for the geographies that they cover.

Regional Energy Plans have been developed for every Welsh region, setting out the economic and strategic ambitions.

Local Area Energy Plans will establish the pathway to transition to low carbon heat at a One of the major barriers to the rollout of low carbon heat is the current permitted local level, and the energy infrastructure needed to support this. Led by local authorities, these will act as the 'master plan' for local energy systems.

Welsh Government are supporting the development of Local Area Energy Plans across the whole of Wales by 2024. Developing the plans needs extensive collaboration with local communities, industries, and energy network operators. However, local area energy plans do not currently have a statutory status in relation to local planning policy or network planning.

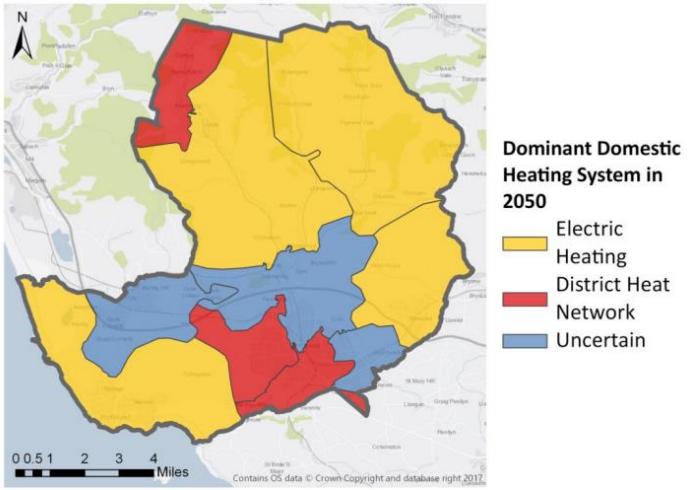
Case study:

Local Area Energy Plans – Bridgend County Borough Council[10]

Bridgend County Borough Councils Local Area Energy Plan was the first developed in Wales as part of a UK pilot.

This Plan sets the zonal approach for heat use across the county. It sets out the priority areas for building fabric retrofit, electrification of heat, and heat network connection.

The Plan considers electrical network feeder and substation capacity by zone across Bridgend for 2038 and also profiles the gas network gas demand for the future. The estimated investment cost to deliver the future energy system in Bridgend is £2.8bn.



development rights for heat pumps. Air source heat pumps require outdoor units which can have a visual and noise impact on the nearby environment. It is important that planning for such units is regulated, but without providing unnecessary constraints.

Permitted development rights allow installations to go ahead without formal planning permission, subject to meeting certain conditions.

Domestic permitted development guidance for air source heat pumps has two key conditions in particular:

- no part of the air source heat pump is within three metres of the boundary of your property
- cannot be installed on a wall or roof that fronts a highway

Non-domestic permitted development guidance for air source heat pumps states that installations on non-domestic land are likely to require an application for planning permission.

These current rules mean that full planning permission for a heat pump would be required for a significant proportion of the Welsh building stock. Formal planning applications take time to go through, incur additional costs, and require effort to manage – all of which are barriers to delivery.

In England, permitted development rights have been reviewed, and are considered less stringent than in Wales. Welsh Government is committed to ensuring that permitted development rights for heat pumps are appropriate to Wales and support their roll out.

How we will deliver this objective

1 - **We will support the delivery of Local Area Energy Plans to enable a place-based approach for the low carbon heat transition** – ensuring that spatial zoning identifies priority areas for low carbon heat and that this process is aligned with network planning by electricity distribution and transmission operators.

2 - **We will facilitate the implementation of Local Area Energy Plans** – by engaging communities and delivery partners to communicate Plans and build engagement for the transition – including using digital solutions to aid collaboration.

3 - **We will ensure the planning rules for permitted development rights for heat pumps are fit for purpose** – we will review the evidence base and seek to remove any unnecessary planning constraints for the low carbon heat transition.

Low carbon heat is understood and supported by heat users in all sectors – collaboration and knowledge sharing have driven demand-side momentum towards net zero heat

The degree to which consumers engage and accept new technologies will underpin the speed and scale of Wales' net zero transition. The scale of change needed is significant. In 2021, only 55,000 heat pumps for central heating were sold across the UK; this is in comparison to 1.6-1.7m gas boilers[11].

For many potential customers, there is a key knowledge gap in how to access suitable suppliers, the accreditations and standards to look for, and the available finance options. These knowledge gaps exist across the domestic and commercial sectors.

Recent polling from Nesta and the Development Bank Wales[12], showed that owner-occupiers "feel uncertain about what green upgrades will be right for their home [and] are delaying making a decision because of this uncertainty." The research concluded that providing support, such as home assessments and referrals to competent tradespeople, are equally as important as the financial support itself.

Publicly Available Specifications, or PAS standards[13], are in place to set the good practice approach for energy efficiency and a whole building approach for low carbon heat for domestic and non-domestic buildings. Welsh Government is committed to championing these standards across our programmes to ensure work delivered under our programmes is high quality and appropriate.

Welsh Government uses multiple channels to engage with people, from snapshot engagement via social media, to involved support and engagement through programmes such as Business Wales. In our Just Transition to Net Zero in Wales consultation, we highlighted the role of our social infrastructure in delivering these services, such as through the NHS. For example, the charity Care & Repair Cymru works with hospitals to identify older patients with housing issues, including excessive cold, and offers support. Community energy groups and fuel poverty charities are also a crucial vector for engagement and can help ensure information and support reaches excluded and vulnerable groups.

How we will deliver this objective

4 - **In line with our Climate Action Wales Public Engagement Strategy, we will engage households to build a better understanding of low carbon heat and communicate the support available for the heat transition.** We will work with civic society and the third sector and make use of our existing programmes, for example, Business Wales, to engage business heat users.

5 - **We will build and share knowledge of the route to market for low carbon heat** – creating a clear customer journey for all sectors that will help heat users access the low carbon heat supply chain.

6 - **We will build trust between businesses and homeowners with low carbon heat suppliers, by reviewing and sharing supply chain certification and standards** – we will seek to share best practice standards and supplier accreditations to give confidence to customers transitioning to low carbon heat, including the use of the TrustMark quality standard.

7 - **We will champion the use of PAS 2030, PAS 2035 and PAS 2038 in our programmes for low carbon heat** – taking recognised standards for a whole building and energy efficient approach will add credibility to our approach, this will be supported further by industry leading best practice.

Our highly-skilled workforce supports local suppliers and manufacturers serving the transition in Wales – new talent, investment, and innovative solutions are drawn into Wales

Investing in local infrastructure and a skilled domestic workforce are essential to maximising the value through the transition.

Tens of thousands of workers will be required to support the transition. It is estimated that net zero will require 25,000 jobs in Wales[14] (65% of which will be new roles) and within this, an estimated 12,000 additional workers will be required to meet the needs of domestic energy efficiency improvements alone.

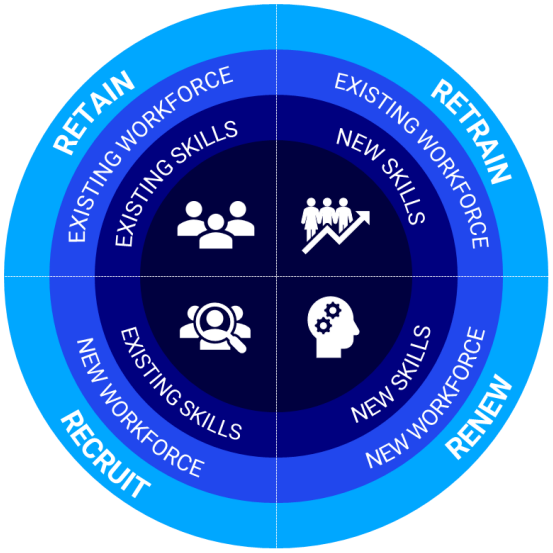


Figure 11: Strategic components of a skills transition – retain, retrain, recruit and renew[15]

A holistic approach that encompasses all aspects of retaining, retraining, recruiting, and renewing will help support a just transition across the workforce. The Net Zero Skills Plan has been released this year; this sets the approach for years to come, starting with a consultation on the skills needed to meet our future economy to inform a skills sector roadmap. We will encourage young people into these careers by developing career pathways and motivating people to upskill within the sector and its supply chains, including maximising transferable skills.

Progress is already being made to train low carbon heat installers. Through the Welsh Government's Green Personal Learning Accounts programme, training is free for those seeking to upskill to meet net zero skills gaps. This is not limited by income and is suitable for existing tradespeople, including plumbers and heating engineers to learn about heat pump systems. However, there is much further to go to support the nationwide transition.

How we will deliver this objective

8 - Through the implementation of our Net Zero Skills Action Plan we will identify the skills required to support low carbon heat solutions and seek opportunities to support retraining of gas engineers into renewable technologies..

9 - **We will attract talent, from apprentices to professionals, into the low carbon heat sector** – engaging our educational institutions to build skills for the sector, and utilising National Occupation Standards to create a detailed structure for skills.

10 - **We will aim to attract new businesses and investment into Wales by signalling a long-term opportunity to support our transition**.

11 - **We will attract new investment into manufacturing in Wales to support the low carbon heat transition.**

Case study:

Stronger, Fairer, Greener Wales: Net Zero Skills Action Plan (2023)[16]

The Net Zero Skills Action Plan (2023) sets the vision for a fairer, stronger and green Wales delivered through the 7 following areas of action:

- Gain an understanding of the current skills position for each emission sector
- Build a shared understanding of net zero skills across Wales
- Grow a skilled workforce to meet our net zero commitments
- Strengthen the skills system
- Promote opportunities for early years and young people to realise their potential
- Cross-government and partnership approach to meet our skills commitment
- Just Transition

Delivering the Plan will develop over time. The initial actions will aim to further understand the net zero skills requirements and upskilling opportunities needed.

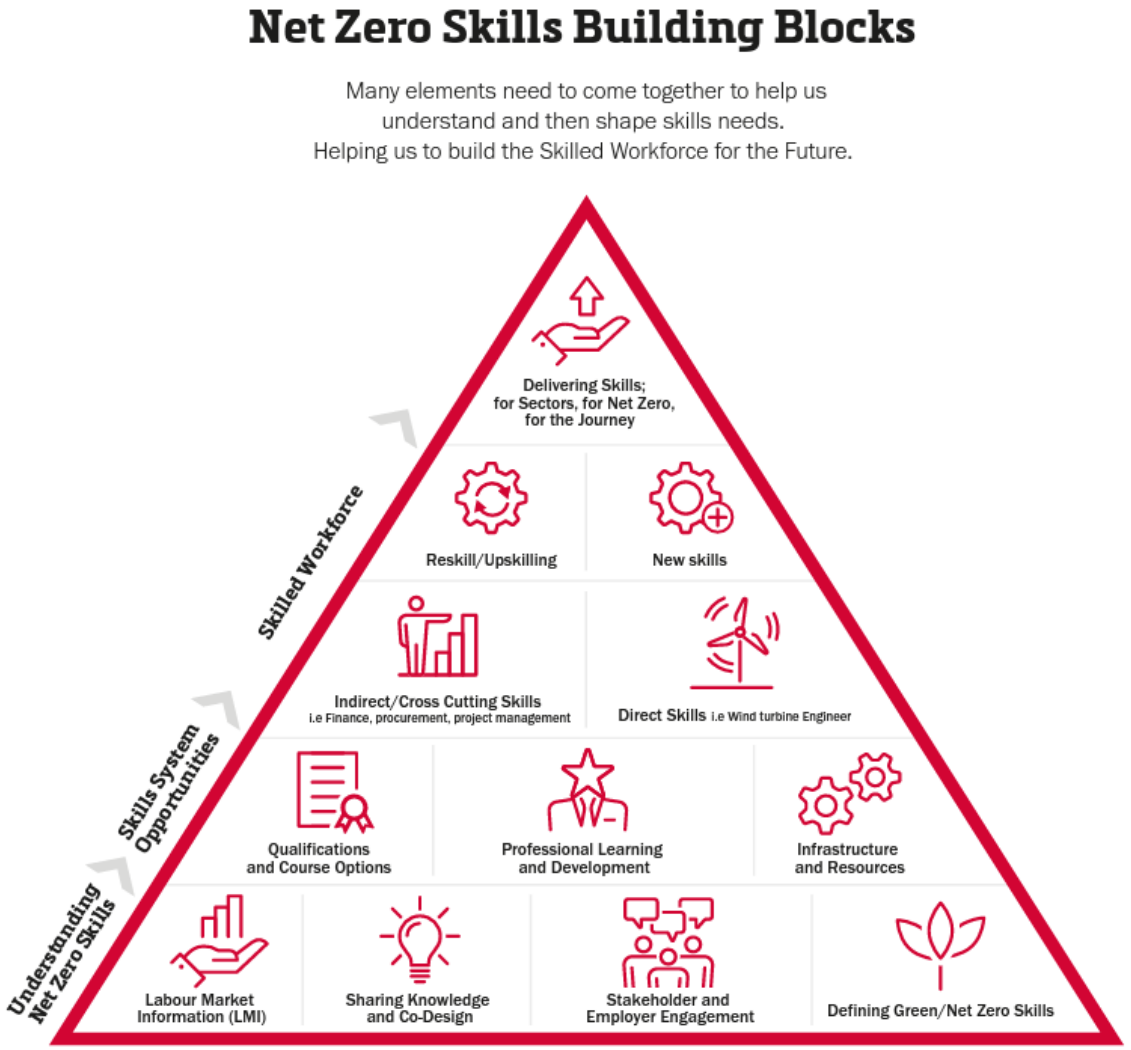


Figure 12: Building blocks for net zero skills [16]

The costs of the transition are fairly distributed across society

The costs of the transition to net zero will be multi-billions of pounds. This is finance invested in Wales which we should seek to recognise the value in Wales, whilst ensuring the benefits and burdens are fairly distributed.

Managing the cost impact on communities, in particular, for those in fuel poverty, will need attention as we transition. The upfront technology costs for a heat pump are more expensive than a replacement boiler. To stimulate the market, the UK boiler upgrade scheme provides grant funding towards low carbon heating solutions (inc. £5,000 towards an air source heat pump); further, heat pumps are currently VAT exempt.

Despite these support mechanisms, the upfront costs of heat pumps are still beyond the means of many people, particularly when coupled with the costs of installing insulation, a requirement for the boiler upgrade scheme funding.

The UK Government aims to increase the number of heat pumps installed in the UK each year from 55,000 to 600,000 by 2028[11]; this is anticipated to reduce the cost of installing a heat pump, as efficiencies are made through economies of scale.

The energy crisis has led to a dramatic increase in energy prices. According to the Office for National Statistics, electricity prices rose by 67% and gas prices by 129% in the 12 months to March 2023[17]. This financial burden on consumers risks greater fuel poverty, reduces available finance to invest, and impacts behaviours where heat pumps are viewed as expensive.

Case study:

Impact of electricity pricing on comparative heat pump operating costs

Energy tariffs have a significant impact on the operating cost of a heat pump versus boilers. The energy price guarantee is in place to limit costs to consumers. Electricity is limited to 30p/kWh and gas is at 8p/kWh (July 2023)[18]. The table shows the operating costs of a heat pump compared to a boiler at varying electricity tariffs. At current rates, a heat pump is 14% more expensive. This analysis assumes a heat pump efficiency of 280%, or 2.8 Seasonal Coefficient of Performance (SCOP), and a boiler efficiency of 85%.

Gas 8p/kWh	Electric (p/kWh) 20	25	30	35	40
	76%	95%	114%	133%	152%

Work to address electricity price mechanisms has already started. The Review of Electricity Market Arrangements is seeking to decouple electricity price setting from the gas market, opening the opportunity for cheaper renewable energy tariffs. The main opportunity lies in reforming environmental levies applied to electricity pricing.

Cost make-up of electricity bills	Wholesale commodity cost	Network and supplier costs	Environment and social obligation	VAT
	29.3%	40.5%	25.5%	4.8%

(19)

Reallocating the 25.5% environmental and social obligation would reduce electricity tariffs to ~22.35p/kWh (from energy price guarantee initial rates) – this would lead to a 15% cost saving in operating heat pumps, unlocking the financial case for investment.

The operational costs of heat pumps compared to gas boilers are one of the major barriers to the transition. Ensuring that energy pricing market mechanisms support low carbon heat is one of the critical changes needed to kick-start the transition at scale. Energy market reform is not within the powers of the Welsh Government, but we can influence the UK Government on the change needed.

Taking a whole building approach is critical to reducing primary energy demand, reducing heating flow temperatures, and reducing costs for heat users. Increasing levels of insulation and optimising the design of heat emitters and heat pump operation will increase the operational efficiencies of heat pump systems to reduce costs. Vulnerable households may require additional financial and operational support to deliver this.

To further reduce operational costs, energy suppliers are increasingly using variable tariffs. With the opportunity for heat energy storage, heat users can be well positioned to further reduce costs with a smart approach to their energy use timing. Energy suppliers have a key role in not only providing affordable rates, but also engaging and supporting heat users in the transition.

The UK Low-Carbon Heat Scheme is expected to launch in 2024. This will place an obligation on manufacturers of fossil fuel heating appliances to deliver a rising number of low carbon heat pump sales. Manufacturers will have the flexibility to meet this standard by selling their own heat pumps or purchasing credits from others. This approach aims to encourage competition in the heat pump market, stimulating innovation and cost reductions over time.

How we will deliver this objective

12 - **In developing and implementing our Just Transition to Net Zero Framework, we will identify financial and other forms of support needed for our workforce and for vulnerable households, including those in fuel poverty, to deliver a fairer transition to low carbon heat.**

13 - **We will continue to engage the UK Government on their upcoming review of the future electricity pricing comparative to gas** – currently, the taxation on electricity prices leaves a marginal cost case for heat pumps in many cases. We will continue to influence the UK Government to move taxation and levies on electricity bills into general taxation to support a just transition to a net zero Wales.

14 - **We will seek to influence energy suppliers and electricity distribution operators on how funding may be used to reduce demand-side costs** – some investment may kick-start wider energy efficiency and demand reduction, reducing overall grid constraints during the transition, and reducing consumer costs.

Transforming our energy networks

Evolving our energy networks, the pipes and wires that transport energy to our doors, is key to net zero Wales. As we switch from high to low carbon heat sources, we are shifting *how* we deliver the energy. We need to ensure the infrastructure is in place to distribute the energy for heat reliably and affordably.

The majority of Welsh homes and businesses use natural gas, delivered via the gas network, for their heat. The UK Government is funding trials of low carbon hydrogen delivered through the gas network as a replacement for natural gas in some areas. A fraction of the gas network could also be replaced by sustainable biogas. However, the Climate Change Committee's central 'Balanced Pathway' concludes that the majority of buildings in Wales need to transition to heat pumps.

Heat pumps use electricity, so our electricity networks will need an upgrade to deliver the increased electricity demand. However, Wales will be using less energy overall for its heat. The shift away from fossil fuel[20] heat will enable a more efficient whole energy system – providing more affordable warmth.

