RENEWABLES IN BUILDINGS

KEY FACTS FOR 2024

- Heat accounted for 74% of energy consumption in the buildings sector.
- Space cooling is the fastest-growing energy end use in the buildings sector, increasing 4% per year on average since 2000.
- Policies to accelerate decarbonisation in the buildings sector are advancing globally, however, the sector is not on track to meet net-zero emissions targets.
- Investment in energy efficiency is insufficient to meet net-zero emissions targets.

31%
of total final energy consumption (TFEC) is in the buildings sector

17.7%
is the share of renewables in buildings TFEC as of 2024

60 countries
had policies aimed at integrating renewable energy and energy efficiency in buildings in 2024

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SECTOR OVERVIEW

The buildings sector[i] accounted for 31% of total final energy consumption (TFEC) in 2022, following a decade of rising energy demand (+8% since 2012).[1] In 2022, mild winters in several regions led to a 4% drop in energy use for space heating, while energy demand for space cooling increased 3%.[2] This trend continued in 2023, when again mild winters led to a small reduction in fossil gas consumption and a slight decrease in TFEC for buildings.[3]

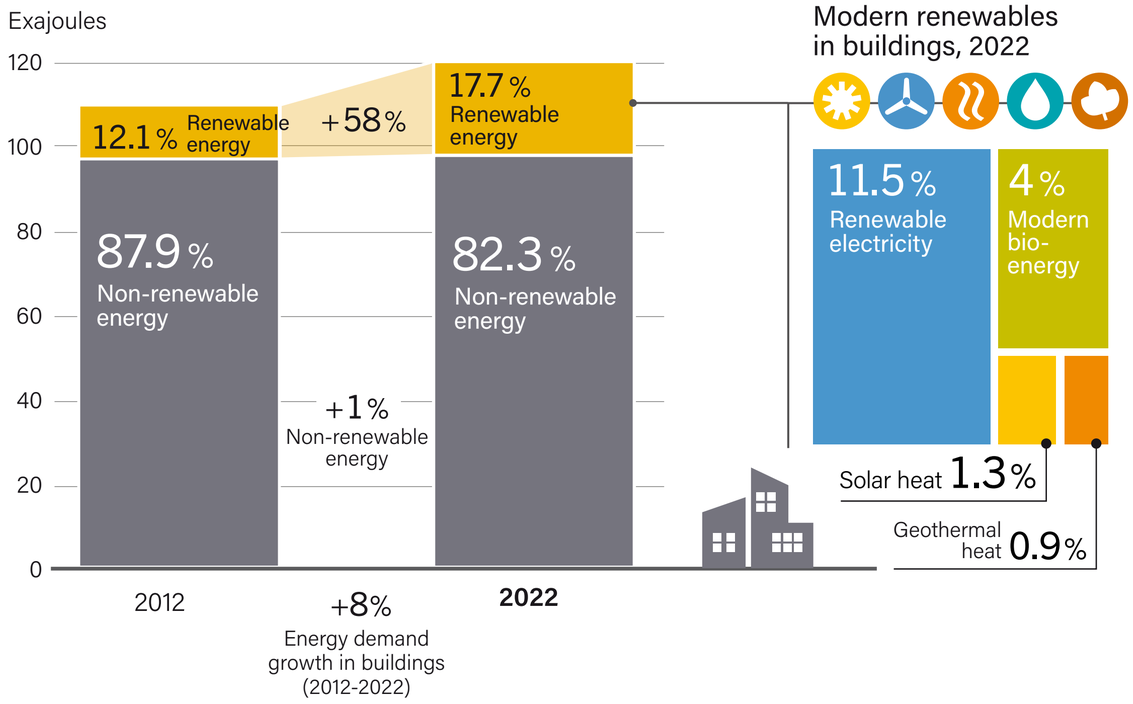
As of 2022, renewables provided 17.7% of the sector's TFEC, up from 12.1% a decade earlier.[4] (→ *See Figure B-1.*) This share includes both renewables in the electricity mix and the direct use of renewables in buildings – mainly through the installation of solar PV systems. In addition, the use of modern bioenergy has grown notably, and solar thermal and geothermal technologies meet a small but growing share of building energy demand.[5]

i Excluding construction

Space cooling

is the fastest growing energy use in the buildings sector

FIGURE B-1
Share of Renewables in Total Final Energy Consumption in Buildings, 2012 and 2022

