OECD Urban Studies

Global Monitoring of Policies for Decarbonising Buildings

A MULTI-LEVEL APPROACH

OECD

OECD Urban Studies

Global Monitoring of Policies for Decarbonising Buildings

A MULTI-LEVEL APPROACH

OECD
BETTER POLICIES FOR BETTER LIVES

This document, as well as any data and map included herein, are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Please cite this publication as:
OECD (2024), *Global Monitoring of Policies for Decarbonising Buildings: A Multi-level Approach*, OECD Urban Studies, OECD Publishing, Paris, https://doi.org/10.1787/d662fdcb-en.

ISBN 978-92-64-45449-1 (print)
ISBN 978-92-64-87503-6 (PDF)
ISBN 978-92-64-85653-0 (HTML)
ISBN 978-92-64-59921-5 (epub)

OECD Urban Studies
ISSN 2707-3432 (print)
ISSN 2707-3440 (online)

Photo credits: Cover © sl-f/Getty images Plus.

Corrigenda to OECD publications may be found at: https://www.oecd.org/en/publications/support/corrigenda.html.

Foreword

Addressing climate change requires decisive action from the buildings sector, which is responsible for nearly 40% of global energy-related CO_2 emissions. With continued urbanisation and a projected 15% increase in global floor area by 2030, building-related emissions are set to rise unless ambitious policy actions are implemented to support investment in sustainable buildings.

Governments around the world are actively seeking ways to decarbonise buildings. However, the pace and ambition of actions need to be accelerated and strengthened. The OECD Programme on Decarbonising Buildings in Cities and Regions seeks to help governments in those endeavours. Launched in 2021, it has been collecting data and best practices to decarbonise buildings on both national and local levels, advising specific countries and cities through deep-dive studies, and sharing the latest knowledge on innovative initiatives via its annual Sustainable Buildings Roundtable.

At the request of the French Ministry of Ecological Transition and Territorial Cohesion, the OECD ran a Global Survey on Buildings and Climate (2024) across 28 countries in Africa, America, Asia, and Europe to gather information on strategies and policies on decarbonising buildings being developed and implemented across the globe. This new report provides insights from that survey.

While the report stresses the need for urgent action, it also advocates caution in adopting sudden overhauls in policy approaches. France's new environmental and energy regulations (Réglementation environnementale 2020, RE2020), which entail a gradual process of extensive data collection, stakeholder involvement and pilot projects, provide a good example of the incremental approach set out in this report. The step-by-step approach has allowed for a period of trial and error, enabling practical adjustments before the regulations were extended nationwide in 2022.

The report also sheds light on multi-level partnerships, as exemplified by the Netherlands' Natural Gas Free Neighbourhood Programme (PAW). While the national government oversees the energy transition, each municipality faces different challenges in decarbonising buildings due to variations in, for example, available heating sources, workforce, building energy efficiency and energy poverty levels. Moreover, each neighbourhood has unique geographic and social characteristics, which also require tailored solutions. To address this heterogeneity of local needs, the Netherlands has established the PAW to co-ordinate efforts across all levels of government. Under the PAW scheme, the national government has provided EUR 4-5 million to each selected neighbourhood. With this fund, the municipality of Rotterdam has opted for district heating solutions for its neighbourhoods, taking advantage of its proximity to its port. In contrast, the municipality of Leusden, which lacks access to district heating, has focused on improving building insulation combined with heat pump installations.

Cities can take the lead in providing exemplary models for national governments. For example, in addition to the national government's overarching ambition to decarbonise buildings, the city of Tokyo introduced a buildings cap-and-trade programme in 2010 — one of the first of its kind globally. This programme has set mandatory emissions targets for Tokyo's largest emitters, such as commercial buildings and industrial facilities, which together accounted for nearly 40% of the metropolitan area's total emissions in 2017. By addressing the specific needs of its urban landscape, Tokyo has created a framework aligning national and local efforts to tackle the complexities of the energy transition.

Finally, this report highlights the importance of international collaboration on decarbonising buildings, including through technical assistance and technology transfers, echoing the 2024 Chaillot Declaration, a landmark commitment of over 70 countries adopted at the first Ministerial Meeting of the Global Forum on Buildings and Climate. By expanding the evidence base on sustainable, low-carbon and resilient building initiatives, this report aims to further advance on the Chaillot Declaration goals.

Moving forward, the OECD Programme on Decarbonising Buildings in Cities and Regions will continue to support policymakers in OECD and partner countries as they strive to decarbonise buildings and create a more sustainable urban future, notably through greater emphasis on whole life carbon approaches. The programme will also investigate sustainable real estate investment, including the impact that stranded assets may have on global property values if no action is taken to address physical and transition risks associated with climate change.

Acknowledgements

This publication was prepared by the OECD Centre for Entrepreneurship, SMEs, Regions and Cities (CFE), led by Lamia Kamal-Chaoui, Director, as part of the OECD Programme on Decarbonising Buildings in Cities and Regions in the Programme of Work and Budget of the Regional Development Policy Committee (RDPC). The report was supported financially by the Ministry of Ecological Transition and Territorial Cohesion of France.

The report and underlying policy dialogue were co-ordinated by Takeshi Miyamori, Programme Manager – Sustainable Buildings, with the support of Ji Soo Yoon, Policy Analyst, under the supervision of Aziza Akhmouch, Head of the Cities, Urban Policies and Sustainable Development (CITY) Division in the CFE. The report was drafted by a core CFE team composed of Takeshi Miyamori and Ji Soo Yoon, with input and desk research from Connaught Lee, Andres Rocha Zarate, Mahala Lahvis, Matylda Strand and Albert Alonso-Villar (all CFE). The report benefited from comments and suggestions from Nadim Ahmad, Deputy Director, Soo-Jin Kim, Deputy Head of Division, and Tadashi Matsumoto, Head of the National Urban Policy and Climate Resilience Unit in the CFE.

The authors are grateful to Emmanuel de Lanversin, Yves-Laurent Sapoval and Régis Meyer from the Ministry of Ecological Transition and Territorial Cohesion of France for their excellent collaboration and support throughout the policy dialogue.

The report builds on the results of the OECD Global Survey on Buildings and Climate, which was conducted from September 2023 to January 2024, in collaboration with UNEP/Global ABC, UN-Habitat and the Partnership for Energy Efficiency in Buildings (PEEB). Special thanks are conveyed to all country respondents from Belgium, Brazil, Canada, Colombia, Costa Rica, Côte d'Ivoire, Finland, France, Germany, Greece, Iceland, Israel, Italy, Japan, Korea, Lithuania, Mexico, the Netherlands, Norway, the Philippines, Poland, Singapore, Spain, Sweden, Switzerland, Thailand, the United Kingdom, and the United States.

An earlier version of the report was discussed at the 35th session of the OECD Working Party on Urban Policy (WPURB) on 14 May 2024, under cote [CFE/RDPC/URB(2024)11]. The final report was submitted to the WPURB for approval by written procedure on 12 August 2024, under cote [CFE/RDPC/URB(2024)15]. The publication process was led by Jack Waters (CFE).

Table of contents

FIGURES

TABLES

BOXES

Abbreviations and acronyms

BEE	Building energy efficiency
BIM	Building Information Modeling
BAN	*Base Adresse Nationale*, National address website
BREEAM	Building Research Establishment Environmental Assessment Method
BDNB	Base de Données Nationale des Bâtiments, National Buildings Database
C3S	Copernicus Climate Change Service
CBECS	Commercial Building Energy Consumption Survey
CBIM	Cloud-based Building Information Modelling
CDD	Cooling degree days
CEB	Council of Europe Development Bank
CEP	Coefficient d'Énergie Primaire, Primary Energy Coefficient
CIBIM	*Comisión Interministerial para la incorporación de la metodología BIM en la contratación pública*, Interministerial Commission for the Incorporation of the BIM Methodology in Public Procurement
CO_2	Carbon dioxide
CWFIS	Canadian Wildfire Information System
DH	Degree hours
DPE	*Diagnostic de Performance Énergétique,* Energy Performance Diagnostic
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
EPD	Environmental Product Declaration
ETS	Emissions Trading System
EU	European Union
EUR	Euro
EWRB	Energy and Water Reporting and Benchmarking
FBS	Future Buildings Standard
FHS	Future Homes Standard
FPRNM	*Fonds de Prévention des Risques Naturels Majeurs*, Major Natural Risks Prevention Fund
FY	Fiscal Year
GFA	Gross Floor Area
GHG	Greenhouse gas
Global ABC	Global Alliance for Buildings and Construction
GRESB	Global Real Estate Sustainability Benchmark
GST	Global Stocktake
HDD	Heating degree days
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, ventilation and air-conditioning
IDP	Integrated Data Platforms
IEA	International Energy Agency
JHF	Japan Housing Finance Agency
JPY	Japanese Yen
LCA	Life cycle assessment
LEED	Leadership in Energy and Environmental Design
LUSH	Landscaping for Urban Spaces and High-rises
NDC	Nationally Determined Contributions
NOK	Norwegian krone
MEPS	Minimum Energy Performance Standards
MLIT	Ministry of Land, Infrastructure, Transport and Tourism of Japan

MPG	*Milieuprestatieberekening,* Netherlands Environmental Performance of Buildings
MWh	Megawatt-hour
NYC	New York City
OECD	Organisation for Economic Co-operation and Development
ONPE	Observatoire national de la précarité energétique, French Energy Poverty Observatory
PAPI	*Programmes d'Actions de Prévention des Inondations*, Flood prevention action programmes
PAW	*Programma Aardgasvrije Wijken,* Natural Gas-free Neighbourhood Programme
PEEB	Partnership for Energy Efficiency in Buildings
PPPs	Public-Private Partnerships
PPRN	*Plan de prévention des risques naturels*, Natural Risk Prevention Plan
PV	Photovoltaic
R&D	Research and Development
RAP	Regulatory Assistance Project
RVO	*Rijksdienst voor Ondernemend Nederland,* Netherlands Enterprise Agency
SDFR	Sustainable Finance Disclosure Regulation
SLE	Super Low Energy Label
SMEs	Small and medium-sized enterprises
SNBC	*Stratégie Nationale Bas-Carbone*, National Low-Carbon Strategy
SRI	Smart Readiness Indicator
TMG	Tokyo Metropolitan Government
UK	United Kingdom
UNDESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Programme
UN-Habitat	United Nations Human Settlements Programme
URA	Urban Redevelopment Authority
USA	United States of America
ZEB	Zero-energy building
ZEH	Zero-energy house

Executive summary

At the source of nearly 70% of global energy-related CO2 emissions in large cities like New York, Paris and Tokyo, buildings have a critical role to play in efforts to reduce greenhouse gas (GHG) emissions. With urban populations projected to increase by 2.5 billion by 2050, the demand for new buildings is poised to surge, primarily in urban areas. If sustainable solutions are not implemented, this growth could significantly exacerbate climate change.

Buildings are inherently local infrastructure that reflect different climate zones, historical contexts, and social conditions. While many national governments recognise the importance of tailoring decarbonisation approaches to local needs, they often struggle to effectively address the diverse nature of building-related challenges across cities and regions. Countries can gain valuable insights by examining how their peers are addressing these challenges. Similarly, subnational policy makers can draw on international best practices to guide their own policies. In this context, this report underlines lessons from a variety of strategies to decarbonise buildings, drawing on a first ever Global Survey on Buildings and Climate carried out across 28 countries.

Key findings

Although more than 140 countries have announced or are considering net-zero targets, many still lack concrete quantitative targets and monitoring mechanisms for decarbonising buildings at the local level. Only half (54%) of countries that responded to the OECD Global Survey on Buildings and Climate have incorporated building-related actions into their Nationally Determined Contributions (NDCs), and around half (46%) have set up specific plans for phasing out fossil fuels in heating and cooling systems. In addition, 54% of responding countries do not have monitoring frameworks to track progress on decarbonisation efforts at the local level.

Countries currently focus on energy-related measures, while whole-life carbon receives comparatively less attention. A majority of responding countries have implemented mandatory energy-efficiency codes (89%), alongside financial incentives (86%) such as subsidies and low-interest loans. Moreover, building codes tend to focus primarily on insulation (79% in responding countries) but with only 7% focused on whole-life carbon (7%).

However, future decarbonisation priorities will gravitate towards whole-life carbon and circularity, passive design for cooling and retrofitting existing buildings. Looking ahead, responding countries anticipated a significant shift towards whole-life carbon policies. Embodied carbon will increase from 14% (of responding countries) in current priorities to 43% in future priorities, and the circularity of materials from 11% to 68%. Moreover, rising temperatures and urban heat island effects are causing countries to prioritise cooling over heating, with an emphasis on passive cooling designs. Meanwhile, 76% of countries plan to prioritise retrofitting existing buildings over constructing new ones, a significant increase from the current 39%.

Countries are employing a range of strategies to adapt to climate change in the buildings sector. Addressing climate change requires both reducing carbon emissions from buildings and enhancing their climate resilience. The survey highlights that 25% of responding countries have regulations for extreme heat, and 21% for floods and storms. Financial incentives are also in place, with 29% of countries providing support for measures against extreme heat, and 18% for flood and storm protection. Furthermore, 75% of responding countries offer publicly accessible geographic databases with information on climate risks.

For new buildings, some countries have begun to adopt near-zero standards as the new norm, incorporating measures on whole life carbon emissions. This shift requires the implementation of stringent new standards that focus on energy efficiency, cleaner heating technologies, and sustainable building practices. Countries like France, the Netherlands, Norway and Sweden have started to implement new requirements that address whole life carbon in new buildings. Policies addressing whole-life carbon ambitions complement existing energy standards by introducing separate requirements for operational carbon and embodied carbon. Typically, these policies begin with the development of assessment methodologies and the creation of a national database (e.g. the French national reference database called INIES, which provides extensive environmental and health data on construction products and equipment). This paves the way for the implementation of regulations such as mandatory declarations and limit values (e.g. kg CO_2 equivalent per m^2). However, 60% of responding countries have reported that a key challenge for new buildings is to make decarbonisation measures affordable.

For existing buildings, energy labeling and minimum energy performance standards are gaining traction but remain at an early stage of adoption. The Energy Performance Certificate (EPC) is the most common form of energy labeling, adopted by 64% of respondents, followed by broader certifications such as Leadership in Energy and Environmental Design (LEED) and Building Research Establishment Environmental Assessment Method (BREEAM) at 36%, as well as labels indicating annual energy consumption at 29%. However, only 18% of responding countries currently include whole life carbon emissions in their labeling systems. To date, only a few countries like France, the Netherlands, and England and Wales in the United Kingdom, have implemented Minimum Energy Performance Standards (MEPS). Moreover, the survey found that the main challenge for existing buildings lies in standardising methodologies, reducing the economic burden on building owners and resolving conflicts of interest.

Countries are adopting a step-by-step approach to decarbonise buildings, starting with preparatory measures through pilot projects and stakeholder engagement, and targeting specific types of buildings such as public/private or residential/non-residential. For example, France's RE2020 policy, which includes regulations for energy and whole life carbon emissions in new buildings, has been the result of a process to refine methodologies gradually. It was developed through a series of preparatory actions, notably with the E+C- (Energy plus and Carbon minus) initiative to test its methodology with relevant stakeholders. Similarly, Japan's approach has targeted specific building types. Aiming for net-zero energy for all buildings by 2050, Japan began with mandatory energy efficiency standards for large non-residential buildings in 2017 and plans to extend these standards to small non-residential and all residential buildings by 2025. In addition, countries such as Brazil, Lithuania and Singapore have started implementing more stringent measures on public buildings to showcase the effectiveness of decarbonisation policies and technologies before scaling them up. This incremental approach seeks to ensure continuous improvement, tailored solutions, and gradual expansion based on feasibility and impact, leading to effective progress toward decarbonisation goals.

Furthermore, local governments are implementing ambitious measures at a smaller scale, in cities or neighbourhoods. Successful initiatives can then be scaled up for broader impact. For instance, Helsinki's proactive enforcement of carbon footprint limits in construction, which uses emissions calculation methods developed by the national government, began two years ahead of nation-wide adoption. This early implementation has served as a practical trial-and-error opportunity for the national government to learn from city-level experiences before wider rollout. The Netherlands also chose to start from a neighbourhood scale to test technically and economically feasible measures before wider implementation.

Countries are strengthening their multi-level approach to better co-ordinate decarbonisation policies. With 93% of responding countries involving at least three ministries in strategies to decarbonise buildings, countries are shaping horizontal co-ordination strategies. Over half (57%) of countries are also addressing energy poverty and inequalities via building decarbonisation strategies. Support for local governments is strong, with 82% of countries providing local actors with toolkits, co-ordinating regional networks, and developing online platforms. Moreover, there are efforts to leverage public-private partnerships, with 54% of countries establishing funding programmes for SMEs, although further support is needed.

Recommendations

- **Develop tailored step-by-step roadmaps**: As opposed to a sudden overhaul (or inaction), a step-by-step approach aims to achieve incremental long-term transformations by breaking down seemingly overwhelming challenges into a sequence of realistically manageable steps, whilst also providing flexibility to respond and adapt to new developments. Regulatory measures should be introduced progressively, allowing each phase to build momentum, refine strategies and expand efforts. Clear and ambitious goals with measurable targets should guide the process, starting with low-hanging fruit such as targeting a specific building type. A long-term roadmap with milestones and timelines, supported by robust monitoring mechanisms, can help track progress and ensure adaptability. Additionally, this approach fosters more effective stakeholder engagement, as stakeholders have an opportunity to witness tangible results and see their input reflected in decisions throughout the process.
- **Enhance multi-level co-ordination**: Fostering co-ordinated efforts across various levels of government and sectors can help enhance building-decarbonisation efforts by bridging ministry siloes and leveraging cities as testbeds for scalable national policies. Building strong partnerships with private entities, particularly through public-private partnerships (PPPs) with small and medium enterprises (SMEs), is equally important in accelerating this transition. Given that SMEs accounted for over 99% of all enterprises and 80% of turnover in the European Union's construction industry in 2017, they play a substantial role in shaping the built environment. However, SMEs have more limited capacities than larger companies to adapt to new regulatory environments and standards, which means that targeted support or enabling mechanisms will be essential for ensuring a just, bottom-up transition in the buildings sector. Moreover, facilitating green investment in the real estate sector can unlock much needed capital and expertise. To this end, national governments could actively organise regular policy dialogues between governments and investors.
- **Strengthen international collaboration**: Governments can accelerate their climate and energy policies by engaging more deeply in international dialogues to learn from best practices and find common solutions to shared global challenges. For example, by participating in the Intergovernmental Council for Buildings and Climate (ICBC) – one of the outcomes of the Chaillot Declaration from the Global Forum on Buildings and Climate in 2024, endorsed by 70 countries – countries can strengthen international co-operation in promoting decarbonisation and climate resilience in the building sector.

1 Setting the scene

This chapter sets the scene and provides the rationale for decarbonising buildings. It analyses challenges which require customised solutions based on varying characteristics of building stock, climate and other factors. Recognising the complex nature of decarbonising buildings, this chapter explains the rationale behind conducting the OECD Global Survey on Buildings and Climate (2024).

Introduction

Buildings account for nearly 40% of energy-related CO_2 emissions worldwide, making them a primary target for reducing greenhouse gas emissions (UNEP, 2022[1]). In the face of rapid urbanisation – with an estimated 2.5 billion more people expected to live in urban areas by 2050 – much of the demand for new buildings will be in and around cities. Without sustainable solutions, the building sector will exacerbate carbon lock-in, further contributing to climate change (UNDESA, n.d.[2]).

The benefits of decarbonising buildings go far beyond reducing greenhouse gas emissions. Studies show that for every million dollars spent on energy efficiency initiatives, up to 30 jobs can be generated (IEA, 2020[3]). Additionally, improvements in energy efficiency can help alleviate energy poverty, with a 1% efficiency gain correlating with a 0.21% reduction in energy poverty rates (CEB, 2019[4]). Moreover, enhancing energy efficiency in buildings has been linked to public health benefits. One study from the United States showed that for every megawatt-hour (MWh) of electricity reduced in buildings in the US, there is another USD 0.63 to 74.66 in health co-benefits, contingent on the location and composition of the electricity grid (Parichehr Salimifard, 2023[5]). Another study quantified health co-benefits across the EU, ranging from EUR 1.4 to 1 508 per MWh of electricity reduced, depending on the country and the grid composition (Gen Pei, 2024[6]). Building characteristics that correspond with lower energy demand in homes can also be linked to on-site public health benefits. One study showed that following thermal insulation retrofits in buildings, lower blood pressure was reported among residents in Japan (Umishio et al., 2022[7]),

Yet, the process of decarbonising buildings presents multifaceted challenges, requiring customised approaches catering to the specific characteristics of the building stock, particularly when considering pathways for decarbonising new versus existing buildings.

- For existing buildings, renovating the old building stock is a key task. In the EU alone, buildings constructed before 1945 account for 23% of all building stock. In buildings with multiple owners, additional complexities arise due to potentially conflicting interests. Reaching agreement on renovation plans can also be further complicated by “split incentives”, where owners might be reluctant to finance energy-saving upgrades that primarily benefit tenants through lower utility bills (OECD, 2022[8]). To overcome these hurdles, it is essential to secure political buy-in and provide government support through grants, tax breaks, and targeted policies.
- For new buildings, it is crucial not only to incorporate energy efficiency measures, but also to minimise the upfront carbon footprint, notably of construction materials. To reduce the overall negative environmental impact, governments need to prioritise low-carbon materials from the start and take into account the building’s entire life cycle.

Cross-governmental collaboration

Decarbonising buildings is a shared responsibility across global, national and local scales:

- At **the global level**, setting overarching goals and standards, alongside sharing best practices, is key to support countries in implementing effective measures. For instance, the European Green Deal aims to achieve carbon neutrality by 2050, and initiatives such as the Fit for 55 package and REpowerEU seek to reduce emissions and enhance energy security. Moreover, the revised Energy Performance of Buildings Directive (EPBD) focuses on renovating the worst-performing buildings and mandates all new EU buildings to be zero-emission by 2030 (European Parliament, 2024[9]).
- At **the national level**, the involvement of numerous ministries, each with its own set of prerogatives and responsibilities, calls for policy coherence and co-ordination. The pursuit of energy efficiency in buildings cuts across many different policy domains, encompassing energy, environment,

housing, building regulations, and urban development strategies. According to the OECD Global Survey on Buildings and Climate (2024), 93% of responding countries have at least three ministries involved in decarbonising buildings. Through collaborative efforts, these diverse policy domains can create synergies and overcome potential discrepancies, ultimately leading to a more sustainable built environment.

- At **the local level,** cities and regions need to significantly upscale their strategies and actions towards decarbonising buildings. Cities and regions deliver 69% of climate-significant public investment (OECD, n.d.[10]) and hold critical prerogatives over policies in the built environment, especially in terms of building regulations and financial incentives. This is even more critical in large metropolitan areas, such as Tokyo, Paris and New York, where buildings account for 73%, 71% and 68% of their respective total emissions (Tokyo Metropolitan Government, 2022[11]; Ville de Paris, 2020[12]; NYC Mayor's Office and Environmental Justice, n.d.[13]).

The OECD Global Survey on Buildings and Climate

Recognising the shared responsibility across global, national and local scales, facilitating continuous international dialogue by all levels of governments for decarbonising buildings is paramount. At COP28, the Buildings Breakthrough initiative, comprising 28 member states and 28 organisations, was launched under the leadership of the French Ministry for Ecological Transition and Territorial Cohesion and the Kingdom of Morocco's Ministry of National Territory Planning, Land Planning, Housing and City Policy. The initiative is also co-ordinated under the umbrella of the Global Alliance for Buildings and Construction (GlobalABC), hosted by the United Nations Environment Programme (UNEP). This initiative sets an ambitious target to make near-zero emissions and resilient buildings the new standard by 2030 (UNEP, 2023[14]).

Furthermore, in March 2024, the French government, in collaboration with UNEP, hosted the Global Forum on Buildings and Climate – which included a ministerial-level meeting specifically for the building sector. The Chaillot Declaration, signed by 70 countries, calls for actions including the implementation of roadmaps, regulatory and financial frameworks, and building and energy codes for moving towards more carbon-neutral buildings, as well as the promotion of low-carbon building materials and collaborative value chains for developing innovative solutions. It underscores the insufficient current pace of renovations and construction of sustainable buildings, and highlights the disparity between the sector's trajectory and the Paris Agreement's objective of limiting global warming to below 1.5°C by 2100 (Ministry of Ecological Transition and Territorial Cohesion, 2024[15]). To address these issues, the Declaration sets forth the path towards national commitments and international collaboration to reduce carbon emissions in the pursuit of decarbonising buildings and enhancing climate resilience.

In alignment with these efforts, the OECD conducted a Global Survey on Buildings and Climate (2024). The goal was to collect cutting-edge and comparable data and information across 28 countries, while accounting for their varying economic sizes, geographical characteristics and governance structures. This survey encompasses a range of topics from national regulations to local initiatives to gather granular information on decarbonising buildings efforts all across the world (Box 1.1)

Box 1.1. The OECD Global Survey on Buildings and Climate

Survey Structure

This report draws key findings from the OECD Global Survey on Buildings and Climate. The survey aimed to collect comprehensive information about policy measures undertaken to decarbonise buildings as well as to identify policy challenges. This includes efforts to reduce operational carbon emissions, address embodied carbon, and enhance climate resilience.

The survey draft benefited from insightful feedback from the OECD Programme on Decarbonising Buildings in Cities and Regions' task force group, including experts from UN/Global ABC, UN-Habitat and the Partnership for Energy Efficiency in Buildings (PEEB). As a result, the survey encompassed the following key areas:

Table 1.1. An overview of the OECD Global Survey on Buildings and Climate (2024)

Section number	Section theme	Key information
Section 1	Basic data	Final energy consumption, GHG emissions on building sector, building stock, annual new construction and renovation
Section 2	Goals and strategies	Nationally Determined Contributions (NDC), long-term goals, quantitative target and policy priorities
Section 3	Standards and regulation	Building codes, Minimum Energy Performance Standards (MEPS), whole-life carbon, green public procurement
Section 4	Financial incentives	Financial incentive tools, split incentives
Section 5	Information and training	Energy Performance Certificate (EPC), energy performance database, national training programmes, digitalization
Section 6	Climate resilience	Policies for heat wave resistance and storm/flood
Section 7	Multi-level governance	Horizontal co-ordination, vertical co-ordination, monitoring frameworks on local governments, neighbourhood approach

Survey Dissemination

To achieve global participation, the survey was disseminated to policy makers in both OECD member and non-member countries. The survey targeted building policy makers within the Global ABC network. Additionally, delegates from the OECD Working Party on Urban Policy played a key role in disseminating the survey and contributing their own responses. This collaborative effort resulted in participation from 28 countries across the world (Figure 1.1).

Figure 1.1. Participating countries in the OECD Global Survey on Buildings and Climate (2024)

Note: The survey was conducted only in Belgium''s Flanders region. Consequently, the results cannot be extrapolated to represent the entire country.

References

CEB (2019), *Energy Poverty in Europe, How Energy Efficiency and Renewables Can Help*, https://coebank.org/media/documents/CEB_Study_Energy_Poverty_in_Europe.pdf (accessed on 22 February 2024). [4]

European Parliament (2024), . [9]

Gen Pei, J. (2024), "Assessing the climate and health impacts of energy consumption in European", The paper is a non-peer reviewed preprint submitted to EarthArXiv, https://doi.org/10.31223/X5MM6G (accessed on 17 July 2024). [6]

IEA (2020), *Sustainable Recovery World Energy Outlook Special Report*, https://iea.blob.core.windows.net/assets/c3de5e13-26e8-4e52-8a67-b97aba17f0a2/Sustainable_Recovery.pdf (accessed on 22 February 2024). [3]

Ministry of Ecological Transition and Territorial Cohesion (2024), , https://www.ecologie.gouv.fr/diagnostic-performance-energetique-dpe (accessed on 16 April 2024). [15]

NYC Mayor's Office and Environmental Justice (n.d.), *NYC Greenhouse Gas Inventories*, https://climate.cityofnewyork.us/initiatives/nyc-greenhouse-gas-inventories/ (accessed on 23 February 2024). [13]

OECD (2022), *Decarbonising Buildings in Cities and Regions*, OECD Urban Studies, OECD Publishing, Paris, https://doi.org/10.1787/a48ce566-en. [8]

OECD (n.d.), , https://www.oecd.org/regional/subnationalexpendituretracking.htm#:~:text=Key%20data%20on%20subnational%20government,or%200.4%25%20of%20GDP). (accessed on 22 February 2024). [10]

Parichehr Salimifard, M. (2023), "A novel method for calculating the projected health and climate co-benefits of energy savings through 2050", *Building and Environment*, Vol. 244, https://doi.org/10.1016/j.buildenv.2023.110618 (accessed on 17 July 2024). [5]

Tokyo Metropolitan Government (2022), *Final Energy Consumption and Greenhouse Gas Emissions in Tokyo*, https://www.kankyo.metro.tokyo.lg.jp/en/climate/index.files/Tokyo_GHG_2019.pdf (accessed on 23 February 2024). [11]

Umishio, W. et al. (2022), *Association between Indoor Temperature in Winter and Serum Cholesterol: A Cross-Sectional Analysis of the Smart Wellness Housing Survey in Japan*, https://www.jstage.jst.go.jp/article/jat/29/12/29_63494/_article. [7]

UNDESA (n.d.), *Around 2.5 billion more people will be living in cities by 2050, projects new UN report*, https://www.un.org/en/desa/around-25-billion-more-people-will-be-living-cities-2050-projects-new-un-report. [2]

UNEP (2023), , https://www.unep.org/news-and-stories/press-release/buildings-breakthrough-global-push-near-zero-emission-and-resilient (accessed on 18 April 2024). [14]

UNEP (2022), *2022 Global Status Report for Buildings and Construction*, https://www.unep.org/resources/publication/2022-global-status-report-buildings-and-construction (accessed on 22 February 2024). [1]

Ville de Paris (2020), *Bilan des emissions de gas a effet de serre de Paris*, https://cdn.paris.fr/paris/2020/02/06/dc2edb10d13ae050815850f721f5a837.pdf (accessed on 23 February 2024). [12]

2 Policy goals and measures

This chapter documents governments' policy objectives and actions to decarbonise buildings. It reviews policy goals and actions in place such as building codes, energy labels, minimum energy standards and financial incentives. This chapter further sheds light on challenges in implementation, such as monitoring progress, and introduces evolving policy priorities.

Introduction

Decarbonising buildings requires a multifaceted strategy. While pursuing emissions reductions in both new and existing buildings, governments should also consider financing capacity. Drawing from the OECD Global Survey on Buildings and Climate (2024), this chapter delves into how governments are gradually decarbonising their building stock by setting goals, regulations and incentives.

Goal setting and monitoring mechanisms

Clear and well-communicated goals and roadmaps with transparent timelines and regulations are essential for all stakeholders. Establishing a clear roadmap fosters public trust and encourages community buy-in. However, the goals should be coupled with monitoring mechanisms to track progress and identify areas for improvement.

Table 2.1. Goal setting and monitoring mechanisms

Country	Building-related commitments in NDCs	Plans to phase out fossil fuels for heating and cooling buildings	Quantitative targets included in long-term goals	Monitoring frameworks to track progress at the local level
Belgium (Flanders)	N/A	✓	✓	✓
Brazil		✓		
Canada	✓			
Colombia				✓
Costa Rica	✓	✓		✓
Côte d'Ivoire	✓			
Finland		✓		
France	✓	✓	✓	✓
Germany		✓	✓	
Greece			✓	
Iceland	✓		✓	✓
Israel				
Italy	✓		✓	✓
Japan	✓		✓	✓
Korea	✓	✓		✓
Lithuania			✓	
Mexico				
Netherlands	✓	✓	✓	✓
Norway		✓		
Philippines	✓	✓	✓	
Poland	✓	✓	✓	✓
Singapore	✓		✓	
Spain		✓	✓	
Sweden				
Switzerland				✓
Thailand	✓			

United Kingdom	✓	✓	✓	✓
United States	✓			✓
Percentage of responding countries	54% (15/28)	46% (13/28)	50% (14/28)	46% (13/28)

Note: The figure consolidates the responses to the questions from the survey: "Does your country's NDC include a dedicated and stand-alone commitment for climate change mitigation in the building sector?", "Has your government already implemented or announced plans to ban or phase out fossil fuels for heating/cooling?", "Does your country's long-term target include any quantitative targets of the following measures?", "Does the national government gather information of the implementation/progress in each regions/municipalities on policy indicators for decarbonising buildings and climate resilience (e.g. the number of insulation retrofits/year for each region/city)?"
The responding countries could choose multiple answers if applicable. Unchecked cells indicate the absence of these commitments/targets/frameworks. N/A indicates that the option is not applicable to the country/region.
Source: OECD Global Survey on Buildings and Climate (2024)

54% of responding countries have included building-related commitments in their NDCs

In these countries, Nationally Determined Contributions (NDCs) include commitments to achieve zero-emission buildings, use renewable energy, or reduce whole-life cycle carbon. The commitment to achieving zero-emissions in existing buildings is the most widespread theme of sustainability, consistently addressed across all relevant institutional levels and implementation mechanisms.

