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Towards zero-emission efficient and resilient buildings.
Global Status Report

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Publication date:
2016

Citation (APA):
Dean , B., Dulac, J., Petrichenko, K., & Graham, P. (2016). *Towards zero-emission efficient and resilient buildings. Global Status Report*. Global Alliance for Buildings and Construction (GABC).

Towards zero-emission efficient and resilient buildings

GLOBAL STATUS REPORT 2016

Global Alliance for Buildings and Construction

» ACKNOWLEDGEMENTS

The Global Status Report 2016 was prepared by the GABC on the occasion of the 22nd Conference of Parties (COP22) to the United Nations Framework Convention on Climate Change (UNFCCC). The report was coordinated by UN Environment and made possible through the generous support of the Government of France.

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Aaron Staniszewski, Meredydd Evans and Sha Yu – Pacific Northwest National Laboratory

A number of reviewers provided valuable input and feedback to this report, including:

Sylvie Lemmet, Yves-Laurent Sapoval and Regis Meyer – French Ministries MEEM-MLHD

Martina Otto, Frederic Auclair and Curt Garrigan – UN Environment

Michel Sudarskis – International Urban Development Association

Oliver Rapf and Frances Bean - Building Performance Institute Europe

Terri Wills – World Green Building Council

Ursula Hartenberger – Royal Institution of Chartered Surveyors

Frank Hovorka – Caisse des Dépôts

David Donnerer – Energy Cities

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Global Alliance for Buildings and Construction

» GLOBAL ALLIANCE FOR BUILDINGS AND CONSTRUCTION WORKING GROUPS

The Global Alliance for Buildings and Construction (GABC) was launched at the 21st Conference of Parties (COP21) Buildings Day in Paris on the 3rd of December 2016. It was initiated by France and the United Nations Environment Programme (UN Environment) to bring together the building and construction industry, countries and stakeholders to raise awareness and facilitate the global transition towards for low-emission, energy-efficient buildings.

With its creation, GABC members acknowledged that the buildings and construction sector can contribute significantly to achieving climate goals and the common objective of limiting global warming to well-below 2 Celsius (2°C).

Indeed, the GABC aims at supporting and accelerating the implementation of the NDCs, and thus facilitate the implementation of the Paris Agreement for the buildings and construction sector in terms of energy efficiency gains, growth of renewable energy and GHG emissions reduction. Moreover, the GABC aims at dramatically reducing the GHG emissions of the global building stock by increasing the share of eco-friendly buildings, whether new or renovated.

Today, the GABC gathers together 23 countries and 64 non-state organisations (sub-national, non-governmental organisations and private sector) from all over the world and is intended to increase the pace and scale of actions through communication, collaboration and implementation.

GABC activities are organized around different working groups contributing to the transition towards low-GHG and resilient real estate: Education and Awareness; Public Policies; Market Transformation; Finance; and Measurements, Indicators and Accountability. These working groups have been established during the inaugural meeting and seminar of the GABC, held in Paris on the 18th and 19th of April 2016.

During the inaugural meeting in Paris, GABC members agreed on the need for two ad-hoc frameworks: a Global Roadmap for the transition towards low-emission and resilient real estate and this Global Status Report, along with a Building and Climate Yearbook that will be produced on an annual basis hereafter.

This is the first draft of the Global Status Report, which will track each year the progress made in the transition towards low-emission and resilient real estate. The next complete edition will be issued on November 2017.

The GABC Secretariat is hosted by the UN Environment, Economy Division in Paris and served by the GABC Coordinator. Contribution of new data and information to enrich this document are welcome.

For more information, please contact the following email address: globalstatusreport@globalabc.org.

»GLOBAL PERSPECTIVE

Energy use in **buildings and for building construction** represents more than one-third of global final energy consumption and contributes to nearly one-quarter of greenhouse gases (GHG) emissions worldwide [1].

A growing population, as well as rapid growth in purchasing power in emerging economies and developing countries, means that energy demand in buildings could increase by 50% by 2050 [2], while global building floor area is expected to double by 2050, driving energy demand and related GHG emissions for construction.

