



# The governance of residential heat transitions in the Netherlands and the UK

August 2022

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# Acronyms

ABS	Area-based Scheme (Sc)
ACM	Autoriteit Consument & Markt (Authority for Consumers & Markets) (NL)
AI	Approved installer (UK)
ASHP	air-source heat pump
BEIS	Department of Business, Energy and Industrial Strategy (UK)
BENG	Bijna Energieneutrale Gebouwen (Almost Energy Neutral Building) (NL)
BFIP	Biomass Feedstocks Innovation Programme (UK)
BR	Building Regulations (UK)
BRE	Building Research Establishment (UK)
BTIC	Construction and Technology Innovation Centre (NL)
BZK	Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (Ministry of the Interior and Kingdom Relations) (NL)
CARES	Community and Renewable Energy Schemes (Sc)
CBS	Centraal Bureau voor de Statistiek (Statistics Netherlands) (NL)
CCA	Climate Change Act (UK)
CCC	Climate Change Committee (UK)
CHP	combined heat and power
CMA	Competition and Markets Authority (UK)
CWP	Cold Weather Payment
CITB	Construction Industry Training Board (UK)
DECC	Department of Energy and Climate Change (UK)
DEI	Demonstration of Energy Innovation (NL)
DHLF	District Heat Loan Fund (Sc)
DNO	Distribution Network Operator (UK)
DoE	Department of Education (UK)
DSO	Distribution System Operator (NL)
ECC	Energy Consumer Commission (Sc)
ECO	Energy company obligation (UK)
ECW	Expertise Centrum Warmte (Heating Expertise Centre) (NL)
EES	Energy Efficient Scotland (Sc)

EESSH	Energy Efficiency Standard for Social Housing (UK)
EIP	Energy Innovation Programme (UK)
EPBD	Energy Performance of Buildings Directive (EU)
EPC	Energy Performance Certificate
ERDF	European Regional Development Fund
ESC	Energy Systems Catapult (UK)
ESCo	energy services company
EST	Energy Saving Trust (UK)
EZK	Ministerie van Economische Zaken en Klimaat (Ministry of Economic Affairs and Climate) (NL)
FE	Further education (UK)
FHS	Future Homes Standard (UK)
FSO	Future System Operator (UK)
FTE	full-time equivalent
GHG	greenhouse gas
GHG LAD	Green Homes Grant - Local Authority Delivery (UK)
GSHP	ground source heat pump
GW	gigawatt
HER	Hernieuwbare Energietransitie (Renewable Energy Transition) (NL)
HMG	Her Majesty's Government (UK)
HNDU	Heat Network Development Unit (UK)
HNIP	Heat Network Investment Programme (UK)
IKIA	Integral Knowledge and Innovation Agenda (NL)
ILT	Inspectie Leefomgeving en Transport (Human Environment and Transport Inspectorate) (NL)
IMRP	Iron Mains Replacement Programme (UK)
IPO	Interprovinciaal Overleg (Interprovincial Consultation) (NL)
KEV	Klimaat en Energieverkenning (Climate and Energy Outlook) (NL)
KLP	Knowledge and Learning Programme (NL)
kW	kilowatt
kWh	kilowatt hour
LA	Local Authority (UK, Sc)
LAEP	local area energy planning (UK)

LCITP	Low Carbon Infrastructure Transition Programme (Sc)
LHEES	Local Heat and Energy Efficiency Strategy (Sc)
LILEE	Low-income, low energy efficiency (UK)
MAIS	Multi Actor Impact Simulation (NL)
MEES	Minimum Energy Efficiency Standards (UK)
MHCLG	Ministry of Housing, Communities and Local Government (UK)
MMIPs	Multi-year Mission-driven Innovation Programmes (NL)
MW	megawatt
NAO	National Audit Office (UK)
NEN	Nederlands Normalisatie-instituut (Netherlands Standardisation Institute Foundation) (NL)
NPEA	National Public Energy Agency (Sc)
NPLW	National Programme for the Local Heat Transition (Nationaal Programma voor de Lokale Warmtetransitie) (NL)
NVDE	Nederlandse Vereniging Duurzame Energie (Dutch Sustainable Energy Association) (NL)
NZEB	Near Zero Energy Buildings (NL)
OECD	Organization for Economic Cooperation and Development
Ofgem	Office of Gas and Electricity Markets (UK)
PAW	Programma Aardgasvrije Wijken (Natural gas-free neighbourhoods programme) (NL)
PBL	Planbureau voor de Leefomgeving (Environmental Assessment Agency) (NL)
RdSAP	Reduced Standard Assessment Procedure (UK)
RES	Regional Energy Strategies (NL)
RHI	Renewable Heat Incentive (UK)
RIVM	Rijksinstituut voor Volksgezondheid en Milieu (National Institute for Public Health and the Environment) (NL)
RSW	Regionale Structuur Warmte (Regional Heat Structure) (NL)
RVO	Rijksdienst voor Ondernemend Nederland (Netherlands Enterprise Agency) (NL)
SDE++	Stimulering Duurzame Energieproductie (Encouraging Sustainable Energy Production) (NL)
SEEH	Subsidie Energiebesparing Eigen Huis (Subsidy for Energy Saving at Home) (NL)
SEEP	Scottish Energy Efficiency Programme
SER	Sociaal-Economische Raad (Social and Economic Council) (NL)

SG	Scottish Government
SHDF	Social Housing Demonstration Fund (Sc)
SO	Supplier obligation (UK)
TSO	Transmission System Operator (NL)
UvW	Unie van Waterschappen (Union of Water Authorities) (NL)
VAT	value added tax
VNG	Vereniging van Nederlandse Gemeenten (Association of Dutch Municipalities) (NL)
VvEs	Vereniging van Eigenaars (Apartment Owners' Associations) (NL)

# 1. Introduction

Amongst European and OECD countries the Netherlands and the UK are the most heavily dependent on natural gas for residential heating, due to a combination of high population density and access to domestic sources of natural gas (Lowe, 2019). About 85% of residential properties in the UK are heated by mains gas (BEIS, 2018), and in the Netherlands almost 90% of homes have a natural gas-fired central heating system for space heating (CBS, 2021a).

The challenge of decarbonising residential heating is therefore largely the same for both countries – how to get off gas. Both countries are embarking on this transition from a similar starting point. Domestic gas production is declining in both countries and both have liberalised gas and electricity markets. They also both have a strong climate policy framework. In the UK, heat falls under the overarching framework of the 2008 Climate Change Act, and there are also recent heat strategies at both the UK (HM Government, 2021a) and Scottish levels (Scottish Government, 2021d) that have decarbonisation as an aim. The Netherlands has a Climate Act (2019)<sup>1</sup> that specifies targets and actions for heat decarbonisation and exiting the use of gas in its built environment section. The Act was the outcome of a Climate Agreement<sup>2</sup> process involving a broad set of stakeholders. There are common expectations in both countries that lower heat demand, more district heat networks and a higher proportion of heat from renewable sources will form elements of the solution (Lowe, 2019).

However, the two countries are also doing things differently. Following earthquakes in the Groningen region linked to gas extraction in January 2018, the Dutch government moved decisively to ‘get rid of gas’ (*van loos gas*) by 2030, including for residential heating (Beckman and van den Beukel, 2019; Tigchelaar et al., 2019). This has provided major momentum to heat decarbonisation policy in the Netherlands, which is currently moving ahead more quickly than that in the UK (Policy Connect, 2019). Unlike the UK to date, NL’s strategy is also highly decentralised, with a major role for local planning of heat decarbonisation. By contrast, while there is a lot of activity and experimentation in heat and energy planning in the UK, there is as yet no overall formal framework for the role of local actors, especially in England and Wales (Tingey and Webb, 2020a), and more widely there is considerable uncertainty and a view that heat decarbonisation will be challenging and disruptive (Lowe and Woodman, 2020).

Within this context, this document seeks to map out and compare governance arrangements for residential heat decarbonisation in the UK and the Netherlands in some detail. While there is some discussion of policies, the focus is on the institutions that determine who has power and resources to make and implement policies. This mapping forms part of the wider *Going Dutch?* project, which aims to share experience and learn lessons between the two countries.<sup>3</sup> Within the UK, we focus on Great Britain and exclude Northern Ireland, in part because the latter has a much lower proportion of homes on gas heating. Throughout, we also make a distinction between England and Wales on the one hand and Scotland on the other. This is because, while the UK national government has retained many powers within energy policy within the 1997 devolution settlement, Scotland has the most autonomy and is developing a distinctive approach

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<sup>1</sup> <https://wetten.overheid.nl/BWBR0042394/2020-01-01>

<sup>2</sup> <https://www.klimaataakkoord.nl/documenten/publicaties/2019/06/28/national-climate-agreement-the-netherlands>

<sup>3</sup> <https://www.going-dutch.org/>

in the areas of heat transition and energy efficiency (Cowell et al., 2017; Wade et al., 2021; Webb and van der Horst, 2021). However, it should also be noted that in some areas powers overlap, or their division is poorly defined, and the process of communication and discussion between the UK and Scottish governments is said to be poorly institutionalised (McEwen and Petersohn, 2015).

The document is organised as follows. We start in section 2 with targets, commitments and national governance arrangements on climate and heat. We then go on to look at frameworks explicitly designed for heat transition planning in section 3, and those for the development of heat decarbonisation technologies, including piloting, in section 4. The following sections cover governance arrangements in areas not explicitly aimed at heat decarbonisation but are nevertheless relevant to that transition, including: building regulations (section 5); energy efficiency standards and programmes (section 6); skills and training (section 7); regulation of energy networks (section 8), and gas and electricity taxation (section 9).

Finally, in section 10 we draw these themes together to make a comparison between the governance of residential heat transitions in England and Wales, Scotland and the Netherlands. This comparison brings out a number of dimensions of difference, including centralised vs decentralised, technocratic vs consensus-building and market-coordinated vs state-coordinated governance. This comparison is of course based on a snapshot of the picture in 2022, but institutions typically display path dependence and gradual rather than abrupt change most of the time (Mahoney and Thelen, 2010), so we see contrasts across these dimensions as being of a structural rather than a passing nature.

## 2. National targets

The first area of governance we consider are high-level climate and heat policy targets. Having targets does not guarantee their delivery (see for example the UK's experience on fuel poverty and child poverty targets (Rutter and Knighton, 2012), but they often form part of frameworks that do involve monitoring and delivery elements.

### 2.1 National climate commitments and monitoring mechanisms

#### **Netherlands**

The Netherlands has a climate policy framework established through a consultative process, leading to legislation and an action plan, all within the wider framework of the European Union (EU). In May 2019, the Dutch Senate passed a Climate Act setting a goal of a 49% greenhouse gas reduction by 2030 compared to 1990 levels and a 95% reduction by 2050. In November 2019, the Dutch government presented the first Climate Plan 2021-2030<sup>4</sup> to the Senate and the House of Representatives, specifying policy actions for the next decade to meet the Climate Act objectives. The Climate Act requires the national government to assess and amend, if necessary, the Climate Plan every five years. In December 2019, to comply with the EU climate policy framework, the Dutch government submitted to the European Commission the National Energy

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<sup>4</sup> <https://www.rijksoverheid.nl/documenten/beleidsnotas/2020/04/24/klimaatplan-2021-2030>



and Climate Plan 2021-2030<sup>5</sup>, laying down strategies to achieve a 49% greenhouse gas reduction by 2030.

The Climate Act and Climate Plan were aligned with a Climate Agreement that was brokered over the course of 2018-19. The Agreement sets out a course of action and commitments within five sectors of the economy (electricity, industry, built environment, agriculture and land use, and mobility). More than 100 parties, including business, civil society and government organisations, negotiated these commitments over the course of a year, with further input from political parties in the Dutch government and Parliament. The negotiation process was facilitated by the Social and Economic Council (SER) of the Netherlands, a consultative body consisting of equal numbers of employer representatives, employee representatives, and experts appointed by the Crown on the government's advice. Although the Dutch polder model<sup>6</sup> of decision-making has evolved since its classic mode, many principles, especially inclusion and consensus-seeking, applied to the process of the development of the Climate Agreement (Kooistra, 2021).

On 14 July 2021, the European Commission presented the *Fit for 55* package as part of the European Green Deal. This package of legislative initiatives sets a goal to achieve the 2030 EU Climate target plan: a 55% greenhouse gas reduction by 2030 compared to 1990 levels. The legislative initiatives contain proposals for revising the EU climate and energy laws and regulations, including the Energy Tax Directive, the Renewable Energy Directive, the Energy Efficiency Directive, and the Energy Performance of Buildings Directive (European Parliament, 2021). The Netherlands will have to put in place additional climate policies to achieve more ambitious goals set in the *Fit for 55* package (PBL, 2021).

### *Monitoring mechanisms*

The Climate Act requires the Netherlands Environmental Assessment Agency (PBL) to publish a Climate and Energy Outlook (KEV) in October of each year, tracking greenhouse gas emissions reductions by sector and assessing the measures taken to achieve climate targets. PBL partners with the Netherlands Organisation for Scientific Research (TNO), Statistics Netherlands (CBS), the National Institute for Public Health and the Environment (RIVM) and the Netherlands Enterprise Agency (RVO) to produce the Climate and Energy Outlook. In October of each year, the Minister of Economic Affairs and Climate presents a Climate Memorandum to the Dutch Parliament. The Memorandum discusses progress in achieving climate targets and responds to the findings of the Climate and Energy Outlook.

The Climate Act also requires the national government to produce biannual progress reports on the implementation of the Climate Plan and, if necessary, specify additional policies to reach stated goals. To promote accountability, the Climate Act mandates an entity outside of the Dutch government, the Advisory Division of the Council of State, to assess progress made towards the Climate Act goals. The Council of State is an advisory body to the Dutch government and parliament on legislative and governance issues, whose members are appointed by the Crown. The Advisory Division of the Council of State examines the Climate Plan and the Climate Memorandum, taking legal and budgetary considerations into account.

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<sup>5</sup> [https://energy.ec.europa.eu/topics/energy-strategy/national-energy-and-climate-plans-necps\\_en](https://energy.ec.europa.eu/topics/energy-strategy/national-energy-and-climate-plans-necps_en)

<sup>6</sup> The Netherlands has a long history of consensus decision-making in the battle against water. The current version of the polder model was introduced by the Wassenaar agreement of 1982 in an effort to combat the early 1980s economic recession and rising unemployment (Kooistra, 2021).

## **UK**

The UK climate governance framework is somewhat more technocratic than the Dutch framework, but it has also been partially shaped by EU membership up until the implementation of Brexit in 2021.

A Climate Change Act was passed in the UK in November 2008, which committed the UK to reducing its GHG emissions by 80% (from a 1990 baseline) by 2050. The Act also required the formation of the independent, non-departmental public body to advise the Government on climate change, the Climate Change Committee (CCC).

This target was however, revised and made more ambitious in 2019 when the UK Government committed the country to net zero emissions by 2050. This commitment includes reducing emissions across the whole of the UK including the devolved administrations (Scotland, Wales and Northern Ireland); these currently account for about 20% of the UK's emissions. The net zero target was based on advice from the CCC's 2019 Net Zero report (CCC, 2019).

The UK Government has committed to an interim target of 68% by 2030 (excluding aviation and shipping) and a 78% reduction by 2035 as part of the sixth carbon budget setting (this will also include shipping and aviation for the first time).<sup>7</sup>

Recommendations for setting carbon budgets are made by the independent Committee on Climate Change (CCC). The Government is allowed to give general direction to the Committee, but not to influence the content of any of its reports. Once the recommendations are made, the government must then decide whether to adopt them or not. If it does not do so, it must give an account to Parliament of why it is rejecting the advice of the Committee. To date the Government has accepted all the recommendations, although there was some controversy over the fourth budget (Lockwood, 2013).

Responsibility for making policy to deliver the budgets remains with government; in practice the task of collating policy measures and estimating their abatement effects has been undertaken by DECC and then BEIS as the department with the lead on climate policy. Once carbon budgets have been agreed by Parliament, the government must produce a plan for reaching the budgets within a reasonable time. On most occasions this has been within 2-3 months but following the setting of the fifth carbon budget in 2016 it was well over a year before the associated plan was produced (Lockwood, 2021). In addition, this plan did not contain emissions reductions sufficient to fully meet the budget.

Formally, the role of the CCC in relation to policy is quite proscribed. A 2010 framework agreement specifies that the CCC should not provide 'detailed recommendations or proposals on specific policies', except when requested (HMG, 2010: 14). In practice the CCC has provided analysis and recommendations on policy, and successive Chairs of the Committee have frequently written to government urging action. However, so far, this informal policy guidance has largely been ignored (Fankhauser et al., 2018).

## **Scotland**

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<sup>7</sup> <https://www.gov.uk/government/news/uk-enshrines-new-target-in-law-to-slash-emissions-by-78-by-2035>

Scotland initially legislated for a carbon emission reduction target of 80% by 2050 (against 1990 levels) in the Climate Change (Scotland) Act 2009. This was amended in the 2019 Climate Change (Emissions Reduction Targets) (Scotland) Act to a net zero target for 2045. The 2019 Act also included a legislated interim target of 75% reduction in economy-wide emissions by 2030 (against 1990 levels) and 90% by 2040 (The Scottish Government, 2019). The new targets led to the publication of a Climate Change Plan update in December 2020 and a new Heat in Buildings Strategy in October 2021 (Scottish Government, 2020d; Scottish Government, 2021d).

While the 2045 target was in line with the recommendations from the CCC, the 2030 target was more ambitious than recommended.

## **Wales**

There has not been a separate Climate Change Act in Wales (although the UK act applies to Wales). The Environment (Wales) Act 2016 provided the Welsh Government with the powers to introduce statutory emission reduction targets and carbon budgeting. At the time this was intended to achieve an 80% reduction in emissions by 2050. Following the CCC advice in 2019, the Welsh Government introduced an Amendment in 2021 that required net zero emission by 2050 with all interim carbon budgets also adjusted (Welsh Government, 2021a). In March 2021, a net zero target for 2050 was approved by Welsh Government. Wales also has interim targets for 2030 of 63% reduction and 2040 of 89% reduction, and a series of 5-year carbon budgets.<sup>8</sup> They include Wales's share of emissions from international aviation and international shipping. The Welsh Government publishes low carbon delivery plans every five years, with the most recent being the Carbon Budget 2 plan for 2021-25 (Welsh Government, 2021c).