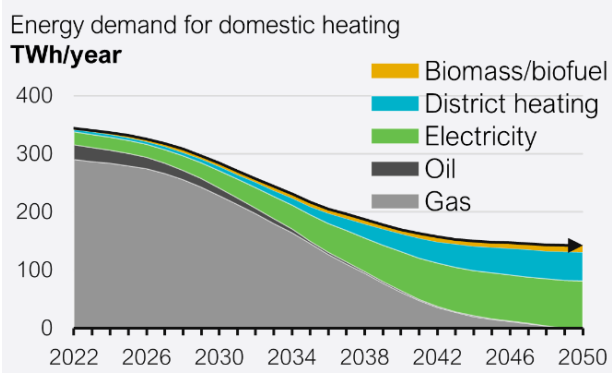


Figure 13: Domestic heating energy projections to 2050 for Great Britain[20]

We will also need to build new heat infrastructure from the ground up. Heat networks are insulated pipes that deliver heat from centralised sources. If connected to a low carbon heat source, such as a heat pump or waste heat source, they can offer an efficient and affordable approach to decarbonising heat in dense urban areas.

The key challenges with this infrastructure relate to both planning and creating an investment case. As a result, while they are a well-established method of heat delivery in Europe, there has been low uptake in Wales to date. However, by working to overcome the deployment barriers, by 2050, heat networks could be delivering a significant proportion of our heat.

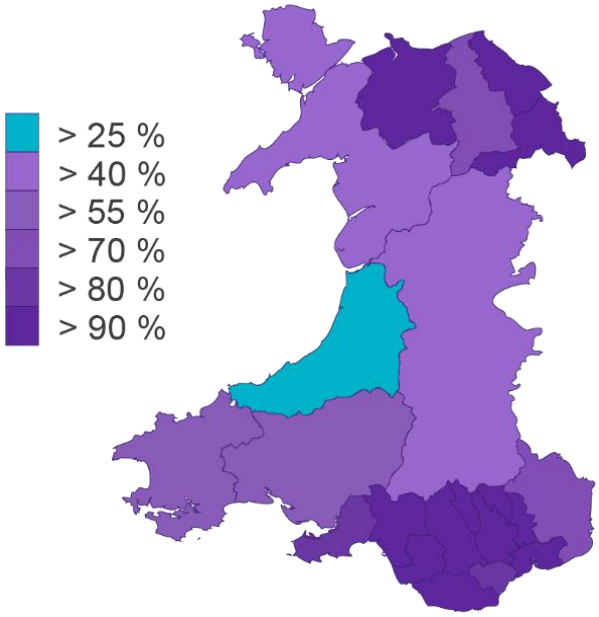


Figure 14: Homes reliant on natural gas for heating, by local authority[1]

Flexible and secure electricity networks have the infrastructure in place to effectively support electrified heat as part of a net zero energy system

Upgrading the electricity networks for net zero is achievable, but it is a major undertaking. Upwards of £100 billion of investment is estimated to be needed in the network across the UK, by 2050.[21] A key challenge is to do this efficiently to minimise the costs to bill payers.

The electricity networks have agreed business plans for 2023-2028 with the regulator, Ofgem. These plans include smarter ways to manage networks and increased investment. They include commitments to ensuring networks are not a blocker to net zero and that households can connect heat pumps to the grid quickly and easily.

Ofgem is now reviewing the regulatory framework to ensure our networks are enablers rather than blockers to net zero. To minimise long-term costs on bills and ensure timely connections, networks need to be able to strategically invest, considering long-term forecasts, working on a proactive rather than reactive basis. They also need to ensure that the infrastructure is in place to ensure that local net zero plans can be delivered.

Ofgem has proposed establishing a Regional System Planner (RSP) function that will ensure energy network operators are making the investments and putting in place the infrastructure to enable net zero, in line with local ambitions.

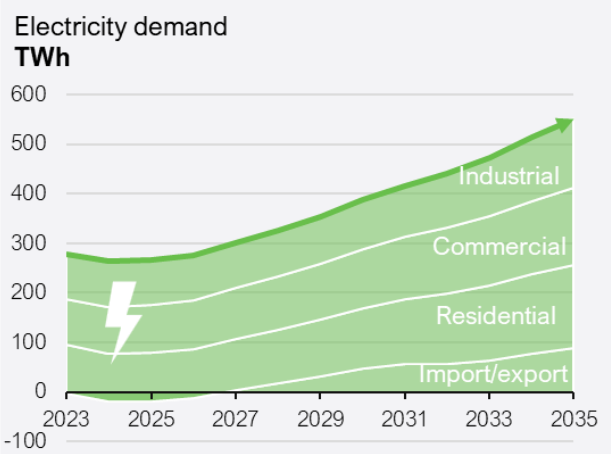


Figure 15: Great Britain's electricity networks must support a doubling of demand by 2035 to enable decarbonisation of heat and transport [20]

Roles in ensuring the networks can deliver low carbon heat

Welsh Government: Clear leadership and direction of travel on heat decarbonisation to provide evidence of the infrastructure needed.

Local authorities: Clear plans to inform electricity grid District Network Operator (DNO) investment.

Distributed network operators: Provide infrastructure to deliver on LA plans and WG overarching visions to ensure the network is not a blocker to net zero.

Ofgem: ensure the networks meet their commitments to enable net zero and a fair and efficient cost for households.

Electricity system operator (ESO): Ensure security of supply and operability of the decarbonised electricity system. The ESO has demonstrated that this is achievable, even on high and low renewable days and highlighted the work which needs to be done.

A smart, flexible approach

By using heat energy more efficiently, and in a smart way, we can go some way to reduce upgrades to our electricity networks. These measures, which will also help to reduce energy bills, and increase Wales' security of supply, include:

- Insulating and improving the energy efficiency of our homes, wasting less heat and/or generating renewable energy from home, via solar PV and solar thermal.
- Replacing direct electric heating with heat pumps, or other innovative electrical heating solutions.
- Installing heat pumps with smart controls, so that they can react to periods of low carbon, low cost electricity and integrate with generation and storage technologies within a property.
- Smart local energy systems that integrate and balance local generation and demand for energy, using smart controls, data, storage and flexibility

UK Government estimates that an electricity system that is smart and operates flexibly in response to renewable output could reduce costs by up to £10bn a year - by reducing the amount of generation and network infrastructure that needs to be built to meet peak demand.[22]

Case study:

Future Energy Networks Wales

Welsh Government commissioned the Energy Systems Catapult to assess the future requirements of Wales' energy network infrastructure. The project will generate a set of whole energy system scenarios for Wales. These outputs will help inform the steps needed for the energy network providers to evolve their plans to support the country's Net Zero carbon ambition.

Case study:

Innovation to prepare distribution networks for heat pump uptake

Project Heat-up – SP Energy Networks (North Wales): This innovation project created a method for estimating the peak load on the networks as a result of heat pump uptake, on a house-by-house basis, for several scenarios. The aim is to use the analysis to identify areas of the network requiring reinforcement.

Equinox – National Grid Electricity Distribution (South Wales): Project Equinox, which ran its first trials in early 2023, is testing commercial models for domestic flexibility from heat pumps. In partnership with the Welsh Government, the project is asking how reliable this flexibility is, and what the cost and benefits are for households.

Policy context

The UK Government and Ofgem have made changes to how networks are regulated and paid for and are consulting on further measures:

- The UK Government has committed to fully decarbonise the electricity system by 2035.[23]
- Ofgem has changed network charging to make installing a heat pump fairer across Wales. Individuals will no longer need to pay for local network upgrades when they are needed for their new heat pump (except in exceptional cases).
- In May 2023, Ofgem committed to taking a central role in driving progress on the reform of grid connection arrangements. A UK Government and Ofgem joint connections action plan is due for publication later this year. There has also been a consultation on effective governance arrangements,[24] regarding the Regional System Planner.
- The Energy Bill is going through UK Parliament and has provisions to establish an Independent System Operator and Planner (ISOP) as a public body. The ISOP will have a remit to produce a Centralised Strategic Network Plan.

How we will deliver this objective

15 - **We will continue to collaborate with partners to understand and support delivery of the future grid capacity needed to meet our ambitions for low carbon heat** – continuing the work of the Future Energy Networks Wales project, we will engage with stakeholders across Wales on building the detailed requirements for our future grid and exploring smart and flexible approaches that reduce the extent of infrastructure investment needed.

16 - **We will engage with Ofgem and UK Gov to reform network planning and the investment regime to support our plans -** ensuring increases in capacity at both transmission and distribution levels are delivered in line with Wales' net zero delivery plans.

17 - **We will engage with the Distribution Network Operators on their approach to net zero enablement and how this integrates with Local Area Energy Plans –** we will work with the networks on reform and innovation activity to support the process of connecting heat pumps to the network and how to align network plans with local ambitions.

18 - **We will engage with Ofgem and UK Gov to improve the processes for managing applications to the grid and managing the connection queue** – more effective management of grid applications will unblock capacity.

Heat networks are a reliable and efficient provider of low carbon heat in suitable areas across Wales

Heat network infrastructure accesses shared low carbon heat sources, such as heat from the ground, air, mine water, and waste heat, and distributes the energy efficiently across multiple end users.

Heat networks can vary greatly in scale, from inter-city to single apartment blocks. There are two broad types, which will make up the new heat network infrastructure in Wales:

1. Low-temperature, district heat:
   Large scale and only suitable in dense urban areas
2. Ambient temperature:
   Suitable for streets, tower blocks and community heat projects

Low carbon heat networks will be the least cost path to net zero heat for some areas of Wales. However, at present, there are very few heat networks in Wales and those installed tend to use gas as the source of energy. These existing schemes will need support to transition to low carbon energy sources.

As infrastructure projects, new heat networks need extensive early stage support to prove they are economically viable and to find investment. Feasibility studies need to be carried out and it is critical that schemes can guarantee a sufficient number of customers. The public sector, with the right support, can play a critical role in funding the early stage development of schemes and in signing up properties to connect as customers.

There is also an important role for local government in using planning policy to support the development of new schemes - for example, by identifying the potential for schemes through local area energy plans, designating heat network zones, and requiring new developments and large public sector buildings to connect to schemes in those zones.

Case study:

Waste heat from mine water

The Welsh Government is funding the investigation of using water from disused coal mines to provide heat to homes, businesses, and industries in Wales.[25]

Geological processes heat the water in flooded mines, which can then be extracted and pumped to nearby buildings as part of a heat network. The exploration project has the potential to identify areas where this may be a feasible low carbon heat system helping to achieve a Net Zero Wales by 2050.

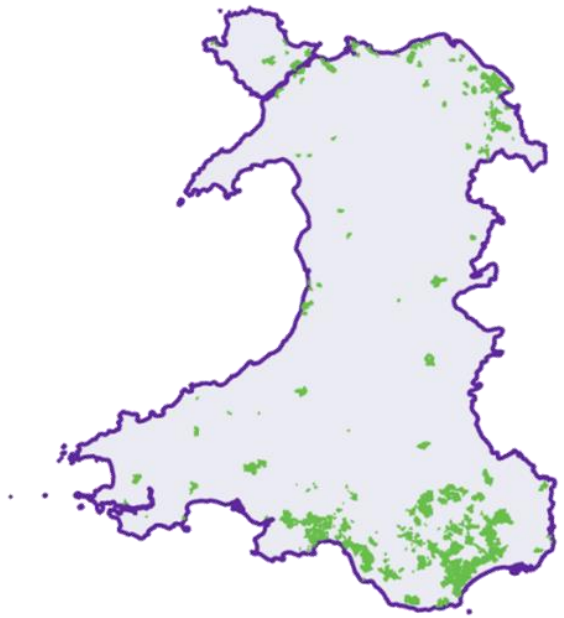


Figure 16: Areas potentially viable for district heat networks[26]

Community-led, ambient temperature heat networks are a relatively undeveloped approach to decarbonising heat, but one with significant potential and benefits,[27] [28]particularly for Wales' off-gas communities. Further support is needed to develop the business and delivery models for these schemes.

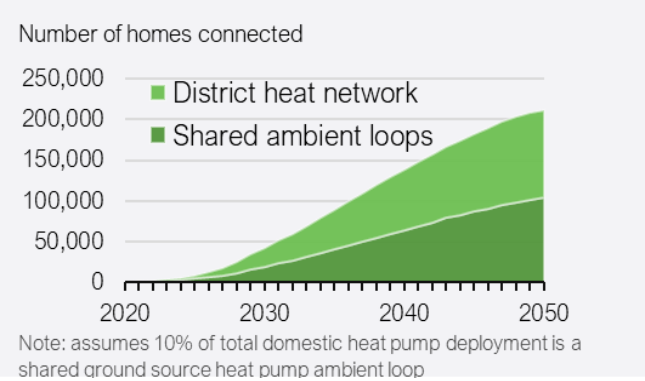


Figure 17: Net zero pathway shows 200,000 homes connecting to heat networks by 2050 in Wales[6]

Case study:

Shared ground loop array - Denbigh

The Llwyn Eirin social housing estate is under construction on the edge of Denbigh, a small market town in north Wales. It is a pioneering example of a small-scale, ambient temperature heat network; the homes will be connected to a shared ground loop array providing renewable heat from the ground.

The nine 136m deep boreholes across the site access year-round stable ground temperatures which connect to Kensa Shoebox heat pumps, within each property. Funded by Denbighshire County Council and the Welsh Government's Innovative Housing Programme, the project will see 22 sustainable homes constructed, including low embodied carbon timber frames, exemplar fabric efficiency via the Passive House Standard, and rooftop solar panels.[29]

While households have full control over their heating and hot water usage, this type of shared solution can significantly bring down the capital costs, due to the otherwise high construction costs. While this solution has so far been appealing to social landlords, with the help of RHI funding, in future it could be implemented by community groups.

Policy context

Building on the 2014 Heat Network Metering & Billing regulations, the UK Government plans to appoint Ofgem as the Heat Networks regulator for Great Britain to ensure consumers receive a fair price and reliable supply of heat – with further regulation due to come into force in 2024.

Support is available from the Heat Networks Delivery Unit (HNDU) for local authorities in England and Wales for the early stages of heat network development. This support is backed up in Wales by support through the Welsh Government Energy Service for local authorities and communities.

In addition, The Heat Network Efficiency Scheme (HNES) provides funding to heat network operators in England and Wales for efficiency and low carbon improvements to existing district communal heat networks.

The UK Government is exploring new heat network zoning powers in England through the Energy Bill. To date, Welsh Government has focussed instead on using Local Area Energy Plans as the means to identify areas for heat networks. There is potential for the Welsh Government to opt into some aspects of the zoning powers in the Energy Bill, such as mandatory connections for new developments.

How we will deliver this objective

19 - **We will review the zoning powers in the Energy Bill and consider the benefits of adopting a similar approach in Wales** – although zonal planning will be driven through our local area energy planning programme, the powers to oblige connections to suitable low carbon heat networks can be an enabler for future low carbon heat – in particular for new builds.

20 - **We will support the scale-up of viable low carbon heat networks –** we will support access to funding and expertise to develop new low carbon district and communal heat networks, and transition existing heat networks to low carbon heat. We will continue to engage UK Government on heat network support and regulations.

Case study:

Cardiff Heat Network

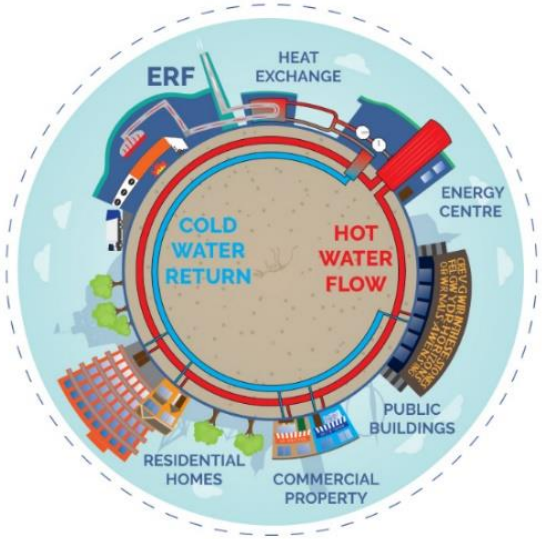
The Cardiff Heat Network (CHN) will use heat from the Viridor Energy Recovery Facility (ERF) at Trident Park in Cardiff Bay.

Cardiff's ERF currently processes 95% of South Wales' waste that would have gone to landfill. This non-recyclable waste is incinerated, which generates 250 GWh of electricity, enough to supply 68,448 households. The CHN will capture waste heat produced from the generation of electricity and give it a new purpose within the energy system.

The ERF is expected to contribute up to 85% of the heat needed for the final heat network, with a gas-powered backup energy centre needed for resilience. Whilst this is not a renewable source of energy, it is capturing waste heat. If all of the excess heat is utilised, the city could save 5,600 tCO_2e each year. As the heat network expands across Cardiff over time, there could be opportunities to incorporate renewable heat sources. The CHN has been designed to easily enable future expansions to other areas of the city, including residential and commercial properties.

For now, the ERF's excess heat will be used for phase one of the CHN, supplying 11 public buildings across the city, including the Senedd and Wales Millennium Centre, with a cost-effective, locally sourced, reliable heating and hot water system.

Cardiff City Council received a Heat Network Delivery Unit development grant from the UK Government and employed the Carbon Trust to explore the CHN feasibility and engage with key stakeholders across the city.



Funding for phase one of the £26.5 million project was secured through £15.2 million of grants and loans from the Welsh and UK Governments. This allowed for construction to begin in early 2022 with an operational date planned for 2024.

Wales will have championed zero-carbon hydrogen from renewables at localised hydrogen hubs – hydrogen will be utilised in high-temperature industries, and for other hard to decarbonise solutions

Hydrogen distribution and storage infrastructure will be a critical enabler for the decarbonisation of Welsh industry.

Hydrogen, today, is used as a chemical for oil refining, ammonia production, methanol production, and steel production and is derived from fossil fuels. However, by converting renewable electricity into hydrogen via electrolysis, 'green' hydrogen is a low carbon fuel alternative. Green hydrogen could be used for difficult-to-decarbonise sectors, which include high-temperature industrial processes, aviation, heavy transport, and long-term energy storage, as well as chemical processes.

Efficiency losses of around two-thirds are inherent in the conversion from electricity to hydrogen. As such it will remain a more expensive fuel than electricity and will not be competitive in some sectors. This is one of the reasons, as detailed in the CCC's Balanced Pathway, hydrogen is unlikely to have a significant role in supplying heat to buildings.

Role of industrial heat

Many industrial processes in Wales require high-temperature heat. Low carbon hydrogen is a low carbon alternative for such processes, like high-temperature kilns in cement production. Steel manufacturing also needs high-temperature heat, as well as a reduction agent for the chemical reaction, for which hydrogen can serve a dual purpose.[30]

Welsh Government has a clear role to play in aggregating the need for hydrogen from industrial hubs, via Net Zero Industry Wales, to ensure the infrastructure is in place to deliver the low carbon hydrogen required.

There is also a need for innovation and support for industry to make the most of the potential opportunities of switching to using hydrogen for these hard to decarbonise processes. The UK Government's Industrial Fuel Switching Competition, with a budget of £20 million, provided innovation funding to encourage early investment in fuel switching processes and technologies, in various sectors such as cement, refineries, glass, and lime.

Role of heat in buildings

Whilst there is consensus that hydrogen will be a necessary part of the solution to decarbonising heat in industry, there is a lack of strong impartial evidence to support it as the ubiquitous heating fuel in Welsh buildings. Issues include:

- High production costs
- Supply limits
- Global warming impacts of leaks
- Distribution and storage logistics
- NOx emissions impacting air quality

Off gas areas will not use hydrogen for heating and Local Area Energy Plans will work to establish the areas, if any, which may repurpose the gas grid for hydrogen heating. Households and businesses must get clarity on which low carbon heat options will be available to them.