46% of responding countries have set a plan to phase out fossil fuels for heating and cooling buildings

Setting a plan to phase out fossil fuels creates a sense of urgency that pushes governments, businesses and individuals to move away from fossil fuels. With a plan in place, policy makers can develop a roadmap with specific milestones and actions needed to achieve it.

In the **United Kingdom**, for example, the previous administration set the aim to phase out the installation of new and replacement of fossil fuel heating systems from 2035, installing 600 000 heat pumps per year by 2028 and reducing costs of heat pumps by 25-50% by 2025 (making them as affordable to purchase and operate as current natural gas boilers) (Department for Energy Security & Net Zero, 2021[1]).

More than half of the responding countries do not have concrete quantitative targets on decarbonising buildings

Although broader goals for decarbonising buildings exist, the survey shows that less than half of the countries have established quantitative goals for specific decarbonisation measures. About 29% of responding countries (Belgium (Flanders), France, Germany, Greece, Japan, the Netherlands, Spain, and the United Kingdom) have quantitative targets for the adoption of heat pumps, whereas only 14% (Belgium (Flanders), France, Japan, and the Philippines) and 11% of countries (France, Japan, and the Netherlands) have established targets for rooftop photovoltaic (PV) systems and insulation, respectively.

The **Netherlands** stands out because it has clear, quantitative targets for specific decarbonisation measures. Due to its high dependence on natural gas for heating (approximately 90% of homes), the main climate goal for the built environment in the Netherlands is to phase out natural gas by 2050. As an intermediate goal, 1.5 million of the almost 8 million dwellings in the Netherlands should be heated without natural gas by 2030. By working closely with municipalities, the national government plans to provide 500 000 new connections to district heating networks in existing buildings by 2030. The Dutch government has therefore introduced a National Insulation Programme, which aims to insulate 2.5 million homes by 2030, with a particular focus on buildings with an energy label E, F or G. Additionally, the Dutch Hybrid Heat Pumps Programme aims to install 1 million hybrid heat pumps by 2030 (The Ministry of the Interior and Kingdom Relations, 2022[2]).

Table 2.2. Quantitative targets included in long-term goals

Country	District heating/cooling	Fossil fuel-free buildings	Heat pumps	Insulation	Rooftop PVs	Solar heating of water	Other renewable energy	Other
Belgium (Flanders)			✓		✓			
Brazil								
Canada								
Colombia								
Costa Rica								
Côte d'Ivoire								
Finland								
France	✓	✓	✓	✓	✓			✓
Germany	✓		✓					
Greece			✓			✓		
Iceland								✓
Israel								
Italy							✓	✓
Japan			✓	✓	✓			
Korea							✓	✓
Lithuania		✓						
Mexico								
Netherlands	✓	✓	✓	✓			✓	
Norway								
Philippines					✓			
Poland	✓	✓					✓	✓
Singapore								✓
Spain	✓	✓	✓					

Sweden								
Switzerland								
Thailand								
United Kingdom			✓					✓
United States								
Percentage of responding countries	18% (5/28)	18% (5/28)	29% (8/28)	11% (3/28)	14% (4/28)	4% (1/28)	14% (4/28)	25% (7/28)

Note: The figure consolidates the responses to the questions from the survey: "Does your country's long-term target include any quantitative targets of the following measures?"
The responding countries could choose multiple answers if applicable. Unchecked cells indicate the absence of these quantitative targets in the long-term goals.
Source: OECD Global Survey on Buildings and Climate (2024)

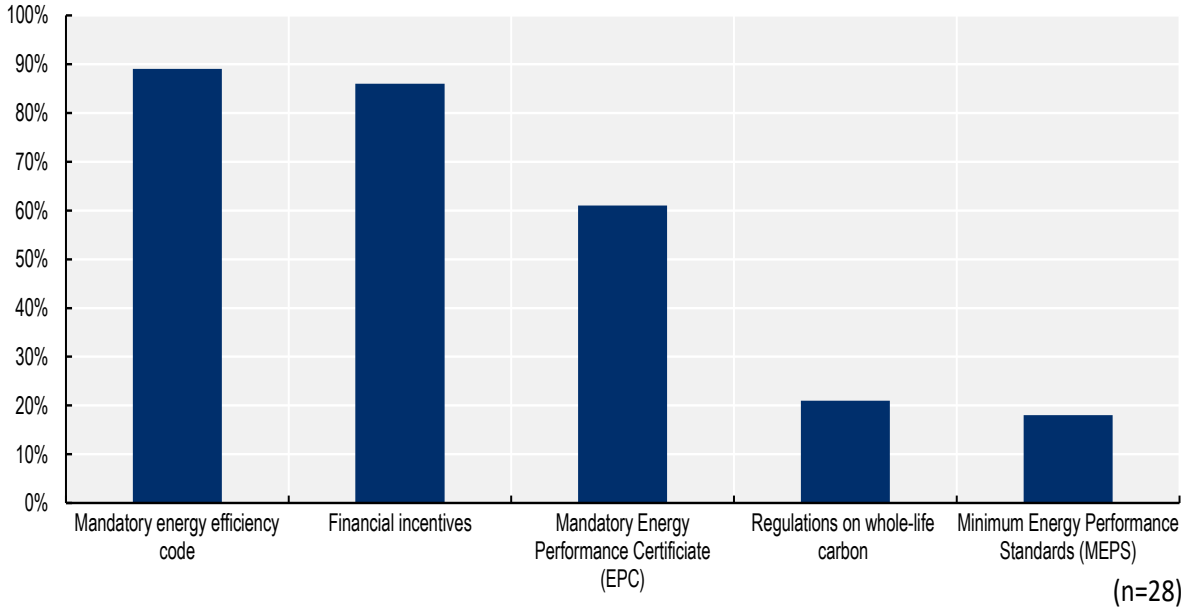
54% of responding countries do not have monitoring frameworks to track progress on decarbonisation efforts at the local level

While most of the responding countries do not have monitoring framework for local actions, in **Korea**, the national government launches a "Green Building Co-ordination Support Plan" every five years. The plan serves as a guideline for local governments to formulate their own green building plans and report back to the central government. Each year, the national government assesses local governments' green building efforts using a national energy database. The three local governments demonstrating the most significant performance receive ministerial awards, encouraging further efforts towards energy reduction. The results of these evaluations are made publicly available on a dedicated website, ensuring transparency and easy access to information (Ministry of Land, Infrastructure, and Transport of Korea, 2019[3]).

Varying levels of policy adoption rate

While most of the countries are aiming to reach net-zero as set in Paris Agreement, each country uses different policy instruments to achieve their goals. The OECD Global Survey on Buildings and Climate (2024) shows that a majority of responding countries have implemented mandatory energy-efficiency codes (89%) and offer financial incentives such as subsidies and low-interest loans (86%). Additionally, 61% of countries have introduced mandatory energy performance certificates or labelling programmes. Other policies are still in their infancy. For example, only 21% of countries (Finland, France, Italy, the Netherlands, Norway and Sweden) have regulations on whole-life carbon (mandatory declaration or limit value), and 18% (Belgium (Flanders), France, the Netherlands, Singapore and the United Kingdom) have established minimum energy performance standards (MEPS) that include mandatory renovations (Figure 2.1).

Figure 2.1. Adoption rates for policy instruments differ across countries

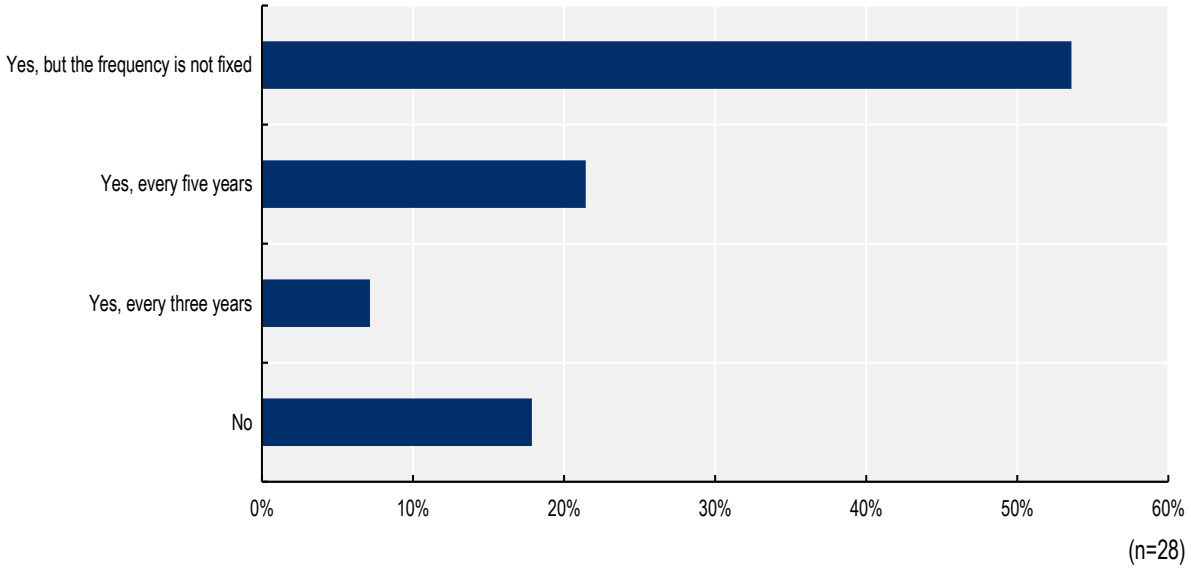


Note: The figure consolidates the responses to the questions from the survey: "Does your country have a building code for obtaining a building permit?", "Are there any direct financial incentives available for energy-efficient upgrades (e.g. heat pumps, district heating installation, insulation, renewable energy, etc.) in buildings?", "Does your country have a mandatory energy performance certificate (EPC) or mandatory energy labeling programme for buildings in place?", "Which building regulation does your national government have for addressing embodied carbon / life cycle CO_2 emissions?", "Does your country have Minimum Energy Performance Standards (MEPS) regulation for existing buildings?"
The responding countries could select all applicable options.
Source: OECD Global Survey on Buildings and Climate (2024)

Regular strengthening of building energy efficiency standards

Despite variations in the adoption of policy instruments across countries, there is a general trend of gradual enhancement of standards aimed at decarbonising buildings. The OECD Global Survey on Buildings and Climate (2024) finds that 82% of responding countries regularly strengthen the level of energy efficiency standards of buildings (Figure 2.2). The regular improvement in standards plays a crucial role in speeding up the decarbonisation efforts within the building and construction sector. Regular updates to energy efficiency requirements ensure that new constructions and renovations effectively contribute to achieving decarbonisation goals.

Figure 2.2. Regular strengthening of building energy efficiency standards



Note: The figure consolidates the responses to the questions from the survey: "Does your national government regularly strengthen the level of energy efficiency standards of buildings to promote building decarbonisation?"
Source: OECD Global Survey on Buildings and Climate (2024)

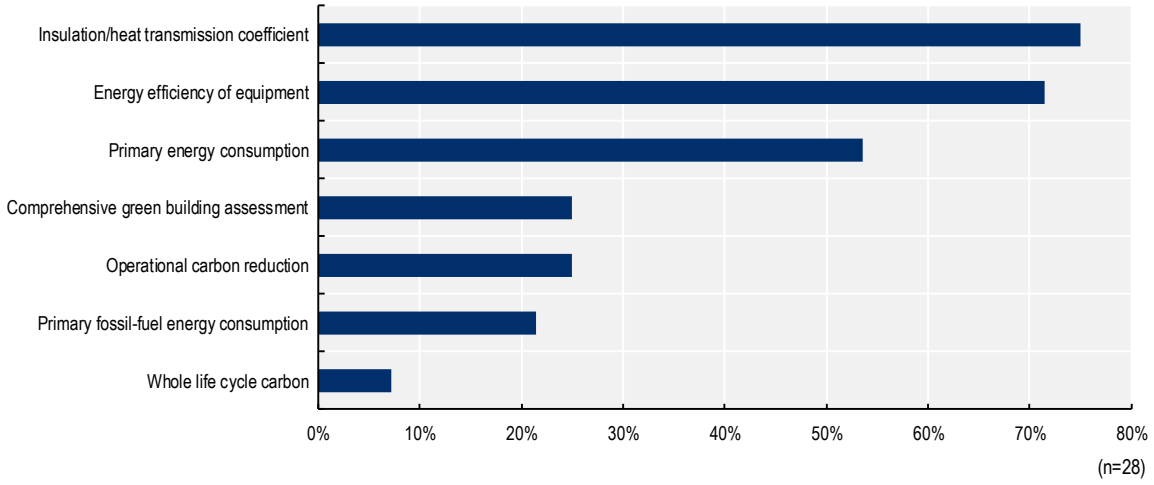
Identifying policy measures for new and existing buildings

Building codes can be enhanced to decarbonise buildings

By 2023, global building codes have expanded to 81 for residential and 77 for non-residential buildings, with 80% being mandatory. However, more than 30% of these codes remain unchanged since 2015, potentially failing to meet high-performance standards. 80% of increase in floor area by 2030 will be in developing economies where many lack stringent energy codes, offering an opportunity for enhanced enforcement and alignment with net-zero CO_2 goals (UNEP, 2024[4]).

Regarding the components of building codes, findings from the OECD Global Survey on Buildings and Climate (2024) highlighted the disparities across countries in terms of comprehensiveness. Insulation is the most prevalent dimension (addressed in 75% of building codes), followed by equipment energy efficiency (71%) and primary energy consumption (54%). Yet, operational carbon reduction (25%), primary fossil-fuel energy consumption (21%) and whole-life cycle carbon (7%) are relatively less addressed in legislative and regulatory frameworks (Figure 2.3).

Figure 2.3. Elements included in building codes



Note: Question from the survey: "Please select all elements that are included in the building codes which are applicable to new construction." The responding countries could select all applicable options.
Source: OECD Global Survey on Buildings and Climate (2024)

Table 2.3. Elements included in building codes

Country	Insulation/heat transmission	Energy efficiency of equipment	Primary energy consumption	Primary fossil-fuel energy consumption	Whole-life carbon
Belgium (Flanders)					
Brazil					
Canada	✓	✓	✓	✓	
Colombia	✓	✓	✓		
Costa Rica		✓			
Côte d'Ivoire					
Finland	✓	✓	✓		
France	✓	✓	✓	✓	✓
Germany	✓	✓		✓	
Greece	✓	✓			
Iceland	✓		✓		
Israel	✓	✓	✓		
Italy	✓	✓	✓		
Japan	✓	✓	✓		
Korea	✓	✓	✓		
Lithuania					
Mexico					
Netherlands	✓	✓		✓	✓
Norway	✓	✓			
Philippines					

Poland	✓	✓	✓		
Singapore	✓	✓			
Spain	✓	✓	✓	✓	
Sweden	✓		✓		
Switzerland	✓	✓	✓	✓	
Thailand	✓	✓	✓		
United Kingdom	✓	✓	✓		
United States	✓	✓			
Percentage of responding countries	75% (21/28)	71% (20/28)	54% (15/28)	21% (6/28)	7% (2/28)

Note: Question from the survey: "Please select all elements that are included in the building codes which are applicable to new construction." The responding countries could select all applicable options. Unchecked cells indicate the absence of these elements in the building codes.
Source: OECD Global Survey on Buildings and Climate (2024)

Near-zero buildings must be the "new normal" for new buildings

New standards for new buildings

Setting new standards for new buildings is a pivotal strategy in the effort to decarbonise the building sector. The buildings currently under construction will still stand in 2050. We must therefore make sure that the standards set for these buildings put us on the right path. By prioritising energy efficiency, promoting cleaner heating technologies and fostering a sustainable built environment, the new standards can lead the charge in combating climate change.

In this regard, **the United Kingdom** introduced the Future Homes Standard (FHS) and Future Buildings Standard (FBS), with implementation proposed for 2025. The standards proposed by the previous administration represent a notable elevation in requirements, particularly concerning energy efficiency and heating specifications for both residential and non-residential structures. By tightening these standards, the aim is to accelerate the reduction of emissions. Specifically, the anticipated outcomes include a substantial decrease in CO_2 emissions, with new homes projected to emit at least 75% less CO_2 on average compared to 2013 standards (Ministry of Housing, Communities & Local Government of the UK, 2019[5]).

Whole-life carbon

While operational carbon emissions from buildings represent a significant portion of global carbon emissions making 75% of the total carbon emissions in buildings, the embodied carbon of materials and construction is also crucial and constitutes another key aspect of a building's overall carbon footprint throughout its life cycle. However, projections indicate that under business-as-usual scenario, embodied emissions could rise to nearly half of all building emissions by 2050 (UNEP, Yale Center for Ecosystems + Architecture, 2023[6]).

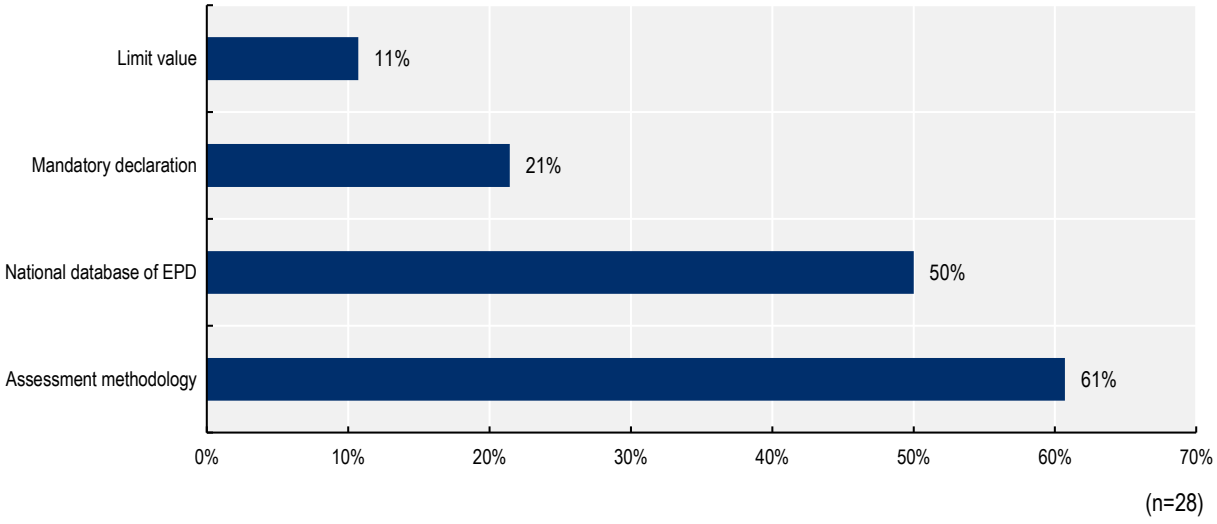
Against this background, the Chaillot Declaration – signed by 70 countries – emphasises the use of on-site assets, recycled materials, and locally sourced, sustainable, low-carbon materials to construct and retrofit buildings throughout their entire life cycle (Ministry of Ecological Transition and Terriotorial Cohesion, 2024[7]).

Policies should target reductions in embodied carbon through the adoption of sustainable practices and materials of new buildings, alongside promoting retrofitting initiatives aimed at significantly reducing energy consumption. Policies addressing whole-life carbon complement existing energy standards by introducing

separate requirements for operational and embodied carbon. Typically, policies addressing whole-life carbon begin with the development of methodologies for assessing embodied emissions. Subsequently, data compiled using these methodologies lead to the creation of national databases accessible to all stakeholders, paving the way for the implementation of regulations. One such example is the French national reference database INIES, which provides extensive environmental and health data on construction products and equipment.

The OECD Survey on Buildings and Climate (2024) echoes this trend. While 61% of responding countries have already established assessment methodologies, only 21% (Finland, France, Italy, the Netherlands, Norway, Sweden) require developers to declare the whole-life carbon of buildings when constructing new structures. Furthermore, a mere 11% of countries (Finland, France and the Netherlands) have set limit values on carbon emission from buildings (Figure 2.4).

Figure 2.4. Whole-life carbon policies



Note: The figure consolidates the responses to the questions from the survey: “Does your country have standardised methods and tools for calculating and reporting embodied carbon or life cycle GHG emissions of buildings?”, “Does your country have a national database of CFP (Carbon Footprint) / EPD (Environmental Product Declaration) for building materials/equipment?”, “Which building regulation does your national government have for addressing embodied carbon / life cycle CO_2 emissions?” The responding countries could select all applicable options.
Source: OECD Survey on Buildings and Climate (2024)

Meanwhile, several countries have begun addressing embodied carbon by adopting life cycle assessment to consider all carbon emissions from cradle to grave. Table 2.4 provides an overview of the specific LCA regulations of the responding countries.

Table 2.4. Examples of whole-life carbon regulations in countries

Country	Finland	France	The Netherlands	Norway	Sweden
Year	2025	2022	2018	2023	2022
Regulation / standards	Building Act	RE2020	MPG	TEK17	Climate Declaration 2022
Target buildings	New buildings	New residential buildings and offices, and educational buildings	New residential buildings, and offices	New buildings, renovation for existing buildings	New buildings
Upfront carbon / whole-life carbon	While life carbon	Whole-life carbon	Whole-life carbon	Upfront carbon	Upfront carbon
Regulatory measures	Declaration, limit value	Declaration, limit value	Declaration, limit value	Declaration	Declaration

Note: Countries that have reported having regulatory measures (mandatory declaration or limit value) for embodied/life cycle carbon in place.
Source: OECD Global Survey on Buildings and Climate, (Nordic Sustainable Construction, 2023[8]) (Boverket, 2023[9]) (Nationale Milieu Database, n.d.[10]) (The Central Government of the Netherlands, 2017[11])

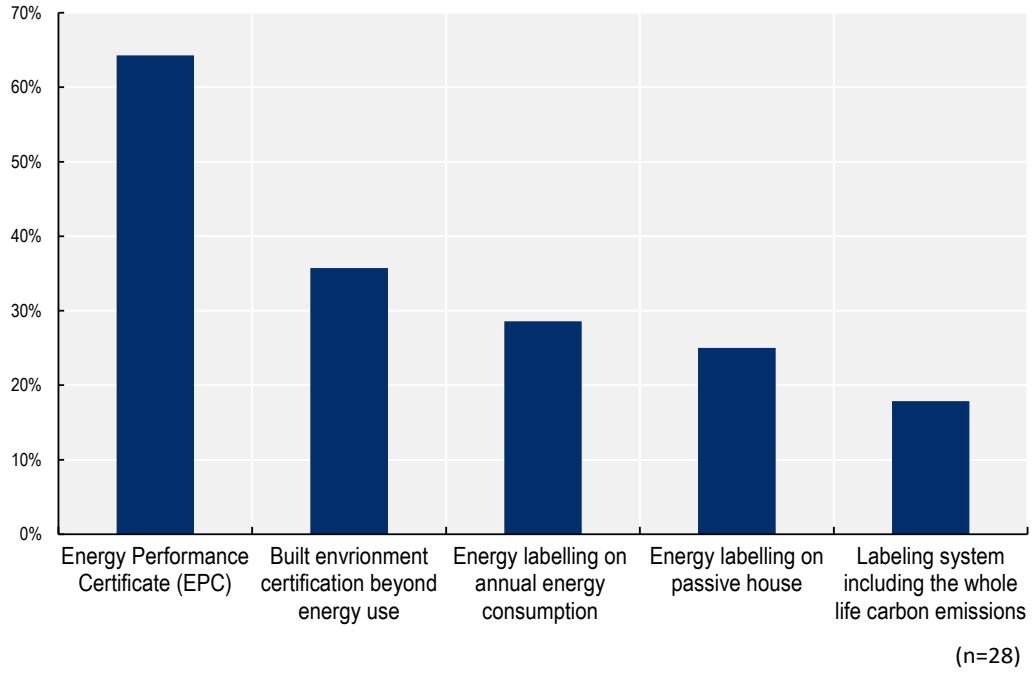
Improving energy performance of existing buildings is imperative

Energy labelling of buildings plays a critical role in the fight to decarbonise existing buildings by providing clear information about building's energy performance and by putting market pressure for improvement. Clear information about the energy performance of buildings empowers potential buyers, renters and even current occupants to understand the building's energy consumption. Moreover, stringent regulatory measures on energy labelling and subsequent placement of minimum energy performance standard signal to all stakeholders in the market that more energy efficient and energy saving measures need to be in place according to the timeline set by the regulations. Well-designed energy labels play a pivotal role in accelerating the decarbonisation of buildings.

According to the OECD Survey on Buildings and Climate (2024), the most common type of energy labelling was the Energy Performance Certificate (EPC) (64%), followed by built environment certification beyond energy use such as LEED and BREEAM (36%), and energy labelling on annual energy consumption (29%). Only 18% of responding countries have a labelling system which includes whole-life carbon emissions (Figure 2.5).

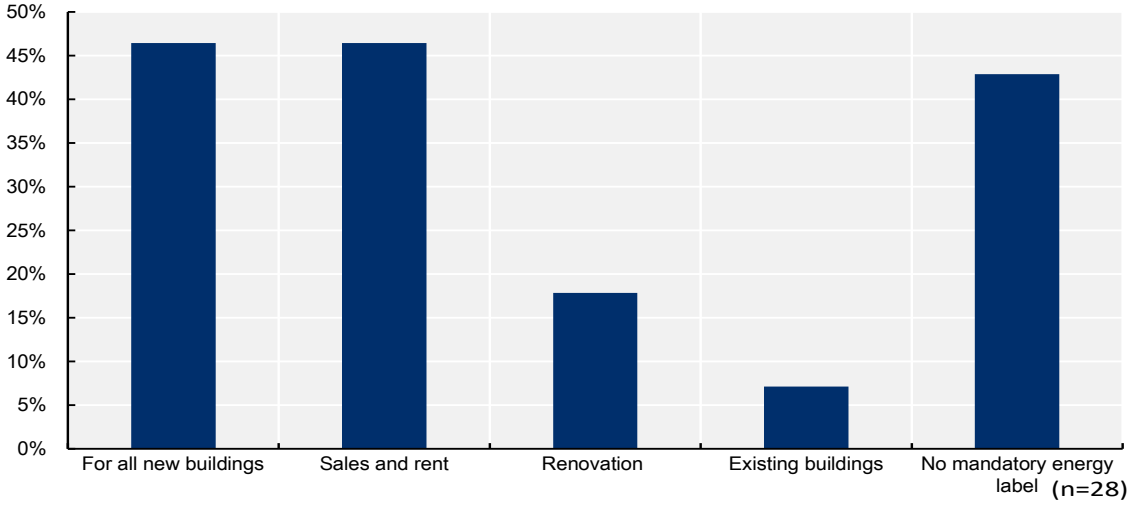
Regarding the issuance of energy labels of buildings, about 46% of responding countries apply mandatory energy labelling to all new buildings. What's more, 46% of responding countries use sales and rent as trigger points to enforce energy labelling of buildings (Figure 2.6).

Figure 2.5. Types of energy labelling for buildings



Note: Question from the survey: "Does your country have an energy/environment labelling programme for buildings in place?"
The responding countries could choose multiple answers if applicable.
Source: OECD Global Survey on Buildings and Climate (2024)

Figure 2.6. Mandatory energy labelling programmes



Note: Question from the survey: "Does your country have a mandatory energy performance certificate (EPC) or mandatory energy labeling programme for buildings in place?"
The responding countries could choose multiple answers if applicable.
Source: OECD Global Survey on Buildings and Climate (2024)

Energy Performance Certificate (EPC)

An Energy Performance Certificate (EPC) is a document that provides information about a building's energy efficiency. It uses a rating system to show how energy efficient building is, ranking from A, the most efficient, to G. EPCs also include recommendations for cost-effective improvements to increase the building's energy performance.

The European Union (EU) plays a major role in promoting EPCs. The Energy Performance of Buildings Directive (EPBD) (2002/91/EC) introduced EPCs across the EU (IEA, 2019[12]). Findings from the EU respondents to the OECD Global Survey on Buildings and Climate (2024) show that EPC integration and implementation methods vary considerably across member states, ranging from calculation approaches, to building scope, and other information.

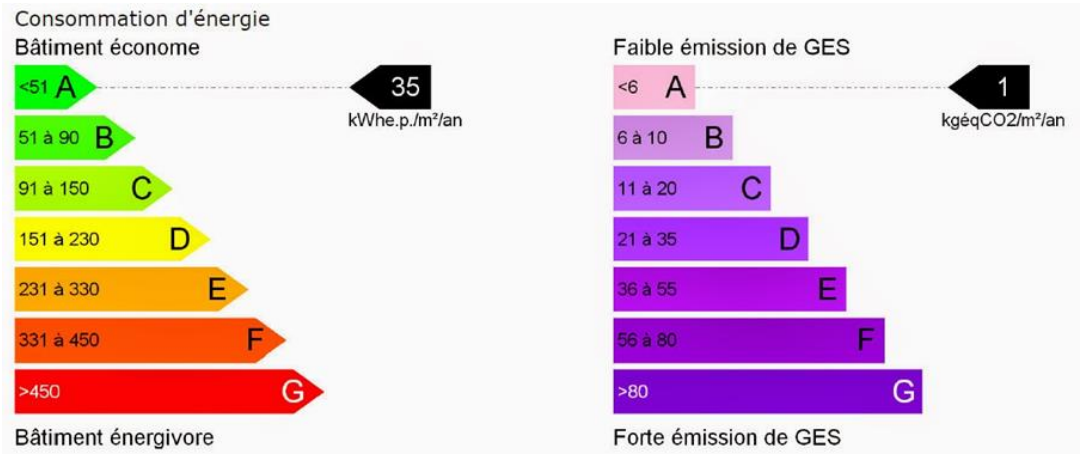
For instance, in **France**, the Diagnostic de Performance Énergétique (DPE) was introduced in 2006, undergoing reforms in 2013 and 2021. The 2021 reform extended DPE information to encompass greenhouse gas emissions (GHG) alongside energy performance (Figure 2.7, Figure 2.8 and Figure 2.9). Normally, a DPE is valid for 10 years. However, in order to accelerate the harmonisation of DPE to the new reformed standard in 2021, DPEs carried out between 1 January 2013 and 31 December 2017 are valid until 31 December 2022; and DPEs carried out between 1 January 2018 and 30 June 2021 are valid until 31 December 2024 (The Ministry of Ecological Transition and d Territorial Cohesion of France, 2024[13]).

In **the Netherlands**, approximately 64.1% of homes possess EPC as of January 2024 (Netherlands Enterprise Agency (RVO), 2024[14]). Since 2015, EPCs are mandatory for property sales or rentals, with a transition in 2021 to the NTA8800 calculation method to align with EU standards and zero-emission building goals. The Dutch EPC evaluates requirement (kWh per m^2 per year), fossil energy use and renewable energy share, issuing labels from A++++ to G and suggesting potential energy-saving measures (Government of the Netherlands, 2024[15]).

In April 2024, the European Council adopted a revised Energy Performance of Buildings Directive (EPBD) aimed at standardising Energy Performance Certificates (EPCs) across all 27 member states. The revision involves a common template for EPCs including indicators for energy, greenhouse gas emissions, and optional ones for charging points and indoor air quality controls. Additionally, a clearer A-G classification system will be implemented, with member states given the flexibility to introduce an "A+" class for buildings exceeding zero-emission standards (European Commission, 2024[16]).