### *Monitoring arrangements*

There is a duty on the Secretary of State to ensure that carbon budgets are met and to report to Parliament on progress. In addition, the CCC reports on progress annually to Parliament, and the Government must then respond. Legal routes to accountability are possible, for example through judicial review. However, because there is in practice no meaningful penalty, accountability is in practice based on reputation (Muinzer and Little, 2020).

In Scotland, an annual progress report from the CCC to the Scottish Parliament on the Scottish Government's efforts to mitigate the impacts of climate change is required by the Climate Change (Scotland) Act 2009. The CCC does not produce annual progress report for Wales, but an Advice Report for Net Zero was published in 2020 (CCC, 2020a).

## **2.2 National heat decarbonisation targets**

### **Netherlands**

In 2015, the Dutch government began restricting the volume of natural gas extraction in the Groningen gas field to reduce seismic hazards (CBS, 2019). In the same year, the Netherlands adopted a Heat Vision within the context of a broader Energy Agreement signed in 2013. The Heat Vision called for making the country's heating supply more sustainable by, amongst other

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<sup>8</sup> <https://gov.wales/climate-change-targets-and-carbon-budgets#:~:text=In%20March%202021%20Senedd%20Cymru,ran%20from%202016%20to%202020>.

things, developing heat networks, increasing energy efficiency, making use of residual heat, electrifying heating, and expanding renewable heating sources, but did not include any targets (EZK, 2015).

In 2018, following more earthquakes, the Dutch Cabinet decided to halt natural gas extraction in Groningen; starting in mid-2022, gas resources will be used only for limited periods as a back-up resource for extreme conditions (Dutch Government, 2020). At the same time, the Netherlands' ambitious climate targets established in 2019 necessitated swift action in residential heat decarbonisation, amongst other areas.

The Climate Agreement and the Climate Plan state that 7 million homes should be natural gas-free by 2050. As an interim goal, 1.5 million homes should be made 'more sustainable' by 2030 (about 20% of residential dwellings). Achieving this goal would result in a 3.4 Mt carbon dioxide reduction in residential heating by 2030. The Climate Agreement specifies measures to make homes 'more sustainable': insulating homes to reduce heat demand, installing heat pumps to make use of renewable electricity, connecting homes to heat networks, and increasing the use of biogas, geothermal and aqua-thermal energy, residual heat, and hydrogen as heating sources.

## **UK**

The climate governance framework in the UK provides only economy-wide carbon budgets and targets, with an economy-wide 68% emission reduction target by 2030 from 1990 levels but does not translate this into a specific target for emissions from buildings. The recent Heat and Buildings Strategy (HM Government, 2021a) therefore does not have any hard targets, but does include a number of less binding ambitions and statements, including:

- an 'ambition of phasing out the installation of new natural gas boilers from 2035' (p 13)
- a strategic decision on the role of hydrogen in decarbonising heat in 2026 (p 13)
- 'at least 600,000 hydronic heat pumps per year by 2028 can keep us on track to get to Net Zero' and potentially 1.7 million per year by the mid-2030s

Some of these targets fall somewhat short of the recommendations of the Climate Change Committee for a least-cost pathway to net zero by 2050; for example the CCC has called for the phase out of domestic gas boilers by 2028 (CCC, 2020d). The Committee also takes the view that the emissions reductions from residential buildings projected to arise out of plans in the Strategy fall short of the reduction it considers necessary to be on track for net zero by 2050 (CCC 2022).

## **Scotland**

The move to a net-zero target for 2045 at the Scottish Government level led to a Climate Change Plan update in December 2020 and a new Heat in Buildings Strategy in October 2021 (Scottish Government, 2020d; Scottish Government, 2021d). Prior to these developments, Scotland had interim targets for the heating sector of 11% of non-electrical heat demand to be met by renewables in 2020 – in 2019 the figure was 6.5% (EST, 2020) - and an overall 35% of heat in domestic buildings supplied using low-carbon technologies by 2032 (Scottish Government, 2018).

The Heat in Buildings Strategy sets out the ambition to move 1 million homes currently using mains gas, and the vast majority of off-gas homes (altogether accounting for about 50% of the

housing stock) to zero-emission heating by 2030 (Scottish Government, 2021d). The Scottish Government see the majority of these properties moving to some form of electric heating with these likely to be an individual heat pumps or a heat network running on a heat pump. All new homes consented from 2024 must also use zero-carbon heat (The Scottish Government, 2021a).

Box 1 gives a summary of climate and heat targets:

### **Box 1: Climate, heat and natural gas phase out targets**

#### **Climate**

##### *Netherlands*

- (2019) 49% GHG emissions reduction by 2030 compared to 1990 levels and a 95% reduction by 2050
- (2021) EU Climate target plan: a 55% GHG emissions reduction by 2030 compared to 1990 levels

##### *UK*

- Net zero emissions by 2050
- 68% GHG emissions reduction by 2030 (excluding aviation and shipping) and a 78% reduction by 2035 as part of the sixth carbon budget setting (including shipping and aviation for the first time) from 1990 levels

##### *Scotland*

- Net zero target by 2045
- Interim target of 75% reduction in GHG emissions by 2030 (against 1990 levels) and 90% by 2040

#### **Heat and natural gas phase out**

##### *Netherlands*

- 7 million homes should be natural gas-free by 2050, with 1.5 million homes should be made 'more sustainable' by 2030 (about 20% of residential dwellings)

##### *UK*

- 'ambition of phasing out the installation of new natural gas boilers from 2035'

##### *Scotland*

- 11% of non-electrical heat demand to be met by renewables in 2020
- 35% of heat in domestic buildings to be supplied using low-carbon technologies by 2032
- move 1 million homes currently using mains gas, and the vast majority of off-gas homes to zero-emission heating by 2030

## 3. Framework for heat transition planning

Within the overall frameworks for climate action in each country, the most directly relevant forms of governance of heat decarbonisation are explicit frameworks for heat transition planning and implementation. In this section we focus particularly on planning. In all countries, implementation is at an early stage, and mainly takes the form of piloting, technology support programmes etc., frameworks for which are discussed in section 4.

### 3.1 Powers, responsibilities and resources

#### **Netherlands**

The 2019 Climate Agreement lays out a detailed framework for residential heat transition planning. The cornerstone of this framework is the district-oriented strategy. This requires that heat transition approaches must be developed for each specific district (neighbourhood). Another essential element of the strategy is giving municipalities significant authority and responsibilities in leading transitions to sustainable heating. Municipalities are the third tier of government below national and provincial levels, with 344 in the country. They are roughly the equivalent of local authorities in the UK.

The Climate Agreement states that each municipality must adopt a vision for heat transition by the end of 2021. Municipal visions and subsequent implementation plans should contain:

- 1) a timeframe specifying the number of homes (by district) that will be insulated and will switch to sustainable heating solutions between 2022 and 2030;
- 2) sustainable heating approaches with the lowest social and end-user costs to be adopted by each district in the municipality (e.g., all-electric, district heating).

However, municipalities currently lack any enforcement mechanisms for heat decarbonisation in the existing building stock. A proposed Bill on Municipal Instruments for Heat Transition, if adopted, would give municipalities the authority to decide which districts must stop using natural gas by which date (although they may not all choose to use this power immediately).<sup>9</sup> The Bill is currently under discussion in the Parliament.

The Climate Agreement emphasises the point that heat decarbonisation planning is an unfamiliar task for Dutch municipalities, for which they will need financial support. The Ministry of Economic Affairs and Climate launched the External Advice Heat Transition scheme as a grant programme to assist municipalities in obtaining outside expertise necessary for heat transition planning (a total of €3.3m was available in 2020 and €4.0m in 2021, with a maximum of €20,660 per municipality) (EZK, 2020).

In June 2022, the Dutch government announced the launch of the National Programme for the Local Heat Transition (NPLW) (Nationaal Programma voor de Lokale Warmtetransitie) by the end of 2022, as part of the Acceleration Programme for the Sustainability of the Built Environment (Beleidsprogramma Versnelling Verduurzaming Gebouwde Omgeving). NPLW will focus on supporting and monitoring the implementation of the municipal heat transition

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<sup>9</sup> <https://nltimes.nl/2022/04/29/municipalities-force-neighborhoods-gas-network-new-bill>

visions and on facilitating knowledge sharing in that process. Dutch municipalities will receive additional funding to cover the costs associated with the implementation of the municipal heat transition visions (the Acceleration Programme for the Sustainability of the Built Environment contains expenditures for implementation costs of local authorities, planning offices, and other climate sectors, with a total budget of €2.5bn over 2022-2026)<sup>10</sup>.

Beyond municipalities, public officials, business organisations, community groups, and network operators have co-developed Regional Energy Strategies (RES) to achieve goals stated in the Climate Agreement. In total, 30 RESs were developed in 2019-2020. These strategies do not directly map on to pre-existing administrative provinces in the Netherlands, of which there are twelve. RESs specify regional actions for meeting targets in the electricity and built environment sector. They also pinpoint regions' availability for and spatial distribution of renewable electricity sources, and areas with socially acceptable and financially feasible resources. As part of the RES, the regional actors develop a Regional Heat Structure (RSW) that identifies the availability and geographic distribution of sustainable heat sources (e.g., geothermal, residual heat, biofuel). RSWs also map out heat demand and supply in the region and the opportunities for creating a heat infrastructure that spans several municipalities. The National RES Programme is coordinated by the Ministry of the Interior and Kingdom Relations (BZK), the Ministry of Economic Affairs and Climate (EZK), the Association of Dutch Municipalities (VNG), the Interprovincial Consultation (IPO), and the Union of Water Boards<sup>11</sup>.

National government agencies coordinate and oversee developments outlined in the Climate Agreement. The Ministry of Economic Affairs and Climate (generally responsible for climate and energy policy in the Netherlands) is responsible for the electricity and industry sectors, while the Ministry of the Interior and Kingdom Relations oversees developments in the built environment.

## UK

In contrast with the Netherlands, the framework for decarbonising heat in the UK has been more centralised. The following covers UK government level frameworks that effectively apply to England and Wales. The situation in Scotland is rather different because of the framework for local heat planning established by the Scottish Government, which is discussed below.

At the UK level, economy-wide carbon budgets are recommended by the Climate Change Committee (CCC), then adopted by government and approved by the Westminster Parliament. Within each budget, the CCC does make policy recommendations for specific areas, including in the area of heat (e.g., CCC, 2016), but its role is purely advisory. Rather it is government that responds with a plan to meet the budget, with sectoral policies as part of that plan (Lockwood, 2021, Averchenkova et al., 2021). Specific sectoral strategies have then been developed by government departments.

The lead central government department for heat is the Department for Business, Energy and Industrial Strategy (BEIS), created in 2016 when the Dept. for Energy and Climate Change (DECC) and the Department for Business, Innovation and Skills (BIS) were merged. BEIS is

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<sup>10</sup> <https://www.rijksoverheid.nl/documenten/rapporten/2022/06/01/beleidsprogramma-versnelling-verduurzaming-gebouwde-omgeving>

<sup>11</sup> <https://www.regionale-energiestrategie.nl/home/default.aspx>

responsible for a wide remit incorporating business, industrial strategy, science, research and innovation, energy, clean growth and climate change.<sup>12</sup> While most of the responsibilities and policy levers for delivering low-carbon heat are held by BEIS, the Department for Levelling Up, Housing and Communities (MHCLG) also has responsibility for some aspects such as the framework for spatial planning and building regulations.

A strategic framework for low-carbon heat was produced in 2012 (DECC, 2012). This focused on national level policies such as the Green Deal (subsequently closed down), the Energy Company Obligation (see below section 6), the Renewable Heat Incentive, and Zero Carbon Homes for new build (subsequently abandoned). It took the view that decarbonising heat would have to be achieved through more than one route, with low carbon heat networks in urban areas and heat pumps and/or biomass in less densely settled housing.

This framework was then superseded in 2021 by the *Heat and Buildings Strategy* produced by BEIS (HM Government, 2021a). The strategy sets the framework for the roles of different actors in heat decarbonisation. UK and devolved national governments remain the most important actors in most areas. It distinguishes between categories of buildings, including housing, which the government identifies as having clear solutions and those for which the direction of policy is less clear. In the former group are: new build housing, where national planning frameworks can require heat networks or heat pumps; off gas grid buildings (which will transition to heat pumps, supported by subsidy and other policies – see section 4.2 and 4.3); and flats with resistive electric heating (also to switch to heat networks or heat pumps). In the latter group are buildings on the gas grid, which comprise the great majority of homes, especially in England.

Here the approach, set by national government, then provides a context for further decisions that will be taken at various levels (Table 1).

**Table 1**  
**Level of decision making in UK heat decarbonisation**

National decisions	Sub-national decisions	Local decisions
<ul style="list-style-type: none"> <li>• Strategic case for using hydrogen to heat buildings</li> <li>• CCUS requirements</li> <li>• Economic prioritisation if resources are constrained (e.g., biomass)</li> </ul>	<ul style="list-style-type: none"> <li>• Regional hydrogen infrastructure requirements</li> <li>• How to best utilise regional geography and opportunities</li> <li>• Pace and timing of infrastructure upgrades and whether a regional framework is required</li> </ul>	<ul style="list-style-type: none"> <li>• Distribution network upgrades needed</li> <li>• How to best utilise local geography and consider population density (informing suitability of different heat sources)</li> <li>• Suitability of local heat networks (location, size and heat sources used)</li> </ul>

<sup>12</sup> <https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about>



<ul style="list-style-type: none"> <li>• Major/national network infrastructure requirements</li> <li>• Fairly distributing costs and support</li> <li>• Customer protection and product standards</li> <li>• Regulatory framework</li> </ul>		<ul style="list-style-type: none"> <li>• What local level smart and flexible solutions should be implemented (e.g., local energy storage)</li> </ul>
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Source: HMG (2021a: 124)

Key strategic decisions (on the role of hydrogen by 2026, the overall approach to heat networks, distribution of costs and subsidy, and regulation) will form part of the overall approach and will be taken by central government. The role of local actors, including local government, is mainly to focus on and inform decisions about infrastructure at local level.

However, at present there appears to be limited engagement with local government from UK Government departments involved in heat transition planning (McDowall and Britchfield, 2021; Britton and Webb, 2021), and more broadly there is as yet no overall framework at the UK government level for the role of local authorities in achieving net zero (CCC; 2020b; NAO, 2021). The UK Government is described by Wade et al. (2021) as ambivalent about and uncommitted to local energy planning.

The Heat and Buildings Strategy calls for clearer mechanisms for distinguishing decision-making at each level and a coordinated approach across all three levels:

“If we fail to keep [national] strategic oversight of these decisions, we run the risk of a taking sub-optimal path to Net Zero. If national decisions are made without input from local actors, they will not adequately reflect the local landscape. Similarly, if local decisions precede or are made in isolation to a national approach, this could cause greater regional difference and inequality, and possibly result in higher costs for consumers” (HMG, 2021a: 130).

The strategy notes the importance of local government for democratic accountability, local knowledge and relationships, and calls from the National Audit Office and the CCC for action on heat at a local level. It also refers to the ‘Local Climate Action’ chapter in the Net Zero Strategy (HM Government, 2021b) for specific action that national government is taking to enable local actors as delivery partners. The existing roles of local authorities in developing and delivering heat networks, implementing and enforcing national regulations (e.g., building regs), statutory duties in planning for new build, piloting innovative low carbon heating measures, and engaging with business are also mentioned.

The strategy itself signals that the final design of this coordination has yet to be decided:

“To make these decisions on buildings decarbonisation in a co-ordinated way across these levels, we may need to rely on or increase the responsibilities of existing bodies and

groups of organisations (such as local authorities, cities, Ofgem, system operators, network owners and operators, and markets). We will need to consider what type of decisions and responsibilities will be held (whether that be planning, co-ordinating or delivery). We also need to consider how best to ensure impartiality is maintained, local expertise is used, and impacts of and to the wider energy system are taken into account. We will review the suitability of our current institutional arrangements required to meet this challenge as part of our work on strategic decisions.” (HMG, 2021a: 130).

It also notes that: ‘BEIS has work underway with Ofgem to develop a better understanding of the opportunities and challenges presented by local area energy mapping and planning and is considering the most appropriate policy options to take forwards.’ (HMG, 2021a: 135).

Despite the lack of formal powers or statutory responsibilities in local energy planning, there is in fact a large amount of activity by English and Welsh local authorities in this area (Tingey et al., 2017),<sup>13</sup> reflecting the ambition of local authorities to contribute to climate policy as well as meeting other goals such as reducing fuel poverty.

Beyond heat transition planning narrowly defined, local authorities in the UK do have a range of powers related to new and existing building performance (UK100, 2021). However, beyond their own housing stock, these powers are in practice limited. For existing homes, local authorities can enforce improvements for the worst performing homes through Building Regulations (see section 5 below) and legislation covering the private rented section. For new homes, they have the power to require improvements above and beyond national standards, but only to a marginal extent. The Net Zero Strategy (HM Government, 2021b) states that the National Planning Policy Framework is being reviewed to ensure it contributes to climate change mitigation.

Local authorities are expected to gain some new powers in the area of heat network infrastructure planning (see section 4.2 for frameworks for scaling up heat networks). The 2020 Energy White Paper committed to bringing in heat network zoning in England by 2025, and in 2021 the government consulted on proposals that would give local authorities a role in identifying areas for heat network development, with powers to require non-domestic building owners to connect to these networks (BEIS, 2021a), an approach that has now been confirmed. However, local authorities will be working within a heat network planning process led by central government, using standardised methodologies and a national dataset. Protections for heat network consumers regarding pricing, transparency, quality of service and step-in arrangements will all be set by the UK-wide energy regulator Ofgem.

