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International heat and energy efficiency policy review

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1 Executive summary

1.1 Project aims

This report provides an analysis of international approaches to regulating domestic energy efficiency and heat decarbonisation that are comparable with Scotland's aims, as outlined in the Scottish Government's Heat in Buildings Strategy. Particularly of interest were regulations focused on existing domestic buildings (more so than new build) and regulations that promote a phase out or ban the use of fossil fuel-based heating.

The research identifies regulations and policies relevant to heat and energy efficiency internationally. We investigate their effectiveness or otherwise, and where possible, aims to identify why some approaches work and others fail.

We also highlight key considerations or precedents within the international policy area to better determine how similar regulations could work in Scotland. This report provides key learnings from other countries, regions and cities, which will be useful to the development of successful regulations by the Scottish Government.

1.2 Summary of key findings

The study identified 78 international examples of domestic heat and energy efficiency regulations and policies. This section provides a short summary of the key findings:

- The most common type of domestic heat regulations are bans prohibiting the use or installation of certain heating systems or certain fossil fuels, and mandates that set minimum emissions levels from these heating systems.
- For energy efficiency, the most common type of regulation is mandating minimum energy efficiency levels.
- Bans and mandates are similar in nature and impact. Generally, mandates provide more flexibility to the householder as to how they meet regulations. Both bans and mandates are effective in reducing the use of fossil fuelled heating systems and/or reducing carbon emissions from homes.

- Regulations and policies are heavily focused on new builds rather than retrofitting existing buildings. In many cases, implementing measures in new build was a precursor to implementing them in existing housing.
- There isn't a regulation or measure focusing only on multi-family homes, although these types of homes are usually included as a target in the regulations.
- There is little evidence of legal challenges to the measures and policies analysed in this study. In the rare instances when it happened, citizens challenged the regulation for fears of housing cost increase, but there was general support for the objectives of the regulation. However, it should be noted that the regulations implemented to date have mostly been tackling old and inefficient appliances and more ambitious regulations are likely to be needed to meet more stringent climate change targets.
- A few of the regulations allow hybrid heating systems. For example, in Germany, the Building Energy Act states that in the event a low-carbon alternative isn't technically feasible, the heating system needs to be hybridised to include at least one renewable source. This reduces the overall impact of the ban but makes it more manageable for households from a financial point of view.
- With bans and mandates, there is usually a phase-in period before the measure is enforced and compliance monitored. The phase-in period is at least one year, with some as long as 10 years. Financial support schemes have been implemented by governments alongside bans and mandates.

1.3 Recommendations and value to a policy audience

Our research and analysis demonstrate that there are precedents for both outright bans on some forms of fossil-fuel heating and for mandates that ensure homeowners must make energy efficiency improvements to their properties.

A key consideration for policymakers going forward is that all countries that have introduced bans or mandates, have subsidies for the installation of low-carbon heating systems. Should the Scottish Government decide to implement similar regulations to those identified in this research, key recommendations are:

- **Review existing subsidy support for low-carbon heating** – prior to the introduction of a ban, ensure there is adequate support available for people to replace their old fossil-fuel heating systems.
- **Review existing support for energy efficiency measures** – if improvements in building performance are to be mandated, ensure subsidy support aligns with new regulation.
- **Detailed assessment of Scottish Government powers** – this report includes a high-level appraisal of devolved Scottish powers and provides a view on which powers could be used to develop new regulation. Additional research and legal advice is needed to confirm the assertions presented here.
- **Bespoke policy development** – any new regulation would need to be tailored to the Scottish context to ensure effectiveness. Additional research is therefore recommended, so that use of policies presented here is suitable for Scotland.

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2 Glossary

Term	Definition
Ban	A ban is the formal prohibition of an action. In the case of heat policies, a ban is an official order prohibiting the installation, use and / or repair of a specific heating appliance.
Devolved areas	In devolved areas, decisions are made by the parliaments and governments in Scotland, Wales and Northern Ireland. Devolution laws passed by the UK parliament list which matters are reserved.
EPC	Energy Performance Certificate
Heat in Buildings Strategy	The Heat in Buildings Strategy sets out the Scottish vision for the future of heat in buildings and the actions they are taking in the building sector to deliver climate change commitments, maximise economic opportunities and ensure a just transition, including helping address fuel poverty.
Heat pump	A device taking heat from a renewable heat source (air, ground) to increase it to a temperature that keeps homes warm inside.
Hybrid heating system	A hybrid heating system uses two systems to heat homes. Most often, when referring to a domestic hybrid heating system, it includes a gas boiler and a small capacity heat pump.
kWh	A measure of how much energy is used per hour. Thus,1 kilowatt hour is the amount of energy needed to keep a 1000-watt appliance running for an hour.
Mandate	A mandate is an official order or commission to do something. Mandates can apply to any sector and industry. In the frame of our study, mandates are pieces of legislation making it compulsory for end-users to comply with the product standards / emission levels stated in the mandate.
MFH	Multi-family homes are buildings occupied by multiple families in different units, such as apartment blocks and high-rises.
SFH	Single-family homes are buildings occupied by only one family, most often a house.
Reserved areas	In reserved areas, decisions are made by the UK parliament and government.

3 Introduction

This report provides findings from an international review into residential heat and energy efficiency regulations. The intention is to inform the Scottish Government's decision-making around decarbonising residential buildings in Scotland. The review covers the types of regulations that have been applied in various countries and details on a chosen set of regulations deemed to be relevant to the Scottish Government.

3.1 Policy context

The Scottish Government has ambitious and legally binding climate change targets[1] to reduce greenhouse gas emissions by 75% by 2030 and 90% by 2040. Given that buildings in Scotland account for around a fifth of current emissions, decarbonisation of them is essential to meet climate change targets. This represents a major step-change and challenge. For example, recent years have seen around 3,000 renewable heating systems installed in Scotland's homes annually; this will need to increase to 200,000 systems per year in the late-2020s (Scottish Government, 2021).

The Scottish Government has outlined how it intends to decarbonise buildings in Scotland in its Heat in Buildings Strategy (HiBS) (Scottish Government, 2021). This sets an overall aim of achieving zero emissions buildings by 2045 and ensuring that no more than 5% of households are fuel poor by 2040. The strategy contains a range of actions the Scottish Government intends to take or encourage, such as area-based approaches and funding schemes. It also includes a commitment to regulate energy efficiency and heat decarbonisation in existing domestic properties from 2025, subject to legal competence, using a mix of efficiency standards, bans, support schemes and a technology neutral approach. Relevant targets include:

- **Minimum energy efficiency levels** through the requirement of minimum Energy Performance Certificate (EPC) ratings. The requirements include private rented properties needing to have an EPC rating of C (or equivalent) by 2028, the same level for all homes by 2033 and a non-legislative EPC rating of B in social rented homes by 2032.
- **Prohibition on Direct Emissions Heating Systems (DEHS).** This has been set out as ending the use of DEHS in new build homes warranted from 2024 and in existing homes from 2025 and by 2045.

3.2 Research aims and scope

We provide an overview of the main types of residential energy efficiency and heat regulations that have been implemented in other countries, regions and cities. The research provides an understanding of the types of regulations that have been applied, how successful they have been and the likelihood of whether they would apply to the Scottish context (for example, our assessment of whether the Scottish Government is likely to have the legal powers to implement). A detailed description of a selection of regulations deemed to be of particular interest and/or relevance to Scottish Government is provided. The research focused only on existing domestic buildings, rather than new builds. A full methodology is provided in Appendix 1.

[1] As set out in the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019

4 Overview of regulations

A key focus of this project was to identify international examples of residential heat and energy efficiency policy and regulation. The research started with gaining a broad understanding of the types of regulations and policies that have been implemented in various jurisdictions. From this a smaller number of regulations and policies that represented different categories of measures were examined in more detail. The focus of this stage of the research was to find effective energy efficiency and low-carbon heating policies which could be replicated within the Scottish devolved legal context, and to understand how and why these measures had been successful.

In addition to the reporting, an Excel database has been produced and provided to CXC with all the policies and regulations identified throughout the project. In total, 78 policies were identified. From this, numerous examples of subsidy support for heat and energy efficiency measures, including in France, Germany, Italy, Finland, Poland and the Netherlands. Outside of Europe, similar measures were found in Canada, Japan, New Zealand and the United States were identified.

Subsidy support is common in European Union (EU) nations, as they are required to improve the energy efficiency in buildings (including domestic) through the Energy Performance of Buildings Directive (EPBD). Similarly, the EU's Energy Efficiency Directive (EED) requires member states to establish long-term strategies to increase the use of renewable energy sources for heating. While each nation has developed regulation suitable for their own unique context, similarities are not unusual.

Throughout this project, the team determined that incentive-based policies, such as provision of funding, were a common policy instrument to encourage homeowners to retrofit their properties and upgrade their heating systems. In total, 25 policies that included provision of finance for either low-carbon heating, energy efficiency or both were identified (nearly a third of the total). The Scottish Government already offers similar funding through the Home Energy Scotland Grant and Loan, Warmer Homes Scotland and Private Rented Sector Landlord loan (Home Energy Scotland, 2023). Therefore, there is limited learning to be gained from detailed study of similar subsidy support mechanisms for Scottish Government, which is why these policies are not included in the analysis of this report.

Less common, are examples of prohibitive policy or regulation, that bans a particular type of heating system. Similarly, explicit mandates that push homeowners to upgrade the energy performance of their properties, rather than providing guidance and suggestions only, are also less common. In collaboration with CXC, the project team agreed to focus on more 'push' policies, such as bans and mandates rather than 'pull' policies. As there are no such regulations currently in Scotland, these policies had the most to offer in terms of potential new policy development.

Another focus for the project was to investigate if there were any examples of specific support for the supply chain. While several countries, such as Germany and Canada have referenced the importance of training and upskilling their workforces to retrofit existing housing stock, there is a lack of data on the level of funding allocated. It is unclear if this is a shortcoming of policy design, or if governments have confirmed that the supply chain is sufficiently mature. Alternatively, governments may have excluded this detail as they anticipate that policies which either provide subsidy support or mandate the upgrade of properties will be sufficient to spur development of the supply chain. A lack of evidence

means it is not possible to determine a definitive answer as the data is not available. Therefore, the findings in this report are primarily focused on regulations for homeowners, as information is more readily available on these policies.

4.1 Research limitations

As this project was a broad, desk-based study the project team focused on ensuring policies were identified from a fully global perspective and as broad a range as possible. It was not possible within the timeframe to investigate each policy extensively. Additional details on the policies identified that could be further investigated includes:

- **Detailed 'before and after'** – The evidence presented includes success of the policy, where we are confident there has been a clear impact. However, each country is different in terms of social and political context, as well as market maturity for heat and energy efficiency measures. The policies presented here do not exist in a vacuum and it is highly possible that other factors may have contributed to the progress highlighted in this report. To explain the impact of each policy more fully would require a more thorough examination of each country.
- **Impacts** – The impacts presented are those that the project team were able to identify from desk-based research. These are primarily focused on how successful each policy was in achieving its intended goal. We have not been able to determine broader impacts, such as on housing markets or energy networks. Similar to the above, this would have required considerably more time to complete additional research and a detailed analysis of the nuances of each country.
- **Language** – The policies and evidence presented are those that the project team was able to identify using desk-based research in English and French.

5 Key findings: Low-carbon heat regulations

To facilitate analysis and dissemination, we have grouped the regulations into two categories – heating system bans and mandates for end users. Below, we summarise the findings for each category.

5.1 Heating system bans

5.1.1 Introduction

A ban is the formal prohibition of an action. In the case of heat policies, a ban is an official order prohibiting the installation, use and / or repair of a specific heating appliance. Different governments have chosen different approaches to bans: banning the **installation** or the **repair** of a specific heating appliance is a measure which usually would give households time to source alternatives to their current heating system. A definition of a repair is given in the overview of the Ban on oil furnaces regulation (Government of Quebec, 2018), in Table 7 (Appendix 3). However, in the case of a distressed purchase (i.e., when a heating system has broken down), households have to make a decision fairly quickly and often rely strongly on the advice of their heating engineer. This means that in addition to the ban and financial support provided to households, heating professionals need to be trained and upskilled to have the knowledge required to best advise households.

Banning the **use** of a specific heating appliance forces households to immediately stop using it. In most cases this would lead households to replace it with a cleaner, more sustainable alternative heating system. These bans usually include a transition period providing from one to up to 10 years for households to prepare for the new installation – for example, to carry out research on a new heating system or choose the best heating system for their home. When implementing a ban, most governments choose to provide subsidies, loans, grants or other financial help to support households in changing their heating appliances. Grants range from €200 in France for a smart thermostat installation, to €150,000 in Germany for households undertaking energy efficient renovation work.