Policy context

The development of hydrogen for industrial heat in Wales is contingent on the UK-wide industrial and hydrogen strategies. The UK Hydrogen Strategy is being implemented through three scaled trials of hydrogen infrastructure throughout the 2020s, with the aim of these to provide a potential evidence base for further hydrogen heating development. The outcomes from the neighbourhood and village trials will feed into the government's decision on hydrogen heating in 2026. Proceeding with the implementation of a third town-scale trial by 2030 is dependent on this decision and trial outcomes.

In the meantime, the UK has been consulting on hydrogen policies to prepare for the 2026 decision. These include the introduction of a hydrogen levy to pay for new infrastructure and a hydrogen 'ready' boiler mandate. [31]

We consulted on a pathway and next steps for developing the hydrogen energy sector in Wales in 2021, in which we proposed a near-term focus on the transport sector, due to its relative technical maturity for use in hydrogen fuel cells. The majority of respondents favoured domestic production of hydrogen and support for solely green hydrogen was the most popular.[32]

It is important to consider green hydrogen as a limited resource, in particular with competing uses for renewable power. Therefore, it is important that we use available green hydrogen in the most effective way for industries where there is no alternative, and to 'green' existing hydrogen use.

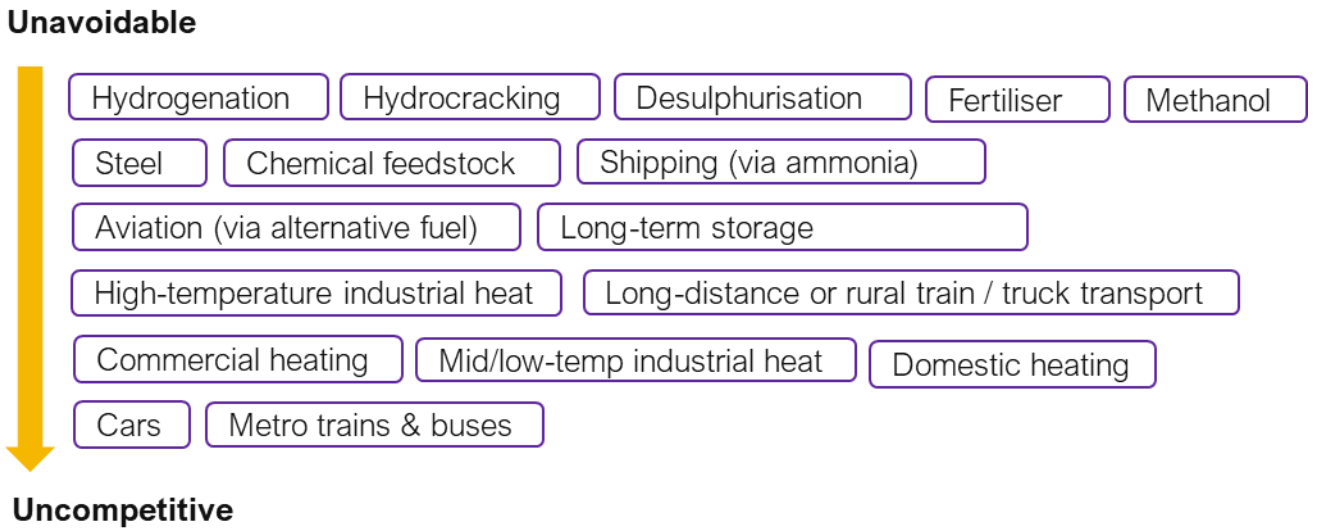


Figure 18: Comparison of the competitiveness of hydrogen with low carbon and conventional technologies (adapted from the Clean Hydrogen Ladder[33])

How we will deliver this objective

21 - **We will publish a clear statement on the role of hydrogen in meeting our buildings' heat decarbonisation ambitions in our upcoming hydrogen policy position statement** – the evidence collected for the Heat Strategy for Wales will inform this statement. Heat pumps will be the championed solution for most sectors with hydrogen having a role to play in defined hydrogen hub zones for high-temperature industry and wider net zero aligned solutions prioritised by the hydrogen ladder.

22 - **We will continue to support hydrogen innovation local to our hydrogen hubs, and map industrial heat demand across Wales** – supporting innovation will ensure Wales can recognise the benefit from the local opportunities for hydrogen.

23 - **We will use our evidence base and policy positions to influence UK Government policy on hydrogen** – ensuring that the approach adopted, for instance regarding the hydrogen levy and hydrogen-ready boiler mandate, supports our plan to transition to low carbon heat in Wales.

Improving the energy performance of our homes

Almost a quarter of energy consumption in Wales is attributed to space and water heating in our homes. Of this demand, 85% is currently fulfilled through fossil fuels, making domestic heating a primary source of nationwide emissions (10%).

Domestic emissions are distributed across 1.4 million households, and widespread and compelling solutions are required to drive change across all tenure and property types. Equally important is nurturing an effective supply chain that supports the provision and maintenance of low carbon solutions.

Welsh homes are some of the oldest and poorest energy-performing in Europe, and 'hard-to-treat' homes (so-called because their construction makes retrofit more challenging) are widespread.

Decarbonising every Welsh home should account for local (e.g. grid connectivity) and hyper-local (e.g. construction archetype) factors. Local delivery approaches led by empowered individuals and communities are needed to optimise solutions across Wales.

However, setting out a clear expectation of which technologies will be the dominant technologies in the transition is necessary to stimulate the supply chain and provide consumer confidence.

To do so, this Strategy supports heat pumps as the primary mechanism for domestic heat decarbonisation in Wales; they provide the most efficient, integrated, and affordable solution in Wales' decarbonised future for most use cases. Other low carbon solutions will complement the rollout of heat pumps where compelling contextual factors support their adoption.

Emissions from domestic cooking are outside of the scope of this Strategy, but the electrification of space and water heating will have synergies with the electrification of cooking heat, providing further carbon and air quality benefits.

Energy efficiency measures, such as improved insulation, are prominent in all credible decarbonisation pathways in Wales. Scaling demand-side momentum and a supply chain capable of delivering home energy efficiency improvements is a priority of our Strategy.

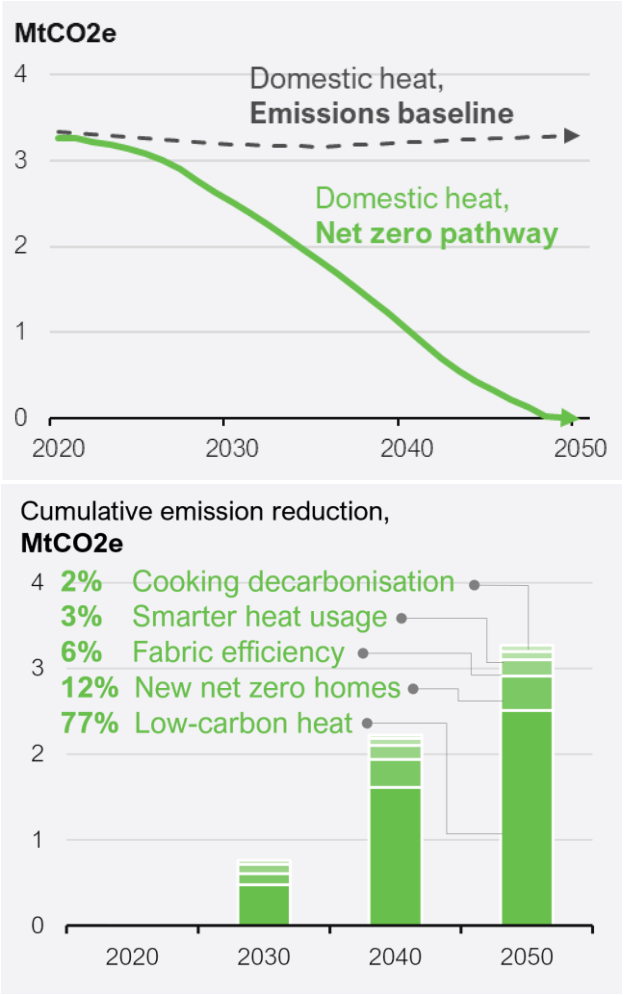


Figure 19: Decarbonisation pathway for homes in Wales and the contribution of emissions reduction measures[5]

Research shows that heating use is correlated to household income, with lower-income households sacrificing comfort for affordability. A whole building approach to domestic decarbonisation is an opportunity for every Welsh household to prioritise their comfort and health.

At the same time, decarbonising our housing stock must not create unintended and perverse outcomes, such as reduced housing options, increased rental costs, or privileged access to high-efficiency homes. The transition must include everyone.

The vision and objectives of this Strategy are intrinsically linked to our fuel poverty plan, which sets three targets for 2035:

- No households are estimated to be living in severe or persistent fuel poverty as far as reasonably practicable;
- Not more than 5% of households are estimated to be living in fuel poverty at any one time as far as reasonably practicable;
- The number of all households "at risk" of falling into fuel poverty will be more than halved based on the 2018 estimate.

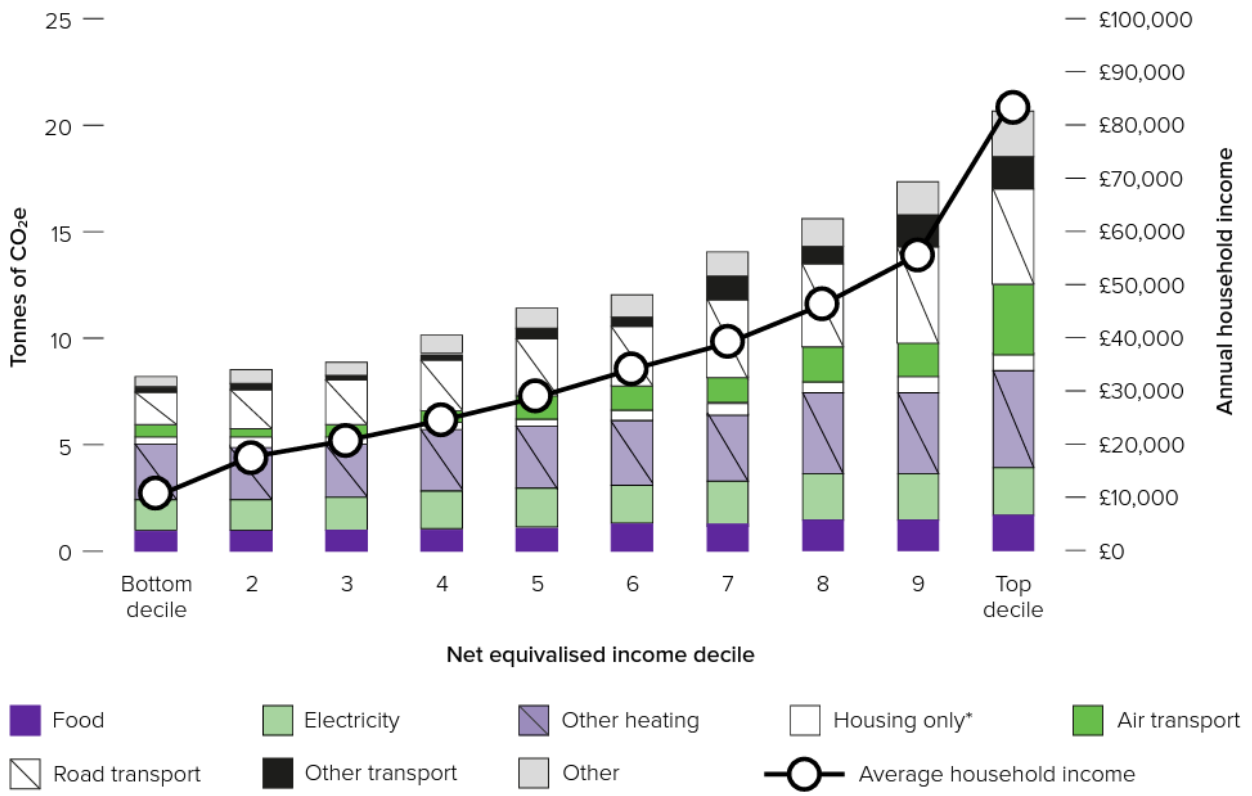


Figure 20: Average greenhouse gas footprint by net equivalised household income decile[34]

HOUSING SEGMENT [35]	POLICY DRIVERS	EXISTING SUPPORT
SOCIAL HOUSING 223,000 homes (17%)	**Wales Housing Quality Standard (WHQS)** Social landlords must maintain the WHQS. The updated WHQS2023 will take a fabric-first approach to improve the underlying performance of our social housing stock, and then aim to bring all social housing as close as feasibly possible to EPC Band A and EIR Band A.	**Optimised RetroFit Programme (ORP)** The Welsh Government's ORP supports the installation of home decarbonisation measures in Wales' social housing stock. It takes a whole house approach to understand the best value combination of building fabric improvements, low and zero-carbon technologies, and sophisticated control technologies.
PRIVATE: RENTAL 231,000 homes (17%)	**Domestic Minimum Energy Efficiency Standard (MEES)** Landlords must meet a minimum EPC rating before they're legally allowed to let a domestic property. This is currently set to EPC band E, though the UK Government has consulted on moving the MEES to EPC C. This would upgrade over 110,000 homes in Wales that are subject to MEES and currently have an EPC rating of D or lower.[36]	**Leasing Scheme Wales (LSW)** The LSW scheme aims to increase access to, and affordability of, renting privately in Wales. Standards apply to homes available through the scheme. **Empty Homes Grant** This funding scheme supports individuals to bring empty homes back to use. Up to £25,000 is available, and energy efficiency measures are within scope. **Boiler upgrade scheme** The Boiler Upgrade Scheme is a £450m grant scheme open to households in England and Wales to cover part of the cost of replacing a fossil fuel heating system with a heat pump or biomass boiler.
PRIVATE: OWNER-OCCUPIED 895,000 homes (66%)	**National Milestone: All homes in Wales will have adequate and cost-effective energy performance by 2050** National Milestones are required under section 10(3) of the Well-being of Future Generations (Wales) Act 2015 to assist in measuring progress towards the achievement of the well-being goals.	**Energy Company Obligation (ECO)** The ECO scheme is a £4bn nationwide scheme providing grant funding to improve the domestic energy efficiency of households living in fuel poverty and social housing. **Warm Homes programme (WHP)** The WHP funds energy efficiency measures to eligible households plus free and impartial advice to all households. Since its inception, the Welsh Government has invested more than £394m through the programme.

A clear regulatory framework will be in place that supports net zero homes across all rented, owner-occupied, and social housing

Clear Government signals are critical for industry and businesses to make strategic investments in Wales, and for Welsh households to have confidence in transitioning to low carbon heating solutions.

Policymakers have an important role to play in the transition by overseeing regulation for planning, buildings, and suppliers. In the domestic heat sector, firm policy positions are needed to transfer momentum from current fossil fuel technologies towards low carbon technologies.

This Strategy advocates regulation that will stimulate investment and support the efficient delivery of the transition across the domestic sector while protecting consumers from perverse outcomes. We will consult on potential regulations that will fundamentally support domestic heat decarbonisation by:

- Reducing fuel demand and energy bills by driving energy efficiency improvements across Wales through a review of standards at the point of sale and letting, as well as supporting ambitious improvements to the social housing stock
- Indicating the direction of travel towards low carbon technologies, by exploring the potential for a ban restricting the sale of fossil fuel heating systems with clear dates for new developments and existing dwellings.

Engaging with UK Government will be key to putting the regulatory requirements in place. This will mean influencing the UK Government's plans to ban gas boilers in new builds in 2025, and to phase out the installation of all new gas boilers beyond 2035.

How we will deliver this objective

24 - **We will consult on introducing planning policy that restricts fossil fuel heating in new developments with a firm date communicated as a ban –** we'll explore other mechanisms such as through building regulations to assist in this goal as required, and also engage with UK Government.

25 - **We will develop and consult on phasing out fossil fuel boilers in existing dwellings at the point of replacement.**

26 - **We will investigate options for the use of energy performance standards at the point of sale and letting as a mechanism to drive low carbon heat uptake**.

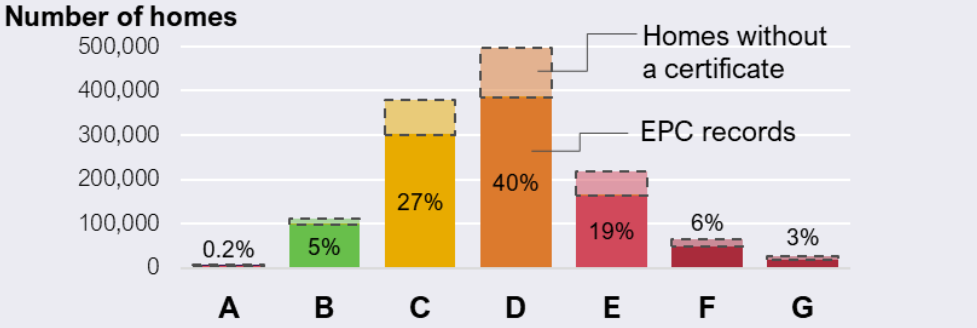
27 - **We will continue to drive standards through our Welsh Development Quality Requirements and Welsh Housing Quality Standard where all new social housing must achieve EPC A or an equivalent standard, and existing social housing must have a Target Energy Pathway in place to achieve EPC A by 2033 or by a date after 2033 that Welsh Government has authorised.**

Homes are thermally-efficient and served in the main by heat pumps – a whole building approach has been taken to the transition and homeowners understand how to operate their systems

Thermally efficient homes retain heat and facilitate optimal performance of heating systems, increasing comfort whilst simultaneously reducing fuel bills.

In part due to their age (34% of households were built before 1929), Welsh homes are some of the worst performing in Europe; 68% are EPC rating D or lower. Improving the energy performance of Welsh households is a no-regrets option that this Strategy supports.

Reducing heat demand is one part of the puzzle. The second is meeting the heat demand with low carbon heat sources. Over 85% of Welsh households are served by fossil fuelled heating and require support transitioning to low carbon heat sources, such as heat pumps.



Note: Not all homes have an EPC record. Missing homes have been evenly distributed to represent the full housing stock. However, some homes are underepresented - only 64% of owner occupier homes are accounted for, accourding to the 2021 census.

Figure 21: Number of properties by EPC rating across Wales

How we will deliver this objective

28 - **We will support homeowners with advice and support for the transition to low carbon heat** – we'll share resources and opportunities such as the Boiler Upgrade Scheme grant, and share a customer journey for how to implement and operate a heat pump system supported by fabric improvement.

29 - **We will prioritise low carbon heat as part of the next iteration of the Warm Homes Programme to support households in fuel poverty in owner-occupied and private rented homes.**

30 - **We will support social landlords – delivering our 'Optimised RetroFit' programme in the short term and exploring the longer term options to help social landlords achieve EPC A.**

31 - **We will undertake exemplar schemes and share best practice to demonstrate how historic and traditionally constructed buildings can effectively decarbonise heat.**

32 - **We will support the smart meter roll-out as part of our programmes and in our advice** – this will futureproof our homes for variable tariff and demand management opportunities.

33 - **We will explore how to transition to low carbon heat for the owner-occupied and private rented sectors** – our housing decarbonisation implementation group will assess pathways and support options, taking the learnings from existing programmes and wider best practice.

Low carbon heat solutions will be affordable to install and affordable to operate

The transition to clean technologies is also a transition to more efficient, more integrated, and smarter heating systems, and an opportunity to eradicate fuel poverty in Wales.

To do so, low carbon heating systems must be affordable to purchase and have lower operating costs compared to current systems – both are achievable.