Local authorities have limited resources and ability to access technical expertise for heat transition planning (HM Government, 2021a). The capacity of local authorities has been squeezed in recent years due to a decline in general resources for local authorities in England over the 2010s, due to cuts in grant funding from central government under austerity policies and

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<sup>13</sup> e.g. Coventry’s RESO project; the Leeds PIPES scheme; Islington’s Bunhill heat and power scheme; the London Heat Map through THERMOS; West Midlands Combined Authority and Energy Capital, with the Energy Innovation Zones; Prospering from the Energy Revolution demonstrators pilots in Orkney, Oxfordshire, West Sussex, Oxford; the Energetik heat network partnership in North London; Bridgend, Bury and Newcastle with the Energy System Catapult Local Energy Area Planning programme,; Bristol’s net zero by 2030.

a freeze on council taxes. Over the period 2009/10 to 2019/20, per person revenue and spending by English local authorities in real terms fell by almost a quarter (Harris et al., 2019). Fiscal revenues fell by a little over £11bn. Because local authorities have statutory duties in areas other than energy (such as social care), this has meant that resources for energy planning have been scarce.

BEIS funded a Local Net Zero Programme in 2017, which invested £22m in local capacity and capability and to encourage joined-up working between local areas, investors and central government. Five Local Net Zero Hubs were established across England for identifying and incubating low-carbon projects. However, the relatively small scale of this funding has meant that most local energy planning that would include elements of heat transition planning have been funded through other sources, including EU funding and research and innovation funding.

## **Scotland**

As in many areas of governance, the Scottish Government (SG) has some amount of self-rule with respect to heat transition planning but does not have full control. The CCC states that in buildings decarbonisation the balance of powers is ‘mixed’ but that the primary responsibility is largely devolved<sup>14</sup> (CCC, 2020c: Table 3.1. and Table 5.1.), meaning that the SG can ‘still make substantial progress using devolved policy levers’. The main area where there is joint responsibility centres on ‘strategic decisions on the future of the gas grid’ (ibid, Table 5.1). Areas relevant to heat decarbonisation where policy levers are largely devolved include planning and consenting and local government.

On the relationship between Scottish Government and local authorities the CCC state that arrangements are more coherent and collaborative in Scotland (than in England) (CCC, 2020b). This view is in keeping with wider observations that the Scottish approach to policy is more comfortable with local discretion. The scale of Scotland is seen as critical as it allows relatively close personal relationships to develop between key actors, and closer links to develop across departmental ‘silos’ (Cairney et al., 2015).

The Scottish Government contains a Cabinet Secretary for Net Zero, Energy and Transport and a Minister for Zero Carbon Buildings, Active Travel and Tenant’s Rights. Other Ministers that have some relevance to heat transition include the Minister for Green Skills, Circular Economy and Biodiversity, Minister for Social Security and Local Government (responsibilities include local government, cold winter fuel payments and winter fuel payments) and the Minister for Just Transition, Employment and Fair Work (responsibilities include work of the Just Transition Commission, co-ordination of Sectoral Just Transition).

The key role of local government in Scottish heat transition planning is in the form of Local Heat and Energy Efficiency Strategies (LHEES). These were formally introduced in 2017 (Hofman et al., 2021), and noted in the 2018 Climate Change Plan alongside the pilot projects of the Scottish Energy Efficiency Programme (SEEP, which became Energy Efficient Scotland, EES).

The CCP update of 2020 states that LHEES will be in place by the end of 2023 (Scottish Government, 2020d) and the Heat in Buildings Strategy of 2021 states that LHEES is ‘at the heart of a place based, locally-led and tailored approach to the heat transition’ and will be

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<sup>14</sup> The CCC classify the balance of powers as either ‘largely devolved’ (SG can make progress support by UKG), ‘joint’ (SG can still make significant progress with devolved policy levers) and ‘largely reserved’ (decarbonisation is most contingent on UKG policy, but SG policy is also needed).

accompanied by LHEES Delivery Plans (Scottish Government, 2021d). LHEES are now statutory and are required to be in place for every LA by the end of 2023.

From 2017 to 2021, there have been various phases of LHEES pilot programmes. These pilots have included a LHEES for a particular geographic area of the LA or for a particular sector e.g. SMEs or the private rental sector (Wade et al., 2021). Technical and social evaluations of each pilot programme have been carried out and a Synthesis Evaluation report was released in January 2022 (The Scottish Government, 2022b). 14 local authorities have been provided with funding to develop full, local authority-wide LHEES, testing the LHEES methodology.

LHEESs are intended to have a focus on ‘no and low regrets areas’ and strategic technologies e.g. heat networks, heat pumps and energy efficiency (Scottish Government, 2021d). The LHEES methodology is currently being finalised and is due to go through a period of consultation in 2022. The key challenges identified in the evaluations were considered to be securing buy-in from senior officers and elected officials, the availability of the full range of data sources and analysis skills, and a lack of resources for effective stakeholder engagement (Scottish Government, 2022b).

The Heat Networks (Scotland) Act 2021 places a duty on local authorities to conduct a review of areas likely to be particularly suitable for heat networks within its area (see section 4.2 below). This mandate links to the LHEES methodology which may also involve wider heat decarbonisation zoning (The Scottish Government, 2021b). A Heat Networks Delivery Plan (Scottish Government, 2022) and a first National Assessment of Potential Heat Network Zones were launched in April 2022 (The Scottish Government, 2022a).

In addition, Scotland is to develop a National Public Energy Agency (NPEA) with a remit to ‘coordinate delivery of investment, and coordinate national, regional and local government delivery of heat decarbonisation and energy efficiency rollout, working closely with public, private and third sector partners’ (Scottish Government, 2021d). The plan is for the NPEA to be ‘virtual’ from 2022 and for it to be a ‘dedicated agency’ with a ‘physical presence’ from 2025 (Scottish Government, 2021c).

## **Wales**

As in Scotland, there is a mix of responsibilities between UK and Welsh Governments that are relevant for heat transition planning. Powers for decarbonising buildings are partially devolved, with some key powers reserved at the UK level, but with significant progress possible through the use of devolved policy levers available to the Welsh Government (CCC, 2020a).

In Wales, the Department of the Economy, Skills & Natural Resources contains a Climate Change, Energy & Planning Directorate. There is a Minister for Climate Change and a Deputy Minister. The Welsh Government also considered the possibility of a publicly owned energy company (Welsh Government, 2017).

Wales has responsibilities over heating and cooling networks (but not the regulation of them), renewable energy incentive schemes, and encouragement of energy efficiency. The Welsh government has introduced a heat network policy in the context of the spatial planning document *Future Wales: The National Plan 2040* (Welsh Government, 2021b). It also has a 2016 energy efficiency strategy<sup>15</sup> covering the period to 2026, which sits under the low carbon delivery plan

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<sup>15</sup> <https://gov.wales/energy-efficiency-strategy>

(see Section 2.1 above). The Plan includes Welsh Government level programmes, such as the Optimised Retrofit Programme. There is a focus on social housing via the Welsh Housing Quality Standard.

There are developing plans for the implementation of Local Area Energy Plans (LAEP) in every LA in Wales. The Welsh Government will fund LAEPs for every LA to be completed by March 2024. This would be slightly later than the LHEES in Scotland, but these are full energy plans as opposed to the LHEES which only considers heat and energy efficiency. The Government plan to procure LAEPs contracts on a regional basis, with four regions in Wales and one contractor to do all the LAEPs for a particular region. Once the LAEPs are complete, Energy Systems Catapult (ESC) will align all the different LAEP methodologies.

## 3.2 Providing technical guidance

### Netherlands

The Climate Agreement contains commitments for the development of technical guidelines at national level to assist municipalities in creating their heat transition visions. The guidelines consist of two components. The first component, the ‘Start Analysis’, was developed by the Dutch Environment Agency PBL in 2019 and updated in 2020. It is a technical-economic analysis created with the help of the Vesta Multi Actor Impact Simulation (MAIS) model and based on national public data. The Vesta MAIS is an open-source modelling tool developed by PBL in 2010 and available for download and use free of charge (PBL, 2017).

The Start Analysis provides estimates of the technological feasibility, GHG reduction potential and associated costs of five sustainable heating strategies: an all-electric strategy with individual heat pumps; a strategy based on a heat network with a medium- to high-temperature source; a strategy based on a heat network with a low-temperature source; a strategy based on green gas, and a hydrogen-based strategy. It also produces maps for heating strategies for each district, data tables customised for each municipality, and data files for further analysis. The Start Analysis is supplemented by an End-User Costs Dashboard, which calculates costs for homeowners, tenants of housing associations, and tenants of private rented properties<sup>16</sup>.

The second component of the technical guidelines, the ‘Local Analysis Guide’, is prepared by the Heating Expertise Centre established under the Climate Agreement. The Local Analysis Guide helps municipalities supplement the Start Analysis with local data and developments when planning heat decarbonisation strategies. It also assists municipalities in establishing criteria for prioritising neighbourhoods that will begin heat transition before 2030 (ECW, 2021). Municipalities can ask questions related to the planning of heat decarbonisation through the Heating Expertise Centre’s helpdesk.

The Heating Expertise Centre’s work is coordinated by the Netherlands Enterprise Agency. Its Steering Committee includes representatives of the Association of Dutch Municipalities, the Interprovincial Consultation, the Union of Water Boards, the Ministry of the Interior and Kingdom Relations, and the Ministry of Economic Affairs and Climate. Its Advisory Council includes representatives of a number of different organisations: the association of network operators (*Netbeheer Nederland*); the association of producers, traders and retail companies of

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<sup>16</sup> <https://www.expertisecentrumwarmte.nl/themas/de+leidraad/startanalyse/default.aspx>

heat, gas and electricity (*Energie Nederland*); the Dutch Sustainable Energy Association (*NVDE*); the association of technical service providers, installation companies and the technical retail sector (*Techniek Nederland*); the Dutch Association of housing associations (*Aedes*); the transmission network operator; the Expert Group for Energy Transition Calculation Models (*EG ETRM*); the Economic Institute for Construction; the Dutch Association for companies in the construction and infrastructure sector (*Bouwend Nederland*), and the Netherlands' Heat Network Foundation.

More broadly, the development of the technical guidelines has been a collaborative effort of the national government, municipalities, and other stakeholders. According to the Climate Agreement, the Heating Expertise Centre's Advisory Council, VNG, EZK, BZK, and IPO have reviewed the approaches and validated the data sources used to develop the Start Analysis. Municipalities provided feedback for developing the updated version of the Start Analysis.

## UK

### England and Wales

Heat decarbonisation planning and piloting in England and Wales is not currently mandated as it is in Scotland and the Netherlands, and is instead dependent on voluntary initiatives by local actors. There are a variety of bodies that provide technical assistance for low carbon energy planning and piloting. The Energy Systems Catapult<sup>17</sup> was originally set up within Innovate UK before being spun off as an independent, not-for-profit agency to work with UK business and consumers to 'capture the opportunities for green growth'. Together with the Centre for Sustainable Energy in Bristol it has provided technical assistance and developed a methodology for Local Area Energy Planning<sup>18</sup> used in a number of English and Welsh cities. There are also a number of consultancy groups that are routinely involved with local energy planning, including DELTA Energy and Environment, Element Energy, Arup and Buro-Happold.

While there are multiple studies and stakeholders using cost and technical performance data for low-carbon technologies, building fabric improvements and heating networks in the UK, there are no standard low-carbon technology cost estimates mandated for use by the government. There is also currently no common reporting system for emissions in English local authorities, but there are systems in Scotland and Wales (CCC, 2020b). However, there is a national database on the energy performance of buildings,<sup>19</sup> based on the Standard Assessment Procedure,<sup>20</sup> and the Energy Savings Trust offers a Home Analytics modelling tool<sup>21</sup> based on this data.

The Heat and Buildings Strategy notes that data on the capacity and performance of energy networks and assets such as heat pumps is difficult to find and use (HM Government, 2021a: 130-131). BEIS has been collecting data on the cost of heat pump installations through the Renewable Heat Incentive (see section 4.2 below). For heat networks, a National Comprehensive Assessment of the potential for heat networks, which applies to all parts of the UK was published

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<sup>17</sup> <https://es.catapult.org.uk/about/>

<sup>18</sup> <https://es.catapult.org.uk/report/local-area-energy-planning-the-method/>

<sup>19</sup> <https://epc.opendatacommunities.org/>

<sup>20</sup> <https://www.gov.uk/guidance/standard-assessment-procedure>

<sup>21</sup> <https://energysavingtrust.org.uk/service/home-analytics/>

in 2015, with a second version coming out in 2021 (BEIS, 2021b). As described in Section 3.1, the government intends to move towards a national mapping system for heat networks.

The government, together with Ofgem and Innovate UK is also working on an Energy Digitalisation Strategy (BEIS/Innovate UK/Ofgem 2021) intended to provide data on millions of low-carbon assets across the country. The strategy aims at having standards and regulatory frameworks for energy data collection in place by the mid-2020s. It appears to be intended for DNOs and suppliers as much as local government.<sup>22</sup>

Within Wales, the Welsh Government Energy Service offers technical, commercial and procurement advice on energy planning to public sector or community enterprises,<sup>23</sup> which also helped to support the Bridgend heat network.<sup>24</sup>

## Scotland

Scotland has a more structured approach to technical support than the rest of the UK. A National Assessment (Scotland-wide) of the building stock to identify initial strategic heat decarbonisation zones has recently been released (The Scottish Government, 2022a). The National Assessment will create a central resource that local authorities can draw on to support access to the data and analysis needed to underpin their LHEES. The Assessment uses the LHEES methodology together with relevant national datasets such as Home Analytics and the Scottish Heat Map.<sup>25</sup> This was developed in 2013-14 and allows assessment of the density and location of heat demand from buildings across Scotland. Heat demand estimates are presented for areas ranging from 50m grid squares to whole local authorities. It also shows where there are existing and planned heat networks, and existing and potential sources of energy supply, alongside other relevant data

Direct LHEES technical support has been provided by the Scottish Government and private sector firms. Atkins (and sub-contractors including Changeworks, Carbon Trust and Resource Efficient Solutions LLP) have provided technical support to nine of the twelve local authorities successful in obtaining funding to pilot LHEES (Scottish Government, 2019b). Edinburgh, Renfrewshire and the Borders did not work with Atkins. The Scottish Borders Council commissioned Changeworks to complete their LHEES pilot (Changeworks, 2019) and they have also helped East Renfrewshire with their LHEES pilot.<sup>26</sup> City of Edinburgh Council have been carrying their LHEES pilot in-house

The Scottish Government commissioned Element Energy to carry out an analysis of what low carbon heat measures are technically feasible in the Scottish housing stock (Element Energy, 2020). Alongside this, Cambridge Econometrics were commissioned to carry out an assessment of the economic impact of heat decarbonisation to 2030 (Cambridge Econometrics, 2021). The National Public Energy Agency (Scottish Government, 2021c) is also expected to play a role in providing technical guidance (see section 3.1).

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<sup>22</sup> An early output is a [Catalogue of Projects in Energy Data \(CoPED\)](#) produced by EnergyREV with support from BEIS and the Energy Systems Catapult.

<sup>23</sup> <https://gov.wales/energy-service-public-sector-and-community-groups>

<sup>24</sup> <https://gov.wales/kick-start-new-welsh-schemes-heat-homes-and-businesses-using-city-centre-heat-networks>

<sup>25</sup> <https://heatmap.data.gov.scot/custom/heatmap/>

<sup>26</sup> <https://www.changeworks.org.uk/projects/local-heat-and-energy-efficiency-strategy-pilots>

### 3.3. Public engagement and incorporating citizen initiatives into heat transition plans

#### Netherlands

The Climate Agreement emphasises the importance of public participation and support in achieving a successful heat transition:

‘The principal goal of the Climate Agreement, namely the reduction of greenhouse gas emissions, will affect everyday life. The transition we face as a nation will primarily be a social transition. Both citizens and businesses will face a series of decisions that affect how we live, our mobility, our food and diet, what products we buy and how we earn a living. These will not always be easy choices, and citizens and businesses will also have to rely on each other and on the government.’<sup>27</sup>

Residents and other stakeholders (building owners, housing associations, energy network managers, heat suppliers, providers of sustainability technologies) are consulted through deliberative sessions before each municipal council adopts a heat transition vision. Residents can also put forward their initiatives for heat decarbonisation. Such initiatives may include proposals to develop community-owned local heating networks and collectively generate electricity.

In 2018, (i.e., preceding the Climate Agreement) the national government launched the Natural Gas-Free Neighbourhoods Programme (Programma Aardgasvrije Wijken, PAW) to test methods of phasing out natural gas as a heating source at the neighbourhood level (see section 4.1 below). Two of the PAW’s themes include strategies to engage with residents in the most productive way, as well as strategies for using natural gas phase-out activities to address neighbourhoods’ challenges that are not immediately related to the heat transition.

The Participation Coalition – a collaborative initiative formed by five civil society organisations – offers local knowledge and a network of people to support effective collaboration between municipalities and residents and helps incorporate residents’ initiatives into municipal heat transition visions.<sup>28</sup>

Despite the consultative nature of the process for the Climate Agreement and the local initiatives, the issue of citizen participation has remained a concern in Dutch government, which has started to look at the Citizens’ Assembly model. The government commissioned the advisory committee

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<sup>27</sup> <https://www.government.nl/documents/reports/2019/06/28/climate-agreement>, p. 5

<sup>28</sup> The Partnership Coalition involves the following organisations: HIER (a nonprofit organisation that helps people adopt solutions to mitigate climate change); Natuur en Milieufederaties (a nonprofit organisation that implements projects related to renewable energy, nature, landscapes, and circular economy); Energie Samen (a national umbrella organisation for energy cooperatives and an advocacy group for sustainable energy initiatives); Buurkracht (an organisation that coordinates citizen participation by connecting residents with each other and local authorities), and LSA residents (an association of residents dedicated to a fair energy transition) (Participation Coalition, n.d.).



of the Council of Ministers to produce a report on citizens' participation in climate policy and the role of climate forums,<sup>29</sup> which appeared in 2021.