5.1.2 Analysis of effectiveness and success

From the review, there are five policies in the heating system category. These are from Germany, Norway, Denmark, Canada and Switzerland. They all use the same policy lever to prohibit the use of a specific heating appliance. They all focus on highly-polluting, fossil fuel-based heating appliances, using either oil or natural gas. An outright ban is a clear and explicit way of reducing or eliminating the use of this kind of appliance (although other policy measures – which do not appear to be as absolute - may have the same impact). In some instances, bans aren't welcomed by homeowners, with examples in Switzerland or Germany where homeowners' associations have legally challenged such regulations. However, in most cases, the bans focus on old, polluting heating systems that are widely seen and accepted as replaceable.

The bans detailed below are the most advanced bans for residential heat currently implemented. In Norway, Denmark and Canada, the bans have first been applied to new builds before expanding to all residential buildings. There are several reasons why governments would focus on new builds first:

- It helps raise awareness of the alternative heating appliances and technologies available without disrupting homeowners directly, as the heating appliance gets installed before homeowners move in.
- It helps the industry ramp up production and installation capacity gradually. Examples show that once a ban has been successfully implemented in new build, governments can then expand it to cover all existing buildings. When the ban evolves in this direction, the industry is more likely to be ready to provide and install the required amount of heating appliances and can build on its experience in new builds.
- Applying a ban to new builds is easier to implement as well as more practical and cheaper: the installation is less disruptive for as it's done during the build, and it doesn't rely on homeowners to make an individual decision.
- New build homes do not require retrofit work ahead of meeting zero carbon targets, as they are zero carbon from when they are built.
- These bans are also relevant to Scotland as they are legislatively replicable and are likely to fall within the Scottish Government's devolved powers.

In some cases, the bans include significant caveats, so as not to disrupt households too much. For example, in Germany, the Building Energy Act states that in the event a low-carbon alternative isn't technically feasible, the heating system needs to be hybridised to include at least one renewable source. This means that the heating system can still use fossil fuels, as long as there's a share of renewable energy being used, which reduces the overall impact of the ban. Similarly, the Danish energy agreement bans the installation of oil-fired heating appliances in existing buildings only in areas supplied by district heating or natural gas. In off-gas, rural areas for example, the ban can't be enforced, and households can still use oil-fired heating systems. Finally, in Zurich, the ban on oil and gas heating systems is only enforced if it is technically possible and financially viable. The technical possibility is assessed by a certified heating installer according to the property, space and connections required for a new system. However, the financial viability is assessed by a heating specialist and the ban can't be enforced if the costs of a clean heating system over its entire service life are more than 5% higher than those of a new oil or gas heating system. These caveats reflect the lobbying of homeowners' associations, equipment OEM and oil and gas suppliers, and significantly reduce the impact of these bans.

Bans can apply both to single-family homes (SFH) and multi-family homes (MFH). Single-family homes are buildings occupied by only one family, most often a house. Multi-family homes are buildings occupied by multiple families in different units, such as apartment blocks and high-rises. The target of bans depends on the end objectives and which types of heating systems are most common in the country. It is also difficult to make comparisons between different countries as the ownership and management structures of MFHs varies between different countries. For example, it is common in some countries to have a building manager and centralised maintenance funds. Replacing heating systems in SFHs could take longer overall than in MFH as every single household needs to decide to change their heating system, find the finance and the installation performed in each home. Conversely, replacing the heating system in a MFH can also be challenging as this will require a joint decision between owners and pay for the equipment, for example through an increased service charge. It can also be challenging technically in terms of space, capacity and cost. This evidence review has not found evidence of whether replacements in SFHs or MFHs is more straightforward. It is likely to depend on a number of factors such as size of building

(i.e., smaller buildings are likely to be more straightforward), technical complexity, legal structure (which can impact decision making) and availability of finance.

For the majority of the bans detailed below, enforcement is done by local authorities and building inspectors. In most cases, local councils or municipalities deliver building permits and as such are capable of monitoring compliance with bans on heating systems. In most cases, public information campaigns accompany the implementation of a ban to ensure households understand why the specific heating systems need to be replaced and how the government is supporting this effort. Canada is an outlier in terms of enforcement, as it is the heating professional and not the homeowner who must send in writing to the Ministry within 30 days their name, contact details, the address, date at which the appliance was installed / replaced, with appliance details, characteristics, manufacturing date and serial number.

Although the data is limited, available evidence indicates that all the bans detailed in Table 1 have been successful so far. This is because governments do not publish the data comparing installed base before and after the ban was implemented, because the ban is too recent to allow a robust impact assessment, or because the government stopped reporting on the banned appliances. However, we found supportive evidence at the national level for most bans showing the successful impact of the ban. In Norway, less than 1% of dwellings now use oil for heating, down from 3% in 2017. In Denmark, the consumption of oil for heating was halved since the ban was first implemented for new builds in 2013 and for all buildings in 2016. In Canada, analysis has shown an increase in electric heating uptake with more than 75% of new builds using electricity for heating compared to 90% of new builds using oil back in the 2000s. The ban in Germany has recently been revised to cover more buildings and develop renewable sources of heating in existing buildings. The ban in Switzerland is too recent for any analysis.

Table 1 lists each of the international policies considered in relation the ban of heating systems. These are covered in more detail in Appendix 3.

Table 1 Summary of heating system bans

Name	Country	Type of ban	Details	Impact
Climate Protection Programme 2030 – Building Energy Act	Germany	Installation	From 2026, the installation of oil-fired heating systems is banned for all households, when a more low-carbon alternative is technically feasible.	No data available
Heating oil ban	Norway	Installation and use	In 2016, ban on the installation of fossil fuel-based heating systems for new builds. In 2020, ban on the use of oil-fired heating appliances in new and existing buildings.	Decrease in number of dwellings using oil for heating
Energy agreement	Denmark	Installation	Since 2013, ban on the installation of oil-fired and natural gas heating appliances in new builds. Since 2016, ban on the installation of oil-fired heating appliances in existing buildings.	Decrease in the use of natural gas for individual heating
Ban on oil furnaces	Canada	Installation and repair	Since 2021, ban on oil-powered heating systems in all new construction projects. From December 2023, the ban will evolve into a ban on the replacement and installation of fossil fuel-powered heating systems, and a ban on the repair of oil-powered heating systems.	Increase in adoption of electric and natural gas heating systems in new builds

Energy Act	Switzerland	Installation	Since 2021, when existing oil- and gas-powered heating appliances reach the end of their service life, households in the Zurich Canton will have to replace them with climate-neutral appliances. The Canton will provide the equivalent of £13.5 million in subsidies, partly in relation with this measure.	No data available

5.2 Mandates for end users

5.2.1 Introduction

A mandate is an official order or commission to do something. Mandates can apply to any sector and industry. In the frame of our study, mandates are pieces of legislation making it compulsory for end-users to comply with the product standards / emission levels stated in the mandate. In this section, we'll look at mandates relating to heating appliances. Most relevant mandates focus on **emissions levels**.

The goal of a heating mandate is to phase out old, inefficient and polluting heating systems in a broad effort to reduce GHG and carbon emissions coming from the residential sector. Mandates often act as de facto bans: they mandate the level of emissions or energy efficiency required for specific products (in this study, heating systems or buildings), which effectively prohibits the use / installation of any appliance or building not meeting these levels. Using emissions levels is more straightforward as it can apply to any technology and makes it easier for manufacturers to produce heating systems to this standard. Using energy efficiency standards can be a bit more complex when drafting the regulation as it involves developing the standards before issuing the mandate. Developing a standard is often a lengthy process involving industry stakeholders, consumer associations and market experts to develop an efficiency standard for every single type of heating appliance available on the market. An efficiency standard calculates the efficiency and emissions of specific appliances or buildings. Despite this lengthy process, energy efficiency standards can be more inclusive of less popular technologies used in specific cases and more difficult to replace.

As with bans, mandates usually come with financial support schemes in the form of incentives, grants, subsidies or tax breaks to help end-users transition to a compliant heating system.

5.2.2 Analysis of effectiveness and success

From the review, there are four policies in this second heating mandate category. They come from France, Poland, the Netherlands and Baden-Wurttemberg in Germany. It is likely that they would be largely replicable to Scotland. Some specific aspects of the mandates might not be applicable / relevant, but the objectives and rules could achieve the same results in Scotland.

We have found evidence of the success of some of these policies. As with bans in the previous section, the evidence can't be directly associated to each regulation. Instead, national data can provide an indication of the impact of the regulation. However, there are always other contributory factors that also impact this data. The mandate in France and in the Netherlands are too recent to gather any meaningful data attesting of their success. However, following the implementation of the mandate in 2020, the rate of annual heat pump installations has steadily increased by 75% in Poland. Similarly, in Germany, the share of renewable energy in the heating sector has increased from 7.8% in 2008 to 14.6% in 2020, which is linked to the mandate's first implementation in 2008 and its revision in 2015. Energy efficiency has also improved in Germany resulting from the mandate's implementation, evidenced by the 16% reduction in primary energy consumption in the building sector between 2008 and 2019.

Mandates vary across countries and are difficult to compare. For example, France requires that any new equipment installed for heating or hot water production in new or existing

residential buildings to comply with a greenhouse gas emission ceiling of 300g CO2eq/KWh. This mandate effectively bans coal- or oil-fired heating systems as they can't comply with the emissions levels (and there was no evidence from our review as to why a complete ban was not implemented instead). In Poland, the new emissions standards were implemented to replicate the European Union's Eco-design Directive (2009/125/EC) which includes its own standards. In Germany, the renewable energy quota requires households replacing their heating system to install renewable heat sources that cover at least 15% of their annual heating demand.

Enforcement for mandates is usually done by local authorities, including municipalities and local councils. Local government can often collaborate with relevant government agencies, such as in the state of Baden-Wurttemberg where local government works with regional energy agencies and environmental protection offices. In this case, MFH building owners are required to submit regular reports on the performance of their heating systems, including data on energy consumption, the share of renewable energy and compliance with energy efficiency standards. Local building authorities use these reports to monitor compliance. They also carry out inspections to verify compliance, either scheduled or unannounced. In case of non-compliance with the requirements set out in the Act, homeowners can face penalties such as fines, legal proceedings or restrictions on building permits.

Table 2 lists each of the international policies that were identified as part of the review. These are covered in more detail in Appendix 4.

Table 2 Summary of heating system mandates for end users

Name	Country	Type of mandate	Details	Impact assessment
Decree to limit GHG emissions from heating systems	France	Limit on GHG emissions	From July 2022, all new equipment installed for heating or hot water must comply with a GHG emission ceiling of 300g CO_2eq/KWh	No data available
Clean Air 2.0 programme – Local emissions standards	Poland	Limit on emissions	Since 2020, all new and existing heating systems must comply with new emissions standards and limits for particulate matter, carbon monoxide, nitrogen oxides and organic gaseous compounds. Deadlines for compliance range between 2022-2027. The Polish Government plans to spend the equivalent of £20 billion over 10 years to support homeowners in their transition.	Sharp increase in rate of annual installation of heat pumps after the ban was announced
Local Renewable Heat Act and Climate Protection Act	Baden Wurttemberg and Hamburg, Germany	Mandatory renewable energy quota	Since 2015 (amendment to the 2008 Act), new buildings and existing buildings undergoing a renovation must have at least 15% of their annual energy demand for heat met by renewable energy sources	Increase in the share of renewables in energy mix and decrease in primary energy consumption

Heating appliance standard for 2026	Netherlands	Mandatory efficiency standards	Introduced in 2022, new efficiency standards for replacement heating systems were introduced, with a deadline for compliance in 2026.	No data available

6 Key findings: Energy efficiency mandates for end users

6.1 Introduction

This section also looks at the use of mandates. This time however, we look at mandates relating to energy efficiency standards. These differ from the previous section as they focus on the energy efficiency of the residential building instead of focusing on the heating appliance. As a result, the mandates detailed in this section focus particularly on the building envelope, looking at insulation, climate control or energy performance labels. The aim of an energy efficiency mandate is to upgrade the building stock by installing new, more efficient products and equipment or by retrofitting / renovating buildings. These improvements lead to more efficient homes which cost less to heat / cool, emit less greenhouse gas emissions, use less energy and are more sustainable and comfortable to live in. Energy efficiency mandates require a lot of work from policymakers to establish the standards that are to be set and their enforcement. Mandates usually also come with financial support to help homeowners afford the cost of renovation / retrofit or upgrades.

6.2 Analysis of effectiveness and success

The energy efficiency mandates in the policies detailed in Table 3 are all expected to be replicable, at a high level, in Scotland. It is important to note that some of the measures in this policy already exist in Scotland: for example, energy performance labelling is already used throughout Scotland to inform homeowners and tenants of the energy performance of their home. Scotland is also planning to require an EPC rating equivalent to EPC C or above to be able to privately rent a property. The regulations in this section are similar to Scotland's, although some go further in pushing homeowners to upgrade their homes and reduce their carbon emissions.