1 This data covers more than building-related energy. This concept will be further explained in the GABC Roadmap.

2 IEA (2016), Energy Technology Perspectives 2016, IEA/OECD, Paris.

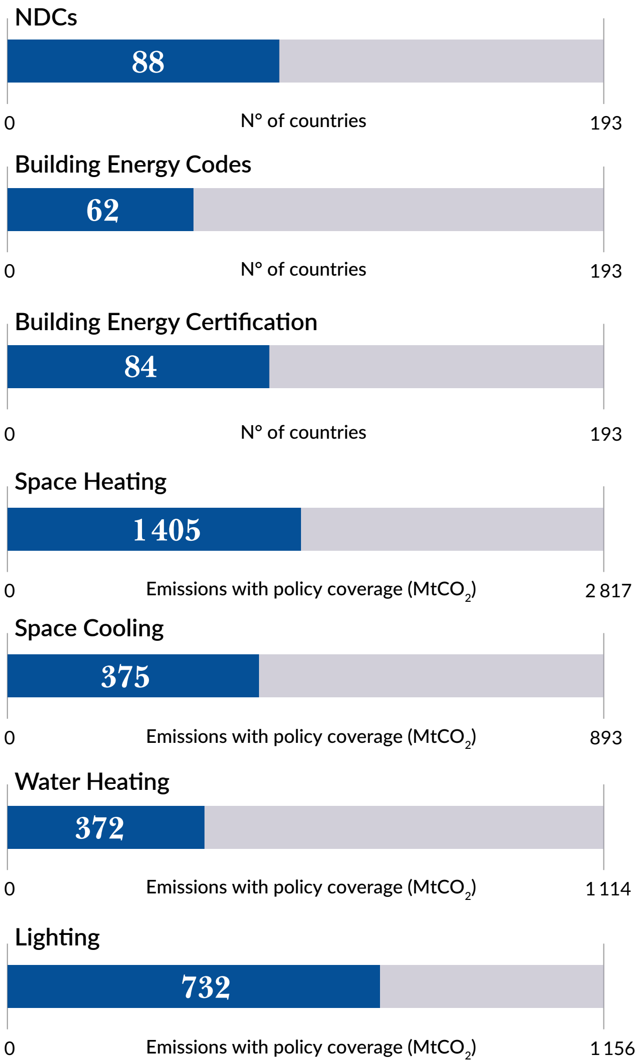
Table **Building floor area growth to 2050 by region[3]**

Billion m2	2015	2030	2050
North America	38.1	47.1	56.9
Western Europe	29.8	34.3	36.9
Eurasia	9.8	13.1	14.9
China	57.2	79.3	84.6
India	15.8	32.1	57.6
Japan and Korea	9.8	10.9	11.1
Southeast Asia	15.6	23.8	32.3
Australia and New Zealand	2.1	2.7	3.4
Latin America and Caribbean	19.3	29.1	43.1
Middle East	8.0	12.7	18.3
Africa	18.0	30.4	56.0
World	**223.4**	**31.54**	**415.2**

Yet, the building sector offers the largest cost-effective GHG mitigation potential, with net cost savings and economic gains possible through implementation of existing technologies, policies and building designs[4].

Building energy efficiency technologies and policies have been demonstrated as cost effective means for collectively improving energy security and productivity, while also improving health and wellbeing, reducing local air pollution, creating jobs and adapting to climate change. Governments are looking increasingly at ways to accelerate investment in net-zero/low-carbon buildings, and the essential role of the building sector is well recognised as a critical element to achieving the Paris Agreement's goal of limiting global warming to well-below 2°C.

Nearly 90 countries have now included building sector actions in their Nationally Determined Contributions (NDCs), and a coalition of over 90 states and non-state actors has formed the Global Alliance for Buildings and Construction to raise awareness of the building sector's huge climate action potential and focus specifically on engaging relevant stakeholders to help achieve a well-below 2°C pathway.



3 IEA (2016), *Energy Technology Perspectives 2016*, IEA/OECD, Paris.

4 Intergovernmental Panel on climate Change (IPCC) (2014), *Climate Change 2014: Mitigation of Climate Change, 5th Assessment Report, WG III.*

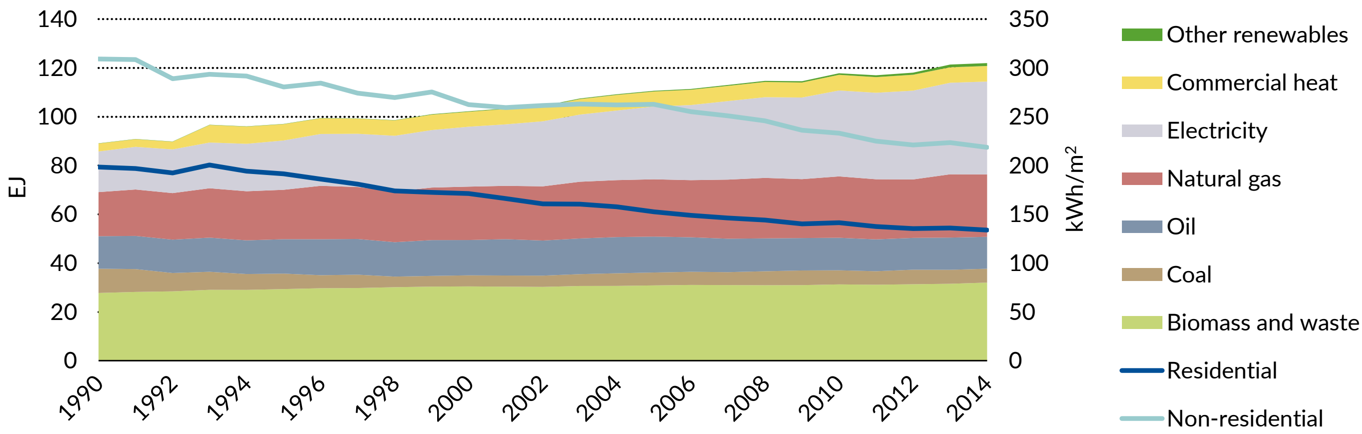
In addition, more than 3 000 city-level and 500 private sector commitments and actions in the building sector have been registered under the United Nations Framework Convention on Climate Change. The finance sector is also mobilising investors, representing over USD 3 000 billion in assets to increase financing for energy-efficient buildings. A number of industry and professional bodies are also mobilising their networks of company and professional members to support market development for high-performance buildings, including initiatives to implement net-zero/carbon-neutral building certification programmes, platforms for private sector engagement with cities to develop and implement local decarbonisation action plans, and communication and education campaigns on net-zero buildings and deep renovation of existing buildings[5].