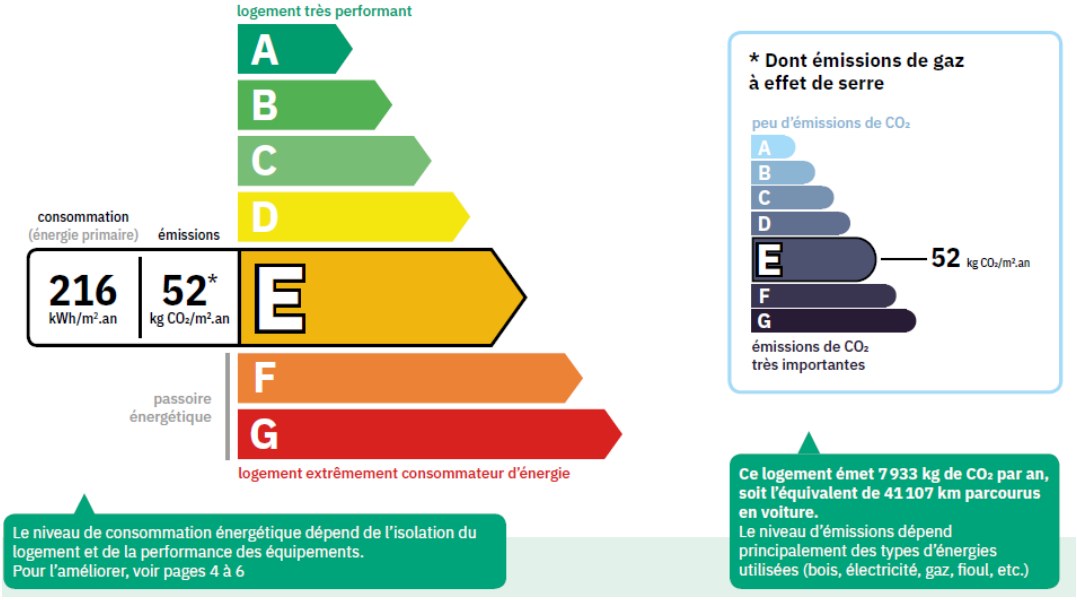
Furthermore, the revision extends EPC issuance to more trigger points such as major renovations and rental contract renewals to raise awareness among stakeholders. Enhanced control mechanisms and visibility in property advertisements are included, alongside public reporting requirements on EPC quality assurance processes. The directive also requires the establishment of national databases on building energy performance to facilitate renovations, alongside the introduction of renovation passport schemes to offer tailored roadmaps for buildings owners planning renovations (European Commission, 2024[16])

Figure 2.7. Diagnostic de Performance Énergétique (DPE) in France before 2021



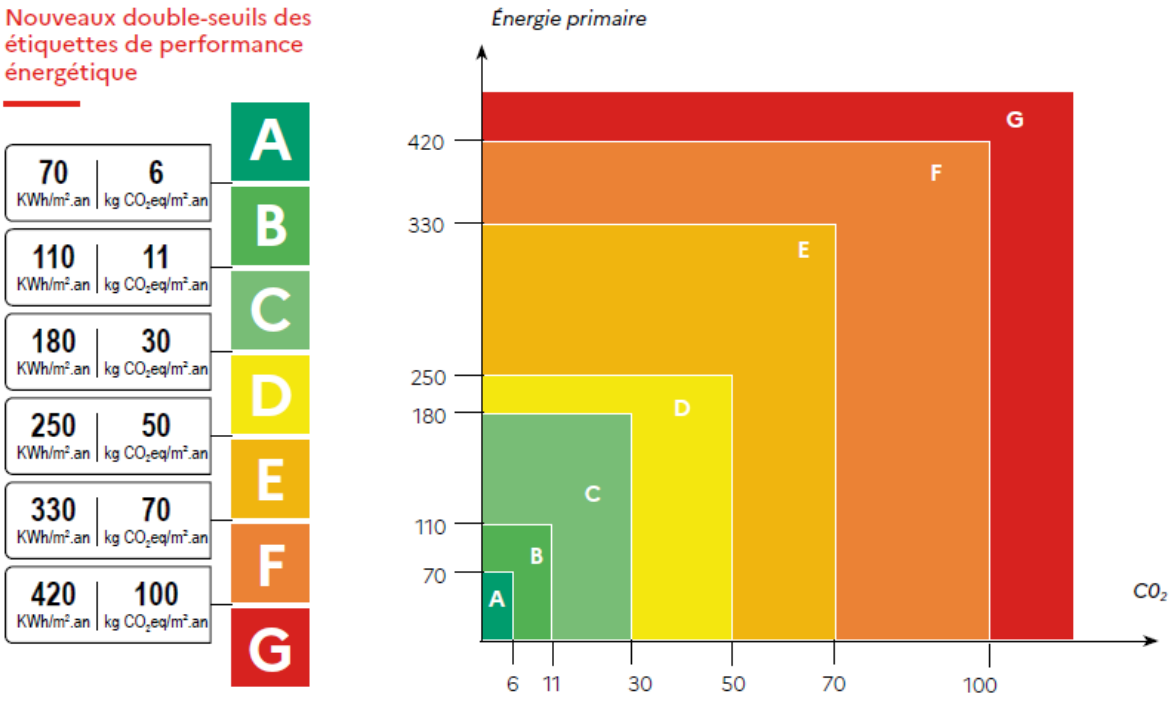
Source: https://rt-re-batiment.developpement-durable.gouv.fr/dpe-logement-r377.html?lang=fr

Figure 2.8. Diagnostic de Performance Énergétique (DPE) in France after 2021



Source: https://www.ecologie.gouv.fr/sites/default/files/2021.02.15_ew_dp_dpe.pdf

Figure 2.9. The new DPE calculation, after 2021



Note: The new DPE includes an "energy" label that directly integrates two aspects: energy consumption and greenhouse gas emissions, expressed respectively in kilowatt-hours of primary energy and kilograms of carbon dioxide equivalent (CO_2). To qualify for an energy label (from A to G), a property must meet a minimum performance threshold for each of the two criteria.
Source: https://rt-re-batiment.developpement-durable.gouv.fr/dpe-logement-r377.html?lang=fr

Other voluntary and mandatory energy-labels

Other than the EPC model in the EU, the mix of voluntary and mandatory energy labels play a significant role in creating a more energy-efficient building stock. By empowering consumers with information about building energy performance, these programmes can lead to lower energy bills, reduced environmental impact and more sustainable future.

In **the United States**, a diverse array of voluntary programmes contributes to fostering energy-efficient building practices. These initiatives empower consumers with information about building energy performance, aiming to reduce energy bills and minimise environmental impact.

For residential buildings, the Home Energy Score offers certification for existing homes based on an asset rating. It provides a standardised assessment of energy-related assets, enabling easy comparison of energy use across the housing market. Each home receives a score on a one-to-ten scale, with higher scores indicating greater energy efficiency (Figure 2.10) (U.S, Department of Energy, 2022[17]). Similarly, the Zero Energy Ready Home Program, launched in 2013, focuses on certifying high-performance new homes. These homes are designed to be so energy efficient that a renewable energy system could offset most of all of their annual energy use (U.S. Department of Energy, n.d.[18]).

Figure 2.10. Home Energy Score in the USA

Source: https://www.energy.gov/eere/buildings/articles/home-energy-score

ENERGY STAR, the largest voluntary housing eco-labelling programme in the United States, plays a crucial role in conveying the energy efficiency of homes and buildings. To qualify for ENERGY STAR certification, homes must meet stringent energy efficiency requirements established by the ENERGY STAR Residential New Construction programme. This certification is available for single-family homes, multifamily buildings, and manufactured homes (ENERGY STAR, n.d.[19]).

In the commercial sector, the ENERGY STAR Commercial Buildings programme serves as a voluntary labelling initiative aimed at recognising and promoting high-performance buildings. Central to its operations is an operational energy rating system, drawing data primarily from the periodic Commercial Building Energy Consumption Survey (CBECS) conducted by the U.S. Department of Energy's Energy Information Administration. This survey, conducted every 5-7 years, collects comprehensive data on building characteristics and energy usage from commercial buildings nationwide (ENERGY STAR, n.d.[20]).

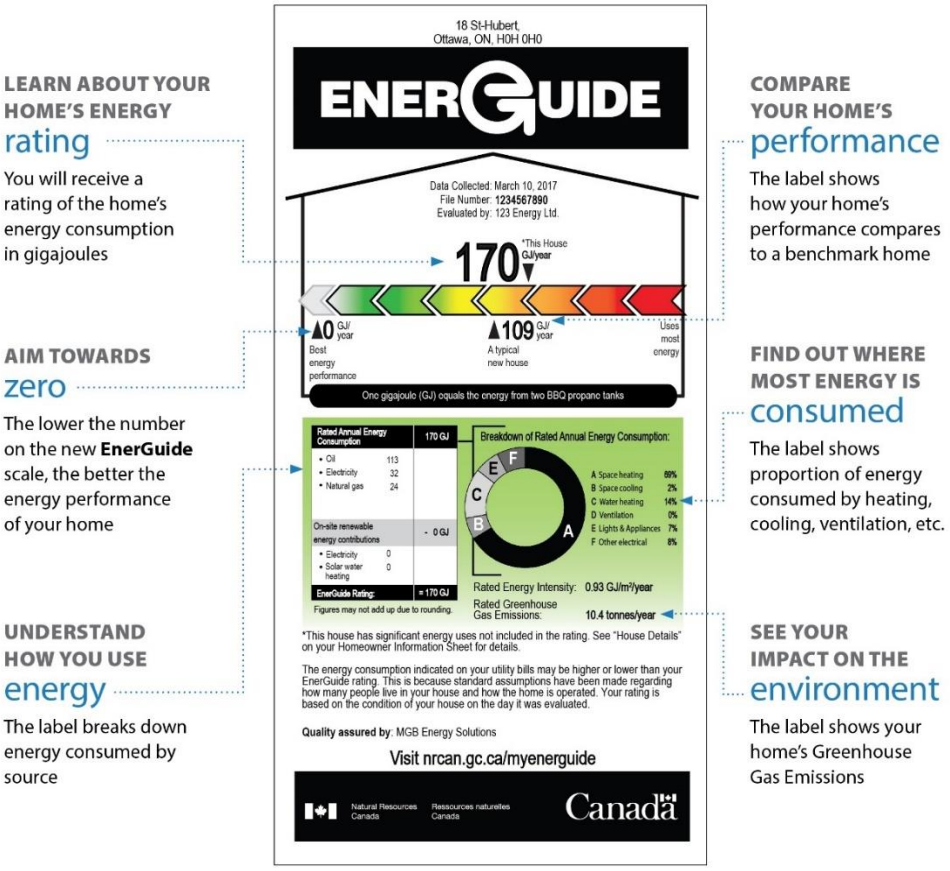
Utilising the detailed information gathered through the CBECS, the ENERGY STAR programme algorithmically estimates a building's energy usage based on various factors such as size, location, occupancy, and equipment. It projects energy consumption levels for best, worst, and intermediate scenarios, and then compares the actual energy data provided by the building owner to these estimates. This comparison allows for a relative ranking of the building's energy efficiency compared to its peers in the industry (ENERGY STAR, n.d.[20]).

Canada utilises two main programmes for building energy labeling, the EnerGuide Label and the ENERGY STAR Portfolio Manager. The EnerGuide Label is specifically designed for residential buildings as demonstrated by Figure 2.11. An EnerGuide home evaluation assesses a home's energy efficiency and assigns it a rating. This rating reflects the estimated annual energy consumption compared to a benchmark home in the region. The label also provides the proportion of energy consumed by heating, cooling, ventilation, etc. Moreover, the label shows dwelling's GHG emissions. The EnerGuide label empowers owners to understand their home's energy performance and identify potential areas for improvement (Natural Resources Canada, n.d.[21]).

In Canada, larger buildings utilise the ENERGY STAR Portfolio Manager, adapted from the US benchmarking and disclosure tool, allowing building owners to monitor and report their energy performance. This tool has been tailored to Canadian needs, incorporating weather conditions, postal codes, languages, the metric system and specific data relevant to the country. Like its US counterpart, the ENERGY STAR Portfolio Manager is voluntary, although some provinces and cities have implemented mandatory disclosure and labelling initiatives aligned with the national programme (Natural Resources Canada, 2023[22]).

For instance, the Canadian province **Ontario** has instituted the Energy and Water Reporting and Benchmarking (EWRB) regulations. Under these regulations, large building owners are required to report their buildings' energy and water usage annually to the Ontario Ministry of Energy. Reporting deadlines vary, with buildings 50 000 square feet and larger mandated to report by 1 July every year. Building owners typically utilise the ENERGY STAR Portfolio Manager to submit their building information and energy consumption data (Ministry of Energy of Ontario, n.d.[23]).

Figure 2.11. EnerGuide from Canada



Source: https://natural-resources.canada.ca/energy-efficiency/homes/what-energy-efficient-home/welcome-my-energuide/16654

Korea launched the Zero Energy Building (ZEB) Certification in 2017 to promote energy-efficient buildings. The ZEB certification programme uses a rating system with five tiers (ZEB 1 being the most energy-efficient). Buildings are evaluated based on two key factors: energy efficiency and renewable energy production (energy self-sufficiency). Since 2020, public buildings larger than 1 000 m^2 were required to meet ZEB 5 level. From 2023, public buildings larger than 500 m^2 were required to meet ZEB 5 level. Moreover, from 2024, private residential apartment buildings more than 30 dwellings should obtain at least ZEB 5 level (Zero Energy Buildings of Korea, n.d.[24]).

Minimum Energy Performance Standards (MEPS)

Meeting climate goals in the building sector requires renovating buildings at unprecedented rates. Recognising this urgency, the European Union has implemented several key directives to drive change.

For instance, Energy Efficiency Directive (2012/27/EU) requires EU countries to conduct regular assessments of efficient heating and cooling systems in buildings. These assessments, carried out every five years, help identify areas for improvement. The revised Renewable Energy Directive (EU/2023/2413) strengthens the use of renewable energy on heating and cooling within buildings. This is achieved by setting stricter targets for overall heating and cooling renewable energy use, as well as the district heating and cooling target (Article 23 and Article 24) (European Commission, n.d.[25]).

Moreover, the European Commission launched the Renovation Wave in 2020 with an aim to green buildings, create jobs and improve lives. The Renovation Strategy highlighted the importance of tackling energy poverty and worst performing buildings, renovation of public buildings and decarbonisation of heating and cooling (European Commission, n.d.[26]).

In alignment with this effort, the EU's Energy Performance of Buildings Directives (EPBD) has introduced Minimum Energy Performance Standards (MEPS). The goal of MEPS is to eliminate the worst-performing buildings by setting a future compliance date or using trigger points such as the sale or rental of the property (European Commission, 2021[27]; RAP, 2023[28]). The revised EPBD primarily targets non-residential buildings, aiming to renovate the poorest-performing structures. MEPS will be based on maximum energy performance thresholds, targeting 16% of the worst-performing non-residential buildings by 2030 and 26% by 2033. Member states have flexibility to exempt certain buildings, such as historical or heritage structures, based on cost-benefit assessments. Additionally, member states must establish pathways to meet lower energy performance thresholds by 2040 and 2050 as part of their National Building Renovation Plans (European Commission, 2024[16]).

For residential buildings, MEPS remain optional, but member states must adopt trajectories to reduce average primary energy use by 16% by 2030 and 20-22% by 2035. The focus will be on renovating the worst-performing buildings, comprising 43% of the residential stock, prioritising cost-efficient measures. Member states must ensure that at least 55% of energy performance improvements are achieved through the renovation of these poorest-performing residential buildings (European Commission, 2024[16]).

According to the OECD Global Survey on Buildings and Climate (2024), only 18% of countries (Belgium (Flanders), France, the Netherlands, Singapore, and the United Kingdom) currently have such MEPS for existing buildings. Some of their MEPS implementation is showed in Table 2.5.

Table 2.5. Examples of countries with Minimum Energy Performance Standards (MEPS)

	France	England, Wales	Netherlands
Target buildings	1) Residential buildings for rent 2) Tertiary buildings	1) Residential buildings 2) Non-residential buildings	Office buildings
Trigger points	1) Rent for residential buildings 2) Annual reporting for tertiary buildings	Rent, Date (1 April 2018, 1 April 2020, 1 April 2023)	Date (1 January 2023)
Minimum Energy Performance Stands (MEPS)	1) Residential buildings: In metropolitan France, to be eligible for rent, a dwelling must: • From January 2023, final energy per m^2 of living space per year, is less than 450 kWh/m^2 • From 1 January 2025, have at least a class F • From 1 January 2028, have at least a class E • From 1 January 2034, have at least a class D 2) Tertiary buildings: Éco Énergie Tertiaire mandates a progressive reduction of final energy consumption for the entire tertiary sector by at least -40% by 2030, -50% by 2040, -60% by 2050, compared to a reference year chosen by the owner or lessee, between 2010 and 2019.	1) Residential buildings • Since 1 April 2018, private landlords may not rent domestic properties on new tenancies to new or existing tenants if the Energy Efficiency Certificate (EPC) rating is below E (unless an exemption applies). From 1 April 2020 the prohibition on renting F and G properties will extend to all relevant properties, even where there has been no change in tenancy. 2) Non-residential buildings: • Since 1 April 2018, non-domestic landlords could only grant new tenancies or extend/renew existing ones if their property had at least an EPC E rating, unless exempt. • Starting 1 April 2023, this requirement applies to all privately rented non-domestic properties, regardless of tenancy changes.	Since 2023, every office building in the Netherlands larger than 100 m^2 is required to have at least energy label C (the use of energy with a primary fossil energy in an office building is no more than 225 kWh/m^2 per year). This applies to existing buildings.

Note: The selected countries are from the countries which have answered to have MEPS in place.
Source: OECD Global Survey on Buildings and Climate (2024)

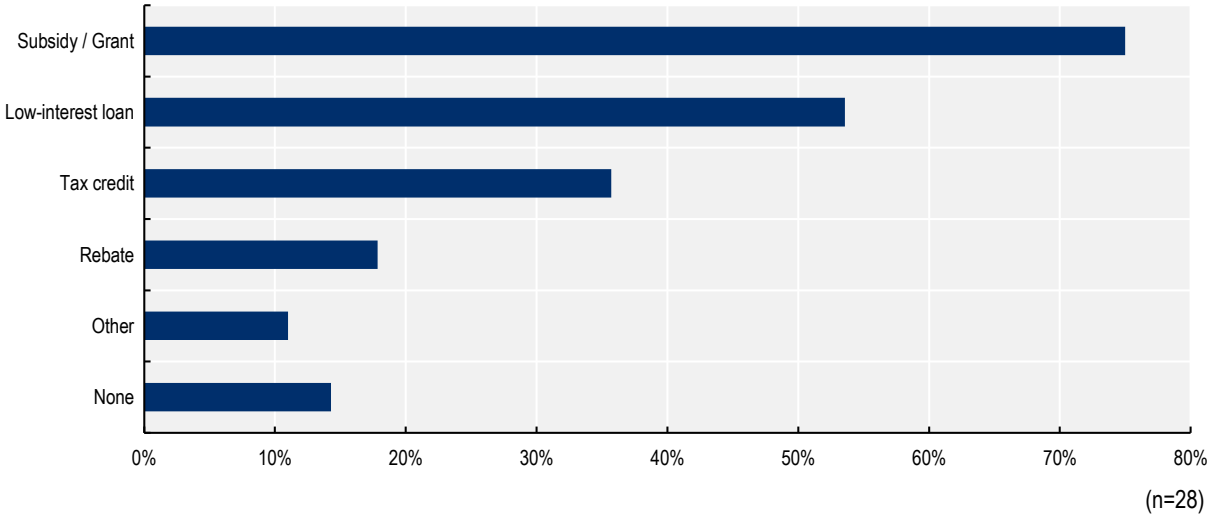
Financial incentives

Decarbonising buildings requires effective financing mechanisms that incentivise investments in deep retrofit of entire buildings, as well as upgrades to the heating or cooling systems. Stable financial incentives designed and implemented by governments can also ensure policy stability, which is key for actors on both the supply and demand side (Kerr and Winskel, 2020[29]). On the demand side, the upfront costs associated with energy-efficient refurbishments can be significantly alleviated through an array of financial incentives provided by governments. On the supply side, a reliable, long-term government-supported funding initiative is essential to make retrofitting businesses more attractive. Contractors are hesitant to adapt their business models to focus on energy-efficient installations unless they receive consistent, long-term policy signals about the potential returns (Gillich, 2013[30]).

These financial incentives, which intend to overcome the upfront cost barrier, can be divided into grants and loans. On one hand, subsidies, grants, tax credits and rebates are direct financial aid that is not expected to be repaid; on the other hand, loans usually make use of public funds for direct lending or as credit enhancements such as low-interest rates. Often, the eligible loans for energy efficiency improvements are repaid through the savings in monthly utility bills (Gillich, 2013[30]). This financing method captures savings not otherwise available and replenishes the original funding on a revolving basis, making it easier for property owners to manage their repayments. Governments can use public funds to lower commercial interest rates or provide loan guarantees to mitigate some of the lender's risks (Kerr and Winskel, 2020[29]).

The OECD Global Survey on Buildings and Climate (2024) finds that 86% of responding countries have direct financial incentives for energy-efficient upgrades in buildings. However, the type and the coverage vary significantly. Three out of four countries have a subsidy or a grant in place. Low-interest loans rank second, available in 54% of countries. Tax credits are offered in 36% of countries, followed by rebates in 18%. While 11% of countries provide other types of financial incentives, 14% of countries offer none (Figure 2.12).

Figure 2.12. Types of Financial Incentives for Energy Efficiency in Buildings



Note: Question from the survey: "Are there any direct financial incentives available for energy-efficient upgrades (e.g. heat pumps, district heating installation, insulation, renewable energy, etc.) in buildings?" The responding countries could select all applicable options. The responding countries could select all applicable options.
Source: OECD Global Survey on Buildings and Climate (2024)

Grants reduce upfront cost for retrofitting and renovation

By providing direct financial aid to the property owners and tenants for implementing energy-efficiency measures, the energy demand can be reduced within a short period of time since one-off payment grants are attractive to households. **Germany**'s "Federal Funding for Efficient Buildings" has a "heating system exchange" programme which provides a basic subsidy of 30% available for all residential and non-residential buildings for all groups of applicants, including landlords. This includes an additional 5% efficiency bonus for installing heat pumps that use water, soil or wastewater as a heat source, or use a natural refrigerant. EUR 2 500 will be granted on top for biomass heating systems if they comply with a dust emission limit of 2.5 mg/m³. The programme also specifies that the cost relieved by the subsidies cannot be passed on to the rent, dampening the rise in rents through renovations. Moreover, a 20% "climate speed bonus" for owner-occupiers is given to those who replace their old fossil fuel heating systems before 2028. From 2029 onwards, this "climate speed bonus" will decrease 3% every two years. In addition, a 30% bonus is available for owner-occupiers with EUR 40 000 of taxable annual household incomes (Bundesministerium für Wirtschaft und Klimaschutz, 2024[31]).

Some grants are designed to target specific types of buildings, reflecting the structure of the building stock in the given country. For example, in **Sweden,** detached and semi-detached homes comprise 92% of Sweden's residential building stock (Lantmäteriet, 2021[32]). What's more, single-family homes accounted for 39% of space heating and hot water usage in 2021 (Swedish Energy Agency, 2022[33]). For this reason, Sweden focuses on single-family homes by offering grants to convert from electricity and gas-based heating systems (Boverket, 2024[34]). The direct financial aid is designed to rapidly reduce the demand for electricity and gas in residential buildings.

Norway offers a subsidy to municipalities aimed at supporting energy-efficiency measures in municipality-owned public housing, care homes, and nursing homes due to their substantial potential for energy efficiency improvements. In 2023, NOK 300 million of public funds was granted to the Norwegian State Housing Bank, the agency that manages the financing scheme at the national level. Municipalities can apply to the subsidy and will receive the subsidy upon the implementation of the energy-efficiency measures. The subsidy covers up to 50% of the costs of the measures undertaken with a cap of NOK 5 million for each project. The eligible energy-efficiency measures include post-insulation of exterior walls, post-insulation of external roof/cold attic, replacement of windows, thermal insulation of char, heat humps, solar thermal collector, solar and solid fuel bio-boiler (Ministry of Local Government and Regional Development of Norway, 2023[35]).

Spain's Recovery, Transformation and Resilience Plan introduces measures to encourage building energy renovation, including tax credits for property owners. These credits can be offset against the personal income tax owed for energy efficiency improvements in homes. From 2021 to 2024, individuals can apply for tax credit when carrying out renovation works for reducing heating and cooling demand with a deduction percentage of 20% and a maximum of EUR 5 000, as well as for improving the consumption of non-renewable primary energy with a deduction percentage of 40% and a maximum of EUR 7 500 (Jefatura del Estado, 2022[36]).

Low-interest loans ensure long-term cost-effectiveness

While direct financial aid, such as grants and subsidies, can significantly reduce the upfront cost for renovations, it requires substantial public funds. Low-interest loans provide an effective alternative financing method for scaling up energy efficiency programmes, lessening the financial strain on public investment and ensuring long-term cost effectiveness and market transformation.

The **Japan** Housing Finance Agency (JHF) has initiated a low-interest "Green Renovation Loan" to support energy-saving renovations, offering financial assistance for renovation projects that enhance energy efficiency, such as improving heat insulation or installing energy-saving equipment. For renovations that significantly improve energy-saving performance, meeting the Zero Energy House (ZEH) standards, the interest rate on the loan is reduced. Loans can be issued up to JPY 5 million, with no collateral, guarantor, or financing fees required. The total construction cost, including other renovations, can also be up to JPY 5 million. Before construction begins, applicants must obtain a certificate of conformity and have their construction plan inspected to ensure compliance with requirements. Furthermore, a special repayment provision for the elderly is available, allowing monthly interest-only payments. The principal is repaid in a lump sum by the heirs or through the sale of collateral property upon the borrower's death (Japanese Housing Finance Agency, n.d.[37]).

Financial support for low-income households is necessary

Decarbonising buildings measures can be costly especially for low-income households. Even if low-income households do not bear the financial cost of retrofit directly if they are renting the property, they might face significant rent increase following retrofit work. Against this backdrop, the revision of the EPBD mandates member states to establish National Building Renovation Plan. This plan should set out the national strategy to decarbonise the building stock while addressing barriers such as financing. In addition, the

Social Climate Fund established under the European Grean Deal will mobilise EUR 86.7 billion for the period of 2026-2032 to support vulnerable households and small businesses with energy renovations as one of the two focus areas on structural measures (European Commission, 2024[16]).

France provides financial support for retrofit via MaPrimeRénov' programme, which differs based on household income levels. MaPrimeRénov' is a scheme designed to prioritise the installation of decarbonised heating or hot water systems, meaning those that operate using cleaner and more energy-efficient sources. It is possible to obtain MaPrimeRénov' multiple times for different types of work within the same property (for instance, renovations on a different area of the property or for another piece of equipment), with a cap of EUR 20 000 for works per property over a five-year period. Funding is provided as a lump sum, which varies depending on the type of work, such as installing heat pumps or solar systems, and the income level of the household.

Additionally, MaPrimeRénov' Parcours Accompagné is intended for more extensive renovations that achieve an improvement of at least two energy performance classes. It can cover up to EUR 70 000, with funding amounts depending on the cost of the work and the household's income level. MaPrimeRénov' Copropriété is aimed at the renovation of common areas in shared ownership buildings and collective work in private sections. Within this scheme, there is an individual bonus for each dwelling, providing EUR 3 000 for very low-income households and EUR 1 500 for low-income households. (Agence nationale de l'habitat, 2024[38]).

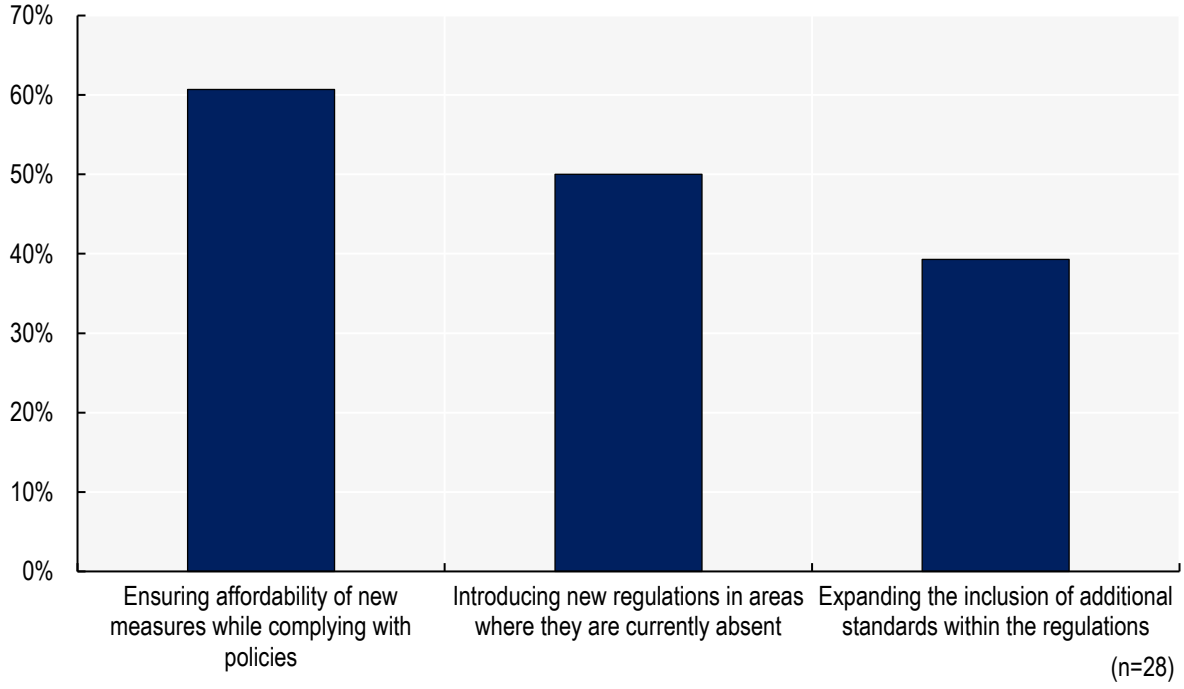
Furthermore, **the United States'** Greenhouse Gas Reduction Fund has a budget of USD 27 billion to mobilise finance and private capital for projects that reduce greenhouse gas emissions and air pollution, particularly for low-income and disadvantaged communities. This fund was established as part of the Inflation Reduction Act, which was signed into law on 16 August 2022. It is comprised of three programmes: the National Clean Investment Fund, Clean Communities Investment Accelerator and Solar for All, which aim to finance clean technology deployment nationwide, support clean technology initiatives in low-income and disadvantaged communities, build the capacity of lenders serving communities and promote the adoption of distributed solar energy to lower energy bills for millions of Americans in low-income and disadvantages communities (EPA, 2024[39]). In addition, the U.S. Department of Housing and Urban Development (HUD) introduced direct financing schemes such as the Green and Resilient Retrofit Program in 2023 to enhance energy efficiency and climate resilience in HUD-assisted multifamily housing and affordable housing communities serving low-income families (U.S. Department of Housing and Urban Development, 2023[40]).

Similarly, **Poland** has implemented subsidies for entire building deep retrofits and heating or cooling system energy performance upgrades for people with low and average incomes. This should also help achieve the country's quantitative targets for district heating, heat pumps and renewable energy as indicated in the Polish Resilience and Recovery Plan (Ministry of Funds and Regional Policy of Poland, 2022[41]).

Challenges for policy implementation

Ensuring affordability of new measures is the primary challenge for decarbonising new buildings
The introduction of regulations for new buildings entails significant hurdles, particularly concerning financial burdens. Compliance with stringent energy efficiency and whole-life carbon requirements may substantially increase construction costs, potentially making new developments financially prohibitive for developers and residents alike. 60% of responding countries identified the economic feasibility of new measures as a primary concern, underscoring the pervasive challenge of aligning regulatory requirements with financial constraints (Figure 2.13).

Figure 2.13. Top 3 challenges in regulatory measures for new buildings

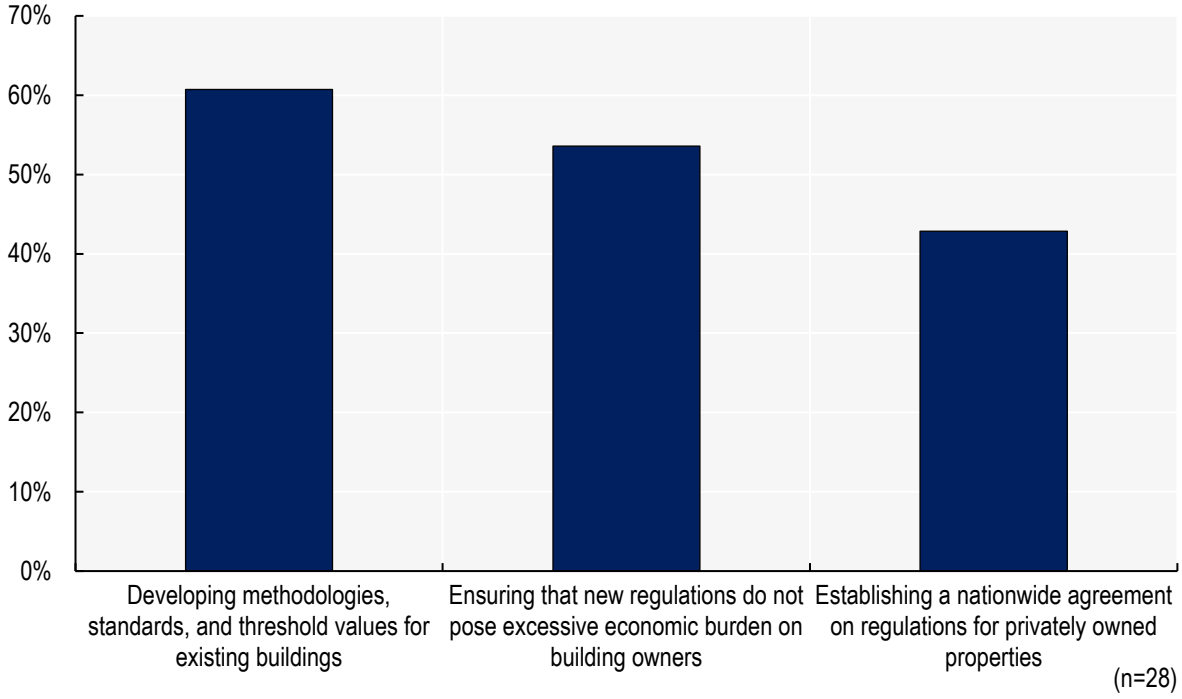


Note : Question from the survey: "What are the main challenges for regulative measures on energy performance of new buildings?" Countries could select two options for this question.
Source: OECD Global Survey on Buildings and Climate (2024)

The efforts to decarbonise existing buildings are hindered by lack of standardised methodologies, financial costs and conflicts of interests

Decarbonising existing buildings requires the gradual elimination of worst-performing buildings. Currently, only 18% of responding countries have established Minimum Energy Performance Standards (MEPS) that require mandatory renovations of worst-performing buildings. The top three challenges to introducing MEPS identified by respondents are: i) the development of tailored methodologies and standards for diverse types of buildings (61%); ii) ensuring that the regulations do not impose financial burdens on building owners (54%); and iii) securing nationwide consensus on regulations for privately owned buildings (43%) (Figure 2.14).