In France, residential energy consumption has decreased by 9% following the adoption of the mandate on the installation of programmable thermostats for all new builds. This may partially be explained by France having one of the highest new build rates in Europe; over 380,000 new homes were built in 2020; more than twice as many as the UK, despite very similar population sizes (approx. 67 million) (Hawkins, 2022). Societal pressures and Government-led communications campaigns around "energy sobriety" have also contributed to this decrease in residential energy consumption. Additionally, French households typically used electrified heating, with most power coming from nuclear rather than natural gas, as is the case in the UK. In addition, the 2022-2023 winter was relatively mild in France compared to previous winters, which naturally led to a decrease in residential energy consumption. In Germany, carbon emissions from the residential sector declined by 43% after the adoption of the energy conservation ordinance. In Japan, whilst exact figures aren't available, the government communicates on significant reductions in carbon emissions coming from the building sector. In the US and Belgium, the regulations are too recent to measure their impact, but they are expected to lead to significant reductions in carbon emissions coming from buildings.

In Table 3, a list of each of the international policies identified concerning energy efficiency mandates is provided. This is covered in more detail in Appendix 5.

Table 3 Summary of energy efficiency mandates for end users

Name	Country	Type	Details	Impact Assessment
Energy sobriety plan	France	National strategy	Implemented in 2022, the plan aims to reduce the energy consumption of all buildings by 10% by 2024 and is structured around 15 key measures to fight against waste and better manage energy consumption. For example, one of the measures is the obligation to install a boiler thermostat.	Decrease in overall energy consumption over autumn and winter 2022
Energy conservation Ordinance	Germany	Standard	First introduced in 2002 and revised several times since, it aims to reduce the amount of energy consumed in heating, climate control and hot water provision in new buildings by roughly 25 to 30%. It unifies thermal insulation and heating installation ordinances. The ordinance sets stricter energy requirements when doing a modernization or retrofit.	Decrease in overall energy consumption, although challenging to pinpoint its cause

Improvement of Energy consumption Performance of Buildings Act	Japan	Standard	Introduced in 2015, the act implements mandatory efficiency standards starting in 2020 for large new buildings and new residential buildings, with a set of incentives to support energy saving renovations	Decrease in energy consumption from commercial and residential sectors
Local Law 97: Carbon caps	United states	Regulation	The New York City Council enacted this law in 2019 to cut carbon emissions for buildings larger than 25,000 square feet in the city by implementing carbon caps. A phased approach will be implemented to improve and set stricter carbon caps every year, starting in 2024.	No data available
Energy performance (Energieprestatie)	Belgium	Regulation	From 2023 onwards, the regulation mandates that all properties (single- and multi-family homes) purchased from 2023 with label E or F must be renovated to label D or better within 5 years of the purchase. A fine between 500 and 200,000€ can be imposed for non-compliance.	No data available

7 Key findings: Other policies

The following two regulations are neither considered as bans nor mandates, so we have categorised them as outliers to the other regulation categories. However, for completeness, we decided to include them to this report:

- The Danish Heat Supply Act is applicable to heat networks. Compared to Denmark, Scotland only has a small number of heat networks. Therefore, whilst the regulation is relevant to Scotland, it would currently have limited applicability. However, when first implemented, this regulation was key to increasing the number of district heating systems in Denmark and give local governments the required powers to expand, build or commission heat networks. As a result, this regulation can be useful as an example for Scotland of how it could increase the number of heat networks in the country (as per Scottish Government policy ambition).
- By definition, the Finnish Voluntary Energy Efficiency Agreement, doesn't ban or mandate anything. Rather, households choose to commit to an energy efficiency improvement and get rewarded when they reach their goal. This is a uniquely innovative regulation that has proven its efficacy in several sectors, including housing, transport, agriculture or industry. However, it hasn't been reproduced in other countries. We believe the Scottish Government can use it as inspiration to expand its portfolio of policies and regulations in energy efficiency.

A complete analysis of these regulations can be found in Appendix 6.

8 Conclusions

8.1 Key findings for policy development

The report has presented 16 policies across 4 categories:

1. Heating system bans (5)
2. Heating mandates for end users (4)
3. Energy efficiency mandates for end users (5)
4. Other interesting policies (2)

The following sub-sections bring out the key findings in each of these four cases.

8.1.1 Heating system bans

These policies prohibit a particular type of fossil-fuel heating system, such as a boiler. The policies identified usually also specify the fuel used by the banned heating system, such as oil or coal. Some regulations ban the installation of the specified heating system, whereas others ban their use. Additionally, some policies extend to bans on the repair of a particular fossil-fuel heating system, although the definition of repair varies. Bans identified include oil, coal and gas-fired heating systems. In some instances, the regulation allows heating appliances to be hybridised, which reduces the effectiveness of the ban but also mitigates the cost impact on households.

In most of the countries where these regulations have been introduced, the ban refers to old, polluting heating systems. This may partially explain why there is no evidence of significant opposition to the bans in the countries that have introduced them. In the rare cases where such measures have been challenged (e.g. Switzerland), citizens believed in the objective set by the measure but feared the cost implications it would have on low-income populations. The policies have broadly been regarded as successful. Although evidence is limited, several countries have noted a reduction in the number of properties using fossil-fuel heating systems.

Most regulations that ban carbon intensive heating systems in existing buildings were preceded by bans on such systems in new builds. Banning high-carbon heating systems in new build properties is much easier than retrofitting existing buildings. The skills needed within industry to install low-carbon heating system in new-build properties can be used later on to improve energy efficiency and heating systems in existing homes.

These regulations demonstrate that bans on fossil-fuel heating systems have been enacted by other governments and have been shown to be effective. The majority of low-carbon heating options qualify as renewable energy. An accepted definition for renewable heat technologies is the UK Government's (now closed) Renewable Heat Incentive, which included heat pumps (both air and ground), biomass boilers and solar thermal (Ofgem, 2022). All these technologies can be considered renewable energy; solar thermal uses the sun, biomass fuels have previously sequestered carbon – although they can negatively affect biodiversity and air quality – and heat pumps use electricity, which is largely decarbonised in Scotland due to the high penetration of renewables, to extract heat from a renewable heat source like air or ground..

8.1.2 Heating mandates for end users

These policies focus on emissions levels from homes. Unlike a ban, which prohibits the installation, use or repair of a system, the policies put the onus on the homeowner to meet a certain emissions standard for their properties. This could either be ensuring their home emits less than a defined quantity of CO_2 or mandating that homes meet a certain level of efficiency, for example stipulating that renewable heat provides a minimum percentage of their annual heating demand. These regulations usually translate to a de facto ban on fossil fuel heating without explicitly wording the legislation in those terms.

These regulations provide more flexibility for homeowners than bans by allowing them to meet a set criterion in a greater range of ways. By not explicitly banning any specific heating system, some properties may indeed retain carbon-intensive heating systems, but regulations will ensure that additional measures are implemented to reduce the total carbon footprint of the building. Our analysis shows that this has been successful in other countries and is worthy of consideration by the Scottish Government. Following the introduction of mandates, most countries saw an increase in the number of low-carbon heating systems being installed, particularly heat pumps.

8.1.3 Energy efficiency mandates for end users

These policies are similar to those in the previous section in that the regulations mandate that a property must meet a certain energy efficiency standard. Specifics of each policy vary but usually include consideration of insulation levels. Some policies also include climate controls or other products that improve how energy is used. Some policies include both heat and energy efficiency, thereby encouraging a whole house approach to retrofit. Several of the regulations are focused on reducing the total energy consumed within a building, whilst others are framed in terms of improving overall efficiency. In both cases, the goal is to reduce the total carbon emissions for the building.

As with the policies in the category above, a mandate allows the homeowner flexibility in terms of how a reduction in the emissions from a home is achieved. These regulations have been shown to be successful in three different continents: Europe (Belgium, France and Germany), North America (United States) and Asia (Japan).

It is important to note that there are versions of these regulations already in place in Scotland, including energy performance labelling (EPCs) and targets for minimum standard to be achieved for social housing (EPC B by 2032) and private rented accommodation (EPC C by 2028) (Scottish Government, 2021). The energy efficiency regulations from other nations presented in this report are therefore for learning and comparison.

8.1.4 Overall conclusion

Our research demonstrates that there is potential for learning from policies and regulations implemented by other countries. We have determined that there is precedent in implementing outright bans on some forms of fossil-fuel heating. Other forms of regulation are more nuanced and while they do not specifically ban any form of heating, they place greater emphasis on reduced carbon emissions and improved performance. In practice, this would mean a significant number of homes would need to replace their fossil-fuel heating system to meet the standard.

It is important to note that all countries that have introduced bans or mandates, also have complementary policies, which provide subsidies so that homeowners can replace their old

systems with new low-carbon heating systems. Scotland already has subsidies for low-carbon heating. If the Scottish Government decides to introduce a ban or mandate similar to those described here, it will be important to review the subsidy policies and ensure they are sufficient to provide the right level of support should a ban be enacted.

8.2 Priorities for further research activity

We have outlined where we see potential for Scottish Government to replicate the regulations we have identified. However, this is a high-level assessment of Scottish Government powers and further research or legal advice would be needed to confirm this.

In addition, we anticipate that any new regulation devised by the Scottish Government would need to be specifically designed for Scotland in order to be effective. Additional research would therefore be required to ensure that any newly developed regulation is suitable for Scotland, to increase its chance of success. This could include investigating the market readiness of alternative low-carbon heating systems (in the case of a ban of fossil fuel heating systems) or an assessment of the readiness of the energy efficiency supply chain (in the case of a mandate to improve building performance).

9 Appendices

Appendix 1 Methodology

Regulation search

The starting point for this piece of work was an internal database held by LCP Delta detailing heat and energy efficiency policies, primarily within the UK and Europe. The project team then conducted a methodical online search of policies, focusing on countries outside of the EU which were less likely to be represented in the existing in-house dataset. A list of keywords is included in Appendix 8. Countries with a similar climate to Scotland were given particular focus, as these were more likely to have policies relevant for Scottish Government. Policies were included on the following basis:

- Focused on decarbonisation, particularly net zero,
- Targeted on domestic sector buildings,
- Included an innovative method or legislative tool.

This ensured the project team included regulations from as broad a range of sources as possible. All regulations found were added to the existing internal database. The final compilation of the database found included 78 different policies that had potential interest for this project. Basic details of each policy were recorded in the database.

Scottish Government powers

A key consideration for this project was to ensure policies that were investigated in more detail were likely to fall within the remit of the Scottish Government. The Scottish Parliament is a separate entity to the parliament in Westminster and is the law-making body for devolved matters in Scotland. However, as part of Scotland Act 1998 Schedule 5, some powers remain 'reserved' by Westminster; this means that not all policies initially identified by the team are necessarily suitable as the Scottish Government is not legally able to pass legislation outside of its competence.

The project team established clear parameters with CXC regarding Scottish Government powers to ensure that learnings from other countries has the potential to be replicated in some form. Regulation that we considered to clearly fall outside the Scottish government's jurisdiction was deliberately excluded from the shortlist for this reason. The project team reviewed the database and determined which regulations were likely to fall within Scottish Government powers (if replicated) and which would be reserved by Westminster.

Categorisation

Once the relevant power for each regulation had been assigned, the long list was reviewed again, and policies were grouped together into categories for further analysis. This enabled the project team to establish similarities between policies. Following discussion with CXC, a final shortlist of 26 policies in five different categories were chosen for further analysis in the main report:

1. Heating system bans – 5 examples
2. Heating mandates for end-users – 4 examples
3. Energy efficiency mandates for end-users – 5 examples
4. Other policies– 2 examples
5. Policies focused on new buildings (excluded from the review) – 10 examples.

These categories emerged through the review process. Similarities between policies from different countries were identified and a systematic approach taken to grouping the policies together based on their target, goal and the government powers used to legislate them.

The fifth category was deliberately excluded. While these policies are important for ensuring that the construction and development sector provide new homes with high thermal performance and low-carbon heating installed, the Scottish Government, like many others in Europe is already spearheading policy to target new buildings. As stated by the 'Heat in Buildings Strategy' from 2024, "all new buildings must use zero emissions heating as the primary heating source and meet significantly higher energy efficiency standards." (Scottish Government, 2021)

In agreement with CXC, the project team therefore focused on the challenging issue of existing housing stock and policies that could be replicated to ensure much needed retrofit. The project team performed a 'deep dive' analysis on the 16 shortlisted polices across four groups to provide insight and learnings on how other countries have tackled the challenge of existing buildings. The impact of the policies to date is also presented.

Foreign currencies were converted into Great British Pounds using April 2023 exchange rates.

