



Global Alliance for Buildings and Construction

2019 Global Status Report for Buildings and Construction

*Towards a zero-emissions, efficient and resilient
buildings and construction sector*

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Acknowledgements

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Foreword

Decarbonising the buildings and construction sector is critical to achieve the Paris Agreement commitment and the United Nations (UN) Sustainable Development Goals (SDGs): responsible for almost 40% of energy- and process-related emissions, taking climate action in buildings and construction is among the most cost-effective. Yet, this *2019 Global Status Report* on buildings and construction tells us that the sector is not on track with the level of climate action necessary. On the contrary, final energy demand in buildings in 2018 rose 1% from 2017, and 7% from 2010.

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These findings stand in stark contrast with the 2019 Emissions Gap Report, which states that we will have to cut almost 8% of emissions each year from 2020, and are confirmed by the International Energy Agency (IEA) *World Energy Outlook 2019*, which found that in 2018 the rate of improvement in energy intensity had slowed to 1.2% – less than half the average rate since 2010. Both reports underline the need for urgent action by policy makers and investors. To meet the SDGs and the IEA Sustainable Development Scenario, we need to reverse the trend and make a concerted effort to decarbonise and enhance energy efficiency in buildings at a rate of 3% a year.

In 2020, Nationally Determined Contributions (NDCs) under the Paris Agreement are due for revision – an opportunity that cannot be missed to ramp up ambition in the buildings and construction sector. The *2018 Global Status Report* on buildings and construction found that a total of 136 countries have mentioned buildings in their NDCs, yet few have specified the actions they will use to reduce emissions. Therefore, in their new NDCs, nations must prioritise actions to decarbonise this essential sector. This means switching to renewable energy sources. It means improving building design. It means being more efficient in heating, cooling, ventilation, appliances and equipment. It means using nature-based solutions and approaches that look at buildings within their ecosystem, the city.

The report also tells us that the building stock is set to double by 2050, which presents another important opportunity not to be missed. In making good on SDG 11 with its provision for affordable and adequate housing for all, we need to make sure we promote clean solutions and innovations to make buildings future-proof. In line with SDG 7, we have to double our efforts on energy efficiency to bring gains of at least 3% per year.

Such efforts must be supported through investments in energy efficiency; but here also, the numbers show that we are headed in the wrong direction: investment in buildings sector energy efficiency flattened in 2018 instead of showing the growth needed. In September, at the UN Secretary General's Climate Summit, countries as well as the private sector made commitments to a zero-carbon buildings sector, and the goal of mobilising USD 1 trillion in "Paris-compliant" building investments in developing countries by 2030 was set. At the same time, the Net-Zero Asset Owner Alliance was founded with the world's largest pension funds and insurers – responsible for directing more than USD 2.4 trillion in investments – committed to carbon-neutral investment portfolios by 2050.

These are signs of hope. And change is in the works. This report provides examples of country, city and private sector actions, of how the buildings and construction sector is reforming. Through this *Global Status Report* series, we are keeping an eye on progress made. And through another joint product – a series of regional roadmaps – we are working with experts and policy makers in defining their regionally appropriate actions across eight priority action areas to put the sector on track: urban planning; new buildings; retrofits for existing buildings; building operations; appliances, lighting, cooking and systems; materials; resilience of buildings; and clean energy. These roadmaps and actions can then be further adapted nationally.

It is well within the realm of possibility for the buildings and construction sector to deliver its full mitigation potential and help the world achieve its climate and sustainable development goals. Together, we can build for the future.

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Programme and Under-Secretary-General
United Nations



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Executive Summary

The buildings and construction sector accounted for 36% of final energy use and 39% of energy and process-related carbon dioxide (CO₂) emissions in 2018, 11% of which resulted from manufacturing building materials and products such as steel, cement and glass. This year's *Global Status Report* provides an update on drivers of CO₂ emissions and energy demand globally since 2017, along with examples of policies, technologies and investments that support low-carbon building stocks.

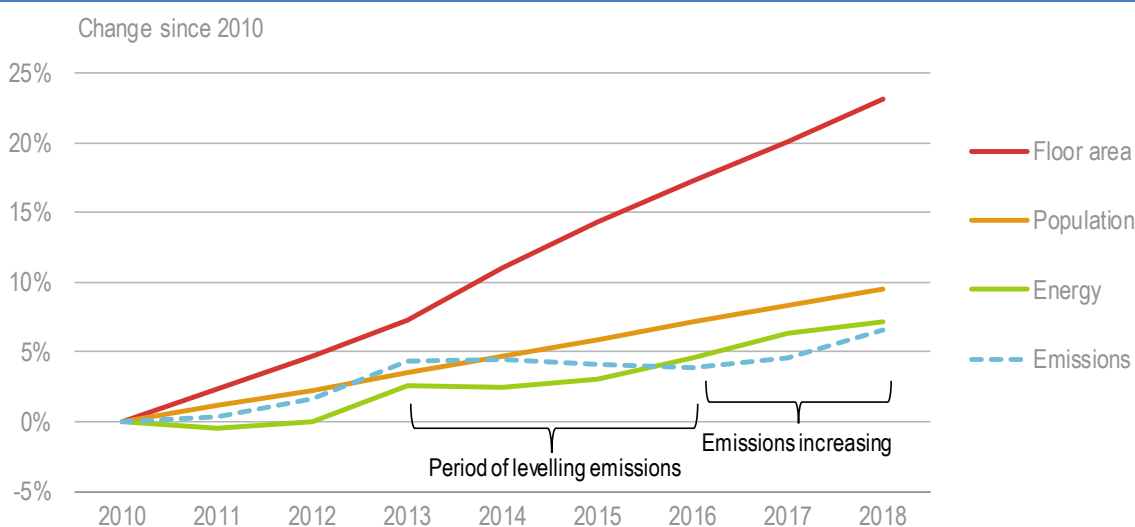
The key global buildings sector trends are:

- Global buildings sector emissions increased 2% from 2017 to 2018, to reach a record high, while final energy demand rose 1% from 2017 and 7% from 2010.
- Increases were driven by strong floor area and population expansions. While efficiency improvements continued to be made, they were not adequate to outpace demand growth.
- 2020 is a key year for countries to enhance their Nationally Determined Contributions (NDCs), especially concerning further actions to address energy use and emissions including embodied emissions in the buildings and construction sector.
- Countries are innovating and implementing measures to improve efficiency and reduce emissions from their building stock. As sharing effective measures globally would amplify their impact, regional roadmaps are being developed for this purpose.

Global building stock emissions continue to rise

In 2018, global emissions from buildings increased 2% for the second consecutive year to 9.7 gigatonnes of carbon dioxide (GtCO₂), suggesting a change in the trend from 2013 to 2016, when emissions had been levelling off. Growth was driven by strong floor space and population expansions that led to a 1% increase in energy consumption to around 125 exajoules (EJ), or 36% of global energy use.

Figure 1 • Changes in floor area, population, buildings sector energy use and energy-related emissions globally, 2010-18



IEA (2019). All rights reserved.

Source: Derived from IEA (2019a), *World Energy Statistics and Balances 2019*, www.iea.org/statistics and IEA (2019b) *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

A major source of rising energy use and emissions by the global building stock is electricity, the use of which has increased more than 19% since 2010, generated mainly from coal and natural gas. This indicates how crucial it is to make clean and renewable sources of energy accessible, and to use passive and low-energy designs more widely in building construction.

From 2017 to 2018, energy intensity continued to improve for space heating (-2%) and lighting (-1.4%), but increased for space cooling (+2.7%) and remained steady for water heating, cooking and appliances. At an 8% increase in 2018, space cooling became the fastest-growing use of energy in buildings since 2010, though it accounted for only a small portion of total demand at 6%.

2020 NDC revisions are a new opportunity to reduce buildings sector emissions

As part of their plans to limit greenhouse gas (GHG) emissions, 184 countries have contributed NDCs under the United Nations Framework Convention on Climate Change (UNFCCC). Although most countries (136) mention buildings in their NDCs, few detail explicit actions to address emissions within the buildings sector. In the next round of NDCs, covering 2020 to 2025, further focus is needed on actions to mitigate building emissions through switching to low-carbon and renewable energy sources, and greater attention should be paid to low-carbon building materials, building envelope improvements, nature-based solutions, and equipment and system efficiency.

These efforts will require higher investments than the USD 139 billion of 2018 – which was a 2% drop from the previous year. To tackle emissions and reduce energy intensities in the buildings and construction sector, governments, companies and private citizens must raise investments in efficiency adequately to offset growth.

New policies lead the way forward

Although greater ambition is needed, policy makers, designers, builders and other participants in the buildings and construction value chain globally are undertaking activities to decarbonise the global building stock and improve its energy performance.

- In a number of countries, building codes are being introduced for the first time or are being strengthened, for example in India through the Eco-Niwas Samhita India's first energy conservation code for the residential sector, and in Rwanda through the Green Building Minimum Compliance System. Policies regulating the energy performance of new buildings are a powerful means to address future emissions growth.
- Building owners continue to adopt advanced certifications for high energy performance or low- and zero-carbon buildings, which stimulates improvements in both the new and existing building stock. The World Green Building Council offers support for such actions through its Net Zero Carbon Buildings Commitment that is being developed among its partners.
- Investors are establishing dedicated products and funding schemes for low-energy and low-carbon buildings across the world. For example, the EU Green Tagging strategy that sets rules for European green financing is the first to include recommendations for net-zero-energy buildings (nZEBs) and green renovation.

These activities to enact regulations and enable greater market adoption of low-energy buildings are encouraging signs of efforts to curb future energy demand and emissions.

Some countries have also established strategies to work towards achieving a net-zero-carbon building stock by 2050 or earlier. For example, Japan and Canada are developing new policies to achieve net-zero and net-zero-ready standards for buildings by 2030. As more countries prepare their NDCs, more ambitious strategies to address existing building stocks will be put forward.

The Global Alliance for Buildings and Construction (GlobalABC) and the International Energy Agency (IEA), in collaboration with regional members and stakeholders, are developing Regional Roadmaps for Latin America, Africa and Asia to forge pathways towards efficient and resilient zero-emissions buildings and construction sectors. The roadmaps:

- Highlight priority actions for each region in eight key areas: urban planning; new buildings; existing building retrofits; building operations; systems; materials; resilience; and clean energy.
- Are being developed through consultations, workshops and webinars held across the three regions to gather insights and opinions from regional, national and local stakeholders on the targets and timelines for delivering an energy-efficient, low-carbon building stock.
- Are regionally owned living documents that will be shared by the end of 2019 and continue to be developed throughout 2020.
- Support activities such as national alliances that unite local construction value chains to enable the development and implementation of national strategies for zero-net-energy and -emissions buildings.