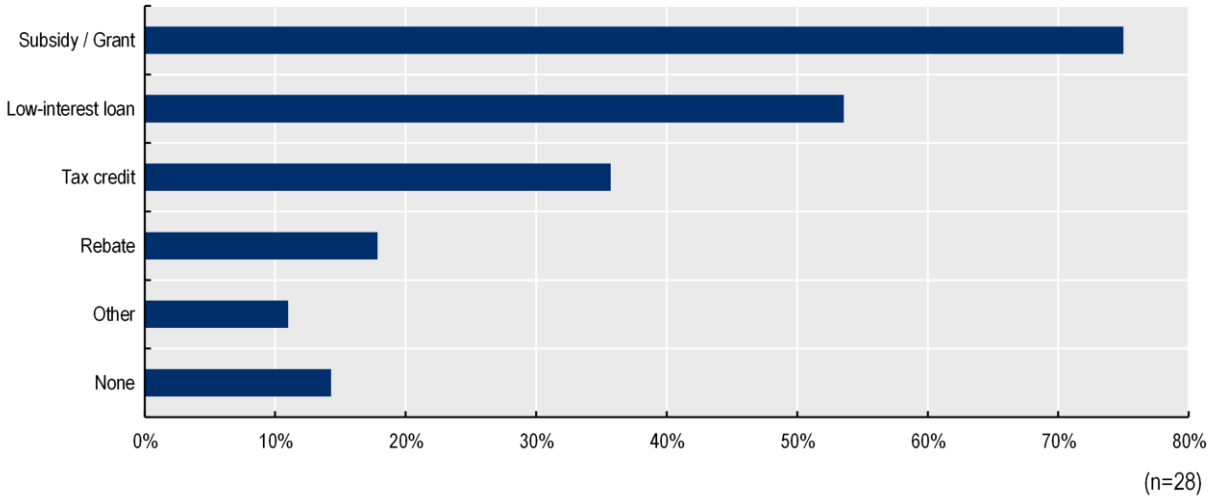
Figure 2.14. Top 3 challenges in regulatory measures for existing buildings



Note: Question from the survey: "What are the main challenges in introducing regulation on Minimum Energy Performance Standards (MEPS) of existing buildings?".
Countries could select 3 options.
Source: OECD Global Survey on Buildings and Climate (2024)

Initiating retrofit projects in multi-owner buildings poses challenges due to varying interests among households sharing common spaces and utilities. This diversity of interests can hinder decision-making and consensus-building, impeding the implementation of retrofit measures. Additionally, financial barriers present a significant obstacle to decarbonising existing buildings. The costs associated with retrofitting may dissuade building owners from investing in energy efficiency improvements. Moreover, rental properties face additional complexities due to split incentives between owners and tenants. Owners may hesitate to invest in energy efficiency upgrades if the benefits primarily benefit tenants through reduced utility bills. Conversely, tenants may lack the authority or financial means to undertake retrofit projects independently. Addressing this disparity necessitates innovative financial mechanisms and collaborative approaches that align the interests of both parties, facilitating retrofits to enhance energy efficiency and sustainability in rental properties (Figure 2.15).

Figure 2.15. Top 3 types of buildings that need financial incentives the most to encourage deep retrofits



Note: Question from the survey: "Which types of buildings need financial incentives the most to encourage deep retrofits?" Countries could select up to three options.
Source: OECD Global Survey on Buildings and Climate (2024)

Current and future policy priorities

Currently, countries have different policy priorities based on climate and building conditions

Heating and cooling variability due to climatic conditions

Several factors contribute to the diverse approaches taken by countries in terms of decarbonising buildings. For example, countries tailor their heating and cooling strategies according to their specific climatic conditions. Table 2.6 divides countries into three groups based on their priorities: i) countries that prioritise heating (i.e. Finland, Sweden); ii) countries with emphasis on both heating and cooling (i.e. Greece, Japan, Spain); and iii) countries that focus primarily on cooling (i.e. Brazil).

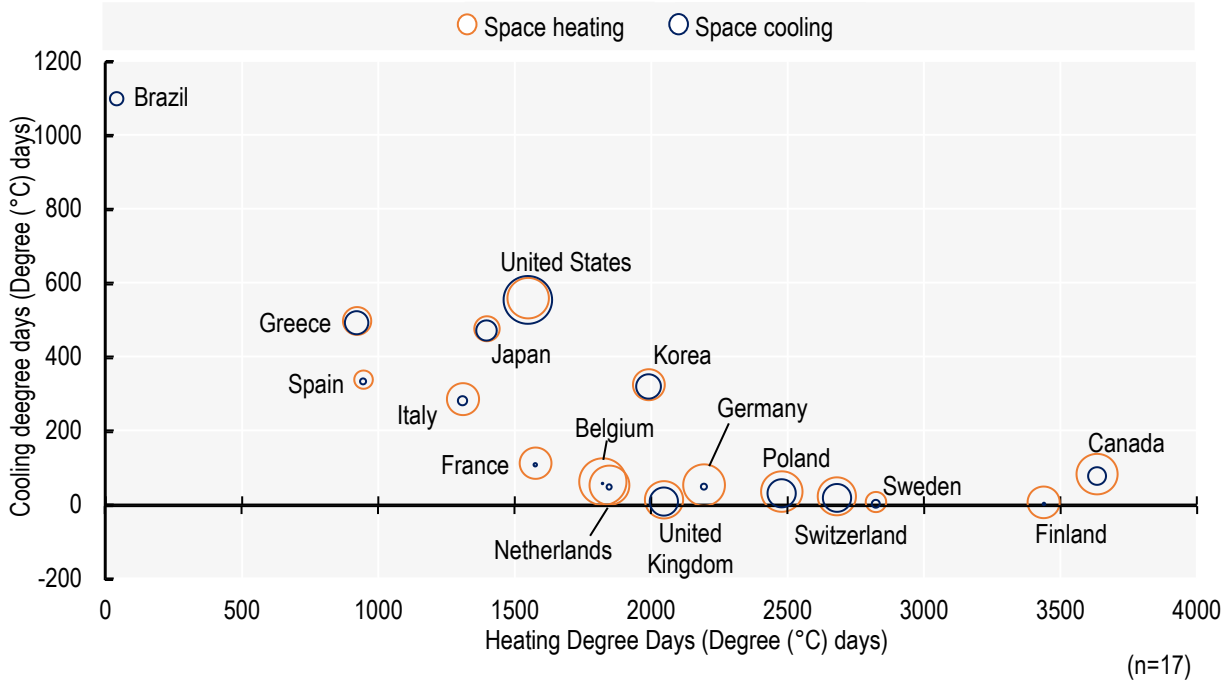
Per capita emissions from space heating and cooling vary significantly across countries, influenced by factors such as climate (represented by heating and cooling degree days), the energy performance of their heating and cooling systems in place. In general, countries prioritising heating tend to report considerably higher per capita emissions associated with space heating compared to those emphasising cooling (i.e. Germany, France, Finland). Conversely, countries focusing on both heating and cooling display comparable per capita emission levels for both space heating and cooling (i.e. Japan, Greece) (Figure 2.16).

Table 2.6. Clustering of countries according to heating or/and cooling priorities (current focus)

Priorities	Country
Heating	Belgium (Flanders), Canada, Finland, France, Germany, Iceland, Italy, Lithuania, Netherlands, Norway, Philippines, Poland, Sweden, Switzerland, United Kingdom, United States
Heating & Cooling	Colombia, Greece, Japan, Korea, Spain
Cooling	Brazil, Costa Rica, Ivory Coast, Israel, Mexico, Singapore, Thailand

Source: OECD Global Survey on Buildings and Climate (2024)

Figure 2.16. Residential space heating and space cooling emissions per capita (2021)



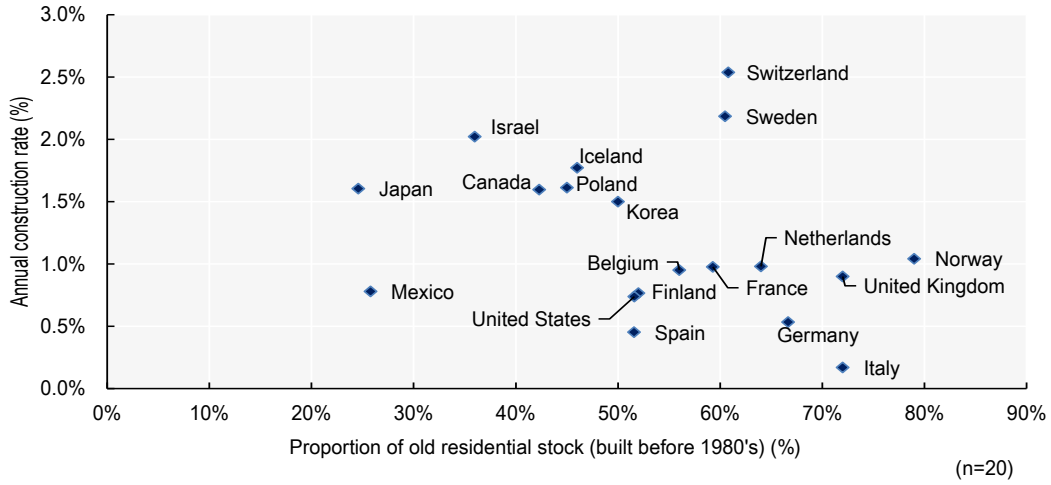
Note: 17 countries out of 28 responding countries had available data on emissions data from the IEA database.
The reference degree for Heating Degree Days is 16 degrees (°C). The reference degree for Cooling Degree Days is 21 degrees (°C).
Source: OECD calculation based on https://www.iea.org/data-and-statistics/data-tools/weather-climate-and-energy-tracker?tab=Weather+for+energy+tracker, https://www.iea.org/countries

Policy priorities regarding building decarbonisation are linked to building stock age and rates of construction

Countries such as Japan, Canada, and Mexico prioritise new buildings due to their relatively high rates of new construction, and comparatively fewer existing older buildings than other countries. In such countries, decarbonisation policies are essential to prevent the long-term lock-in of buildings dependent on fossil fuels, especially given their extended life expectancy. Conversely, other countries such as Finland, Italy and the United Kingdom prioritise existing buildings, as they have lower annual rates of construction and a significantly higher share of old residential buildings (Figure 2.17).

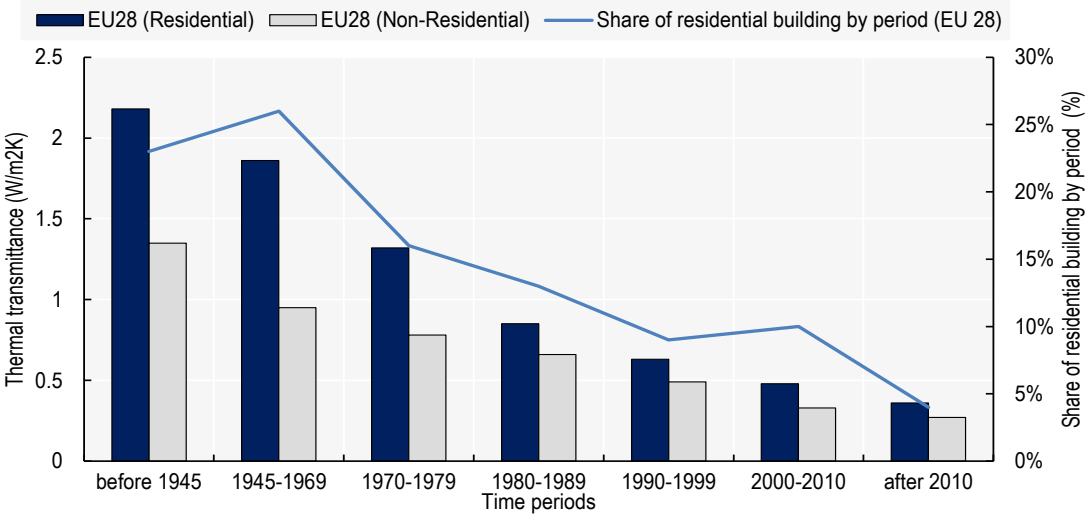
Existing buildings are particularly challenging in the EU as 65% of existing buildings were constructed before 1980 and buildings built before 1945 leak 5 times more energy than modern ones (Figure 2.18). Despite the challenges posed by their energy demand, some countries have made significant efforts to decarbonise buildings Countries such as Canada, Finland and Sweden have managed to reduce their heating emissions over the past two decades, although their colder climates naturally result in higher demands for heating (Figure 2.19).

Figure 2.17. Old residential building stock and annual construction rate



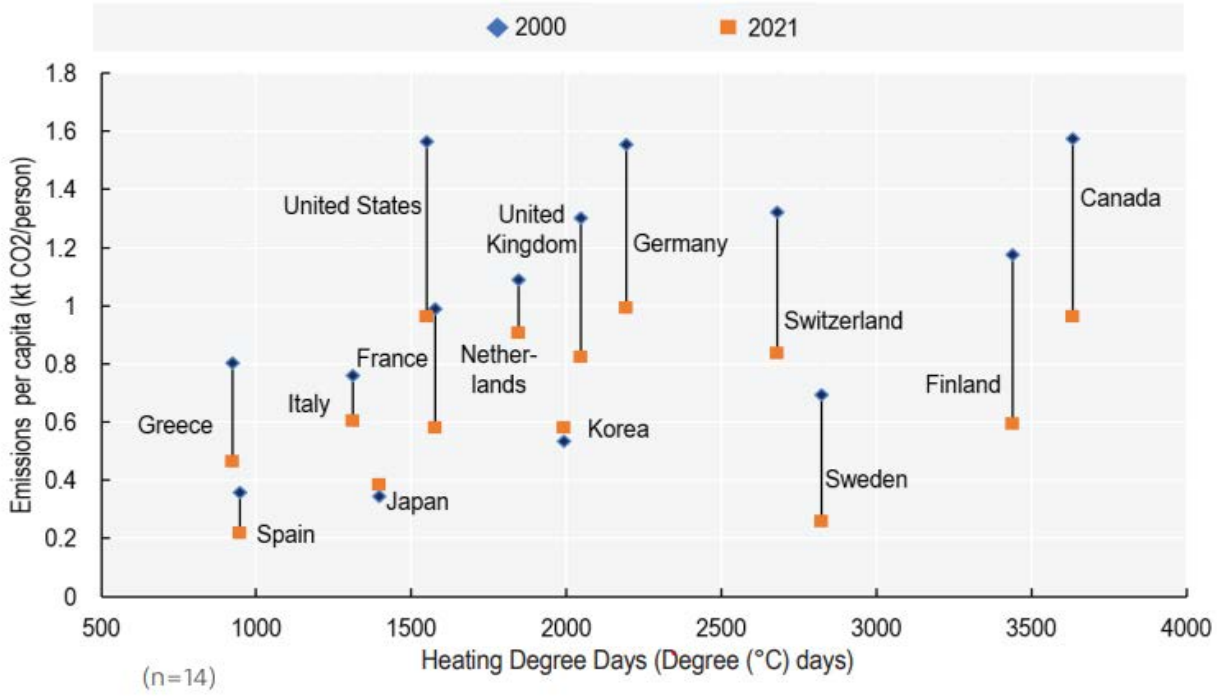
Note: The survey requested countries to report on various indicators related to residential building stock for the most recent available year. Specifically, countries provided data on the percentage of old residential buildings constructed before 1980 and the annual construction rate of new residential units. The indicators include the number of residential dwellings, square meters of residential building space, and distribution by dwelling type and year of construction. Data availability varied by country, with most providing national level data, and some offering provincial or municipal level data.
Source: OECD Global Survey on Buildings and Climate (2024)

Figure 2.18. Thermal transmittance value of external wall by building age (W/ m²K), 2017



Source: OECD calculation based on https://energy.ec.europa.eu/index_en

Figure 2.19. Residential space heating emissions per capita

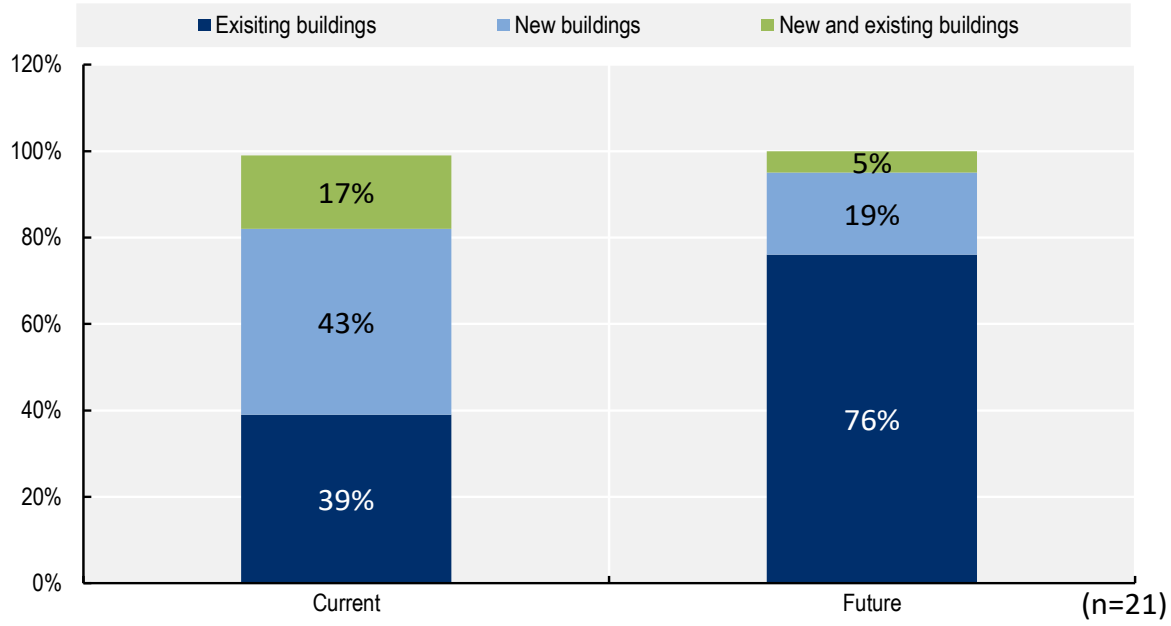


Note: The reference degree for Heating Degree Days is 16 degrees (°C). The reference degree for Cooling Degree Days is 21 degrees (°C).
Source: https://www.iea.org/data-and-statistics/data-tools/weather-climate-and-energy-tracker?tab=Weather+for+energy+tracker
Future policy priorities will focus more on embodied carbon & circularity, existing buildings, and cooling

76% of countries have reported that they will prioritise existing buildings over new ones in the future

Looking into the future, 76% of responding countries have indicated a shift in focus towards prioritising existing buildings. This marks a significant surge from the current share of 39%. Conversely, the proportion of surveyed countries that will prioritise interventions for new constructions in the future is set to decline, with only 19% compared to the current 43% (Figure 2.20).

Figure 2.20. Policy priorities on new and existing buildings



Note: Question from the survey: "What is the main target/priority on decarbonising building policies?"
Countries could select one option for each priority.
Source: OECD Global Survey on Buildings and Climate (2024)

Table 2.7. Country Policy priorities on new and existing buildings

Country	Current / Future	New buildings	Existing buildings	New and existing buildings
Belgium (Flanders)	Current	✓		
	Future		✓	
Brazil	Current	✓		
	Future	✓		
Canada	Current	✓		
	Future		✓	
Colombia	Current	✓		
	Future		✓	
Costa Rica	Current			✓
	Future			✓
Côte d'Ivoire	Current		✓	
	Future	✓		
Finland	Current		✓	
	Future			
France	Current			✓
	Future		✓	
Germany	Current			
	Future			
Greece	Current		✓	
	Future		✓	

Iceland	Current	✓		
	Future	✓		
Israel	Current	✓		
	Future		✓	
Italy	Current		✓	
	Future		✓	
Japan	Current	✓		
	Future		✓	
Korea	Current		✓	
	Future		✓	
Lithuania	Current			✓
	Future		✓	
Mexico	Current			
	Future			
Netherlands	Current		✓	
	Future			
Norway	Current			
	Future			
Philippines	Current	✓		
	Future		✓	
Poland	Current		✓	
	Future		✓	
Singapore	Current	✓		
	Future		✓	
Spain	Current			✓
	Future		✓	
Sweden	Current			
	Future			
Switzerland	Current		✓	
	Future		✓	
Thailand	Current	✓		
	Future		✓	
United Kingdom	Current		✓	
	Future	✓		
United States	Current			
	Future			
Percentage of responding countries	Current	43% (10/23)	39% (9/23)	17% (4/23)
Percentage of responding countries	Future	19% (4/21)	76% (16/21)	5% (1/21)

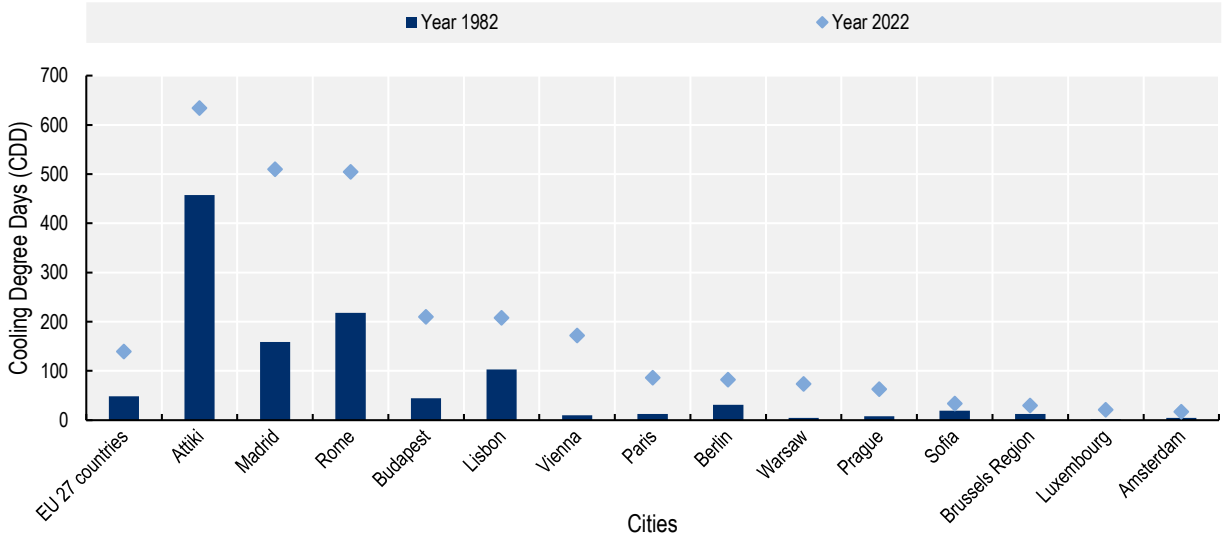
Note: Question from the survey: "What is the main target/priority on decarbonising building policies?"
Countries could select one option for each priority. Unchecked cells indicate that these options are not policy priorities.
Source: OECD Global Survey on Buildings and Climate (2024)

14% of responding countries are shifting their focus from heating to cooling

As global temperatures rise, access to cooling becomes increasingly vital. This shift in priority is reflected in several countries. Finland, France, Italy and the United Kingdom reported that cooling will become a priority in the future whereas the current priority focuses more on heating. Also, increasing number of countries (Brazil, Colombia, Costa Rica, France, Italy, Mexico, Singapore, Thailand and the United Kingdom) are emphasising passive design for cooling, with projections for its use rising from 21% to 32% in the future.

This trend is especially evident in European countries, as demonstrated by the significant rise in Cooling Degree Days (CDD) observed over last 40 years, indicating a growing demand for cooling (Figure 2.21).

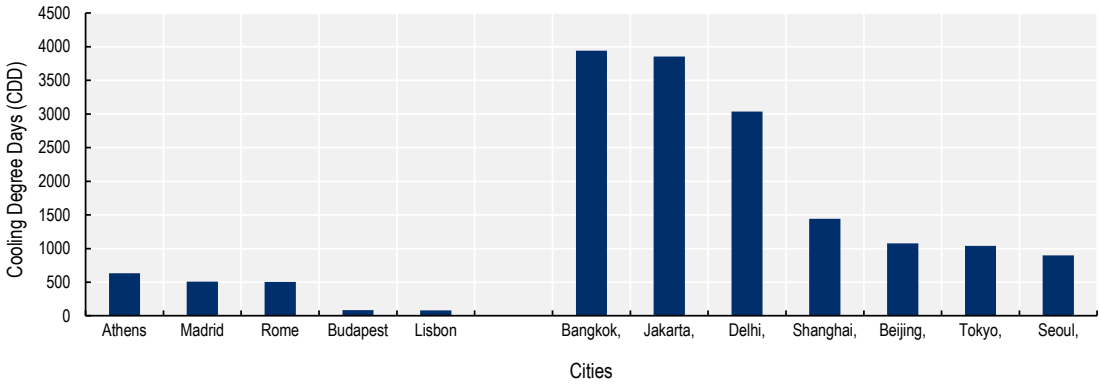
Figure 2.21. Significant increase of Cooling Degree Days over the past 40 years in EU cities



Note: The reference degree for Heating Degree Days is 16 degrees (°C).
Source: OECD calculations based on Eurostat (2023), Cooling and heating degree days by NUTS 3 regions – annual data; Japan Meteorological Agency (2024), World Weather Data Tool, https://www.data.jma.go.jp/gmd/cpd/monitor/dailyview/graph_mkhtml_d.php?&n=48455&p=183&s=7&r=0&y=2022&m=7&d=2&e=0&k=0

However, this need for improved cooling isn't uniform worldwide. South Asia and America, for example, have historically grappled with extreme heat, leading to significantly higher cooling demands compared to Europe. For this reason, among the nine countries prioritising passive design, only Singapore, Thailand and Costa Rica – all situated in tropical climates – are putting emphasis on cooling for both current and future priorities. Moreover, Figure 2.22 shows that Bangkok (Thailand) has cooling degree days roughly 80 times higher than Rome in 2022. Therefore, international co-operation is pivotal in sharing knowledge and experiences, as the dynamics of cooling and heating needs are evolving over time.

Figure 2.22. Cooling Degree Days in EU and Asian Cities in 2022

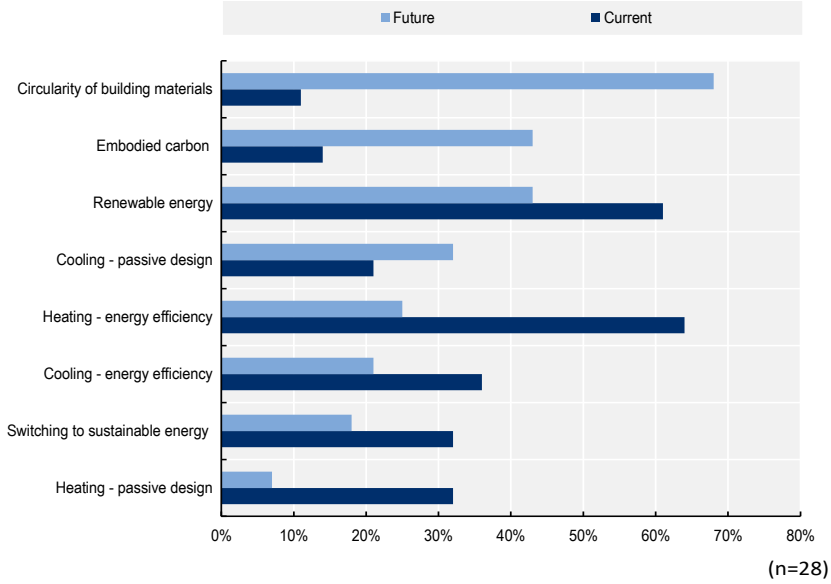


Note: The reference degree for Cooling Degree Days is 21 degrees (°C).
Source: OECD calculations based on Eurostat (2023), Cooling and heating degree days by NUTS 3 regions – annual data; Japan Meteorological Agency (2024), World Weather Data Tool, https://www.data.jma.go.jp/gmd/cpd/monitor/dailyview/graph_mkhtml_d.php?&n=48455&p=183&s=7&r=0&y=2022&m=7&d=2&e=0&k=0

Countries are planning to focus on embodied carbon and the circularity of building materials in future policies

Our survey identifies a notable surge in the emphasis placed on embodied carbon and the circularity of building materials. The focus on embodied carbon has risen from 18% to 46%, alongside a substantial increase in prioritising circularity of building materials, rising from 14% to 64% (Figure 2.23).

Figure 2.23. Shift of policy priorities



Note: Question from the survey: "Among the options below, which are the main targets/priorities on building policies?". The responding countries could choose three options respectively for current and future priorities.
Source: OECD Global Survey on Buildings and Climate (2024)

Table 2.8. Short-term and long-term policy directions

Country	Current / Future	Passive design to reduce heating demand	Energy efficiency on heating	Passive design to reduce cooling demand	Energy efficiency on cooling	Switching energy to sustainable energy	Renewable energy	Embodied carbon	Circularity of building materials
Belgium (Flanders)	Current	✓	✓				✓		
	Future		✓				✓	✓	
Brazil	Current				✓		✓		
	Future			✓				✓	✓
Canada	Current		✓			✓	✓		
	Future	✓						✓	✓
Colombia	Current	✓	✓		✓				
	Future			✓			✓		✓
Costa Rica	Current			✓	✓		✓		
	Future			✓			✓		✓
Côte d'Ivoire	Current			✓	✓		✓		
	Future								✓
Finland	Current		✓				✓	✓	
	Future				✓			✓	✓
France	Current	✓	✓			✓			
	Future			✓				✓	✓
Germany	Current	✓	✓				✓		
	Future		✓					✓	✓
Greece	Current		✓		✓		✓		
	Future					✓			✓
Iceland	Current		✓					✓	✓
	Future		✓			✓			✓
Israel	Current			✓			✓	✓	
	Future								✓
Italy	Current	✓	✓				✓		
	Future			✓	✓		✓		
Japan	Current	✓	✓	✓					
	Future						✓	✓	✓
Korea	Current		✓		✓		✓		
	Future		✓		✓		✓		
Lithuania	Current	✓						✓	✓
	Future	✓						✓	✓
Mexico	Current				✓	✓	✓		
	Future			✓	✓			✓	
Netherlands	Current		✓			✓			✓
	Future						✓	✓	✓
Norway	Current	✓	✓						
	Future	✓	✓						
Philippines	Current	✓	✓			✓			
	Future					✓	✓		✓
Poland	Current		✓			✓	✓		
	Future		✓			✓	✓		

Singapore	Current			✓	✓		✓		
	Future			✓	✓		✓		
Spain	Current		✓		✓	✓			
	Future							✓	✓
Sweden	Current		✓				✓	✓	
	Future		✓					✓	✓
Switzerland	Current	✓				✓			✓
	Future						✓	✓	✓
Thailand	Current			✓	✓		✓		
	Future			✓	✓		✓		
United Kingdom	Current		✓			✓	✓		
	Future			✓		✓	✓		
United States	Current								
	Future								
Percentage of responding countries	Current	36% (10/28)	64% (18/28)	21% (6/28)	36% (10/28)	32% (9/28)	61% (17/28)	18% (5/28)	14% (4/28)
Percentage of responding countries	Future	11% (3/28)	25% (7/28)	32% (9/28)	21% (6/28)	18% (5/28)	46% (13/28)	46% (13/28)	64% (18/28)

Note: Question from the survey: "Among the options below, which are the main targets/priorities on building policies?"
The responding countries could choose three options respectively for current and future priorities. Unchecked cells indicate that these options are not policy priorities.
Source: OECD Global Survey on Buildings and Climate (2024)

Climate resilience is of increasing importance as buildings face escalating risks due to climate change

While climate change mitigation requires a reduction of carbon emissions generated throughout the life cycle process of buildings, creating a climate-proof built environment is equally important to accelerate adaptation to climate change. Adaptative measures are notably necessary given that buildings are capital-intensive and long-lasting assets exposed to multiple climate risks, affecting building structures, materials, indoor climate and energy use.

A spectrum of climate-related disasters, including storms, cyclones, flooding, wildfires and heat waves, present a significant risk to buildings. Countries are experiencing a growing need for cooling to combat extreme heat, exacerbated by climate change. For example, the Copernicus Climate Change Service (C3S) indicates that in 2022, the global average surface temperature was 0.34°C higher than the 1991-2020 period (Copernicus Climate Change Services (C3S), 2024[42]). Extreme temperatures due to climate change have tangible impacts on buildings, leading structural damage, higher maintenance costs, and shortened lifespan of buildings, as well as reduced comfort and increased health risks for inhabitants. For example, residents in **Japan** reported lower blood pressure following thermal insulation retrofits in buildings (Umishio et al., 2022[43]). This requires the integration of climate considerations into building design and construction to ensure resilience against future climate scenarios.

The urgent need for energy-efficient and climate-resilient buildings has been recognised by governments throughout the world. Against this backdrop, there is a growing emphasis on fostering international collaborations and policy exchanges aimed at advancing the construction of near-zero emission and climate-resilient buildings. Launched by France, Morocco, and UNEP at COP28, the Buildings Breakthrough initiative strives to promote and make near-zero emission climate-resilient buildings the new

normal by 2030. The Chaillot Declaration, emerging from the first ever Buildings and Climate Global Forum held in March 2024, stands as a testament to the shared commitment of 70 countries to decarbonise and bolster the climate resilience of buildings.