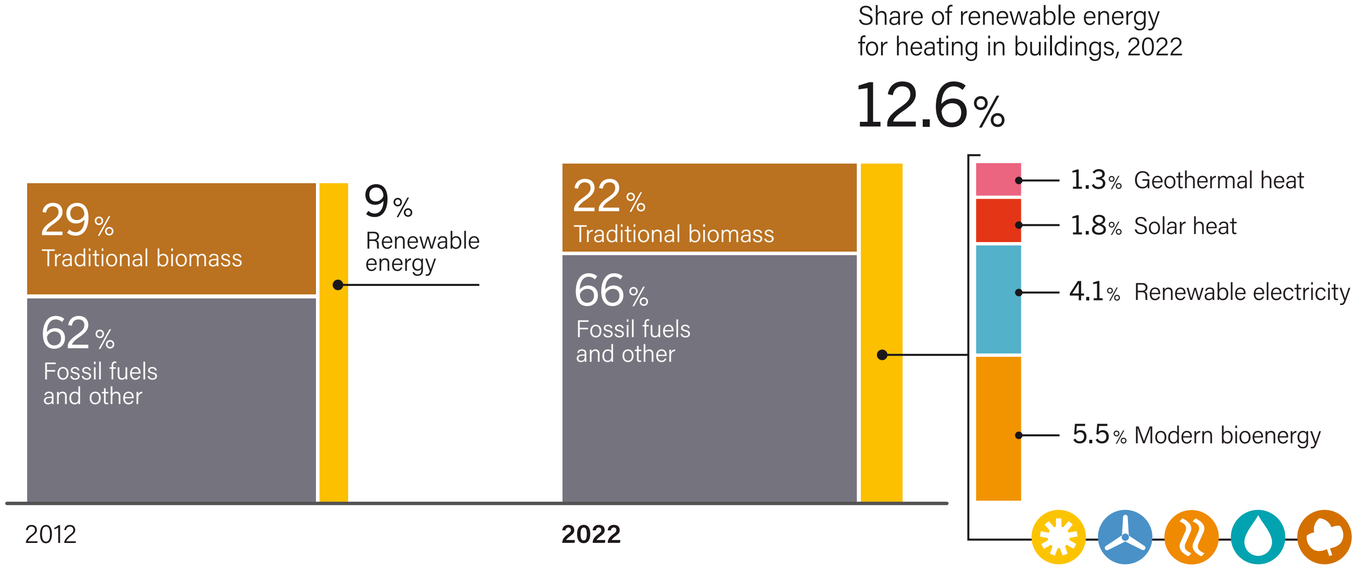


Source: See endnote 4 for this section.

Thermal uses, such as heating, domestic hot water, cooking and space cooling, dominate energy use in the buildings sector. Heat accounted for 74% of the sector's TFEC in 2022.[6] The share of renewables in heat consumption in buildings grew from 9% in 2012 to 12.6% in 2022, while the share of fossil fuels grew from 62% to 66% and the share of traditional biomass decreased from 29% to 22% in 2022.[7] Modern bioenergy remained the predominant renewable energy source used for heating in buildings, followed closely by renewable electricity and far behind by solar and geothermal heating.[8] (→ *See Figure B-2.*)

Meanwhile, electricity use is rising. The share of electricity in the building sector's energy consumption continued grew from 31% in 2012 to 35% in 2022. During the same period, the share of renewable electricity in the electricity mix grew from 23% in 2012 to 32% in 2022.[9]