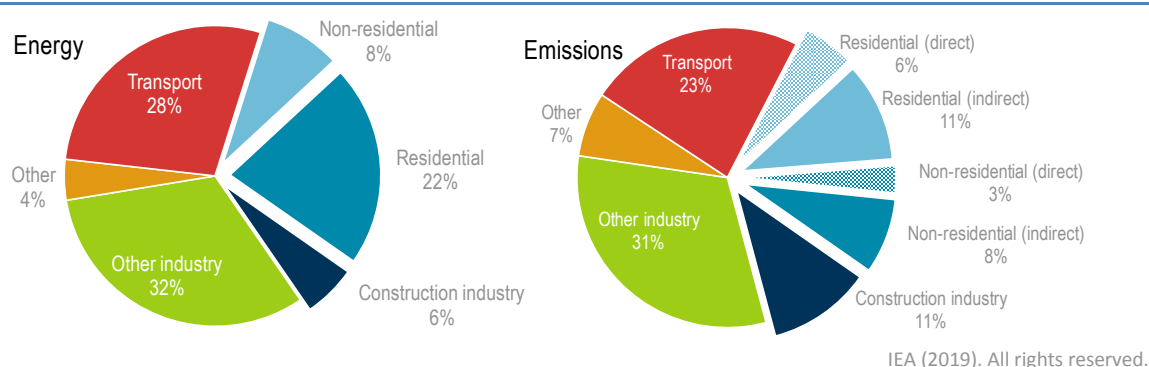
Global status

The buildings and construction sector globally is showing an increase in both emissions and energy use, limited progress on new and existing policies, and a further slowdown in energy-efficiency investment growth. More action is therefore needed to curb emissions and deliver a low-carbon, sustainable built environment.

Energy and emissions in the buildings and construction sector

Building construction and operations accounted for the largest share of both global final energy use (36%) and energy-related CO₂ emissions (39%) in 2018 (Figure 2).

Figure 2 • Global share of buildings and construction final energy and emissions, 2018



Notes: *Construction industry* is the portion (estimated) of overall industry devoted to manufacturing building construction materials such as steel, cement and glass. Indirect emissions are emissions from power generation for electricity and commercial heat.

Sources: Adapted from IEA (2019a), *World Energy Statistics and Balances* (database), www.iea.org/statistics and IEA (2019b), *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

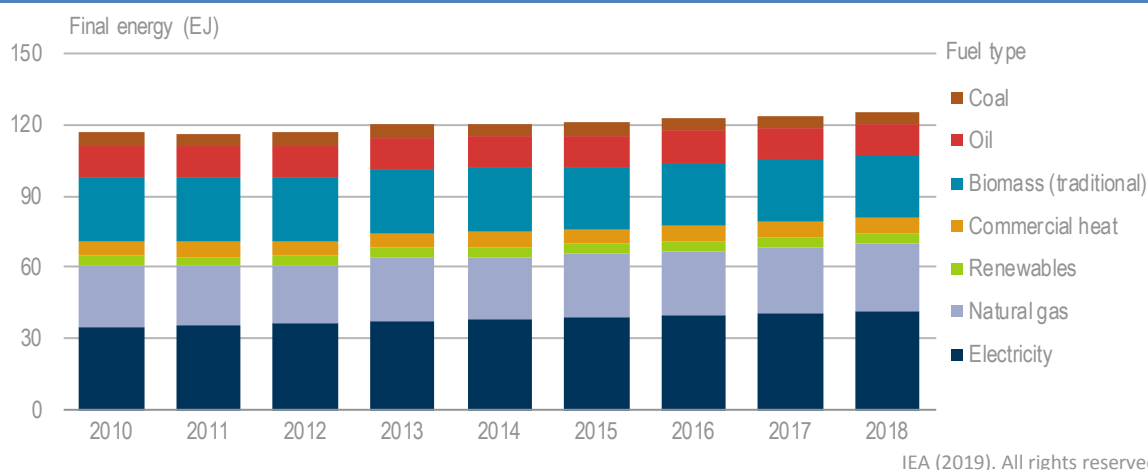
Key message • The buildings and construction sector should be a primary target for GHG emissions mitigation efforts, as it accounted for 36% of final energy use and 39% of energy- and process-related emissions in 2018.

Energy trends

Global final energy consumption in buildings in 2018 increased 1% from 2017, and by more than 8 EJ (about 7%) since 2010 (Figure 3). While strong growth in the main buildings sector resulted from floor space and population expansion outpacing energy efficiency gains, floor area growth continues to decouple from energy demand, with floor area in 2018 having increased 3% from 2017 and 23% since 2010.

From 2010 to 2018, global electricity use in buildings rose by over 6.5 EJ, or 19%. Emissions, which result from the fuel sources used for electricity generation and still include high levels of coal, especially in emerging economies, also rose in 2018. Continued decarbonisation of the electricity supply is therefore needed to transition to clean-energy, low-carbon buildings. Also during 2010-18, renewable energy became the fastest-growing energy source for buildings, with its use increasing 21% (up 3% during 2017-18 alone). Natural gas use rose 8% during the same period, meeting new demand as well as displacing coal use, which dropped by almost 10% globally during 2010-18 (-2% from 2017 to 2018).

Figure 3 • Global buildings sector final energy use by fuel type, 2010-18



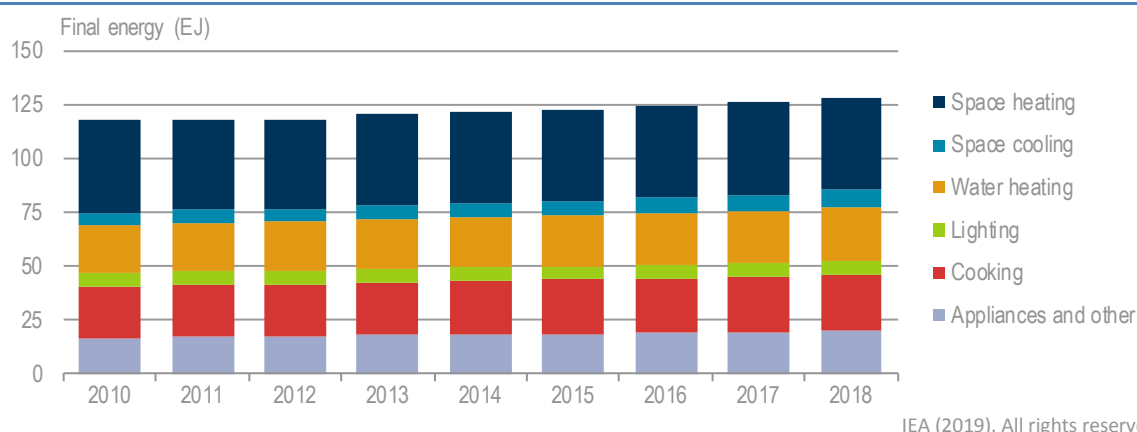
Notes: Energy data are not normalised for weather, so yearly energy changes may be due to climatic differences. Biomass (traditional) refers to conventional solid biomass (e.g. charcoal and forest or agricultural resources) used in inefficient heating and cooking equipment. Renewables includes solar thermal technologies as well as modern biomass resources (e.g. pellets and biogas).

Sources: Adapted from IEA (2019a), *World Energy Statistics and Balances* (database), www.iea.org/statistics and IEA (2019b), *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

Key message • Global growth in buildings sector fuel use has concentrated on electricity, natural gas and traditional biomass since 2010, and higher electricity use in recent years has further increased CO₂ emissions.

Globally, greater end-use energy consumption due to significantly higher electricity use since 2010 for space cooling, appliances and hot water, is resulting in increased emissions (Figures 4 and 5). Space cooling demand rose more than 33% during 2010-18 and by 5% in 2017-18, while energy demand for appliances in 2018 increased by 18% since 2010 and for water heating by 11%. At the same time, space heating demand decreased 1% from 2010, though it has remained stable for the past five years at one-third of total global energy demand in buildings.

Figure 4 • Global buildings sector final energy consumption by end use, 2010-18

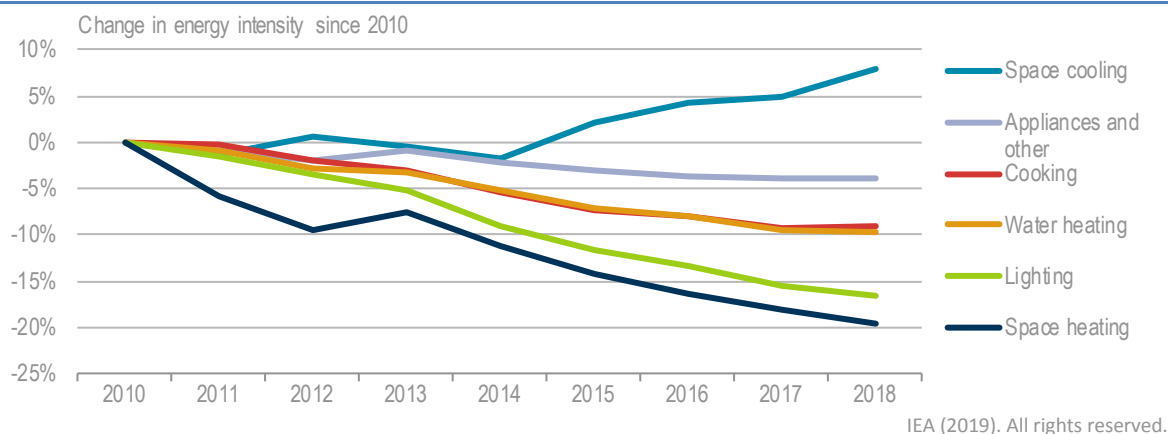


Sources: Adapted from IEA (2019a), *World Energy Statistics and Balances* (database), www.iea.org/statistics and IEA (2019b), *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

Key message • Although space heating, water heating and cooking continue to be the primary end-use energy demands in the buildings sector globally, the fastest-growing end uses are still space cooling, appliances and other plug loads.

From 2010 to 2018, changes in buildings sector energy intensity per unit of floor area (as a proxy for energy efficiency) show that the greatest improvements (i.e. reductions) were in global average space heating (-20%) and lighting (-17%) (Figure 5). Light-emitting diodes (LEDs) continue to be important in reducing energy consumption for lighting as floor area increases and falling consumption for space heating indicates that building envelopes have improved. However, as floor area has been expanding rapidly in hot countries, cooling demand is increasing. As better building envelopes are crucial to reduce energy use for heating and cooling, building codes must remain a policy priority along with technology efficiency improvements.

Figure 5 • Global buildings sector final energy intensity changes by end use, 2010-18



Notes: *Energy intensity* is final energy used per unit of floor area. *Appliances and other* includes household appliances (e.g. refrigerators, washers and televisions), smaller plug loads (e.g. laptops, phones and other electronic devices) and other service equipment.