Governments throughout the world have employed a variety of policy instruments to respond to climate-risks in their respective countries and local contexts. These instruments encompass a spectrum of measures, including more stringent regulations and standards on the built environment supported by ambitious climate resilience plans and incentives to climate-proof the existing building stock and new developments. Additionally, building certification programmes and national climate databases that are accessible to the public are also valuable tools.

Regulations and standards for climate resilience

The OECD Global Survey on Buildings and Climate (2024) demonstrates that respondents employ a range of regulations and standards to bolster the climate resilience of buildings. In particular, 25% of countries have established a range of building regulations to tackle extreme heat (Table 2.9), amongst which green roofs and orienting main building facades away from direct sunlight are the most popular (Table 2.10). 21% of the respondents have established regulations to protect buildings from floods and storms (Table 2.9). Hip-roofs and defining the lowest livable floor above ground level are the primary regulatory measures (Table 2.11).

Table 2.9. Countries with climate resilience measures for buildings

	Extreme heat	Floods/storms
Regulations	Costa Rica, France, Italy, Japan, Poland, Singapore, the United Kingdom	Costa Rica, France, Japan, Poland, Spain, Sweden
	25% (7/28)	21% (6/28)
Financial incentives	Costa Rica, France, Italy, Japan, Korea, Poland, Singapore, the United States	Costa Rica, France, Japan, Sweden, the United States
	29% (8/28)	18% (5/28)

Note: The figure consolidates the responses to the questions from the survey: “What kind of measures are put in place in the building sector to tackle extreme heat?”, “What kind of measures are put in place in the building sector to tackle storms/floods?” The responding countries could select all applicable options.
Source: OECD Global Survey on Buildings and Climate (2024)

Table 2.10. Types of climate resilience measures to tackle extreme heat

	Orientation of main building facades away from direct sunlight to minimise solar gains	Light coloured and reflective materials	Green roof	Green facades
Regulation	Costa Rica, Japan, Poland, Singapore, the United Kingdom	Costa Rica, Italy, Singapore	Costa Rica, France, Italy, Japan, Singapore	Costa Rica, Japan, Singapore
	18% (5/28)	11% (3/28)	18% (5/28)	11% (3/28)
Financial incentives	Costa Rica, Singapore	Costa Rica, France, Korea, Singapore, the United States	Costa Rica, Italy, Japan, Korea, Poland, Singapore, the United States	Costa Rica, Japan, Korea, Poland, Singapore, the United States
	7% (2/28)	18% (5/28)	25% (7/28)	21% (6/28)

Note: Question from the survey: "What kind of measures are put in place in the building sector to tackle extreme heat?" The responding countries could select all applicable options.
Source: OECD Global Survey on Buildings and Climate (2024)

Table 2.11. Types of climate resilience measures to protect buildings from floods/storms

	Lowest liveable floor elevated above ground level	Effective roof drainage system	Hip-roof	Hurricane straps to fasten the roof to the walls	Impact-resistant glass for windows and doors	Installation of backup generators	Installation of microgrids
Regulation	Costa Rica, France, Japan, Poland, Sweden	France	Costa Rica, Japan, Poland, Sweden	France, Japan	Costa Rica	/	/
	18% (5/28)	4% (1/28)	14% (4/28)	7% (2/28)	4% (1/28)	0% (0/28)	0% (0/28)
Financial incentives	Costa Rica, Sweden, the United States	Poland	Costa Rica, France, Sweden	France, the United States	Costa Rica, France, the United States	Japan, the United States	Japan, the United States
	11% (3/28)	4% (1/28)	11% (3/28)	7% (2/28)	11% (3/28)	7% (2/28)	7% (2/28)

Note: Question from the survey: "What kind of measures are put in place in the building sector to tackle storms/floods?" The responding countries could select all applicable options.
Source: OECD Global Survey on Buildings and Climate (2024)

Colombia uses building codes to address the challenges posed by heatwaves, particularly those affecting coastal areas and the eastern lowlands. In 2015, Colombia's Ministry of Housing, City, and Territory launched the Sustainable Construction Guide for Water and Energy Saving in Buildings, following the Decree 1285 on sustainable construction. The guide established technical parameters and design standards for passive cooling measures in the design of public buildings and renovated buildings. It also detailed strategies for minimising heat gain, enhancing insulation and defined standards for natural ventilation, window-to-wall ratios, orientation and shading (Ministry of Housing, City, and Territory of Colombia, 2015[44]).

Facing similar threats from rising temperatures, **Singapore** adopted a government inter-agency working group in 2019 co-led by the Ministry of Sustainability and the Environment and the Urban Redevelopment Authority, to implement initiatives that address urban heat island effects. Key initiatives implemented in the city-state include incorporating climate-sensitive measures into urban design. Via environmental and building energy modelling, these policies aim to optimise shading and wind flow, enhance urban greenery and adopt "cool materials" on public housing buildings (Ministry of Sustainability and the Environment; Urban Redevelopment Authority, n.d.[45]; Institute of High Performance Computing, 2023[46]; Housing and Development Board, n.d.[47]).

In addition, the Landscaping for Urban Spaces and High-rises (LUSH) programme grants gross floor area (GFA) exemptions for incorporating green features within construction projects. These features include sky terraces, communal planter boxes, ground gardens, and pavilions within landscaped areas. By 2017, two out of three new residential developments and half of the new offices, shopping centres and hotels in Singapore had taken up a LUSH incentive scheme. LUSH 3.0, the latest phase of the scheme, expands the programme to include urban farming, communal rooftop gardens, greenery and solar panels on rooftops (Urban Redevelopment Authority, 2017[48]).

In 2022, the **United Kingdom** introduced a new regulation to address rising temperatures through limiting unwanted solar gains in the summer and removing excess heat from the indoor environment of newly constructed residential buildings. The regulation is implemented through two assessment methods – the Simplified method and the Dynamic Thermal Modelling Method – which target buildings without communal heating and all types of buildings respectively. These methods help minimise heat gains in buildings by tailoring glazing area to factors such as location, orientation and shading. In addition, the regulation mandates passive design compliance and promotes strategies to reduce excess heat such as fixed shading devices (shutters, blinds, overhangs, awnings), window opening and wall-mounted ventilation louvres. Mechanical cooling can only be used where passive measures are insufficient (Department for Levelling Up, 2022[49]).

France also aims for improved thermal comfort in buildings during the summer. Its most recent environmental regulation for buildings, the RE2020 (Box 2.1), addresses the issue (Ministry of Ecological Transition and Territorial Cohesion, 2021[50]) through implementing a new summer comfort indicator. The new indicator is based on the number of summer discomfort degree hours (Degré-heure d'inconfort, DH) in a year, considering the climate and heat wave data from the country's meteorological service over the period between 2000 and 2018 (Ministry of Ecological Transition, 2024[51]).

Similarly, in 2017, **Finland** introduced the Decree on the energy efficiency of new buildings (1010/2017), which mandates that during the summer months, the calculated room temperature in blocks of flats must not surpass the cooling limit of +27°C and +25°C in non-residential buildings. The regulation sets a threshold of 150 degree hours between 1 June and 31 August. It ensures the summer comfort in new buildings by limiting their accumulated degree hours during the warmest months, given that the building design incorporates ventilation air flows. (Ministry of Environment in Finland, n.d.[52]).

Box 2.1. France's RE2020 environmental regulation for summer comfort in buildings

RE2020, or Réglementation Environnementale 2020, is the energy and environmental regulation governing all new construction in France, which came into effect in January 2022. Overall, RE2020 sets ambitious standards for sustainability and environmental performance in new construction, aiming to reshape the future living spaces of French residents with a focus on energy efficiency, reduced carbon emissions and enhanced comfort.

This regulation is designed to address three primary objectives:

Energy Sufficiency and Decarbonisation of Energy: RE2020 aims to promote energy efficiency and reduce reliance on carbon-intensive energy sources. It encourages the use of renewable energy and efficient building practices to minimise energy consumption.

Reduction in Carbon Impact: The regulation targets a significant reduction in the carbon footprint of new buildings. This includes measures to limit greenhouse gas emissions throughout the life cycle of the buildings, from construction through occupancy.

Guaranteeing Comfort in Hot Weather: RE2020 prioritises ensuring comfortable living conditions during periods of high temperatures. This involves incorporating strategies for natural ventilation, shading and efficient cooling systems in building designs.

Among the three objectives, thermal comfort in buildings during the summer months is the priority. This is due to the increasing frequency and intensity of heatwaves in France over the past two decades. The regulations mandate the use of passive cooling solutions and the design of buildings to maximise natural ventilation and shading, ensuring that occupants remain comfortable even under extreme temperatures.

RE2020 introduces a new summer comfort indicator, based on summer discomfort degree hours (Degré-heure d'inconfort, DH) in a year, to regulate new building designs and encourage passive cooling. This aspect of the regulation reflects a holistic approach to sustainability, whereby the environmental impact of a building is considered to extend beyond its energy use and carbon footprint to include the well-being of its inhabitants.

A dwelling is considered uncomfortable when its indoor temperature exceeds the threshold set between 26°C and 28°C during the day (varies as the capacity of human body to adapt to higher temperatures is considered) and 26°C at night. Each hour of temperature exceedance is then quantified and cumulated to define the level of discomfort in the home. The plan sets a bottom threshold of 350 DH, and a ceiling of 1250 DH or above. The indicator considers any building without an additional cooling system that has a DH value of less than 350 as adequately comfortable even in heat waves. However, buildings without air-conditioning that have a DH value between 350 and 1250 are subject to a "cooling charge", which is proportional to degree hours and is modulated according to the building's geographical location. This additional charge is added to the RE2020 energy indicator, called the primary energy co-efficient (Coefficient d'Énergie Primaire, CEP) of the building. Buildings that exceed the ceiling are deemed non-compliant and their design must be reviewed (Ministry of Ecological Transition, 2024[51]). The ceiling may vary depending on factors like climate zone, noise pollution, or the presence of air conditioning.

The DH indicator aims to anticipate cooling consumption according to the level of discomfort experienced by the resident, should they decide to install active cooling equipment, such as air conditioning, following the construction of a building. This also encourages the passive design of buildings, such as thermal insulation against heat, night-time ventilation, shade louvres and fans, to minimise the DH indicator and enhance summer comfort (Cerema, 2021[53]). The regulation encourages

the installation of air ventilation systems and the installation of external solar protection particularly in the south of France.

Source: https://www.ecologie.gouv.fr/reglementation-environnementale-re2020; https://www.ecologie.gouv.fr/sites/default/files/2021.02.18_DP_RE2020_EcoConstruire_0.pdf; https://www.ecologie.gouv.fr/sites/default/files/guide_re2020_version_janvier_2024.pdf

Countries are also adopting building resilience initiatives to protect buildings from other extreme climate conditions, like more frequent extreme storms. For example, **Japan** revised its Buildings Standards Act in 2022 to strengthen the hurricane straps regulations in the aftermath of the Typhoon Faxai in 2019, which was the strongest since 2004 (Ministry of Land, Infrastructure, Transport and Tourism of Japan, 2024[54]; Ministry of Land, Infrastructure, Transport and Tourism of Japan, 2020[55]). The revised Act mandates that all new construction and additions to existing buildings must implement protective measures against strong winds, including securing all roof tiles with nails. The revision introduced more rigorous standards for fastening the flat surfaces of roof tiles, particularly in areas with higher standard wind speeds. (Ministry of Land, Infrastructure, Transport and Tourism of Japan, n.d.[56]). In response to storms and floods, the Buildings Standard Act specifies that the first floor of wooden buildings must be elevated at least 45 cm above the ground and must incorporate ventilation beneath the floor (Tomohiro, 2013[57]). Japanese municipalities have the authority to create district plans that specify the minimum elevation of the lowest habitable floor above ground level which can be adjusted to local conditions. (Ministry of Land, Infrastructure, Transport and Tourism of Japan, 2003[58]). This ensures that new developments are designed to adapt to the local climate and environment, making buildings more resilient to climate-related risks.

Financial incentives for climate resilience

Providing financial incentives facilitates adaptation measures and the transition towards near-zero emission and climate-resilient buildings. The OECD Global Survey on Buildings and Climate (2024) reveals that 29% of the responding countries offer financial incentives for the building sector to address extreme heat, and 18% have financial incentives in place to encourage the adoption of protective measures against floods and storms (Table 2.9). To tackle heat waves, 25% of responding countries have implemented financial incentives to promote the use of green roofs, while 21% have introduced financial incentives to encourage the installation of green facades (Table 2.10). To protect buildings from storms, 11 % of responding countries reported that there are financial incentives in place to encourage the use of hip-roof and impact-resistant glass for windows and doors (Table 2.11).

France introduced a EUR 2.5 billion Green Fund (Fonds vert) in 2023 with tailored financial incentives for subnational governments and social housing providers to make public buildings, social housing, and urban spaces more climate-resilient (Ministry of Ecological Transition, 2023[59]). The fund offers support for fortifying buildings against threats like cyclones and floods (Ministry of Ecological Transition, 2024[60]). Moreover, vulnerability assessments to floodings and renovation efforts of public buildings can be finances through this scheme, along with initiatives aimed at mitigating flood risks that fall outside the scope of current Natural Risks Prevention Plans (PPRN) or Flooding Prevention Action Programmes (PAPI) (Ministry of Ecological Transition, 2024[61]).

The Green Fund also allocates EUR 500 million to support projects aimed at greening urban spaces by financing green roofs, facades and other nature-based solutions (Ministry of Ecological Transition, 2024[62]). Furthermore, projects improving summer comfort become eligible for support from the Green Fund, which assists local authorities in renovating public buildings to be suitable for current and future climates (Ministry of Ecological Transition, 2024[63]).

Japan has introduced financial incentives aimed at facilitating adherence to its updated building standards. Specifically targeting individuals and households, an initiative adopted in 2021 seeks to promote the identification and upgrading of wind-resistant roof tiles. To facilitate compliance, a subsidy of up to JPY 31 500 per building is offered for a diagnostic check by a technician. Additionally, a significant financial aid of up to JPY 24 000 per square meter, capped at JPY 2 400 000 per building, is provided for the replacement of non-conforming roof tiles. This initiative is specifically targeted at regions with an average wind speed of 32 m/s or higher, ensuring that buildings are better equipped to withstand adverse weather conditions (Ministry of Land, Infrastructure, Transport and Tourism of Japan, n.d.[56]).

Databases for climate resilience

Climate risk databases are a useful tool to disseminate information and raise public awareness on environmental hazards. Governments can leverage the wealth of climate data collected by public meteorological agencies and public service departments at different geographical levels to better inform the citizens and the building sector about the potential impact of climate risks on buildings. As a result, building owners and developers can better understand the types of climate risks facing their buildings and take informed decisions regarding future construction and renovation.

The OECD Global Survey on Buildings and Climate (2024) enquired whether national governments provide a publicly available geographic database where citizens can have access to information on climate risks, which is the case for, 21 out of the 28 responding countries. The survey revealed that 71% of the responding countries have a public database for flood risk information, while 36% of the countries have a public database for heat wave risks and 32% have one for wildfires. However, only 4% of the responding countries have a public database for storm risks. Additionally, 25% of the countries reported having other types of public climate risk databases, while 25% of the countries do not currently have any publicly available climate risk databases (Table 2.12). Regarding the geographical granularity of the data, a third of the 21 countries with a public climate risk database provide data at the regional level (such as state or prefecture), 29% provide data at the local level (city or municipality), 18% offer data at the neighborhood level, 14% have household level data and 7% provide data at other specified levels (Table 2.12).

Table 2.12. Publicly available geographic database with climate risks information

Country	Climate risks					Available geographical level of the database				
	Heat wave	Flood risk	Storm	Wildfire	Other	Regional (state/province/prefecture)	Local (city/municipality)	Neighbourhood	Household	Other
Belgium		✓							✓	
Brazil										
Canada	✓	✓		✓						✓
Colombia					✓	✓	✓			
Costa Rica	✓	✓		✓		✓				
Côte d'Ivoire										
Finland		✓						✓		
France		✓		✓		✓	✓	✓		
Germany	✓	✓			✓	✓	✓			
Greece										
Iceland										

Israel	✓	✓					✓			
Italy		✓		✓		✓				
Japan		✓							✓	
Korea	✓	✓	✓	✓	✓			✓		
Lithuania		✓			✓		✓			
Mexico		✓		✓	✓	✓	✓			
Netherlands	✓	✓							✓	
Norway		✓							✓	
Philippines										
Poland	✓	✓		✓	✓					✓
Singapore	✓	✓						✓		
Spain	✓	✓		✓		✓	✓			
Sweden		✓						✓		
Switzerland										
Thailand										
United Kingdom	✓	✓	✓		✓	✓				
United States	✓	✓		✓		✓	✓			
Percentage of responding countries	39% (11/28)	71% (20/28)	7% (2/28)	32% (9/28)	25% (7/28)	32% (9/28)	29% (8/28)	18% (5/28)	14% (4/28)	7% (2/28)

Note: Question from the survey: "Does your government provide a publicly available geographic database where people can have access to information on climate risks? If you answered Yes to the previous question, what are the available geographical level of this database?" The responding countries could select all applicable options. Unchecked cells indicate that no public database is available on these climate risks/at these geographical levels.
Source: OECD Global Survey on Buildings and Climate (2024)

Countries provide public databases tailored to their unique climate conditions and the accessibility of data. **Canada**'s climate risk data is comprehensive and accessible through various databases, each focusing on different types of environmental hazards. Natural Resources Canada and the Canadian Open Government Portal provide detailed mapping services of flood-prone areas across the country. This includes the Canada Flood Map Inventory, a collection of flood hazard map throughout Canada; the Flood Susceptibility Index, a national map indicating flood susceptibility or flood-prone areas based on historical flood event patterns as predicted by an ensemble machine learning model; and Floods in Canada, featuring flood extent maps developed in near-real time using satellite imagery for emergency response (Natural Resources Canada, 2023[64]). The Canadian Wildland Fire Information System (CWFIS) offers real-time and historical wildfire information through an interactive map (Canadian Wildland Fire Information System, n.d.[65]). Access to climate risk data can provide building owners and developers with insights into their buildings' climate resilience and vulnerability of their properties to various hazards.

Germany's approach to climate risk data is multifaceted, with databases focusing on specific hazards such as flood risk, drought, and extreme heat. Notably, the Federal Agency of Cartography and Geodesy (Bundesamt für Kartographie und Geodäsie) provides a Digital Heat Atlas with detailed information on heat wave patterns and urban heat island effects. This serves as useful tool for building owners especially in densely populated urban areas (Bundesamt für Kartographie und Geodäsie, 2023[66]).

Japan's Hazard Map Portal Site serves not only as a repository of real-time and historical climate risk data but also as a tool for managing and designing climate-resilient buildings at regional and municipal levels. One of the key features of the portal is its ability to offer detailed information about the expected duration, scale, and estimated damage of floods at the household level. This level of detail is crucial for building owners and residents to make informed decisions. Furthermore, the portal offers a Town Hazard Map, enabling users to access hazard maps from local governments across Japan (Ministry of Land, Infrastructure, Transport and Tourism of Japan, n.d.[67]). The Hazard Map Portal Site stands out as a model of how data availability across multiple geographical levels can significantly enhance natural disaster prevention efforts, as well as raising public awareness about the importance of making buildings climate-proof.

Digital technology can help address data fragmentation for greater innovation, efficiency and sustainability in buildings

The integration of digital technologies throughout the building lifecycle – including strategic planning, initial design, engineering, development, documentation and construction, day-to-day operation, maintenance, refurbishment, repair and end-of-life – offers a profound opportunity for the decarbonisation of the building sector (UK Green Building Council, 2019[68]). Several technologies can help mitigate problems arising from the complexity of data due to the involvement of a wide range of parties.

Fragmentation in the building industry remains a significant barrier to lowering carbon emissions. Issues arise from limited data availability, compatibility and consistency, coupled with the increased temporal and financial costs associated with reconstructing lost datasets. Data frequently gets lost during transitions or handovers due to inadequate systematic data management practices, while storage remains dispersed across organisations. In some instances, crucial data is never generated due to unrecognised needs (European Construction Sector Observatory, 2021[69]).

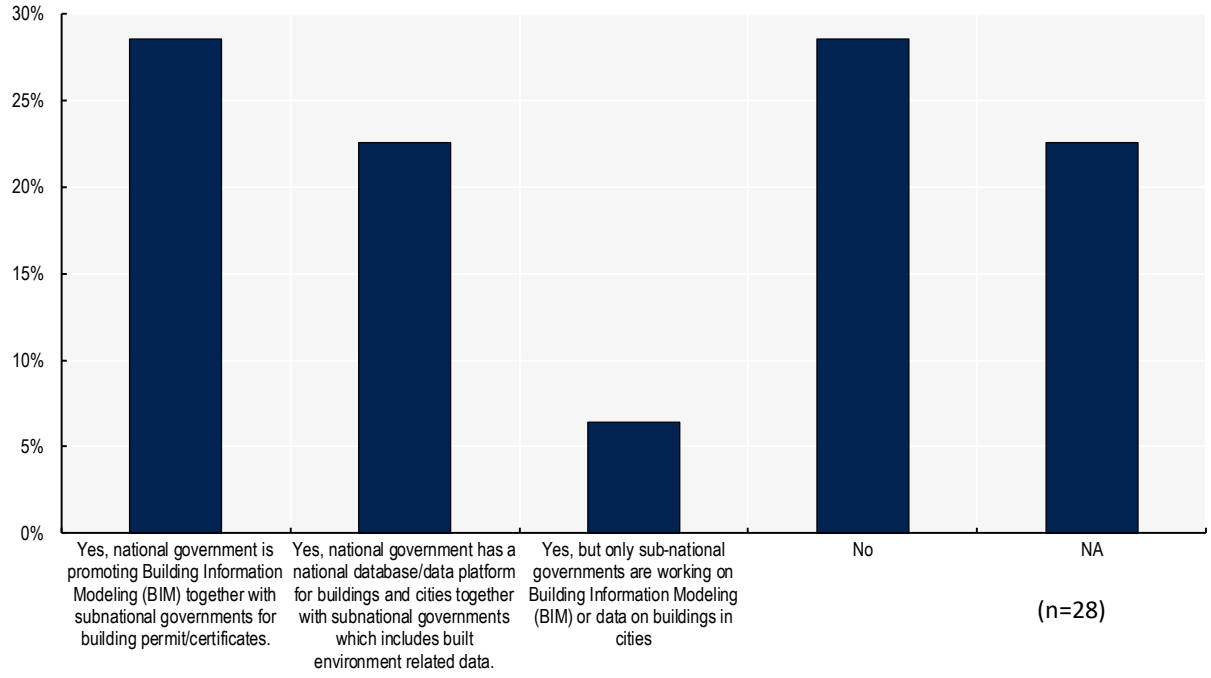
Digital technologies have emerged as crucial tools in bridging these data and information fragmentation issues within the building industry. By implementing Energy Performance Monitoring and Reporting Systems, Building Information Modelling (BIM) and Integrated Data Platforms (IDP), the industry can enhance innovative solutions, efficiency, and sustainability. Moreover, digital technologies significantly drive innovation by enabling new methodologies and solutions that were previously unattainable, allowing the sector to achieve higher levels of performance.

- **Energy Performance Monitoring and Reporting Systems** are essential tools for tracking and analysing energy consumption, providing detailed insights into energy use critical for discovering inefficiencies and optimising energy management. These systems encompass various technologies and methodologies, including real-time monitoring, smart meters, data analytics, and comprehensive reporting programs (U.S. Department of Energy, 2022[70]).
- **Building Information Modelling (BIM)** is an advanced technology that relies on various software tools used in construction that creates a 3D digital representation of the physical and functional characteristics of a building. This software provides professionals the tools and insights to more efficiently plan, design and build infrastructure (FHWA, 2022[71]).
- **Integrated Data Platforms (IDP)** specifically focus on integrating and managing data from various sources, ensuring that data from different stages and stakeholders in the building sector is harmonised and easily accessible. Unlike BIM, which relies on specific software, these platforms operate on cloud infrastructure, allowing users to access and manage data through web interfaces. This web-based approach enhances transparency and decision-making by providing a unified view of all relevant data streams (NREL, 2021[72]).

According to the OECD Global Survey on Buildings and Climate (2024), about 29% of responding countries indicated that their national governments are promoting Building Information Modelling (BIM) together with subnational governments for building permits and certificates. Another about 23% reported having a national database or data platform for buildings and cities, which includes built environment-related data, in collaboration with subnational governments. Furthermore, approximately 6% mentioned that only sub-national governments are working on BIM or data on buildings in cities. Conversely, about 29% of countries stated that their government does not work on promoting digital/data tools related to buildings with subnational governments (Figure 2.24).

Moreover, by leveraging the digital twin concept – a virtual representation that serves as the real-time counterpart of a physical object or process – industry leaders and policy makers can now use data and analytics to influence decisions affecting environmental performance, operational costs and life cycle assessments (Centre for Digital Built Britain, 2018[73]).

Figure 2.24. National and Subnational Government Collaboration on Promoting BIM and Digital / Data Tools for Buildings



Note: The figure consolidates the responses to the question from the survey: "Does your country work on promoting digital/data tools related to buildings with subnational governments?" The responding countries could select all applicable options. NA refers to "Not applicable". This percentage represents the countries that have not answered this question.
Source: OECD Survey on Buildings and Climate (2024)

Energy performance monitoring and reporting systems

Energy performance monitoring and reporting systems, along with real-time data collection technologies, are pivotal in the building sector's efforts to decarbonise buildings. By capturing detailed data on energy and resource consumption, these systems provide detailed, actionable insights into building operations. This information is crucial for identifying inefficiencies, maintaining regulatory compliance, and adjusting energy demand profiles to enhance sustainability. Offering continuous feedback, energy monitoring

systems empower consumers with visualisations of their energy usage, fostering greater awareness and promoting energy-efficient behaviours (U.S. Environmental Protection Agency, 2019[74]) . These systems not only contribute to substantial energy savings but also improve the overall marketability of properties by validating their energy efficiency standards.

Governments recognise the potential of these technologies in achieving ambitious decarbonisation targets. Energy performance monitoring and reporting systems enable precise tracking and reduction of buildings' carbon footprints, making them indispensable for data-driven policy making and environmental compliance. Complementing these systems, real-time management technologies such as smart grids and demand response systems actively adjust energy usage based on real-time data. This dynamic approach enhances grid reliability, reduces peak loads, and integrates renewable energy sources more effectively (European Commission, 2023[75]). Together, these strategies represent a comprehensive toolkit for building decarbonisation, offering both immediate and long-term benefits for energy management and sustainability.

In the **United States**, the Department of Energy's "Decarbonizing the U.S. Economy by 2050" blueprint aims to cut greenhouse gas emissions from buildings by 65% by 2035 and 90% by 2050 compared to 2005 levels. This strategy focuses on both residential and commercial buildings and involves integrating advanced digital technologies and real-time demand response systems to optimise energy consumption and integrate renewable energy sources. (U.S. Office of Energy Efficiency & Renewable Energy, n.d.[76]). Key components include smart grids to improve electricity management, grid-edge technologies for efficient electricity demand, and energy storage solutions to enhance resilience and flexibility. Economic incentives such as low-interest loans, grants, tax credits, and deductions are offered to promote the adoption of these technologies, especially in disadvantaged communities. Pilot projects and R&D funding further support innovation in building energy management. The implementation is phased with milestones in 2030, 2040 and 2050, focusing initially on reducing technology costs and raising public awareness, then scaling high-impact solutions, and finally completing the transition with retrofits and addressing residual emissions from building operations and materials.

The **European Commission**'s Delegated Regulation (EU) 2020/2155 for Smart Readiness Indicator (SRI) is a regulatory method designed to rate the smart readiness of both residential and non-residential buildings. The SRI assesses buildings' ability to interact with occupants and the energy grid, evaluating systems such as heating, hot water, ventilation and lighting to raise awareness of smart technologies. These technologies include building automation systems for HVAC control, smart lighting systems, advanced metering infrastructure, demand response technologies, and energy storage solutions. The benefits include improved energy efficiency, enhanced comfort, increased property value, reduced environmental impact and regulatory compliance (European Comission, 2020[77]).

The SRI framework includes provisions for periodic reviews and updates to ensure it remains relevant and effective. These updates may involve refining assessment criteria, incorporating new smart technologies, and enhancing methodologies for evaluating buildings' smart readiness. This ongoing development aims to keep pace with technological advancements and evolving energy efficiency standards, ensuring that the SRI continues to effectively promote the integration of smart technologies in buildings.

Similarly, the city of **London**'s "Be Seen"' energy monitoring programme establishes a structured framework for monitoring and reporting the energy performance of new major developments throughout the building's lifecycle. As part of the London Plan 2021 aiming for a zero-carbon city by 2050, the programme mandates the submission of detailed energy consumption data of residential and non-residential newly built and existing developments undergoing renovation at three different stages: the planning stage, the as-built stage, and the in-use stage.

- In the **planning stage**, data on energy consumption estimation is required to establish benchmarks and expectations.
- For the **as-built stage**, updates based on actual construction outcomes are submitted, including specifics about metering infrastructure and their technical calibration.
- Once operational, in the **in-use stage**, actual energy usage data is reported annually for minimum of five years, potentially extending to ten years to enhance accuracy and utility of data collected (Greater London Authority, 2021[78]).

The structured timeline for data submission – from planning to long-term usage – allows stakeholders to track performance continuously and implement necessary adjustments to enhance energy efficiency. The information provided will guide and shape future policy by identifying additional measures to reduce emissions further. This systematic tracking not only helps in adhering to environmental regulations but also promotes economic benefits through operational cost savings and improves the overall marketability of properties due to the verification of those properties' energy efficiency standards (Greater London Authority, 2021[79]).

Building Information Modelling (BIM)

Building Information Modelling (BIM) is a digital technology supported by a range of software tools that enhance the construction, maintenance, and management phases of building lifecycles by creating detailed 3D representations of buildings. These tools enable precise architectural design, simulations, and evaluations, optimising both design and construction processes. BIM is more than a tool for initial planning; it plays a crucial role in addressing sustainability challenges in the construction industry, particularly through its contributions to Life Cycle Carbon Assessment (LCA) and building decarbonisation. By integrating with LCA, BIM enables detailed analyses of energy use and environmental impacts across all phases of a building's lifecycle, enhancing the efficiency and accuracy of environmental impact assessments (EU BIM Taskgroup, 2018[80]). Additionally, BIM facilitates the sharing and collaboration of information throughout the building's lifecycle, allowing stakeholders to model the effects of decisions such as building orientation, material selection, and energy systems (European Commission, 2021[81]).

Globally, there is a spectrum of strategies to integrate BIM. In **Japan**, the Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) is actively promoting BIM implementation through incentives. Recognising BIM's potential to improve efficiency and quality in building projects, the Japanese government provides significant economic support, with a focus on small and medium-sized businesses. It offers subsidies under the BIM Acceleration Projects, demonstrating a strong commitment to drive BIM adoption across the construction sector (Japanese Ministry of Land Infrastructure Transport and Tourism, 2021[82]). BIM in Japan focuses on optimising the entire building lifecycle, enhancing data management and operational efficiency. This approach reduces long-term costs and environmental impacts while promoting better regulatory compliance. (MLIT, 2019[83]).

On the other hand, countries such as **Denmark** require the use of BIM to strengthen their construction industries' adherence to environmental regulations. The national building regulation BR18 serves as the cornerstone of Denmark's BIM framework, which includes rigorous lifecycle assessments and mandatory documentation of the climate impact of new buildings (Danish Social and Housing Authority, n.d.[84]). Starting from January 2023, BR18 requires detailed documentation of a building's environmental impact throughout its lifecycle, from material production to construction, replacements and end-of-life stages. As per the current regulations, the limit value for the building's climate impact is 12 kg CO_2-equivalents per m² per year. Starting from 2025, this limit will be tightened further to enforce stricter sustainability standards. To comply with these requirements, the architecture, engineering and construction industries use software tools that ensure data accuracy and support interoperability through open standards such as the Industry Foundation Classes (IFC) format, enabling seamless data exchange between different BIM software systems (Danish Authority of Social Services and Housing, 2023[85]).

While the use of BIM is not explicitly mandated for lifecycle assessment calculations or building permit applications across all projects, it is widely utilised and integrated into the Danish construction process, particularly for public sector projects. The Information and Communication Technology "ICT" regulations, effective since 2007 and updated in 2011, require the use of BIM for larger public sector construction projects that are fully or partially funded by the government and exceed DKK 5 million. This indicates a strong governmental push towards BIM adoption in public construction to improve data sharing, project co-ordination, and lifecycle management of building projects, ensuring that all stakeholders have access to the latest project information, which helps in reducing errors, saving costs and enhancing overall project outcomes. (Danish Building and Property Agency, n.d.[86]). This approach facilitates accessibility and interoperability, ensuring that data can be easily shared and utilised across various platforms and stakeholders.

Sweden is progressively moving towards the widespread use of Building Information Modelling (BIM) through a combination of legislative frameworks and strategic initiatives. The country has established comprehensive regulations for climate declarations via Act (2021:787), Ordinance (2021:789), and Provision (BFS2021:7), effective from January 2022. These regulations mandate detailed environmental reporting for new buildings but do not explicitly require the use of BIM. However, BIM is strongly encouraged through guidelines and programs such as the Nationella Riktlinjer and the Smart Built Environment program, which aim to enhance transparency, efficiency and sustainability in construction (Nordic Innovation, 2023[87]).