Appendix 2 Detailed Results

Figure 1 Screenshot of a section of the database - full version in Excel has been provided to CXC

LCPDelta

Policy and regulation database

Description: Policy and regulations database
Date: Mar-23
By: Robin Kaloustian, Katharine Blacklaws, Emma Moulan

Country / Region	Type	Sub-type	Topic	Target	Name	First introduced	Objective (why has it been implemented?)	Details (how is it reaching its objective?)	Level of governance	Implementing body	Eligible households	Level of ambition to reach Net Zero	Measured impact	Relevant government power
Scotland	National Strategy	N/A	Both	All buildings	**Heat in Buildings Strategy**	07/10/2021	Deliver Scotland's climate change commitments, maximise economic opportunities and ensure a just transition	The strategy sets out Scotland's plan to decarbonise its buildings to help meet its 2045 net zero commitments, maximise economic opportunities and address fuel poverty issues. The Scottish Government promises to commit £1.8B over the next five years. Some headline policy ambitions and targets from the strategy include: •By 2030, ambitions to see a large majority of buildings achieving at least an energy efficiency EPC C standard. •Ambitions for all homes to meet an energy efficiency EPC C standard by 2033, where it is cost effective and feasible. •Ambitions for over 1M homes to convert to zero direct emissions heating systems by 2030, which equates to around 50% of the residential housing stock in Scotland, and all buildings by 2045. •£200M to support decarbonisation of social housing through the Social Housing Net Zero Fund. •Ambitions for phasing out fossil boilers in off-gas homes by 2025.	National	Minister for Zero Carbon Buildings, Active Travel and Tenants' Rights	All households	High	TBD	SG: Energy efficiency
France	National Strategy	Primary	Energy Efficiency	All buildings	**Energy sobriety plan**	01/10/2022	Reduce energy consumption by 10% by 2024	The energy sobriety plan was announced by the Government on October 6, 2022. It sets the objective to reduce energy consumption by 10% by 2024. The program is structured around 15 "key measures" designed to fight against waste and better manage energy consumption in all sectors of the economy, public administration and private households. Measures include: - a sobriety bonus to promote energy savings and lower bills for households. - in offices, the maximum temperature must be of 19 degrees and the use of hot water must be reduced. - in MFH buildings, the individualisation of heating costs must be applied which should allow to save around 15% energy in each household. - in residential buildings, the obligation to install a boiler thermostat in all new residential buildings by 2025 will be extended to all buildings (non-residential and existing residential). The installation of a thermostat allows gas savings of between 5 and 15%. To implement this mandate, the government is taking several steps. First, it set a timeline for the installation of programmable thermostats in all households. By 2022, all new buildings must have a programmable thermostat installed, and by 2025, all existing buildings must also have one. Second, the government is providing financial incentives to households to encourage the installation of programmable thermostats. These incentives include tax credits and subsidies for the purchase and installation of the thermostats. Third, the government is working with manufacturers to ensure that there is a sufficient supply of programmable thermostats on the market. This includes providing funding for research and development to improve the efficiency and effectiveness of these thermostats. Finally	National	Energy Transition Ministry (Ministere de la Transition energetique)	All households	Low	TBD	SG: Energy efficiency
France	National Strategy	Primary	Heat	All buildings	**La Programmation pluriannuelle de l'énergie (PPE) (multiannual energy programme)**	01/08/2015	Sets priorities for France over the next decade in terms of energy	The PPE is a strategic document for steering the energy transition and putting France on the path to carbon neutrality by 2050, which was introduced by the Energy Transition for Green Growth Law of 2015. The 2023 interim targets of the programme include an ambition to replace 10,000 coal heaters and 1 million oil boilers with renewable heating or high efficiency gas. It also set to renovate 2.5 million more dwellings compared to the end of 2018. The targets for renewable heat from heat pumps set by the PPE is of 45 TWh for A/A and A/W HPs and 7 TWh (scenario B) by 2028. This will represent a park of 6.8M A/A and A/W HPs and 315k GSHPs installed in SFHs, and 2.2M A/A and A/W HPs installed in MFHs by 2028 as well as 1000 MFHs buildings equipped with a GSHP per year. The objectives set by the PPE for biogas are to reach 7% of gas consumption in 2030 if the cost reductions targeted in the reference trajectory are achieved and up to 10% in the event of a higher cost reduction.	National	Energy Transition Ministry (Ministere de la Transition energetique)	All households	Medium	TBD	WG: Energy (most aspects)
France	National Strategy	Primary	Both	New buildings	**Energy Regulation 2020 (RE2020)**	01/01/2022	Prioritising energy sobriety and energy decarbonisation, reducing the carbon impact of the building construction and ensuring comfort in case of	Overall, the RE 2020 aims to go further in reducing primary energy consumption, in line with previous thermal regulations, introducing for the first time strong requirements to limit greenhouse gas emissions over the life cycle of buildings. Key highlights from the RE2020: - In new SFHs, offices and education buildings, since January 2022, the emission factor of new buildings must be below 4kgCO2eq/m²/year. This implicitly bans gas boilers as the	National	Energy Transition Ministry (Ministere de la Transition energetique)	All households	High	TBD	SG: Housing: policy and building control
France	Policy	Secondary	Heat	All buildings	**De Facto ban on oil (and coal) boiler sales and replacements**	Jul-21	Ban the installation of new coal and oil-fired heating systems	From 1 July 2022, new equipment installed for heating or hot water production in new or existing residential or commercial buildings must comply with a greenhouse gas emission ceiling of 300 gCO2eq/KWh. This limit leads to the exclusion of the installation of new coal- or oil-fired equipment. This threshold is set in the decree published in the Official Journal on Thursday 6 January 2022, relating to the minimum environmental performance of heating and domestic hot water equipment. From mid-2022, only class A oil boilers running on biofuel (E30) can be installed. Oil hybrid HPs of class A can also be installed and run on any type of fuel. Owners of existing oil	National	Citizens' Climate Convention, Prime Minister's Office (Convention Citoyenne pour le Climat, Bureau	All households	High	N/A	SG: Energy: promotion of renewable heat
France	Subsidy	Primary	Both	Renovation or retrofit	**Zero-rate eco-loan (eco pret a taux zero)**	Apr-09	Support the renovation of old and most inefficient buildings	The éco-PTZ has been one of France's key policies for supporting the renovation of its oldest and most inefficient buildings. First implemented in 2009, it has been extended in March 2022 to run until December 2023. This loan is a zero-interest loan and is accessible to individuals and non-trading companies, regardless of their financial situation, to finance energy efficiency improvements. The loan helps to finance all thermal insulation work, the replacement of heating systems and water heaters, and the rehabilitation of non-collective sanitation system. Eligible technologies include heat pumps, biomass, micro-CHP, and efficient gas condensing boilers. Hybrid heat pumps and thermally-driven heat pumps are not explicitly included or excluded.. The amount of the loan is equal to the amount of eligible expenses, within the following limits: €15,000 to €30,000 based on the number of improvements planned. For a global renovation, the limit is of €50,000. The repayment period cannot exceed 15 years, or 20 years for a global renovation. The Eco-PTZ can be combined with my MaPrimeRenov', the 'Coup de pouce Chauffage', the reduced VAT to 5.5%, and the aid offered by local authorities.	National	Economy Minister (Ministere de l'Economie, des Finances et de la Souverainete Industrielle et Numerique)	All households	N/A	TBD	SG: Energy efficiency
France	Subsidy	Primary	Both	Renovation or retrofit	**Energy Savings Certificates (CEE)**	Jul-09	Ensure energy suppliers support improved energy efficiency for their end users	Most energy suppliers (electricity, natural gas, LPG, heat and oil) are subject to a CEE obligation. The scheme's fifth iteration started in January 2022 for four years (ending in December 2025), with a total obligation level of 2500 TWhc. The funding from energy efficiency certificates is available to individuals, local and regional authorities and companies, wanting to complete renovation work or energy efficiency measure.. Around 200 different types of work are eligible: insulation (walls, roofs, windows...), heating and regulation (boiler, heat pump, etc.), hot water production, ventilation... It is available for A/A, A/W, W/W and DHW HPs, with the amount of the aid based on household resources. The CEE scheme can be combined with the 'éco-prêt à taux zero' (zero-rate eco-loan), MaPrimeRénov', and from 1 July 2022 MaPrimeRénovSérénité. However, it cannot be combined with certain aid offered by local authorities.	National	Mandated by French Government but implemented by energy suppliers	All households	N/A	TBD	SG: Energy efficiency

Figure 2 Screenshot of a selection of the long-list selected for detailed analysis

Longlist: 29 in total

Short-list to be max 20 (Agreed to focus on 16)

	Reasons to exclude	Fossil fuel heating ban for newbuilds only Other

Database Row	Country / Region	Type	Topic	Target	Name	Objective (why has it been implemented?)	Level of governance	Eligible households	Relevant government power	EE - Categorisation	Heat - Categorisation	Outliers - Categorisation	Additional details	CXCs recommended exclusion
11	France	National Strategy	Energy Efficiency	All buildings	Energy sobriety plan	Reduce energy consumption by 10% by 2024	National	All households	SG: Energy efficiency	Cat 1 : Mandate for end-users				
13	France	National Strategy	Both	New buildings	Energy Regulation 2020 (RE2020)	Prioritising energy sobriety and energy decarbonisation, reducing the carbon impact of the building construction and ensuring comfort in case of heatwaves	National	All households	SG: Housing: policy and building control		Cat 1: Emissions		For newbuilds (both EE and Heat)	X - New build
14	France	Policy	Heat	All buildings	De Facto ban on oil (and coal) boiler sales and replacements	Ban the installation of new coal and oil-fired heating systems	National	All households	SG: Energy: promotion of renewable heat		Cat 1: Emissions		For existing buildings	
20	Germany	Regulation	Both	Residential buildings	Climate Protection Programme 2030	Key measures to achieve its target to be carbon neutral by 2050 and 55% reduction in GHGs from 1990 levels by 2030	National	All households	WG: Taxation (most aspects)		Cat 2: Ban		For existing buildings	
21	Germany	Regulation	Both	New buildings	Building Energy Act (Gebaudesenergiegesetz)	Sets requirements for energy efficiency, thermal insulation and renewable heat sources for new builds	National	All households	SG: Housing: policy and building control	Cat 1 : Mandate for end-users			Mainly for newbuilds	X - New build
32	Germany	Subsidy	Heat	Renovation or retrofit	Local Renewable Heat Act (EEwarmeG in Baden Wurrtemberg) and Climate protection act in Hamburg	Increase the share of renewables in the heat supply mix in the Baden Wurrtemberg state and in Hamburg	Regional	All households	SG: Energy: promotion of renewable heat		Cat 5: Mandate for end-users		For existing buildings	
41	Italy	Regulation	Heat	All buildings	Building regulations: renewable energy requirements	Increase the mandatory share of renewable energies for domestic hot water and electricity	National	All households	SG: Housing: policy and building control		Cat 5: Mandate for end-users		Mostly for newbuilds	X - New build
42	Italy	Regulation	Both	All buildings	Building regulations NZEB	Increase the number of Net Zero Energy Building (strict standard of energy performance)	National	All households	SG: Housing: policy and building control	Cat 1 : Mandate for end-users	Cat 5: Mandate for end-users		EE for newbuilds	X - New build
51	United Kingdom (England only)	Regulation	Both	New buildings	Part L1A	Reduce the carbon emissions of new homes	National	All households	SG: Housing: policy and building control		Cat 1: Emissions		For newbuilds (both EE and Heat)	X - New build
52	United Kingdom (Wales only)	Regulation	Both	New buildings	Welsh Development Quality Requirements 2021	Reduce carbon emissions and energy intensity of new social homes	National	Social housing tenants	SG: Housing: policy and building control	Cat 1 : Mandate for end-users	Cat 5: Mandate for end-users		EE for newbuilds / social housing	X - New build
54	Netherlands	Standard	Both	New buildings	Implementation of EPBD: Almost Energy Neutral Buildings (BENG)	Have all new buildings comply with strict emissions and efficiency standards to reach national CO2 emissions target	National	All households	SG: Housing: policy and building control	Cat 1 : Mandate for end-users			EE for newbuilds	X - New build
55	Netherlands	Regulation	Heat	New buildings	"Gas Free" new build homes by 2021	When possible, ban natural gas for new build homes	National	All households	WG: Energy (most aspects)		Cat 2: Ban		Fossil fuel heating ban for newbuilds	X - New build
59	Netherlands	Standard	Energy Efficiency	Low-income households	Social housing renovation obligation	Upgrade the energy label of social housing as they usually are low performing	National	Social housing tenants	SG: Energy efficiency	Cat 1 : Mandate for end-users			EE for social housing (all building stock)	X - Social housing - reasonable to exclude

Appendix 3 Analysis of heating system bans

Each table below is the analysis of a regulation banning a heating appliance.