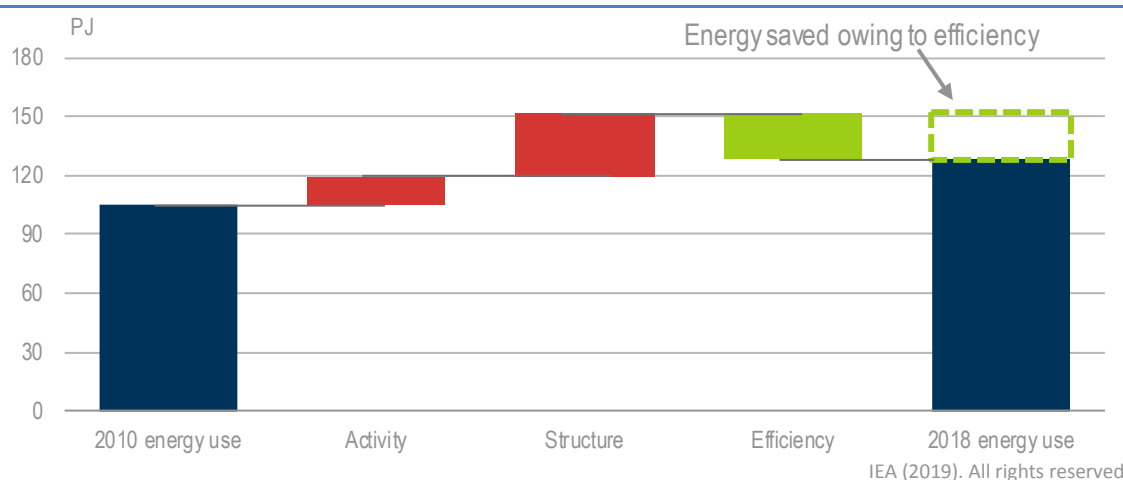
Sources: Adapted from IEA (2019a), *World Energy Statistics and Balances* (database), www.iea.org/statistics and IEA (2019b), *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

Key message • Owing to technological improvements, overall reductions have been made in energy intensity for space heating, lighting, appliances, cooking and water heating. However, space cooling energy intensity has increased as a result of greater cooling demand in hot regions.

Factors influencing global buildings sector energy use include changes in population, floor area, energy service demand (e.g. more household appliances and cooling equipment), variations in climate and how buildings are constructed and used. Those that have contributed most to higher energy demand since 2010 are floor area, population and building use, while improvements in building envelopes (e.g. better insulation and windows) and in the performance of building energy systems (e.g. heating, cooling and ventilation) and components (e.g. cooking equipment) have helped to offset energy demand growth (Figure 6). Nevertheless, total energy demand in buildings continues to increase and greater investments in efficiency and passive design strategies are needed to limit demand and reduce energy intensity.

Final energy consumption in residential buildings made up more than 70% of the global total in 2018, with growth resulting primarily from floor area and population increases, while floor area alone remains the main driver of higher consumption in non-residential buildings (Figure 7). Consumption in residential buildings rose more than 5 EJ during 2010-18, and 3 EJ in non-residential buildings. Growth in residential demand continues to reflect population and floor area increases as well as development in emerging economies, along with a continued shift away from the traditional use of biomass towards modern fuels (e.g. electricity, liquefied petroleum gas and natural gas).

Figure 6 • Factors influencing building energy use, 2010-18

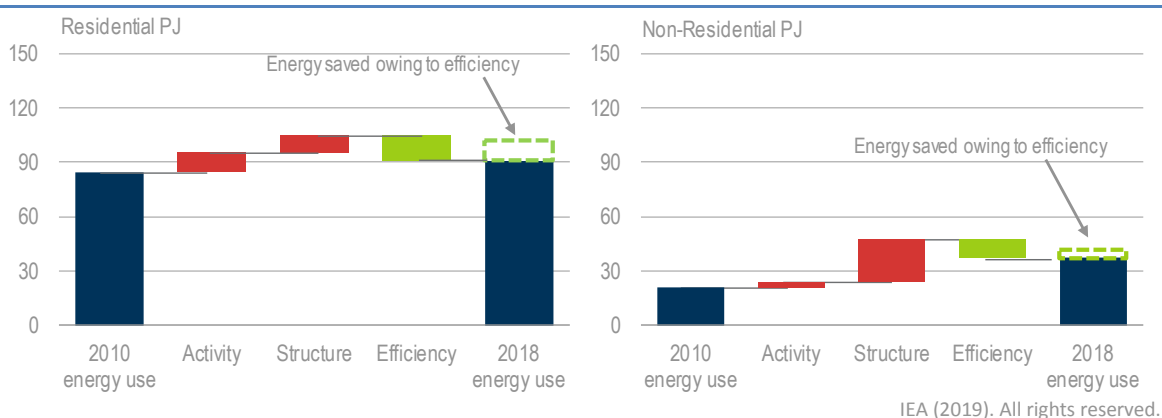


Notes: PJ = petajoule. *Activity* includes changes in population, climate and the use of buildings and appliances. *Structure* includes changes in floor area, occupancy and access to services.

Sources: Adapted from IEA (2019a), *World Energy Statistics and Balances* (database), www.iea.org/statistics and IEA (2019b), *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

Key message • Strong floor area and population expansions continue to raise buildings sector energy use; building envelopes and systems have not improved enough to offset this growth.

Figure 7 • Factors influencing building energy use by building type, 2010-18



Notes: *Activity* includes changes in population, climate and the use of buildings and appliances. *Structure* includes changes in floor area, occupancy and access to services.

Sources: Adapted from IEA (2019a), *World Energy Statistics and Balances* (database), www.iea.org/statistics and IEA (2019b), *Energy Technology Perspectives*, buildings model, <https://www.iea.org/etp/etpmodel/buildings/>.

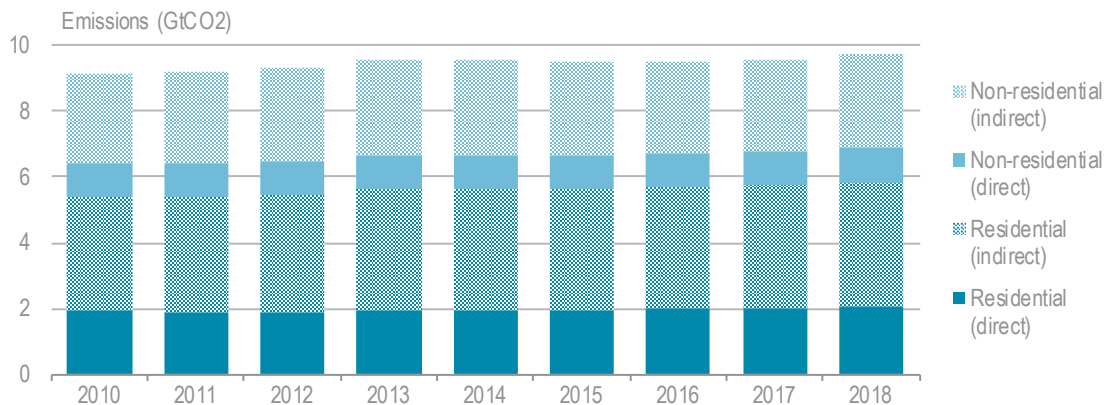
Key message • Energy-efficient building systems and envelopes continue to limit growth in both residential and non-residential building energy use, though continued effort is needed to reduce energy intensity.

GHG emissions trends

In a reversal of the previous five years, buildings sector emissions appear to have risen to 9.7 GtCO₂ in 2018 – an increase of 2% since 2017, and 7% higher than in 2010. Buildings represent 28% of global energy-related CO₂ emissions (39% when construction industry emissions are included). Indirect emissions (i.e. from power generation for electricity and commercial heat) account for the largest share of energy-related CO₂ emissions in the buildings sector, representing around 68% of total buildings-related emissions from energy consumption in 2018 (Figures 8 and 9). The increases in emissions in 2016 and 2017 correspond with floor area and population expansions as well as

growth in electricity demand (i.e. indirect emissions). Building construction emissions – those related to the manufacturing of building materials – amounted to a further 11 GtCO₂ in 2018, for a total of 39% of global energy-related emissions.

Figure 8 • Global buildings sector energy-related emissions by building type and indicator, 2010-18

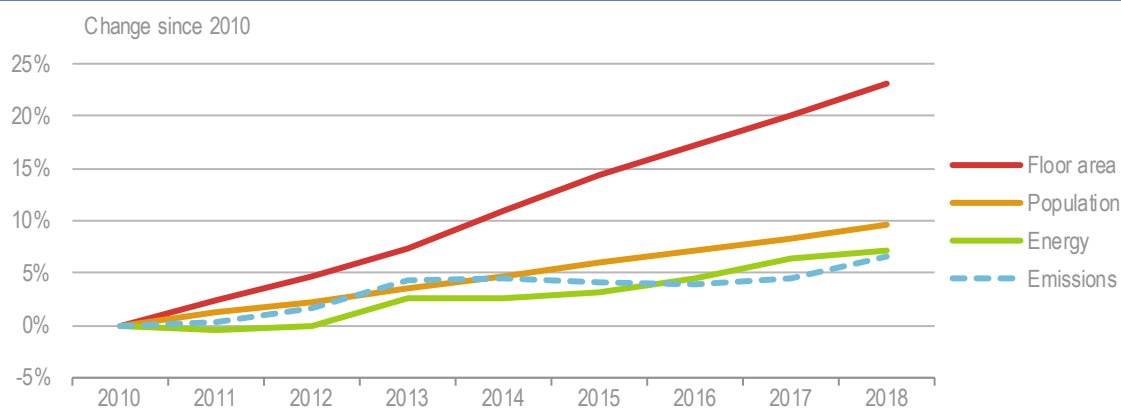


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Sources: Adapted from IEA (2019a), *World Energy Statistics and Balances* (database), www.iea.org/statistics and IEA (2019b), *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

Key message • Global buildings sector emissions are dominated by indirect sources, mostly power generation, and reflect the fuels used to meet end-use heating, lighting, cooking, etc. demand.

Figure 9 • Changes in floor area, population, buildings sector energy use and energy-related emissions globally, 2010-18



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Sources: Derived from IEA (2019a), *World Energy Statistics and Balances* (database), www.iea.org/statistics and IEA (2019b), *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

Key message • In 2018, global buildings sector emissions increased for the second consecutive year, rising by 2% from 2017 to a record high of 9.7 GtCO₂. This growth resulted from increases in floor space and demand for electricity, which is still primarily fossil fuel-generated.

Sustainable buildings and construction policies

By 2020, countries are requested to communicate their new or updated nationally determined contributions (NDCs) setting out their efforts to reduce national emissions and adapt to the impacts of climate change. 2020 is therefore a key year for countries to enhance their NDCs and commit to more aspirational targets.

In addition to NDCs, the coverage and strength of energy performance building codes and certification policies have continued to expand, and in 2018 several countries with updated codes adopted meaningful improvements that should reduce buildings sector energy demand growth, especially for heating and cooling, and make buildings and construction more sustainable.

Nationally Determined Contributions (NDCs)

Reporting on NDCs is an international process during which countries announce their national-level commitments to reduce emissions to limit the rise in average global temperature to less than two degrees Celsius (°C) above pre-industrial levels by 2100, as set out in the Paris Agreement.

The 24th Conference of the Parties (COP24) in Katowice, Poland, presented the Katowice Climate Package that sets out the procedures and mechanisms to operationalise the Paris Agreement. Within the package is guidance on communicating efforts to adapt to climate impacts; a transparency framework for efforts on climate change; a process for conducting a global stocktake of overall progress towards the aims of the Paris Agreement; and directions for assessing progress on technology development and transfer. The package also contains directions for a further round of NDCs to be submitted by 2025.