Despite this surge of awareness and commitment across stakeholders, the energy savings and GHG mitigation targets being set for the building sector are not yet ambitious enough to achieve the Paris Agreement's pledges. A below 2°C pathway requires reducing global energy and process-based carbon dioxide (CO_2) emissions by 60% in 2050 compared to 2012[6].

For the building sector, this means avoiding at least 50% of projected growth in energy consumption through mainstreaming of highly energy-efficient, near-zero, net-zero energy and energy-plus buildings in new construction as well as massive uptake of deep renovation of the existing building stock by 2030[7].

Ensuring this transformation requires investing around an additional USD 220 billion annually by 2020 – an almost 50% increase on 2014 investments in energy-efficient buildings[8]. This does not necessarily require new funding, but rather a reallocation of less than 3% of the current total global annual investment in construction activity (roughly USD 8.5 trillion in 2014)[9]. Returns on this investment could be more than 100%[10] if investments in ambitious policy and technology actions are made

Figure 2 **Global building sector energy consumption and intensity by sub-sector, 1990-2014**



Note: Building sector energy consumption and intensities represent final energy consumption; EJ = exajoules; kWh/m2 = kilowatt-hour per square metre.
Source: International Energy Agency (IEA), calculations derived from IEA World Energy Statistics and Balances 2016, www.iea.org/statistics.

Key point

Building energy intensities have improved since 1990, but not enough to offset strong growth in building floor area. As a result, global building energy consumption and related GHG emissions continue to rise.

5 For a list of GABC member initiatives, see: http://web.unep.org/climatechange/buildingsday/take-action.
6 IEA (2015), Energy Efficiency Market Report 2015, IEA/OECD, Paris
7 Ibid.
8 IEA (2015), Energy Efficiency Market Report 2015, IEA/OECD, Paris
9 Construction Intelligence Center (2014), Global Construction Outlook 2020, Timetric, April.
10 Diana Urge-Vorsatz, Andras Reith, Katarнna Korytárová, Mynika Egyed, János Dollenstein (2015), Monetary Benefits of Ambitious Building Energy Policies, research report prepared by Advanced Building and Urban Design (ABUD) for the Global Building Performance Network (GBPN), January.

now, and possibly even higher when accounting for the potential multiple benefits, such as improved health and wellbeing[11]. Alternatively, if business-as-usual or even only moderate performance improvements in new and existing buildings continue to be implemented, there may never be a positive return on investment, and even a possible loss of about 6% by 2050[12].

Priorities for Action

The most efficient and low-carbon building and construction markets have often taken decades to develop. However, a global transformation to a highly energy-efficient, low-carbon building sector must occur over the next decade to ensure a well-below 2°C ambition. This is especially true in emerging economies, where there is a critical window of opportunity to address the largest new construction markets to avoid locking in inefficient buildings for decades.

50% or more

Building sector energy savings potential in 2050 in support of a below 2°C pathway.

There are many strategies for reducing the climate related impact of buildings and construction. Key priorities identified in the draft GABC roadmap include:

1 Urban planning policies for energy efficiency

Use urban planning policies to impact the form and compactness of buildings to enable reduced energy demand and increased renewable energy capacity.

2 Improve the performance of existing buildings

Increase the energy efficiency renovation rate and increase the level of energy efficiency in existing buildings.

3 Achieve net-zero operating emissions

Increase the uptake of building or system level net-zero operating emissions for new buildings.

4 Improve energy management of all buildings

Reduce the operating energy and emissions through improved energy management tools and operational capacity building.

5 Decarbonise energy

Integrate renewable energy and reduce the carbon footprint of energy demand in buildings.

6 Reduce embodied energy and emissions

Reduce the environmental impact of materials and equipment in the buildings & construction value chain by taking a life-cycle approach.

7 Reduce energy demand from appliances

Collaborate with global initiatives to reduce the energy demand from appliances, lighting and cooking.