FIGURE B-2
Energy Consumption for Heating in Buildings, by Source, 2012 and 2022



Source: See endnote 8 for this section.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74%

is the share of heat in the buildings sector Total Final Energy Consumption

In 2024, the buildings sector accounted for nearly 60% of the overall growth in global electricity consumption. This increase was due to factors including growing demand for space cooling in countries such as India and China, as well as rising electricity demand from data centres.[10] Space cooling is the fastest growing energy end use in the buildings sector, increasing an average 4% per year since 2000, driven by rising global average temperatures and the growing frequency and intensity of heatwaves.[11]

The United States, China and the European Union were the top energy consumers, together accounting for almost half of the building sector's TFEC in 2022, followed by India, the Russian Federation, Japan, Canada and the United Kingdom.[i] Japan, the United States and Canada have the highest share of electricity in buildings' total final energy consumption (→ *See Figure B-3*).[12]

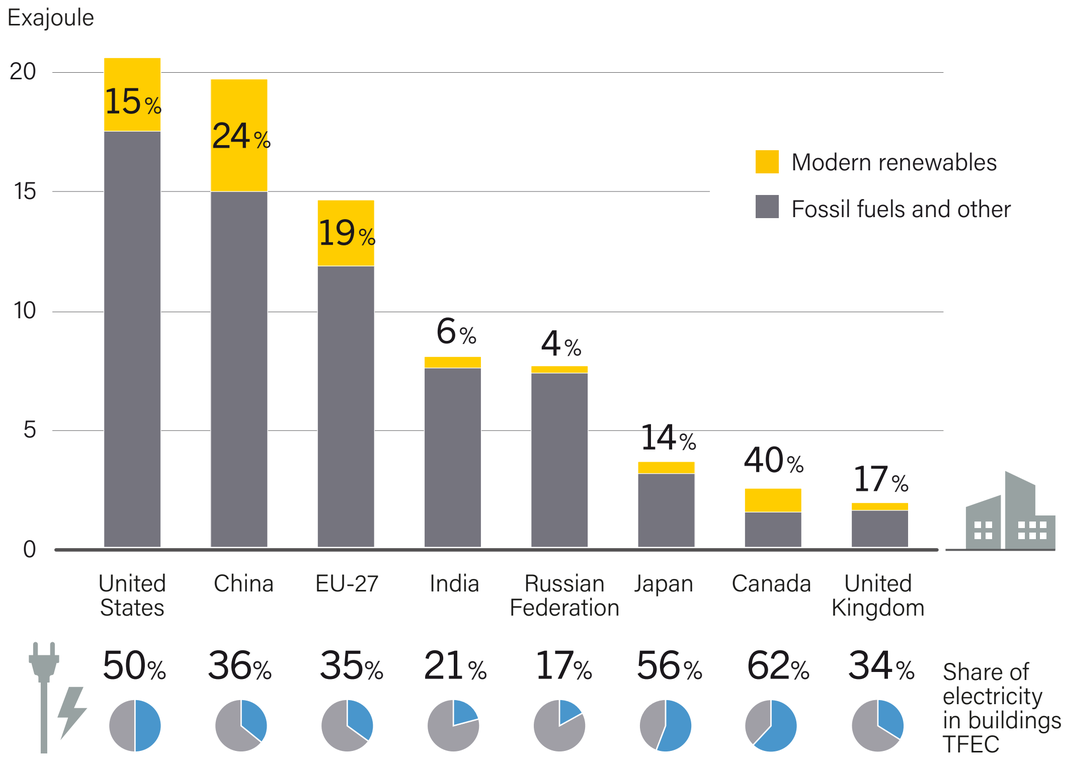
i Germany, France and Italy, also in the top 10 largest energy consumers in the buildings sector, are included in the European Union numbers.

The buildings sector accounted for nearly

60%

of the overall growth in global electricity consumption in 2024.