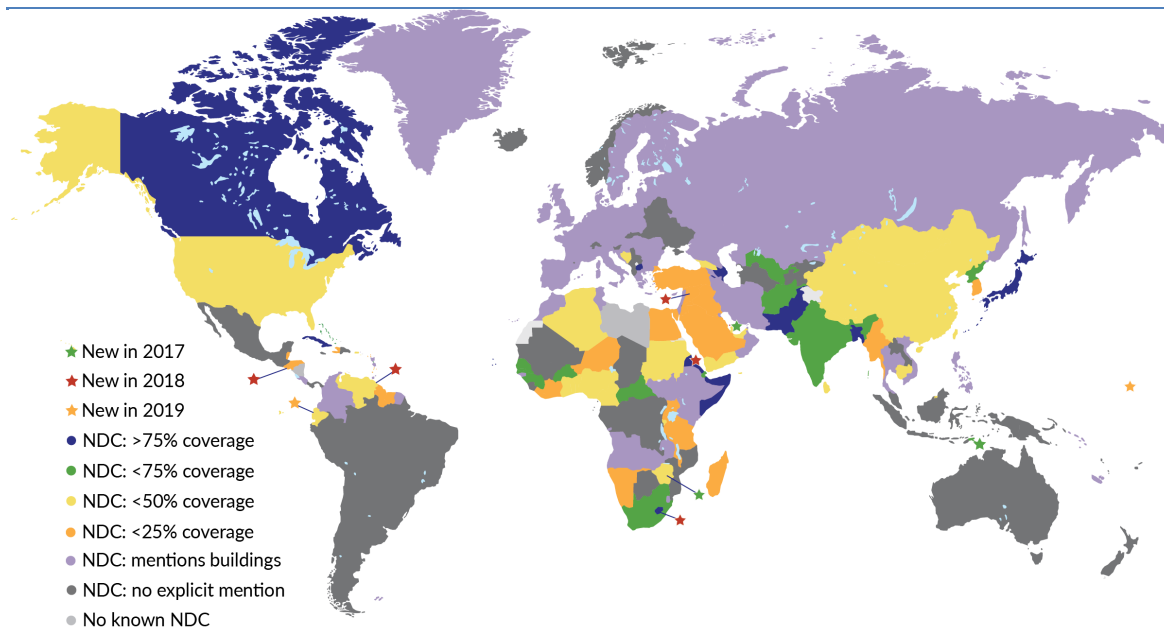
To ensure comparability across all NDCs, it outlines how to develop mitigation goals and activities, specifically covering:

- mitigation co-benefits
- capacity-building support to help developing countries produce their NDCs
- a common time frame for communicating NDCs
- negative impacts of response measures on certain countries and sectors
- modalities for operating and using the public NDC registry.

To date, most countries (184) and the European Union have submitted NDCs, and many countries (136) mention buildings, although most NDCs still do not include explicit actions to address buildings sector energy use and emissions (Map 1). Seven countries updated their NDCs in 2018-19, and the Marshall Islands submitted their second NDC in 2019.

To help countries address buildings-related emissions, GlobalABC has developed guidance on how to include buildings in the NDCs through mapping, prioritising, implementing and monitoring (UNEP, 2018). GlobalABC supports ambitious buildings sector climate actions, defined as those that will move the sector towards zero emissions by 2050 while increasing the built environment's resilience and adaptive capacity.

Map 1 • Buildings sector emissions coverage in NDCs, 2018-19



This map is 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.

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Notes: Emissions coverage is estimated based on specific mentions of measures related to the buildings sector, building end uses and technology with respect to 2018 buildings sector CO₂ emissions. Country NDCs that do not explicitly mention measures or actions for buildings, for example the economy-wide targets in the European Union, have not been counted in emissions coverage.

Source: Adapted from UNFCCC (2019), *Interim NDC Registry*.

Key message • Most current NDCs do not explicitly cover buildings sector emissions.

[NDCs submitted in 2018-19](#) focus on improving building performance codes and standards, fuel conservation and phasing out inefficient products and equipment (Box 1).

Box 1 • 2018-19 NDC updates related to buildings and construction

Kuwait

In May 2018, the Government of Kuwait submitted its NDC that proposes a set of large projects aimed at reducing the GHG emissions of the energy sector. As part of its climate commitment, the country has developed legal and regulatory instruments, including an Environmental Protection Law in which Article 11 highlights the government’s interest in improving energy efficiency in the buildings sector through the use of better materials and equipment (light bulbs, air conditioning, retrofitting, etc.).

Oman

Oman intends to reduce its GHG emissions by 2% during 2020-30. The government plans to adopt various mitigation measures for the energy, industrial processes and waste sectors, including promoting energy efficiency and reducing the use of HCFCs (hydrochlorofluorocarbons) in foam and refrigeration. Oman has also requested special support for funding, capacity-building and technology transfer to effect further action on sustainable buildings.

San Marino

Despite contributing only 0.00052% of global emissions, San Marino has committed to reduce its GHG emissions to 20% below the 2005 level by 2030. Since 2008, San Marino has deployed environmental policies to improve buildings sector energy efficiency, promote renewable energy through solar photovoltaic (PV) and reduce energy consumption. Additional efforts on waste management, solvent emissions and new technologies have been made in recent years.

Suriname

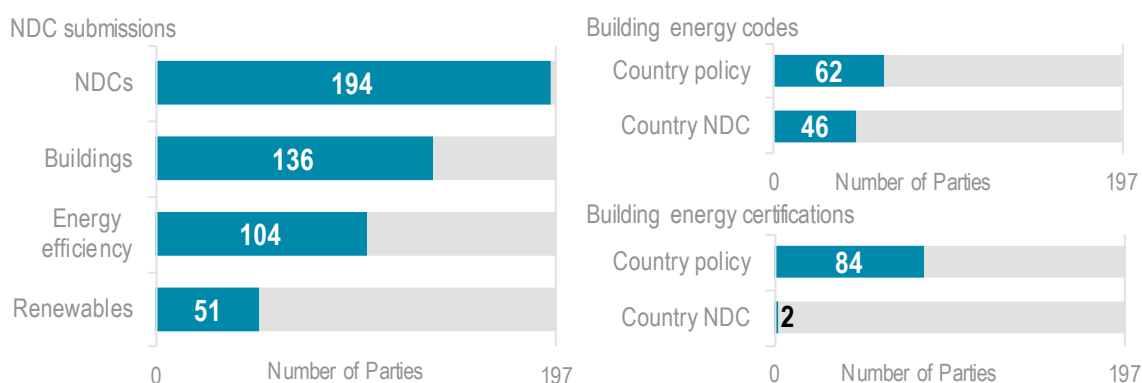
In February 2019, Suriname submitted its NDC that focuses on promoting further actions for forest management and renewable energy. The government prepared a National Energy Plan 2013-2033 that outlines PV, waste-to-energy, micro-hydro power, wind, and biomass initiatives. The plan also includes a national energy efficiency programme to support efficient appliances, energy-saving in buildings and consumer awareness in electricity consumption. Additional climate change actions have been taken through the National Climate Change Policy, Strategy and Action Plan (NCCPSAP) that provides the legislative and administrative framework for low-carbon development in the country.

Uzbekistan

Uzbekistan intends to reduce its specific carbon emissions per unit of gross domestic product (GDP) to 10% below the 2010 level by 2030. The efforts of the country cover three main pillars: energy efficiency; research, education and training; and control and monitoring of GHG emissions. Specific measures to improve energy efficiency in buildings to reduce the country's overall energy consumption and to develop financial schemes to support these actions are key measures within the energy efficiency pillar.

Of the 136 NDCs that now reference the buildings sector, most do not have specific targets or policy actions (Figure 10). While existing policies and NDCs covered more than 50% of buildings-related CO₂ emissions as of 2018,¹ if committed NDCs were to become policy, the coverage would increase to more than 60%.

Figure 10 • NDCs and buildings sector policy coverage, 2018-19



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Notes: The left figure shows the number of Parties having submitted an NDC and mentioning specific actions related to buildings, energy efficiency in buildings or renewables in buildings. The right figure shows the number of Parties with energy codes or certifications, as well as the number of Parties mentioning those policies in their NDCs.

Source: Adapted from IEA (2019b), *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

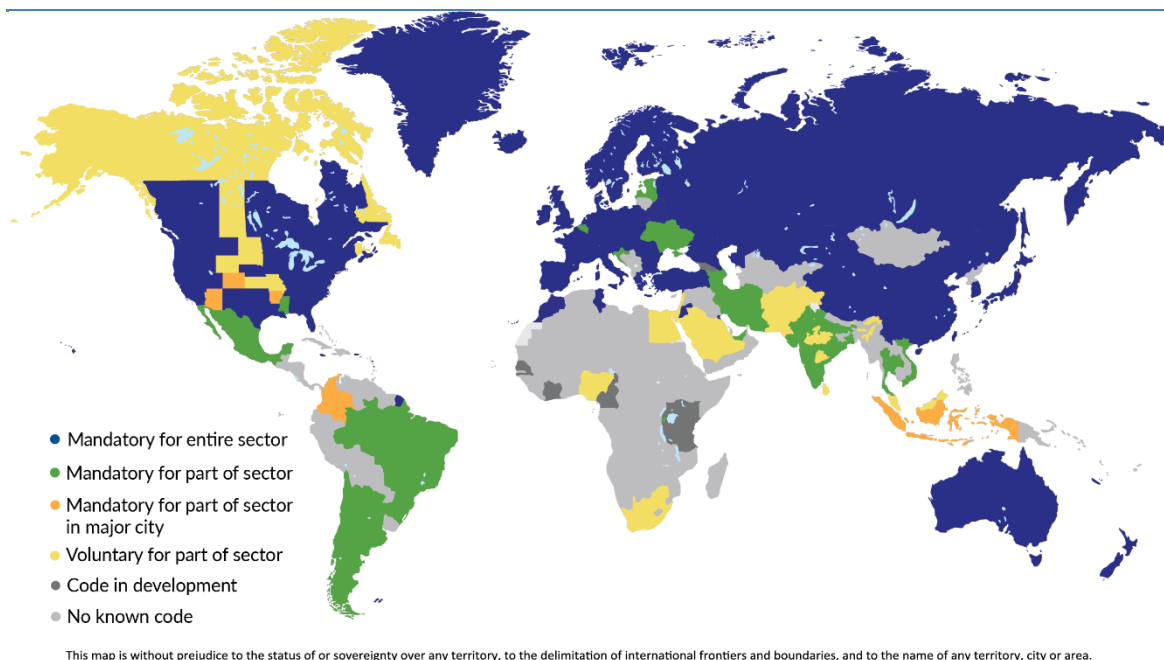
Key message • With a new reporting phase beginning in 2020, NDCs should increasingly target the buildings sector through policies and codes to support improvements in building energy performance.

¹ IEA analysis has estimated the portion of energy use and emissions associated with building end uses covered under policies or mentioned in NDCs. It does not reflect reductions in energy use or emissions, and is an indicator only of the portion of current energy and emissions falling under existing or expected policies.

Building energy codes

Building energy codes, or standards, are requirements set by a jurisdiction (national or subnational) that focus on reducing the amount of energy used for a specific end use or building component. In 2018, 73 countries had mandatory or voluntary building energy codes or were developing them.

Map 2 • Building energy codes by jurisdiction, 2018-19



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Source: Adapted from IEA (2019c), *Energy efficiency policies: Buildings*, www.iea.org/topics/energyefficiency/policies/buildings.

Key message • Although many developing economies still do not have mandatory building energy codes despite high construction rates, changes are beginning in regions that have traditionally not had codes, such as sub-Saharan Africa.