8 Upgrade adaptation

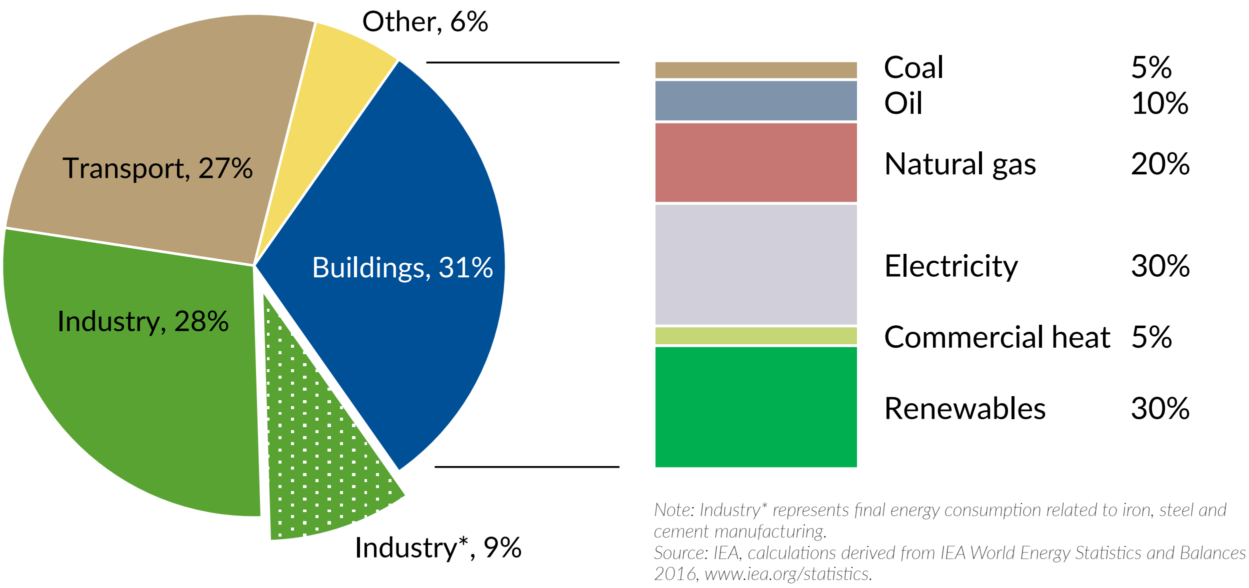
Reduce climate-change related risks of buildings by adapting building design and improving resilience.

11 World Green Business Council (2014), Health, Wellbeing and Productivity in Offices, www.betterplacesforpeople.org.
12 Ibid.

» GLOBAL STATUS

The global building sector consumed nearly 122 exajoules (EJ) (equivalent to 34 x 10^6 gigawatt-hours [GWh]) in 2014[13], over 30% of total final energy consumption[14] for all sectors of the economy, having increased by more than 35% since 1990[15]. Buildings also accounted for half of global electricity demand, with electricity consumption increasing by more than 500% in some regions since 1990. When upstream power generation is taken into account, the building sector therefore represents roughly 30% of global energy-related CO_2 emissions.

Figure 3 **Global final energy consumption and building energy use by fuel share, 2014**



Note: Industry represents final energy consumption related to iron, steel and cement manufacturing.*
Source: IEA, calculations derived from IEA World Energy Statistics and Balances 2016, www.iea.org/statistics.

Key point

Buildings and construction account for nearly one-third of global final energy consumption.

Globally, building energy performance (as measured by final energy per floor area) has continued to improve by around 1.5% per annum since 1990. Building energy codes and energy efficiency policies have helped to offset growth in total energy consumption. However, the simultaneous effect of growing global wealth, which typically corresponds to increased demand for larger spaces, smaller household size (i.e. fewer persons per household), and increased demand for energy services and comfort, have offset many of those efficiency gains.

If no action is taken to improve the energy performance of buildings, global building sector energy demand could increase another 50% by 2050[16]. Nearly 80% of this growth occurs in developing countries and emerging economies, where there is an important window of opportunity to address a rapidly growing building sector.

Under a below 2°C trajectory, effective action to improve building energy efficiency could limit building final energy demand to just above current levels, meaning that the average energy intensity of the global building stock would decrease by more than 80% by 2050.

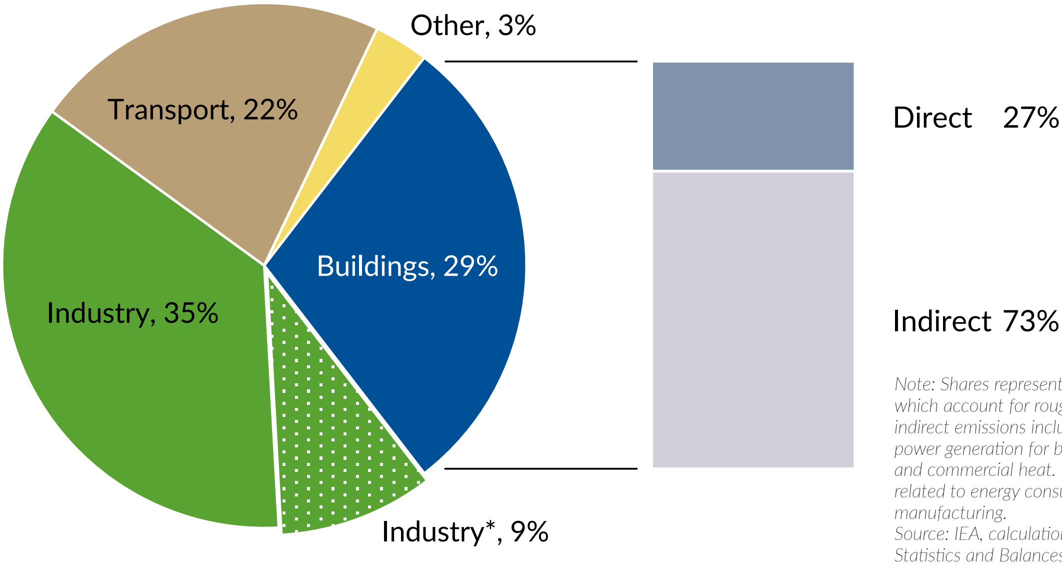
13 *The final energy consumption accounted for in the IEA's global building sector analysis and outlooks includes energy consumption for space heating and cooling, water heating, lighting, cooking, household appliances and other building-related equipment and plug-loads. Energy efficiency and low-emission actions for cooking, appliances and other buildings-related equipment are not treated explicitly in this report or in the GABC Roadmap.*