- **Upfront cost:** It is envisaged that the upfront cost of heat pumps will remain higher than gas boilers,[37] even with expected cost reductions. We will support the development of bespoke finance mechanisms to reduce financial barriers to uptake at the point of replacement, whilst simultaneously supporting cost reductions.
- **Operating costs:** Optimising system performance is critical in ensuring acceptable operating costs. A whole building approach to developing low carbon heat helps to ensure that systems are optimally designed.

Mechanisms to reduce operating costs:

	**Improving energy efficiency** will decrease the amount of fuel that we need to keep our homes comfortable and reduce household and system costs.
	Promoting **best-practice installation** will ensure that a heating system operates as it was designed and in the most efficient way possible.
	Developing **smart systems and variable tariffs** will allow households to take advantage of periods of low cost electricity.
	In line with our Climate Action Wales Public Engagement Strategy, we will help people by making green choices easier, more convenient and more affordable.

How we will deliver this objective

34 - **We will convene a taskforce to address financial barriers for low carbon heat solutions across the domestic sector** – the taskforce will be in place for the longer term; it will take a consolidated view across all support programmes, and the future needs of homeowners to implement low carbon heat.

35 - **We will ask the Development Bank of Wales to champion a whole house approach to low carbon heat solutions in its housing development finance offers.**

36 - **We will work with the UK Government and energy suppliers to understand how variable tariff offers can be utilised better for homeowners.**

37 - **We will consider options for further funding for social landlords to meet EPC A across all homes.**

Evolving our businesses

Currently, heat supplied to Welsh businesses accounts for 15% of the country's total energy use, with the retail, office, and leisure sectors being the main users, with much of this currently coming from natural gas (an estimated 7.3-9.3 TWh[39]). This heat is used for a wide range of purposes, from space heating and water heating to cooking and cleaning.

Industrial businesses also heavily rely on heat, this is discussed further in *Future-proofing our industry.*

Businesses have the power to influence supply chains, consumer behaviour, and industry norms.

Through sustainable procurement practices, responsible production methods, and the promotion of low carbon products and services, businesses can foster a culture of sustainability throughout their operations and beyond. This ripple effect can create positive environmental impacts, drive innovation, and shape a market that prioritises sustainability.

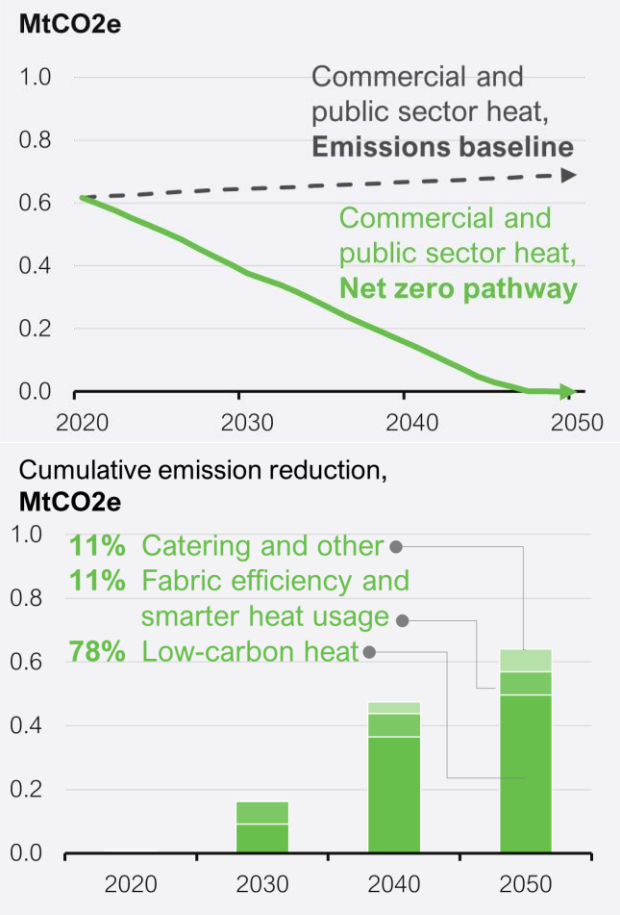


Figure 22: Pathway for commercial and public sectors buildings and emissions reduction measures [6]

Figure 23: Key business sectors and gas use in Wales [39]

Collaboration is key in this journey towards a net zero future, and businesses have an opportunity to leverage their expertise, resources, and influence by working together. By fostering partnerships, co-creating innovative solutions, and sharing best practices, businesses can accelerate the adoption of sustainable technologies and practices on a larger scale.

The transition to a net zero future necessitates a collective effort, and businesses are at the forefront of this transformative journey. By proactively embracing decarbonisation, promoting sustainable business models, and embracing corporate social responsibility principles, businesses can become the driving force behind the creation of a sustainable and resilient economy for the future.

Improving the energy efficiency of businesses in Wales stands as a critical initial stride towards decarbonising business heat. Encouraging businesses to embrace energy-efficient practices and technologies can yield multiple benefits, including reduced energy consumption, lower carbon emissions, and decreased energy costs. Notably, there has been a significant improvement in average Energy Performance Certificate (EPC) ratings for non-domestic buildings over the past decade, driven by enforced energy efficiency standards in planning and rental requirements, over 40% of businesses now have an EPC rating of A-C[38]. This progress highlights the potential for further advancements.

In Wales, micro, small, and medium-sized enterprises (SMEs) comprise over 99% of businesses and employ 62% of the workforce. However, many of these SMEs face financial constraints that hinder their ability to invest in low carbon heat solutions. This presents a challenge for small businesses in actively contributing to Wales' net zero targets. There is also a diverse range of commercial building tenure structures across Wales, including, privately rented, owner-occupied (freehold or tenants in common), or leases.

To achieve meaningful progress, we must move beyond a one-size-fits-all approach. Each business in Wales possesses unique characteristics, and our decarbonisation strategy must acknowledge and embrace this diversity. By tailoring our approach and providing targeted support, we ensure that no business is left behind in our journey towards a sustainable and net zero future.

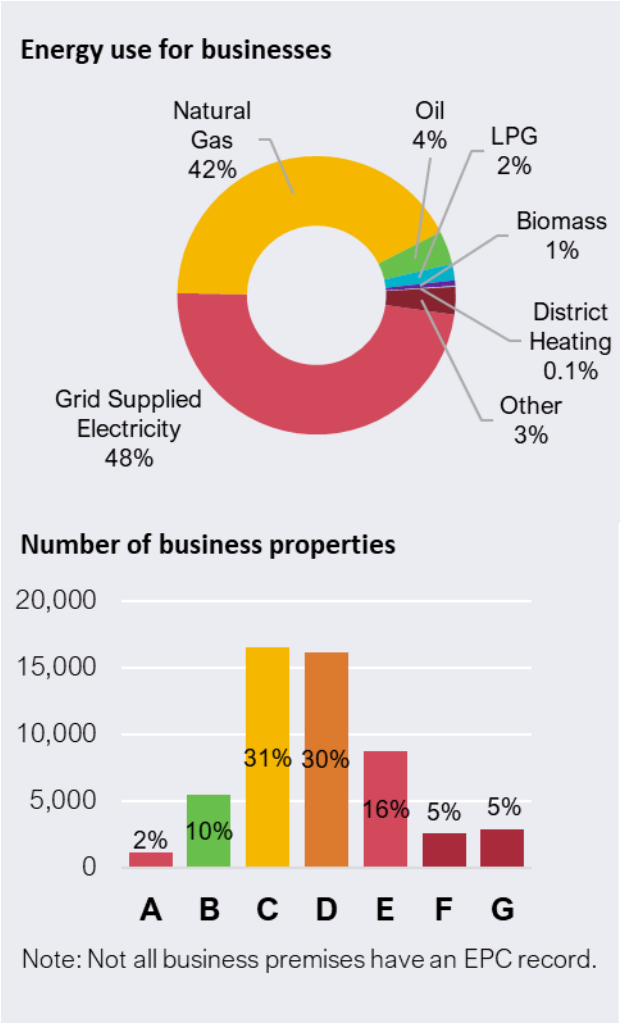


Figure 24: Energy use and EPC ratings of businesses [38]

There are a number of policy drivers for businesses to transition to low carbon heat, these include:

- **Streamlined Energy and Carbon Reporting (SECR)** is a requirement for large companies in the UK to include information about their energy usage, greenhouse gas emissions, and energy efficiency measures in their annual reports.
- **Energy Savings Opportunity Scheme (ESOS)** a mandatory energy assessment and reporting scheme; requires qualifying organisations to identify energy-saving opportunities and report on energy consumption and efficiency.
- **The Minimum Energy Efficiency Standards (MEES) Regulations** are designed to enhance the energy efficiency of privately rented commercial buildings with low performance. As of 1st April 2023, it is against the law to let or rent out a property that does not have a minimum EPC rating of E. This requirement will further increase to a rating of C in 2028 and B in 2031.

Green Business Loan Scheme, Development Bank of Wales

- Repayable finance (up to £1.5m) for the deployment of renewable technologies. Loan term linked to the payback on the project, up to a maximum of 15 years. With reduced interest rates for low carbon heat projects.
- Match funding of up to 50% for feasibility work, with up to £10,000 of grant support.

Business Advice

- Free Business Wales Decarbonisation Advisors are available to support businesses to adopt or improve environmental strategies, and work with businesses towards creating a resource efficient and resilient business.

Grant Funding Support

- The UK Governments Boiler Upgrade Scheme (BUS) supports the decarbonisation of heat in buildings. It provides upfront capital grants to support the installation of heat pumps and biomass boilers

Figure 25: Available support for businesses to decarbonise

Businesses in Wales will be sustainable and supported by affordable low carbon heat solutions

Our vision for businesses in Wales is to create a sustainable environment where affordable and accessible low carbon heat solutions are readily available. We recognise the challenges that businesses face.

We want to explore existing costs and ensure that low carbon heating provides cost-effective alternatives, making the transition to a more sustainable future financially viable and attractive for all.

Our strategic approach is to prioritise our efforts in areas where we can achieve significant carbon and financial savings.

One such area of focus is the approximately 22,000 commercial buildings in Wales that are off the gas grid and primarily rely on oil heating systems.[39] The CCC has signalled in the Sixth Carbon Budget that oil boilers should be phased out by 2026 in commercial properties. The UK Government has consulted upon introducing regulations to address large off-gas-grid non-domestic buildings (over 1,000m^2 no earlier than 2024, followed by small and medium off-gas-grid non-domestic buildings from 2026).[40]

On-grid properties are responsible for the majority of business heating emissions. While the Committee on Climate Change (CCC) and the Net Zero Review recommend phasing out sales of gas boilers by 2033, the UK Government's current ambition is to phase out the installation of natural gas boilers by 2035, which represents a less ambitious timeline. The lack of specific phase-out targets for gas boilers in businesses is due to the need for strategic decisions on the role of hydrogen, which are expected to be made in 2026. As a result, there is currently no legislation or consultation in place to determine the precise timeline for the phasing out of gas boilers in the business sector.

Affordability is a central consideration in achieving our vision. We understand that businesses operate within budget constraints, and the cost of implementing low carbon heat solutions must be justifiable for every business. Many businesses discover poor business cases for the installation of low carbon heat and we want to strengthen this case. By addressing the financial barriers, promoting the business case for installation, and fostering a supportive market environment, we aim to create a thriving ecosystem where businesses can easily access and benefit from low carbon heat.

How we will deliver this objective:

38 - **We will explore how we can phase out the installation of all new gas boilers for commercial properties by 2033** – aligning with the Climate Change Committee recommendation that the sale of gas boilers to businesses will be phased out by 2033.

39 - **We will explore how we can prioritise the phase-out of off-gas grid fossil fuel boilers for commercial properties** – off-gas grid properties have the greatest carbon impact and prioritising these will have the greatest impact.

40 - **We will explore non-domestic rates support for the installation of low carbon heat technology to assist the cost-effectiveness of businesses transitioning to low carbon heat.**

Businesses will have the confidence to invest in the transition to low carbon heat and net zero buildings

Our vision is to empower businesses with the confidence to invest in the transition to low carbon heat and achieve net zero buildings. We understand the challenges businesses face in navigating the complex landscape of low carbon heat solutions. Many businesses are uncertain about the available options and lack the necessary resources to make investments in low carbon heat technologies.

We are committed to providing businesses with clear guidance and support, helping them navigate through the various low carbon heat solutions and identify the most suitable options for their specific needs. We will work to bridge the knowledge gap, ensuring that businesses have access to reliable information on different low carbon technologies.

By fostering an environment of confidence and providing the necessary support, we aim to empower businesses to embrace the transition to low carbon heat and net zero buildings.

Case study:

Development Bank for Wales, Green Business Loans

The Green Business Loans Scheme offers a package of support to enable Welsh businesses to tackle energy efficiency and decarbonisation action by providing low interest loans. A variety of eligible technologies are available for funding including:

- Heating, ventilation and air conditioning replacement, management, low carbon technology
- Building fabric improvements
- Insulation, double glazing, LED lighting
- Renewables – solar PV, ground/air/water source heat pumps
- Monitoring & controls, replacement, low carbon technology
- Water usage & waste reduction/improvements

Projects with unattractive payback (i.e. over the term of the loan) and/or low carbon heat solutions receive a 5% discount on interest rates. This includes renewable heat technology and building fabric upgrades.

How we will deliver this objective:

41 - **We will explore an accelerator programme for commercial buildings in Wales** – we'll share best practices and build confidence in the role of low carbon heat for sustainable business in Wales.

42 - **We aim to continue support through the Development Bank of Wales Green Business Loan Scheme** – we will track the success of the scheme through the scale of engagement in feasibility support and the overall investment recognised in low carbon heat.

43 - **We will continue to support businesses in Wales through our Business Wales Decarbonisation Advisors** – we will ensure that the support provided includes advice on the approach for low carbon heat and the opportunity of the net zero transition.

Our businesses and commercial properties will demonstrate their net zero credentials, building confidence and engagement with consumers

By fostering a culture of transparency and accountability, we will enable businesses in Wales to differentiate themselves as sustainability leaders. This will not only benefit their reputation and competitiveness but also contribute to the collective efforts in achieving our ambitious climate goals.

"Only 36% of small businesses have a plan to combat climate change"

- Federation of Small Businesses

Businesses have various accreditations to demonstrate their commitment and progress towards achieving net zero emissions. These accreditations provide third-party verification and recognition of a company's sustainability efforts.

Some commonly used accreditations include:

- **Science Based Targets (SBTi)** offer companies a well-defined pathway to reducing greenhouse gas (GHG), ensuring they align with the goals of the Paris Agreement and the latest climate science.
- **The International Organization for Standardization (ISO)** provides a range of standards that businesses can adopt to enhance their environmental performance.
- **The Carbon Disclosure Project (CDP)** is a global platform that enables companies to disclose their environmental data transparently.
- **Carbon Trust Standards** are certifications that recognise companies that have achieved significant carbon reductions or have demonstrated sustainable practices in specific areas such as demonstrating the route to net zero, carbon reduction, or zero waste to landfill.

We recognise that navigating the sustainability landscape can be challenging and transitioning to low carbon heat solutions can be a complex and resource-intensive project. We already support businesses to take the first step towards improving sustainability through our Green Growth Pledge.

Case Study:

Business Wales, Green Growth Pledge

The Green Growth Pledge helps Welsh businesses take proactive steps towards improving their sustainability, demonstrating their positive impact on the people and places around them, as well as joining a growing community of forward-thinking organisations that are helping Wales transition to a low carbon future.

It offers a range of straightforward, practical actions that can be taken, such as reducing vehicle use, increasing water and energy efficiency, and working with responsible suppliers that will help companies become more efficient, decarbonise and win new business.

Our objective is to go further and streamline the process and provide further accountability for businesses of all sizes and sectors. Through our support, businesses will have the opportunity to certify their commitments and measure their performance, demonstrating their dedication to sustainability.

How we will deliver this objective:

44 - **We will review the use of building performance certificates, their role in minimum energy efficiency standards for renting, and how improvements can be made to champion net zero assurance –** we'll consider the accuracy and perceived importance of building performance certificates and how to better drive low carbon heat activity.

45 - **We will champion our businesses independently certifying their net zero commitments and performance, demonstrating progress to net zero –** we will continue to deliver our Green Growth Pledge through Business Wales and explore the options to support a net zero charter for businesses to build commitments, further, standards such as Science Based Target Initiative certification will be shared with businesses to help demonstrate net zero alignment.

Future-proofing our industry

Industry has long been a cornerstone of our economy, providing employment opportunities for our communities and strengthening our foundational economy. As we embark on a new era, it is crucial to recognise and build upon Wales' rich industrial heritage.

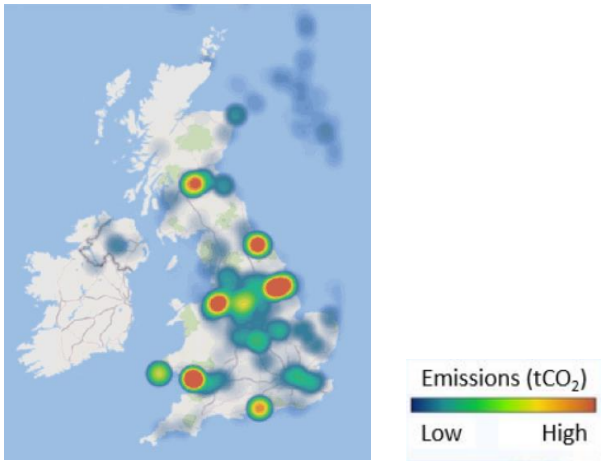


Figure 26: Emissions from UK industrial sites[41]

We have a diverse landscape of industrial activity across our nation. From light manufacturing to heavy industry, each sector has bespoke heat requirements and decarbonisation challenges. It is essential to understand these industries' specific needs to develop tailored strategies for their decarbonisation journeys.

Industrial processes are often complex and highly integrated, and a whole-process approach must be taken to many industrial decarbonisation challenges, including heat.

The establishment of industry clusters, such as the South Wales Industrial Cluster (SWIC), creates opportunities for integration between sites. Optimising industrial decarbonisation in Wales will require collaboration and knowledge sharing locally, nationally, and internationally, and the Welsh Government commits to supporting the collective action of Welsh industry.

Decarbonising the South Wales Industrial Cluster is a £30bn investment opportunity with the potential to support 113,000 jobs.

SWIC: A plan for clean growth

Industrial processes require a diverse spectrum of temperatures, ranging from process chilling to high-temperature furnaces. The Climate Change Committee previously labelled industry as a 'hard-to-treat' sector[42]; however, it is widely accepted that technologies already exist to reduce emissions to low levels by the middle of the century. For high-temperature processes, the incorporation of low carbon hydrogen is expected to play a pivotal role, and electric solutions are expected to be competitive over a vast range of temperatures (low to high).

It is vital to deploy and develop solutions that enable the transition to low carbon alternatives without compromising productivity or competitiveness on a global stage. Not doing so endangers the livelihoods of thousands working in industry, as well as emissions being offshored to regions with less stringent environmental regulations.

By embracing decarbonisation strategies that enhance efficiency, promote innovation, and leverage sustainable technologies, we can create a competitive advantage that positions Welsh industries as leaders in the global transition to a low carbon future.

Together, we will navigate the path towards a sustainable and just transition for our industries, our communities, and our nation.

Policy context

Many of the powers to enable deep decarbonisation of Welsh industry are held by the UK Government. The globalised nature of large industry also means that the Welsh industry is sensitive to overseas policy.