Building energy codes play an important role in setting standards for building construction that will reduce the long-term energy demands of the buildings sector. With mandatory and progressive codes, energy use can be better managed as floor space expands, and progressive codes can respond to changes in legislation and the availability of cost-effective technologies. For maximum impact, it is essential that a building code be strong, be improved progressively over time and be implemented effectively. It is also advisable to move towards mandatory codes for both residential and non-residential buildings.

Of the 73 countries with codes, 41 have mandatory residential building codes and 51 have mandatory non-residential codes; 4 have voluntary residential codes while 12 have voluntary non-residential codes; and 8 more are in the process of developing building codes. Greater coverage, adoption and strength are needed to continue improving the energy performance of new buildings and major refurbishments.

There is still considerable need for countries and subnational jurisdictions to develop and effectively implement building energy codes to reduce future energy demand and avoid expensive retrofits later. There are signs, however, that such codes are being considered by a number of countries in central Africa and Central America.

Box 2 • Examples of building energy codes

US code updates

Many US states and cities are adopting more stringent residential and non-residential building energy codes. States that have updated their building energy codes include California, Florida, Idaho, Illinois, Utah, Vermont and Wisconsin, in addition to cities such as Chicago.

Eco-Niwas Samhita (Part 1: Building Envelope), [India](#)

India's Ministry of Power launched ECO Niwas Samhita, an Energy Conservation Building Code for Residential Buildings (ECBC-R) to promote the energy-efficient design and construction of homes, apartments and townships. Given the pace at which India's building stock is expanding, it is a landmark policy that introduces energy efficiency into the buildings sector and is relevant for all involved in the construction process. The code is being implemented at the state level with national support.

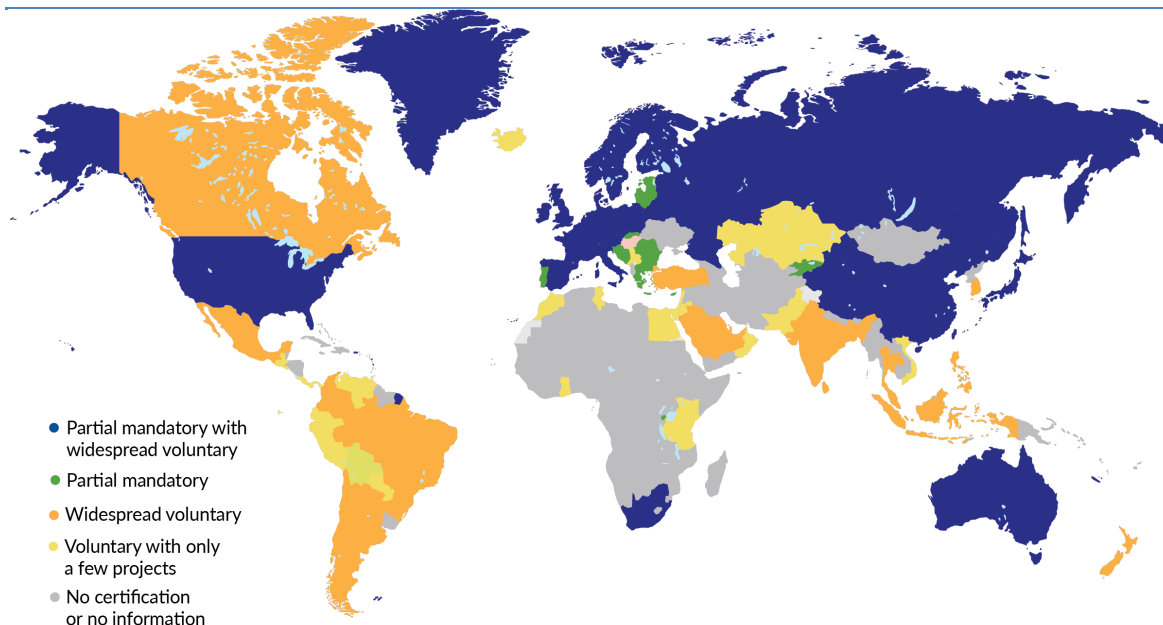
Rwanda Green Building Minimum Compliance System, [Rwanda](#)

The Green Building Minimum Compliance System is point-based and applies to new commercial buildings, public buildings, assembly buildings, health facilities and educational buildings to help owners and developers choose indicators based on building type, usage and associated benefits. The system identifies 29 indicators for the basic green features any building should have, such as appropriate orientation, daylighting, natural ventilation, rainwater harvesting, efficient plumbing fixtures, low-impact refrigerants, greenery protection and safe paints.

Building energy certification

Building energy certification involves programmes and policies that evaluate the performance of a building and its energy service systems. Certification may focus on rating a building's operational or expected (notional) energy use, and can be voluntary or mandatory for all or part of a particular buildings sector. The aim of energy performance certification for buildings is to provide information to consumers about their buildings and to gradually create a market for more efficient buildings.

Map 3 • Building energy certification programmes by jurisdiction, 2017-18



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IEA (2019). All rights reserved.

Source: Adapted from IEA (2019c), "Energy efficiency policies: Buildings", www.iea.org/topics/energyefficiency/policies/buildings.

Key message • Certification programmes are still primarily voluntary in most countries.

As of 2018, 85 countries had adopted building energy performance certification programmes (Map 3), and several countries and subnational jurisdictions also updated their building energy certification policies in 2017-18 (see Box 3). The use of certification programmes is growing, with voluntary certification for high-end buildings becoming a popular means of adding value, but there is still a lack of large-scale adoption of full, mandatory certification programmes outside the European Union and Australia. This means that tracking building energy performance over time and subsequently disclosing the information is still limited.

Box 3 • Examples of building energy certifications, ratings and labels

Green buildings for financial institutions, global

Property developers are beginning to benefit from financing offered by forward-thinking banks that encourage the construction sector to design better-performing buildings. These banks offer financing to developers for projects that are certified green at the design stage through EDGE and other leading certification systems. In turn, banks benefit from owning a portfolio of green assets with greater value and less risk. In Colombia, there were no green-certified homes before banking incentives were introduced, but the market was transformed when the International Finance Corporation (IFC) launched EDGE and collaborated with local financial institutions and the government. Now, hundreds of residential (as well as commercial) buildings are being certified as green.

[Energy Efficiency in Municipalities Project, Ukraine](#)

More than 50 municipalities in Ukraine are participating in a benchmarking system for the energy performance of their buildings. It comprises a dataset of about 2 000 municipal buildings and compares their energy performance, allowing each municipality to better plan and prioritise renovation activities.

[Building Efficiency Accelerator \(BEA\) project, Dubai, United Arab Emirates](#)

Dubai is the first and only city in the Middle East committed to the BEA project, aiming to accelerate implementation of building efficiency policies and programmes and to double the global energy efficiency improvement rate by 2030. A demonstration project was conducted to benchmark the energy performance of existing hotels, schools and shopping malls. The project covers 121 UAE properties, 103 of which are in Dubai.

Green Building Councils' Net-Zero Certification, global

Green building rating tools increase awareness and uptake of green building measures, encouraging a holistic approach to sustainability in the built environment and acknowledging performance beyond local regulatory requirements. To recognise buildings that are responding to the climate crisis, Green Building Councils (GBCs) globally have been developing or adapting tools to certify net-zero-carbon buildings. Under the WorldGBC's Advancing Net Zero project, these tools are developed within a framework of common principles to ensure alignment in their approach while applying locally specific criteria such as energy efficiency standards or inclusion of whole lifecycle emissions. Nine certification schemes and two frameworks have been released so far, including Leadership in Energy and Environmental Design (LEED) Zero from the US GBC. The performance-based approach ensures that there is a focus on the way buildings actually perform, and flexibility for projects to achieve the same performance standards in a contextually appropriate way.

WorldGBC's Net-Zero-Carbon-Buildings Commitment, [global](#)

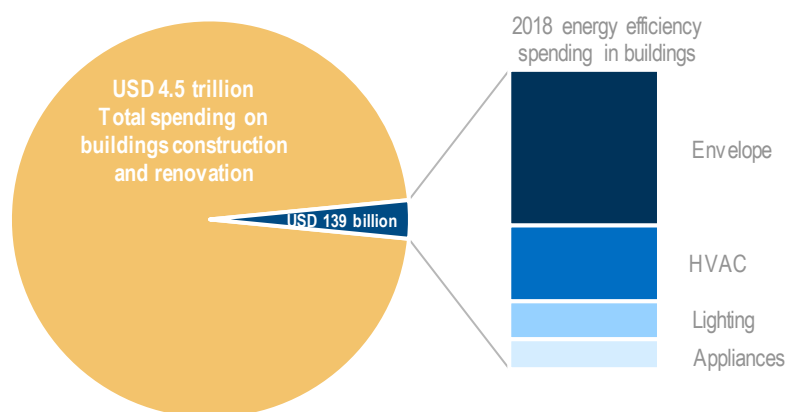
WorldGBC's Net-Zero-Carbon-Buildings Commitment challenges businesses, organisations, cities, states and regions to reach net-zero operating emissions in their portfolios by 2030 and to advocate for all buildings to be net-zero-carbon by 2050. It currently has more than 60 signatories from 31 businesses and organisations, including developers, real estate investors and property funds, manufacturers and global design firms. Six states and regions are involved, as well as 26 cities including London, Tokyo and New York.

Investment and financing for sustainable buildings

Total energy efficiency spending² on buildings amounted to USD 139 billion in 2018 (Figure 11), a decline of 2% from 2017 (IEA, 2019). Driving this deceleration is the slowdown in investment within the European Union, even though the United States and China continue to invest in more energy-efficient building systems. Within Europe, governments have either limited investment expansions (e.g. the United Kingdom and France) or have cut it back (e.g. Germany). In China, by comparison, overall real estate investment has grown 6% per year since 2015 to over USD 1.8 trillion in 2018. Chinese investment has been focused largely on residential buildings, with investments in efficiency rising to USD 27 billion in 2018 – a 33% increase from 2015. In the United States, investments in both residential and non-residential construction grew at a rate of 3.8% from 2015 to 2018, to reach USD 1.4 trillion, but the share of investment for improving building energy efficiency is in decline at 2% of total 2018 investment. The real estate market continues to embrace and invest in green buildings and green-building rating systems, with their overall Environmental, Social and Governance (ESG) scores increasing, which is a promising sign for the sector (GRESB, 2019).

The *2018 Global Status Report* (IEA and UNEP, 2018) provides further details on past investment and financing in sustainable buildings.

Figure 11 • Global energy efficiency investments and total spending on buildings, 2018



IEA (2019). All rights reserved.

Note: HVAC = heating, ventilation and air conditioning.

Source: Adapted from IEA (2019d), *Energy Efficiency 2019*, <https://www.iea.org/efficiency2019/>.

Key message • Although the buildings sector continues to receive the largest portion of energy efficiency investments, sums levelled off between 2017 and 2018.

The overall investment trend mirrors slower progress for energy efficiency outcomes, with 2018 marking the third consecutive year in which the energy efficiency improvement rate slowed. An underlying factor was the static energy efficiency policy environment in 2018, with little progress made in implementing new efficiency policies or increasing the stringency of existing ones.