## UK

While public participation does play a role in the various local energy planning initiatives in England and Wales, and the importance of public engagement is emphasised in the Heat and Buildings Strategy (HMG, 2021a), there is no formal governance framework for this dimension, with the possible exception of SmartEnergyGB<sup>30</sup> for the smart meter rollout. At a wider level, Climate Assemblies are seen as a key public engagement tool in low carbon transitions (Sasse et al., 2021). The first UK-wide citizens' assembly on climate change was commissioned by six House of Commons Select Committees and published its final report in September 2020 (Climate Assembly, 2020). The government welcomed the report<sup>31</sup> but is not bound to adopt any of its recommendations. The BEIS Committee will monitor and review the government's engagement and interaction with the findings of the assembly and progress in implementing its proposals.

However, the UK-wide assembly was focused on economy-wide policies and measures rather than specific local energy planning. There have also been Citizens' Climate Assemblies in a number of UK cities and other locations, including Leeds, Glasgow, Bristol, specific London boroughs, Blaenau Gwent, Devon, Warwick, Brighton etc.<sup>32</sup> Some of these assemblies do produce recommendations for local action, but these are not necessarily tied to a specific local energy planning exercise.

There is a significant community energy movement in the UK, but the sector receives little support or attention.<sup>33</sup> The most recent community energy strategy was in 2014 (DECC, 2014), which did include some funding, but this was last updated in 2015. Community energy projects have mostly focused on renewable electricity rather than heat, and while they benefitted from the small-scale feed-in tariff policy adopted in 2010, they were also adversely affected when support for solar PV and onshore wind was effectively removed in 2016 (Nolden et al., 2020). There is some political support for the community energy sector, with more than 280 MPs committing to a Local Electricity Bill but this again focuses more on renewable electricity.

## Scotland

The Scottish Government has stated that it is developing a 'bespoke public engagement strategy for heat in buildings' (Scottish Government, 2021d) which will build on the existing *Net Zero Nation: Climate Change Public Engagement Strategy* (Scottish Government, 2020b). The government is also working on consumer engagement through an Energy Consumer Commission (ECC) which was formed by the Scottish Government in July 2020 with members from NGOs,

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<sup>29</sup> [https://www.rijksoverheid.nl.translate.google.com/onderwerpen/klimaatverandering/klimaatbeleid/betrokken-bij-klimaat/betrokkenheid-burgers-bij-klimaatbeleid? x tr sl=nl& x tr tl=en& x tr hl=en& x tr\\_pto=sc](https://www.rijksoverheid.nl.translate.google.com/onderwerpen/klimaatverandering/klimaatbeleid/betrokken-bij-klimaat/betrokkenheid-burgers-bij-klimaatbeleid? x tr sl=nl& x tr tl=en& x tr hl=en& x tr_pto=sc)

<sup>30</sup> <https://www.smartenergygb.org/>

<sup>31</sup> <https://houseofcommons.shorthandstories.com/climate-assembly-beis-committee/index.html>

<sup>32</sup> <https://www.involve.org.uk/citizens-assembly-tracker>

<sup>33</sup> <https://www.edie.net/uk-community-energy-leaders-say-government-has-abandoned-them-despite-net-zero-commitment/>

academia and community groups. The ECC will be incorporated into Consumer Scotland when this is established. In addition, the National Public Energy Agency will have a remit to ‘raise public understanding and awareness’(Scottish Government, 2021c).

There is also Scotland’s Climate Assembly, required by the Climate Change (Scotland) Act 2019. The Assembly’s first report was laid in the Scottish Parliament in June 2021, sets out 81 recommendations agreed by consensus.<sup>34</sup> The Climate Assembly has been unsatisfied with the Scottish Government’s response to its proposals.<sup>35</sup> However, as with the UK level Climate Assembly, this group is not engaged with specific local transition planning processes.

In 2011, a target was set of 0.5GW community and locally owned renewable energy capacity in Scotland by 2020. This was exceeded in 2015 with a new 1GW target set for 2020 and a 2GW target for 2030. By 2020 there was 0.85 GW (Energy Saving Trust, 2021). The Scottish Government has funded many of these projects via the Community and Renewable Energy Scheme (CARES), the Low Carbon Infrastructure Transition Programme (LCITP) and Resource Efficient Scotland SME loan (RESSME loan) (ibid).

### 3.4 Frameworks for knowledge sharing and dissemination

#### **Netherlands**

Under the Climate Agreement, VNG, in collaboration with EZK, BZK, IPO and UvW, implements a Knowledge and Learning Programme (KLP), the aim of which is to share knowledge gained through the implementation of the PAW with all Dutch municipalities. To provide municipalities with consistent advice, the implementing actors ensure that the Heating Expertise Centre and the KLP work together effectively.

The KLP focuses on knowledge dissemination on the following topics that are central to the PAW: 1) issues pertaining to management and administration (methods of effective coordination of heat transition activities by municipalities); 2) identifying cost-cutting techniques and effective funding strategies; 3) selecting the most appropriate technology; 4) the impact of existing and future laws and regulations; 5) strategies to engage with residents in the most productive way; 6) using natural gas phase-out activities to address neighbourhoods’ challenges that are not immediately related to the heat transition.

#### **UK**

There is no formal knowledge sharing framework for heat transition planning at the UK, English or Welsh levels. Some organisations and initiatives, such as EnergyREV do provide resources in this area.<sup>36</sup>

At a more general level, energy efficiency advice to households and advice and loans to community energy schemes has been provided by the Energy Savings Trust (EST) since it was

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<sup>34</sup> Although Extinction Rebellion withdrew their support and left the stewarding group shortly before the Assembly began.

<sup>35</sup> <https://www.scotsman.com/news/opinion/columnists/scottish-government-must-drop-cant-do-attitude-on-climate-climate-assembly-3560841>

<sup>36</sup> <https://www.energyrev.org.uk/news-events/blogs/local-energy-systems-in-the-uk-where-and-why/>

founded in 1992.<sup>37</sup> UK Government funding to the EST was halved in 2011, and it now obtains funding from a variety of partnerships. It currently gives energy efficiency advice to households in Scotland and Wales.

## **Scotland**

The Local Heat and Energy Efficiency Strategies (LHEES) will involve some form of formalised best practice sharing and the pilot stages have seen an LA forum for this purpose every month. The evaluation reports of LHEES have, however, thus far reported that ‘to establish an accurate picture of individual building condition and energy consumption for businesses the biggest hindrance to progress was the sharing of data amongst different organisations.’ (Wade and Webb, 2020). Access to the necessary data and lack of data analysis skills are highlighted in the LHEES evaluation synthesis as some of the main challenges facing the LHEES process.

More widely, the Scottish Government states that an expansion of delivery programmes in the next 5 years will showcase ‘Net Zero Leadership and share learning through early adoption in key areas of focus’ (Scottish Government, 2021d). In addition, the Energy Consumers Commission (ECC) is partly tasked with helping to disseminate best practice in low carbon heat technologies and behaviour change.

Following the closure of the Low Carbon Infrastructure Transition Programme (LCITP)<sup>38</sup> in 2021, information will be disseminated about a number of the projects that have been funded, many of which are heat networks. A heat networks forum of heat network operators and associated practitioners will also be established (Scottish Government, 2022).

The Community and Renewable Energy Schemes (CARES) provides advice and funding support specifically to community groups and other eligible organisations seeking to explore renewable energy solutions. The scheme is delivered by the Energy Saving Trust under the Local Energy Scotland branding

## **4. Developing heat decarbonisation technologies and energy sources**

### **4.1 Framework for technology piloting**

In general, the Netherlands, the UK and the devolved nations are all considering the same set of technologies and energy sources for decarbonising heat. These include: air source, ground source and water source heat pumps, renewable electricity, solar heating, heating networks with low-carbon energy sources, biomass, biogas, bio-methane and blue or green hydrogen. Some of these are relatively novel technologies, especially in national markets, and so frameworks for supporting piloting and deployment for learning-by-doing and scale economies are important.

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<sup>37</sup> <https://energysavingtrust.org.uk/>

<sup>38</sup> See section 4.2 below

## Netherlands

Established in 2018 by the Dutch government, the PAW has tested methods of phasing out natural gas as a heating source at the neighbourhood level. The PAW provides grants to municipalities to pilot sustainable heating and insulation technologies, identify approaches for effective local involvement, and evaluate measures for cost reductions. In the first two rounds (2018 and 2020), 50 municipalities (out of all 352 municipalities in the Netherlands) received PAW grants. The third (and final) round provided funding for an additional 14 pilots in 2022. The municipalities that have received the PAW grants are considered frontrunners in their heat transition efforts. Successful submissions must meet the following criteria: being ready for immediate launch, with a target of completion by 2030; having the potential for carbon dioxide reductions; and having the capacity for upscaling<sup>39</sup>. This programme has received a total of €400m in government funding.

Several government bodies coordinate the PAW programme: Ministry of the Interior and Kingdom Relations, Ministry of Economic Affairs and Climate, Association of Dutch Municipalities, Interprovincial Consultation and Union of Water Boards. The programme also has an Advisory Committee which also includes academics and representatives of: the Dutch Association of housing associations ; the Dutch Association for companies in the construction and infrastructure sector; the Dutch association of network operators; the Dutch association of producers, traders and retail companies of heat, gas and electricity; the Dutch Sustainable Energy Association, and the Dutch association of technical service providers, installation companies and the technical retail sector<sup>40</sup>.

In addition to the PAW pilots defined around neighbourhoods, there are also a number of technology innovation programmes. The Dutch government launched the Top Sector strategy in 2011 to promote innovation in nine sectors of the economy. Top Sector Energy was identified as one of these high-priority sectors. The goal was to facilitate joint investment and collaboration between businesses, knowledge institutions, and the government to spur innovation, which would help increase the competitiveness of Dutch companies, tackle pressing societal challenges like climate change, and strengthen the Dutch economy<sup>41</sup>.

In 2019, the Climate Agreement set out an Integral Knowledge and Innovation Agenda (IKIA) within Top Sector Energy to create a mission-oriented framework for accelerating innovations to reduce greenhouse gas emissions across all five sectors of the Agreement. The Ministry of Economic Affairs and Climate Policy oversees the IKIA through implementation. The IKIA consists of 13 Multi-year Mission-driven Innovation Programmes (MMIPs). Four MMIPs relate to the built environment, including<sup>42</sup>:

- MMIP 2: Renewable electricity generation on land and in the built environment;
- MMIP 3: Acceleration of energy renovations in the built environment;
- MMIP 4: Sustainable heating and cooling in the built environment;
- MMIP 5: Electrification of the energy system in the built environment.

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<sup>39</sup> <https://www.aardgasvrijewijken.nl/proeftuinen/default.aspx>

<sup>40</sup> [Deelnemende gemeenten aardgasvrije wijken | Aardgasvrije wijken | Rijksoverheid.nl](https://www.aardgasvrijewijken.nl/Deelnemende-gemeenten-aardgasvrije-wijken-|Aardgasvrije-wijken-|Rijksoverheid.nl)

<sup>41</sup> <https://www.topsectoren.nl/innovatie>

<sup>42</sup> <https://www.topsectorenergie.nl/missies-energietransitie-en-duurzaamheid/missie-gebouwde-omgeving>

The IKIA shapes the use of funds intended for promoting innovations. Top Sector Energy has a yearly budget of around €130m for projects with applications in industry, the built environment, or the electricity sector<sup>43</sup>. Funding schemes pertaining to the built environment in 2022 include:

- Mission-driven Research, Development and Innovation (MOOI)<sup>44</sup> scheme funds projects developing innovative solutions that focus on the tasks outlined in the Climate Agreement. Funds available in 2022: €39.4m for the built environment, €21m for electricity, €21m for industry. The scheme supports partnerships of at least 3 organisations.
- Demonstration Energy and Climate Innovation (DEI+)<sup>45</sup> scheme funds pilots and demonstration projects focusing on energy efficiency, CCUS, circular economy, renewable energy, flexibility of the energy system, local infrastructure, and other CO<sub>2</sub>-reducing measures in industry, the built environment, or electricity sector. Funds available in 2022: €58.6m.
- DEI+ scheme has a separate, supplementary budget of €9m<sup>46</sup> in 2022 for developing innovative products and services facilitating the transition to natural gas-free buildings and neighbourhoods.
- DEI+ scheme has a separate, additional budget of €29.4m<sup>47</sup> in 2022 for hydrogen (energy storage and conversion of renewable energy, production of green hydrogen based on renewable electricity, transport and storage of hydrogen, innovative applications of hydrogen as a fuel in industry).
- Renewable Energy Transition (HER+)<sup>48</sup> – the successor to the Renewable Energy Subsidy – provides subsidies for developing innovative solutions that focus on producing renewable energy and implementing solutions reducing CO<sub>2</sub>, including CCS, hydrogen production, and sustainable heat production. Funds available in 2022: €20m.

A further initiative, specified in the Climate Agreement, is the Construction and Technology Innovation Centre (BTIC) which coordinates efforts to accelerate innovation in the decarbonisation of the built environment. BTIC develops consortia that consist of industry, government, and research institutions to develop innovative processes, goods, or services. Partners contribute monetary and human resources to the consortia. BTIC emphasises an open innovation approach and commits to publicly sharing knowledge developed by the consortia. Consortia create solutions that contribute to one or more of the core BTIC goals, such as<sup>49</sup>:

- Developing scalable building renovation solutions that would result in significant cost reductions (20–40%) and nuisance reductions (renovations completed in up to 5 days).
- Enhancing heat pump and heat storage technologies.
- Improving policy, regulatory, and financial mechanisms for building decarbonisation.

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<sup>43</sup> <https://www.rvo.nl/subsidies-financiering/subsidies-energie-innovatie>

<sup>44</sup> <https://www.rvo.nl/subsidies-financiering/mooi>

<sup>45</sup> <https://www.rvo.nl/subsidies-financiering/dei>

<sup>46</sup> <https://www.rvo.nl/subsidies-financiering/dei/aardgasloos>

<sup>47</sup> <https://www.rvo.nl/subsidies-financiering/dei/waterstof-en-groene-chemie>

<sup>48</sup> <https://www.rvo.nl/subsidies-financiering/her>

<sup>49</sup> <https://btic.nu/over-btic/>

- Increasing heating efficiency by 30% through improved management of heating supply and demand, as well as seasonal storage.

## UK

The approach in the UK has been to link innovation and piloting support to the development of specific technologies and fuels rather than localities. BEIS has funded an Electrification of Heat Decarbonisation Project to install and monitor the performance of heat pumps in a representative range of UK homes (about 750 in total).<sup>50</sup> A consortium led by Energy Systems Catapult (ESC) with Delta Energy and Environment and Oxford Computer Consultants are managing the project and have begun to release some data and case studies from the project.<sup>51</sup> This project is taking place across Great Britain with roughly £15m of funding.

It was funded by the wider Energy Innovation Programme (EIP) for which there was a budget of £505m over 2015-2021. This wider programme contained £90m for ‘built environment (energy efficiency & heating)’,<sup>52</sup> with other themes such as ‘smart systems’<sup>53</sup> (£70m) ‘renewables innovation’ (£15m) and ‘energy entrepreneurs and green financing’ (£50m) also pertaining to heat decarbonisation.

The Government also recently set up a Biomass Feedstocks Innovation Programme (BFIP)<sup>54</sup> to support the development of more sustainable domestic sources of biomass, although these are likely to be aimed at commercial applications rather than home heating). This has so far disbursed £30m of funding.

Two ‘hydrogen villages’ are to be trialled at Redcar and Ellesmere Port, both existing areas of heavy industry that could be used as hydrogen production hubs. These sites will trial 100% hydrogen use by 2025 and will inform the UK Government’s strategic decision on hydrogen for heating due in 2026 (Ofgem, 2022).

## Scotland

In Scotland, a Low Carbon Infrastructure Transition Programme (LCITP) has provided support for large-scale low carbon energy demonstration projects since 2015, with financial support of £67m to 2022 and expertise.<sup>55</sup> Support was targeted at innovative low-carbon infrastructure projects that were large-scale, connected multiple buildings and had potential for replication, and was available for projects with a technology readiness level of 7-9. The programme is funded primarily by the Scottish Government but with some co-funding from the European Regional Development Fund.

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<sup>50</sup> <https://www.gov.uk/government/publications/electrification-of-heat-demonstration-project-successful-bids>

<sup>51</sup> <https://es.catapult.org.uk/news/electrification-of-heat-trial-finds-heat-pumps-suitable-for-all-housing-types/>

<sup>52</sup> <https://www.gov.uk/government/collections/innovations-in-the-built-environment>

<sup>53</sup> <https://www.gov.uk/guidance/funding-for-innovative-smart-energy-systems>

<sup>54</sup> <https://www.gov.uk/government/publications/apply-for-the-biomass-feedstocks-innovation-programme>

<sup>55</sup> For a list of LCITP projects up to 2021 see: <https://www.gov.scot/publications/capital-projects-supported-through-the-low-carbon-infrastructure-transition-programme/>

LCITP projects have often involved heat networks or integrated energy systems e.g. heat pumps or solar PV with storage (Scottish Government, 2021e). The scheme is delivered in-house with support from Scottish Future Trust and Zero Waste Scotland (Scottish Government, 2021a). LCITP closed in 2021 with a successor fund due to be launched in 2022.

A Green Growth Accelerator Model has also recently been announced which is based on a Growth Accelerator model that was used to fund large regeneration projects in Edinburgh and Dundee. The Accelerator will be ‘an outcome based funding model whereby a Local Authority will commit to deliver a set of agreed economic, environmental and social outcomes that will be delivered through investment in infrastructure. Where these outcomes are met the Scottish Government makes a regular payment over a set period, typically 25 years, reflecting the value of the outcomes achieved.’ (Scottish Government, 2020c).<sup>56</sup> The scheme is to be trialled with a £1m investment in 2022/23.