FIGURE B-3
Energy Consumption in Buildings by Major Consuming Country/Region, 2022



Source: See endnote 12 for this section.

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Air conditioning system installed on a building

DRIVERS FOR RENEWABLES ADOPTION IN BUILDINGS

Efficient electrification of heating and improvements in cooling efficiency can be achieved through the adoption of high-performance heat pumps. These measures play an important role in integrating renewables in the buildings sector. Such efficient systems can also play a role in increasing power system flexibility and reducing pressure on the grid at peak demand times.[13]

Heat pump sales fell 1% globally in 2024. After a sharp decline of 10% in the first half of the year, sales recovered strongly in the second half of the year in some regions, such as the United States (+15%) and Japan (+5%), but not sufficiently to compensate for the decline in Europe (-21%) and the lack of growth in China.[14] Possible reasons for the decrease in sales in Europe include the slowdown in the construction sector, high prices of electricity compared to fossil gas and uncertainty about supporting policies.[15]

Heat pumps are significantly more energy efficient than traditional heating systems and can contribute to reducing energy consumption, especially if operated in a well-insulated home, while facilitating an increase in the share of renewables in the buildings sector's TFEC.[16] Statistics on newly installed heat pumps do not capture directly how many are replacing conventional heating technologies, or were additionally installed for cooling purposes.

The growth in installations of **distributed renewable energy** technologies such as solar PV and solar thermal systems has also contributed to the increase in renewable energy consumption in the buildings sector in recent years.[17]

The adoption of small-scale solar PV systems by households and companies has surged in several regions, in response to high electricity prices and, in some cases, unreliable service from the grid. Global rooftop solar PV capacity increased 22% in just one year (2023-2024) and this sector has seen spectacular growth in many countries in recent years.[18] **Pakistan** was the top destination for exports of **Chinese solar PV modules** in fiscal year 2024, importing an estimated USD 2.1 billion's worth. Solar PV was primarily deployed in industry, agriculture and buildings, mostly for self-consumption.[19] In **Lebanon**, private households and businesses have driven a spectacular increase in solar PV capacity, rising from 100 megawatts (MW) in 2020 to 1,300 MW in 2023.[20] In **South Africa**, the national utility Eskom reported capacity additions of behind-the-meter solar PV of on average 273 MW per month between March and September 2023.[21] In Türkiye, 90% of solar PV installations during 2021-2025 were small-scale, licence-exempt facilities, primarily for self-consumption.[22] **Australia, Brazil, Mexico** and many European countries also saw significant increases in rooftop solar PV installations in 2024.[23]

Small-scale solar water heating systems and combined systems for space and water heating can also significantly increase the share of renewables in the buildings sector. However, these technologies represented only 1.8% of the sector's TFEC in 2022.[24]

DISTRICT HEATING

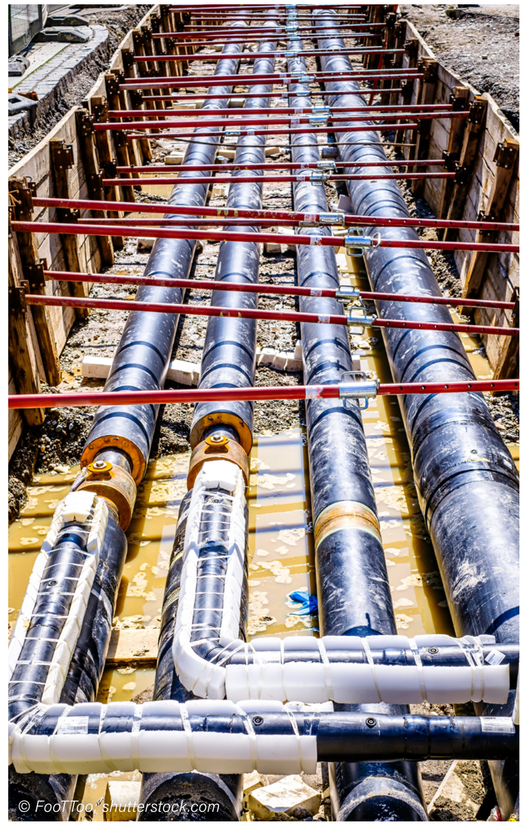
District heating accounted for 7% of total heating energy consumption in buildings in 2022, with significant variation between countries and regions. District heating networks provide significant opportunities for large-scale renewable heating.[25]