² Total energy efficiency project costs, including the sum of incremental energy efficiency investments and all service and product costs.

Global survey

In the summer of 2019, an online questionnaire was sent to all GlobalABC members requesting their input for the *2019 Global Status Report*, as well as case studies.

The questionnaire provided members the opportunity to highlight their activities in support of low-energy and low-carbon buildings and cities through actions such as new or improved building codes and standards, building certifications and NDCs. The following sections present insights from the responses.

Survey findings

The survey received 43 responses from a mixture of civil society organisations (30%), national governments (28%), the private sector (21%), non-governmental organisations (NGOs) (7%) and others. Although the majority of countries noted that no updates had been made to their NDCs in 2017 or 2018, several had updated their commitments relating to strategies for 2050 on buildings and construction (see Box 4) and most that responded had begun the 2020 revisions process.

A number of countries identified financing schemes to facilitate investment in low-emissions buildings through forms of green financing, for example a state grant in Sweden to support low-rent apartments, whereby a higher grant can be received if the building's energy performance surpasses the building code. In Senegal, local governments are offering reduced taxes on development when local materials are used in housing construction.

In 2018 and 2019, building energy codes were updated in three respondent countries: Colombia, Japan and Senegal. For Colombia, this involved revision of its mandatory local and regional building energy codes for both residential and non-residential buildings, covering public and transport spaces for the first time. Japan's revisions included an update to the national partially mandatory energy code for both residential and non-residential buildings.

Several countries are considering innovative building codes or expanding existing ones to cover broader lifecycle emissions beyond energy. For example, Sweden is investigating addressing the environmental impact of new buildings by using an environmental certification. Currently in the process of revising its CO₂ Act, Switzerland is considering introducing a very strict CO₂ emissions cap for existing buildings, which in most cases would result in the banning of fossil fuel-based heating systems unless the building is very well insulated. Meanwhile, Canada's codes seek to leverage high-performance technologies and construction practices that are at the commercialisation stage, and to include more climate change adaptation and resilience measures.

Building energy performance certification remains largely voluntary among respondent countries, with some exceptions for certain building types (commercial buildings in Tokyo, New York and Singapore, for example) or locations (e.g. both residential and non-residential buildings in the European Union). A range of certification types are being used around the world to indicate performance, and they are a mix of predicted and measured approaches. Respondents that recently updated their certifications include Sweden (2018), which has included mandatory coverage for all building types, and Medellín, Colombia (2019), which updated its voluntary coverage for residential and commercial buildings.

Box 4 • Examples of country strategy updates for 2050

Japan

The Japanese government has decided that net-zero or less-than-average energy consumption for new houses and buildings will be required by 2030 (the zero-energy-building [ZEB]/zero-energy-house [ZEH] policy). Furthermore, the government will require that new houses contribute negative net emissions over their entire lifecycle –i.e. from material production and construction to dismantling and reuse. For existing houses and buildings, the government will facilitate renovations and energy-efficiency actions. In addition, it will further support innovative technology development and the wider use of building materials and equipment necessary to bring average energy consumption in houses and offices to approximately net-zero or less (ZEH/ZEB equivalents) as early as possible in the second half of this century.

Canada

Canada's provinces and territories, in consultation with Indigenous peoples, have developed a plan to meet their emissions reduction targets, grow the economy and build climate resilience. The Government of Canada is working with provinces and territories to: 1) develop a net-zero-energy-ready building code, with the goal of having provinces and territories adopt it by 2030; 2) develop a model code for existing buildings to help guide energy-efficiency improvements during renovations, to be adopted by all provinces and territories; 3) develop tools to support the aim of implementing building energy use labelling by as early as 2019; 4) help provinces and territories expand their efforts to improve building energy performance through green infrastructure investments; 5) set new standards for heating equipment and other key technologies; and 6) support Indigenous communities and governments as they improve the energy efficiency of their buildings.

Argentina

The Argentine Secretariat of Environment and Sustainable Development and the Secretariat of Housing of the Ministry of the Interior, Public Works and Housing, have developed a National Strategy of Sustainable Housing. Its main objective is to gain an understanding of sustainability in the housing sector, including promoting actions that can change attitudes among the population, planning and designing buildings considering environmental and climatic factors, using more efficient construction systems, and gathering a wide range of public and private stakeholders to further discuss and promote sustainable housing from a lifecycle perspective.

Germany

In 2019, the German government formed a climate cabinet headed by the chancellor to achieve consensus on a new package of emissions reduction measures to meet the 2030 targets. The resulting Climate Action Programme 2030 includes a phased CO₂ pricing system that will also apply to heating emissions not covered by the EU Emissions Trading System (ETS) and thereby encourage ongoing energy efficiency efforts. Furthermore, the cabinet agreed on additional sector-specific measures for buildings and heating, such as tax relief for energy-efficient refurbishment of buildings, a premium to promote the exchange of oil heaters for new, efficient heating systems, and the expansion of heat grids and district heating with a view to integrating renewable energy sources into heat supplies, especially in densely populated areas.

Global Roadmap recommendations

A global transformation to a highly energy-efficient and low-carbon buildings and construction sector is essential to realise global ambitions to limit the rise in average global temperature to less than 2°C above preindustrial levels by 2030. The critical window of opportunity to address buildings and construction emissions is in the coming decade, to avoid locking in inefficient buildings for decades to come. There is an equally critical need to address energy performance improvements and emissions reductions in the world's existing building stock.

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The following section outlines the key priority areas identified in GlobalABC's 2016 *Global Roadmap* (UNEP and GlobalABC, 2016) as well as the actions necessary to deliver a zero-carbon global building stock.

Future GlobalABC work includes developing regional roadmaps to provide targets that are more country- and region-specific. For further information on best practices and examples of existing policies and technologies for the buildings sector, see www.iea.org/buildings.

Updates on Global Roadmap activities

GlobalABC roadmaps focus on developing a collaborative approach across eight thematic areas necessary to create a sustainable built environment for the future. Efforts exemplifying roadmap ideas are being made in countries and cities all around the world, and this section highlights numerous country-level case studies across various themes as examples of these activities (Box 5).

Urban planning

Urban planning policies should be used to reduce energy demand, increase renewable energy capacity and improve infrastructure resilience. Globally, local jurisdictions have significant control over how energy is used, and the emissions created by transportation, building construction and lifetime building operations can be regulated through urban planning. Urban planning can also help combat climate risks by ensuring building resilience. Key actions in the area of urban planning include:

- Enacting urban planning policies that account for the long-term goal of decarbonising the buildings and construction sector.
- District energy planning, i.e. enabling a systemic approach that can integrate energy demand and supply at the district level to deliver more efficient low-carbon solutions.

New buildings

There needs to be a higher uptake of net-zero-operating-emissions buildings. With the global population increasing by 2.5 billion by 2050, new buildings will have an important effect on future buildings-related energy use and emissions. Several key policy, investment and design actions can achieve sustainable (low-emissions, efficient and resilient) new buildings:

- Develop and implement mandatory codes. Transition from voluntary to mandatory codes that set a minimum efficiency for new buildings.
- Strengthen building codes. Establish a building code improvement cycle to strengthen performance requirements every three to five years, with the aim of achieving zero emissions and net-zero-energy codes.
- Integrate renewable energy into new building designs to achieve net-zero emissions or net-zero energy.

- Mobilise sustainable building financing. Facilitate widespread designing and construction of sustainable buildings by raising access to/use of financing to enable private investment.
- Lead by example. Develop policies ensuring that all new government facilities are efficient low-emissions buildings.

Existing buildings

The rate of energy renovations and the level of energy efficiency in existing buildings need to be increased. Key steps to raise the performance of existing buildings involve increasing both the number of buildings improved and the amount of improvement achieved.

- Increase renovation rates in industrialised countries to an average of 2% of existing stock per year by 2025, and to 3% by 2040. Renovation rates in developing countries should reach 1.5% by 2025 and 2% by 2040.
- Increase the depth of renovation. Enable deep energy renovations that reduce energy consumption of existing building by 30-50% or more.
- Make renovation financing available. Raise renovation rates by increasing access to/use of financing to enable private investment in renovations.
- Lead by example. Develop policies ensuring that existing government facilities are renovated to become efficient low-emissions buildings.

Building operations

Better energy management tools and operational capacity-building can reduce the amount of operating energy needed and, hence, emissions. While delivering efficient and resilient low-emissions new or renovated buildings is essential, it is equally important to manage existing buildings efficiently. Key actions to improve the energy management of buildings include:

- Installing energy management systems. Offer training in energy management systems and use energy management processes in all buildings, particularly non-residential ones.
- Strengthening human resources. Hire sustainability and energy managers and support capacity-building among them.
- Using smart controls. Deploy temperature, lighting and ventilation system controls and sensors as well as energy metering.
- Making information accessible. Provide data and information that will help building operators and occupants make better decisions.

Systems

It is important to reduce energy demand from systems, appliances, lighting and cooking. Energy-consuming lighting, appliances and equipment systems, which commonly have a shorter lifetime than the buildings they are in, offer a significant opportunity to reduce emissions in new and existing buildings. Key actions to increase system sustainability in buildings include:

- Establishing minimum energy performance standards (MEPS). Develop, enforce and improve standards to set product quality and performance requirements.
- Mobilising financing for clean systems. Facilitate the use of sustainable products by increasing access to/use of financing to enable private investment.
- Leading by example. Develop policies ensuring that all government buildings invest in low-emissions and efficient systems.

Materials

Taking a lifecycle approach can reduce the environmental impact of materials and equipment in the buildings and construction value chain. Key actions to increase the sustainability of building materials and products include:

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- Encouraging people to purchase low-energy and low-emissions products and materials by implementing policies that promote better purchasing decisions based on embodied carbon and energy.
- Reducing demolition by implementing policies to help people make better decisions based on the impact of building demolition versus reuse.
- Recycling construction materials. Support the development of material recycling processes for products and materials that can reduce lifecycle embodied energy and emissions.
- Phasing out high-global-warming-potential (GWP) refrigerants through policies and technology evolution, enabling a phase-down and then phase-out of refrigerants that give off global warming emissions.
- Introducing information and awareness campaigns to disseminate information on low-carbon materials and technologies (e.g. wood and earth constructions, innovative concrete) among professionals involved in building design and construction.
- Leading by example, by developing policies that ensure all government buildings invest in low-emissions and efficient materials based on lifecycle analyses.
- Developing a circular economy by embracing a cradle-to-grave or cradle-to-cradle lifecycle approach in the buildings sector to promote systemic, material-neutral, performance-based methods and business models.

Resilience

Building risks related to climate change can be reduced by adapting building designs and improving resilience. Key actions to increase the resilience of buildings include:

- Incorporating risk-zoning into urban planning. Use data and information to document potential risk exposure by location to enable improved decision-making during the building and infrastructure design process.
- Employing wind- and seismic-resistant construction methods. Implement policies and use best-practice designs and strong materials to make buildings more resistant to natural disasters and extreme weather events.
- Managing storm water. Require improved storm water retention within properties to reduce the negative impacts of water flowing to other properties and to surging waterways.
- Endorsing thermal-resistant construction. Implement policies and use best-practice designs to make buildings more resistant to extreme temperatures. The anticipated increase in cooling demand in particular needs to be addressed through the promotion of building designs that avoid excess cooling demand and use passive cooling measures and external shading.