## 4.2 Measures to scale up heat decarbonisation technologies

### Netherlands

The main support mechanism to stimulate large-scale production of sustainable (renewable) energy and the implementation of CO<sub>2</sub>-reducing techniques in the Netherlands is the Stimulating Sustainable Energy Production and Climate Transition (SDE++) subsidies. The total budget of the SDE++ scheme in 2022 is €13bn<sup>57</sup>. There are five main subsidy categories, including:

- Renewable electricity (osmosis, hydropower, wind, solar);
- Renewable heat (CHP) (renewable biomass heating, composting, geothermal (ultra-deep), solar thermal);
- Renewable gas (renewable gas from biomass);
- Low CO<sub>2</sub> heat (aquathermal (TEO, TEA and TED), daylight greenhouse, solar-PVT panels with a heat pump, electric boiler, geothermal (shallow), residual heat, industrial heat pumps, hybrid glass oven);
- Low CO<sub>2</sub> production (carbon capture and storage, carbon capture and use, advanced renewable fuels, hydrogen by electrolysis).

Investment subsidy for sustainable energy and energy saving (ISDE) offers homeowners subsidies for insulation measures and the installation of low-carbon heating solutions. There are four subsidy categories: 1) subsidies for insulation measures at a fixed rate per m<sup>2</sup><sup>58</sup>; 2) subsidies for a heat pump that range from €500 to €13,200 depending on the type of the heat pump<sup>59</sup>; 3) a subsidy for a connection to a heat network of €3,325<sup>60</sup>; 4) subsidies for a solar boiler<sup>61</sup> (the

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<sup>56</sup> <https://www.gov.scot/news/accelerating-green-growth/>

<sup>57</sup> <https://www.rvo.nl/subsidies-financiering/sde>

<sup>58</sup> <https://www.rvo.nl/subsidies-financiering/isde/woningeigenaren/isolatiemaatregelen#over-isolatiemaatregelen>

<sup>59</sup> <https://www.rvo.nl/subsidies-financiering/isde/woningeigenaren/warmtepomp>

<sup>60</sup> <https://www.rvo.nl/subsidies-financiering/isde/woningeigenaren/aansluiting-warmtenet>

<sup>61</sup> <https://www.rvo.nl/subsidies-financiering/isde/woningeigenaren/zonneboiler>

amount depends on the boiler model). The ISDE annual budget is specified yearly, €228m is available in 2022. Cumulative installations of all heat pumps by 2020 were just under 200,000.<sup>62</sup>

Incentive scheme for natural gas-free rental properties (SAH)<sup>63</sup> offers subsidies for connecting existing homes to a heat network (both indoor housing costs and connection costs) that will switch off from natural gas within 5 years. The subsidies are available for housing associations, institutional investors, business and private landlords. From 1 October 2021 apartment owners' associations (VvEs) are eligible, where some of the owners live in the apartment and some rent it out. The total budget is €195.3m, with a maximum of €5,000 per home.

The Dutch approach to heat decarbonisation involves the implementation of demand-pooling techniques that allow for the development of standardised supply packages for home insulation and sustainable heating, which can lower prices by 20% to 40% (Climate Agreement, 2019). To link supply and demand, a digital platform<sup>64</sup> was created to provide householders with verified information on possibilities for sustainable heating improvements. Different options for home insulation and sustainable heating sources installation include information on available subsidies, energy savings, and investment costs.

The Dutch Hydrogen Strategy states that green hydrogen may have potential to make a significant contribution to heating in the longer term, but that uncertainty over its cost makes it difficult to predict whether it will be an 'affordable option' for home heating; 3-4GW of electrolyzers producing green hydrogen are planned for 2030. The strategy also states that the government is considering imposing a blending obligation for green hydrogen in the natural gas grid as a means of boosting demand and scaling up production (Kerr and Winskel, 2021).

## UK

Policy support for scaling up low-carbon domestic heat technologies in the UK is decided on by the UK and devolved national governments. Levels of support are the outcomes of negotiations within government, between the energy department (BEIS), the Treasury and No. 10.

### England and Wales

The main support measure for new heat technologies for individual homes in England and Wales has been the Renewable Heat Incentive (RHI).<sup>65</sup> The RHI was introduced in 2014 under DECC and had both domestic and non-domestic schemes. It provided payments for heat energy produced by a range of technologies and fuels, including biomass, air-source heat pumps (ASHPs), ground-source heat pumps (GSHPs) and solar thermal. Subsidy rates are technology specific and linked to estimation of per unit of heat used. To date, total support under the

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<sup>62</sup> <https://heatpumpingtechnologies.org/wp-content/uploads/2021/07/defhptnl-country-report-presentation-2021mbto.pdf>

<sup>63</sup> <https://www.rvo.nl/subsidies-financiering/sah>

<sup>64</sup> <https://www.verbeterjehuis.nl/>

<sup>65</sup> <https://www.ofgem.gov.uk/environmental-and-social-schemes/domestic-renewable-heat-incentive-domestic-rhi>



domestic RHI has been £836m, the majority of which has gone to biomass heating.<sup>66</sup> The RHI was replaced in April 2022 by a Boiler Upgrade Scheme which provides a purchase subsidy for heat pumps and some biomass boilers.<sup>67</sup>

While still at a relatively low level, growth in the adoption of ASHPs has been supported by the RHI and is now approaching 100,000 installations.<sup>68</sup> Further electrification of heating will also need supportive regulation for electricity networks, which is discussed in Section 7.2 below.

The UK Government has also presented proposals for low-carbon heat market development that would oblige existing boiler manufacturers or energy retailers to install low carbon heating technologies (BEIS, 2021a). These plans are intended to be UK-wide so that: ‘different rules do not apply to sales of heating appliances in different parts of the UK to ensure the policy is effective’. The scale of a UK-wide approach could help to drive low carbon heat uptake and cost reduction in Scotland in the way that other UK-wide policies have done for other energy technologies e.g., Contracts for Difference.

Biomethane injection into the gas grid has historically been supported in the UK via the Non-Domestic RHI, and from 2021 via a Green Gas Support Scheme. However, while there have been a number of projects over the 2010s, biogas and biomethane supplies only around 5% of the UK’s total gas supply in 2017.

There has also been a programme of support for heat networks, along with recent legislation to introduce direct regulation (see Section 7.1 below). The development of heat networks has historically struggled in the highly liberalised UK market (Toke and Fragaki, 2008); they currently provide only 2% of UK heat demand whereas the CCC estimates they could provide up to 18% by 2050. Technical potential based on heat density assessments is much higher at 50% or more (DECC, 2013; Energy Technologies Institute, 2018).

The support programme has been led by a Heat Networks Delivery Unit (HNDU) established in 2013, which provides funding for projects. Some of these then progress to the Heat Networks Investment Project (HNIP) for capital funding.<sup>69</sup> HNIP has provided more than £165m of funding for schemes across England and Wales since 2018. There were a number of teething problems with the first round, but the rules have been changed to allow greater flexibility. From 2022, the HNIP is to be replaced by the Green Heat Network Fund, which has £270m of funding.<sup>70</sup>

Finally, the potential use of hydrogen for heating homes is currently on the agenda, in part driven by a technology lobby coalition that includes oil and gas companies and gas network operators (Lowe et al., 2020). The government published a Hydrogen Strategy in 2021 and is due to take a

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<sup>66</sup>

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1081862/rhi-budget-cap-april-2022.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1081862/rhi-budget-cap-april-2022.pdf)

<sup>67</sup> <https://www.ofgem.gov.uk/environmental-and-social-schemes/boiler-upgrade-scheme-bus>

<sup>68</sup> <https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-march-2022-quarterly-edition>

<sup>69</sup> <https://www.gov.uk/government/collections/heat-networks-investment-project-hnip-overview-and-how-to-apply>

<sup>70</sup> [Next generation of heat networks to power UK's green revolution - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/collections/next-generation-of-heat-networks-to-power-uk-s-green-revolution)

strategic decision on the use of hydrogen in residential heating by 2026. At present, deployment support for hydrogen is focused on its production for use in industrial processes.<sup>71</sup>

## Scotland

Existing energy efficiency and heat decarbonisation delivery schemes in Scotland include Home Energy Scotland, Warmer Homes Scotland, Area-Based schemes, Business Energy Scotland, SME Loans, CARES, LCITP and DHLF (Scottish Government, 2021a). The Scottish Government recognises however, that ‘our delivery programmes must now move to a new phase: one capable of supporting deployment at an unprecedented scale’. The intention is to accelerate deployment against four strategic priorities:

1. Supporting those least able to pay
2. Investing in strategic technologies in low or no regrets areas
3. Showcasing Net Zero leadership and share learning through early adoption in key areas of focus
4. Investing in innovation and demonstration to drive forward competitive advantage

In certain aspects of market policy, the Scottish Government has diverged from UK-wide policy, for example opting-out of the UK-wide purchase subsidy for low-carbon heating technologies (Boiler Upgrade Scheme) believing that a scheme specifically designed for Scotland (Home Energy Scotland) will be more effective. It is worth noting that Scotland has historically taken much more than its pro-rata share of UK-wide heat and energy efficiency funding, including from the RHI and from ECO (Kerr and Winskel, 2021).

The District Heat Loan Fund (DHLF) has been used since 2011 to assist the development and implementation of heat networks in Scotland. Managed by the Energy Saving Trust, it has helped to fund over 50 projects with low interest, unsecured loans repaid over 10 or 15 years, with projects reviewed on a case by case basis (Databuild, 2015). Over the period 2011-20, £20 million has been lent.<sup>72</sup> The scheme is open to LAs, registered social landlords, SMEs and Energy Service Companies (ESCo) with fewer than 250 employees. This scheme will continue but will be re-focused to projects employing net zero emissions heat technologies (The Scottish Government, 2021b).

The DHLF was joined by the Heat Networks Fund in early 2022 which will provide £300m of capital grant funding to either new zero emission networks, expanded networks with additional zero emission generation or the decarbonisation of existing networks (Scottish Government, 2022b). The LCITP (see Section 4.1) and the DHLF combined have invested around £66m in renewable heat since 2013 (Scottish Government, 2021e).

The new Heat in Buildings Strategy also proposes a Green Heat Finance Taskforce that will: ‘explore and identify innovative financing mechanisms to maximise investment and find new

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<sup>71</sup>

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1011469/Consultation\\_on\\_a\\_business\\_model\\_for\\_low\\_carbon\\_hydrogen.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011469/Consultation_on_a_business_model_for_low_carbon_hydrogen.pdf)

<sup>72</sup> <https://energysavingtrust.org.uk/programme/district-heating-loan-fund/>

products and financing/delivery mechanisms to help people and organisations make their properties warmer, greener and more efficient'.<sup>73</sup>

The Scottish Government released a Hydrogen Policy Statement in December 2020 (The Scottish Government, 2020) and a Draft Hydrogen Action Plan in November 2021 (Scottish Government, 2021b). The Action Plan sets out the 'necessary actions over the next five years to implement the key policy positions and ambitions set out in our Hydrogen Policy Statement. These actions will help put us on the pathway to becoming a leading nation by 2045 in the production of reliable, competitive, sustainable hydrogen and provide the potential to secure Scotland's future as a centre of international excellence'. The Policy Statement asserts that a significant increase in low carbon gases (hydrogen or biomethane) in the gas network is needed by 2030. It also highlights the H100 pilot project in Fife which plans to switch around 300 homes to 100% hydrogen. Overall, the Government want to 'ensure all options for deploying hydrogen for heat are kept open, fully explored, evidenced and developed' (The Scottish Government, 2020).

## 5. Building regulations and energy performance standards

Both the UK and the Netherlands have had some form of regulation governing the construction of new buildings and alterations to existing buildings over the post-war period. Since 2002, the EU Energy Performance of Buildings Directive (EPBD)<sup>74</sup> has regularised building regulations across Member States, requiring the adoption of a standard methodology for calculating energy performance, energy performance certificates (EPCs) and the inclusion of energy performance standards in building regulations, to be periodically updated and tightened. However, Member States were left to determine what the actual levels of required performance would be, partly reflecting differences in the nature and age of housing stock, and different climates.

The EPBD was updated in 2018, although the changes were rather minor. However, more recently, the European Commission has proposed a revision to the Directive with higher ambition, aiming eventually for a zero-emission and fully decarbonised building stock by 2050.<sup>75</sup> This opens up the possibility of future divergence between the Netherlands within the EU and the UK post-Brexit.

### Netherlands

Under the EPBD and its transposition through the Dutch Energy Performance of Buildings Decree, homeowners must present an energy label that details the home's energy efficiency before selling or renting a home. The energy label is valid for ten years and provides information on a home's energy performance as well as recommendations to make the home more efficient.

On 1 August 2021, the energy label began providing information on whether the home could be readily disconnected from natural gas. Such information includes details on whether additional insulation is necessary to install heat pumps or connect the home to a heat network. To obtain an

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<sup>73</sup> <https://www.gov.scot/publications/heat-in-buildings-green-heat-finance-taskforce-terms-of-reference/>

<sup>74</sup> <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:001:0065:0071:EN:PDF>

<sup>75</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0802&qid=1641802763889>

energy label, residents must make an appointment with an energy advisor. The energy performance advisory platform<sup>76</sup> provides a list of energy advisors. Energy advisors use the NTA 8800 determination method to issue the energy label. Home energy labels<sup>77</sup> are also publicly available (RVO, 2021b).

The EU Energy Performance of Buildings Directive has required all new buildings to be nearly zero-energy buildings (NZEB) since 31 December 2020. The Dutch Building Decree adopted the Almost Energy Neutral Building requirements (Bijna Energieneutrale Gebouwen, BENG) to achieve this goal. The BENG standards supersede the Energy Performance Certificate (EPC) regulations, and specify limits to heating demand, fossil fuel use and requirements for renewable energy (RVO, 2021a). Assessing whether standards have been met relies on a NTA 8800 determination method, the development of which involved more than 30 stakeholders to garner support for its utilisation (NEN, 2021).

The Dutch government is currently amending the Building Decree to require households to install sustainable heating solutions when the central gas boiler is to be replaced. It is anticipated that the most common solution will be a hybrid heat pump, but other options will be also possible, including all-electric heat pumps and connections to heat networks. This mandate is expected to come into effect in 2026<sup>78</sup>.

In June 2022, the Dutch government announced<sup>79</sup> that from 1 January 2030, private landlords and housing corporations will not be permitted to rent out properties with low energy performance labels (E, F, and G). To encourage landlords to insulate their properties, the Dutch government allocated subsidies targeting rental dwellings and implemented tax reductions for landlords with more than 50 social housing units (for more information, see Section 6.1).

As part of the Climate Agreement's commitments, the national government collaborated with the Association of Netherlands Municipalities, homeowners, tenants, landlords, housing associations, Bouwend Nederland, Techniek Nederland, financial institutions, energy suppliers, and other stakeholders to develop a standard for annual net heating demand for existing buildings. The debate points included the standard's target values and measures necessary to comply with the standard. The standard is not compulsory, and it is not specified when it will become mandatory. It varies depending on the architectural and technological attributes of the building and the financial feasibility of the standard's implementation. For example, the requirements are less stringent for pre-war homes that are difficult and expensive to insulate, necessitating the use of a high-temperature heating source. The standard specifies the required degree of insulation for disconnecting the home from natural gas, which assists homeowners in making long-term decisions about home energy upgrades. The standard also serves as a reference point for developing funding and subsidy schemes.

Municipalities are responsible for enforcing compliance with the Building Decree requirements and issuing permits for new buildings and major renovations. Each municipality develops its enforcement strategy, in which it specifies the procedures and frequency of compliance

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<sup>76</sup> <https://epadviseurs.energieprestatie-adviesplatform.nl/>

<sup>77</sup> <https://www.energielabel.nl/woningen/zoek-je-energielabel/>

<sup>78</sup> <https://www.rijksoverheid.nl/actueel/nieuws/2022/05/17/hybride-warmtepomp-de-nieuwe-standaard-vanaf-2026>

<sup>79</sup> <https://www.rijksoverheid.nl/actueel/nieuws/2022/06/01/duurzaam-wonen-voor-iedereen>

monitoring. The national government provides municipalities with tools to help them devise such enforcement strategies (Dutch Government, 2013).

For existing buildings, failure to obtain an energy label may result in fines issued by the Human Environment and Transport Inspectorate (ILT), a division of the national Ministry of Infrastructure and the Environment that enforces this requirement.

## **UK**

The first set of national Building Regulations (BR) for England and Wales were introduced in 1965, with fundamental changes made as a part of the Building Act 1984 (MHCLG, 2015). Scotland has had its own building standards since 1963. Building regulations are statutory instruments that can be updated, rewritten and consolidated periodically by the government without further primary legislation. The first energy conservation standards for new buildings in the UK were introduced in 1972 (Energy Saving Trust, 2019). Part L of the BRs (Conservation of Fuel and Power) deal with energy, including requirements for thermal performance in materials etc. Part L is then broken down into regulations for dwellings and non-dwellings, and new and existing buildings, with regulations for new build being more demanding than those for existing buildings. BRs are not as effective as might be thought, since they apply to a building at the point at which it obtains planning permission, whereas construction may take place several years later (Edmondson et al., 2020). However, they have played an important role – for example they were the mechanism used to effectively make condensing boilers mandatory (Mallaburn and Eyre, 2014).

The calculation methodology for domestic buildings is the reduced Standard Assessment Procedure (RdSAP, originally developed by the BRE). Energy Performance Certificates produced from applying the RdSAP have had to be displayed to tenants and to prospective homebuyers since 2008.

Responsibility for BRs in England rests with the UK government, while those for Scotland and Wales rest with the Scottish and Welsh Governments respectively. Local authorities (LAs) have the powers to build homes for rent or sale and the powers to build homes (or to require housing associations) to their own standards (UK100, 2021), but in practice the vast majority of housing is constructed by the private sector and housing associations.<sup>80</sup> LAs may also currently have powers to directly intervene on carbon emissions in at most 10% of the stock but ‘where powers do exist, they are often limited by lack of political will and risk-aversion as well as resources and capacity to use them in any meaningful way.’ (UK100, 2021).