Table 4 Climate Protection Programme 2030 – Building Energy Act

Climate Protection Programme 2030 – Building Energy Act
Country: Germany
Overview (German Federal Government, 2020) The Building Energy Act was implemented in November 2020 after being voted in December 2019 by the German Bundestag. It replaces three previous laws on the topic: the energy Saving Ordinance (EnEV), the Renewable Energy Heat Act (EEWärmeG) and the Energy Conservation Act (EnEG). Part of the German Government's Climate Protection Programme 2030, it is one of its plans to achieve a 55% reduction in greenhouse gases by 2030 (GHG levels compared to 1990), and carbon neutrality by 2050. **It bans the new installation of oil-fired heating systems from 1st January 2026, if a low-carbon alternative is technically feasible** (including heat pumps, biomass heating systems, solar thermal systems, district heating, gas-fired and other hybrid heating systems). The technical feasibility is assessed by a heating professional according to the compatibility with the building's architecture, structure and layout; the availability of required resources (space, energy source, infrastructure); the potential for integrating the low-carbon technology with existing systems; and the technical expertise required for installation, operation and maintenance. In the event that a low-carbon alternative isn't technically feasible, the heating system needs to be hybridised to include at least one renewable source, with no limit on the hybrid split or the hours used per year for the higher-carbon part of the hybrid. This measure applies to all households, both single- and multi-family homes. The work is to be completed at the homeowners' expense, helped by Government support schemes. The German Government have already implemented three support schemes to help homeowners afford the transition to low-carbon heating. (International Energy Agency, 2022) • When doing some renovation work improving the energy efficiency of the house, owner-occupiers can deduct 20% of the total cost of the renovation from their annual property taxes, spread over 3 years. This includes replacing a heating system with a low-carbon alternative, fitting high performance windows, insulating the roof and external walls. This scheme has been made available since January 2020 and is set to continue until 2029. • The Federal Office for Economic Affairs and Export Controls (BAFA) also implemented an exchange bonus for homeowners. Through this bonus, they can claim up to 45% of the cost of the new, low-carbon heating system when it replaces an oil-fired system. • The German development bank (KfW) implemented a funding mechanism for energy-efficient building renovations. Homeowners can receive up to €150,000 (£132,400) depending on the energy efficiency level of the building after renovation, for a maximum of

50% of the cost of renovation. Funding is provided either as a non-repayable investment grant, or in the form of a low-interest loan with a repayment grant (FI Group, 2022).

Legislative process, replicability in Scotland and enforcement (German Federal Government, 2020)

The Building Energy Act was first proposed by the German Federal Ministry for Economic Affairs and Energy (BWMi) in 2016 to simplify and consolidate existing energy laws related to buildings. Before it started its legislative process, the draft law went through a public consultation period in which public stakeholders helped revise it. **The law was eventually passed in December 2019 in the Bundestag and signed by President of Germany in July 2020**.

The ban on oil-fired heating systems, part of the Building Energy Act, is likely to be replicable in Scotland. The third support scheme implemented in Germany – tax breaks – would theoretically also be feasible, However, devolution in terms of taxation is more complex in practice, and the Scottish Government would need to ensure it is consistent with any existing UK tax law and EU state aid rules (EU state aid rules still apply to the UK during the transition period).

Enforcement of the measure is primarily done by local authorities and building inspectors. They ensure compliance during construction or renovation projects and can issue fines or other penalties.

Impact assessment (Energy-M, 2023)

The Building Energy Act has been revised a few times since its first implementation. In early 2021, the German Government launched a public consultation and review process to assess the effectiveness of the Act in achieving its goals and identify improvement areas. The results of this assessment haven't been published, however a few new amendments to the Energy Building Act will take effect from January 2024. Of note, this includes **a new requirement for existing heating systems installed more than 30 years ago** – including oil- and gas-fired as well as solid-fuel and electric resistance heating systems – **to be gradually replaced by a new heating system, operated with at least 65% renewable energy.** The age of the heating system is determined using the best available information, including original installation documentation and manuals, data plate and serial number or a professional assessment. Oil-fired heating systems are a minority in Germany. As The Building Energy Act is a relatively recent measure targeting a minority of heating systems, we would not expect it to have a major impact on Germany's overall carbon emissions. Data on the impact of this measure was not readily available or published by the German Government at the time of writing.

Table 5 Heating oil ban

Heating oil ban
Country: Norway
Overview (International Energy Agency, 2022) The Norwegian Government announced its intention to **phase out the use of oil-fired heating systems back in 2016**, in an effort to reduce Norway's reliance on fossil fuels and promote the use of low-carbon or zero-emission heating systems. The most significant of these measures is **a regulation that banned the installation of fossil-fuel based heating systems for all new buildings in 2016**. Subsequently, in 2017, the Norwegian Government amended the regulation to **ban the use of oil-fired heating appliances in all new and existing buildings in 2020 which gave homeowners 3 years to replace their heating systems.** The Norwegian Government also included support schemes to help homeowners with the cost of replacing their oil-fired heating system. The support was provided through grants, subsidies and low-interest loans, depending on the households' economic status. The Norwegian Government also tried to raise awareness using public information campaigns explaining to the public the benefits of transitioning away from oil-based heating systems. The information campaigns included key information like the financial savings associated with the switch to zero-emission heating systems, as well as the environmental impact of heating oil.
Legislative process, replicability in Scotland and enforcement The ban on heating oil regulation and support schemes regulation was first drafted by the Norwegian Ministry of Climate and Environment and subsequently amended and approved in the Norwegian Parliament (Stortinget) in 2017. **The ban on heating oil, along with support schemes is likely to be replicable in Scotland**. In fact, considering Scotland's strong track record of promoting renewable energy and addressing climate change, with ambitious goals to reduce greenhouse gas emissions, implementing a ban on heating oil would complement these policies and support the country's ambitions. The ban is enforced by the Norwegian Environment Agency. The agency conducts regular inspections at construction sites and requires periodic reporting from building owners, contractors and heating specialists. The agency also has access to building permits. When a building is not compliant, the owner, contractor and heating specialist may receive a fine or other legal sanctions. The severity of the penalty depends on the nature of the violation, the size of the building and any prior history of non-compliance.
Impact assessment

In 2017, when the ban on heating oil was implemented, it was reported that 80,000 (~3%) dwellings were using oil for heating. This figure was already a significant decrease from a few years ago due to the rapid uptake of heat pumps and electric heating. Norway hasn't published updated figures for the number of dwellings still using heating oil after the ban, however it has communicated on its continued decline, showing effectiveness of the ban. LCP Delta analysis (LCP Delta, 2022), based on stakeholder interviews and market analysis, show that less than 0.5% of Norwegian dwellings use heating oil today.

Table 6 2012 Energy agreement

2012 Energy agreement
Country: Denmark
Overview (International Energy Agency, 2020) The 2012 energy agreement laid the foundation for the country's transition to more sustainable and renewable energy. The main focus was to reduce Denmark's reliance on fossil fuels, increase energy efficiency and establish the country as the leader in climate action and green technology. This piece of legislation focused on six areas, including developing renewable energy, developing wind power, improving energy efficiency across industry, transportation and households, transitioning to green transportation, supporting research and development of clean technology, and working on climate adaptation. Of interest to this study, the Danish government's plan included several energy efficiency measures for the residential sector. In addition to stricter energy performance requirements for new buildings, subsidies and tax incentives for energy-efficient renovation work in existing buildings, expanding district heating networks throughout the country, introducing energy labelling for all buildings and encouraging energy audits for residential buildings, the legislation included **a phased ban on oil-fired or natural gas heating appliances for new builds and existing buildings**. From 2013, the installation of oil-fired or natural gas heating appliances was banned in new builds. Subsequently, from 2016, the measure **banned the installation of oil-fired heating appliances in existing buildings**, in areas supplied by district heating networks or natural gas. To support homeowners and help them transition to cleaner heating systems, the Danish Government also provided a financial support scheme. Homeowners can receive a subsidy between 13-25% of the cost of installing a low-carbon heating system (heat pumps and district heating expansions).
Legislative process, replicability in Scotland and enforcement

The legislative process to implement the energy agreement was based on negotiations and consultations with political parties, industry stakeholders and experts as well as policy professionals. The Danish Government started the process by identifying priorities and objectives for the country's future energy policy and initiated consultations with various representatives from political parties, industry stakeholders and experts, as well as policy professionals and interest groups to discuss the proposed energy policy objectives and gather input on proposed measures and initiatives. Once the feedback was incorporated into the draft agreement, the **Danish Government successfully secured endorsement and approval from all major political parties in the Parliament** (Folketing).

The ban on oil-fired and natural gas heating systems in new builds is likely to be legislatively replicable in Scotland. Similarly, banning the installation of new oil-fired heating systems where district heating networks or natural gas are available is also likely to be replicable. However, some considerations for implementation need to be noted. Scotland has a different building stock to Denmark, with many fewer heat networks and many more natural gas connections. The consequences of such bans would thus be different to Denmark.

The 2012 energy agreement is enforced by the Danish Energy Agency, who is responsible for monitoring and reporting on the progress of the implementation of the agreement. Local municipalities can support the agency locally in enforcing compliance with the agreement's provisions, including conducting inspections, evaluating energy labelling and performance of buildings, and ensuring new builds comply with energy performance requirements.

Impact assessment

Installed base data on oil-fired heating systems isn't publicly reported by the Danish Government. However, the Danish Energy Agency reports **a significant decline in oil consumption for heating purposes over the years** (Danish Energy Agency, 2022). Before the ban, oil consumption for individual heating systems declined from ~3,000 TJ in 2000 to ~1,000 TJ in 2012 (Danish Energy Agency, 2022). Following the energy agreement, oil consumption for individual heating systems was down to ~478 TJ in 2020, a significant reduction from 2012 levels. In addition, natural gas consumption for individual heating systems declined from approximately 3,300 TJ in 2012 to around 2,200 TJ in 2020, according to the Danish Energy Agency (Danish Energy Agency, 2022). Whilst the decrease in oil consumption for heating is more of a continuing trend that started well before the ban, the decline in gas consumption for individual heating can be attributed, in part, to the energy agreement's ban on gas-fired heating systems. In addition, heat pump sales and district heating connections have significantly increased since 2012 (LCP Delta, 2022).

Table 7 Ban on oil furnaces

Ban on oil furnaces
Country: Quebec, Canada
Overview The Quebec Government set a target of reducing greenhouse gas emissions by 37.5% below 1990 level by 2030 across sectors, including the residential sector. To that end, the Quebec Government issued a ministerial decree **to ban the installation of oil-fired heating systems in all new residential buildings starting in December 2021**. Subsequently, from December 2023, the decree will evolve into **a ban on the replacement (existing buildings) and installation (new builds)** of all heating systems powered by fossil fuels. In addition, the decree bans the repair of oil-fired heating systems that are older than 20 years, and oil-powered water heaters older than 10 years. The ban applies to all heating systems using oil as fuel, whether primary or secondary. The goal is to limit the emission of greenhouse gases and other atmospheric pollutants, including fine particles. (Government of Quebec, 2018) The age of the appliance is determined by the installation date (Quebec Government, 2021). In many cases, the age of the existing heating system is unknown. Any information pointing to its age can be used, such as manufacture information (serial number), inspection stickers or markings, visible wear and tear (rust and corrosion) or the assessment of a licensed HVAC contractor or technician. As part of the regulation, any professional installing or replacing an oil-furnace must send in writing to the Ministry within 30 days their name and contact details, the address, the date the appliance was installed / replaced, appliance details characteristics, manufacturing date and serial number. The regulation defines a repair as: any work performed on an appliance to restore it to good condition, except for a planned service / health check, an engine repair or repair of a mobile component operated by the engine, a repair or replacement of an electronic or electrical component related to operation and safety of the device. Effectively, the regulation bans the repair or replacement of the combustion chamber or the heat exchanger of an oil furnace. Quebec's energy efficiency agency, Transition énergétique Quebec, provides support schemes to help homeowners afford the renovation and replacement of their heating systems. The schemes include financial incentives, technical support and information on available products and services.
Legislative process, replicability in Scotland and enforcement In Quebec, a ministerial decree is a legal tool issued by a provincial government minister, under the authority of a specific regulation. After drafting the proposed ministerial decree, it is subjected to public consultation to gather input from individuals, industry stakeholders and political parties. After the consultation period, the draft decree is reviewed by the government's legal services to

ensure compliance with applicable laws and regulations. When approved, the province's minister can sign it into a decree published in the Quebec Official Gazette.

The ban on oil furnaces in new builds is likely to be replicable in Scotland. The ban on repairs of older, oil-fired appliances hasn't been implemented anywhere else than in Canada. However, the ban itself and the support schemes available to homeowners are theoretically replicable within Scotland's existing legislation.

Transition énergétique Quebec is responsible for enforcing the ban. Enforcement is mainly done by administrative fines (CAD1,500 or £900 if the professional doesn't declare the installation / replacement, CAD7,500 or £4,500 if a professional installs an oil furnace in a new build, existing building or repairs an oil furnace) or penal sanctions (CAD6,000-CAD600,000 of £3,600-£360,000 if a company fails to declare the installation / replacement of an oil furnace). (Energy Transition Quebec, 2023)

Impact assessment (Chung, 2022)

Implemented in December 2021, this regulation is too recent for a robust impact assessment report. The Quebec Government haven't yet published assessments or revisions to the decree either. A high-level indication that the ban has worked is the **increase in the adoption of electric and natural gas heating systems in new builds since the ban's implementation**. The Quebec Ministry of Energy and Natural Resources stated, in a news release, stated that "more than 75% of new residential construction in Quebec now uses electricity or natural gas as a source of energy for heating and domestic hot water". This is compared to an estimated 80% to 90% of heating systems running on oil back in the 2000s.