In **Europe**, district heating met 13% of the buildings sector energy demand for heating in 2022 (latest data available).[26] In 2023, the share of renewables in the region's district heating energy use was 44.1% (up 9.4% compared to 2022), the vast majority of which was bioenergy, while the use of heat pumps and electric boilers also increased significantly.[27] The continent is also home to more than 260 district heating networks relying on solar energy.[28]

In the **Russian Federation** and **China**, which have the largest district heating networks, district heating met 40% and 14% of buildings sector heat demand in 2022. However, the share of renewables in district heating networks remained far below 1% in these two countries. In Korea, where 11% of building heat demand was met through district heating networks in 2022, these networks used less than 4% renewable energy. These figures show a vast untapped potential for the uptake of renewables-based heat through district heating globally.[29]

44%

is the share of renewables in Europe's district heating networks



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ENERGY EFFICIENCY

Alongside the deployment of renewable energy, energy efficiency plays a central role in decarbonising energy use in the buildings sector. Measures such as promoting the construction of new energy-efficient buildings, as well as retrofits of existing ones to improve insulation and the replacement of fossil fuel-based heating systems with more efficient, renewables-based technologies have the potential to reduce energy consumption significantly.[30]

Between 2010 and 2023, the energy intensity of the buildings sector decreased by a total of 17%, which translates to an average annual improvement in energy efficiency of 1.4%. In 2023 alone, global energy efficiency improved by 2.6%. This is far below the annual 4.4% improvement required between 2023 and 2030 to achieve the International Energy Agency's Paris Agreement-aligned decarbonisation scenarios for the buildings sector.[31]

Currently, the renovation rate of the global buildings stock lies around 1% per year, far short of the 2.5% per year required by 2030 under the IEA's decarbonisation scenarios.[32] Moreover, the financial burden of retrofitting falls largely on homeowners and the recent high inflation has significantly increased costs, making it even more difficult for households to afford or secure finance for these renovations.[33]

In 2024, governments representing more than 70% of the world's total energy demand implemented or updated their national energy efficiency policies, some of which covered the buildings sector.[34] For example, the **European Union** raised the ambition of its Energy Efficiency Directive by setting targets for a 4% annual efficiency improvement and an 11.7% annual decline in total energy use by 2030.[35] **Kenya** updated its building code to include measures for energy efficiency and **China** mandated an increase in the area of new ultra-low energy and near-zero energy consumption buildings of more than 20 million square meters by the end of 2025, compared with 2023.[36] However, as of 2024, nearly half of the world's newly constructed buildings by floor area are not covered by any energy efficiency requirements.[37]

Investment in energy efficiency in the buildings sector was USD 243,7 billion in 2023, far below the investment requirements projected in the IEA's decarbonisation scenarios.[38]


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USD 244 Bn

was the investment in energy efficiency in the buildings sector in 2022

Nearly half

of the world's newly constructed buildings by floor area were not covered by any energy efficiency requirements in 2024.