### **England and Wales**

Part L of the BRs in England and Wales has been tightened progressively in recent years, with the Welsh standards historically being somewhat more stringent than those in England.<sup>81</sup> In 2022 Part L in both countries was updated so that new domestic and non-domestic buildings will produce 30% less carbon emissions (compared to the previous version). Heating systems in dwellings are now also required to have a maximum flow temperature of 55°C in preparation for lower temperature systems.

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<sup>80</sup> <https://www.gov.uk/government/statistical-data-sets/live-tables-on-house-building>

<sup>81</sup> <https://www.iesve.com/discoveries/blog/3157/welsh-english-part-l-compliance-the-key-differences-explained>

In addition, rules on ‘consequential improvements’ i.e., additional energy efficiency measures must be undertaken under certain circumstances (typically where the liveable building area is extended or where the capacity of building services is increased) apply in England and Wales. These requirements apply only to large, existing residential and non-residential buildings (greater than 1,000 m<sup>2</sup>) and can include improvements to the performance of the building fabric and/ or services where technically, functionally or economically feasible. There were plans to apply the regulations to a wider set of buildings, but these were dubbed a ‘conservatory tax’ and scrapped in 2012.

In the private rented sector, Minimum Energy Efficiency Standards (MEES) have required all properties at the point of letting to be at least EPC band E from 2018 (this applied to all rented properties from 2020). A new Bill is currently going through Parliament that will require all newly let properties to be band C from 2025 (and for all rented properties from 2028). The Government have consulted on all rented buildings in England and Wales being required to meet EPC band B by 2030, where cost-effective (HM Government, 2021a). However, most local authorities ‘lack the resources to spend time finding and pursuing landlords in breach of energy efficiency standards. Local authorities in England often lack basic data on which properties in their area are privately rented’ (McDowall and Britchfield, 2021).

The Government is also considering long-term regulatory standard to improve social housing to EPC C (ibid), and possible regulation for the owner-occupied sector, but have not announced firm dates and targets. They have consulted on the prospect of mortgage lenders having voluntary targets to improve the energy performance of their portfolios to an average of EPC C by 2030 (HM Government, 2021a).

In 2006, plans for a Zero Carbon Homes standard for new build housing were initially proposed, which were to come into effect from 2016. However, this target was abandoned shortly before implementation due to a lack of political support and lobbying from the housing industry (Edmondson et al., 2020). In 2019, plans for a Future Homes Standard (FHS) (recently rebranded as a Future Homes and Buildings Standard) (MHCLG, 2021) were announced with plans for all new domestic buildings consented from 2025 to use renewable energy/low carbon heating. The FHS is designed so that no new building will require retrofit to be zero carbon (this means that as electricity becomes decarbonised the buildings will become fully zero carbon).

There are issues with the compliance with and enforcement of BRs. Local authorities, via their planning and building control departments, are responsible for ensuring that new developments, conversions and extensions meet heat and energy efficiency standards. In England, enforcement of building regulations was ‘partially privatised’ in 1985, when in addition to the Local Authority Building Control an Approved Installer (AI) could certify work. Initially the National House Building Council (NHBC) was the only AI, but the range has since been widened. It has been estimated that the firm LABC has a market share of 65-70% (MHCLG, 2017). According to Benson and Elsmore (2022: 930): ‘There have been suggestions that the use of private inspectors is regulatory capture in that the use of private inspectors who derive income based on repeat business is a conflict of interest’. A study of England and Wales conducted in 2012 found poor compliance with Part L1A (new dwellings), with underlying issues being: ‘incorrect compilation and/or insufficient submission of carbon emissions calculations by builders/ developers; inappropriate timings of such submissions; and a paucity of proper checks by building control.’ (Pan and Garmston, 2012: 594), although it is likely that awareness of Part L requirements has improved over the last 10 years.

## Scotland

Scotland sets its own BRs, with different standards required for U-values from those in England, but with lower target emissions rates.<sup>82</sup>

In Scotland, the Scottish Government has committed all private rented sector properties to reaching a minimum standard equivalent to EPC C, where technically feasible and cost effective, at change of tenancy, with a backstop of 2028 (Scottish Government, 2021d). For owner occupiers the Scottish Government has committed to all properties being band C by 2028 (where technically feasible and cost-effective) at the point of sale, with a backstop of 2033 for all properties (ibid). The Energy Efficiency Standard for Social Housing (ESSH) required band C or D (depending on fuel type by 2020 with this being met in 89% of properties. A new stage of ESSH requires social housing to be as energy efficient as practically possible by the end of 2032 (ibid).

The Scottish Government is also consulting for a New Build Heat Standard in 2024 that will result in zero direct emissions heating systems from new buildings (The Scottish Government, 2021a). This move is ahead of the rest of the UK, but there is an expectation from the industry that the England & Wales will follow this move. On enforcement and compliance, Scottish LAs are gatekeepers of the entire process compared with England where the AI system is in place, but Scottish LAs are under-resourced.

The ambitious Scottish targets for 50% of domestic properties to be on zero carbon heat by 2030 mean that there is a pledge to phase out the need to install new or replacement fossil fuel boilers, in off gas from 2025 and in on gas areas from 2030, subject to technological developments and decisions by the UK Government in reserved areas (Scottish Government, 2021d).

## 6. Energy efficiency and fuel poverty programmes

### 6.1 Energy efficiency programmes

#### Netherlands

The Dutch approach to residential heat decarbonisation emphasises the importance of insulation measures. As outlined in section 4.2, homeowners are eligible for the Investment subsidy for sustainable energy and energy saving (ISDE) that offers subsidies for insulation measures at a fixed rate per m<sup>2</sup> depending on the insulation measure. The ISDE annual budget is specified yearly, €228m is available in 2022 (both for energy-saving improvements and for switching to more sustainable heating solutions such as heat pumps and district heating).

Apartment owners' associations (VvEs), housing associations and housing cooperatives are eligible for the Subsidy for Energy Saving at Home (SEEH)<sup>83</sup> for obtaining energy advice and/or implementing energy-saving measures. A total of €2m is available in 2021 and 2022 for energy advice, and a total of €31.5m is available in 2021 and 2022 for energy saving measures. Landlords with more than 50 social housing units are also eligible for tax reductions through the Regulations for Reduction of Landlord Tax (RVV).

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<sup>82</sup> <https://www.ukbuildingcompliance.co.uk/sap-calculations/sap-calculations-scotland/>

<sup>83</sup> <https://www.rvo.nl/subsidies-financiering/seeh-voor-vve>

In April 2022, as part of a response to the energy crisis, the Dutch government launched the National Insulation Programme allocating €4bn to insulate a total of 2.5 million homes by 2030<sup>84</sup>. The programme focuses on insulating homes with energy labels E, F, and G. This effort is linked to the neighbourhood approach to the heat transition – municipalities will receive funding to insulate 750,000 homes in the neighbourhoods scheduled to become natural gas-free in the next several years. The programme also aims to insulate one million rental properties (both owned by private landlords and housing associations). In addition, households will be able to get a 0% interest energy efficiency loan through the National Heat Fund.

## **UK**

### **England and Wales**

The main approach to energy efficiency in England and Wales has been to work through energy suppliers. The central and most consistent policy encouraging retrofit to improve existing housing has been to impose obligations on suppliers to meet certain energy, or later carbon, savings equivalent, which they meet by offering subsidised or free measures such as insulation, boiler upgrades or low energy lighting. However, in most cases such Supplier Obligations (SOs) are in practice delivered in partnership with bodies that command more consumer trust, such as local authorities, charities and social enterprises. SOs have been funded through suppliers passing the costs of the programmes through to consumers on bills (see section 9 below).

SOs have been in place since the early 1990s (Helm, 2003). They expanded significantly during in the second half of the 2000s (Mallaburn and Eyre, 2014), but the level of obligation was effectively halved in 2013 under the new version of SO, i.e., the Energy Company Obligation (ECO), introduced by the Coalition Government. Rates of loft and cavity wall insulation plummeted as a result and have remained relatively low since (CCC, 2022).

SOs have historically had around 50% of their spending focused on priority social groups i.e., households on benefits or pensions. Under the current ECO, energy efficiency and heating measures apply solely to those on some form of government benefits, i.e., low income, fuel poor or vulnerable households. This restricted approach reflects the potentially regressive nature of ESOs, as their costs are passed on to all consumer bills (Kerr and Winskel, 2021). ECO4 from 2022-26 will continue to support fuel poor homes and homes of those unable to pay (HM Government, 2021a).

In principle, local authorities can also seek to mobilise more funding for energy efficiency (UK100, 2021). In September 2020, the government introduced the Social Housing Decarbonisation Fund (SHDF) for England, which aims to upgrade a significant amount of the social housing stock that is currently below EPC band C up to that standard with a budget of £800m for 2022/23 to 2024/25, and a Green Homes Grant Local Authority Delivery Scheme (GHG LAD) aimed at low-income fuel poor households, with funding of £500m between September 2020 and March 2022. GHG LAD is an area based scheme, but the tight timeline only allowed LAs with proposals that were bid ready to apply, making it very difficult for local authorities to respond unless they had schemes readily available (UK100, 2021). The Greater London Authority also has some EU funding for technical support to whole house energy

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<sup>84</sup> <https://www.rijksoverheid.nl/ministeries/ministerie-van-binnenlandse-zaken-en-koninkrijksrelaties/nieuws/2022/04/02/kabinet-start-landelijke-energiebesparingscampagne-en-komt-met-nationaal-isolatieprogramma-om-2.5-miljoen-woningen-snel-te-isoleren>



efficiency retrofits available that London Boroughs can bid for.<sup>85</sup> However, the competitive nature of funding processes has been criticised for leading to allocation that does not meet needs, and making it difficult for local authorities to plan for the long term (NAO, 2021).

Beyond low income and vulnerable households, the approach of recent governments to energy efficiency for the able-to-pay sector has increasingly been to seek ways of incentivising or requiring households to undertake such measures themselves, effectively bypassing energy suppliers and local authorities, and working through markets. The first attempt was in the form of the Green Deal, introduced in 2012, which provided loans for investments in building energy performance (Rosenow and Eyre, 2013). However, this programme was ineffective and was wound up in 2015 due to a lack of uptake (Rosenow and Eyre, 2016).

In the current Heat and Buildings Strategy (HM Government, 2021a), a combination of incentives and regulation are signalled, although details are not clear. The idea of minimum energy performance standards for owner-occupiers is raised (see section 5 above), but there are as yet no concrete proposals. The Strategy also refers to efforts through the 2019 Green Finance Strategy (HM Government, 2019) to encourage mortgage lenders and other financial institutions to offer finance for energy efficiency measures.

## **Scotland**

Scottish consumers have historically been awarded a disproportionately large share of UK-wide SO funding. The Scottish Government provides additional funding for retrofit in Scotland under the Energy Efficient Scotland (EES) programme. The dedicated Scottish funds and the high share of UK funds means there is a significant difference between public investment on energy efficiency in England (£8 per capita/year) and Scotland (£35) (UK100, 2021). This is partly due to Scottish Government policy which seeks to encourage energy companies to fulfil their obligations in Scotland, and for it to be easier for Scottish homes and businesses to take advantage of UK-wide funding schemes.

The Scottish Government also award funds to local authorities to develop and deliver energy efficiency programmes. This funding is often combined with that from ECO and from Registered Social Landlords. Area-based schemes (ABS) are a key component of Scottish policy with £433m allocated to ABS since 2013 with a further £64m due in 2022/23.<sup>86</sup> LAs are required to spend the funds in the areas of their administration that have the lowest levels of energy efficiency and/or highest levels of fuel poverty.

Looking ahead, the Scottish Government plans to spend at least £1.8bn on energy efficiency and low carbon heat improvements in this parliament (2021-25), with ‘at least £465m to support those least able to pay through our programmes targeted at those in fuel poverty and over £1bn to support heat decarbonisation and energy efficiency across our other strategic priorities’ (Scottish Government, 2021a).

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<sup>85</sup> <https://www.london.gov.uk/what-we-do/environment/energy/retrofit-accelerator-homes>

<sup>86</sup> <https://www.gov.scot/publications/area-based-schemes/#:~:text=The%20area%2Dbased%20schemes%20are,and%20helping%20reduce%20fuel%20poverty.>

## 6.3 Measures for reducing energy poverty

### Netherlands

The Netherlands, unlike the UK, has no explicit national policy for evaluating and alleviating energy poverty. The topic, however, has recently received increased attention from the government and the scholarly community (Dalla Longa et al., 2021). Feenstra et al. (2021) argue that municipal actors' existing efforts to address energy poverty and EU statutory requirements could lead to the creation of a national policy to combat energy poverty.

Recent studies examining this topic have embarked on the task of providing insight into the level of energy poverty in the country. According to TNO (2021), 550,000 households (about 7% of all Dutch households) experience energy poverty. These households have low incomes and high energy bills or live in poorly insulated homes, without the ability to improve their home's energy efficiency. The problem of energy poverty is more severe in less-urbanised areas than in major cities (Utrecht, Rotterdam, Amsterdam, and The Hague) (TNO, 2021). Subsidy schemes developed to facilitate heat transition measures are available to all households, without identifying any specific categories who might need more assistance.

### UK

The concept of fuel poverty has been officially recognised in the UK since the late 1990s and has recently received increased political attention in other parts of Europe. It is an area where policy has been considerably devolved to administrations in Scotland, Wales and Northern Ireland, but where previous targets have not been missed and definitions changed:

- In England, the original fuel poverty reduction target was eradication by 2016, but this was not met, and was replaced in 2014 with a target for England 'to improve as many fuel poor homes as is reasonably practicable to a minimum energy efficiency rating of Band C, by the end of 2030'. The definition of fuel poverty was also changed to focus on low-income households with high energy costs, and recently updated in the Low-Income Low Energy Efficiency (LILEE) measure.
- In Wales, original targets set out in 2003 to eradicate fuel poverty by 2018 were again not met, and in 2021 the Welsh Government adopted new targets for 2035 that were somewhat less ambitious (Welsh Government, 2021a; Kerr et al., 2021).
- In Scotland, previous fuel poverty targets have also been missed (Rutter and Knighton, 2012). The recent Fuel Poverty (Target, Definition and Strategy) Act set a new definition of fuel poverty and a statutory target for the proportion of Scottish households in fuel poverty to be no more than 5% by 2040, and less than 1% in extreme fuel poverty (it is currently about 25%) (Kerr et al., 2021).

Regardless of definition, fuel poverty has remained a chronic problem in Britain. According to the latest figures (which vary between the countries within the UK) 25% of Scottish households, 10% of households in England, 12% of Welsh households, and an estimated 11% in Northern Ireland are in fuel poverty (BEIS, 2020).

Interventions to reduce fuel poverty fall into two broad categories. One comprises different forms of transfer payments to consumers to raise income or reduce bills, including both general and targeted payments. These schemes mostly apply across the whole of the UK (although may be branded differently). The Winter Fuel Payment is a non-targeted payment to older people,

while the Cold Weather Payment is a payment made on low temperature days targeted at households on certain welfare benefits (in Scotland the CWP is being replaced by a targeted Low Income Winter Heating Assistance which will not need to be triggered by cold weather). The Warm Homes Discount is a targeted programme to reduce bills delivered through energy suppliers.

The second is free or subsidised measures to improve housing energy performance, which differ across the nations:

- In England, the ECO is the major scheme in place, funded via consumer bills. In addition, there are some targeted tax-funded schemes, including the Green Homes Grant – Local Authority Delivery (GHG-LAD) scheme working through local authorities, the Home Upgrade Grant and the Social Housing Decarbonisation Fund.
- In Wales, the Welsh Government also supports a tax-funded Warm Homes Programme that provides energy efficiency measures delivered through local authorities, an advice scheme, and a retrofit programme delivered through social housing providers.<sup>87</sup> The Warm Homes Programme, which consists of an element targeted at households on benefits and an element targeted at areas of high deprivation, has been criticised by Audit Wales and the Welsh Parliament as too narrow (Welsh Parliament, 2022), and is currently under review.
- In Scotland, Homes Scotland is the Scottish Government’s national fuel poverty scheme with £24m allocated in 2018/19 (roughly half that of the Area-Based Schemes – see above section 6.2)(Scottish Government, 2019a). Wade et al. (2021) suggest that public funding for fuel poor areas has been more consistent (than in England) with an obligation to include Local Housing Strategies that include reporting on measures taken to ameliorate fuel poverty. These policies have helped to contribute to more ‘established actor networks across governance scales in Scotland’ (p. 232). Fuel poverty policy governance in Scotland also involves some advisory groups: a newly launched Scottish Fuel Poverty Advisory Panel,<sup>88</sup> an Energy Consumers Commission (see section 3.3), and a Scottish Rural Fuel Poverty Task Force (the impact of policies on remote and island communities is an important factor in Scottish politics).

## 7. Skills and training

Many of the skills needed for a low-carbon heat transitions will be vocational rather than academic.

### **Netherlands**

According to Thelen (2014), a primary role in training of young people in the Netherlands is taken by the state rather than companies, with two-thirds of young people in vocational training going through the publicly funded vocational school route rather than apprenticeships (p 170).

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<sup>87</sup> <https://gov.wales/tackling-fuel-poverty-2021-2035-html>

<sup>88</sup> <https://www.gov.scot/publications/public-appointment-chair-and-members-appointed-to-the-scottish-fuel-poverty-advisory-panel/>

Partly as a result, there is an emphasis on general skills rather than industry or firm specific skills. Arrangements for reskilling of existing workers are somewhat different, as there are sectoral retraining funds that were negotiated in the late 1990s, organised and financed by firms within a given industry. However, these are also augmented by the Dutch government.