Table 8 Energy Act

Energy Act
Country: Zurich, Switzerland
Overview (Canton of Zurich, 2021) Switzerland and its 26 'cantons' (i.e., regions) have been actively working on improving energy efficiency and promoting the use of renewable energy sources of the past few years. Among others, notable Swiss measures on the topics include the Energy Strategy 2050 which aims to reduce energy consumption, increase energy efficiency and promote the use of solar, wind, biomass and hydropower; regular updates to building energy efficiency with the adoption of the Swiss MINERGIE standard focused on low energy consumption, high comfort and good air quality in buildings; the promotion of renewable energy through financial incentives such as Feed-in Tariffs, investment grants and tax exemptions, as well as research and development funding. In

addition, the canton of Zurich has developed an efficient public transportation system which helps reduce the reliance on personal vehicles and has implemented energy management programs for public buildings aiming to reduce energy consumption and costs through efficiency measures and the use of renewable sources.

In this effort, the Zurich canton has passed a law to **ban the replacement of oil-fired and natural gas heating systems for residential buildings**. When reaching the end of their service life, (there is no clear definition for a service life; it is rather the time when a heating system stops working) these heating appliances will have to be replaced by climate-neutral heating systems – heat pumps, district heating, biogas or wood-fired heating systems – if it is technically possible and financially viable. The technical possibility is assessed by a certified heating installer and will vary according to the property, space and connections required for a new system. The financial viability will be assessed, and the ban not enforced if the heating specialist finds that the costs over the entire service life are more than 5% higher compared to a new oil or gas heating system. In addition, there is also a hardship exemption in place for homeowners who cannot afford the initial investment costs for a renewable energy heating system (Pestalozzi Attorneys at Law, 2021).

To support residents, the canton of Zurich also provides financial support for climate-neutral heating systems. For example, for a ground source heat pump, the support amounts to CHF10,000 (~£9,000). This financial support is meant to help homeowners afford the replacement cost of a high-carbon heating system and is not taken into account for the financial viability assessment mentioned above. Overall, the new regulation increases Zurich's annual cantonal amount for subsidies in the energy sector from CHF8 million (£7.1 million) to CHF15 million (£13.5 million).

Legislative process, replicability in Scotland and enforcement

The cantonal government drafted the law in early 2021. After going through a consultation period to receive input from stakeholders, municipalities and political parties, the draft was presented to the Cantonal Council and adopted by the majority. However, the local homeowners' association requested a referendum vote for this law, in the hope it wouldn't be adopted. They feared this law would increase the cost of housing and in turn have an unfair impact on disadvantaged populations. Following the referendum and more than 62% approval from the voters, the law was announced in December 2021.

The Energy Act's ban on the replacement of oil-fired and natural gas heating systems is likely to be **legislatively replicable in Scotland**. In practice, the caveat included in this regulation stating that the costs "over the entire service life are more than 5% higher compared to a new oil or gas heating system" can make it difficult to replicate to Scotland as costs differ. Subsidies, grants and taxes should be implemented in Scotland to level out the price difference between oil-fired and natural gas heating systems and low-carbon systems.

The Energy Act is enforced by the Office for Waste, Water, Energy and Air (AWEL), under the canton's Directorate of the Environment and Energy. AWEL is responsible for monitoring compliance with the act and other energy efficiency building standards as well as overseeing

issuing permits and licenses for energy-related installations and operations and providing financial incentives and subsidies for renewable energy and energy efficiency measures.
Impact assessment (SwissInfo, 2021) It is reported that oil-fired and natural gas heating systems accounted for 40% of the canton of Zurich's greenhouse gas emissions at the end of 2021. As a result, this regulation is expected to significantly reduce greenhouse gas emissions through the canton as well as the installed base of oil-fired and natural gas heating systems. However, since it was only implemented in 2022, it is too early to measure its impact and efficacy.

Appendix 4 Analysis of heating mandates for end users

Table 9 Decree to limit GHG emissions from heating systems

Decree to limit GHG emissions from heating systems
Country: France
Overview (Elysee - French President's Office, 2020) France has been working to reduce greenhouse gas emissions in line with the UNFCCC Paris Agreement. After several regulations to limit primary energy consumption, the French Government has chosen to focus on reducing the greenhouse gas emissions over the lifecycle of buildings. To reduce greenhouse gas emissions, the French Government issued a decree in January 2022 making it mandatory for **new equipment installed for heating or hot water production in new or existing residential buildings to comply with a greenhouse gas emission ceiling of 300g CO_2eq/KWh**. This limit applies to all heating and hot water equipment in residential buildings and de facto leads to the exclusion of new coal- or oil-fired heating systems from July 2022. The French Government offers a number of financial support schemes to help homeowners afford the cost of a more efficient heating system (French Government, 2022). Schemes include the Heating Boost and MaPrimeRenov, which are available to all households with a strong focus on supporting low-income households.
Legislative process, replicability in Scotland and enforcement (Elysee - French President's Office, 2020) The decree came as a recommendation from the Citizens Convention for Climate, a citizens' assembly held in 2019 and 2020 which discussed reducing France's carbon emissions by 40% from its 1990 levels in a spirit of social justice, initiated by the government in response to the Yellow Vest protests. The Convention gathered 150 citizens randomly selected from a representative sample of the French population. Assisted by a governance committee made up of experts, as well as a guarantor college and a legal board, the members divided into working groups on housing, food, employment, consumption and transportation. In the end, the convention approved 149 proposals, one of which being this greenhouse gas emissions limit for heating systems. As a result, it was implemented as a decree in 2022, by the French President, benefiting from the legitimacy of the convention. Whilst the legislative process to implement this mandate isn't currently replicable to Scotland, **the substance of the decree is likely to be replicable to Scotland**. The Scottish Government's devolved powers do not include the prohibition of the sale of goods. However, the Scottish Government can prohibit the installation of a good / appliance in a property. This subtle distinction would mean a

slight change of the mandate is required in the event that the Scottish Government wanted to replicate this legislation.

This decree is enforced by municipalities. An energy audit is required for all sales and lettings in France, where the energy efficiency and greenhouse gas emissions of heating appliances are reported. Municipalities also oversee the issuance of building permits, which are required in most cases when changing heating systems (expect in the case of like-for-like replacements).

Impact assessment

Implemented in July 2022, this decree is too recent to assess its impact. Based on internal LCP Delta data, in 2021, 0.7% of all households used coal and 16% used oil for heating in France. The data for 2023 will provide a good indication of the impact of this measure.

Table 10 Clean Air 2.0 programme – Local emissions standards

Clean Air 2.0 programme – Local emissions standards
Country: Poland
Overview (Polish Ministry of Climate and Environment, 2020) Poland has been implementing a number of policies to address air pollution and improve air quality in cities. The Clean Air Programme was launched in 2018 to improve air quality throughout the country, which was facing significant air pollution issues due to the common use of coal and other fossil fuels for residential heating and energy production. Building on this initiative, in 2020, led by Krakow, 11 out of 16 Polish regions implemented new emissions standards for heating appliances in single-family homes. The regions' objective was to phase out older, inefficient and polluting heating systems while promoting cleaner and more efficient heating sources. The new air quality emissions standards were in line with the European Union's Eco-design Directive (2009/125/EC), under which new heating appliances must meet strict emissions limits for particulate matter, carbon monoxide, nitrogen oxides and organic gaseous compounds. This new regulation is specifically targeted at improving air quality, rather than reducing greenhouse gas emissions. **If appliances do not meet the new emissions standards, it becomes illegal to use them and they will need to be replaced by an alternative and compliant heating system. This rule applies to all existing and new buildings.** Deadlines for compliance vary across regions, with each region having a compliance deadline between 2022 and 2027. The Polish Government also offers financial support schemes to help homeowners replace their old heating appliance. Most households can get a grant of up to €5,000 when replacing their heating system. Low-income households can claim up to €7,000, in addition to the €1,000

available for installing a solar PV system. In total, the Polish Government has allocated €23 billion (£20 billion) over 10 years to this scheme. (Gibb & Morawiecka, 2022)
Legislative process, replicability in Scotland and enforcement Details on the legislative process to adopt this measure in the 11 Polish regions are broadly the same. The legislative process is relatively straightforward and involves a drafting period, a consultation period, a vote by the regional council and implementation by relevant regional bodies. The new emissions standards are likely to be replicable to Scotland. The body responsible for enforcing this standard varies according to the region. The responsibility of enforcing emission standards generally falls on regional, local and municipal authorities in Poland. The regional environmental protection inspectorates (WIOS) are responsible in each region for enforcing environmental protection laws. Local and municipal authorities must enforce emission standards within their jurisdictions and collaborate with regional inspectorates to monitor compliance. In some cases, building inspectors can help ensure new constructions or renovations are compliant with emission standards.
Impact assessment Before the emissions standards were announced, there was almost no heat pump industry in Poland. **After the standards, the rate of annual installations has risen exponentially and was expected to increase by as much as 75% in 2020** (Rosenow & Cowart, 2020)**.** This experience in Poland shows the importance of public debate, awareness raising, consensus building and high-level political commitment to create the space for such an important undertaking. It demonstrates that such an approach can't be imposed from the top down or overnight.

Table 11 Local Renewable Heat Act and Climate Protection Act

Local Renewable Heat Act and Climate Protection Act
Country: Baden-Wurttemberg and Hamburg, Germany
Overview (Ministry for the Environment, Climate Protection and the Energy Sector Baden-Wurttemberg, 2021) In 2008, the German state of Baden-Wurttemberg adopted the Local Renewable Heat Act (LEEWG) to promote the use of renewable energy, particularly when looking at residential heating. This act came as part of the state's commitment to achieving a sustainable energy future and reducing its greenhouse gas emissions and focused mostly on new builds. In 2015, the state brought significant

changes to the Local Renewable Heat Act. Notable improvements include the extension of the act to existing buildings undergoing renovation or retrofitting, a mandatory quota for the use of renewable energy in heating systems, new energy efficiency and performance standards for residential buildings as well as financial incentives and stricter monitoring and enforcement mechanisms.

Of interest to this study is the new renewable energy quota, introduced in July 2015. The revised act requires households replacing their heating system to **install renewable heat sources covering at least 15% of their annual heating demand.** This requirement only applies to homes built before January 2009 and in which the heating system is being replaced. The revised text includes a number of renewable heating technologies and allows households to opt for substitute measures which can all be combined in different ways to meet the requirements. The following are eligible:

- Renewable heat sources: solar thermal, wood central heating, heat pump, single room heating, biomethane and bio-oil.
- Insulation: roof / loft, exterior walls, basement or entire building envelope.
- Other substitute measures: Combined Heat and Power, district heating, solar PV.

The German Government offers a number of financial incentives for homeowners to undertake retrofitting or renovations, including tax breaks, grants and low-interest loans.

Legislative process, replicability in Scotland and enforcement

In 2008, policymakers in the Baden-Wurttemberg region noticed a growing concern about climate change, energy security and the need to transition to a more sustainable energy system. After a consultation period, the draft regulation was presented to the state parliament for a vote and subsequently signed into law by the state's Minister-President.

The Local Renewable Heat Act is likely to be legislatively replicable in Scotland. If implemented, the regulation would also support the transition of residential heat to cleaner, more efficient solutions and help Scotland reach its climate goals.

The Act is enforced by local building authorities in the state of Baden-Wurttemberg as well as regional energy agencies and environmental protection offices. Households and larger building owners are required to submit regular reports on the performance of their heating systems, including data on energy consumption, the share of renewable energy and compliance with energy efficiency standards. Local building authorities use these reports to monitor compliance. They also carry out inspections to verify compliance, either scheduled or unannounced during construction. In case of non-compliance with the requirements set out in the Act, homeowners can face penalties such as fines, legal proceedings or restrictions on building permits.

Impact assessment (German Federal Government, 2023)

The Baden-Wurttemberg state hasn't published an official impact assessment with precise figures for the region. However, country-level indicators can be taken as hints of the Local Renewable

Heat Act's success. **The share of renewable energy in the heating sector has increased since the first adoption of the Local Renewable Heat Act, from 7.4% in 2008 to 14.6% in 2020** according to the Federal Ministry for Economic Affairs and Energy. Energy efficiency has also improved in the building sector, with the German Government's National Energy Efficiency Action Plan reporting **a 16% decrease in primary energy consumption in the building sector** between 2008 and 2019. Most significantly, the Local Renewable Heat Act has driven policy innovation and **served as an inspiration for other German states and other local governments in Europe to promote renewable energy and energy efficiency** in the heating sector. Four other German states – Hesse, Rhineland-Palatinate, North Rhine-Westphalia and Bavaria – have followed the lead of Baden-Wurttemberg since 2008.