Clean energy

Increasing access to secure, affordable and sustainable energy can reduce the carbon footprint of energy demand in buildings. Key actions to support the clean energy transition in buildings include:

- Integrating onsite renewable energy by including building-integrated photovoltaic (BIPV), solar thermal and micro-wind renewable energy projects in the planning and design of buildings and neighbourhoods.

- Eliminating onsite fossil fuel-burning equipment by replacing systems with equipment that use clean energy, including highly efficient heat pump technology.
- Connecting buildings to low-emissions district energy systems. Support district energy system clean-energy transitions by connecting buildings when districts commit to upgrade their systems to clean energy.
- Purchasing only green power to support electricity grid clean-energy transitions.
- Implementing zero-carbon policies that support the clean energy transition based on the lifecycle benefits of the measures.

Box 5 • Examples of other sustainability commitments and actions

Urban planning: Eskişehir's building efficiency policies and projects, Turkey

The Eskişehir Urban Development Project is one among a pioneering class of ecological restorations in urban areas and a model for Turkish and global cities alike. With the technical support of WRI Turkey Sustainable Cities, the Eskişehir Metropolitan Municipality has been developing and implementing a suite of building efficiency policies and projects. A few priority projects include: Greener Municipal Buildings, Energy Audits, Job Training, and Public Awareness-Raising. As part of delivering sustained progress on these priorities, the city is now designing a management scheme, possibly including a dedicated Municipal Energy Management Division, to weave building efficiency into the city's energy master plans.

Urban planning: La Marine Eco-district, Paris, [France](#)

The goal of La Marine Eco-district was to reclaim an industrial wasteland for the construction of a new sustainable neighbourhood of 6.7 hectares. The project was conceived by the Charles de Gaulle district to open up the site and create an urban and social link between the present and the future. Several project innovations contribute to the quality of the project: a biomass heat network supplies all the buildings in the eco-district and the social housing stock in the south; the parking lots are shared to reduce the construction of infrastructure and limit the traffic impact on the neighbourhood; and an installation aims to achieve zero rainwater discharge both in public spaces and at the level of each plot. Phase 2 was launched in 2017, and while the second part of this new neighbourhood was to be largely office-based, the state of the office building market required that the plan be revised to include nearly 300 new housing units and 27 social housing units. The space intended for economic activity has been reduced to 2 500 m², on the edge of boulevard Charles de Gaulle.

Urban planning/building retrofits: Universidad del Media Ambiente (UMA), [Mexico](#)

UMA produces zero wastewater, grows its own food and is surrounded by a growing, edible forest. The university has also implemented green features that conserve natural resources. To reduce its energy consumption, classrooms are ventilated naturally, solar hot water collectors are used for 100% of hot water demand and solar panels produce electricity. The building is projected to reduce water use by nearly 90%, with a rainwater harvesting system on the roof and a black water treatment and recycling system. Innovative building materials such as compressed stabilised earth blocks for the walls, timber window frames, etc., were used to reduce embodied energy by nearly 70%.

Building retrofits: Agency of Urbanism and Development of Guyana (AUDEG), [Guyana](#)

Thermal performance was improved by replacing awnings made of Wapa shingle with an aluminium solar brise-soleil, replacing windows with solar control glass, adding a tin canopy on the gable floor to the west, and adding a vertical wooden sunshade at the entrance. Insulation has also been laid under the wooden floors to ensure better thermal and acoustic quality and more efficient A++ air conditioners have replaced older, less-efficient ones, and a locally produced wooden mesh has been installed to protect them. Reversible fans have also been installed in all offices.

Circular economy: The ROCKWOOL Group's RockCycle programme, [Denmark](#)

RockCycle is a circular business model devised by the ROCKWOOL Group. The RockCycle programme varies by country, depending on the local situation. For example, the take-back programme for flat roof insulation in Germany is offered in combination with the delivery of new ROCKWOOL material, allowing the company to make use of empty delivery-truck runs from the place of delivery (mainly renovation sites) back to its production facilities, where the discarded material is recycled. The installers pay ROCKWOOL a fee for this take-back service rather than paying to dispose of the materials in a landfill, so there is a financial as well as environmental incentive to reduce landfill waste.

Circular economy/new buildings: NEST, Switzerland

NEST is a living lab near Zurich, run by the Swiss Federal Laboratories for Materials Science and Technology and the Swiss Federal Institute of Aquatic Science and Technology. NEST consists of a central building core and three open platforms where individual modules can be installed based on the plug-and-play principle. These modules are temporary apartments or offices in which people live and work and new ideas are tested. The system can be used to validate new energy concepts and examine the potential for increasing efficiency and reducing CO₂ emissions.

New buildings: Gillies Hall at Monash University, Frankston, [Australia](#)

Gillies Hall, a new student residence, is Australia's largest Passivhaus building. Cross-laminated timber reduces carbon emissions by half, and the project is also fossil fuel-free thanks to its rooftop solar panels and all-electric thermal plant.

New buildings/materials/resilience/clean energy: Konseguela business area, [Mali](#)

The buildings in the Konseguela business area were built according to the principles of the Nubian Vault Technical Concept promoted by the Nubian Vault Association (AVN) in Sahelian Africa for the past 20 years. Raw earth and local stone were used to make all the structures. Some outdoor spaces between buildings were embellished with light IPE+ steel box covers, creating shaded and ventilated useable spaces at a lower cost. The photovoltaic installation produces electricity, and a generator running on jatropha oil from locally cultivated seeds ensures peak and backup electricity in the event of breakdowns or insufficient sunshine, and provides energy for non-electrical consumption. An electrical energy storage device is also in place to ensure service continuity.

Materials/circular economy: Low-Carbon Charter, [Hong Kong](#)

Hong Kong's low-carbon charter is an important private sector initiative that unites the whole value chain in committing to a low-carbon buildings and construction sector.

New buildings: Net-zero-energy-ready buildings, Canada

The Government of Canada is currently investing CAD 48.4 million to support the development and implementation of deep retrofits for existing buildings and new net-zero-energy-ready buildings through research, development and demonstration (RD&D) initiatives to accelerate the development of technologies necessary for highly energy-efficient building design and construction practices.

New buildings: TADI Office Complex Building B, Tianjin, [China](#)

The project, which aims to create a comfortable, healthy and environmentally friendly workplace, uses thirty passive and active technical measures, including the integration of renewable energy through a ground source heat pump coupled with a solar cooling and heating system. It has won several awards, including LEED Gold-Grade Certification.

Resilience: Climate-resilient Honiara project, Solomon Islands

This is a four-year project supported by the UNFCCC Adaptation Fund and administered by UN-Habitat, with multi-disciplinary scientific support from RMIT University, Australia, that is working to reduce the vulnerability of those living in informal settlements, through a range of co-designed initiatives. The overarching goal of this project is to enhance the resilience of Honiara and its inhabitants to current and future climate impacts and natural disasters, with a particular focus on pro-poor adaptation actions that involve and benefit the most vulnerable communities.

New buildings/materials: Waste collection logistics base, France

The bioclimatic design of the buildings improves passive energy gains, and the buildings are oriented to allow solar gains without causing overheating. The office area opens towards the south and the west while the workshop side is turned northwards to take advantage of indirect lighting and avoid overheating. The cost of the efficient, low-carbon construction was equivalent to that of a standard construction. Locally available hemp from the Vendée was used in the wood frame, the walls are insulated with wood fibre and hemp concrete or vegetable wool, and vegetable wool insulates the roofs.

Building retrofits: BUILD UPON 2, Europe

BUILD UPON is the world's largest collaborative project on building renovation; it aims to create a renovation revolution across Europe by helping countries deliver strategies to renovate their existing buildings. BUILD UPON 2 is the second phase, designed to strengthen the effectiveness and implementation of the national building renovation strategies required by the EU Energy Performance of Buildings Directive (EPBD). BUILD UPON 2 is being led by a consortium of eight national GBCs. The eight pilot cities will develop and test a multi-level renovation impact framework containing a suite of milestones and measurable progress indicators covering emissions reductions, increased employment and improved health. By capturing data at the local level, the framework will link renovations

to policy and decision-making processes at the national level. The overall aim of the project is to have at least 10 cities publicly commit to establishing strategies to decarbonise their building stock by 2050.

Systems: Multifunctional facade element for multi-story housing construction, Germany

A building's facade can take on numerous functions of the building envelope. The German Federal Government is funding a [research project](#) as part of its Energy Research Programme that aims to intelligently link these functions into one system. To this end, scientists are developing a facade element with integrated organic PV, textile solar protection, a sustainable insulation material and the sensors necessary for an overall control system. The components are controlled via an intelligent overall control concept to increase the energy efficiency of the building and user comfort. A high degree of prefabrication and the modular design of the facade element should make it economical to use in multi-story residential buildings.

Materials: GreenPro ecolabelling, India

The main objective of using Greenpro certification in India's ready-mixed concrete (RMC) industry is to make it easier for RMC producers to adopt green measures and to enhance the environmental performance of their products with the ultimate objective of reducing the industry's GHG emissions. The certification system evaluates the green features of RMC based on eight parameters: product design; product performance; raw materials; manufacturing process; waste management; lifecycle approach; product stewardship; and innovations.

Building retrofits/materials: Les Fuschias residence, Paris, [France](#)

This project involves the renovation of a 60-year-old building to enhance its performance and meet the objectives of the Climate Plan of Paris. Replacement of the cladding and the installation of improved insulation were accompanied by replacement of the boiler room and the ventilation system to ensure reduced energy consumption as well as greater thermal comfort for the inhabitants. 80% of the waste materials have been reused and various materials recovered onsite (wooden battens, aluminium plates and cladding boards) are being used to manufacture items in the association's workshops.

Building retrofits/systems /clean energy: Greenpeace Spain headquarters, [Spain](#)

Passive measures – including the use of high-performance glass, solar gains management, insulation and natural lighting – have been implemented to minimise energy demand. The building is cooled using an evaporative system that has an 80% lower energy demand than a conventional system and also avoids the use of chlorofluorinated gases. The ventilation system incorporates a heat recovery system to reduce energy losses, and low-impact ecological materials have been used, taking into consideration the lifecycle impacts of the materials. Existing polyvinyl chloride (PVC) floors were replaced with cork, wood chips and recycled textiles for insulation. Forest Stewardship Council (FSC)-certified wood for furniture and plant-based paints were also used. Greenpeace promotes the shift to renewable energy by using 100% renewable energy from a wind turbine installed in Catalonia, and the building's use does not result in CO₂ emissions since it is 100% electrified, using 100% renewable energy.

Building retrofits/urban planning/clean energy: Canada

The Government of Canada is providing CAD 1 billion in investments to the Federation of Canadian Municipalities to retrofit buildings in Canadian communities and improve their energy efficiency. The Federation of Canadian Municipalities advocates on behalf of over 2 000 municipalities at the national level and has a longstanding partnership with the Government of Canada.