14 *Energy consumption here refers to final energy use, unless otherwise noted.*

15 *IEA (2016), Energy Technology Perspectives 2016, IEA/OECD, Paris.*

16 *Ibid.*

Figure 4 **Building emission share, 2014**

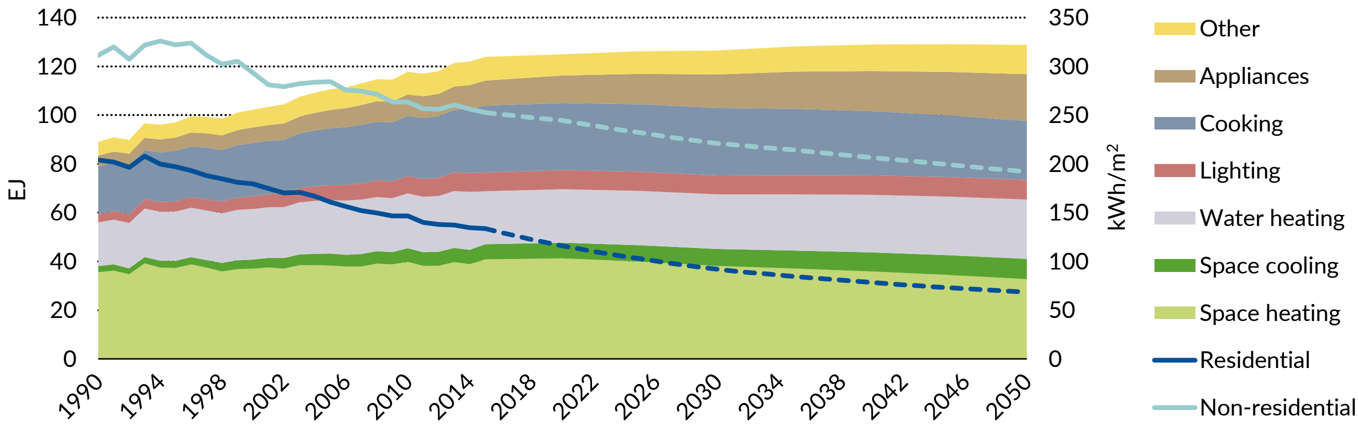


Note: Shares represent energy-related CO_2 emissions, which account for roughly two-thirds of global GHG emissions; indirect emissions include upstream CO_2 emissions from power generation for building consumption of electricity and commercial heat. Industry represents CO_2 emissions related to energy consumption for iron, steel and cement manufacturing.*
Source: IEA, calculations derived from IEA World Energy Statistics and Balances 2016, www.iea.org/statistics.

Key point

When indirect building emissions from power generation are included, buildings and construction represent nearly 40% of energy-related CO_2 emissions.

Figure 5 **Global building sector final energy consumption and intensity to 2050 in support of a 2°C trajectory**



Note: kWh/m² = kilowatt-hour per square metre. / Source: IEA (2016), Energy Technology Perspectives 2016, www.iea.org/etp.

Key point

Building energy intensities need to decrease by at least 80% by 2050 in order to reach 2DS targets. Building envelope improvements to reduce heating and cooling loads will be critical to achieving those ambitions.