- UK Emission Trading Scheme (ETS): The UK ETS currently applies to energy intensive industries, the power generation sector and aviation. The scheme uses a 'cap and trade' system to limit the amount of carbon that can be emitted, with the limit decreasing over time. Participants in the UK ETS are required to obtain allowances equivalent to their annual emissions under the scheme, priced at £83.03/tCO_2e for 2023.
- EU Carbon Border Adjustment Mechanism (CBAM): The EU CBAM is aimed at preventing 'carbon leakage' into the EU and aims to price the carbon emitted during the production of carbon intensive goods entering the EU. Not complying with the EU's level of policy stringency for industrial sectors could risk Welsh industry exports to the EU being penalised by the CBAM.
- Climate change agreements are voluntary agreements made between the UK industry and the Environment Agency to reduce energy use and CO_2 emissions. In return, operators receive a discount on the Climate Change Levy, a tax added to electricity and fuel bills. The use of Climate Change Agreements has been extended to March 2025.
- Just Transition to Net Zero Wales: Over 100,000 Welsh workers[43] will be impacted by the transition to a net zero industry. The Welsh Government's recent call for evidence is aimed at fully understanding the consequences of the transition[7]. We must work with industry to mitigate impacts and leverage opportunities, using the transition to pivot towards improved outcomes for those involved in the Welsh industry.

Case study:

South Wales Industrial Cluster: A Plan for Clean Growth

South Wales has long been home to a thriving and diverse industrial sector, and today includes the UK's largest integrated steelworks, one of only seven oil refineries in the UK, and several other sectors including cement, paper, glass, food and chemicals. South Wales is the second largest industrial and power carbon emitter in the UK, and decarbonising the cluster is key to achieving both Wales' and the UK's national climate commitments.

The South Wales Industrial Cluster brings together 31 partners within the region, and in March 2023 published a regional plan for decarbonisation: A plan for clean growth. The plan outlines a vision for net zero industries in South Wales by 2040 (equating to a 40% reduction of Wales' national carbon emissions), leading to £30bn of investment opportunities and a net positive impact on employment and economic output.

SUPPORT FOR INDUSTRIAL HEAT DECARBONISATION

Strategic planning	**Local Industrial Decarbonisation Plans competition:** £5m of grant funding aims to foster collaborative and strategic decarbonisation plans for industrial manufacturers in dispersed sites.	**Industry of Future Programme:** allows for high-emitting industrial sites to apply for funding to develop industrial decarbonisation roadmaps.	**The Industrial Decarbonisation Challenge (IDC):** £210m is ringfenced to support the UK's six largest industrial clusters (inc. South Wales) to develop projects focussed on the reduction of carbon emissions from energy intensive industries. The IDC supported the development of the South Wales Industrial Clusters' decarbonisation plan: A plan for clean growth.
Fuel switching	**Industrial Fuel Switching Competition:** £55m of funding will be awarded to the development and demonstration of industrial fuel switching and fuel switch enabling solutions.		£20m of the IDC funds the **Industrial Decarbonisation Research and Innovation Centre,** which aims to develop innovative decarbonisation solutions for UK industry.
Energy efficiency	**Industrial Energy Efficiency Accelerator:** funds industrial-scale demonstrations of novel technologies with the potential to reduce energy consumption, maximise resource efficiency and cut carbon emissions.		**Industrial Energy Transformation Fund:** Now in its third phase, the IETF provides grant funding to UK businesses for energy efficiency and deep decarbonisation studies and deployment projects.
Low carbon H_2	**Industrial Hydrogen Accelerator Programme:** providing up to £27m to support innovation projects that can demonstrate end-to-end industrial fuel switching to hydrogen.	**Low Carbon Hydrogen Supply 2 competition:** circa £63m was awarded to identify and physically demonstrate innovative hydrogen supply solutions	**Net Zero Hydrogen Fund (£1bn):** Provides up to £240m in support of the development and construction of new low carbon hydrogen production plants across an array of production technologies.

Industry is transitioned, competitive, and sustainable for the long-term following implementation of best available techniques for energy efficiency and low carbon heat

Decarbonising heat in Welsh industry is a multi-year, multi-billion-pound transition centred around large scale implementation. The decisions that are made will have a significant impact and, in some cases, will be 'locked in' for decades.

The potential reward is a renewed, low carbon, and globally competitive industry at the heart of the Welsh economy. The Welsh Government commits to supporting this vision across the lifecycle of projects – from strategic planning and knowledge sharing to technology development and implementation.

A combination of complementary technologies will be required to drive the transition across the Welsh industrial sector. No-regret options such as resource and energy efficiency improvements should be pursued as standard, and planning for large-scale implementation projects should be initiated at the earliest opportunity.

Table 1: Technologies impacting industrial heat decarbonisation

CATEGORY	KEY TECHNOLOGIES
Resource and energy efficiency	Low-grade waste heat recovery, enhanced separation, process and system integration.
Electrification – High temperature	Electromagnetic heating: induction, infrared, microwaves; Electric arc and plasma arc furnaces
Electrification – Low temperature	Electromagnetic heating: infrared; heat pumps; electric boilers
Hydrogen	High-temperature hydrogen furnaces and kilns

How we will deliver this objective

46 - **We will support industry to access available funding and support options to enable its transition to affordable low carbon heat -** we will work with industry and Net Zero Industry Wales to maximise the opportunities to access to UK Government funding streams.

47 - **We will work with industry to create decarbonisation pathways for each key industrial heat application –** we will work in collaboration with industry and the industrial clusters to consider opportunities for energy efficiency, waste heat, hydrogen hubs and other innovative approaches. We will disseminate best practice and facilitate and incentivise data sharing, learning and collaboration, working with Net Zero Industry Wales.

Low carbon hydrogen hubs are established and serving high-temperature industrial processes and local users where appropriate

Hydrogen is a vital feedstock for Wales' current industry (e.g., oil refining, nickel refining, steel production) and is expected to remain so in the future. The supply of hydrogen from low carbon sources is therefore a prerequisite to achieving a net zero industry.

To achieve this, the Welsh Government will support industry, energy networks, and technology developers to progress innovative solutions to deliver integrated low carbon hydrogen hubs in proximity to future off-takers.

In areas where suitable hydrogen infrastructure is developed, hydrogen is expected to be competitive for the provision of high-temperature industrial heat. The localised extension of a network to serve non-industrial users may also be viable where efficiencies from utilising the hydrogen infrastructure create a compelling case for adoption in the wider local area. However, the widespread expansion of hydrogen infrastructure (production, distribution, supply) is not anticipated away from key industrial users.

Case study:

Trecwn Green Energy Hub

Statkraft is developing a green energy hub in Trecwn, Pembrokeshire. The project is aiming to produce green hydrogen (so-called because the hydrogen is produced using renewable electricity) from onsite wind and solar generation. The hydrogen is intended to be used locally for a range of purposes including as a feedstock or heat source for industry and manufacturing, as well as for serving local buildings for heat and heavy transport.

The project has been supported by UK Government funding under the Net Zero Hydrogen Fund.

How we will deliver this objective

48 - **We will continue to support hydrogen innovation local to our hydrogen hubs, and map industrial heat demand across Wales** – supporting innovation will ensure Wales can recognise the benefit from the opportunity for a hydrogen economy.

49 - **We will engage our energy network operators on the plan for hydrogen in industrial areas, the infrastructure needed, and the opportunities for renewable electricity generation.**

Leading the way with public services

Our public sector plays a crucial role in the makeup of our society. They provide vital services to manage our communities and support the well-being of families in Wales.

The public sector in Wales is made up of around 40 larger public sector organisations and a significant number of community and town councils and other public bodies. Universities and colleges are supported with public funding and considered part of an extended public sector.

As well as providing services, public bodies have a leadership role to play in the transition to a net zero future. The ambition has been set for the Welsh public sector to be collectively net zero by 2030 – delivering low carbon heat in the public estate will be critical to meeting this goal.

Beyond directly tackling public sector heat emissions, public bodies have an important role in enabling low carbon heat across all sectors in Wales. In particular, the Welsh Government will provide the policy for the ongoing strategic direction, and local authorities will deliver the planning services needed to implement the transition.

Many challenges will face public bodies in delivering net zero. For the shorter term, there is a need to sustain services in the face of constrained resources and finance as we recover from the Covid-19 pandemic. With 2030 not long away, the scale of the delivery challenge is significant, in particular as the low carbon heat market and skills still need to grow to meet the demand.

Despite the challenges, good progress is already being made. Across most of the 40 larger public bodies strategies and action plans for decarbonisation are in development; this is backed up by Net Zero Reporting to assess emissions each year. Local authorities are leading Local Area Energy Plans across Wales to set the priorities and pathway for a low carbon future.

Figure 27 Welsh public sector

There are ~4,600 public sector buildings in Wales, each with unique requirements for low carbon heat retrofit.

The estimated scale of direct public sector heat emissions from Welsh Government Energy Service analysis is as follows:

~380,000 tCO_2e
emitted from heating public sector sites, 90% from grid connected natural gas

1.64 TWh heat demand
Equivalent to 136,500 homes

£150m
estimated cost of heat

4,610 buildings
with 3,913 using natural gas as the heat source.

12.1 km^2 of floor area
Equivalent to the size of Cwmbran

Analysis shows that healthcare and schools are the largest contributors of heat emissions from the public sector. However, there are very different challenges to address across these types of buildings – with over 2,000 school buildings requiring a sizeable roll-out, and ~100 healthcare sites needing bespoke solutions for complex sites.

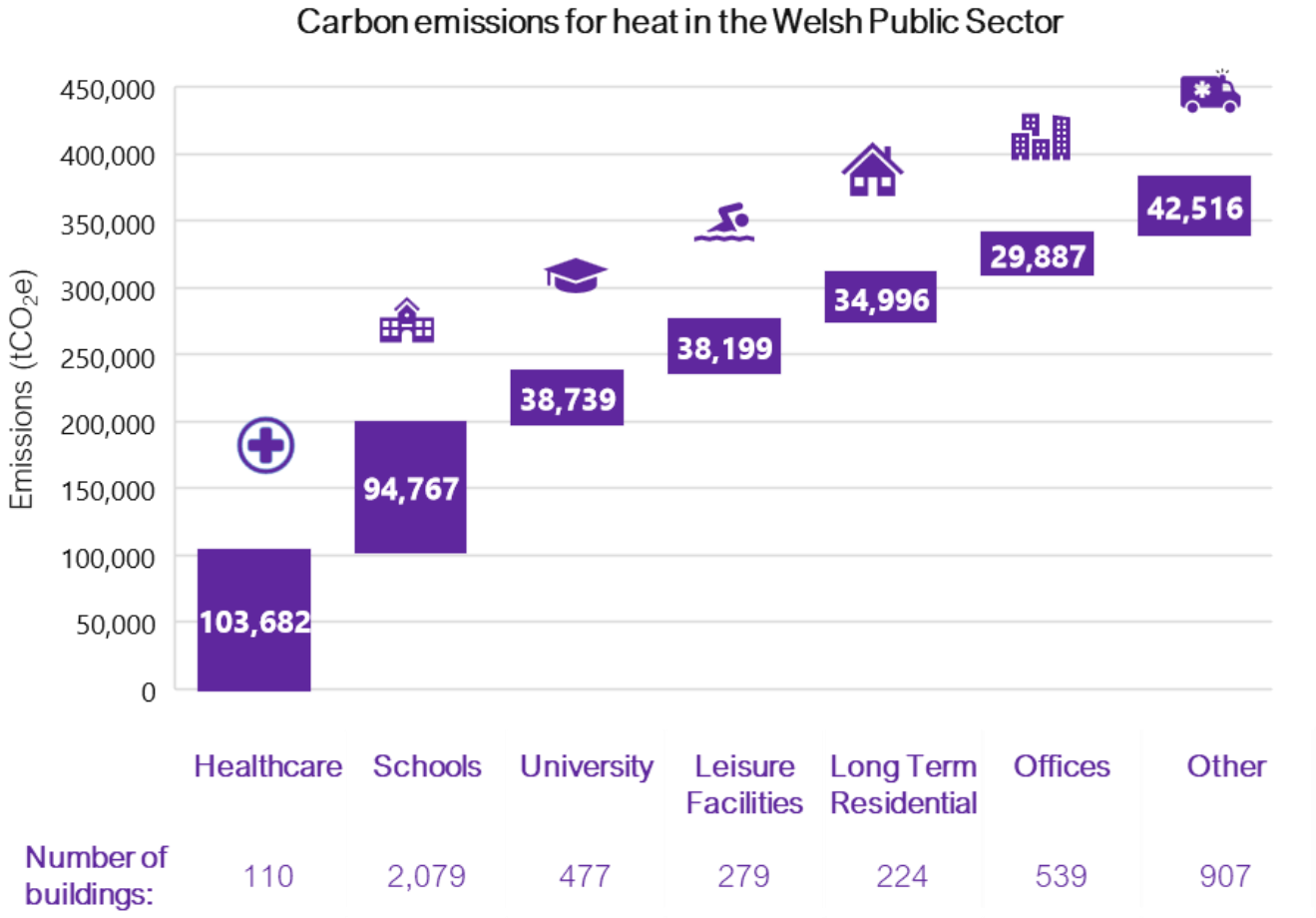


Figure 28: Heat emissions by public service from Welsh Government Energy Service analysis

There are numerous policy drivers for the public sector to transition to low carbon heat, including:

- Net Zero Wales sets policy objectives for the public sector to lead the way and achieve net zero collectively by 2030. It contains a specific chapter for public sector actions in support of a net zero Wales.
- Programme for Government reinforces the ambitions of a net zero public sector whilst setting the requirement to embed the climate and nature emergency into everything the Welsh Government does.
- Climate Emergency declarations were made by Welsh Government and the Senedd in 2019, with Wales being the first parliament to declare a climate emergency.
- Well-being of Future Generations Act sets the requirement for public bodies to report progress against the well-being goals.

Support is in place for the public sector to deliver low carbon heat. Firstly, Welsh Government has a routemap for the public sector to achieve net zero by 2030. This sets out a strategic framework for heat in buildings against three stages out to 2030:

- Moving up a gear
  Scoping for Low Carbon Heat pilot projects and developing plans for hard to decarbonise building types and campuses.
- Well on our way
  All new buildings will be net zero and existing buildings will be highly energy efficient or scheduled to be retrofitted with renewable heat schemes.
- Achieving our goal
  All public buildings are supplied with low carbon heat by 2030 and generate their electricity where feasible.

Several support, funding and capacity building schemes are in place for the public sector:

Welsh Government Energy Service

- Technical, commercial, and strategic support led by Welsh Government to deliver decarbonisation projects and build capacity in public bodies and community enterprises.

Transition & Recovery Support Scheme

- A Welsh Local Government Association (WLGA) led scheme to collaborate across local authorities and strategically support net zero delivery.

Funding

- The Wales Funding Programme provides interest-free loans.
- Grant funding for decarbonisation is allocated through Welsh Government policy teams.

Local Area Energy Plans

- Funding for technical development of Local Area Energy Plans led by local authorities.

The public sector are leaders in the transition to net zero – working towards net zero by 2030 and supporting delivery on a regional and local basis to recognise the benefit to Wales

The public sector is uniquely positioned to be a leader in the transition to heat. Our communities engage with public services daily – public bodies are seen and held to account, and also hold high levels of public trust.

The ambition has been set for the public sector to collectively reach net zero by 2030. With public funding being used to support this, it is important that the transition is successful, timely, and cost effective.

Local authorities in particular have an important leadership role to play. As local planning authorities, they set planning policy for their areas, and administer planning applications. Their approach to running the planning function is important to the transition across all sectors.

Local authorities are also leading Local Area Energy Plans. They are convening with other public bodies, communities, businesses, and energy network providers to set out a strategic plan for the energy system. Continuing this leadership role and building further momentum is needed.

Case Study:

Public Sector Net Zero Reporting[44]

Welsh Public Sector Net Zero Reporting mechanisms are in place to understand emissions and give assurance that the public sector is progressing towards net zero by 2030.

For buildings, reported fossil fuel heat demand was around 1.86TWh in 2021/22 representing around 350,000 tCO_2e of emissions – which accounted for 57% of total building emissions. An estimated 8,000MWh of renewable heat was produced in 2021/22 by the public sector. With less than 1% of public sector heat demand transitioned so far, a lot of work is needed to scale-up activity.

Table 2: Public sector renewable heat generated in Welsh Public Sector Net Zero Reporting 2021/22

Renewable heat generated (MWh)	Air Source Heat Pumps	Ground Source Heat Pumps	Solar Thermal	Biomass Boiler	Biogas CHP	Total
Fire & Rescue Authorities						
NHS Cymru				2,197		2,197
Local Authorities			1	4,734		4,735
National Parks				168		168
Universities & Colleges	6	521			471	998
Welsh Government						
Other						
Total	6	521	1	7,099	471	8,098

How we will deliver this objective

50 - **We will use Net Zero Reporting to track public sector building performance** – this will demonstrate and give assurance that the public sector are leading the way to net zero heat.

51 - **We will communicate success and share learnings across public bodies and to wider sectors** – as we work towards our ambition of a net zero public sector by 2030 we will share learnings and case studies need to be shared to build wider momentum for the low carbon heat transition.

52 - **Our public sector will collaboratively drive decarbonisation regionally and locally through Regional and Local Area Energy Planning** – public bodies will be central to driving change in Wales.

53 - **We will seek to build local supply chains, grow skills and realise social value through the public sector transition to low carbon heat** – through implementing public sector procurement policy.

All public sector buildings will be served by low carbon heat solutions – championing a whole building approach to the transition

The ambition for a net zero public sector by 2030 has been set. This stretching aim is in place to drive activity and demonstrate leadership in Wales. To meet this, transitioning to low carbon heat is the biggest challenge that the public sector will face.

The public sector provides critical services to the public, and unique challenges will be faced in implementing change. Hospitals require secure heat across the year and need backup heat sources in place. For schools, major works can only happen when unoccupied, typically during the traditional six-week summer holiday period.

With 1,463 local authority funded schools in Wales the challenge for the sector and construction supply chains in delivering net zero by 2030 is unprecedented. Upgrading buildings to be net zero aligned as part of normal building maintenance will not work. Currently, there is insufficient capacity across the Welsh supply chain along with workable and affordable solutions to maintain the uninterrupted delivery of education. A One Wales approach towards innovative delivery solutions will be critical.

Progress is starting to be made. The Welsh Government Energy Service is supporting the development of low carbon heat schemes with funding and support. Across Welsh Government, funding is being ringfenced to support decarbonisation, in particular, £20m has been made available to support local authorities in 2023/24.

For public bodies, the choice for low carbon heat is becoming 'business as usual'. However, with heat pumps currently costing more than gas boilers, and current energy tariffs limiting the financial case for energy savings, care must be taken to ensure that public money must be spent sensibly. Welsh Government is reviewing the use of its loan and grant mechanisms for public bodies to ensure that the funding available is used effectively in supporting high impact and the most cost-effective projects.

Public bodies must support a just transition and recognise the well-being benefits in Wales as part of their low carbon heat transition. As part of public procurement regulations, public bodies are guided to assess social value as part of tendering for works. Alongside this, Welsh Government are keen that public bodies support the Welsh economy. To help this, we will explore opportunities for Welsh procurement frameworks that champion the Welsh supply chain.