Table 12 Heating appliance standards for 2026

Heating appliance standard for 2026 (Dutch Central Government, 2022)
Country: Netherlands
Overview In its effort to reduce both carbon emissions and its reliance on gas for heating, the Netherlands are introducing a nationwide standard for heating appliances which will come into effect in 2026. The new standard has been recently announced and most details haven't been unveiled yet as the government is working with suppliers, installers as well as home and building owners to draft the legislation. At a high level, **the standard will require a certain level of efficiency for replacement heating systems.** The aim is to ban gas boiler installations and make gas hybrid heat pumps the standard for homes not connected to district heating. In many cases, particularly when the house is well-insulated, fully electric heat pumps will become the go-to solution. To convince industry stakeholders and consumers, the Dutch Government showed the substantial savings in natural gas resulting from the switch (60% savings on average with a hybrid heat pumps) and has started offering subsidies on the purchase of a hybrid heat pump, amounting to ~30% of the total cost. The cost of a hybrid heat pump is difficult to find, but estimates range between €6,000-8,500 (£5,200-7,500) (Zoofy, 2022). Zero-interest financing is also made available through the National Heat Fund for low- and middle-income households.
Legislative process, replicability in Scotland and enforcement The heating appliance standard hasn't been implemented in the Netherlands yet, the government simply announced its goal and started the public consultation. As such, the legislative process, replicability and enforcement are still unclear.

Impact assessment

This regulation was announced in May 2022 and will only be implemented in 2026. As such, no impact assessment can be conducted at this stage. The expected impact is unclear as well, as the regulation still needs to be drafted. The Dutch Government has already mentioned several exceptions to the regulations will become clearer at the end of the consultation with industry, although they haven't released any information on these exemptions.

Appendix 5 Analysis of energy efficiency mandates for end users

Table 13 Energy sobriety plan

Energy sobriety plan (Energy Transition Ministry, 2022)
Country: France
Overview The energy sobriety plan was announced by the French Government on 6 October 2022. It sets the objective to reduce energy consumption by 10% by 2024. This is a broad program structured around 15 "key measures" designed to fight against waste and better manage energy consumption in all sectors of the economy, public administration and private households. Measures include: • A bonus to promote “energy sobriety” (i.e., reducing energy consumption) through energy renovations. Energy suppliers can offer a discount and lower bills for the households taking actions to reduce their consumption. For example, EDF can offer a 30% discount on electricity bills for people installing heating systems with higher performances such as heat pumps (Mon Chauffage Durable). ENGIE rewards energy saving behaviours by offering advantageous electricity tariffs to its customers (Mon Contrat Electrique) • In multi-family homes buildings, the individualisation of heating costs must be applied which should allow to save around 15% energy in each household. Currently, some buildings use central heating in which residents don’t have control over their heating. Relinquishing control to residents will allow them to control their consumption and avoid any overheating. • In residential buildings, the obligation to install a boiler thermostat in all new residential buildings by 2025 will be extended to all buildings (non-residential and existing residential). The aspect of the plan with most relevance to this study is the obligation to install a room temperature control (thermostat) linked to the boiler as a means to improve energy efficiency. To implement this mandate, the French Government is taking several steps: • First, it set a timeline for the installation of programmable thermostats in all households. By 2022, all new buildings must have a programmable thermostat installed. By 2025, all existing buildings must also be equipped with a programmable thermostat. • Second, the government is providing financial incentives to households to encourage the installation of programmable thermostats. These incentives include tax credits and subsidies for the purchase and installation of the thermostats. • Third, the government is working with manufacturers to ensure that there is a sufficient supply of programmable thermostats on the market. This includes providing funding for research and development to improve the efficiency and effectiveness of these thermostats.

- Finally, the government is working to educate households on the benefits of programmable thermostats and how to use them effectively. This includes providing information on the most efficient temperature settings and how to program the thermostats to minimise energy consumption.

Legislative process, replicability in Scotland and enforcement

The French Government presented the energy sobriety plan in October 2022. It came as the result of nine working groups that considered suggestions from industry stakeholders and energy and climate experts. The working groups included representatives from the different sectors involved, like the energy industry, tourism and digital sectors. The Ministry of Ecology and Energy Transition was then responsible for developing an initial proposal for the plan, based on the results of the working groups as well as analyses conducted by the ministry and independent research bodies. The draft was then voted on in the French Parliament and signed by the President once approved.

The Ministry of Ecology and Energy Transition was responsible for implementing the law's provisions and developed regulations, guidelines, and programs to make sure the goals in the law could be achieved. The ministry is also responsible for monitoring and reporting on the implementation of the plan. They are required to provide regular reports to the government and the public on the progress made.

Public organisations like the ANAH (National Agency for Habitat) or the CSTB (Scientifical and Technical Buildings Centre) provide their help to develop and implement the specific aspects of the plan that are related to energy efficiency and renewable energy in housing.

The French Energy Sobriety plan is an ambitious, national policy framework. Many aspects of the plan may be replicable in Scotland but would need to be adapted to Scotland's energy system and policy landscape. The focus of our study – the mandate to install programmable thermostats – is likely to be replicable in Scotland.

Enforcement of the Energy sobriety plan is a collaborative effort that involves multiple actors at different levels. At the national level, the Ministry of Ecology and Energy transition is responsible for overseeing the plan's implementation. At the local level, regional and local authorities, as well as energy agencies are involved in the plan's enforcement. Various professional organisations, NGOs and industry associations also support the promotion and implementation of the plan. To ensure the plan's enforcement, a combination of legislative measures, regulations and financial incentives are set by the French Government.

Impact assessment

Between the autumn and winter 2022/2023, France has achieved a reduction in overall energy consumption close to 9%. The local TSO, RTE, led some studies that concluded that a quarter of this reduction is thanks to the warm weather that the country has been experiencing and the remaining three quarters are due to energy savings. There is no detailed impact assessment available at the time of writing. However, the mandate for installing thermostats and the French

Government's 19C limit on dwellings' room temperature are believed to have participated to the reduction (Bomond, 2022). The reduction in energy consumption was driven by large industries reducing their electricity demand on purpose, as well as residential and tertiary sectors reducing their overall consumption. (Actu Environnement, 2023)

Table 14 Energy conservation ordinance (EnEV)

Energy conservation Ordinance (EnEV) (GBPN, 2021)
Country: Germany
Overview (International Energy Agency, 2017) The German Energy Conservation Ordinance (EnEV) is a legal instrument designed to promote energy efficiency and reduce energy consumption in buildings, announced in 2002. It aims at reducing the amount of energy consumed in heating, climate control, and hot-water provision in new buildings by roughly 25 to 30%. It unifies the previously separate thermal insulation and the heating installation ordinances. There are several measures in the act, but the following are of particular interest for this study: • New buildings must have an energy-profile certificate showing information on its energy demand. • All boilers installed before October 1978 must be replaced. In 2001, this represented an estimated 2 million boilers. The act doesn't explain how to determine a boilers' age, but heating installers and homeowners can estimate the age of the appliance by looking at manufacturer and model information, serial number, design and technology used, condition and wear and tear. The Energy Conservation Ordinance also encourages energy efficiency improvements in existing buildings. The ordinance sets stricter energy requirements when doing a modernisation or retrofit. In some specific cases the ordinance requires retroactive improvement of insulation of floors, ceilings and piping. By virtue of Germany's Integrated Energy and Climate Programme, adopted on 23 August 2007, these standards are to be raised by an average of 30% by 2008/2009 and will be raised once again by up to the same percentage in a second stage.
Legislative process, replicability in Scotland and enforcement The German EnEV followed the typical process for an ordinance. The government first drafted the ordinance based on policy objectives, technical analysis and input from stakeholders. The draft was then revised based on the inputs received during the public consultation phase. The final draft version was approved by the Federal Ministry of the Environment, Nature Conservation, Nuclear

Safety and Consumer Protection. The draft was then voted on and approved by the German Parliament.

It is likely that the Scottish Government could replicate the policies within the German EnEV.

The enforcement of the Energy Conservation Ordinance falls under the responsibility of the federal states. Each state has its own competent authority to enforce the EnEV (usually the building supervisory authority). Independent experts such as architects are responsible for ensuring compliance with the EnEV in their respective areas of expertise. Inspections are carried out to ensure compliance and financial penalties can be imposed if required.

Impact assessment

The EnEV is a central instrument within German energy and climate protection policies. It is difficult to allocate precisely the amount of success in emission reduction to the EnEV, as it goes hand in hand with other energy efficiency acts. However, between 1990 and 2014, buildings emissions had the largest drop (43% drop compared to 36% for industrial emissions) when compared to other sectors in the country (International Energy Agency, 2019). Overall, the policies implemented have borne results, but further-reaching measures are required to meet the ambitious targets set by the German Government. Germany is among the leaders in Europe in terms of setting new building standards and offering financial incentives for energy savings.

Table 15 Improvement of Energy consumption Performance of Building Acts

Improvement of Energy consumption Performance of Buildings Act (ReThink Tokyo, 2022)
Country: Japan
Overview (International Energy Agency, 2021) The act on the Improvement of Energy Consumption Performance of Buildings Act was adopted in 2015. It introduced mandatory efficiency standards for large (floor area of 2,000 square meters or more) new buildings as well as all new residential buildings (starting in 2020). The policy provides financial incentives and performance labelling. The Act includes regulatory measures for mandatory compliance with energy efficiency standards for large-scale non-residential buildings. Of more relevance to this study, it also mandates that all residential buildings undergo energy performance testing and certification by a qualified assessor. For existing buildings, the testing is required when a major renovation or addition is made, or when the building is sold or leased. For new buildings, the certification must be obtained prior to the issuance of the building permit. Through these measures, building energy consumption by 2030 is expected to be reduced by approximately 8.89 million kL from 2013 levels (approximately 90,883 GWh accounting for oil and natural gas fuels). (Here kL means kilolitres and represents the amount of liquid fuel consumed by buildings for heating and hot water)
Legislative process, replicability in Scotland and enforcement (Grantham Research Institute on Climate Change and the Environment, 2016) The bill was proposed by the Japanese Ministry of the environment. It was deliberated by both the House of Representatives and the House of Councils, two chambers of the Diet (Japanese parliament). Once the bill is approved by both chambers, it was sent to the Cabinet for final approval and became a law. The Scottish Government is likely to be able to implement a similar mandate for residential buildings. However, major aspects of the Japanese ECBA such as taxation and fiscal policy may be difficult to replicate. Local governments are responsible for checking compliance with the law and can order owners to improve their energy efficiency if needed. The Ministry of Environment provides guidance and support to local governments and building owners on how to implement and comply with the law. The Ministry also creates guidelines, regulations and procedures for inspections and certifications. They also have the responsibility of assessing the progress of the law and recommending future improvements

Impact assessment

Energy consumption has declined in the commercial and residential sectors over the past decade. The decline is mainly due to the implementation of energy management and the promotion of energy efficient buildings, supported by this Act. Japan expects building energy consumption to reduce by approximately 8.89 million kL from 2013 levels by 2030.

Table 16 Local Law 97 – Carbon caps

Local Law 97: Carbon caps (Urban Green Council, 2019)

Country: United states

Overview (Urban Green Council, 2019)

New York City Council enacted Local Law 97 to cut carbon emissions for all domestic and non-domestic buildings larger than 25,000 square feet in the city, covering approximately 50,000 properties. Starting in 2024, aspects of the law will phase in over time. Carbon caps will become more stringent over a series of four compliance periods through 2049. Each compliance period has its carbon intensity limit for the covered buildings (non-residential buildings over 25,000 square feet. The limit for smaller buildings is expected to be established soon). The compliance periods are as follows:

Period	Carbon intensity limit	
	Pounds of CO_2 per square foot	(Converted to) Kilograms of CO_2 per square meter
2024 – 2029	75	366
2030 – 2034	60	293
2035 – 2039	45	220
2040 – 2049	15	73

In 2050, all buildings will have to meet zero emissions requirements. This law also applies to the city's affordable housing, which must make best efforts to reduce greenhouse gas emissions by 80% below 2005 levels by 2035,

Legislative process, replicability in Scotland and enforcement (Statter, 2022)

The Local Law 97 was introduced in a package of bills known as the Climate Mobilization Act. A member of the NY City Council introduced the bill to the Council. The bill was then referred to the Committee on Environmental Protection where a hearing was held to review the bill and get input from experts, the public and other stakeholders. The committee voted to move the bill forward to the full City Council where it was reviewed and further amended. The Council voted to pass the bill into law, moving it to the Mayor's review, who eventually approved it.

The legal and regulatory frameworks for buildings and energy systems in Scotland are very different from those in New York. In Scotland, the Building Standards system sets out the minimum standards for energy efficiency in new and existing buildings and compliance is enforced by the local authorities. To implement a similar policy, those existing frameworks would need to be considered, leading to major adaptation changes in the policy. For example, the enforcement mechanisms and responsibilities might differ quite a lot and will need to be adapted to the current structure in Scotland. Scotland's practicalities, such as its complex building stock or the variation in the availability of data on building performance, may also challenge the implementation of a similar carbon cap system.

Local Law 97 is enforced by the Department of Buildings (DOB) in New York City. Building owners must submit annual reports detailing their energy consumption and emissions to the DOB. The DOB is allowed to issue fines if the building is found to be in violation after review of its annual report. The DOB also conducts periodic building inspections to verify the information in annual reports. In addition to their inspection responsibilities, they also help building owners understand the law and advise on how to reduce energy consumption and emissions.