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POLICIES

As of 2024, 60 countries had policies aiming at fostering the integration of renewable energy and energy efficiency in the buildings sector.[39] (→ *See figure B-4*)

Fiscal & financial incentives remained the most widespread policy instruments. As of end 2024, 42 countries had in place incentives for the uptake of rooftop solar PV and solar thermal systems, the replacement of fossil-fuel based boilers by heat pumps, and building retrofits.[40]

During the year 2024, countries including Canada and Greece enacted financial support for the purchase of **heat pumps**,[41] while the Czech Republic, India, Jordan, Malaysia, Malta and Taiwan launched programmes to support residential customers to install **solar PV or solar thermal systems** through direct subsidies.[42]

Also in 2024, many countries adopted **energy efficiency** policies to help lower energy bills, especially for low-income households. Countries and regions representing around 30% of global energy consumption introduced measures focusing on energy affordability through improved efficiency. These include Brazil, Canada, the European Union, the United Kingdom and the United States.[43]

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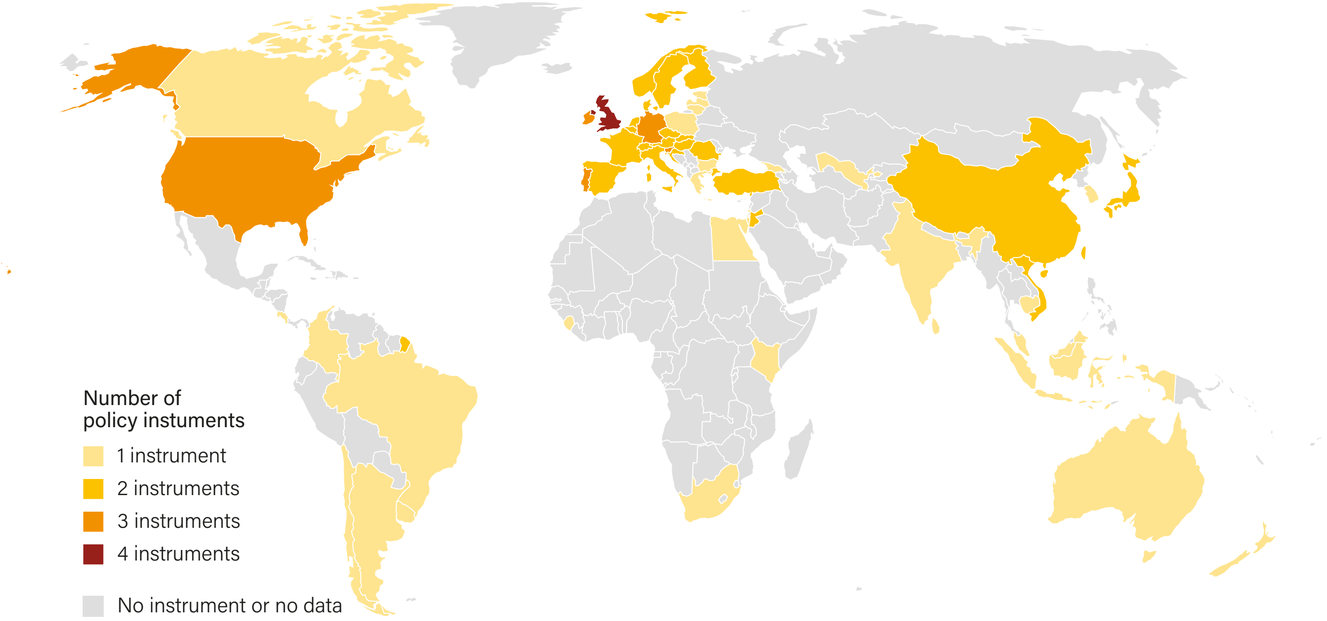
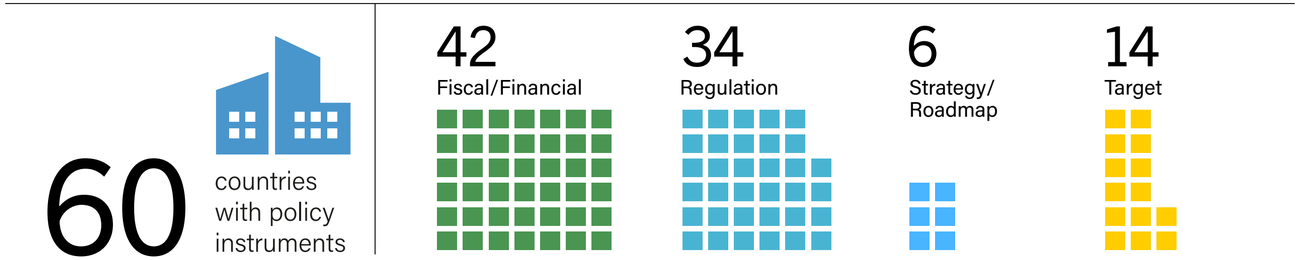
FIGURE B-4
National policies for the integration of renewable energy in the buildings sector, by policy type, as of 2024