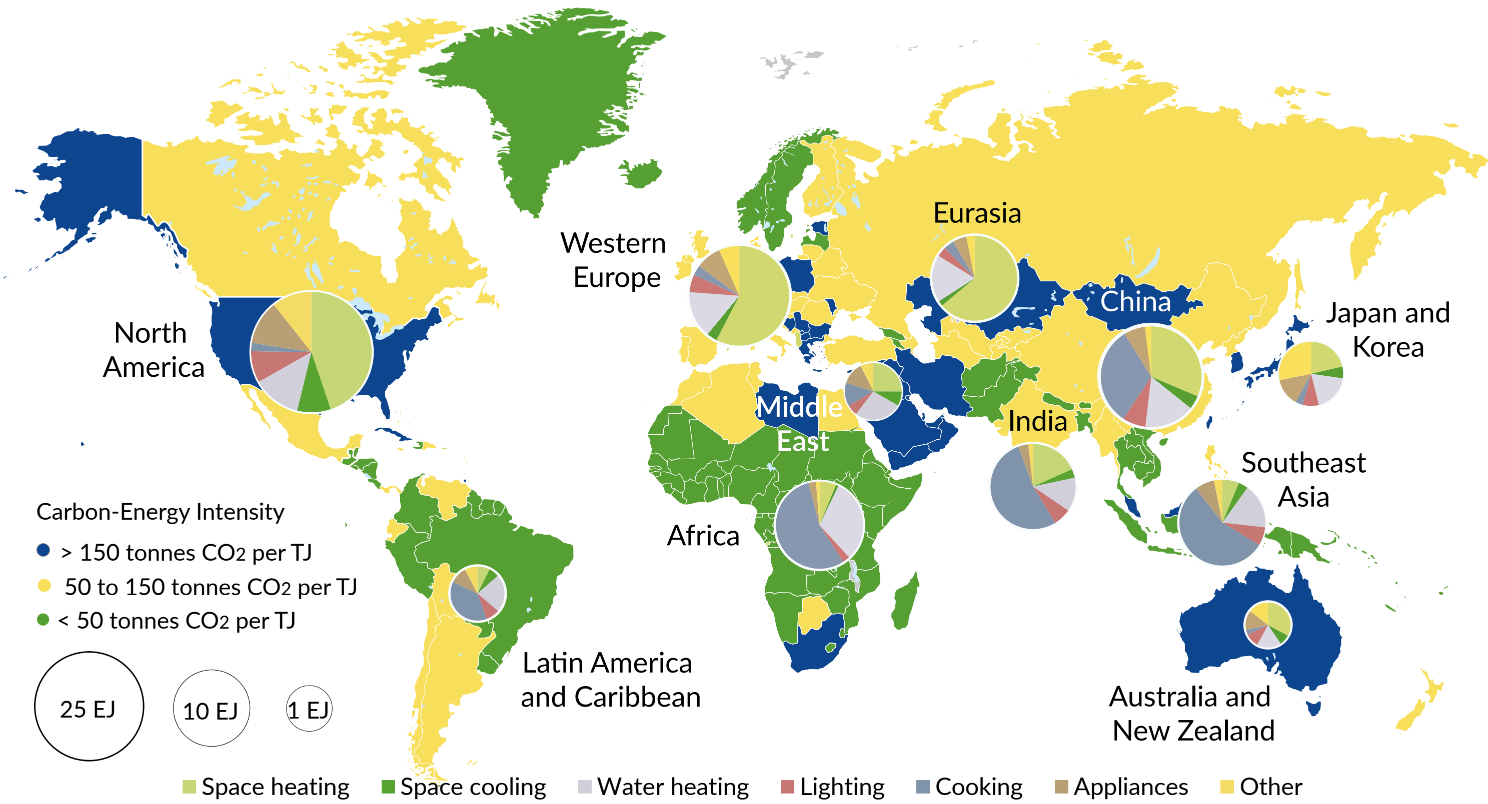
Space heating and cooling demand in buildings continues to be a critical priority area for energy efficiency action in the building sector[17]. Space heating currently accounts for more than one-third of global energy use in buildings and will continue to be a major energy-consuming end use to 2050[18]. Space cooling, while a significantly smaller portion (roughly 5% today) of global energy demand in buildings today, is the fastest-growing end use in buildings and could increase by as much as tenfold to 2050 in some warm-climate, rapidly emerging economies.

Growth in cooling demand will have an important effect on the grid, because peak electricity demand for space cooling can stress ageing or at-capacity power sector infrastructure. Concerted effort is therefore needed to improve building envelope efficiencies, ramp up energy performances of cooling equipment and reduce growing global demand for mechanical conditioned thermal comfort where possible (e.g. through natural cooling solutions).

17 *Note: cooking and water heating often comprise a large share of building energy consumption in many developing countries, due largely to traditional use of biomass. These end-uses and traditional use of biomass are not treated explicitly in this status report.*

18 *IEA (2016), Energy Technology Perspectives 2016, IEA/OECD, Paris.*

Figure 6 **Building energy-carbon intensities by country and building sector energy consumption by sub-sector, 2014**



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boudaries, and to the name of any territory, city or area.

Note: 1 tonne CO_2 per terajoule = 3.6 grams CO_2 per kWh. Energy-carbon intensities represent the building-related CO_2 emissions (including direct emissions from fossil fuel combustion and indirect emissions from upstream power generation for electricity and commercial heat) per unit of final energy consumption in the building sector. These do not include primary energy for production of electricity of electricity and commercial heat.

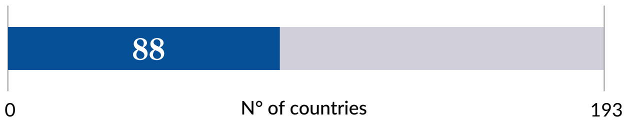
Source: IEA, calculations derived from IEA World Energy Statistics and Balances 2016, www.iea.org/statistics; IEA, Energy Technology Perspectives 2016, www.iea.org/etp/.

Key point

Growing demand for electricity use in buildings, especially for space cooling, lighting and household appliances, will place an increasing onus on the power sector, which remains carbon intensive. Energy efficiency in buildings will play a critical role in reducing carbon emissions in the power generation sector.