Impact assessment

Based on current energy performance, about 20% of properties are over the caps set for 2024, while about 76% of properties are over the caps set for 2030, meaning that the law will have a high impact and will force a significant number of owners to improve energy efficiency or switch to lower carbon fuels. A study estimated that LL97 would reduce citywide carbon emission by at least 14 million imperial tons of CO_2 equivalent, while improving air quality through the reduction of particulate matter by over 22,000 metric tons, nitrous oxides by over 27,000 metric tons and sodium gases by over 2,000 metric tons (Spiegel-Feld, 2021). An urban Green Council analysis calculated that Retrofits associated with LL97 compliance have the potential to grow the retrofit market to $20 billion in economic activity (Urban Green Council, 2019). They also calculated that by 2030, LL97 could reasonably create as many as 141,000 local jobs in New York City.

Table 17 Energy performance (Energieprestatie)

Energy performance (Energieprestatie) (de Clippele, 2022)

Country: Belgium

Overview

Implemented in Flanders only, the regulation mandates that all properties (single- and multi-family homes) purchased from 2023 with EPC label E or F must be renovated to label D or better, within 5 years of purchase. The efficiency of the renovation works will have to be proven by a new EPC. If the label is not obtained in time, an administrative fine of 500 euros to 200,000 euros can be imposed, depending on the nature of the dwelling, the situation of the households and the level of non-compliance observed. A new term is then imposed within which the label must be achieved.

Legislative process, replicability in Scotland and enforcement

The Ministry for Justice and Enforcement, Environment, Energy and Tourism (MJET) developed the initial draft legislation. After considering public and industry feedback, the Flemish Government finalized the regulation and sought approval from the Flemish Parliament.

Legislatively, it is likely to be possible to replicate the Flemish Energieprestatie in Scotland. Scotland already has energy labelling standards and requirements and similar regulations to the Flemish one. For example, social housing and privately rented properties will have to have an EPC rating of C or above to be rented from 2028.

The Flemish Government agency called the Department of Environment, Nature and Energy (Departement Omgeving) is responsible for the enforcement of the Energieprestatie. They monitor compliance, carry out inspections and can impose sanctions for non-compliance. The Flemish Energy Agency is also responsible for providing support and guidance to owners, designers and contractors on how to meet the requirements of the Energieprestatie.

Impact assessment (The Brussels Times, 2022)

In 2022, the European Commission highlighted that Belgium's building stock still ranked low in energy performance. Almost 80% of Belgium's building stock was built before energy standards were introduced. The Energieprestatie regulation was only recently introduced and took effect in 2023. As such, there is no assessment of its impact available yet. It is worth noting that in Flanders, where the regulation was implemented, twice as many households have been built or renovated to performances higher than E level in 2021 compared to 2019. This observation can't be attributed to the Energieprestatie but shows that the Flemish are committed to improving the energy efficiency of their homes.

Appendix 6 Other policies

Table 18 Heat Supply Act

Heat Supply Act
Country: Denmark
Overview (Danish Ministry of Environment and Energy, 2000) The Danish Heat Supply Act is a key legislation that governs the production, distribution, and consumption of district heating in Denmark. First introduced in 1990, the Act has been revised several times since then with significant improvements in 2000. The main objectives of the act are to ensure efficient and cost-effective heating supply, promote the use of renewable energy sources, encourage competition and protect consumers. It is an important part of Denmark's plan to decarbonise its energy sector and aligns with the country's ambitious climate and energy goals. The act has been updated over time to reflect changes in the energy market and adapt to Denmark's evolving energy and environmental policies. The Heating Supply Act includes specific provisions for municipalities to support the local expansion of district heating networks. The act includes the following provisions: • Planning and Approval: The legislative framework assigns an important role to municipalities in the planning, approval, and supervision of local district heating systems. Municipalities are responsible for assessing heating demand, identifying suitable areas for district heating, and approving new district heating projects or expansions of existing systems. • Heat Planning: Municipalities are required to create heat plans that detail the local heating infrastructure, identify potential heat sources, and outline plans for expanding and improving district heating systems. These plans should consider environmental, economic, and social aspects, and be in line with Denmark's national energy and climate goals. • Connection Policies: The legislation allows municipalities to enforce connection policies, mandating all (domestic, commercial and industrial) buildings within a designated district heating areas to connect to the district heating network. This helps ensure a stable customer base and makes the expansion of district heating more economically viable. The enforcement of connection policies varies across municipalities and depends on local conditions and priorities. Generally, municipalities work in close cooperation with district heating companies to identify areas suitable for district heating and establish local connection policies. Municipalities can introduce local regulations and zoning plans that require both new and existing buildings within designated district heating areas to connect to the network. They can also require that new buildings or major renovations within district heating areas include provisions for connecting to the district heating network as a condition for obtaining building permits or construction approvals. In addition to

information campaigns on the benefits of district heating networks, municipalities monitor the implementation of connection policies through their local planning and building authorities and enforce the requirements through fines or other legal measures, if necessary.

- Municipal Ownership and Operation: Municipalities are allowed to own and operate district heating systems, either directly or through municipally owned companies. This enables local authorities to have more control over the expansion and management of district heating infrastructure and can help ensure that the systems are developed in line with local needs and priorities.
- Financial Support: The legislative framework also provides municipalities with access to financial support and incentives for the development and expansion of district heating systems. This can include subsidies, low-interest loans, or other forms of financial assistance, which can help reduce the costs of implementing new projects or upgrading existing infrastructure.

These provisions, along with other aspects of the Danish legislative framework for the heating sector, have helped facilitate the expansion of district heating systems in municipalities across Denmark, contributing to the country's transition towards renewable energy and more sustainable heating solutions.

Legislative process, replicability in Scotland and enforcement

The Danish Heat Supply Act has gone through a legislative process that involved the drafting of the bill, discussions in the Danish Parliament, and eventual approval by the government. The Danish Energy Agency, under the Ministry of Climate, Energy, and Utilities, is responsible for implementing and overseeing the heating sector in accordance with the act.

In terms of replicability, Scotland could potentially adopt a similar approach to regulating its heating sector. However, the specific provisions and implementation strategies will need amending to fit the Scottish context and the current number of heat networks. More funding might be required to expand and create new heat networks.

Enforcement of the Danish Heat Supply Act is carried out by the Danish Energy Agency, which oversees the heating sector and ensures compliance with the legislation. The act sets the framework for planning and approval processes of new district heating projects, and municipalities play a key role in local supervision and enforcement.

Impact assessment (International Energy Agency, 2020)

The Heat Supply Act has had a significant impact on the Denmark's heating sector, contributing to the increased use of renewable energy sources and waste heat in district heating systems. This has led to a reduction in greenhouse gas emissions and improved energy security. While specific figures may vary depending on the data source and timeframe, Denmark has seen a significant shift towards renewable energy in district heating, with a growing share of energy coming from

sources such as wind, solar, biomass, and geothermal energy. As a result, Denmark has become a global leader in sustainable heating and has made very good progress towards achieving its ambitious climate and energy goals. When looking at the share of households connected to district heating systems in Denmark, it increased from ~50% in 2000 to 64% in 2021.

Table 19 Voluntary Energy Efficiency Agreement

Voluntary Energy Efficiency Agreement
Country: Finland
Overview The Voluntary Energy Efficiency Agreement in Finland is a cooperative effort among the Finnish Government, industry sectors, and organizations to improve energy efficiency and reduce greenhouse gas emissions. It aims to support the country's transition towards a more sustainable energy system by encouraging businesses and organizations to implement energy-saving measures and invest in energy-efficient technologies. These agreements have been in place since the 1990s and have evolved over time, with the most recent iteration covering the period from 2017 to 2025. The Finnish Ministry of Economic Affairs and Employment, along with the Energy Authority and Motiva, a state-owned sustainable development company, play key roles in overseeing and implementing the program. The current agreement covers the period from 2017 to 2025 and is a vital component of Finland's broader climate and energy policy goals, which aim to achieve carbon neutrality by 2035. The agreement includes multiple sectors, with real estate and energy being two of the key participants. Real estate participants – landlords, owner-occupiers, property managers, housing associations and cooperatives – from domestic and non-domestic buildings commit to enhancing energy efficiency in their buildings, while energy companies pledge to promote energy efficiency among their customers. Participants joining the Property Sector Energy Efficiency Agreement set an indicative energy savings target, based on a sectoral target of at least 7.5% energy savings for 2017-2025, with an intermediate target of 4% for 2020. In the previous energy agreement period, a subsidy programme was introduced in 2013 to further support building renovations, where property owners could apply for a support of 10% of renovation costs. The programme cost was €115 million (£101 million) over two years. Since 2014, the subsidies are no longer granted.
Legislative process, replicability in Scotland and enforcement The Voluntary Energy Efficiency Agreement is not a legislative act but rather a collaborative initiative facilitated by the Finnish Government. As a result, there isn't a legislative process involved in

adopting the agreement. Instead, the Ministry of Economic Affairs and Employment, the Energy Authority, and Motiva oversee and implement the program.

The Scottish political and regulatory context is different to Finland's. The Scottish Government could draw inspiration from Finland's voluntary approach and adapt it to suit its own context and regulatory framework.

Implementation of the agreement involves participants setting energy-saving targets, conducting energy audits, and receiving financial support and expert advice. Enforcement is achieved through monitoring and periodic reporting of progress. Compliance is incentivised through public recognition for companies that achieve significant energy savings. It is also incentivised through financial benefits such as grants and subsidies to help finance investments in energy-efficiency technologies, equipment or building renovations, as well as tax benefits and deductions for companies investing in energy efficiency investments, or access to low-interest loans.

Impact assessment

An impact assessment for the ongoing 2017-2025 agreement isn't available yet. However, the previous energy efficiency agreements in Finland have shown positive results. For example, during the 2008-2016 period, the industrial and energy sectors achieved 4.4 TWh and 1.1 TWh of energy savings, respectively. The real estate sector has also shown significant improvements, the consumption of heating energy in residential buildings decreasing by ~8% between 2007 and 2015. The ongoing agreement is expected to further contribute to Finland's energy efficiency and carbon neutrality goals.

Appendix 7 Policies for new builds

Table 20 Summary of policies which are exclusively or predominantly for new buildings (Excluded)

Name	Country	Type of mandate	Detail
Energy Regulation 2020 (RE2020)	France	National Strategy	Prioritising energy sobriety and energy decarbonisation, reducing the carbon impact of the building construction and ensuring comfort in case of heatwaves
Building Energy Act (Gebaudesenergiegesetz)	Germany	Regulation	Sets requirements for energy efficiency, thermal insulation, and renewable heat sources for new builds
Building regulations: renewable energy requirements	Italy	Regulation	Increase the mandatory share of renewable energies for domestic hot water and electricity
Building regulations NZEB	Italy	Regulation	Increase the number of Net Zero Energy Building (strict standard of energy performance)
Part L1A	United Kingdom (England only)	Regulation	Reduce the carbon emissions of new homes
Welsh Development Quality Requirements 2021	United Kingdom (Wales only)	Regulation	Reduce carbon emissions and energy intensity of new social homes
Implementation of EPBD: Almost Energy Neutral Buildings (BENG)	Netherlands	Standard	Have all new buildings comply with strict emissions and efficiency standards to reach national CO_2 emissions target

"Gas Free" new build homes by 2021	Netherlands	Regulation	When possible, ban natural gas for new build homes
National building code	Finland	Regulation	Implementing a minimum energy performance requirement for new builds that considers the origin of the energy
Zoning and Development By-law	Canada	Regulation	Ban fossil-fuelled heating systems

Appendix 8 List of keywords used for evidence search

The starting point for the research was LCP Delta's internal database detailing heat and energy efficiency policies and regulations in UK and Europe. Building on this, the project team conducted a methodical online search of policies and regulations focusing on countries outside of the EU which were less likely to be represented in the existing in-house dataset. Countries with a similar climate to Scotland were given particular focus, as these were more likely to have policies relevant for Scottish Government (i.e. focused on heating rather than cooling). We searched for relevant policies in the following countries:

- Austria
- Belgium
- Canada
- Denmark
- Estonia
- Finland
- Italy
- Japan
- Latvia
- Lithuania
- Luxembourg
- New Zealand
- Norway
- Portugal
- Spain
- United States of America

The keywords used in an online search engine for our search in each country were:

- Energy efficiency regulation
- Building energy efficiency
- Renewable heating policy
- Residential energy policy
- Home energy savings regulation / measure
- Building energy efficiency
- Global energy policies
- Energy performance standards
- Thermal insulation
- Building codes
- Energy efficient construction
- Green building certifications
- HVAC efficiency standards
- Residential emissions standards
- Zero-energy buildings
- Renovation measures
- Energy audits
- Minimum energy performance requirements
- Renewable energy integration
- Energy performance certificates
- Carbon emissions reduction
- Residential energy consumption
- Building energy policy
- International energy efficiency benchmarks
- Heat pump regulations
- Hydronic heating standards
- Heating efficiency standards
- Heating system subsidies
- National heating strategies

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