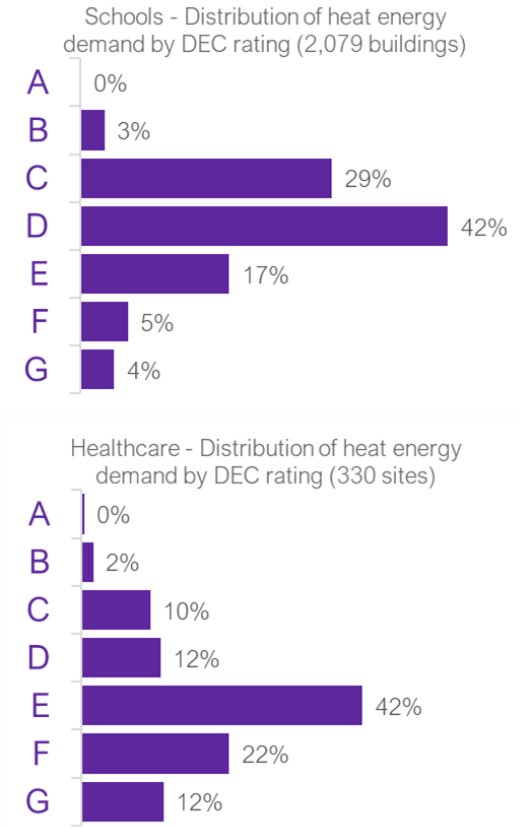


Figure 29: Distribution of heat energy demand by building efficiency rating

How we will deliver this objective

54 - **We will support public bodies with funding to deliver high carbon impact but financially challenging low carbon heat projects** – a new low carbon heat funding scheme is launching to scale-up the transition and support the low carbon option to become business-as-usual.

55 - **We will review funding options to support a net zero public sector by 2030 and a whole building approach to low carbon heat** – we will review the use of Welsh Government loan and grant funding to maximise benefits and seek to leverage further finance to help scale-up the delivery of low carbon heat.

56 - **We will work with public sector partners to explore practical solutions for public procurement to build market capacity** – providing a route to market for public sector delivery and building the opportunity for local supply chains.

57 - **We will build capacity to deliver a whole building approach to low carbon heat deployment** – our Welsh Government Energy Service will support the public sector with strategic, technical and commercial advice to drive activity.

Case study:

Welsh Government Energy Service

The Welsh Government Energy Service is in place to support the public sector and community groups in delivering energy and carbon saving projects.

It provides strategic, technical, and commercial support to organisations to identify and develop opportunities, progress business cases, and source funding.

The impact of the Welsh Government Energy Service in its first 4 years:

Impacts

We have supported the public sector and community enterprises in Wales to secure investment of £155 million to develop energy efficiency, renewable energy and zero emission vehicle projects:

- Saving **716,000 tonnes of CO_2** from being emitted – that's the same as taking 300,000 cars off the road for a year
- Generating **£322 million** in local income and savings
- And committing to **45MW of new renewable energy capacity** in Wales – that's enough electricity to power 13,300 typical Welsh homes, over half of the homes in Merthyr Tydfil

Projects

We have supported **242** projects to reach financial close across all **22** local authority areas.

Financial close occurs when all the project and financing agreements have been signed and all conditions on those agreements have been met.

64 solar power	**4** wind power	**68** energy efficiency	**13** low carbon heat
3 hydro power	**33** efficient street lighting	**56** fleet decarbonisation	**1** storage

Taking action

A Strategy for all

This *Heat Strategy for Wales* is for everyone in Wales.

Our shared ambition for the future well-being of Wales spans across all communities in Wales. With the use of heat and products of heat integrated across every aspect of our lives, it is impossible not to link the future of heat in Wales to meeting our well-being goals.

Our shared vision: clean, affordable heat will be available to all – we will recognise the opportunity of the transition and will secure our future well-being with a sustainable low carbon economy.

The change needed to meet our vision for clean, affordable heat will be the most significant and challenging transformational change across all our buildings, in all our sectors, impacting our whole energy system.

To succeed, we must work together - a team Wales approach is needed.

The Welsh Government's role and our levers for change

As the Welsh Government, we committed to shaping our Heat Strategy for Wales within our Net Zero Wales Carbon Budget 2. This Strategy helps to deliver our legislative commitments for a net zero Wales and will complement our wider strategies for Wales, including the current Programme for Government.

Welsh Government cannot directly install low carbon heat across all sectors in Wales, and we also cannot directly deliver all the objectives and policies in this Strategy. Our role is to provide leadership to the Heat Strategy for Wales. We will do this by using the following levers available to us:

Figure 30: Welsh Government's role and levers for change

Our asks of others

UK Government

It is important to recognise that not all aspects of heat policy are devolved to Welsh Government. For example, regulation of the energy supplier market and international trade impacting supply chains are the responsibility of the UK Government.

We call on UK Government to:

- Reform the electricity market pricing mechanisms so that energy tariffs support the case for low carbon heat - address the market distortion resulting from an unequal application of environmental levies applied to electricity.
- Implement schemes to support supply-side low carbon heat roll-out – such as ensuring the success of the Low Carbon Heat Scheme (due to be launched in 2024) to oblige fossil fuel heat suppliers to scale-up the manufacture of low carbon heat technologies.
- Provide a long-term approach to support low carbon heat installations that creates a sustainable, stable market and provides certainty to homeowners, businesses and installers – for example, ensuring the success of the Boiler Upgrade Scheme to kick-start the transition.
- Provide transparency and access to funding to support the Welsh power and industrial sectors to decarbonise, investing the equivalent of the UK Emissions Trading Scheme revenues in Welsh industrial decarbonisation to move beyond our industries just paying a carbon tax.
- Devolve further consenting powers for the onshore electricity grid transmission network – some renewables projects consented to by Welsh Ministers have not progressed as UK Government Ministers did not give consent for the grid infrastructure required.
- Work with Ofgem to provide a framework that supports proactive investment in our energy networks – supporting local low carbon energy systems, whilst ensuring the transition supports less affluent areas and creates jobs.
- Work with us to develop policies to support the development of hydrogen infrastructure that is appropriate to the Welsh context and supports the just transition.

Communities & businesses

We ask that the Welsh households, communities, businesses, and our industries support the transition to low carbon heat. We ask our communities and businesses to:

- Engage and understand the options for low carbon heat, and plan for future building retrofit – consider how to reduce the energy we use with energy efficiency measures, and implement low carbon heat generation technologies.
- Collaborate within communities, with suppliers, and with support mechanisms available to build demand and scale to the transition for low carbon heat.
- Adopt a One Wales approach towards innovative and affordable solutions for building retrofit whilst minimising the impact on building occupants and the continuity of service delivery. Hospitals, and the number of schools will present a particular challenge but also a significant opportunity for the Welsh supply chain in developing innovative delivery solutions.
- We ask Welsh businesses and industries to commit to net zero targets as part of their corporate social responsibility – as part of

this we ask that their supply chains are engaged to further increase momentum for net zero.

Supply chain

Across our supply chain of manufacturers, suppliers, and installers, and our trades for heating engineers, designers, and planners, we need to build capacity to implement a low carbon heat transition. We ask our supply chain companies to:

- Build capacity in Wales to support our transition and the local economy.
- Support skills in the Welsh workforce to recognise a just transition – creating and protecting jobs in Wales.
- Innovate in Wales to keep us at the forefront of new technology solutions.
- Engage and collaborate to support the low carbon heat transition.

Energy networks

Our energy network providers have a critical enabling role to play. We ask our energy networks to:

- Continue to work with us to plan how our networks evolve.
- Collaborate and support suppliers and heat users in the transition to low carbon heat.
- Innovate to support smart, local, energy systems – including supporting targeted hydrogen innovation.
- Enable renewable electricity generation for secure and affordable energy.

Costs and savings

Investment

Estimating the investment required for decarbonising heat is subject to a high level of uncertainty. Costs can vary significantly as technology, markets, and policy frameworks evolve.

The CCC has estimated that the total cost of decarbonising heat in Wales is to the scale of £80 billion over the period to 2050. This is total cost, when comparing their expected additional costs above a baseline spend, for homes the net zero option is estimated as 23% more expensive out to 2050.

Additional investment will be needed for renewable electricity generation and grid infrastructure. The total investment for this is estimated as £52bn out to 2050.

The investment needed will be spread across all sectors and heat users. Table 3 provides a further breakdown of expected costs by sector.

Although the long term 2050 investment is modelled to be only 23% more expensive for net zero homes, a significant step change in the current scale of investment is needed. As an example, £1 billion is currently spent annually by Welsh homeowners on the repair, maintenance, and improvement of their buildings.[45] Taking 2050 as a long-term timeframe, the average annual investment needed will need to double to over £2 billion annually for low carbon heat and heat energy efficiency.

As we develop Action Plans to deliver on this Strategy, we will further our understanding of the costs to transition, the distributional impacts, and the investment profile needed.

Table 3: Estimated costs of decarbonising heat in different sectors

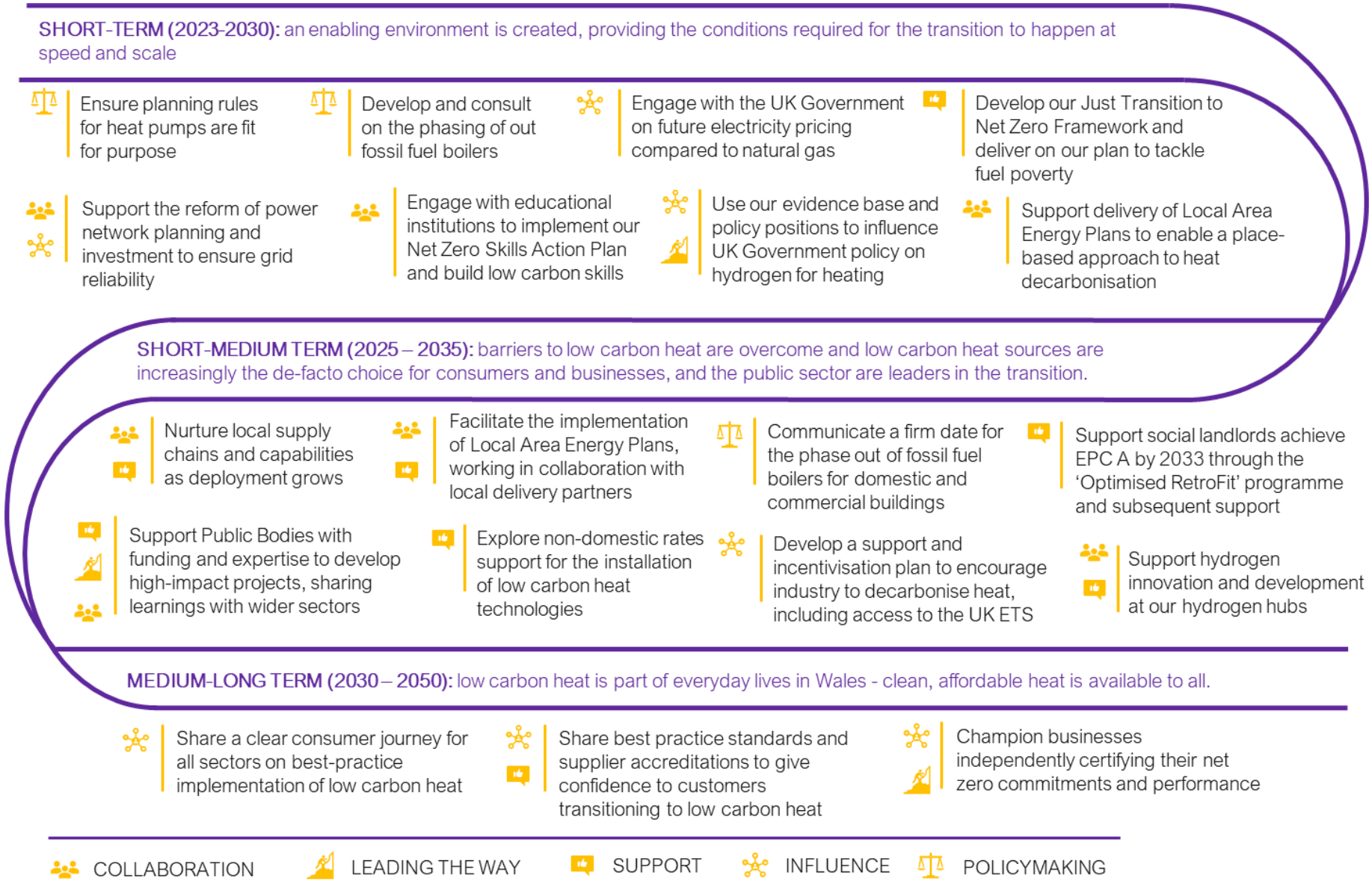
Sector	Description	Scale of challenge	Investment to 2050 (% of which additional)
Domestic	Social Housing	~223,000 homes	£56.7bn [6] (23%)
	Private: Rental	~231,000 homes	
	Owner-Occupied	~895,000 homes	
Public Sector	Local authorities, health, and other public bodies	~4000 sites	£1bn
Businesses	Arts, Community and Leisure	~3,800 buildings	£3.2bn [6]
	Hospitality	~14,400 buildings	
	Offices	~17,000 buildings	
	Shops	~27,000 buildings	
	Warehouses and Other	~21,000 buildings	
Industry	Manufacturing	~6,785 enterprises	£20bn [6] (14%)

Savings

Despite the currently challenging financial case for low carbon heat, it is expected that savings will be recognised:

- Homes: it is estimated that a £15 billion programme over 10 years improving the energy efficiency of homes could provide £8.4bn cumulative savings in energy bills for households up to 2040 with £3.54bn of net tax benefit and 26,500 new jobs.[46]
- Healthcare: poor housing conditions are estimated to cost NHS Wales £95m through worsened health outcomes.[47] Improving the energy efficiency and quality of housing is recognised by the NHS as an effective strategy to enhance health and reduce costs.
- Businesses and the public sector: it is estimated that a £2.7bn reduction in operating costs is achievable by 2050[6]. Energy efficiency is expected to deliver most of these benefits through reducing energy consumption. In turn, this will help enhance the competitive advantage of industries in Wales.

Our route map of key policies



Our pathway

Deployment

The deployment of low carbon heat solutions, including the supporting energy efficiency works, needs to scale-up rapidly in this decade.

As part of a whole building approach, insulation and fabric measures are prioritised first in the CCC's recommended deployment pathway. Individual heat pumps are expected to be the dominant solution for homes in Wales.

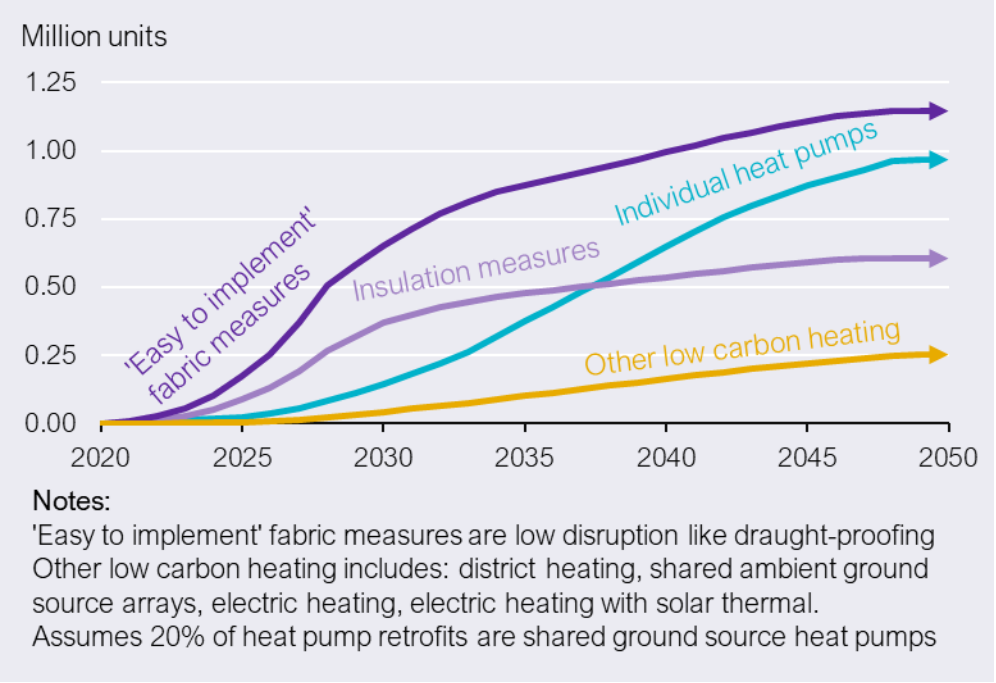


Figure 31: Home retrofit deployment pathway for Wales [6]

Emissions

The pathway for net zero heat to 2050 shows the scale of impact needed for industrial and domestic heat in particular.

From 2030, accelerated change is needed as our emission pathway steepens. This is also supported by the deployment pathway for individual heat pumps.

Over the short term, we must put in place the foundations and enabling framework to meet our long-term vision for clean, affordable heat.

Next steps

Enabling framework

Our enabling framework of policies seeks to put in place the planning policy, engagement, skills, supply chain, and financial mechanisms needed to support the transition. This will be the foundation of our transition to low carbon heat.

In planning our approach, we must consider how we will support a just transition across Wales where we leave no one behind. We already have the statutory requirement to consider the well-being of future generations in our decision making, and this will help guide our approach as we develop our Action Plans.

Over the short term, key policy decisions are needed to kick-start the transition to low carbon heat. In particular, reform of the energy pricing mechanisms, a review of permitted planning permission guidance, a plan to alleviate grid constraints, and schemes to support skills and supply chains will be prioritised.

Figure 32 shows our emissions pathway out to 2035 with indicative milestones for the journey.

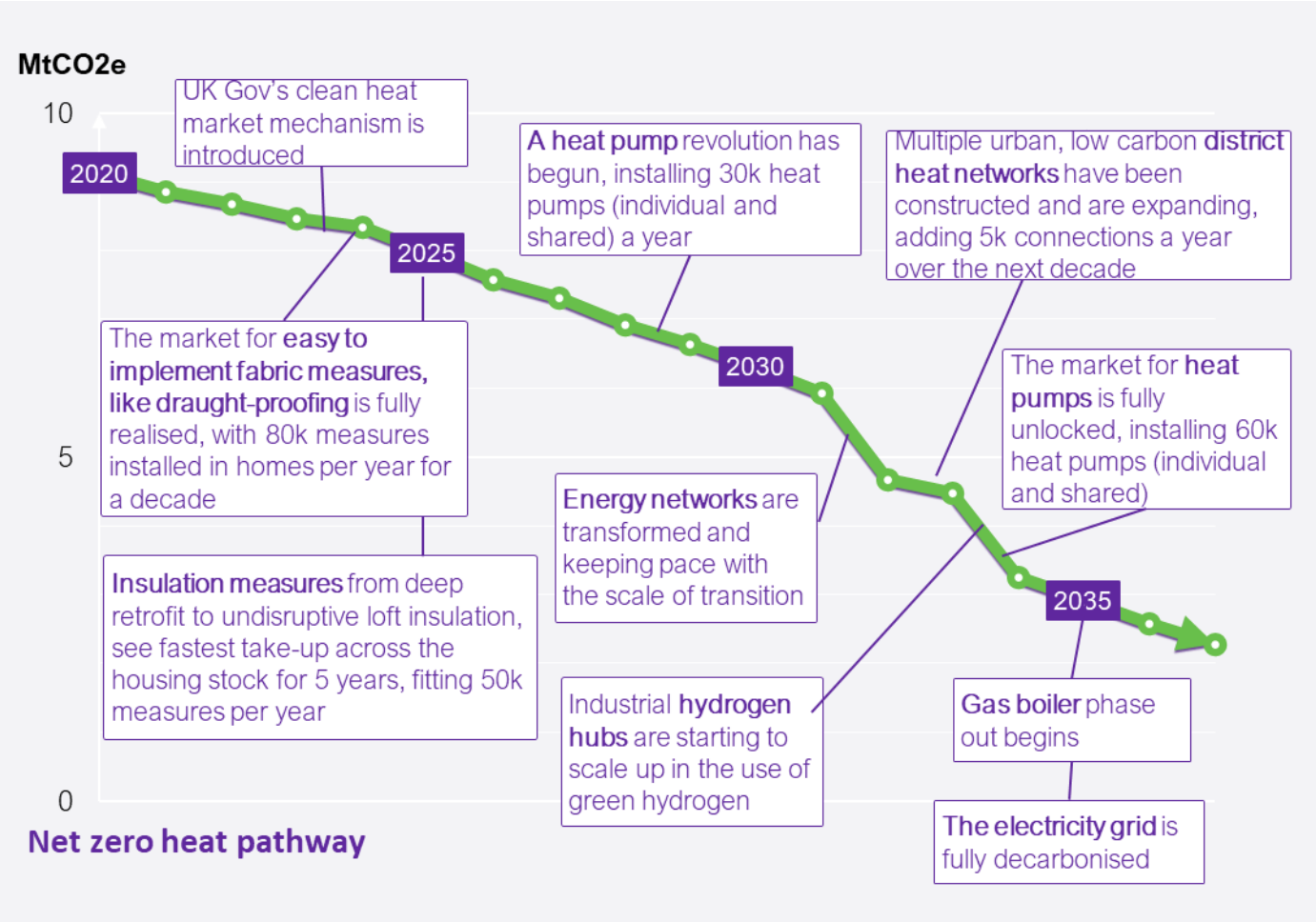


Figure 32: Emissions pathway for heat in Wales up to 2035 with milestones

Action Planning

Following public consultation on this Strategy, we will develop the first of a series of Action Plans to set out the specific activities we will undertake as Welsh Government as well as the actions we expect of others.