Additionally, the "BIM i staten" initiative involves five state-owned developers – Specialfastigheter, Akademiska Hus, Riksdagsförvaltningen, Statens Fastighetsverk and Fortifikationsverket. These agencies have developed a unified strategy and guidelines for implementing BIM in their projects and management practices, emphasising sustainability and decarbonisation. Specific initiatives utilising BIM technology include optimising energy efficiency, conducting environmental impact analyses, and supporting energy simulations to reduce carbon footprints. The targeted projects encompass a wide range of public buildings, including educational institutions, military facilities, government offices, and special purpose properties. These buildings vary in size from small renovations to new large-scale constructions, ensuring that the benefits of BIM are applied across diverse property types. This strategy, supported by continuous development through pilot projects and facilitated by BIM Alliance Sweden, highlights Sweden's commitment to a sustainable and efficient construction sector through collaborative efforts and the sharing of best practices (BIM Alliance Sweden, n.d.[88]).

The **Spanish** government's Interministerial Commission for the Incorporation of the BIM Methodology in Public Procurement (CIBIM) initiated "El Plan BIM en la Contratación Pública" (The BIM Plan in Public Procurement) to enhance public expenditure efficiency and catalyse the digital transformation of the construction sector. Digitalisation in the construction sector contributes to greater accuracy in material ordering and an optimised simulation of energy studies, resulting in lower energy demand and lower consequent greenhouse gas emissions from the built environment. The plan outlines a phased adoption of BIM from 2024 to 2030, varying by the contract's value and targeted BIM levels – ranging from pre-BIM to integrated (Spanish Ministry of Transport Mobility and Urban Agenda, 2023[89]).

These diverse approaches not only underscore the importance of BIM in modernising construction practices but also reflect different national strategies to leverage technology in meeting sustainability goals. Japan's incentivised approach facilitates a gradual adoption, making it accessible to smaller enterprises facing high initial costs. In contrast, the enforced or strongly encouraged frameworks in Nordic countries and Spain emphasise strict compliance and standardisation, ensuring that all new constructions adhere to stringent environmental and operational protocols. By combining these methods, countries can provide comprehensive support for BIM adoption – balancing the encouragement of innovation through incentives with the assurance of compliance through regulations. This dual approach supports technological advancement while ensuring the construction sector's alignment with global sustainability objectives.

Integrated data platforms

Integrated data platforms unify and streamline data management across the construction sector. These web-based specialised tools have become central to the decarbonisation and digitalisation of the construction industry. Unlike Energy performance monitoring and reporting systems, which focus on capturing real-time data on energy and resource consumption, and BIM, which creates detailed 3D models for design and construction, integrated data platforms consolidate data from various sources into a single, accessible system. Operating on cloud infrastructure, these platforms facilitate the collection and analysis of vast amounts of data and enhance collaboration among stakeholders (European Construction Sector Observatory, 2021[90]).

In **Finland**, the Project Ryhti aims to compile and store data created in permit procedures in a coherent and accessible form through a national built environment information system. Supported by the EU's Digital Building Logbook initiative, this project emphasises the importance of interoperable planning and building data accessible through interfaces and download services. Project Ryhti benefits building owners and users, improves building maintenance and enhances municipalities' decision-making. Additionally, it aids in environmental sustainability by facilitating easier monitoring and assessment of carbon footprints, contributing to Finland's goal of becoming carbon neutral by 2035 (Finnish Ministry of the Environment, n.d.[91]).

Similarly, **Flanders**, Belgium, has implemented the Woningpas platform, a digital building passport that serves as a comprehensive repository for a multitude of data points that span the entire lifecycle of a building. Woningpas combines administrative documentation, technical and functional characteristics, and energy performance metrics for every building. Implemented as a one-stop-shop for data centralisation, it has become a cornerstone in Belgium's strategy for sustainable renovation, energy management and climate resilience (Vlaamse overheid, n.d.[92]).

In **France**, the Base de Données Nationale des Bâtiments (BDNB) represents a significant leap forward in the digital transformation of the construction sector. This innovative platform supports real-time sharing and monitoring of building performance data. BDNB organises data at the individual building level, featuring files for over 27 million residential and tertiary buildings. The platform is the result of geospatial cross-referencing from approximately twenty databases sourced from various public bodies. These resources combine to provide a vector-based 3D description of the French territory and its infrastructure. BDNB facilitates energy consumption analysis and serves as a dynamic resource for informing policy decisions and operational strategies aimed at reducing the carbon footprint of buildings (BDNB, 2022[93]).

Complementing **France**'s BDNB, Go-Rénove is a public platform that assists in the energy renovation of buildings. Available on two websites – one for individuals and another for property managers – Go-Rénove enriches its services with data and calculations from the BDNB APIs and offers functionalities that help operators optimise their building renovation policies. The Go-Rénove Particuliers service is designed to be the first step in the thermal renovation of homes, offering an initial overview of a home's performance and potential improvements. Meanwhile, the Go-Rénove Landlords service helps landlords in obtaining a comprehensive view of their building stock and its energy performance, enabling them to target specific buildings of interest and consult detailed information sheets on their characteristics.

In **Japan**, the PLATEAU initiative embodies a comprehensive approach to developing urban digital twins, uniting local governments, private firms, researchers, engineers, and creators in a collaborative effort focused on urban management and sustainable town development. As a platform, PLATEAU integrates BIM models and 3D city models generated from 2D map data, to visualise cities' potential to meet future demands. By promoting open innovation and making data accessible to all, it encourages knowledge sharing and the launch of new initiatives, fostering community development through digital transformation (Japanese Ministry of Land Infrastructure Transport and Tourism, 2020[94]).

These examples from Finland, Belgium (Flanders), France and Japan illustrate a global trend toward leveraging digital platforms to facilitate building decarbonisation and enhance the construction sector's responsiveness to environmental challenges. The platforms are not just repositories of data; rather they are dynamic ecosystems that significantly influence the construction industry's approach to achieving a sustainable, energy-efficient future. Through diverse strategies, these countries illustrate the transformative power of digital integration in the construction sector.

References

Agence nationale de l'habitat (2024), *Les aides financieres en 2024*, https://www.anah.gouv.fr/sites/default/files/2024-02/202402_Guide_des_aides_WEBA.pdf (accessed on 22 April 2024). [38]

BDNB (2022), , https://bdnb.io/bdnb/bdnb_presentation/. [93]

BIM Alliance Sweden (n.d.), *BIM i staten*, https://www.bimalliance.se/inspiration/bim-i-staten/. [88]

Boverket (2024), *Bidrag för energieffektivisering i småhus*, https://www.boverket.se/sv/bidrag--garantier/bidrag-for-energieffektivisering-i-smahus/ (accessed on 9 April 2024). [34]

Boverket (2023), *Climate declaration for new buildings - Boverket*, https://www.boverket.se/en/start/building-in-sweden/contractor/tendering-process/climate-declaration/#:~:text=The%20act%20on%20climate%20declarations,buildings%20that%20require%20building%20permits. (accessed on 1 February 2024). [9]

Bundesamt für Kartographie und Geodäsie (2023), *Der digitale Hitzeatlas*, https://gdz.bkg.bund.de/index.php/default/interaktive-atlanten/hitzeatlas.html (accessed on 10 May 2024). [66]

Bundesministerium für Wirtschaft und Klimaschutz (2024), *Bundesförderung für effiziente Gebäude (BEG)*, https://www.energiewechsel.de/KAENEF/Redaktion/DE/Dossier/beg.html (accessed on 9 April 2024). [31]

Canadian Wildland Fire Information System (n.d.), *Interactive map*, https://cwfis.cfs.nrcan.gc.ca/interactive-map (accessed on 10 May 2024). [65]

Centre for Digital Built Britain, D. (2018), *The Gemini Principles*, https://www.cdbb.cam.ac.uk/. [73]

Cerema (2021), *Réglementation Environnementale 2020 : Quelles évolutions sur le confort d'été ?*, https://www.cerema.fr/fr/actualites/reglementation-environnementale-2020-quelles-evolutions-1#:~:text=Qu%27est%2Dce%20qu%27,%C2%B0%20et%2028%C2%B0C (accessed on 29 April 2024). [53]

Copernicus Climate Change Services (C3S) (2024), *Climate Indicators Temperature*, http://climate.copernicus.eu/climate-indicators (accessed on 29 May 2024). [42]

Danish Authority of Social Services and Housing (2023), *BR18*, https://bygningsreglementet.dk/. [85]

Danish Building and Property Agency (n.d.), *Digital construction*, https://en.bygst.dk/media/10722/ict-in-public-construction.pdf. [86]

Danish Social and Housing Authority (n.d.), *National Strategy for Sustainable Construction*, https://bygningsreglementet.dk/Tekniske-bestemmelser/11/BRV/Version-2-Bygningers-klimap%C3%A5virkning?Layout=ShowAll. [84]

Department for Energy Security & Net Zero (2021), *Heat and building strategy*, https://www.gov.uk/government/publications/heat-and-buildings-strategy/heat-and-building-strategy-accessible-webpage. [1]

Department for Levelling Up, H. (2022), *The Building Regulations 2010 Overheating: Approved Document O*, https://assets.publishing.service.gov.uk/media/6218c5aad3bf7f4f0b29b624/ADO.pdf (accessed on 29 April 2024). [49]

ENERGY STAR (n.d.), , https://www.energystar.gov/buildings/benchmark/understand-metrics/how-score-calculated (accessed on 15 April 2024). [20]

ENERGY STAR (n.d.), *Resources for Residential New Construction Partners*, https://www.energystar.gov/partner_resources/residential_new (accessed on 15 April 2024). [19]

EPA (2024), *About the Greenhouse Gas Reduction Fund*, https://www.epa.gov/greenhouse-gas-reduction-fund/about-greenhouse-gas-reduction-fund (accessed on 17 July 2024). [39]

EU BIM Taskgroup (2018), *Handbook for the Introduction of Building Information Modelling by the European Public Sector*, https://eubim.eu/handbook-selection/. [80]

European Comission (2020), *Smart Readiness Indicator,*, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583922805643&uri=CELEX:02010L0031-20181224. [77]

European Commission (2024), , https://ec.europa.eu/commission/presscorner/detail/en/qanda_24_1966 (accessed on 14 April 2024). [16]

European Commission (2021), , https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_6686 (accessed on 31 January 2024). [27]

European Commission (2021), *Rolling plan por ICT standardisation, CONSTRUCTION-BUILDING INFORMATION MODELLING*, https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/construction-building-information-modelling. [81]

European Commission (n.d.), *Heating and Cooling*, https://energy.ec.europa.eu/topics/energy-efficiency/heating-and-cooling_en (accessed on 2 May 2024). [25]

European Commission (n.d.), *Renovation Wave*, https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en. [26]

European Commission, C. (2023), *Smart Grids in the European Union*, https://publications.jrc.ec.europa.eu/repository/handle/JRC134988. [75]

European Construction Sector Observatory (2021), *Digitalisation in the construction sector, 3.2.2 National digital construction platforms*. [90]

European Construction Sector Observatory (2021), *Digitalisation in the Construction sector, Fragmentation in the construction sector page 109*, https://ec.europa.eu/docsroom/documents/45547. [69]

FHWA, F. (2022), *Building Information Modeling (BIM) for Infrastructure*, https://www.fhwa.dot.gov/infrastructure/bim/. [71]

Finnish Ministry of the Environment (n.d.), *Project Ryhti - Built environment information system*, https://ym.fi/en/project-ryhti (accessed on 9 April 2024). [91]

Gillich, A. (2013), "Grants versus financing for domestic retrofits: A case study from efficiency maine", *Sustainability (Switzerland)*, Vol. 5/6, pp. 2827-2839, https://doi.org/10.3390/su5062827. [30]

Government of the Netherlands (2024), , https://www.rvo.nl/onderwerpen/wetten-en-regels-gebouwen/energielabel-woningen (accessed on 14 April 2024). [15]

Greater London Authority (2021), *'Be Seen' energy monitoring guidance, Overview*, https://www.london.gov.uk/sites/default/files/be_seen_energy_monitoring_london_plan_guidance_2021.pdf. [78]

Greater London Authority (2021), *'Be Seen' energy monitoring guidance, Page 2*, https://www.london.gov.uk/programmes-strategies/planning/implementing-london-plan/london-plan-guidance/be-seen-energy-monitoring-guidance. [79]

Housing and Development Board (n.d.), *Green Towns Programme*, https://www.hdb.gov.sg/about-us/our-role/smart-and-sustainable-living/Green-Towns-Progamme (accessed on 10 May 2024). [47]

IEA (2019), *Energy Performance of Buildings Directive - EPBD (2002/91/EC)*, https://www.iea.org/policies/868-energy-performance-of-buildings-directive-epbd-200291ec (accessed on 23 April 2024). [12]

Institute of High Performance Computing (2023), *Urban Environmental Modelling & Sustainability: Understanding The Urban Microclimate And Building Energy Performance In Sustainable Town Design*, https://www.mnd.gov.sg/docs/default-source/mnd-documents/uss-r-d-congress-2023-speaker-presentations/pohheejoo_uss_rd_congress_urban_environmental_modelling_sustainability_oct2023_sharing_audience.pdf?sfvrsn=2afb98f6_4 (accessed on 10 May 2024). [46]

Japanese Housing Finance Agency (n.d.), *Green Renovation Loans*, https://www.jhf.go.jp/loan/yushi/info/grl/index.html (accessed on 9 April 2024). [37]

Japanese Ministry of Land Infrastructure Transport and Tourism (2020), *PLATEAU*, http://www.mlit.go.jp/plateau. [94]

Japanese Ministry of Land Infrastructure Transport and Tourism, (. (2021), *BIM/CIM related standards and guidelines*, https://www.mlit.go.jp/tec/tec_fr_000079.html. [82]

Jefatura del Estado (2022), *Ley 10/2022, de 14 de junio, de medidas urgentes para impulsar la actividad de rehabilitación edificatoria en el contexto del Plan de Recuperación, Transformación y Resiliencia.*, https://www.boe.es/eli/es/l/2022/06/14/10/con (accessed on 9 April 2024). [36]

Kerr, N. and M. Winskel (2020), "Household investment in home energy retrofit: A review of the evidence on effective public policy design for privately owned homes", *Renewable and Sustainable Energy Reviews*, Vol. 123, p. 109778, https://doi.org/10.1016/J.RSER.2020.109778. [29]

Lantmäteriet (2021), *Lantmäteriet*, https://www.lantmateriet.se/sv/fastighet-och-mark/information-om-fastigheter/Fastighetsregistret/ (accessed on 9 April 2024). [32]

Ministry of Ecological Transition (2024), *Guide RE 2020*, https://www.ecologie.gouv.fr/sites/default/files/guide_re2020_version_janvier_2024.pdf (accessed on 29 April 2024). [51]

Ministry of Ecological Transition (2024), *Le Fonds Vert Axe 1 - Rénovation énergétique des bâtiments publics locaux*, https://www.ecologie.gouv.fr/sites/default/files/FV_Cahier_Axe1_R%C3%A9novation_v2.1.pdf (accessed on 23 May 2024). [63]

Ministry of Ecological Transition (2024), *Le Fonds Vert AXE 2 - Prévention des inondations*, https://www.ecologie.gouv.fr/sites/default/files/Cahier%20accompagnement_Axe2_Inondations.pdf (accessed on 23 May 2024). [61]

Ministry of Ecological Transition (2024), *Le Fonds Vert AXE 2 - Renaturation des villes*, https://www.ecologie.gouv.fr/sites/default/files/Cahier%20accompagnement_Axe2_Renaturation.pdf (accessed on 23 May 2024). [62]

Ministry of Ecological Transition (2024), *Le Fonds Vert AXE 2 - Renforcement de la protection des bâtiments contre les vents cycloniques*, https://www.ecologie.gouv.fr/sites/default/files/Cahier%20accompagnement_Axe2_Cyclones.pdf. [60]

Ministry of Ecological Transition (2023), *LE FONDS VERT pour l'accélération de la transition écologique dans les territoires Guide à l'attention des décideurs locaux GUIDE À L'INTENTION DES DÉCIDEURS LOCAUX*, https://www.ecologie.gouv.fr/sites/default/files/FONDS%20VERT%20A4%20-%2040pages-%20page-WEB.pdf. [59]

Ministry of Ecological Transition and Terriotorial Cohesion (2024), , https://www.ecologie.gouv.fr/forum-mondial-batiments-et-climat-declaration-chaillot#:~:text=Dans%20la%20d%C3%A9claration%20de%20Chaillot,pays%20et%20villes%20en%20d%C3%A9veloppement. (accessed on 18 April 2024). [7]

Ministry of Ecological Transition and Territorial Cohesion (2021), *DOSSIER DE PRESSE - RE2020 Éco-construire pour le confort de tous*, https://www.ecologie.gouv.fr/sites/default/files/2021.02.18_DP_RE2020_EcoConstruire_0.pdf (accessed on 29 May 2024). [50]

Ministry of Energy of Ontario (n.d.), *Report energy and water use in large buildings*, https://www.ontario.ca/page/report-energy-water-use-large-buildings (accessed on 15 April 2024). [23]

Ministry of Environment in Finland (n.d.), *National building code of Finland 2012*, https://ym.fi/documents/1410903/35099218/1010+2017+YMA_uuden_rakennuksen_energiatehokkuus+EN.pdf/87c893a5-08cf-cc7b-b2a1-90032ebb9368/1010+2017+YMA_uuden_rakennuksen_energiatehokkuus+EN.pdf?t=1680607785707 (accessed on 5 June 2024). [52]

Ministry of Funds and Regional Policy of Poland (2022), *Krajowy Plan Odbudowy i Zwiększania Odporności*, https://www.kpo.gov.pl/media/109762/KPO.pdf (accessed on 17 July 2024). [41]

Ministry of Housing, City, and Territory of Colombia (2015), *Resolución 0549 Anexo*, https://camacol.co/sites/default/files/Resoluci%C3%B3n%20549%20de%202015%20con%20Anexos.pdf (accessed on 23 May 2024). [44]

Ministry of Housing, Communities & Local Government of the UK (2019), *The Future Homes Standard*, https://assets.publishing.service.gov.uk/media/5df78ecee5274a0910cb6d4d/Future_Homes_Standard_2019_Consultation.pdf (accessed on 14 April 2024). [5]

Ministry of Land, Infrastructure, and Transport of Korea (2019), *Green Building Basic Plan (녹색건축물 기본 계획)*, https://www.molit.go.kr/USR/NEWS/m_71/dtl.jsp?lcmspage=6&id=95083381 (accessed on 19 April 2024). [3]

Ministry of Land, Infrastructure, Transport and Tourism of Japan (2024), *Strong Wind Protection for Buildings Based on the Reiwa 1 Bōsō Peninsula Typhoon*, https://www.mlit.go.jp/jutakukentiku/build/jutakukentiku_house_tk_000146.html (accessed on 27 May 2024). [54]

Ministry of Land, Infrastructure, Transport and Tourism of Japan (2020), *Document 6: Wind Resistance Measures for Buildings in Light of the Reiwa 1 Bōsō Peninsula Typhoon*, https://www.mlit.go.jp/policy/shingikai/content/001410785.pdf (accessed on 27 May 2024). [55]

Ministry of Land, Infrastructure, Transport and Tourism of Japan (2003), *Introduction of Urban Land Use Planning System in Japan*, https://www.mlit.go.jp/common/001050453.pdf (accessed on 10 May 2024). [58]

Ministry of Land, Infrastructure, Transport and Tourism of Japan (n.d.), *Hazard Map Portal Site*, https://disaportal.gsi.go.jp/ (accessed on 10 May 2024). [67]

Ministry of Land, Infrastructure, Transport and Tourism of Japan (n.d.), *建築基準法の告示基準（昭和46年建設省告示第109号）の改正*, https://www.mlit.go.jp/jutakukentiku/build/content/001387862.pdf (accessed on 29 April 2024). [56]

Ministry of Local Government and Regional Development of Norway (2023), *Prop. 1 S (2022-2023)*, https://www.regjeringen.no/contentassets/d6d0bcc501974eb6a5268da5e3f851d4/no/pdfs/prp202220230001kdddddpdfs.pdf. [35]

Ministry of Sustainability and the Environment; Urban Redevelopment Authority (n.d.), *Factsheet on Singapore's Efforts to Mitigate the Urban Heat Island Effect Background*, https://www.mse.gov.sg/cos/resources/cos-annex-j.pdf (accessed on 11 April 2024). [45]

MLIT (2019), *Vision for the Future and Roadmap to BIM*, https://www.mlit.go.jp/jutakukentiku/content/001351970.pdf. [83]

Nationale Milieu Database (n.d.), , https://milieudatabase.nl/en/environmental-performance/policy/dutch-policy/ (accessed on 23 February 2024). [10]

Natural Resources Canada (2023), , https://natural-resources.canada.ca/energy-efficiency/energy-star-canada/energy-star-for-buildings/3691 (accessed on 15 April 2024). [22]

Natural Resources Canada (2023), *Natural Resources Canada - Data related to flood mapping*, https://natural-resources.canada.ca/the-office-the-chief-scientist/science-and-research/natural-hazards/data-related-flood-mapping/24250 (accessed on 10 May 2024). [64]

Natural Resources Canada (n.d.), , https://natural-resources.canada.ca/energy-efficiency/energuide/energuide-energy-efficiency-home-evaluations/after-your-energuide-home-evaluation/20572 (accessed on 15 April 2024). [21]

Netherlands Enterprise Agency (RVO) (2024), , https://energiecijfers.databank.nl/dashboard/dashboard/energielabels (accessed on 14 April 2024). [14]

Nordic Innovation (2023), *Roadmap Harmonising Nordic building regulations concernning climate emissions*, https://www.norden.org/en/publication/roadmap-harmonising-nordic-building-regulations-concerning-climate-emissions. [87]

Nordic Sustainable Construction (2023), *The Operating Environment of Building LCA and BIM in the Nordics and Estonia*, https://pub.norden.org/us2023-463/preface.html (accessed on 23 February 2024). [8]

NREL, N. (2021), *Integrating Energy Efficiency Strategies with Industrialized Construction for our Clean Energy Future*, https://www.nrel.gov/docs/fy20osti/77259.pdf, https://www.nrel.gov/buildings/industrialized-construction.html. [72]

RAP (2023), , https://www.raponline.org/wp-content/uploads/2023/08/RAP-Sunderland-EPBD-policy-brief-May-2023-4.pdf (accessed on 31 January 2024). [28]

Spanish Ministry of Transport Mobility and Urban Agenda, G. (2023), *PLAN BIM en la contratación pública*, https://cdn.mitma.gob.es/portal-web-drupal/cbim/v_26_bis_web_plan_bim_contratacion_publica.pdf. [89]

Swedish Energy Agency (2022), *Energy in Sweden 2022*, https://www.energimyndigheten.se/48d14e/globalassets/statistik/energilaget/energy-in-sweden-facts-and-figures_2022.xlsx (accessed on 9 April 2024). [33]

The Central Government of the Netherlands (2017), , https://www.rvo.nl/onderwerpen/wetten-en-regels-gebouwen/milieuprestatie-gebouwen-mpg (accessed on 23 February 2024). [11]

The Ministry of Ecological Transition and d Territorial Cohesion of France (2024), , https://www.ecologie.gouv.fr/diagnostic-performance-energetique-dpe (accessed on 14 April 2024). [13]

The Ministry of the Interior and Kingdom Relations (2022), *Programma Verduurzaming gebouwde omgeving*, https://www.volkshuisvestingnederland.nl/onderwerpen/programma-verduurzaming-gebouwde-omgeving/documenten/publicaties/2022/06/01/programma-verduurzaming (accessed on 18 April 2024). [2]

Tomohiro, H. (2013), *Introduction to the Buildings Standard Law - Building Regulation in Japan - (Ver. July 2013)*, https://www.bcj.or.jp/upload/international/baseline/BSLIntroduction201307_e.pdf (accessed on 10 May 2024). [57]

U.S, Department of Energy (2022), , https://www.energy.gov/eere/buildings/articles/home-energy-score (accessed on 15 April 2024). [17]

U.S. Department of Energy (2022), *50001 Ready Program*, https://navigator.lbl.gov/guidance/task/21. [70]

U.S. Department of Energy (n.d.), *Zero Energy Ready Home Program*, https://www.energy.gov/eere/buildings/zero-energy-ready-home-program (accessed on 15 April 2024). [18]

U.S. Department of Housing and Urban Development (2023), *FY 2023 Green and Resilient Retrofit Program (GRRP) Comprehensive*, https://www.hud.gov/program_offices/spm/gmomgmt/grantsinfo/fundingopps/fy2023_grrp_comprehensive (accessed on 23 September 2024). [40]

U.S. Environmental Protection Agency (2019), *Guidebook for Energy Efficiency Evaluation, Measurement, and Verification*, https://www.epa.gov/sites/default/files/2019-06/documents/guidebook_for_energy_efficiency_evaluation_measurement_verification.pdf. [74]

U.S. Office of Energy Efficiency & Renewable Energy (n.d.), *Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector*, https://www.energy.gov/eere/decarbonizing-us-economy-2050-national-blueprint-buildings-sector. [76]

UK Green Building Council (2019), *Net Zero Carbon Buildings: A Framework Definition*, https://ukgbc.org/resources/net-zero-carbon-buildings-framework/. [68]

Umishio, W. et al. (2022), *Association between Indoor Temperature in Winter and Serum Cholesterol: A Cross-Sectional Analysis of the Smart Wellness Housing Survey in Japan*, https://www.jstage.jst.go.jp/article/jat/29/12/29_63494/_article. [43]

UNEP (2024), *Global Status Report for Buildings and Construction*, https://www.unep.org/resources/report/global-status-report-buildings-and-construction (accessed on 7 April 2024). [4]

UNEP, Yale Center for Ecosystems + Architecture (2023), *Building Materials and the Climate: Constructing a New Future.*, https://wedocs.unep.org/20.500.11822/43293 (accessed on 15 April 2024). [6]

Urban Redevelopment Authority (2017), *Updates to the Landscaping for Urban Spaces and High-Rises (LUSH) Programme: LUSH 3.0*, https://www.ura.gov.sg/Corporate/Guidelines/Circulars/dc17-06 (accessed on 10 May 2024). [48]

Vlaamse overheid (n.d.), *Woningpas*, https://woningpas.vlaanderen.be/ (accessed on 9 April 2024). [92]

Zero Energy Buildings of Korea (n.d.), , https://zeb.energy.or.kr/BC/BC00/BC00_01_001.do (accessed on 15 April 2024). [24]

3 A step-by-step approach to decarbonising buildings

Implementing effective policies in the built environment requires a step-by-step approach that introduces regulations and considers time for stakeholders to adjust to changes. The process must address diverse needs and set clear deadlines. Drawing from the OECD Global Survey on Buildings and Climate (2024), two starting points are identified: rolling out preparation and implementation roadmap and targeting specific building types. These initial steps can provide clear signals and incentives for future ambitious action.

Introduction

Given the complexity of the built environment, a systematic approach is essential for effective policy implementation. Regulations should be introduced gradually, giving stakeholders time to adapt. However, this approach requires a multifaceted strategy that considers policy direction and priorities. Specific actions need to be broken down into incremental steps, back casting from future goals. The primary challenge lies in defining the initial step of this process and establishing a long-term roadmap with concrete deadlines for each step.

Drawing from the OECD Global Survey on Buildings and Climate (2024), this chapter outlines two starting points for action.

- First, initiating policy development through preparation and implementation plans. This includes refining methodology, engaging stakeholders from the outset, collecting relevant data and conducting thorough feasibility studies. By preparing incrementally, governments can ensure that policies are well-informed, effectively communicated and aligned with the needs and capabilities of stakeholders. This groundwork sets a solid foundation for successful implementation and facilitates adjustments based on early feedback and insights gained during the preparation phase.
- Second, beginning with targeted building types – such as public/private, non-residential/ residential or large/small – and progressively expanding the scope based on trial outcomes and country-specific priorities. Governments can prioritise feasibility of the policy implementation as well as impact of the action when selecting initial building types.

It is important to note that the first step alone does not complete the process. Subsequent steps are necessary to provide stakeholders and the market with clear signals for forthcoming years.

Preparation and implementation plans

Before rolling out comprehensive policies, it is essential to develop a detailed plan outlining the necessary actions for effective policy implementation. This holds particularly true for decarbonising buildings, where establishing methods to evaluate energy and environmental performance is vital. Governments can begin by initiating pilot projects involving various stakeholders to develop a methodology suitable for national application. This step-by-step approach enables iterative enhancements, integrating feedback and expertise from pilot initiatives and expert consultations.

For example**, France**'s RE2020 marks as a significant advancement in decarbonising new buildings as it considers not only energy consumption but also carbon emissions, including embodied carbon. However, the development of this policy was undertaken progressively. Prior to its implementation, France undertook comprehensive steps to lay the groundwork for effective and inclusive sustainability measures (Ministry of Ecological Transition and Territorial Cohesion, 2023[1]).

At the core of this process was the establishment of the E+C- experiment in 2016, aimed at fostering the construction of new buildings with enhanced energy efficiency (E+) and reduced carbon emissions (C-). This initiative involved the collaborative development of the Energy-Carbon Framework, an evaluation framework that outlined energy and environmental indicators, calculation principles and data utilisation. Notably, this framework incorporated life cycle analysis (LCA), ensuring a comprehensive assessment of buildings' environmental impacts (Ministry of Ecological Transition and Territorial Cohesion, 2023[1]).

Following expert work and technical preparatory phases, a major consultation phase commenced in early 2019, led by the government and the High Council for Construction. This inclusive process allowed all stakeholders in the construction sector to contribute to the refinement of environmental assessment methods, data production, regulatory requirements, and professional support systems. Analysis reports from expert groups, as well as feedback from the ongoing E+C- experiment, informed this consultation phase (Ministry of Ecological Transition and Territorial Cohesion, 2023[1]).

Based on the proposals generated during the consultation, the High Council for Construction presented recommendations to the administration for consideration. These recommendations served as the foundation for determining energy and environment performance calculation in RE2020 policies.

Since its enforcement in January 2022, RE2020 has targeted new residential buildings, and the scope of the coverage is set to extend further to office and education buildings subsequently. The RE2020 will be reinforced gradually in 2025, 2028 and 2031, within various types of buildings. (Ministry of Ecological Transition and Territorial Cohesion, 2021[2]). By 2031, for example, the carbon emissions for constructing single-family homes, including site-specific emissions, will see a significant decrease. The maximum threshold will drop from 640 $kgCO_2/ m^2$ in 2022 to 415 $kgCO_2/ m^2$ in 2031. For multi-family housing, this ceiling will be reduced from 740 to 490 $kgCO_2/ m^2$ (Ministry of Ecological Transition and Territorial Cohesion, 2021[2]).

Starting and scaling up with targeted buildings

Taking the first step is crucial. Governments should start by initiating actions on targeted buildings. The first proposed measures should be feasible and high-impact. Subsequently, governments can expand these efforts to encompass the entirety of the building stock or other carbon emission phases. This step-by-step approach allows for the gradual implementation of measures, ensuring both effectiveness and feasibility in advancing toward decarbonisation objectives.

Starting with low-hanging fruits should be a priority

Targeting larger architectural firms behind large non-residential buildings to set examples

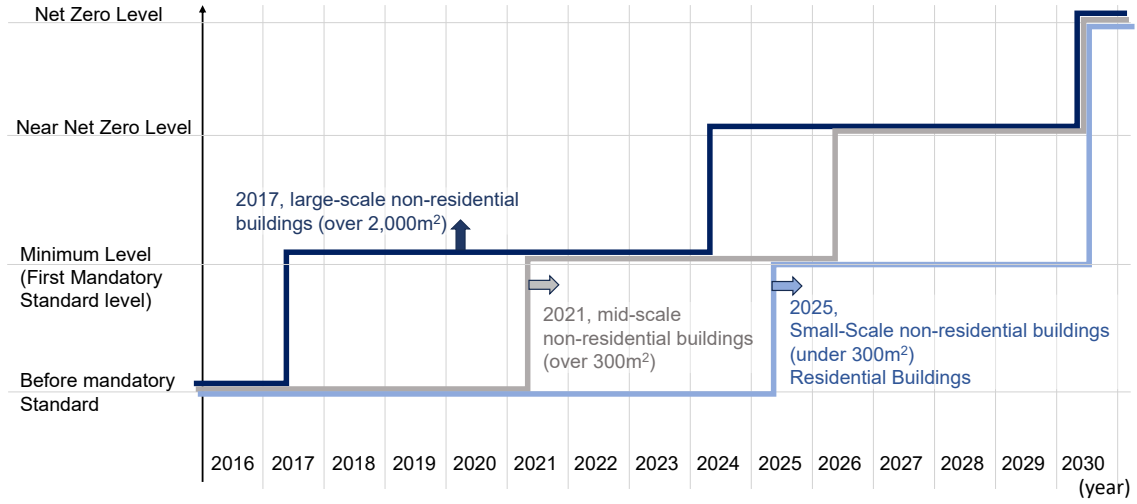
Japan aims to achieve net zero energy for buildings by 2050 and all new buildings reach net zero level by 2030. However, small and medium-sized businesses constitute a significant portion of Japan's building sector, and their aging workforce face challenges in adopting new techniques such as evaluating building energy efficiency performance.