Note: Policies on this map include national regulations (including bans of fossil fuel boilers), fiscal and financial incentives, targets, and strategies and roadmaps for the integration of renewable energy and energy efficiency in the buildings sector. Incentives for the purchase of heat pumps are included under energy efficiency. Building Energy Codes are not included. Subnational policies are not included. European Union policies are reflected at the members state level.

Source: See endnote 39 for this section.

Regulations such as bans of

fossil fuel-based heating

were enacted in several countries in 2024.

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One-stop shops have emerged in recent years as a tool to support residents with technical, administrative and financial advice for retrofits and other energy efficiency actions. One-stop shops are most advanced in the European Union, but similar initiatives exist in countries such as Australia, Canada and Ukraine.[44]

Regulations such as **bans** of fossil fuel-based heating were seen in several countries: the **Isle of Man** banned the installation of fossil fuel heating systems in new buildings from 2025.[45] **Luxembourg**'s submitted National Energy and Climate Plan (NECP) mandates the gradual phase out of fossil fuels in buildings by 2030 and bans the connection of new buildings to the gas grid.[46] In **Slovenia,** the installation of fossil gas and liquefied petroleum gas (LPG) boilers is not permitted in new residential buildings from 2024.[47] In the **United Kingdom**, manufacturers of fossil fuel boilers must meet targets for the installation of heat pumps in existing properties in proportion to their sales of fossil fuel boilers.[48] The updated Energy Performance in Buildings Directive of the **European Union** states that from 2025, Member States will not be able to subsidise standalone boilers that run exclusively on fossil fuels and that by 2040, such boilers may be totally banned in homes in Europe.[49]

Several **mandates** for increasing the **shares of renewable energy** in the buildings sector's energy use were also enacted in recent years.[i] In **Belgium**, all large non-residential buildings that are transferred are required to reach at least 5% renewable energy use within 5 years after the transfer.[50] In **Germany**, an amendment to the national Buildings Energy Act states that all newly installed heating systems must use at least 65% renewable energy.[51] **Ireland** introduced a renewable heat obligation with measures to streamline rules for solar PV installations across various sectors, including commercial enterprises and residential buildings.[52]

Some countries announced or updated **targets** for the uptake of renewables and energy efficiency: **Romania** aims to reduce emissions in buildings by 2% by 2030, through energy efficiency measures and the uptake of heat pumps and solar thermal collectors.[53] **China** issued an action plan aiming to increase the rooftop PV coverage rate for newly constructed public buildings and new factory buildings to 50% by 2025.[54] **Latvia**'s NECP targets a share of 68% renewable energy use in buildings by 2030.[55] **Ireland** set a target of 400,000 dwellings equipped with heat pumps by 2030.[56] In its NECP, **Croatia** outlined measures to upgrade district heating systems and set a target of 47% renewable energy in heating and cooling final energy consumption by 2030.[57] The European Union's revised Energy Performance of Buildings Directive requires new buildings to be ready for solar installations and targets a reduction in residential energy use of 16% by 2030 and up to 22% by 2035. Member states must transpose this directive by May 2026.[58]