This first Action Plan will set out near-term timescales and identify responsible persons for progressing actions. The actions will draw on our levers for supporting the Strategy:

- Influence
- Collaboration
- Policymaking
- Support
- Leading the way
- Managing Implementation

The Action Plan will set out the mobilisation approach and governance structure within Welsh Government. We anticipate that an integrated governance approach across several existing programme boards will provide the most effective means for the successful delivery of the Strategy and its Action Plan.

Our initial Action Plans will be based on the most recent cost evidence available, and we will further our understanding of the distributed costs as we progress.

Measuring the success of our Heat Strategy for Wales will go beyond tracking emissions reduction and technology deployment. We will also seek to understand and measure the wider social, economic and well-being benefits associated with heat decarbonisation across Wales.

Our Action Plan will explore how we maximise the opportunity and measure the benefits for:

- Fuel poverty
- Health
- Local jobs
- Social infrastructure
- Financial value and investment in Wales
- Environment
- Energy security
- Air quality

The success of this Strategy will depend on the engagement across communities, businesses, and industries in Wales. The transition to low carbon heat will be one of the biggest built infrastructure challenge of our generation. People and collaboration are needed to make it happen, and we hope that all in Wales can get behind our shared vision.

Our Vision:

Clean, affordable heat will be available to all – we will recognise the opportunity of the transition and will secure our future well-being with a sustainable low carbon economy.

Our Action Plan

The Action Plan is expected to include:

- Governance arrangements
- Specific actions to meet our policies.
- Responsibilities and short-term timescales for action
- Measurement and evaluation approach
- Timeline to update and evolve our approach

It is expected that the Action Plan cycles will align with the future Carbon Budgets for Wales.

Monitoring and Evaluation

We will develop a monitoring and evaluation framework to track our delivery. This will report on the rollout of low carbon heating solutions in Wales and the associated impact on climate change. Where practicable, we will also report on the wider benefits.

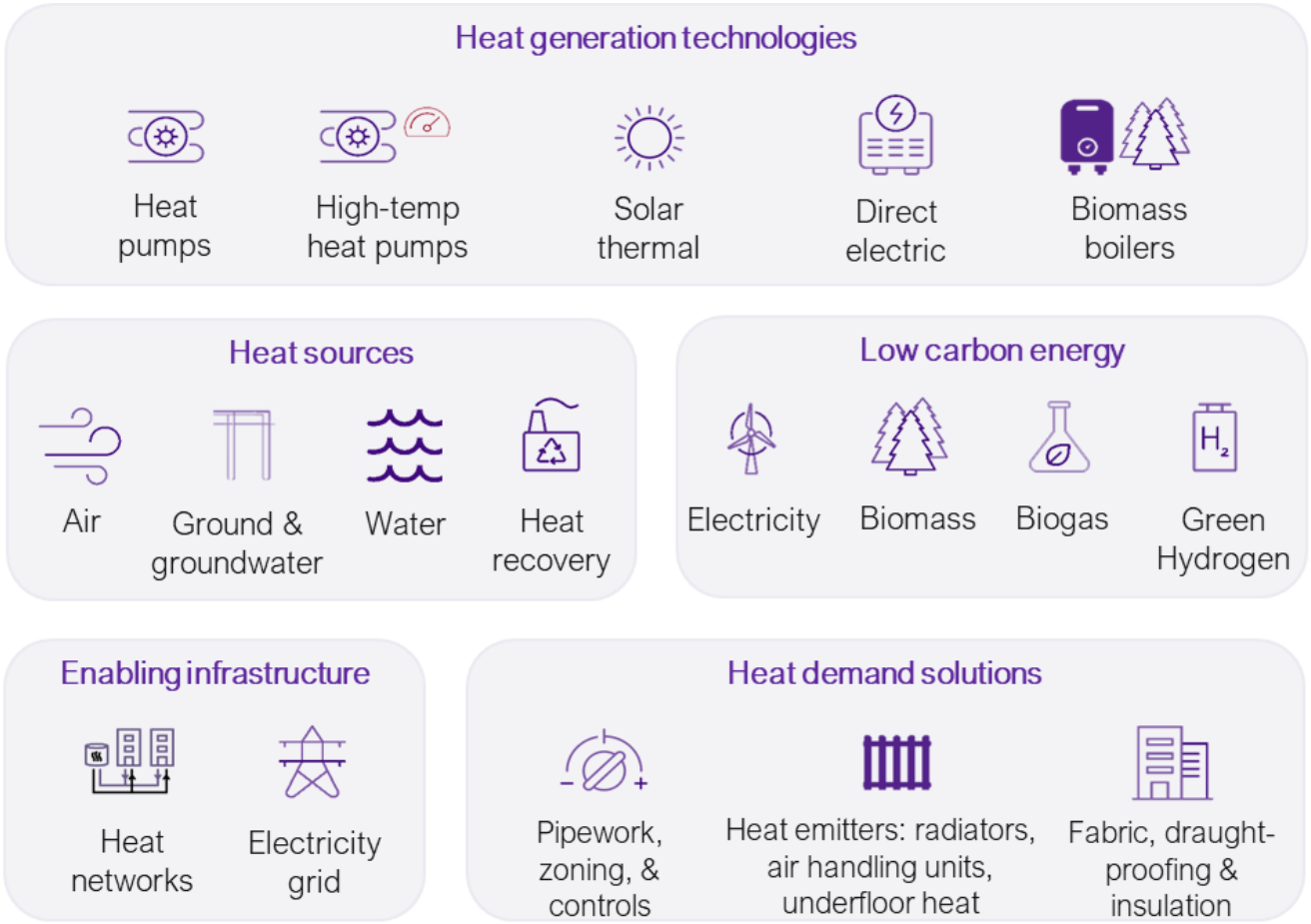
Appendix A: Technologies

When assessing which low carbon heat options are most suitable for a building, a whole building approach should be considered.

A whole building approach considers demand reduction first, through either fabric improvements or control improvements. It should also consider the operating temperatures of the heating systems, with heat pumps operating at better efficiencies when generating lower flow temperatures (such as 55 °C and lower).

Fabric improvements such as loft and cavity wall insulation, and draft proofing, where they don't already exist, can provide energy efficiency benefits at a reasonably low intervention level. The thermal performance of a building shouldn't be a barrier to installing a low carbon heat solution.

Which low carbon heat technology is the most suitable will depend on the specific requirements for the building. This includes considering peak capacity, annual load, and flow temperatures required. Any potential heat sources should be identified and investigated at an early feasibility stage, as utilisation of nearby heat sources can provide improved efficiencies.



Heat Sources

For the efficient generation of low carbon heat, it can be beneficial to recover heat from existing heat sources, mainly via heat pumps. Heat sources can include:

Air: The most readily available heat source - Air source heat pumps can utilise the heat energy within the air.

Water – Open water sources such as rivers, lakes, and the sea can be used with water source heat pumps. Heat from ground-water can also be extracted from underground, either via a closed loop or open loop system.

Heat recovery – waste heat sources, particularly those from industry can provide both high grade and low grade waste heat, such as the outlet of a combustion process or as rejected heat from cooling systems.

Further supplementary heat sources

Solar thermal can have a significant role to play in decarbonising heat. Often solar thermal is used to serve domestic hot water; however, it can be used as part of a low carbon solution alongside heat pumps. Further, solar thermal can reduce the electrical capacity required for heat pump solutions and help to ease some of the grid constraints. As our electricity grid decarbonises, the use of roof space for solar thermal heat generation will become an increasingly more effective carbon saving opportunity than power generation.

Enabling infrastructure

Large enabling infrastructure can be critical for the supply of low carbon heat, namely:

- Heat networks
- The electricity grid

Heat networks (or district heating) involve generating heat at a central location and distributing it via insulated pipework to multiple buildings. They can supply domestic, commercial and industrial sites with space heating and hot water. Typically heat networks can be found in heat dense areas, such as city centres, or areas near a large heat source, such as energy from waste.

The electricity grid provides the power required for electrical heat generation options and is continuing to decarbonise as more renewable generation comes online.

Heat Demand Solutions

As part of a whole building approach, the buildings heating infrastructure and fabric should be considered:

- Pipework, zoning & controls
- Heat emitters
- Insulation and draft proofing

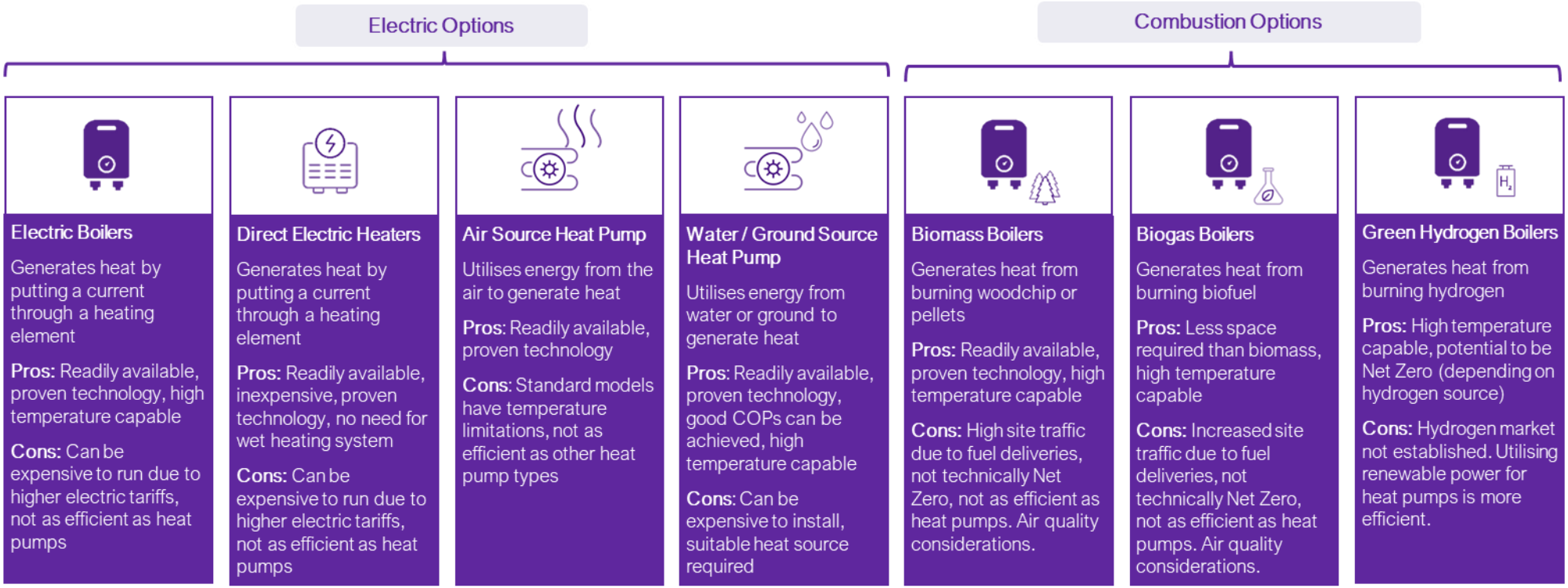
Pipework and zoning reconfiguration and control improvements can help to lower temperatures of the heating system, resulting in improved efficiency in heat generation performance. It can also ensure that areas of the building are not being over heated.

Traditionally heat emitters such as radiators have been designed to operate at a temperature of around 80°C. To operate at lower temperatures, emitters such as radiators and air handling unit coils may need to be increased in size to allow for the suitable heat transfer. Often, heat emitters have been oversized, and may be able to deal with the lower temperatures, this should be investigated if retrofitting.

Simple fabric improvements such as loft insulation or cavity wall insulation, where they don't already exist, can improve the thermal performance of a building. Draft proofing can also improve the thermal comfort of the occupants.

Heat Generation technology, by heat and energy source

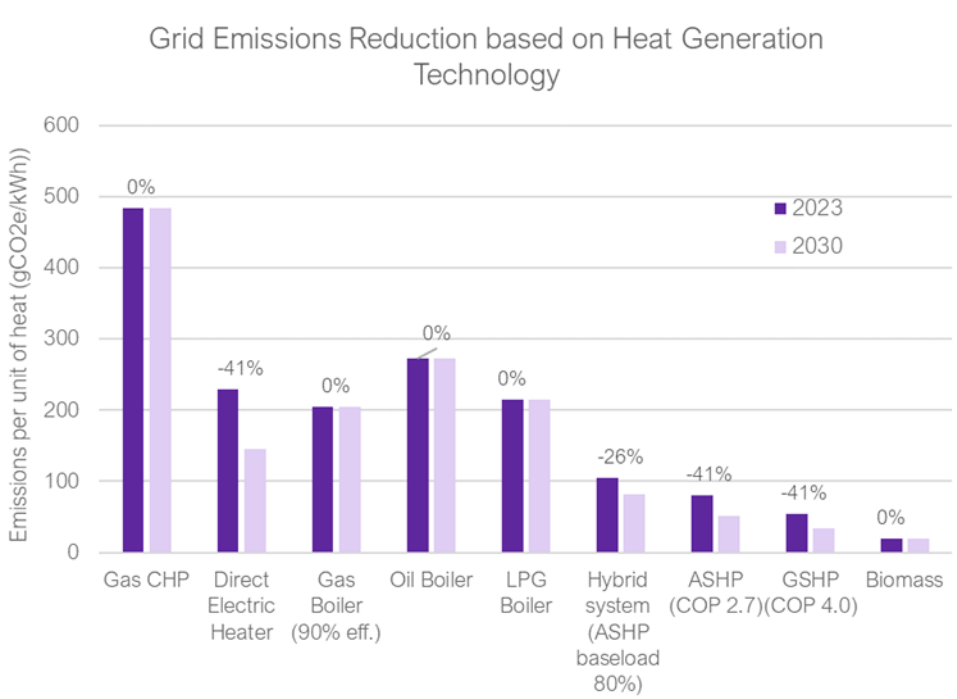
Due to the decarbonisation of the electrical grid, electrical options for heat generation should be considered as a priority. Electric options such as heat pumps, electric boilers and direct electric heaters are readily available on the market, with strides being taken in heat pump flow temperatures and efficiencies to make them more suitable for retrofitting into buildings. Where it is not possible for heat pumps / electric solutions to be retrofitted, low carbon combustion options could be considered. Low carbon combustion fuels include biomass, biogas and green hydrogen. Combustion methods of heat generation are not as efficient as electric heat generation options. The fuel source needs careful consideration, with biomass and biogas requiring fuel deliveries to the site, and green hydrogen not being readily available in the gas grid. Where sites are located near a hydrogen hub, green hydrogen may be an option.

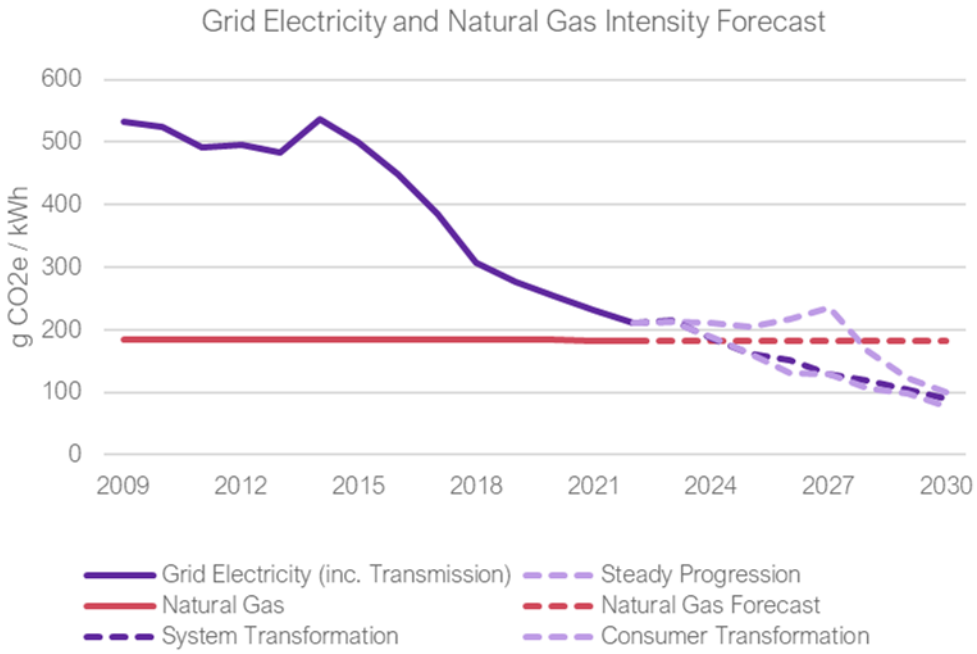


Carbon Case

The national electricity grid has decarbonised rapidly in the last few years, with grid carbon intensity halving since 2014, and this trend is set to continue. The impact of this means that any heat generation technology supplied by the grid will continue to decarbonise over time, as more and more renewables are connected to the grid.