»BUILDINGS-RELATED CLIMATE COMMITMENTS

Nationally Determined Actions (NDCs)



State Actors - Nationally Determined Contributions (NDCs)

Many countries have included energy efficiency and/or building specific measures in their intended[19] or now submitted NDCs (Figure 7). 88 countries (including the European Union) have specifically mentioned building and construction related actions in their NDC. Most of these NDCs reference general actions to improve building energy efficiency, or reduce building energy related GHGs. More than 30 countries described specific policy goals or actions including adopting new or further promoting existing building energy codes and policies such as rating and disclosure programs.

Countries such as Afghanistan, Bangladesh, Gambia, Jordan and South Sudan mentioned specific actions to encourage financing or investment, including public sector investment in energy efficient building, renewables and/or retrofitting programs. The need for awareness raising and capacity building was also acknowledged by countries such as Afghanistan, Cameroon, Dominica, Ivory Coast, Japan, Jordan, Lesotho, Macedonia, Qatar, Singapore, and Yemen.

While most NDCs that mentioned buildings & construction did so in general terms, a number of countries have set clear goals for achieving mitigation from their buildings & construction sectors, and actions for achieving them.

The examples listed in the opposite page are non-exhaustive and illustrative of energy efficiency and/or building specific measures in countries' NDCs.

19 Refers to intended NDCs (INDCs) prior to entry into force of the Paris Agreement.

20 UNFCCC Climate Action – NAZCA http://climateaction.unfccc.int

Non-State Actors – Cities

According to the Non-State Actor Zone for Climate Action database[20], more than 500 cities have committed to reducing emissions from construction supply chains and/or climate neutrality. More than 300 cities have committed to policy actions such as building energy efficiency regulation, rating and disclosure programmes, and almost 800 have joined calls to action. Examples include:

- **C40 Cities** reported 2 216 actions being taken in the building sector
- **Covenant of Mayors for Climate & Energy**: In over 5 500 Sustainable Energy and Climate Action Plans, signatory cities are planning actions in their building sectors to reduce GHG emissions by 40% until 2030.
- **ICLEI**: 1 293 community and government operations commitments (pre- and post-2020) were reported to the Carbon Climate Registry. 67% of commitments were made for GHG reductions; 17% for renewable energy; and 14% for energy efficiency. Roughly half supported by reported actions in the building sector.