Clean energy: Bahnstadt Heidelberg (passive house estate), Germany

The urban area [Bahnstadt in Heidelberg](#) is a new settlement on unused land that provides apartments and jobs for more than 10 000 people. This extensive clean-energy-based sustainable housing development is one of the largest demonstration projects in Germany. It meets the Passive House standard, with an average heat demand of 54 kilowatt hours per square metre (kWh/m²) for all heat applications (space heating, hot water, distribution and storage losses) and allows only the efficient use of renewable energy. The local heating network uses a wood-fired power station to provide for the remaining electricity and heat needs. The installation of smart meters in all households and a comprehensive energy monitoring system enable further optimisation.

[Building performance: Real estate emissions improvements, Global](#)

Large building portfolio owners and real estate companies are making progress on improving their buildings' performance. The Urban Land Institute (ULI) has published its 10th annual report on building performance (the Greenprint Performance Report) and marked the efforts of major real estate companies to improve the energy performance of their building stock and reduce CO₂ emissions. The 2019 report shows that for the 8 916 properties (around 200 million m² of space) being tracked in 32 countries, emissions have fallen 1.5%, and ULI members continue to make progress towards their commitment to reduce energy use 50% by 2030. The [OID Barometer](#) in

2019 Global Status Report for Buildings and Construction

Towards a zero-emissions, efficient and resilient buildings and construction sector

France indicates a similar 1.6% reduction in energy demand in 2017, and [JLL](#) continues to track global real estate market transparency in its reporting of sustainability and CO₂ emissions in the Global Real Estate Transparency Index.

GlobalABC work areas

GlobalABC aims to bring together all elements of the buildings and construction industry as well as countries and stakeholders to raise awareness and facilitate the global transition to low-emissions, energy-efficient buildings. GlobalABC works on a voluntary collaboration basis in five working areas in which members are invited to take part.



Work area 1: Awareness and education

The purpose of this area is to support capacity-building to promote the transition to a resilient, efficient and zero-emissions built environment and to raise awareness of the sector's transformation potential, convey a sense of urgency, develop common narratives, and formulate key messages. It aims to disseminate new approaches and solutions, share best practices through the new GlobalABC website, establish an interactive knowledge database to enhance peer learning, and provide training and education through webinars and online courses.



Work area 2: Public policies

This area attempts to unite the numerous independent and scattered building and construction sector stakeholders – particularly public authorities – through effective regulations and norms as well as financial and fiscal incentives. It also aims to support the development of national alliances, promote the integration of sustainable building objectives into NDCs, and enable city and subnational engagement. A local government public policies group has been created to identify opportunities, facilitate community-level climate and energy strategies and promote co-operation among national and subnational governments. Another sub-group focuses on adaptation and is developing a report to be released in 2020 on how the building industry is readjusting.



Work area 3: Market transformation

This area is designed to engage businesses and other stakeholders in decarbonising the entire buildings sector value chain, fostering multiple partnerships and a common culture among private and public sector participants to facilitate market transformation. This involves defining voluntary arrangements to prepare regulations and enable innovation in the market. It also includes developing guidance on science-based targets that can be used to help transform the buildings and construction sector by identifying a common metric and language for all companies to use through the Science-Based Targets for Buildings (SBT4buildings) project led by the World Business Council for Sustainable Development (WBCSD).



Work area 4: Financing

This area is working to narrow the public and private financing gap for investing in efficient and resilient zero-emission buildings and construction, including property development. It is also helping draw attention to the sector's financing needs, mapping existing financing opportunities, promoting innovative financing tools, enabling the flow of reliable information for investors, and informing public bodies of the budgeting and funding policies needed to conceive and implement energy efficiency measures in buildings. For example, the International Partnership for Energy Efficiency Cooperation (IPEEC) and the Japanese government organised the [G20 Global Summit on](#)

Financing Energy Efficiency, Innovation and Clean Technology, recognising in its final Tokyo Declaration how important it is for the real estate and buildings sector to begin shifting financing towards energy efficiency.



Work area 5: Measurement, data and information

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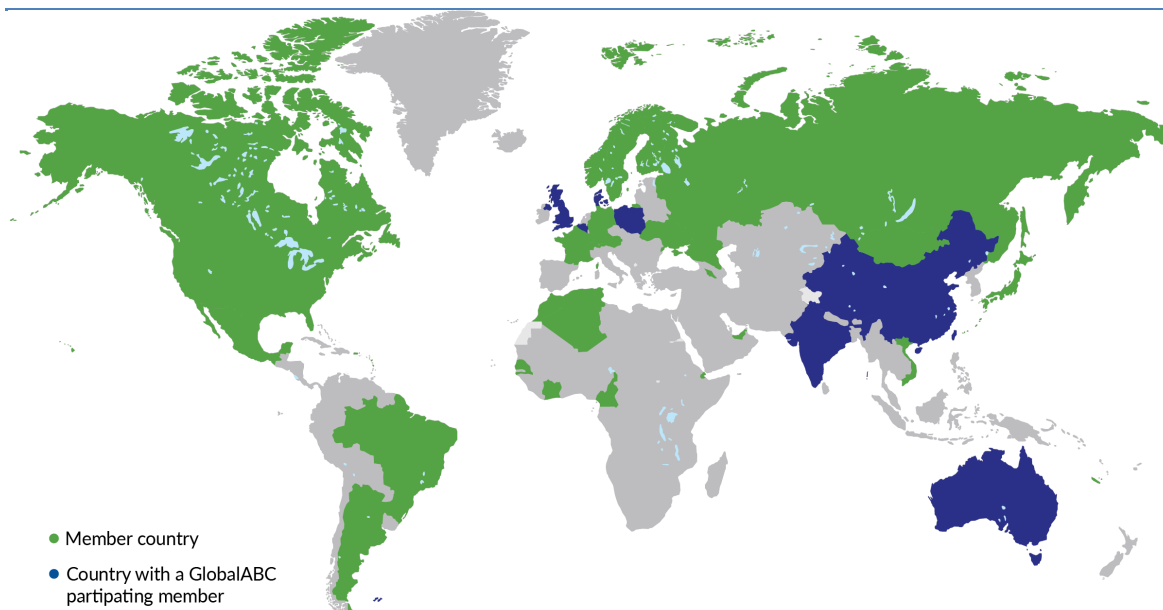
The purpose of this work area is to elaborate a fair and harmonised measurement system to close the information gap and thereby support buildings and construction sector policies and investments with measurable, reportable and verifiable data. Key barriers, however, relate to information availability, collection, quality, reporting, storage and accessibility. To overcome these obstacles, the work area team is co-ordinating an industry-wide global effort to develop a digital building data and information collection tool, known as a “building passport”, to promote greater cross-sectoral data transparency and consistency and information exchange.

All work areas welcome new participants. Please contact global.abc@un.org for more information.

GlobalABC members and activities

[Launched at COP21](#), GlobalABC is a voluntary partnership of national and local governments, intergovernmental organisations, businesses, associations, networks and think tanks committed to a common vision: an efficient and resilient zero-emissions buildings and construction sector. GlobalABC functions as an umbrella or meta-platform – a network of networks – that brings together initiatives and participants focused on the buildings and construction sector. The GlobalABC network currently has 128 members, among which are 29 countries (Map 4), and it welcomes new members interested in contributing to the global transition to a low-carbon, energy-efficient and resilient buildings and construction sector.

Map 4 • GlobalABC membership and participation



This map is 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.

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Note: New members are welcome and can find more information at www.globalabc.org.

Key message • GlobalABC unites 29 countries and 99 non-state organisations and welcomes new members interested in contributing to the transition to sustainable buildings and construction.

Programme for Energy Efficiency in Buildings

The French and German governments jointly initiated the Programme for Energy Efficiency in Buildings (PEEB) at the end of 2016 at COP22, and the programme was catalysed by GlobalABC. PEEB supports implementation of the *Global Roadmap: Towards Low-GHG and Resilient Buildings* in its first partner countries: Mexico, Morocco, Senegal, Tunisia and Viet Nam. PEEB is a partnership programme implemented by the Agence Française de Développement, Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH and the Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME). PEEB has identified EUR 600 million worth of energy-efficient building projects and has already committed EUR 160 million.

National alliances: Mobilising for a buildings sector transition

Action at the national level is needed to work towards an efficient and resilient zero-emissions buildings sector, and national alliances are ideal to help various professions connect and exchange

information, and to make the topic more visible in national policy debates. Alliances can be organised by the public or private sector as either volunteer-based or formalised structures.

National alliances offer recommendations for policy makers and actively work to enhance economic activity. Typical pursuits range from awareness-raising, training sessions and project assistance to legislative lobbying.

National alliances have been successfully established in France, Germany, Mexico, Morocco and Tunisia, in many cases inspired by GlobalABC. Forming bridges among various sectors and industries, these alliances bring together leading representatives of public, private and civil society institutions for the creation of a sustainable buildings sector:

- Plan Bâtiment Durable (PBD) [Sustainable Building Plan], France
- Allianz für Gebäude-Energie-Effizienz (geaa) [German Alliance for Building Energy Efficiency], Germany
- Alianza por la Eficiencia Energética (ALENER) [Mexican Alliance for Energy Efficiency], Mexico
- Alliance Marocaine du Bâtiment pour le Climat (AMBC) [Moroccan Alliance for Buildings and Climate], Morocco
- Alliance Tunisienne Pour les Bâtiments et la Construction (ATBC) [Tunisian Alliance for Buildings and Construction], Tunisia

PEEB currently supports the national alliances in Mexico (ALENER) and Morocco (AMBC) with awareness-raising activities as well as capacity-building and training for their members. Most recently, expert working groups discussed the topic of buildings according to the five GlobalABC working areas during the relaunch of the Mexican national alliance in September.

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Acronyms, abbreviations and units of measure

Acronyms and abbreviations

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ADEME	Agence de l'Environnement et de la Maitrise de l'Energie (French Environment and Energy Management Agency)
BEA	Building Efficiency Accelerator
BIPV	building-integrated photovoltaic
CO ₂	carbon dioxide
COP	Conference of the Parties
EPBD	Energy Performance of Buildings Directive
EPC	energy performance certificate
ESG	Environmental, Social and Governance
EU	European Union
EU ETS	EU Emissions Trading System
FSC	Forest Stewardship Council
GBC	Green Building Council
GDP	gross domestic product
GHG	greenhouse gas
GlobalABC	Global Alliance for Buildings and Construction
GWP	global warming potential
IEA	International Energy Agency
IFC	International Finance Corporation
IPEEC	International Partnership for Energy Efficiency Cooperation
LEED	Leadership in Energy and Environmental Design
MEPS	minimum energy performance standards
NDC	nationally determined contribution
NGO	non-governmental organisation
PEEB	Programme for Energy Efficiency in Buildings
PV	photovoltaic
PVC	polyvinyl chloride
R&D	research and development
RD&D	research, development and demonstration
RMC	ready-mixed concrete
SBT4buildings	Science-Based Targets for Buildings project
SDG	Sustainable Development Goal

ULI	Urban Land Institute
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollar
WBCSD	World Business Council for Sustainable Development
ZEB	zero-energy building
ZEH	zero-energy house

Units of measure

EJ	exajoule
GtCO ₂	gigatonne of carbon dioxide
kg/m ²	kilogramme per square metre
kWh	kilowatt hour
kWh/m ²	kilowatt hour per square metre
m ²	square metre
tCO ₂	tonne of carbon dioxide
TWh	terawatt hour
W	watt