Labour market changes and training are one of the central subjects of the Climate Agreement. A key role is played by the Social and Economic Council (SER) which leads initiatives to enhance opportunities and reduce risks in the labour market due to energy transition developments. In 2019, the Built Environment sector issued a national Declaration of intent on the labour market and training in the district-oriented approach (*Intentieverklaring arbeidsmarkt en scholing in de wijkgerichte aanpak*) titled 'People make the transition'. The letter declared pledges to ensure that personnel have the skills required to carry out technological advancements in heat decarbonisation at the neighbourhood level. The necessary training is conducted through, among other things, public-private partnerships between industry, government, labour organisations, and public and private educational institutions.

Under the Climate Agreement, an Agreement on the Secondary Vocational Education Curriculum for Climate Technologies (*Convenant MBO-aanbod klimaattechniek*) was signed in January 2019 to guarantee that public and private vocational schools can provide students with the opportunity to gain skills relevant for jobs in the energy transition (SER, 2019). In addition, the Green Deal for the development of local and regional renewable heating and cooling technologies (Green Deal *Ontwikkeling Decentrale Duurzame Warmte- en Koudetechnieken*) outlined measures required to assure the training of professionals capable of developing and installing heating and cooling systems.

## UK

In 2019 the Government set up a Green Jobs Taskforce to advise on training and skills needs for greening the economy, which reported in 2021 (Green Jobs Taskforce, 2021). Within the area of residential heat, the report noted the current skills base for domestic heating systems of around 120,000 qualified gas engineers who install gas boilers. By contrast in 2019 there were around 900 heat pump installers, and citing the Construction Industry Training Board (CITB) the report estimates a need for: 'between 7,500 and 15,000 heat pump installers a year to be trained just within the next seven years, resulting in around 60,000 workers needed for heat pump installation in domestic and non-domestic buildings' (p 24). There are also 114,000 FTE jobs in the efficient products sector, and 2.4 million in construction (HM Government, 2021a). The electrification of heat will also contribute to growth in electricity production and networks, with an estimated 400,000 jobs between now and 2050. The use of smart systems to maximise flexibility and reduce costs in electricity could create another 10,000 jobs. Finally, citing the Heat Network Industry Council, the report estimates that by 2050 the heat network sector could require between 20,000 and 35,000 direct jobs.

The Taskforce report makes a number of recommendations, one of which is the establishment of a UK-wide body with representatives of national government, industry, unions and Devolved Administrations 'to ensure momentum and coherence on workforce transition, including

progress in delivery’ (p 41). In May 2022, the government created a Green Jobs Delivery Group, although it is not yet clear what powers and resources it will have.<sup>89</sup>

Skills policy is a devolved area where approaches differ across the nations.

## **England**

The general approach to skills policy for a transition to a low-carbon economy, including a heat transition, has been to work through the current training and skills institutions rather than create a specific new initiative. In England, similarly to the Netherlands, initial training for vocational skills have historically been provided through the formal education sector, especially further education (FE) colleges, rather than organised by firms. In recent years there have also been attempts to increase the number of apprenticeships that rely on in-work training (Powell, 2020). More widely, the 2021 *Skills for Jobs* White Paper (DfE, 2021) puts an emphasis on a greater role for employers in specifying skills needs in vocational training. This includes a £65m pilot scheme to identify employers’ skill needs and work with FE providers to fill gaps, mainly focusing on green skills.

In the area of retraining of existing workers in relevant sectors, there is a National Skills Fund, which amongst other things funds Skills Bootcamps, with specific Green Skills Bootcamps, including on housing retrofit and solar power. There are also plans for a Lifetime Loan Entitlement from 2025 to fund up to 4 years of post-18 education. The Net Zero Strategy (HM Government, 2021b) also calls on employers in the green economy to prioritise investment in retraining and upskilling of workers, and in some instances companies are setting up new courses.<sup>90</sup>

## **Wales**

In Wales there has been a decline in recent years in the numbers of people on FE courses and traineeships (Chapman and Kiberd, 2021). At the same time, post-Brexit Wales is set to lose funding for skills that it previously received from the EU.<sup>91</sup> The Welsh Government has an updated Plan for Employability and Skills that places emphasis on green skills but as with the English approach, does not create a specific new institution in this area.<sup>92</sup>

## **Scotland**

In addition to the UK-wide Green Jobs Taskforce (see above), there are various analyses underway to assess the supply-side needs of a low-carbon transition in Scotland. A Heat in Buildings Supply Chain Delivery Plan is due in 2022 (Scottish Government, 2022). Scottish Enterprise recently commissioned the Building Research Establishment to carry out a Low Carbon Heat - Innovation Needs Assessment (BRE, 2021) which considers the particular aspects of low carbon heat technology where innovation is most likely to occur, how this could improve

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<sup>89</sup> <https://www.gov.uk/government/news/green-jobs-delivery-steps-up-a-gear>

<sup>90</sup> For example, the Heat Pump Association launched a new one-week heat pump installation training course for existing heating engineers, resulting in a qualification from the Chartered Institute of Plumbing and Heating Engineering.

<sup>91</sup> <https://gov.wales/written-statement-loss-funding-wales-result-uk-governments-arrangements-replacement-eu-funding>

<sup>92</sup> <https://gov.wales/stronger-fairer-greener-wales-plan-employability-and-skills-summary-html#section-92543>

the user experience of and the overall transition to low carbon heat. Heat Network skills in Scotland have been recently assessed by the EST (Bush, 2020).

In Scotland, a key policy and political issue is how the existing oil and gas industries and workforce transition to be part of a low carbon economy, with the Climate Emergency Skills Action Plan (CESAP) establishing a Green Jobs Workforce Academy to upskill and reskill workers facing redundancy (Scottish Government, 2021d).

The importance of green industries in the future Scottish economy is also recognised in the National Strategy for Economic Transformation released March 2022.<sup>93</sup> This includes a Green Jobs Fund under the category of Skilled Workforce.

## 8. Regulatory frameworks for energy networks

Energy networks will play an important role in heat decarbonisation:

- With a rise in the use of heat pumps, either for individual homes or for heat networks, demand for electricity will rise, with potentially large increases at peak times, such as winter evenings (for a UK study see Wilson et al., 2013). Unless more innovative and smarter ways of building and operating networks are found, **electricity distribution networks** will have to be expanded, at significant cost (Pudjianto et al., 2013; Bell and Gill, 2018).
- While they do not decarbonise heat by themselves, **heat networks** are expected to play an important role in facilitating low-carbon heat. At present, heat networks play a tiny role on the UK and a relatively small one in the Netherlands, and a key issue is how quickly and how far they can be expanded.
- Natural **gas networks** will have to be closed down, or re-purposed to some extent to transport hydrogen or other low-carbon gases

How far the challenges for each network – innovation, growth and a decision and mechanism about closure or repurposing - are being met depends heavily on their governance.

### 8.1 Heat networks

#### Netherlands

As of 2019, 5.9% of Dutch dwellings were heated through district heating (CBS, 2021b). Large networks with an annual supply of more than 150 TJ accounted for about 84% of all connections and about 89% of supplied heat in 2018. Combined heat and power (CHP) plants run on natural gas or coal have been the main heating supply source for large heat networks. Natural gas-fired CHP plants have been the main heating supply source for small heat networks (CBS and TNO, 2020). The predominant district heating procurement structure in the Netherlands is one in which one entity owns the heat network, provides heat supply by generating or purchasing it, and distributes it to consumers (ACM, 2021). The majority of large heat networks are owned by private companies (e.g., Vattenfall, Eneco), with the remainder owned by municipalities (e.g., HVC).

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<sup>93</sup> <https://www.gov.scot/publications/scotlands-national-strategy-economic-transformation/>

The Ministry of Economic Affairs and Climate is the responsible ministry in the Dutch government with regard to district heating. The 2013 Heat Act (Warmtewet)<sup>94</sup> specifies heat network regulation. Under the Act, the Authority for Consumers and Markets (ACM) regulates heat supply to small and medium consumers (up to 100 kW). The regulator sets a price cap and provides other provisions for customer protection such as the necessary clauses in the service agreement, billing procedures, and compensation measures in case of service disruption. The ACM issues licenses to heat suppliers (those serving more than 10 customers) and checks their compliance with the regulations. There is no mandatory connection to heat networks currently in place.

A new version of the Heat Act was expected to come into effect in January 2022. It was expected to further specify the regulatory model for heat networks by identifying provisions for the market and pricing structure, as well as setting sustainability targets. However, the bill did not find enough support in the legislature, and its adoption was postponed for at least one year.

One of the most debated issues of the bill relates to the question of market structure and ownership of the heat networks. The ACM has discussed three potential market models: 1) a model in which one entity owns the heat network, provides heat supply by generating or purchasing it, and distributes it to customers (the existing model); 2) a model that unbundles the entities owning the heat network and supplying heat; 3) a model that resembles liberalised gas and electricity markets with a competitive market of heat supply providers and a single heat network (ACM, 2021).

Another issue concerns price regulation. The current maximum price set by the regulator is tied to the price of natural gas –the district heating tariff cannot be higher than the natural gas tariff. The new bill proposed to introduce a cost-based price mechanism that would instead reflect the costs of the heat supply. However, there is a concern that customers should be protected from potentially overpaying for heating services, as determining the amount of costs incurred for providing heat supply is a complex task.

## **UK**

### **England and Wales**

Heat networks in the UK have historically not been regulated in the same way as gas and electricity networks, with the only consumer protection provided by the Consumer Protection Act. This looks set to change as BEIS have recently proposed new regulation for heat networks operators. Ofgem (the existing electricity and gas regulator) will fill the role of the regulator and licensing authority across the whole of the UK, bringing existing experience but also the ability to act as an integrating body in wider net zero planning (BEIS, 2021c). Ofgem will reserve the power to introduce rules and/or guidance on fair and consistent pricing, and to take enforcement actions against disproportionately high pricing. In England, licenses will be optional for heat network developers that wish to become ‘statutory undertakers’ a position that will allow them greater rights and powers such as permitted development rights. The regulator will have responsibility for issuing licenses for statutory rights and powers to heat network operators. It will also support the market in case of supplier failure (BEIS, 2021c). Prices paid by consumers will not be capped, at least initially, but regulation will require transparency about costs.

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<sup>94</sup> <https://wetten.overheid.nl/BWBR0033729/2021-10-09>

Importantly, the proposals also include giving local authorities the powers to require non-domestic building owners to connect to a heat network. Minimum technical standards, building on those developed by CIBSE, are to be mandatory in the UK framework (BEIS, 2021c). The UK Government plans to set out a standardised methodology to identify potential heat network zones that all LAs should use (BEIS, 2022).

## **Scotland**

In Scotland, the Heat Networks (Scotland) Act 2021 was in part the result of recommendations by the Competition and Markets Authority (CMA, 2018) that the introduction of regulation to the heat network sector was required ahead of its expected growth (Scottish Government, 2020a). The Act introduces various changes to the heat network market in Scotland (Reid, 2020):

- It sets out a requirement for a heat networks licence, with the licensing system is to be administered by a new authority, Scottish Ministers, or another body designated by Ministers (Ofgem will provide this function across GB).
- A duty on local authorities to review the potential heat network zones, an activity that will form part of LHEES. Although a LHEES methodology has been developed by SG and delivered to all LAs it is not expected to be a mandatory requirement that is used with some LAs looking to take their own approach to zone allocation. Heat network zone permits will give exclusive rights to provide a heat network in a particular area. There is also a duty on public sector building owners to assess the viability of connecting their building to a heat network and to report to their local authority
- Statutory targets for thermal energy from heat networks in Scotland of 2.6 TWh by 2027 (3.3% of current heat demand) and 6 TWh by 2030 (7.5%)(The Scottish Government, 2021c). An estimated 1.18 TWh (1.5%) of heat and cooling demand is supplied via heat networks currently.
- A potentially critical aspect of heat network regulation, i.e. mandating existing properties to use new networks, is still uncertain, the Scottish Governments approach being: ‘We will also consider UK Government proposals to mandate connection to heat networks in designated areas in England to assess their applicability in Scotland and fit with our proposed wider approach to building regulation’ (The Scottish Government, 2021b)

Consumer protection remains reserved to the UK Framework (i.e. Ofgem and the Energy Ombudsman (The Scottish Government, 2021b).

## **8.2 Electricity networks**

In both the UK and the Netherlands, electricity network companies at both transmission and distribution level are regulated monopolies. From a governance perspective, a key question is whether and how such companies are incentivised to manage and anticipate such changes, to adopt innovative solutions to new demands on networks, and to work with other relevant actors, including local governments, in developing such solutions.

### **Netherlands**

The Dutch electricity sector is subject to both European and national laws and regulations. European Directives and Codes set the framework for electricity regulation for EU Member States. The Dutch Electricity Act (Elektriciteitswet) was adopted in 1998 with the goal of



implementing the European Electricity Directive. The Dutch Electricity Act initiated electricity market liberalisation, which was fully completed by 2004 (Van Damme, 2005). The Independent Network Management Act (Wet Onafhankelijk Netbeheer), or the Unbundling Act of 2008, specified that electricity and gas network operators cannot be involved in procuring the supply of electricity and gas.

TenneT, the state-owned TSO, provides transmission and system services, and carries out market facilitation. There are currently three large DSOs operating in the Netherlands (Liander (Alliander), Enexis and Stedin) and three smaller ones (Coteq, Rendo, and Westland Infra). These DSOs are private companies that function as network operators for both electricity and gas. However, all shares of the DSOs are owned by the Dutch provinces and municipalities. For example, the main shareholders of Alliander are the provinces of Gelderland (44.68%), Friesland (12.65%), Noord-Holland (9.16%), the city of Amsterdam (9.16%), the province of Flevoland (less than 3%), with other 69 municipalities owning less than 3% of the shares<sup>95</sup>.

The ACM is the national regulator for the electricity market. It issues licences to suppliers providing electricity to small and medium customers, and sets tariffs for the national transmission system operator (TSO) for electricity, TenneT, and for the distribution system operators (DSOs). The ACM implements incentive regulation to ensure the achievement of established policy goals<sup>96</sup>. The regulatory framework has historically incentivised Dutch DSOs to for efficiency, and to focus on availability and affordability, rather than sustainability (Edens and Lavrijssen, 2019). DSOs have tended to solve problems through network reinforcement and extension rather than flexibility services and other innovative approaches (van der Waal et al., 2020). More broadly, Edens (2017) argues that electricity network regulation has generally not kept pace with the direction of energy policy, despite the public ownership nature of networks.

The Netherlands has seen a growth in smart grid pilot projects over the last 10 years, some of which may help networks to absorb an accelerated deployment of heat pumps more quickly and cheaply. However, unlike in the case of Great Britain (see below), these tend to be funded by European sources, national or local government (Obinna et al., 2016), rather than from within the regulatory framework itself.

## **UK (England, Wales and Scotland)**

Electricity network regulation is the same across the whole of Great Britain (i.e., England, Wales and Scotland). The most immediately relevant companies for heat decarbonisation are distribution network operators (DNOs) operate the regional electricity distribution systems in the UK. These privately-owned companies pass on the costs of investment to customers through charges for the use of the grid.

Electricity network operators in the UK have been regulated since privatisation in 1980s, currently by Ofgem, which decides on how much the DNOs can earn. The basic structure of regulation provides incentives for efficiency (although asymmetric information means that companies can earn high rates of return) (Joskow, 2008; Ofgem 2009). The total amount DNOs can charge is set in five-yearly periods called ‘price controls’.

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<sup>95</sup> <https://www.alliander.com/nl/over-alliander/corporate-governance/aandeelhouders/>

<sup>96</sup> <https://www.tennet.eu/our-key-tasks/energy-industry/regulators/>

Ofgem's original focus on efficiency has changed only slowly, with a number of attempts by the Government to move its remit in the direction of greater sustainability, with only partial success (Lockwood, 2016). However, following the adoption of the net zero target in 2019, Ofgem has become more explicit about the role of regulation in decarbonisation, producing a decarbonisation action plan in 2020.<sup>97</sup>

Since the early 2000s there has been a fund to support innovation – especially in the use of ICTs to monitor and control energy flows - in energy networks. The latest tranche of funding will be £450m over 2023-2028.<sup>98</sup> However, DNOs have been somewhat slow to adopt such innovations into their BAU network planning and operation, partly because of aversion to risk and partly because the uptake of new low carbon technologies (with the exception of solar PV) on electricity networks has actually been quite slow to date.

However, that is now beginning to change, with almost 90,000 heat pumps installed by Q1 2022. The Climate Change Committee estimates that more than 500,000 installations will have to take place every year by 2026 (CCC, 2021b). In principle, DNOs have committed to invest over £2bn in the next price control period (2023-28) to accommodate this level of growth, along with similar growth in electric vehicle charging.<sup>99</sup> It remains unclear how far this will require increasing capacity at low voltage levels, versus managing networks more smartly using voltage regulation through heat storage and demand side management. The latter approach is still at the stage of trials, funded through Ofgem's innovation scheme,<sup>100</sup> and in Scotland also by LCITP and HEEPS.<sup>101</sup>

Although they plan and operate electricity networks in specific localities, DNOs have historically not had a close relationship with local authorities. With only 14 regions in Great Britain operated by six companies, the scale of DNOs is much larger than towns and cities, in contrast with some other countries in Europe where network companies are still owned by municipalities of were in the past. Interaction has usually been confined to discussion of new housing and other developments that require major new connections. Over the 2010s Ofgem has placed increasing emphasis on network companies engaging with stakeholders, including local authorities. However, this has had only limited effects so far (Poulter and Bolton, 2021), and in the forthcoming price control period Ofgem is requiring DNOs to create Customer Engagement Groups to improve communication (Ofgem, 2021). For the forthcoming price control period, DNOs are also encouraged (but not required) to draw on any local area energy planning (LAEP) exercises carried out using the Energy Systems Catapult/Centre for Sustainable Energy methodology (see Section 3.2 above) (UK 100, 2021), when planning investment.