Grid emissions by technology (highlighting carbon reduction by technology now and in 2030) and grid electricity carbon intensity forecast out to 2030 are shown in the charts below. (Welsh Government Energy Service analysis utilising National Grid Future Energy Scenarios)



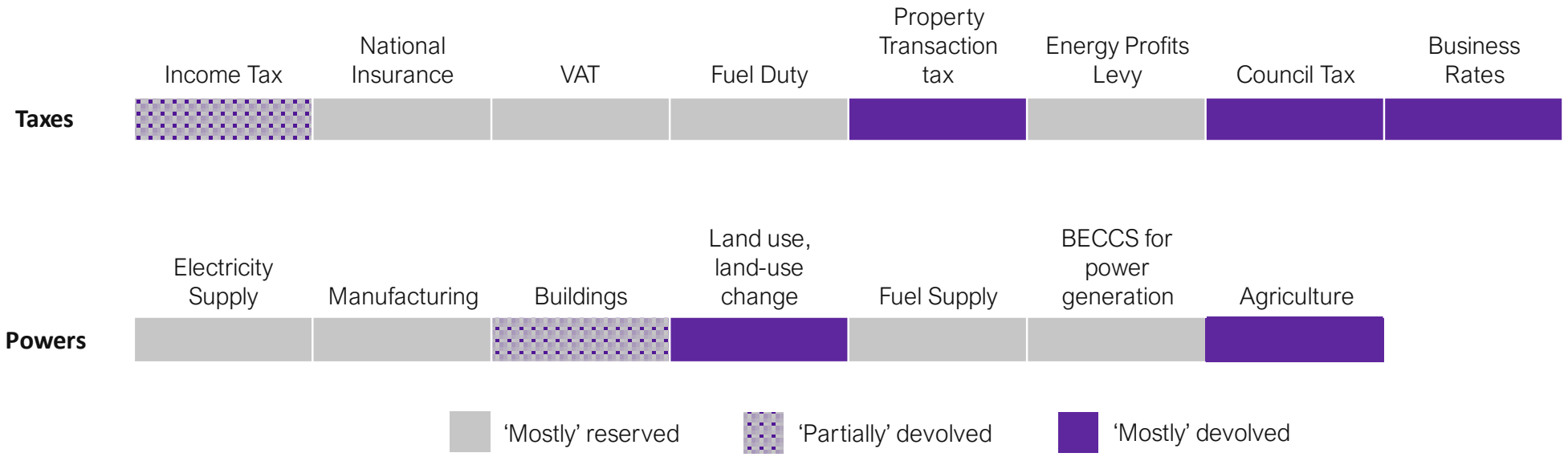


Appendix B: Devolved powers

The devolved powers of Welsh Government and the reserved powers of UK Government are simplified into the following summary chart.

Key reserved powers highlighted in this Strategy for electricity supply, energy profits, and tax sit with the UK Government. Welsh Government can influence UK Government in these matters, however, it does not have direct control to address matters such as energy price mechanisms.

Key devolved powers that can be used in this Strategy include Welsh Governments planning control for buildings, and regulatory mechanisms available through property transaction tax and business rates.



Appendix C: Timeline of objectives

POLICY OBJECTIVES		
Short-term: an enabling environment is created, providing the conditions required for the transition to happen at speed and scale	Planning processes are transparent, streamlined, and fit for purpose - supporting the efficient rollout of low carbon heat A clear regulatory framework will be in place that supports net zero homes across all rented, owner-occupied, and social housing Businesses will have the confidence to invest in the transition to low carbon heat and net zero buildings	Our businesses and commercial properties will demonstrate their net zero credentials, building confidence and engagement with consumers Low carbon heat is understood and supported by heat users in all sectors - collaboration and knowledge sharing have driven demand-side momentum towards net zero heat The costs of the transition are fairly distributed across society
Mid-term: momentum towards low carbon heat grows as barriers to uptake are overcome. Low carbon heat sources are increasingly the de-facto choice for consumers and businesses, and the public sector are leaders in the transition.	Low carbon heat solutions will be affordable to install and affordable to operate All public sector buildings will be served by low carbon heat solutions – championing a whole building approach to the transition The public sector are leaders in the transition to net zero – working towards net zero by 2030 and supporting delivery on a regional and local basis to recognise the benefit to Wales Low carbon hydrogen hubs are established and serve high-temperature industrial processes and local users where appropriate	Heat networks are a reliable and efficient provider of low carbon heat in suitable areas across Wales Flexible and secure electricity networks have the infrastructure in place to effectively support electrified heat as part of a net zero energy system Our highly-skilled workforce supports local suppliers and manufacturers serving the transition in Wales – new talent, investment, and innovative solutions are drawn into Wales
Long-term: low carbon heating is mainstream and part of everyday lives in Wales - clean, affordable heat is available to all.	Homes are thermally-efficient and served in the main by heat pumps – a whole building approach has been taken to the transition and homeowners understand how to operate their systems Industry is transitioned, competitive, and sustainable for the long-term following implementation of best available techniques for energy efficiency and low carbon heat	Wales will have championed zero-carbon hydrogen from renewables at localised hydrogen hubs – hydrogen will be utilised in high-temperature industries, and for other hard to decarbonise emission areas. Businesses in Wales will be sustainable and supported by affordable low carbon heat solutions

Appendix D: Register of all policies

Below is a categorisation of policies based on their main objective, along with two tags assigned to each policy indicating the type of intervention and lever being used:

Tag 1: Broad description of the type of intervention (Planning Policy, Energy, Grid etc.)

Tag 2: Lever that is being used (Collaboration, Leading the Way, Support, Influence, Policymaking)

Enabling framework

a) Planning processes are transparent, streamlined, and fit for purpose - supporting the efficient rollout of low carbon heat solutions

1. **We will support the delivery of Local Area Energy Plans to enable a place-based approach for the low carbon heat transition** – ensuring that spatial zoning identifies priority areas for low carbon heat and that this process is aligned with network planning by electricity distribution and transmission operators.	*Planning Policy*	*Regulation*
2. **We will facilitate the implementation of Local Area Energy Plans** – by engaging communities and delivery partners to communicate Plans and build engagement for the transition – including using digital solutions to aid collaboration.	*Energy, Planning, Grid*	*Support*
3. **We will ensure the planning rules for permitted development rights for heat pumps are fit for purpose** – we will review the evidence base and seek to remove any unnecessary planning constraints for the low carbon heat transition.	*Planning, Collaboration*	*Support*

b) Low carbon heat is understood and supported by heat users in all sectors – collaboration and knowledge-sharing have driven demand-side momentum towards net zero heat

4.	**In line with our Climate Action Wales Public Engagement Strategy, we will engage households to better understand the support available for the heat transition.** We will work with civic society and the third sector and make use of our existing programmes, for example, use our existing programmes, such as Business Wales, to engage business heat users.	*Engagement, Behaviours*	*Support*
5.	**We will build and share knowledge of the route to market for low carbon heat** – creating a clear customer journey for all sectors that will help heat users access the low carbon heat supply chain.	*Engagement, Supply chain*	*Influence*
6.	**We will build trust between businesses and homeowners with low carbon heat suppliers, by reviewing and sharing supply chain certification and standards** – we will seek to share best practice standards and supplier accreditations to give confidence to customers transitioning to low carbon heat, including the use of the TrustMark quality standard.	*Standards, Engagement*	*Influence*
7.	**We will champion the use of PAS 2030, PAS 2035 and PAS 2038 in our programmes for low carbon heat** – taking recognised standards for a whole building and energy efficient approach will add credibility to our approach, this will be supported further by industry leading best practice.	*Standards*	*Leading the Way*

c) Our highly-skilled workforce supports local suppliers and manufacturers serving the transition in Wales – new talent, investment, and innovative solutions are drawn into Wales

8.	**Through the implementation of our Net Zero Skills Action Plan** we will identify the skills required to support low carbon heat solutions and seek opportunities to support retraining of gas engineers into renewable technologies.	*Skills*	*Support*
9.	**We will attract talent, from apprentices to professionals, into the low carbon heat sector** – engaging our educational institutions to build skills for the sector, and utilising National Occupation Standards to create a detailed structure for skills.	*Skills, education*	*Leading the Way*

10. **We will aim to attract new businesses and investment into Wales by signalling a long-term opportunity to support our transition**.	*Investment, Economy*	*Support*
11. **We will attract new investment into manufacturing in Wales to support the low carbon heat transition.**	*Investment*	*Collaboration*

d) The costs of the transition are fairly distributed across society

12. **In developing and implementing our Just Transition to Net Zero Framework, we will identify financial and other forms of support needed for our workforce and for vulnerable households, including those in fuel poverty, to deliver a fairer transition to low carbon heat.**	*Costs, Fuel Poverty, skills*	*Support*
13. **We will continue to engage the UK Government on their upcoming review of the future electricity pricing comparative to gas** – currently, the taxation on electricity prices leaves a marginal cost case for heat pumps in many cases. We will continue to influence the UK Government to move taxation and levies on electricity bills into general taxation to support a just transition to a net zero Wales.	*Costs, Fuel Poverty*	*Influence*
14. **We will seek to influence energy suppliers and electricity distribution operators on how funding may be used to reduce demand-side costs –** some investment may kick-start wider energy efficiency and demand reduction, reducing overall grid constraints during the transition, and reducing consumer costs.	*Investment, Just, Grid*	*Influence*

Energy networks and infrastructure

e) Flexible and secure electricity networks have the infrastructure in place to effectively support electrified heat as part of a net zero energy system

15. **We will continue to collaborate with partners to understand and support delivery of the future grid capacity needed to meet our ambitions for low carbon heat** – continuing the work of the Future Energy Networks Wales project, we will engage with stakeholders across Wales on building the detailed requirements for our future grid and exploring smart and flexible approaches that reduce the extent of infrastructure investment needed.	*Grid*	*Collaboration*
16. **We will engage with Ofgem and UK Gov to reform network planning and the investment regime to support our plans** - ensuring increases in capacity at both transmission and distribution level are delivered in line with Wales' net zero delivery plans.	*Grid*	*Influence*
17. **We will engage with the Distribution Network Operators on their approach to net zero enablement and how this integrates with Local Area Energy Plans** – we will work with the networks on reform and innovation activity to support the process of connecting heat pumps to the network and how to align network plans with local ambitions	*Grid, Planning*	*Influence*
18. **We will engage with Ofgem and UK Gov to improve the processes for managing applications to the grid and managing the connection queue –** more effective management of grid applications will unblock capacity.	*Grid*	*Influence*

f) Heat networks are a reliable and efficient provider of low carbon heat in suitable areas across Wales

19. **We will review the zoning powers in the Energy Bill and consider the benefits of adopting a similar approach in Wales** – although zonal planning will be driven through our local area energy planning programme, the powers to oblige connections to suitable low carbon heat networks can be an enabler for future low carbon heat – in particular for new builds.	*Heat Networks*	*Policymaking*
20. **We will support the scale-up of viable low carbon heat networks** – we will support access to funding and expertise to develop new low carbon district and communal heat networks, and transition existing heat networks to low carbon heat. We will continue to engage UK Government on heat network support and regulations.	*Grid, Planning*	*Support*

g) Wales will have championed zero-carbon hydrogen from renewables at localised hydrogen hubs – hydrogen will be utilised in high-temperature industries, and for other hard to decarbonise solutions

21. **We will publish a clear statement on the role of hydrogen in meeting our buildings' heat decarbonisation ambitions in our upcoming hydrogen policy position statement** – the evidence collected for the Heat Strategy for Wales will inform this statement. Heat pumps will be the championed solution for most sectors with hydrogen having a role to play in defined hydrogen hub zones for high-temperature industry and wider net zero aligned solutions prioritised by the hydrogen ladder.	*Hydrogen*	*Leading the Way*
22. **We will continue to support hydrogen innovation local to our hydrogen hubs, and map industrial heat demand across Wales** – supporting innovation will ensure Wales can recognise the benefit from the local opportunities for hydrogen.	*Hydrogen*	*Support*
23. **We will use our evidence base and policy positions to influence UK Government policy on hydrogen** – ensuring that the approach adopted, for instance in the hydrogen levy and hydrogen-ready boiler mandate, supports our plan to transition to low carbon heat in Wales.	*Hydrogen*	*Influence*

Homes

h) A clear regulatory framework will be in place that supports net zero homes across all rented, owner-occupied, and social housing

24. **We will consult on introducing planning policy that restricts fossil fuel heating in new developments with a firm date communicated as a ban** – we'll explore other mechanisms such as through building regulations to assist in this goal as required, and also engage with UK Government.	*Planning Policy*	*Policymaking*
25. **We will develop and consult on phasing out fossil fuel boilers in existing dwellings at the point of replacement.**	*Gas Boilers*	*Policymaking*
26. **We will investigate options for the use of energy performance standards at the point of sale and letting as a mechanism to drive low carbon heat uptake**.	*Standards*	*Policymaking*

27. We will continue to drive standards through our Welsh Development Quality Requirements and Welsh Housing Quality Standard where all new social housing must achieve EPC A or an equivalent standard, and existing social housing must have a Target Energy Pathway in place to achieve EPC A by 2033 or by a date after 2033 that Welsh Government has authorised.	*Standards, Implementation*	*Policymaking*

i) Homes are thermally-efficient and served in the main by heat pumps – a whole building approach has been taken to the transition and homeowners understand how to operate their systems

28. We will support homeowners with advice and support for the transition to low carbon heat – we'll share resources and opportunities such as the Boiler Upgrade Scheme grant, and share a customer journey for how to implement and operate a heat pump system supported by fabric improvement.	*Education*	*Support*
29. We will prioritise low carbon heat as part of the next iteration of the Warm Homes Programme to support households in fuel poverty in owner-occupied and private rented homes.	*Implementation*	*Leading the Way*
30. We will support social landlords - delivering our 'Optimised RetroFit' programme in the short term and exploring the longer term options to help social landlords achieve EPC A.	*Implementation*	*Leading the Way*
31. We will undertake exemplar schemes and share best practice to demonstrate how historic and traditionally constructed buildings can effectively decarbonise heat.	*Implementation*	*Collaboration*
32. We will support the smart meter roll-out as part of our programmes and in our advice – this will futureproof our homes for variable tariff and demand management opportunities.	*Metering*	*Support*
33. We will explore how to transition to low carbon heat for the owner-occupied and private rented sectors – our housing decarbonisation implementation group will assess pathways and support options, taking the learnings from existing programmes and wider best practice.	*Education*	*Leading the Way*

j) Low carbon heat solutions will be affordable to install and affordable to operate

34. **We will convene a taskforce to address financial barriers for low carbon heat solutions across the domestic sector** – the taskforce will be in place for the longer term; it will take a consolidated view across all support programmes, and the future needs of homeowners to implement low carbon heat.	*Funding*	*Leading the Way*
35. **We will ask the Development Bank of Wales to champion a whole house approach to low carbon heat solutions in its housing development finance offers.**	*Funding*	*Leading the Way*
36. **We will work with the UK Government and energy suppliers to understand how variable tariff offers can be utilised better for homeowners.**	*Energy Costs*	*Influence*
37. **We will consider options for further funding for social landlords to meet EPC A across all homes.**	*Funding*	*Support*

Businesses

k) Businesses in Wales will be sustainable and supported by affordable low carbon heat solutions

38. **We will explore how we phase out the installation of all new gas boilers for commercial properties by 2033** – aligning with the Climate Change Committee recommendation that the sale of gas boilers to businesses will be phased out by 2033.	*Implementation, Funding*	*Policymaking*
39. **We will explore how we can prioritise the phase-out of off-gas grid fossil fuel boilers for commercial properties** – off-gas grid properties have the greatest carbon impact and prioritising these will have the greatest impact.	*Implementation, Funding*	*Policymaking*
40. **We will explore non-domestic rates support for the installation of low carbon heat technology to assist the cost-effectiveness of businesses transitioning to low carbon heat.**	*Costs*	*Policymaking*

l) Businesses will have the confidence to invest in the transition to low carbon heat and net zero buildings

41. **We will explore an accelerator programme for commercial buildings in Wales** – we'll share best practices and build confidence in the role of low carbon heat for sustainable business in Wales.	*Engagement*	*Support*
42. **We aim to continue support through the Development Bank of Wales Green Business Loan Scheme** – we will track the success of the scheme through the scale of engagement in feasibility support and the overall investment recognised in low carbon heat.	*Implementation*	*Support*
43. **We will continue to support businesses in Wales through our Business Wales Decarbonisation Advisors –** we will ensure that the support provided includes advice on the approach for low carbon heat and the opportunity of the net zero transition.	*Engagement*	*Support*

m) Our businesses and commercial properties will demonstrate their net zero credentials, building confidence and engagement with consumers

44. **We will review the use of building performance certificates, their role in minimum energy efficiency standards for renting, and how improvements can be made to champion net zero assurance –** we'll consider the accuracy and perceived importance of building performance certificates and how to better drive low carbon heat activity.	*Standards*	*Policymaking*
45. **We will champion our businesses independently certifying their net zero commitments and performance, demonstrating progress to net zero** – we will continue to deliver our Green Growth Pledge through Business Wales and explore the options to support a net zero charter for businesses to build commitments, further, standards such as Science Based Target Initiative certification will be shared with businesses to help demonstrate net zero alignment.	*Standards*	*Leading the Way*

Industry

n) Industry is transitioned, competitive, and sustainable for the long-term following implementation of best available techniques for energy efficiency and low carbon heat

46. **We will support industry to access available funding and support options to enable its transition to affordable low carbon** heat - we will work with industry and Net Zero Industry Wales to maximise the opportunities to access to UK Government funding streams**.**	*Funding*	*Support*
47. **We will work with industry to create decarbonisation pathways for each key industrial heat application** – we will work in collaboration with industry and the industrial clusters to consider opportunities for energy efficiency, waste heat, hydrogen hubs and other innovative approaches. We will disseminate best practice and facilitate and incentivise data sharing, learning and collaboration, working with Net Zero Industry Wales.	*Planning, collaboration*	*Influence*

o) Low carbon hydrogen hubs are established and serving high-temperature industrial processes and local users where appropriate

48. **We will continue to support hydrogen innovation local to our hydrogen hubs, and map industrial heat demand across Wales** – supporting innovation will ensure Wales can recognise the benefit from the opportunity for a hydrogen economy.	*Hydrogen*	*Influence*
49. **We will engage our energy network operators on the plan for hydrogen in industrial areas, the infrastructure needed, and the opportunities for renewable electricity generation.**	*Hydrogen*	*Collaboration*

Public services

p) The public sector are leaders in the transition to net zero – working towards net zero by 2030 and supporting delivery on a regional and local basis to recognise the benefit to Wales

50	**We will utilise Net Zero Reporting to track public sector building performance** – this will demonstrate and give assurance that the public sector are leading the way to net zero heat.	*Assurance*	*Leading the Way*
51	**We will communicate success and share learnings across public bodies and to wider sectors** – with the public sector addressing their built estate by 2030, learnings and case studies need to be shared to build wider momentum for the low carbon heat transition.	*Education*	*Influence*
52	**Our public sector will collaboratively drive decarbonisation regionally and locally through Regional and Local Area Energy Planning** – public bodies will be central to driving change in Wales.	*Energy Costs*	*Collaboration*
53	**We will seek to build local supply chains, grow skills and realise social value through the public sector transition to low carbon heat** – through implementing public sector procurement policy.	*Just. Supply Chain. Skills.*	*Support*

q) All public sector buildings will be served by low carbon heat solutions – championing a whole building approach to the transition

54	**We will support public bodies with funding to deliver high carbon impact but financially challenging low carbon heat projects** – a new low carbon heat funding scheme is launching to scale-up the transition and support the low carbon option to become business-as-usual.	*Implementation*	*Support*
55	**We will review funding options to support a net zero public sector by 2030 and a whole building approach to low carbon heat** – we will review the use of Welsh Government loan and grant funding to maximise benefits and seek to leverage further finance to help scale-up the delivery of low carbon heat.	*Education*	*Leading the Way*
56	**We will work with public sector partners to explore practical solutions for public procurement to build market capacity** – providing a route to market for public sector delivery and building the opportunity for local supply chains.	*Procurement. Supply Chain. Skills.*	*Support*

57	**We will build capacity to deliver a whole building approach to low carbon heat deployment** – our Welsh Government Energy Service will support the public sector with strategic, technical and commercial advice to drive activity.	*Implementation*	*Support*

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