To address this challenge, Japan introduced the mandatory standards on energy efficiency for large-scale (over 2 000 m^2) non-residential buildings in 2017, typically designed by larger architectural firms with sufficient skills. These standards are set to be upgraded in 2024 and 2030 to further improve energy efficiency (Ministry of Land, Infrastructure, Transport and Tourism of Japan, n.d.[3]).

Subsequently, mid-scale non-residential buildings were targeted (over 300 m^2), with the introduction of standards in 2021 and scheduled upgrades in 2026 and 2030. Finally, small-scale non-residential and residential buildings will need to comply with the standards in 2025, with plans to strengthen them by 2030 (Figure 3.1) (Ministry of Land, Infrastructure, Transport and Tourism of Japan, n.d.[3]).

This approach aims to enable architects, carpenters, SMEs, local authorities and other stakeholders to prepare adequately, ensuring a smoother transition to higher energy performance standards and steady enforcement.

Figure 3.1. Japan's schedule to secure net-zero level on new buildings



Source : https ://www.mlit.go.jp/jutakukentiku/house/content/001419725.pdf

Showcasing public buildings as testbeds

Leveraging government ownership, the decarbonisation of public buildings enables governments to pilot and showcase the effectiveness of various decarbonisation policies and technologies before scaling them up. These buildings can lead by example, inspiring the rest of the buildings to follow suit.

In **Lithuania**, a notable initiative mandates that newly constructed public buildings incorporate at least 50% wood and organic materials since November 2024. Furthermore, starting from 2025, public buildings must adhere to specific sustainable building schemes such as BREEAM and LEED, FITWEL, etc (Ministry of Environment Republic of Lithuania, n.d.[4]).

Singapore aims to make 80% of new buildings achieve Super Low Energy Label (SLE) from 2030 onwards. Since 2021, under the GreenGov.SG initiative, all new and retrofitted public buildings in Singapore must meet the stringent Green Mark Platinum Super Low Energy (SLE) standard, ensuring the highest level of energy performance. This initiative has resulted in 39 buildings achieving significant energy savings, equivalent to at least 60% decrease in used energy compared to 2005 levels (Ministry of Sustainability and the Environment of Singapore, 2022[5]).

In **Brazil**, since 2014, new federal buildings and renovations exceeding 500 m² must attain level A in the National Label of Energy Conservation for Buildings. Additionally, as per Ordinance 23 of 2015, federal institutions must develop Sustainable Logistic Plans, ensuring that building maintenance procurement prioritises energy, water and paper savings, among other sustainable strategies (Ministry of Mines and Energy of Brazil, 2020[6]).

France is demonstrating the potential of targeting public buildings through its Green Fund (Fonds vert), which is dedicated to supporting local governments in their energy retrofitting initiatives. This fund allocates EUR 500 million to the energy renovation of schools, which account for half of the surface area of local public buildings. In 2023, one-third of all accepted applications for energy renovation were submitted for school buildings. The energy renovation of public buildings contributes to the national objective of reducing energy consumption by 40% by 2030 and by 60% by 2050 for all tertiary buildings with a floor area of more than 1 000 m² (Ministry of Ecological Transition, 2023[7]).

Targeting large-emitters including large buildings, worst-performing buildings and upfront carbon will have high impact

Large buildings as visible targets

Large buildings typically have a more significant energy footprint and emit higher levels of carbon compared to smaller structures. Therefore, targeting large buildings first allows governments to make a substantial impact on overall energy consumption and carbon emissions, leading to more visible and quantifiable results. In addition, by starting with large buildings, governments can leverage economies of scale and develop and refine technologies before implementing them in smaller buildings.

Korea's Zero Energy Building (ZEB) Certification starts targeting large buildings. Since 2020, public buildings larger than 1 000 m^2 were required to meet ZEB 5 level. From 2023, public buildings larger than 500 m^2 were required to meet ZEB 5 level (Zero Energy Buildings of Korea, n.d.[8]). In the city of **Vancouver** (Canada), starting from 2023, commercial buildings exceeding 100 000 square feet (approximately 9 290 m^2) are required to report their annual energy use and carbon emissions (City of Vancouver, n.d.[9]). Under the city of **New York**'s (the United States) Local Law 97, most buildings over 25 000 square feet (approximately 2 320 m^2) are required to meet new energy efficiency and greenhouse gas emissions limits as of 2024, with stricter limits coming into effect in 2030 (City of New York, n.d.[10]).

Targeting worst-performing buildings for greatest impact

Addressing the worst-performing buildings first can lead to significant reductions in overall emissions. This approach maximises the impact of decarbonisation efforts as the worst-performing buildings typically have both the highest energy consumption and carbon emissions. The EU's new revision of the EPBD is in alignment with this approach by reinforcing the concept of Minimum Energy Performance Standards (MEPS) which aim to phase out worst performing buildings (European Commission, 2024[11]).

However, phasing out the worst-performing buildings should be a gradual process as building owners and stakeholders need sufficient time to adjust to the new regulations. Owners have their individual timelines for construction or renovation projects, alongside the need to secure finances for such endeavours. Additionally, sufficient time must be allocated to inform all building owners about the impending enforcement of these stringent regulatory measures.

France's MEPS exemplifies this approach. Housing units consuming more than 450 kWh of final energy per square meter per year cannot be rented starting from 1 January 2023. The same rental restrictions will apply to buildings classified as G starting from 2025; buildings classified as F starting from 2028; buildings classified as E starting from 2034 (Ministry of Ecological Transition and Territorial Cohesion, 2024[12]).

Reducing upfront carbon for immediate impact

Unlike operational carbon emissions, which accumulate over the building's lifespan, embodied carbon emissions occur during construction and demolition. By targeting upfront carbon, governments can immediately reduce the environmental impact of new construction projects. Sweden provides an exemplary case for this gradual approach. Starting from 1 January 2022, **Sweden** introduced a climate declaration requirement for new buildings, which mandates developers to calculate the climate impact during the construction stage (Boverket, 2023[13]).

Currently, only upfront carbon (modules A1 to A5) needs to be declared. The reasons for targeting the upfront carbon are multifaceted. First, emissions at the construction stage currently represent a large share of climate impacting emissions across building's life cycle. Second, it is possible to verify upfront carbon as opposed to calculations of the future emissions. The upfront carbon can be quantified based on emissions data of each material whereas estimating future emissions is more challenging due to numerous

variables that evolve over the buildings' lifespan. Last, curbing upfront carbon means the benefits are realised right away, as opposed to strategies that aim to reduce emissions over the long term (Boverket, 2018[14]).

Looking ahead to 2027, or at the earliest to 2025, the plan includes not only stricter values for A1 to A5 but also extension of climate declaration for operational and end-phase of building life cycle (namely, modules B2, B4, B6, C1 and C4) (Boverket, 2023[13]). Moreover, Sweden is now preparing limit values as early as of July 2025 for modules A1 to A5 (Boverket, 2023[15]). This stepwise expansion ensures a comprehensive approach to managing the climate impact across various aspects of the building life cycle while giving enough time for all stakeholders to adjust to changes.

Establishing a long-term roadmap

The journey to carbon neutrality requires a well-defined roadmap. In parallel to targeting specific buildings, governments are establishing a comprehensive plan built on long-term objectives, with achievable milestones guiding progress. For a successful roadmap, clarity is crucial. Stakeholders, including citizens and businesses, need to understand the resources required to achieve carbon neutrality and proactively align their strategies with anticipated regulatory changes.

The city of **Vancouver** (Canada) exemplifies the importance of such a roadmap. Their plan targets a 45% reduction in emissions by 2030, as compared to 2010 levels. Subsequently, carbon neutrality should be reached by 2050 in the region (Metrovancouver, n.d.[16]). The city of Vancouver provides a clear example of the importance of such a roadmap through its regulatory requirements. By creating a clear and comprehensive roadmap, involving diverse stakeholders, and utilising a variety of tools, governments can effectively guide their communities towards a carbon neutral future (Table 3.1) (City of Vancouver, n.d.[9]).

Table 3.1. Regulatory requirements and deadlines to decarbonise buildings in Vancouver (Canada)

Year	Requirements
2023	Annual energy and carbon reporting: • Commercial greater than 9 290 m² (100 000 square feet) • First reporting deadline: 1 June, 2024
2024	Annual energy and carbon reporting: • Commercial greater than 4 645 m² (50 000 square feet) • Multi-family greater than 9 290 m² (100 000 square feet) • First reporting deadline: 1 June 2025
2025	Annual energy and carbon reporting: • Multi-family greater than 4 645 m² (50 000 square feet) • First reporting deadline: 1 June 2026
2026	GHG limits come into effect for commercial office and retail buildings greater than 9 290 m² (100 000 square feet): • Office = 25 kg CO_2e/ m² /year • Retail = 14 kg CO_2e/ m² /year • First reporting deadline: 1 June 2027
2040	GHG limits come into effect for commercial office and retail buildings greater than 9 290 m² (100 000 square feet): • Office and retail = 0 kg CO_2e/ m² /year • First reporting deadline: 1 June 2041 Heat energy limit for commercial buildings greater than 9 290 m² (100 000 square feet): • Office and retail = 0.09 gigajoule/ m² /year • First reporting deadline: 1 June 2041

Source: https://vancouver.ca/green-vancouver/energize-vancouver.aspx

References

Boverket (2023), *Climate declaration for new buildings - Boverket*, https://www.boverket.se/en/start/building-in-sweden/contractor/tendering-process/climate-declaration/#:~:text=The%20act%20on%20climate%20declarations,buildings%20that%20require%20building%20permits. (accessed on 1 February 2024). [13]

Boverket (2023), *Limit values for climate impact from buildings and an expanded climate declaration*, https://www.boverket.se/en/start/publications/publications/2023/limit-values-for-climate-impact-from-buildings/ (accessed on 1 February 2024). [15]

Boverket (2018), *Klimatdeklaration av byggnader*, https://www.boverket.se/globalassets/publikationer/dokument/2018/klimatdeklaration-av-byggnader_slutrapport.pdf (accessed on 19 April 2024). [14]

City of New York (n.d.), , https://www.nyc.gov/site/sustainablebuildings/ll97/local-law-97.page (accessed on 16 April 2024). [10]

City of Vancouver (n.d.), , https://vancouver.ca/green-vancouver/energize-vancouver.aspx#:~:text=GHGi%20limits%20come%20into%20effect,reporting%20deadline%3A%20June%201%2C%202027 (accessed on 26 February 2024). [9]

European Commission (2024), , https://ec.europa.eu/commission/presscorner/detail/en/qanda_24_1966 (accessed on 14 April 2024). [11]

Metrovancouver (n.d.), , https://metrovancouver.org/services/air-quality-climate-action/climate-2050. [16]

Ministry of Ecological Transition (2023), *LE FONDS VERT pour l'accélération de la transition écologique dans les territoires Guide à l'attention des décideurs locaux GUIDE À L'INTENTION DES DÉCIDEURS LOCAUX*, https://www.ecologie.gouv.fr/sites/default/files/FONDS%20VERT%20A4%20-%2040pages-%20page-WEB.pdf. [7]

Ministry of Ecological Transition and Territorial Cohesion (2024), , https://www.ecologie.gouv.fr/diagnostic-performance-energetique-dpe (accessed on 16 April 2024). [12]

Ministry of Ecological Transition and Territorial Cohesion (2023), , https://www.ecologie.gouv.fr/experimenter-construction-du-batiment-performant-demain-0 (accessed on 17 April 2024). [1]

Ministry of Ecological Transition and Territorial Cohesion (2021), *DOSSIER DE PRESSE - RE2020 Éco-construire pour le confort de tous*, https://www.ecologie.gouv.fr/sites/default/files/2021.02.18_DP_RE2020_EcoConstruire_0.pdf (accessed on 29 May 2024). [2]

Ministry of Environment Republic of Lithuania (n.d.), , https://www.sustainability.gov/pdfs/lithuania-nzgi-roadmap.pdf (accessed on 16 April 2024). [4]

Ministry of Land, Infrastructure, Transport and Tourism of Japan (n.d.), , https://www.mlit.go.jp/en/ (accessed on 16 April 2024). [3]

Ministry of Mines and Energy of Brazil (2020), , https://www.gov.br/mme/pt-br/assuntos/secretarias/sntep/cooperacao-brasil-japao-em-conservacao-de-energia/relatorios-e-apresentacoes/dialogue-3-brazil-buildings.pdf (accessed on 26 February 2024). [6]

Ministry of Sustainability and the Environment of Singapore (2022), *GREENGOV.SG Report for financial year 2022*, https://www.mse.gov.sg/files/resources/greengovsg-report-fy2022.pdf (accessed on 26 February 2024). [5]

Zero Energy Buildings of Korea (n.d.), , https://zeb.energy.or.kr/BC/BC00/BC00_01_001.do (accessed on 15 April 2024). [8]

4 Multi-level approach to decarbonise buildings

This chapter analyses horizontal co-ordination among governmental ministries and vertical alignment across different levels of governance, alongside public-private partnerships for effective policy implementation. These co-ordination mechanisms and partnerships are crucial for overcoming challenges and accelerating progress towards decarbonising buildings.

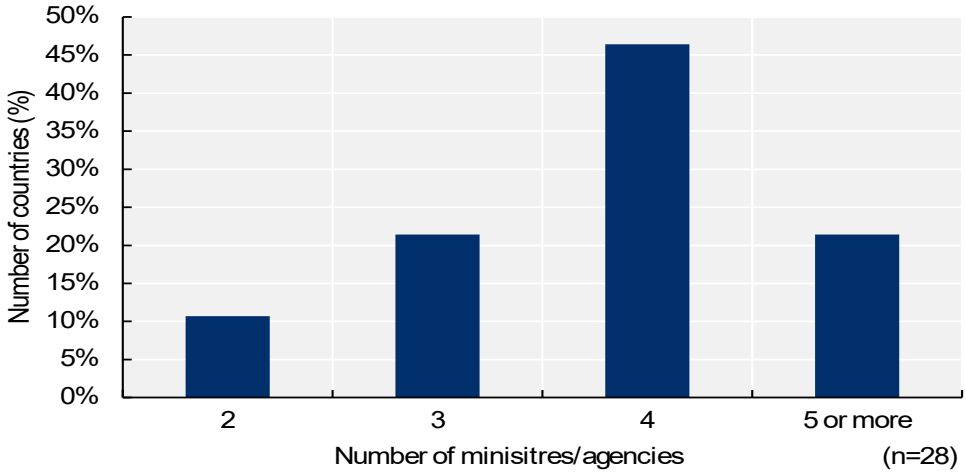
Introduction

Decarbonising buildings requires co-ordinated action across various levels and sectors. This chapter delves into the importance of three collaborative approaches: i) horizonal co-ordination, ii) vertical co-ordination, and iii) public-private partnerships. By working together effectively, these actors can unlock their full potential to develop and implement successful building decarbonisation strategies. This chapter will explore these collaborative approaches, drawing on data from the OECD Global Survey on Buildings and Climate (2024). The survey findings showcase promising examples of collaboration across different government levels and public-private partnerships, along with areas where further support is needed.

Horizontal co-ordination

Considering the large number of entities involved in the decarbonisation agenda, horizontal co-ordination across ministries and agencies within the government structure is crucial in delineating a cohesive long-term vision and mobilising resources to assist subnational governments. According to the OECD Global Survey on Buildings and Climate (2024), 93% of responding countries have at least three ministries involved in decarbonising buildings. Through collaborative efforts, these diverse policy domains can create synergies and overcome potential discrepancies, ultimately leading to a more sustainable built environment (Figure 4.1, Table 4.1). Over half (57%) of responding countries have strategies in place aimed at addressing energy poverty and inequalities through the decarbonisation of buildings. According to the OECD (OECD, 2022[1]), national governments can play a vital role in promoting a whole-of-government and multi-level governance approach in decarbonising buildings. This approach is particularly important in addressing the issue of energy poverty in disadvantaged communities, where access to energy efficient buildings and resources is often limited.

Figure 4.1. Number of ministries working on decarbonising buildings



Note: This figure shows the distribution of countries based on the number of ministries or agencies involved in decarbonising buildings. The national governments provided the data for this research by being asked for specific information on the functions of the several ministries and agencies in charge of the building decarbonisation plans and duties.
Source: OECD Global Survey on Buildings and Climate (2024)

Table 4.1. Number of ministries working on decarbonising buildings

Number of ministries/ Agencies	Countries
2	Greece, Poland, Spain*
3	Japan, Korea*, Lithuania, Norway*, United Kingdom, United States*
4	Canada*, Colombia, Costa Rica*, Côte d'Ivoire, Finland, France, Germany*, Italy*, Mexico*, Philippines, Singapore, Switzerland*, Thailand
5 or more	Belgium (Flanders), Brazil, Iceland, Israel, Netherlands, Sweden

* Countries where subnational governments are leading governmental bodies responsible for policies related to decarbonising buildings, alongside ministries or agencies at the national level.
Source: OECD Global Survey on Buildings and Climate (2024)

The National Observatory on Energy Poverty in **Italy** stands as a prime example of horizontal co-ordination. This institute engages various agencies such as the Ministry of Environment and Energy Security, the Ministry of Labour and Social Policies, the Ministry of Infrastructure and Transport, local governments and the regulatory authority for energy, networks, and the environment. Its functions include monitoring energy poverty at a national level, facilitating the exchange of experiences among regions, local administrations, research institutions and stakeholders, co-ordinating cohesive strategies to alleviate energy poverty nationwide, and implementing initiatives such as tax relief aimed at incentivising energy-efficient measures for buildings (ONPE, 2021[2]).

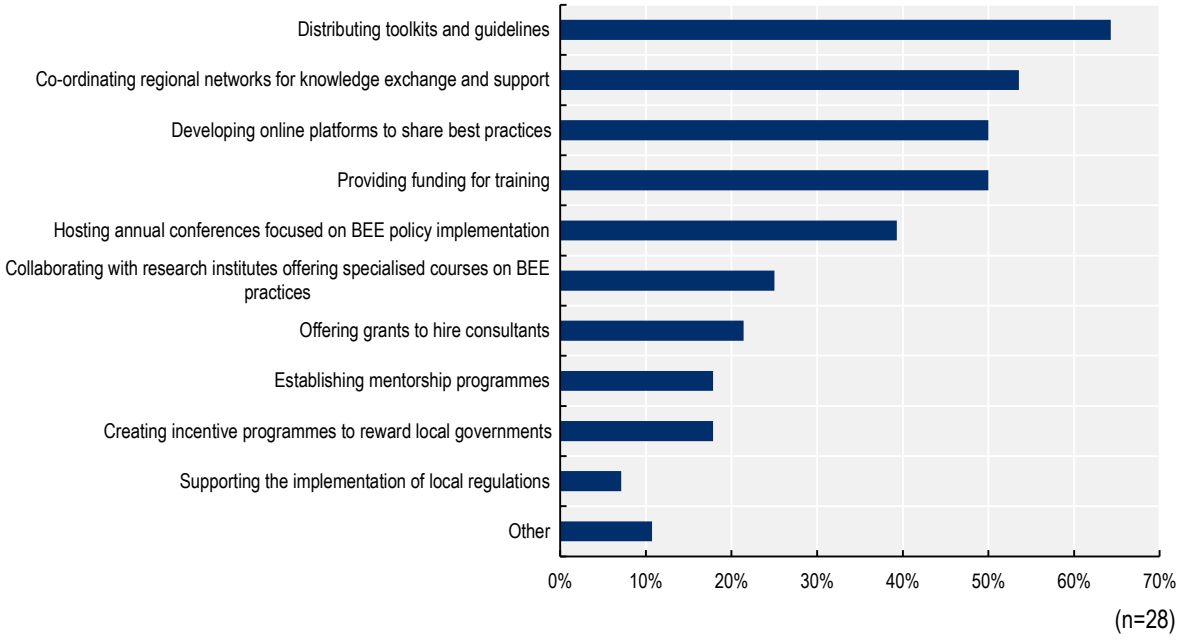
Colombia's National Roadmap for Net Zero Carbon Buildings is a horizontal and multi-level initiative aimed at achieving net-zero carbon in the building sector by 2050. The roadmap was developed under the leadership of the Sustainable Construction Council and the Ministry of Environment of Colombia in 2022. Key participants include the Ministry of Housing of Colombia, the National Planning Department, the Ministry of Energy of Colombia, the Colombian Chamber of Construction (Camacol) and the Planning Departments of Bogotá and Cali, showcasing strong public-private sector involvement.

The roadmap employs a structured strategy of first-level and second-level actions to achieve these goals. First-level actions provide broad transformative strategies focusing on areas such as energy efficiency, urban resilience, life cycle analysis and the promotion of sustainable materials. These are supported by second-level actions, which offer detailed interventions, including 163 specific actions for implementation. These include the creation of energy efficiency codes, the mandatory introduction of building labelling systems and the use of GIS tools to assess climate risks, ensuring more informed decision-making in urban planning and building design (Government of Colombia, 2022[3]).

Vertical co-ordination

82% of responding countries are supporting local governments in decarbonising buildings. Key measures include distributing toolkits and guidelines (64%), co-ordinating regional networks for knowledge exchange and support (54%), developing online platforms to share best practices (50%) and providing funding for training (50%) (Figure 4.2).

Figure 4.2. Actions undertaken by the national governments to support local governments for buildings energy efficiency policy implementation



Note: Question from the survey: "How do higher levels of government support capacity building and technical assistance for local governments to implement building energy efficiency policies?" The responding countries could select all applicable options.
Source: OECD Global Survey on Buildings and Climate (2024)

However, 74% of responding cities report that they do not receive enough support from national governments. According to the OECD Survey on Decarbonising Buildings in Cities and Regions (2022), cities and regions are calling for additional support from national governments to scale up pilot projects and raise public awareness (OECD, 2022[1]). Effective policy implementation requires co-ordinated actions at both national and subnational levels to achieve the desired outcomes and leverage synergies through a whole-of-government and multi-level governance approach.

Cities can be powerful drivers to decarbonise buildings. According to the 2024 OECD Global Survey on Buildings and Climate, 54% of countries reported cities implementing more ambitious policies than national governments. This advantage stems from their ability to pilot innovative solutions at a smaller scale. The OECD report, Decarbonising Buildings in Cities and Regions echoes this trend as 88% of the responding cities and regions surveyed demand higher energy efficiency standards than the national level in building energy code (OECD, 2022[1]). Additionally, the OECD report, Decarbonising Homes in Cities in the Netherlands: A Neighbourhood Approach, exemplifies how Dutch cities prioritise testing technically and economically viable solutions in neighbourhoods before wider implementation, informing national policy (OECD, 2023[4]).

In **the Netherlands**, the Dutch Natural Gas Free Neighbourhood Programme (PAW) (2018-2022) serves as a successful case study. The PAW programme bridges the gap between national ministries and local municipalities, facilitating collaboration and resource sharing across all levels of government. It employs staff seconded from both national and local authorities to ensure swift responses to local needs (OECD, 2023[4]). This multi-level governance approach allowed municipalities to tailor solutions to their specific needs while ensuring implementation of economically and technically viable measures (PAW, n.d.[5]). For instance, the municipality of **Rotterdam**, due to its proximity to the port, opted for district heating solutions, which were a logical fit given the local infrastructure. In contrast, the municipality of **Leusden**, lacking local

access to district heating, focused on improving building insulation combined with heat pump installations as their primary approach to reducing natural gas dependency. Additionally, PAW provided crucial financial support (EUR 4-5 million per neighbourhood) and leveraged economies of scale within neighbourhoods for collective heat solutions. Furthermore, the programme fostered social influence and community engagement through initiatives like neighbourhood ambassadors and counsellors (OECD, 2023[4]).

Germany's Heat Planning Act represents a crucial step towards co-ordinated national and subnational actions to accelerate the shift towards renewable heating sources. The Act, implemented in 2024, requires municipalities to develop climate-friendly heat plans. Subnational governments assess the status quo of heating as well as the local potential for climate neutral energy sources and identify which solution is most cost-efficient to decarbonise heating in a given area. Municipalities have autonomy in developing a strategy to implement the heat plans, for instance by supporting sustainable heat infrastructure (Federal Ministry for Economic Affairs and Climate Action, 2024[6]). Cities must submit plans by June 2026, while towns and municipalities with fewer than 100 000 inhabitants have until June 2028. Municipalities with under 10 000 residents may use a simplified procedure. Operators of energy infrastructure play a crucial role in supporting local governments. This is especially the case for operators of district heating networks that are required to devise plans to develop and decarbonise their heat networks using various climate neutral energy sources, such as industrial waste heat, solar energy, biomass and green hydrogen, depending on local economic feasibility and efficiency (Federal Ministry for Economic Affairs and Climate Action, 2024[6]). The Heat Planning Act also sets out the shares of renewable energy or unavoidable waste heat that need to be achieved in future in each district heating network: 30% by 2030 and 80% by 2040. In addition, the Buildings Energy Act which also came into force in 2024, mandates at least 65% of renewable energy or unavoidable waste heat for heating systems in new buildings. Together these legislative acts offer building owners, consumers, the housing industry and the heating industry a policy framework to inform their investment decisions (Building Forum climate neutral, 2024[7]).

Helsinki's (Finland)' proactive approach to implementing limit values on construction provides a compelling example of how cities can lead by example. By taking initiative two years ahead of the national government's 2025 plan to introduce carbon limit value on new construction, Helsinki requires compliance with carbon footprint limit in new city plans. As of 20 June 2023, building permits must adhere to a limit of 16.0 kg CO_2e/m²/year, calculated per 50 year of use.

Helsinki's initiative is particularly noteworthy because it leverages the calculation method developed by the national government. Helsinki's utilisation of the national calculation method serves as a practical demonstration of the method before its application to the national level. This approach also underscores the effectiveness of shared resources and expertise in driving impactful change (City of Helsinki, n.d.[8]).

Tokyo's (Japan) Cap-and-Trade Programme, initiated by the Tokyo Metropolitan Government (TMG) in April 2010, represents Japan' first mandatory Emissions Trading System (ETS). This programme targets approximately 40% of the metropolitan area's emissions covering about 1 400 buildings and facilities that consume at least 1 500 kL of crude oil per year.

The programme mandates a reduction of emissions below specific baselines for these high-consumption facilities. The baselines are calculated on the basis of average emissions over any three consecutive fiscal years selected between 2002 and 2007. These emissions targets are revised and tightened over successive compliance periods, each with its set reduction goals.

The compliance periods delineate the timeline for achieving emission reduction targets. Period 1 (FY2010-FY2014) aimed for 8% or 6% reductions. Period 2 (FY2015-FY2019) targeted 17% or 15% reductions. Period 3 (FY2020-FY2024) aimed for 27% or 25% decrease. By 2021, the programme demonstrated significant success, with covered facilities achieving a remarkable 33% reduction in emissions compared to base-year levels. This achievement was attributed to the implementation of energy efficiency measures and the adoption of low-carbon energy solutions.

Looking ahead, TMG released the final design elements of the fourth compliance period based on public consultation results. This period is designed to align with the ambitious "2030 Carbon Half" objective, aiming to reduce emissions to 50% of the 2000 level by 2030. Consequently, facilities will be required to achieve a compliance factor of 48-50% below their base-year emissions during this period (Tokyo Metropolitan Government, n.d.[9]).

TMG's initiative had a significant spillover effect on neighboring local areas. A partnership was established between the Tokyo Metropolitan Government (TMG) and **Saitama Prefecture** (Japan) to collaborate on emissions trading systems (ETS). Under this partnership, Saitama Prefecture and TMG share information about their respective systems and mutually exchange credits between the two regions. Saitama's cap-and-trade system applies to approximately 600 facilities that consume the energy equivalent of 1 500 kL or more of crude oil annually over three consecutive years. Many of these facilities have their headquarters or offices located in Tokyo, making the exchange of credits between businesses in both regions highly beneficial (Department of Environment Saitama Prefectural Government, 20217[10]).

Vienna (Austria) exemplifies how cities can drive national long-term climate objectives through city-level strategies and initiatives tailored to their local context. The city has adopted ambitious, quantitative targets to achieve carbon neutrality by 2040, aligning with Austria's national commitment (City of Vienna, 2022[11]; Federal Ministry for Sustainability and Tourism, Republic of Austria, 2019[12]).

In 2023, Vienna updated its buildings codes to mandate the use of heat pumps, district heating and cooling, and decentralised energy supply systems based on renewable energy in new constructions (Rechtsinformationssystem des Bundes, 2023[13]). However, the city's strict tenant laws require the consent of tenants before changing the heating systems (City of Vienna, 223[14]). To navigate this challenge, Vienna's comprehensive Phasing Out Gas programme employs a multi-layered approach including technical, financial, and legal strategies.

A key element of Vienna's Phasing Out Gas programme is the Vienna Heat Plan 2040 introduced in 2024. This plan outlines the measures necessary for shifting towards renewable energy sources for approximately 600 000 gas heaters. The city plans to use district heating and heat pumps as primary methods for heating and cooling a significant portion of its buildings by 2040. The electricity needed for these systems will be sourced from renewable energy, mainly wind and solar power, with biomass heating systems playing a limited role. The goal is to ensure that space heating and hot water are entirely powered by renewable energy (City of Vienna, 2024[15]). Given the high percentage of social and municipal housing, the focus is on district heating, with three large heat pumps set to supply heating to 56 000 households using thermal energy from treated wastewater (International District Energy Association, 2024[16]).

In conclusion, successful city-level initiatives often generate valuable data and insights that inform policy making at higher levels of government. By rigorously documenting and evaluating the outcomes of their programmes, cities provide valuable evidence of what works or not, helping to inform the development of broader policies and strategies at the national level. This evidence-based approach is essential for crafting effective, scalable solutions that can address complex challenges on a larger scale.

Public-private partnerships

Public-private partnerships are essential for decarbonising buildings, as they blend the regulatory guidance and policy support from the public sector with the innovation, resources and execution capabilities of the private sector. These partnerships are increasingly crucial in achieving climate goals and promoting sustainable building practices.

Regulatory framework can drive green investment

In the European Union, regulatory frameworks like the EU Taxonomy and the Sustainable Finance Disclosure Regulation (SFDR) are pivotal in shaping public-private partnerships and influencing private sector standards and evaluations.

The EU Taxonomy provides policy makers and the private sector with a common language and a clear definition of what is sustainable. It was introduced as part of the EU Renewed Sustainable Finance Strategy, aims to push financial and industrial sectors towards climate neutrality based on six environmental objectives: i) climate change mitigation; ii) climate change adaptation; iii) protection of water and marine resources; iv) circular economy transition; v) pollution prevention & control; and vi) biodiversity & ecosystem protection. Under the Taxonomy, an economic activity is considered environmentally sustainable if it makes a substantial contribution to one of the six objectives above, while doing no significant harm to the remaining five objectives (European Commission, n.d.[17]).

The Taxonomy also sets out the following technical screening criteria for economic activities in the building sector, including:

- **Construction of New Buildings**: Primary Energy Demand (PED) of new construction must be at least 10% lower than nearly zero energy building requirements.
- **Renovation of Existing Buildings**: Must reduce primary energy demand by at least 30%.
- **Acquisition and Ownership**: Buildings built before 31 December 2020, must be within the top 15% of national building stock in terms of energy performance or have an Energy Performance Certificate (EPC) of at least class A. Buildings constructed after this date must meet the criteria for new buildings (PEEB, n.d.[18]).

The Sustainable Finance Disclosure Regulations (SFDR) became effective from March 2021. The SFDR requires financial market participants and financial advisers to disclose at the entity and product level how they integrate sustainability risks and principal adverse impacts into their investment decision-making processes. This regulation enhances transparency by informing investors about the sustainability risks affecting their investments and the environmental and social impacts of those investments (European Commission, 2024[19]).

The EU Taxonomy and SFDR significantly influence private investment by providing clear criteria and standards for sustainable building practices. These regulations create a stable and predictable environment for investors, reducing risks associated with non-compliance and enhancing the value of investments.

In response to regulation changes in Europe, in September 2023, the Climate Bond Initiative (CBI) updated its criteria for sustainable buildings to align with the EU Taxonomy. The updated criteria now include assessments of whole-life carbon and various aspects of sustainability, reinforcing the commitment to environmental objectives (Climate Bond Initiative, 2023[20]).

Lastly, the Global Real Estate Sustainability Benchmark (GRESB), a leading ESG data provider for real estate and infrastructure, introduced a new SFDR Reporting Solution to help real estate fund managers comply with SFDR requirements. This solution offers interactive reports detailing a fund's ESG practices, including energy consumption, estimated greenhouse gas emissions, water usage, and waste generation of building assets. By facilitating compliance, GRESB can help fund managers in meeting SFDR disclosure obligations and aligning with sustainable building standards (GRESB, n.d.[21]).