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<sup>97</sup> <https://www.ofgem.gov.uk/publications/ofgems-decarbonisation-action-plan>

<sup>98</sup> <https://www.ofgem.gov.uk/publications/ofgem-proposals-turn-your-street-green-transforming-local-electricity-networks>

<sup>99</sup> <https://www.current-news.co.uk/news/riio-ed2-business-plans-dnos-announces-billions-to-support-profound-change>

<sup>100</sup> <https://www.ofgem.gov.uk/publications/electricity-nic-2021-initial-screening-submission-smarter-heat>

<sup>101</sup>

[https://www.spenergynetworks.co.uk/news/pages/launch\\_of\\_industry\\_first\\_trial\\_to\\_decarbonise\\_heat.aspx?utm\\_campaign=823399\\_LCH&utm\\_medium=email&utm\\_source=Scottish%20Enterprise%20Service%20Delivery&dm\\_i=53AP,HNC7,2UAGD8,21OLX,1](https://www.spenergynetworks.co.uk/news/pages/launch_of_industry_first_trial_to_decarbonise_heat.aspx?utm_campaign=823399_LCH&utm_medium=email&utm_source=Scottish%20Enterprise%20Service%20Delivery&dm_i=53AP,HNC7,2UAGD8,21OLX,1)

The Scottish Government is being more proactive, with a Heat Electrification Strategic Partnership that involves the two Scottish electricity network operators, the Scottish Government and other relevant stakeholders. The forum is meant to ensure that the upgrades required are delivered when and where they are needed and that the LHEES framework (see Section 3.2 above) can inform this process (Scottish Government, 2021d).

## 8.3 Gas networks

### **Netherlands**

Like the electricity sector, the Dutch gas sector is subject to both European and national laws and regulations. European Directives and Codes establish the framework for gas regulation for EU Member States. The Dutch Gas Act (Gaswet) was adopted in 2000. The Act introduced competition to the supply of natural gas. The Ministry of Economic Affairs and Climate prepared a draft of a new law (the Energy Act) that would replace the Electricity Act and the Gas Act. The Act's goal is to introduce the necessary regulatory arrangements for the implementation of the Climate Agreement and the new European regulations.

The ACM is the national regulator for the gas market. It issues licenses to companies supplying gas to small and medium customers, and sets tariffs for the state-owned national transmission system operator for gas, Gasunie, and for the distribution system operators. The DSOs that currently operate in the Netherlands provide services for both electricity and gas (Liander, Enexis and Stedin, Coteq, Rendo, and Westland Infra). The Independent Network Management Act (Wet Onafhankelijk Netbeheer), or the Unbundling Act of 2008, stated that electricity and gas network operators could not engage in procuring the supply of electricity and gas.

### **UK (England, Scotland and Wales)**

The governance of the gas network in the UK case is similar to that of electricity. In Great Britain there is one gas transmission network owned and operated by National Grid, and eight gas distribution networks owned by four companies, all regulated by Ofgem.

As with electricity networks, gas network companies are allocated and can apply for innovation funding for RD&D projects, which in the past have included biomethane injection to the grid and increasingly focus on the use of hydrogen in networks (Ofgem, 2022). The results of these projects will feed into the key strategic decision on the gas network, i.e., how far the entire low pressure distribution network will be retained, which would mainly be for the use of hydrogen in home heating, as opposed to confining hydrogen distribution to a smaller number of industrial users. The decision is due to be taken in 2026 (HMG, 2021b), and is subject to lobbying by both proponents (including gas network companies) and opponents. The value of the network (and therefore cost of compensation for the regulated asset base of the network companies) is also increased by an ongoing iron mains replacement programme (IMRP) which modernises iron pipes, replacing them with polyethylene (Dodds and McDowall, 2013).

There is considerable uncertainty about the technical and cost aspects of the decision (Dodds and McDowall, 2013; Spiers et al., 2018). In April 2022, the Government announced the creation of a new body, the Future System Operator (FSO), which will replace and merge the electricity and gas system operators and make them both legally and commercially independent of National

Grid.<sup>102</sup> This body will: ‘provide strategic oversight of the UK gas system by taking on longer-term planning in respect of gas’, and while the government and the regulator will take the final decision, the FSO will have significant influence.

## 9. Gas and electricity taxation

### Netherlands

Costs associated with transitioning to more sustainable heating are shared by many parties, including the government, end-users (both homeowners and tenants of rented properties), landlords, and housing associations. The Climate Agreement states that the budget-neutral taxation option will raise a tax rate for the first bracket for natural gas by 4 cents per m<sup>3</sup> in 2020 and by 1 cent per m<sup>3</sup> over the next six years. The money collected will be returned through tax cuts and a decreased electricity tax rate for the first bracket. The reforms to Dutch energy taxes are estimated to have moved the total lifetime cost of a gas boiler to be above that of a heat pump (see Figure 10, Rosenow et al., 2022).

The Netherlands has reduced VAT rates on home insulation expenses: costs related to insulation measures for homes older than two years old are subject to a 9% VAT rate, as opposed to a standard rate of 21% (renovation). The Landlord Levy Sustainability Reduction Scheme (RVV Verduurzaming) provides €100m per year to support heat decarbonisation measures (RVO, 2020).

### UK

Tax decisions in the UK are taken by the UK government in Whitehall and are not devolved. However, up until Brexit they have also been subject to agreements at the EU level.

Fuels (including gas) and electricity for domestic use are all subject to VAT at 5%. This is a ‘reduced rate’, with 20% being the standard rate of VAT since 2011 (HMRC, 2016). Proposals to increase the rate on domestic energy to the then standard rate of 17.5% were tabled in the late 1990s but then withdrawn due to political backlash (Mallaburn and Eyre, 2014).

‘Energy saving materials’, which includes building fabric efficiency measures, but also heat pumps, solar panels, wind turbines and biomass boilers (full list at HMRC, 2019) were also subject to a reduced rate of 5% until October 2019, when there was a change in policy to comply with EU rules aimed at harmonisation. However, exemptions meant that 95% of domestic energy efficiency and low carbon energy installations were in will be unaffected (Seely, 2019), with the exception of wind and water turbines. However, the reduced rate did not apply to conventional fossil fuel heating technologies (i.e. including gas boilers) unless they are grant funded (HMRC, 2019). In April 2022, all VAT was removed from solar PV panels, heat pumps and energy efficiency materials.<sup>103</sup>

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<sup>102</sup> <https://www.gov.uk/government/news/government-future-proofs-britains-energy-system-with-launch-of-new-body-to-boost-energy-resilience>

<sup>103</sup>

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1062708/Spring\\_Statement\\_2022\\_Print.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1062708/Spring_Statement_2022_Print.pdf)

In addition to formal taxation, part of the cost of energy paid by consumers includes the current and legacy costs of environmental and social policy obligations, passed through by suppliers, on whom these costs are formally levied (Table 2). The RHI (see Section 4.2 above) is an exception, being tax funded to date. The majority of costs fall on electricity, making up 12% of the bill currently, as opposed to 3.4% for gas.<sup>104</sup> This approach has been justified on the basis that all households use electricity and not all use gas, and that all households should contribute to the cost of policy. Households that use electricity for heat, however, end up contributing a disproportionate amount to the cost of policy (e.g., Rosenow et al., 2022). With electricity increasingly decarbonised and with effectively no carbon taxation on gas for domestic use (Blyth, 2018) there have been calls for moving policy costs from electricity to more high carbon fuels like gas and oil.<sup>105</sup> This will be important for the relative cost of heat pumps, which are currently disadvantaged relative to gas (and oil) boilers (Barnes and Bhagavathy, 2020). Shifting costs from electricity to gas over the next decade is now on the government’s agenda,<sup>106</sup> and is signalled in the Treasury Net Zero Review final report (HM Treasury, 2021).

**Table 2**  
**Policy costs on domestic energy bills**

<b>Policy</b>	<b>Electricity</b>	<b>Gas</b>
Renewables Obligation	√	
Contract for Difference	√	
EU ETS and Carbon Price Floor	√	
Small Scale Feed in Tariff	√	
Capacity Market	√	
Smart meter rollout	√	
Warms Homes Discount	√	√
Energy efficiency Supplier Obligations, including ECO	√	√

Source: <https://www.ofgem.gov.uk/publications/default-tariff-cap-level-1-october-2020-31-march-2021>, Annex 4

<sup>104</sup> <https://www.ofgem.gov.uk/energy-data-and-research/data-portal/all-available-charts>

<sup>105</sup> <https://eciu.net/insights/2021/rebalancing-energy-bills-and-carbon-prices-what-are-the-options>

<sup>106</sup> <https://www.current-news.co.uk/news/ministers-consider-shifting-green-levies-from-electricity-to-gas>

## 10. Conclusion: Points of comparison

A central purpose of this review of current governance of heat transitions in the Netherlands and the UK is to identify differences and similarities in the approaches of the two countries. On the evidence reviewed here, we see areas of governance falling into broadly similar and broadly different approaches as summarised in Table 3.

**Table 3**  
**Differences and similarities in NL and UK governance approaches**

Area	Degree of contrast	Characteristics
Climate framework	Different	<ul style="list-style-type: none"> <li>• Process of climate framework development more consultative in NL</li> <li>• UK more technocratic. Targets for Scotland more ambitious than UK</li> </ul>
Heat transition framework	Different	<ul style="list-style-type: none"> <li>• NL and Scotland have specific heat-related targets</li> <li>• UK has an ambition on gas boiler phase out</li> </ul>
Heat transition planning	Different	<ul style="list-style-type: none"> <li>• NL has a neighbourhood-oriented and municipality-led approach, within a nationally set framework, and with resources for implementation and (possibly) municipal powers for enforcement</li> <li>• UK/England has no mandated role for local government heat (or energy) visions or planning, with official role of local government so far limited to informing decisions about local infrastructure</li> <li>• Scotland has local authority led approach, with some resources for piloting; Wales is planning to require all local government areas to conduct local area energy planning exercises</li> </ul>
Technical guidance for planning	Different	<ul style="list-style-type: none"> <li>• NL has a required standard framework for assessing technical feasibility, GHG emissions potentials and costs, developed through a consultative process</li> <li>• In UK/E&amp;W there are a variety of voluntary methodologies for heat/energy planning, but no agreed framework</li> <li>• Scotland has an official methodology for LHEES, but local authorities are not required to use it</li> </ul>
Heat transition piloting	Different	<ul style="list-style-type: none"> <li>• NL has a well-resourced programme for municipal-led pilots of neighbourhood heat decarbonisation projects (PAW)</li> <li>• The UK/E&amp;W has nothing similar, although Scotland has had a demonstration programme for low-carbon infrastructure (LCITP)</li> </ul>
Public engagement and participation	Different	<ul style="list-style-type: none"> <li>• In both countries, there is acknowledgement that public engagement is essential</li> <li>• In NL the heat vision process has involved consultative and deliberative elements, albeit with variation across municipalities, and the PAW pilot scheme include testing strategies for engagement with the involvement of the Participation Coalition</li> <li>• In UK/E&amp;W there is as yet no formal mechanism for developing public engagement on heat transitions (beyond Smart GB for smart meters)</li> </ul>

		<ul style="list-style-type: none"> <li>• In Scotland the government is developing a strategy for engagement in the context of LHEES delivery</li> </ul>
Knowledge sharing and dissemination	Different	<ul style="list-style-type: none"> <li>• NL has an explicit knowledge sharing and dissemination programme for municipality-led delivery through the PAW</li> <li>• UK/E&amp;W has nothing similar, although the Energy Saving Trust gives advice to local authorities in Scotland and Wales, and the Scottish Government plans the sharing of best practice within LHEES implementation</li> </ul>
Energy efficiency	Different	<ul style="list-style-type: none"> <li>• The age profile of housing in the UK is older than in NL</li> <li>• NL has broader, tax-funded programmes (with expanded funding in 2022) delivered through municipalities, housing association and market mechanisms</li> <li>• UK/E&amp;W programmes (i.e. ECO) are focused on fuel-poor/low income households and delivered through energy suppliers (although often with involvement of local authorities in practice), with combination of regulation and green finance for able-to-pay sector</li> <li>• Scotland has larger public funded programmes and Scottish Government has been more proactive in securing ECO resources</li> </ul>
Energy taxation	Similar	<ul style="list-style-type: none"> <li>• Both countries make tax decisions at national government level, subject until recently to same overarching EU frameworks (e.g. on VAT)</li> <li>• Both countries seeking to move tax burden away from electricity towards gas (NL ahead in practice)</li> </ul>
Building regulations	Similar	<ul style="list-style-type: none"> <li>• Both countries until recently subject to same overarching EU Directives, with minimum requirements for new build and Energy Performance Certificates; possibility of divergence looking ahead, with NL already adopting near zero-emissions buildings and a ban on gas boilers as a sole heating solution in existing buildings from 2026. This is ahead of UK's Future Building Standard</li> <li>• Within UK, regulations are devolved, and Scotland and Wales have higher standards than England, but overall governance approach is the same</li> </ul>
Technology innovation and deployment support	Similar	<ul style="list-style-type: none"> <li>• In both countries there are national support programmes for R&amp;D, demonstration and deployment/scaling up for low-carbon heating technologies, but with higher levels of support in NL taking into account differences in its relative size</li> <li>• Both countries encourage partnerships between research institutions, such as universities and companies, but coordination is stronger in NL</li> </ul>



		<ul style="list-style-type: none"> <li>• Within the UK, the design of some programmes (e.g. RHI/Boiler Upgrade Support) has been different in Scotland</li> </ul>
Skills and training	Similar	<ul style="list-style-type: none"> <li>• Skills for low-carbon heat are a challenge in both countries, and in both countries the state-led vocational training system plays the central role in the approach to meeting the challenge</li> <li>• In both countries there are specific initiatives within the vocational training system (and in retraining) for low-carbon/green skills, including areas such as energy efficiency, heat pump installation etc.</li> </ul>
Electricity network regulation	Some differences	<ul style="list-style-type: none"> <li>• Both countries have independent regulators and unbundled networks under an until recently common EU framework, and both have incentive regulation</li> <li>• In both countries electricity distribution network companies are much larger than local governments, raising the challenge of coordination</li> <li>• In NL distribution companies are owned by groups of municipalities, whereas in the UK they are owned largely by infrastructure banks and funds</li> <li>• The UK (GB) regulator has been more proactive in organising funding for innovation in networks</li> </ul>
Heat network regulation	Some differences	<ul style="list-style-type: none"> <li>• In both countries, heat networks meet a low level of demand, but especially in the UK</li> <li>• In the UK many networks have been developed by local authorities through public-private partnerships; in NL many networks were originally constructed in the public sector, but the majority have since been sold to private operators</li> <li>• In NL heat network operators have been required to be licensed, and there is a degree of price protection through linkage to gas</li> <li>• In the UK historically heat network operators have been virtually unregulated</li> <li>• Both countries have legislation in process that will improve regulation and may give powers to network operators to require connection</li> </ul>
Gas network regulation	Similar	<ul style="list-style-type: none"> <li>• In both countries no decision has yet been taken about the future of the gas transmission and distribution networks, although the UK has committed to a date (2026) for making a decision</li> <li>• In both countries, there is an active hydrogen lobby and the possibility of repurposing all or some of the gas network for hydrogen remains a policy option</li> </ul>

These comparisons point to some broader themes:

- The Netherlands has a more concrete framework for heat decarbonisation and has made greater progress in terms of local level planning and piloting, than the UK; broadly speaking *the Netherlands is ahead in the transition*. This is also reflected in areas such as sales of heat pumps, where cumulative installations in the 2020 were over eight times higher in the Netherlands than in the UK. This is not to say that the Netherlands does not face challenges in the heat transition, or that its approach does not carry risks, such as a failure to coordinate many local plans, but it is currently progressing faster.
- The governance approach to heat decarbonisation in the Netherlands involves a *much stronger role for local government (municipalities) in planning, piloting and knowledge sharing* than in England and Wales to date, while Scotland is in an intermediary position. The lead role given to municipalities arises directly out of the climate governance framework, on the basis that heat is fundamentally local in nature. This point is also acknowledged by the UK government, but the governance framework does not yet reflect this as the role currently envisaged for local government *is far more limited*.
- The governance of the heat transition in the Netherlands is characterised by *consultative processes aimed at reaching consensus between stakeholders*. This can be seen at the level of overarching climate governance, where the Climate Agreement process contrasts with the *more technocratic approach* in the UK. However, the ‘Polder’ approach in the Netherlands delivers compromise and consensus at the level of representatives of national organisations, Parliament etc., i.e., at an elite level, rather than at the level of society as a whole, meaning that challenges of public opposition to getting rid of gas at the local level are still possible. The Dutch approach of inclusion and consensus-seeking also applies at lower levels and more technical areas of governance, for example in areas of establishing methodologies for heat decarbonisation planning and setting standards for building thermal performance.
- The Dutch approach in the governance of heat decarbonisation is more willing to give a *larger role to state intervention and direct delivery* than in the UK, including in areas such as heat planning and energy efficiency improvements, with Scotland again in somewhat of an intermediary position. Interestingly, in recent years heat networks have been an exception, with local authorities in the UK more likely to be involved in ownership than in the Netherlands (although there is now debate about changing this). The role of external consultants also differs at the national level, with more use of consultants in the UK (including by the Scottish Government) as opposed to in-house in the Netherlands. However, at the local government/municipal level, consultants are quite widely used everywhere.
- As noted throughout, it is clear that there are some important differences in governance approach within the UK, with Scotland especially striving to adopt an approach similar to that of the Netherlands, but being somewhat constrained by UK-wide frameworks.

- In some areas, for example building regulations, taxation and electricity network regulation, similarities in governance can be explained by the fact that both countries fell under common EU frameworks until very recently.

These points of comparison raise two further questions, which the Going Dutch? project will investigate in future work. One is why these patterns, especially those of differences, exist, and how they are related to wider institutional features of the two countries. The second is whether and how far aspects of the Dutch approach may be useful for the UK. Given that the role of local government in heat decarbonisation in the UK will almost certainly increase in future, lessons from the Netherlands on how the national and local levels can interact successfully, or indeed unsuccessfully, may be particularly important.

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