Many governments are responding to the rapid rise in cooling demand by adopting **National Cooling Action Plans** (NCAPs), which feature measures to improve efficiency, phase down harmful refrigerants, enhance building design and ensure equitable access. (→ *See Sidebar 8 in the Renewables Global Status Report 2025, Global Overview.*)[59]

As of 2024, at least 23 countries had established NCAPs or similar strategies, often with support from the UN Development Programme and the Clean Cooling Collaborative. These plans typically include targets to reduce the use of hydrofluorocarbons (HFCs), adopt minimum energy performance standards (MEPS), introduce appliance labelling schemes, provide incentives for the adoption of efficient technologies and promote building-level measures. Several NCAPs are aligned with commitments under the Paris Agreement and the Kigali Amendment to the Montreal Protocol, which mandates a gradual global phase-down of HFCs.[60]

While national priorities differ, some plans emphasise the need for renewable-powered cooling, alleviating grid constraints and climate risks, especially in vulnerable countries such as small island developing states. Equity-focused NCAPs go further by addressing affordability through measures like support for public institutions, community cooling hubs and inclusive financing schemes.[61]

Beyond buildings, many plans promote the enhancement of renewable-powered cold chains for food, medicines and vaccines. Initiatives such as solar PV cooling, thermal storage and off-grid systems for health facilities are being scaled up, helping to cut emissions, improve energy security and protect public health.[62]

i Including 2023, 2024, and early 2025.

Building Energy Codes (BECs) set mandatory energy performance requirements – either for specific components (insulation, lighting) or for whole-building performance – for new buildings and major renovations. BECs can include obligations for buildings to be designed to accommodate renewable systems and reduce energy consumption. Some codes, including those of Australia, Singapore, the United Kingdom and the United States, include obligations for large buildings to provide energy management systems to increase flexibility.[63]

As of 2024, 85 countries had national BECs for residential buildings and 88 for non-residential buildings; 80% of these codes are mandatory.[64] Around 70 countries have revised their codes in recent years, with several incorporating requirements for on-site renewable energy systems.[65] In 2024, Kenya, Iceland, Japan, Germany and Viet Nam updated their BECs.[66]

As of 2022, over 110 countries did not have mandatory BECs, resulting in approximately 2.4 billion square metres of new floorspace being constructed without energy performance requirements during the year.[67] Moreover, more than 1.12 billion people lived in informal settlements in 2022, so that the total number of dwellings not covered by any energy or energy efficiency policy is much higher than official construction statistics suggest.[68]

Minimum Energy Performance Standards (MEPS) are rules requiring existing buildings to meet minimum energy efficiency thresholds, usually upon sale, rent or renovation, thereby triggering mandatory upgrades.[69] The European Union introduced MEPS in its Energy Performance in Buildings Directive (EPBD). Member states must determine thresholds for energy efficiency and ensure that at least 16% of their national non-residential building stock meet them by 2030, and 26% by 2033.[70] MEPS remain rare as of 2024, as just a few countries, including France, the Netherlands, and England and Wales in the United Kingdom, have implemented them.[71]

CHALLENGES AND OPPORTUNITIES

CHALLENGES

- Insufficient policy coverage and enforcement, along with limited investment in both renewables and energy efficiency in the buildings sector.
- High upfront costs and high inflation rates hinder investment by private building owners, especially in low-income countries.
- Path dependence: fossil fuel boilers are long-term investments and owners are unlikely to replace them prematurely.

OPPORTUNITIES

- The recent surge of rooftop renewable energy generation capacity.
- District heating networks present significant potential to integrate renewables in the buildings sector.
- Regulations phasing out fossil fuel-based heating systems.
- Distributed renewable energy in buildings can help adress current and future grid constraints.

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For the 2025 edition of the Renewables Global Status Report, REN21 updated the methodology and classification system of its Policy Database to improve clarity and better capture current policy developments. Consequently, some figures in this edition may not be directly comparable with data from previous reports.