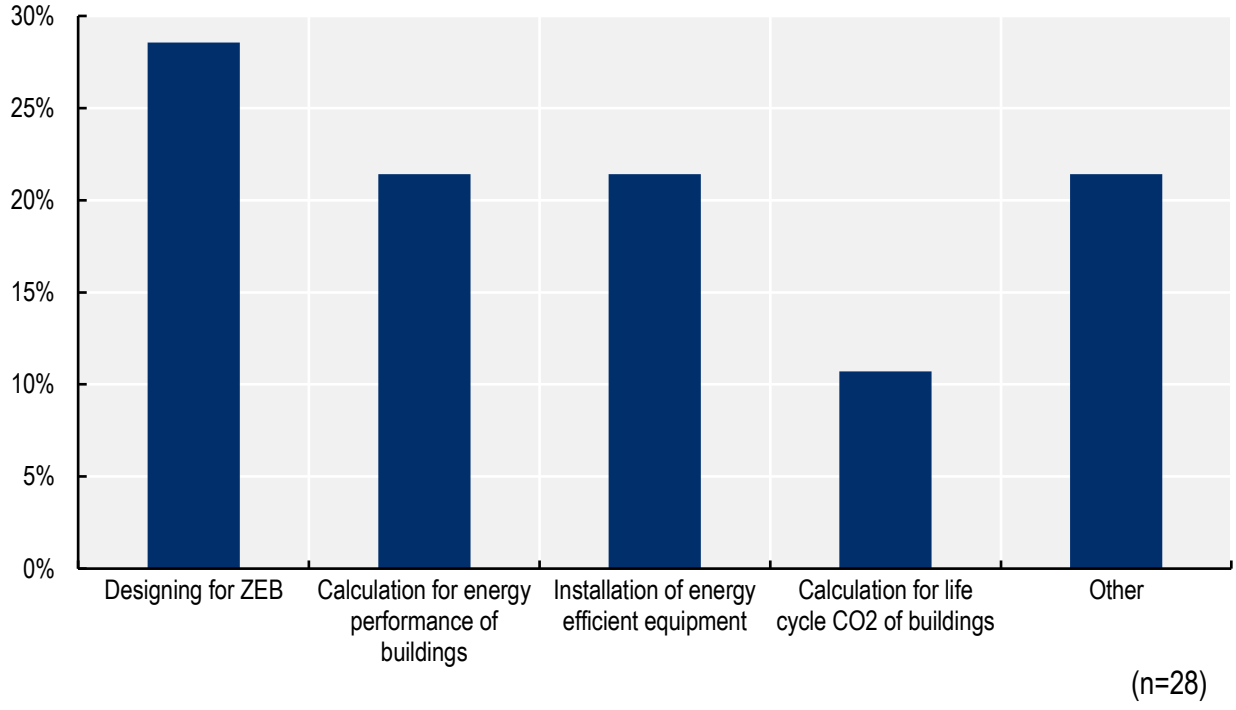
More support for SMEs is needed

Unlike large companies, small and medium-sized enterprises (SMEs) are often ill-positioned and lack the capacity to weather a crisis. Policies should support SMEs to ensure a just transition from the bottom up and engage a broader spectrum of market stakeholders. For instance, SMEs represent 99.95% of all enterprises in the European Union construction industry, including 94% micro businesses, 5.3% small enterprises, and 0.5% medium-sized enterprises as of 2017. SMEs also generate 80.4% of turnover within the European Union's construction industry in 2017, highlighting their substantial impact on the built environment (Europoean Commission, 2024[22]).

The OECD Global Survey on Buildings and Climate (2024) reveals that more than half (57%) of responding countries have set up government funding programmes to help small and medium-sized enterprises, but further support is needed.

Stricter energy codes require skilled contractors and sufficient funds for new building projects and renovations. With 68% of countries facing a shortage of skilled labour, national governments are stepping in to provide training and assistance to SMEs in designing zero-energy buildings, installing energy-efficient equipment and calculating life cycle CO_2 emissions. Public-private partnerships offer a promising avenue for governments to collaborate with private sector entities, tackling resource and labour shortages, while ensuring that buildings meet energy standards effectively (Figure 4.3).

Figure 4.3. Fields where government assistance is provided to SMEs to bridge skill shortages



Note: Question from the survey: "Please select all skills that receive government support for training". The responding countries could select all applicable options.
Source: OECD Global Survey on Buildings and Climate (2024)

Public-private partnerships also play a pivotal role in enhancing the co-benefits of decarbonising buildings. For instance, the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT) exemplifies this approach through its collaboration between the public and private sector and academia. Their research on insulation and health has led to the creation of accessible materials, such as manga, to facilitate broader dissemination of knowledge among SMEs and citizens (Figure 4.4).

Figure 4.4. Manga of Japanese Government on "Zero Energy House"

Source: https://www.mlit.go.jp/common/001582580.pdf

References

Building Forum climate neutral (2024), *Heat generation with renewable energies in detached and semi-detached houses*, https://www.gebaeudeforum.de/realisieren/erneuerbare-energien/waermeerzeugung-erneuerbare-energien-ezfh/ (accessed on 18 September 2024). [7]

City of Helsinki (n.d.), , https://www.hel.fi/en/urban-environment-and-traffic/plots-and-building-permits/applying-for-a-building-permit/carbon-footprint-limit-value (accessed on 26 February 2024). [8]

City of Vienna (2024), *Czernohorszky/Gaál/Hanke/Gara: Wiener Wärmeplan 2040 veranschaulicht klimaneutrale Zukunft Wiens*, https://presse.wien.gv.at/presse/2024/05/06/czernohorszky-gaal-hanke-gara-wiener-waermeplan-2040-veranschaulicht-klimaneutrale-zukunft-wiens (accessed on 25 June 2024). [15]

City of Vienna (2022), *Vienna Climate Guide: Towards a climate-friendly city*, https://www.digital.wienbibliothek.at/wbrup/download/pdf/4047968?originalFilename=true (accessed on 25 June 2024). [11]

City of Vienna (223), *Phasing Out Gas: Heating and Cooling Vienna 2040*, https://www.wien.gv.at/stadtentwicklung/energie/pdf/phasing-out-gas.pdf (accessed on 25 June 2024). [14]

Climate Bond Initiative (2023), , https://www.climatebonds.net/2023/10/climate-bonds-comes-line-eu-taxonomy-low-carbon-buildings. [20]

Department of Environment Saitama Prefectural Government (20217), *Emissions Trading System in Saitama*, https://www.kankyo1.metro.tokyo.lg.jp/archive/en/climate/cap_and_trade/icap_tokyo_2017.files/170614icapsymposium_session3_saitame_pre.pdf (accessed on 18 September 2024). [10]

European Commission (2024), , https://finance.ec.europa.eu/document/download/0f2cfde1-12b0-4860-b548-0393ac5b592b_en?filename=2023-sfdr-implementation-summary-of-responses_en.pdf (accessed on 19 July 2024). [19]

European Commission (n.d.), *EU Taxonomy Navigator*, https://ec.europa.eu/sustainable-finance-taxonomy/. [17]

Europoean Commission (2024), *Internal Market, Industry, Entrepreneurship and SMEs, European construction sector observatory, Data mapper*, https://single-market-economy.ec.europa.eu/sectors/construction/observatory/data-mapper_en (accessed on 10 September 2024). [22]

Federal Ministry for Economic Affairs and Climate Action (2024), *The Heat Planning Act: momentum for the local heat transition*, https://www.bmwk-energiewende.de/EWD/Redaktion/EN/Newsletter/2023/11/Meldung/news1.html (accessed on September 11 2024). [6]

Federal Ministry for Sustainability and Tourism, Republic of Austria (2019), *Long-Term Strategy 2050 - Austria*, https://unfccc.int/sites/default/files/resource/LTS1_Austria.pdf (accessed on 25 June 2024). [12]

Government of Colombia (2022), *National Roadmap for Net Zero Carbon Buildings*, https://www.cccs.org.co/wp/wp-content/uploads/2023/05/national-roadtrip-for-net-zero-carbon-buildings.pdf (accessed on 19 September 2024). [3]

GRESB (n.d.), , https://www.gresb.com/nl-en/products/sfdr-reporting/ (accessed on 19 July 2024). [21]

International District Energy Association (2024), *Europe's biggest heat pump system put into operation in Vienna*, https://www.districtenergy.org/blogs/district-energy/2023/12/19/httpsbalkangreenenergynewscomeuropes-biggest-heat#:~:text=In%20Vienna%27s%20Simmering%20district%2C%20three,for%20the%20future%20of%20heating. (accessed on 25 June 2024). [16]

OECD (2023), *Decarbonising Buildings in Cities in the Netherlands: A Neighbourhood Approach*, https://www.oecd.org/cfe/decarbonising-homes-in-cities-in-the-netherlands-b94727de-en.htm (accessed on 15 April 2024). [4]

OECD (2022), *Decarbonising Buildings in Cities and Regions*, OECD Urban Studies, OECD Publishing, Paris, https://doi.org/10.1787/a48ce566-en. [1]

ONPE (2021), , https://onpe.org/sites/default/files/2024-02/ONPE%20Italy%20EN.pdf (accessed on 16 April 2024). [2]

PAW (n.d.), , https://aardgasvrijewijken.nl/default.aspx (accessed on 23 February 2024). [5]

PEEB (n.d.), , https://www.peeb.build/imglib/downloads/PEEB_EU_Taxonomy.pdf (accessed on 19 July 2024). [18]

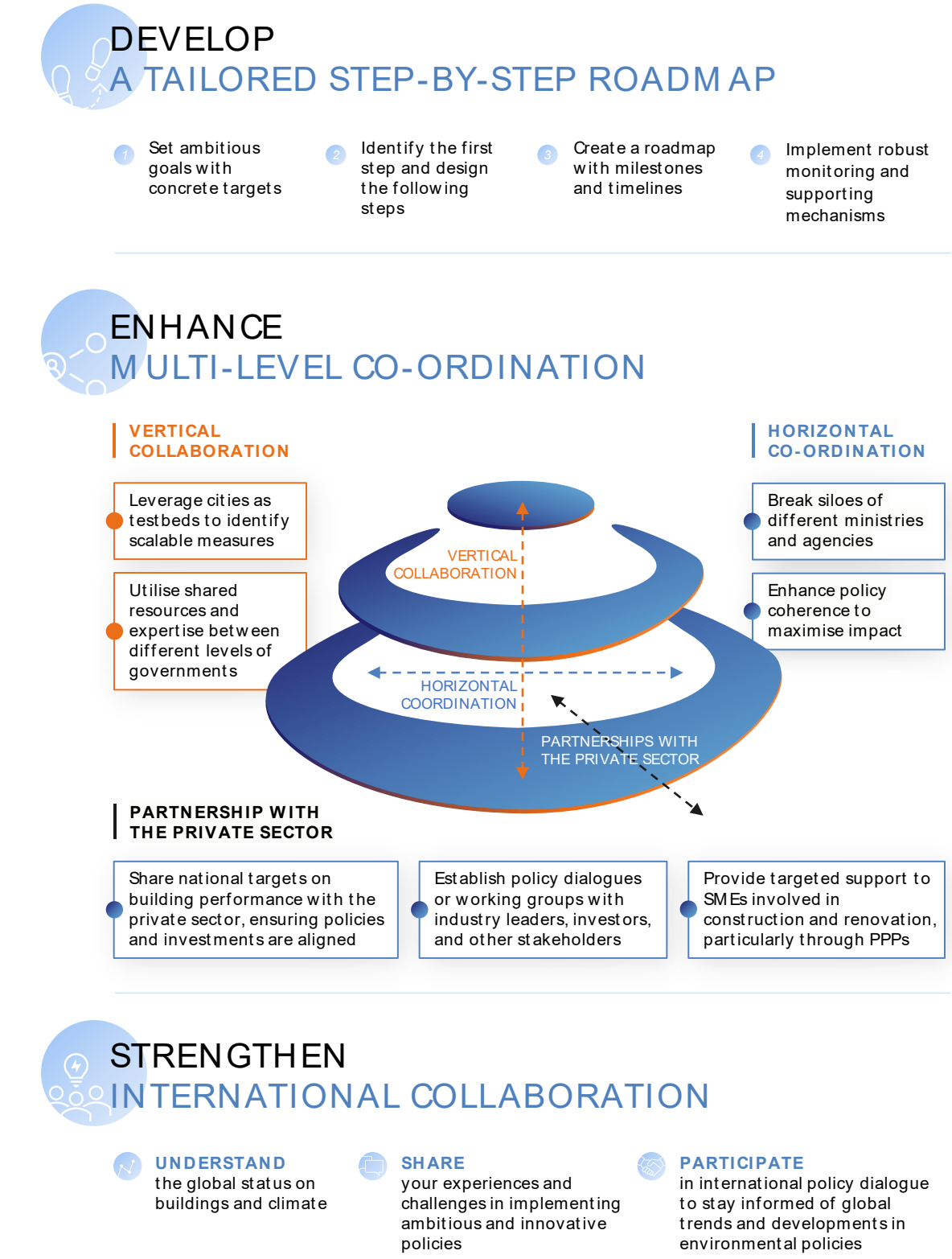
Rechtsinformationssystem des Bundes (2023), *Wiener Stadtentwicklungs-, Stadtplanungs- und Baugesetzbuch (Bauordnung für Wien – BO für Wien)*, https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=LrW&Gesetzesnummer=20000006 (accessed on 25 June 2024). [13]

Tokyo Metropolitan Government (n.d.), , https://www.kankyo.metro.tokyo.lg.jp/en/climate/cap_and_trade/index.html. [9]

5 Policy Recommendations

This chapter provides three major policy recommendations to accelerate the effective design and implementation of decarbonising policies for buildings: i) tailor the step-by-step approach to place-based characteristics; ii) foster a multi-level approach; and iii) engage in international collaboration to learn from best practices and accelerate efforts.

Figure 5.1. Three major policy recommendations for decarbonising buildings



Source: Author's elaboration.

Introduction

In order to reach the net-zero goals by 2050 as set out in the Paris Agreement, it is imperative to significantly accelerate the retrofitting of existing buildings and prioritise the construction of new buildings using low-carbon materials and highly energy-efficient building systems. Moreover, the widespread adoption of a whole-life carbon approach is important. While these tasks present significant challenges, several countries and cities have emerged as leaders in decarbonising buildings, providing valuable insights and examples for others to follow.

This chapter suggests policy recommendations for national and local governments to adopt and strengthen policies towards decarbonising buildings.

First, develop a customised step-by-step approach

As shown in Chapter 3, governments need to develop their own customised step-by-step approach for effective policy implementation in the built environment. The OECD report, Decarbonising Buildings in Cities in the Netherlands: A Neighbourhood Approach, highlights the efficacy of this strategy in the Netherlands' transition from natural gas heating. By initiating changes in small neighbourhoods and progressively expanding to entire municipalities, local authorities can create detailed plans encompassing short, medium and long-term goals (OECD, 2023[1]). This stepwise methodology is essential for successful policy execution. This report expands on this finding, providing a more in-depth framework applicable to various contexts. The key elements include: i) setting ambitious goals with concrete targets; ii) identifying the first step and design the following steps; iii) creating a roadmap with milestones and timelines; and iv) implementing a robust monitoring and supporting mechanisms.

Setting the stage: ambitious goals and measurable targets

The decarbonisation journey begins with establishing clear and ambitious goals. These goals should be translated into quantifiable targets such as the number of homes to be insulated or renovated to achieve certain energy efficiency levels by predefined dates. For instance, the Netherlands' goal of heating 1.5 million dwellings without natural gas and providing 500 000 new constructions to district heating networks by 2030 represents a concrete and measurable target (The Ministry of the Interior and Kingdom Relations of the Netherlands, 2022[2]). Conversely, simply setting a percentage decrease of carbon emissions in the building sector lacks specificity and does not reveal actions needed nor investments expected in the future. More specific and quantitative targets can encourage private sector investment as well as synergies with local governments' policies. Moreover, it is crucial to look beyond immediate priorities and consider future challenges, such as whole-life carbon assessments and retrofitting existing buildings, as highlighted by the findings of the OECD Global Survey on Buildings and Climate (2024).

Taking the first step: incremental progress and targeted action

Once the overall goal is set, it is important to break the process down into achievable steps. The key lies in identifying the first step and creating a long-term roadmap with deadlines for each stage. Drawing from the OECD Global Survey on Buildings and Climate (2024), two starting points are recommended to consider:

- **Roll out policy preparation and implementation plans**: This involves gathering data, establishing benchmarks and testing strategies through pilot projects.
- **Target low-hanging fruits:** This focuses on readily achievable building types such as public buildings or large buildings.

Preparation and implementation plan

Before diving headfirst into regulations, governments should invest in refining the methodology for decarbonising buildings. For this process, governments should first gather comprehensive data on building types, energy consumption patterns and existing energy efficiency measures. This data will inform targeted interventions and the development of effective regulations. Then, governments should establish benchmarks for energy consumption and carbon emissions across different building categories. This provides a clear baseline to measure progress and identify areas for improvement. Governments should also test and refine decarbonisation strategies in buildings through pilot projects on smaller scale. These projects can help identify challenges and best practices before wider implementation. During the process, governments should involve stakeholders representing building owners, architects, engineers, construction companies and citizen groups. This collaborative approach ensures all perspectives are considered in the development of regulations, fostering buy-in and smoother implementation.

The French example of implementing the RE2020 regulation stands out as a model for refining methodology due to several factors. First, before the implementation of the regulation, France not only collected data but also convened a diverse group of stakeholders. This ensured the methodology considered the needs and concerns of various parties who would be impacted by the regulations, leading to a well-rounded approach. Second, the pilot projects (E+C-) were not simply theoretical exercises. They involved testing methods for assessing building performance in real-world scenarios. This ensured the methodology was not only effective but also practical and implementable on a larger scale. (Ministry of Ecological Transition and Territorial Cohesion, 2020[3]).

Low-Hanging Fruit: Early Wins, Big Impact

While establishing a concrete policy plan is essential, the fight against climate change demands immediate action. Governments should not wait for the perfect alignment of conditions before taking such urgent action. Targeting low-hanging fruit allows for immediate emissions reduction and builds momentum for larger initiatives. Two elements need to be considered when targeting low-hanging fruit buildings:

- **Feasibility**: Targeting building types with existing resources or capacity for change, such as public buildings or large non-residential buildings can lead to quicker wins.
- **Impact**: Alternatively, governments can prioritise buildings categories with the greatest potential environmental impact, like large commercial buildings.

Japan's strategy of starting with mandatory energy efficiency standards for large non-residential buildings before tackling smaller ones provides a valuable case study for a step-by-step approach to decarbonising buildings. This approach can be analysed from both the feasibility and impact perspectives. First, large non-residential buildings tend to have dedicated building management teams and access to architectural firms with experience in energy efficiency measures. This existing knowledge base and management structure made implementing these standards more feasible initially. Since the number of new large non-residential projects is small compared to residential construction, this is feasible in terms of the capacity of both the applicant and the reviewer for building permits. Second, from the impact perspective, large commercial buildings, especially office towers and shopping malls, often have significantly higher energy consumption compared to residential buildings. Targeting these buildings first brings a greater immediate impact on overall building sector emissions reductions (Ministry of Land, Infrastructure, Transport and Tourism of Japan, n.d.[4]).

Sweden's approach of tacking upfront carbon emissions in construction is another good example of a step-by-step approach. Sweden prioritised upfront carbon emissions (Module A) before tackling other phases of building life cycle (notably module C and D) (Boverket, 2023[5]).This allowed for immediate action without waiting for a comprehensive framework for all aspects of decarbonising buildings. In terms of impact, construction activities represent a significant portion of a building's total carbon footprint.

Addressing upfront carbon emissions allows for immediate reductions in overall building sector emissions. In addition, early regulations for upfront carbon emissions incentivise innovation in low-carbon building materials and construction techniques. This can lead to long-term benefits beyond the initial reduction in emissions.

By carefully considering these two approaches, governments can choose the most effective first step for their specific context and goals.

Strengthen partnerships with the private sector

Most buildings are designed, built, invested in, and sold or leased by the private sector. Governments should thus proactively engage with private sector entities to develop and implement comprehensive strategies for decarbonising buildings.

In order to facilitate the private sector engagement, governments need to set and share clear targets for building decarbonisation, which are aligned with national and international climate goals. These targets should address various aspects of building performance, including energy efficiency, emissions reduction, and use of renewable energy. Governments can also leverage existing policy framework such as EU Taxonomy, SDFR, EPC and MEPS, while the private sector can leverage its investment expertise and market reach. This shared approach accelerates progress towards decarbonising goals.

It is also important to establish policy dialogues or working groups comprising government officials, industry leaders, and other stakeholders to collaborate on decarbonisation strategies. These groups can identify challenges, share insights and develop joint solutions. France's RE2020 exemplifies how private expertise in regulation can be leveraged. By involving the private sector in the early stages of developing the methodology for energy and environmental performance, the government made the most of private sector expertise, resources and innovative capacity (Ministry of Ecological Transition and Territorial Cohesion, 2023[6]).

Moreover, governments should focus on facilitating Public-Private Partnerships (PPPs) that address critical challenges faced by SMEs in meeting energy standards. This involves providing financial support, training programmes, and technical assistance to SMEs involved in building construction and renovation projects. By partnering with the private sector, governments can mitigate resource and labour shortages while ensuring that buildings meet stringent requirements.

Charting the course: a comprehensive roadmap

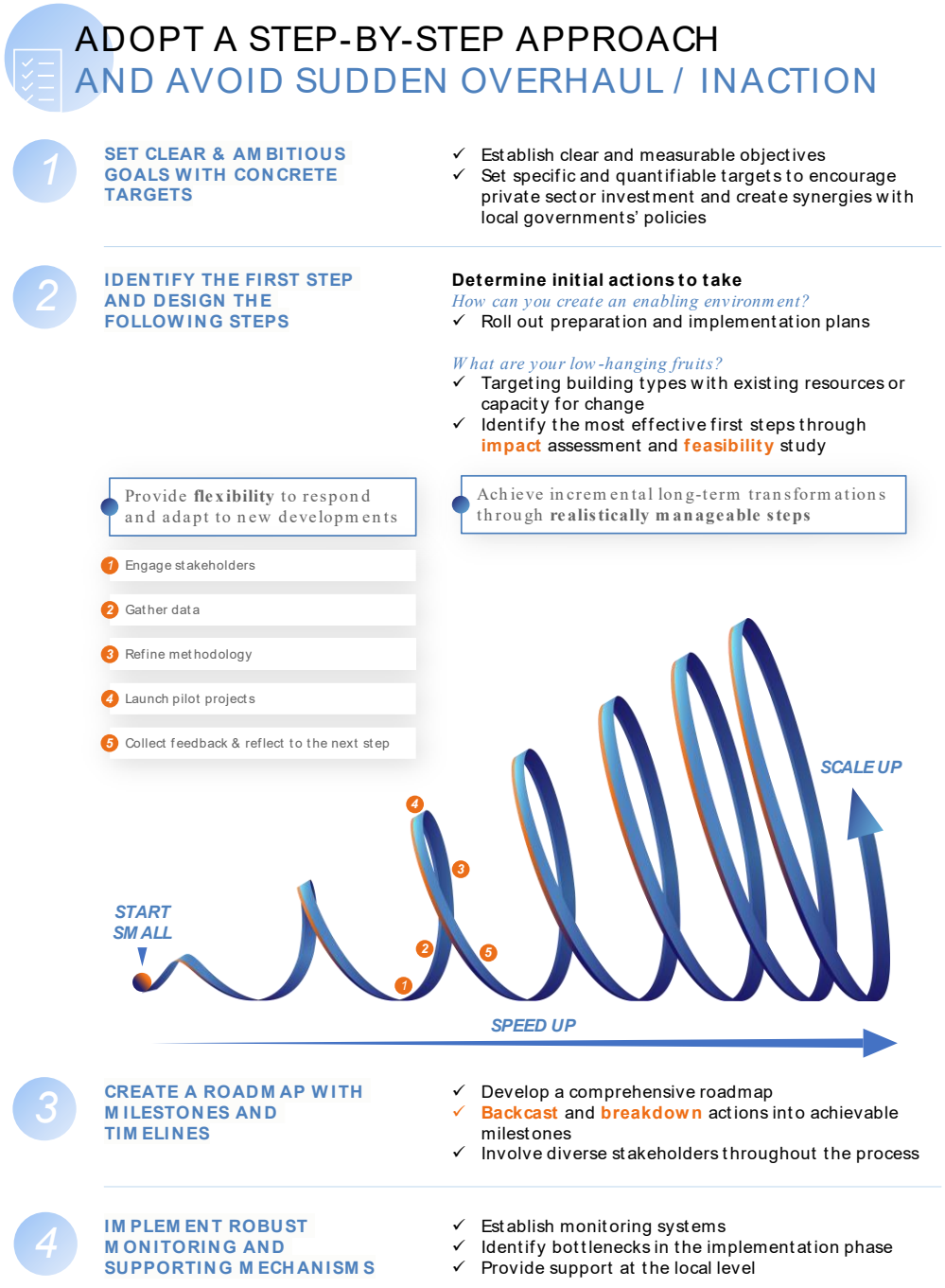
Having taken the first step, governments need to develop a comprehensive roadmap outlining the sequence of policy measures needed to achieve the goals. Governments can backcast and breakdown long-term plans into achievable milestones. Moreover, the roadmap should not be limited to regulations, but it should encompass a wider range of actions including developing standards, enhancing financial incentives, and strengthening staffing and training.

Whether setting specific goals or crafting the roadmap, clarity is crucial. Clear communication about future investment requirements, as well as the specific roles and responsibilities of each party, is essential for fostering collaboration and ensuring successful implementation. To achieve greater transparency and build a successful roadmap, involving diverse stakeholders throughout the process is essential. Their input ensures the plan is achievable, addresses diverse needs and fosters ownership.

Ensuring success: monitoring and support mechanisms

Robust monitoring and support mechanisms, particularly at the local level, are essential for effective policy implementation. This involves identifying and addressing challenges faced by local authorities, fostering accountability and facilitating timely intervention and enhancing co-ordination between national and local stakeholders.

Figure 5.2. Key elements of a tailored step-by-step approach



Source: Author's elaboration.

Second, adopt a multi-level approach

To effectively address interconnected challenges in the transition towards sustainable and low-carbon built environments, governments should adopt a multi-level approach that fosters horizontal co-ordination, facilitates vertical co-ordination, and engages in partnerships with the private sector.

Foster horizontal co-ordination

Efforts to decarbonise buildings traverse various policy domains, including energy, environmental sustainability, housing, building regulations, and urban development strategies. The OECD Global Survey on Buildings and Climate (2024) indicates that in 93% of surveyed countries, at least three ministries are involved in decarbonising buildings. Breaking siloes of different ministries and agencies is the key in bringing policy coherence and maximising impact.

Facilitate vertical collaboration between national and local governments

Cities are at the forefront of decarbonising buildings, with 54% of surveyed countries acknowledging their leadership in adopting more ambitious policies compared to national governments, as per the 2024 OECD Global Survey on Buildings and Climate. Leveraging cities as testbeds can enable national governments to implement ambitious policies and identify scalable measures.

Helsinki's carbon footprint limit for new buildings highlights the effectiveness of utilising nationally developed methods at the local level, providing practical demonstration of their applicability. This approach emphasises the importance of shared resources and expertise between different levels of governments in driving decarbonising buildings (City of Helsinki, n.d.[7]). City-level initiatives yield valuable data and insights crucial for informing policy making at higher government levels.

It is also important to establish policy dialogues or working groups comprising government officials, industry leaders, and other stakeholders to collaborate on decarbonisation strategies. These groups can identify challenges, share insights and develop joint solutions. **France**'s RE2020 exemplifies how private expertise in regulation can be leveraged. By involving the private sector in the early stages of developing the methodology for energy and environmental performance, the government made the most of private sector expertise, resources, and innovative capacity.

Third, engage in international collaboration to learn from best practice

In the face of climate and energy crisis, policies need to speed up further. Moreover, it is now more crucial than ever to enhance international dialogue to address this pressing issue. Understanding other countries' experiences and challenges in implementing ambitious and innovative policies will be very useful when considering next steps.

Governments should actively participate in international policy dialogue to stay informed of global trends and developments in environmental policies, as shown by the Chaillot Declaration, signed by more than 70 countries. The Declaration was signed during the Global Forum on Buildings and Climate in 2024, which was the first high-level ministerial meeting on buildings and construction. The text notably emphasises the importance of international collaboration in promoting buildings' decarbonisation and climate resilience. 10 action areas of commitments are outlined to establish national pathways, policies and measures for building decarbonisation and climate resilience and calls for strengthened international collaboration of all actors in the building and construction sectors (Ministry of Ecological Transition and Terriotorial Cohesion, 2024[8]) (Box 5.1).

Box 5.1. Chaillot Declaration policy commitment for decarbonising buildings and enhancing climate resilience

The Chaillot Declaration, signed by 70 countries across the world, includes 10 key policy commitments for decarbonising buildings and enhancing climate resilience.

Governments committed to the Declaration aim to establish and implement inclusive decarbonisation and resilient pathways for buildings at all levels, with adjustments to actions based on each country's specific context.

The suggested policy action areas are:

1. Implementing long-term regulatory roadmaps and frameworks, mandatory building and energy codes for all buildings, or supporting the adoption of these at the subnational level; requiring integrated comprehensive design;
2. Implementing an appropriate financial framework, including financial and fiscal incentives and regulatory tools such as taxonomies, to dramatically increase affordable near zero emission and climate resilient buildings and to phase out the financing of emissive and non-resilient ones;
3. Advancing and promoting the adoption of standards, labels and certifications in the buildings and construction sector or supporting the adoption of these at the subnational level;
4. Leading by example through ambitious procurement policies with particular attention to public building procurements;
5. Promoting the production, development and use of low-carbon and sustainably sourced construction material at affordable costs;
6. Promoting collaborative value chains, as well as research and development for innovative, sustainable, affordable, cost-effective and healthy solutions, particularly for conventional and hard-to abate industries, enhancing local sourcing of traditional appropriate low-tech solutions;
7. Enhancing skill capacity and capacity building at all levels, notably by strengthening local knowhow and ensuring working conditions are protected and enhanced by mitigation and adaptation strategies;
8. Developing multi-level governance, multi-stakeholder co-ordination, and a participative approach to ensure appropriate implementation, co-ordination and compliance;
9. Developing tools and regulatory frameworks to collect and share best practices and the geographical, energy and environmental data necessary for effective decision-making;
10. Sharing best practices to enhance awareness and advocate for sustainable choices.

Source: https://www.ecologie.gouv.fr/sites/default/files/declaration-de-chaillot-forum-batiments-climat.pdf

Furthermore, governments should actively promote peer learning among countries, particularly in examining the experiences of similar nations and those leading in decarbonising buildings. By studying the best practices and adapting them to their specific contexts, governments can accelerate their own decarbonisation efforts. Additionally, learning from countries at the forefront enables governments to identify their next steps and refine their strategies for achieving ambitious decarbonisation goals.

References

Boverket (2023), *Climate declaration for new buildings - Boverket*, https://www.boverket.se/en/start/building-in-sweden/contractor/tendering-process/climate-declaration/#:~:text=The%20act%20on%20climate%20declarations,buildings%20that%20require%20building%20permits. (accessed on 1 February 2024). [5]

City of Helsinki (n.d.), , https://www.hel.fi/en/urban-environment-and-traffic/plots-and-building-permits/applying-for-a-building-permit/carbon-footprint-limit-value (accessed on 26 February 2024). [7]

Ministry of Ecological Transition and Terriotorial Cohesion (2024), , https://www.ecologie.gouv.fr/forum-mondial-batiments-et-climat-declaration-chaillot#:~:text=Dans%20la%20d%C3%A9claration%20de%20Chaillot,pays%20et%20villes%20en%20d%C3%A9veloppement. (accessed on 18 April 2024). [8]

Ministry of Ecological Transition and Territorial Cohesion (2023), , https://www.ecologie.gouv.fr/experimenter-construction-du-batiment-performant-demain-0 (accessed on 17 April 2024). [6]

Ministry of Ecological Transition and Territorial Cohesion (2020), *Guide RE2020*, https://www.ecologie.gouv.fr/sites/default/files/guide_re2020.pdf (accessed on 16 April 2024). [3]

Ministry of Land, Infrastructure, Transport and Tourism of Japan (n.d.), , https://www.mlit.go.jp/en/ (accessed on 16 April 2024). [4]

OECD (2023), *Decarbonising Buildings in Cities in the Netherlands: A Neighbourhood Approach*, https://www.oecd.org/cfe/decarbonising-homes-in-cities-in-the-netherlands-b94727de-en.htm (accessed on 15 April 2024). [1]

The Ministry of the Interior and Kingdom Relations of the Netherlands (2022), *Programma Verduurzaming gebouwde omgeving*, https://www.volkshuisvestingnederland.nl/onderwerpen/programma-verduurzaming-gebouwde-omgeving/documenten/publicaties/2022/06/01/programma-verduurzaming (accessed on 18 April 2024). [2]

OECD Urban Studies

Global Monitoring of Policies for Decarbonising Buildings

A MULTI-LEVEL APPROACH

How can we rapidly transform the global building sector to combat climate change? This report, based on the OECD Global Survey on Buildings and Climate, presents a comprehensive analysis of the endeavours undertaken by 28 countries across continents to decarbonise and bolster the resilience of their buildings. By examining policy objectives, measures, and trends, the report offers valuable insights into how countries are developing effective strategies for decarbonising buildings. These strategies often involve a step-by-step approach, for example, beginning with targeted measures in buildings that are more feasible or have a greater impact. Successful measures are then scaled up to achieve broader decarbonisation goals. Furthermore, the report emphasises the importance of a multi-level approach, including breaking down silos between government departments. With 93% of responding countries reporting that at least three ministries are involved in decarbonising building measures. The report also underscores the importance of international cooperation and knowledge sharing to fast-forward progress towards a more sustainable built environment.

PRINT ISBN 978-92-64-45449-1
PDF ISBN 978-92-64-87503-6