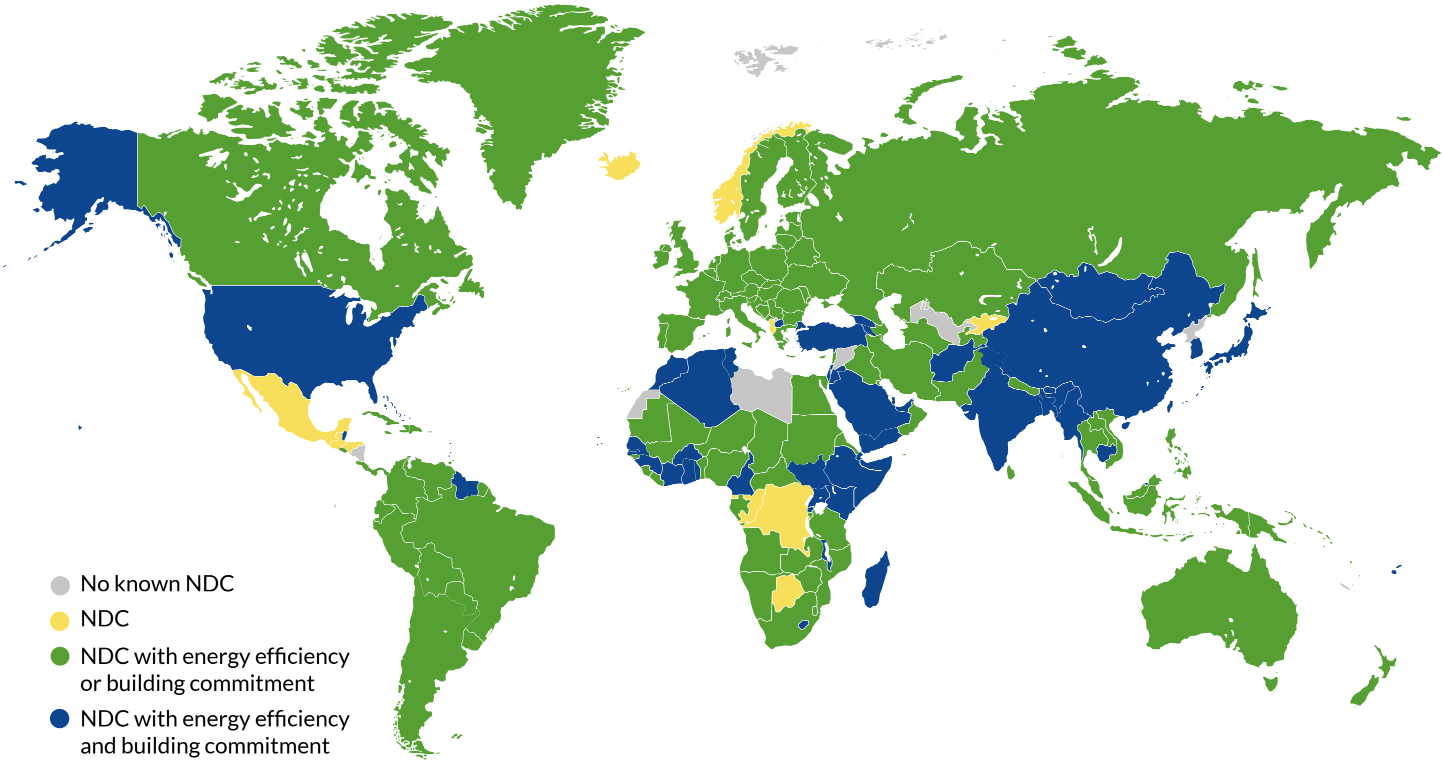
Private Sector Commitments

Nearly 800 commitments to achieve mitigation through action in buildings & construction have been made by private sector partner platforms and companies. These include commitments to:

- reduce energy use in the buildings and facilities they own and/or operate, increasing use of building-integrated renewable energy
- increase investment in low-energy and low-carbon building and construction programmes
- join calls to action on climate change and undertake or facilitate capacity building for green buildings.

Examples include: World Green Building Council (WGBC), national Green Building Councils and member companies commit to advance by 2030 and achieve by 2050 net-zero carbon new buildings and energy efficiency and deep refurbishment of existing stock.

Figure 7 **NDC actions including building and energy efficiency commitments**



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boudaries, and to the name of any territory, city or area.

Grenada plans to:

- Implement energy efficiency actions, including retrofitting of all buildings (20% reduction)
- Implement energy efficiency building codes for all building sectors (30% reduction)
- Implement energy efficiency in hotels (20% reduction).
- Introduce tax reduction incentives for solar panels and solar water heaters and for installation of more efficient lighting in some government buildings.

Djibouti plans to:

- Reduce energy consumption of public buildings, beginning with the retrofit of the Ministerial building and the installation of a rooftop solar farm connected to the grid.
- Perform thermal rehabilitation of "3 000 existing buildings (residen-tial and commercial) per year.

India plans to:

- Increase the stringency of the Energy Conservation Building Code to promote construction of near-zero energy-efficient buildings.

Seychelles plans to:

- Introduce a new Building Code for household dwellings (features natural ventilation and roof insulation), with the target of 50% energy savings on fans and air conditioning in households by 2035
- Require all new builds to incorporate rainwater harvesting, solar PV and other sustainable building features.

Mongolia plans to:

- Reduce heat loss in buildings by 20% by 2020 and by 40% by 2030, compared to 2014.
- Improve insulation for existing panel apartment buildings of 18 184 households in Ulaanbaatar.

China plans to:

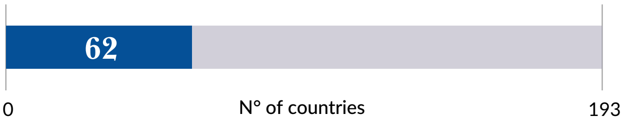
- Improve energy efficiency in buildings and promote construction of green buildings
- Intensify energy conservation transformation for existing buildings
- Promote the application of renewable energy in buildings
- Increase the share of green buildings in new construction in cities and towns to 50% by 2020
- Extend building life spans
- Encourage public institutions to lead by example and advocate low carbon government buildings, campuses, hospitals, stadiums and military buildings.

Morocco plans to:

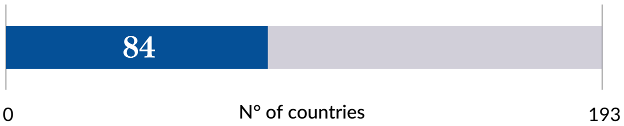
- Reduce energy consumption in buildings, industry and transport by 12 % by 2020 and 15 % by 2030.

»KEY SUSTAINABLE BUILDING POLICY DEVELOPMENTS

Building Energy Codes



Building Energy Certification



In order to realise energy efficiency potential and achieve energy efficiency targets outlined in this report, countries need to establish a comprehensive policy framework on energy efficiency in buildings. A comprehensive policy framework can also assist various actors in overcoming barriers, which may include market failures, hidden costs, upfront (first) costs, and behavioural, informative and structural barriers.

A single policy instrument is rarely able to drive the transformation of the building sector towards high levels of energy efficiency. A properly designed combination of policy instruments is therefore needed to deliver the full spectrum of change needed and to provide the basis for achieving often complex policy goals.

An effective policy package for energy efficiency in buildings typically provides a sound balance between regulatory instruments (e.g. building codes and standards), incentives (e.g. financing schemes and credits) and information and capacity building efforts (e.g. information campaigns, training, and support for research and development). Policy packages should also encourage the application of successful business models, involving utilities and attracting private sector finance, to drive energy efficiency investments in buildings.

United States

The United States Department of Energy, through the Building Energy Codes Program, participates in the process of developing model national codes and helps states to adopt and implement more efficient energy codes. ENERGY STAR and LEED are two voluntary programmes that have been successful. The Energy Independence and Security Act of 2007 calls for new construction to be net-zero energy (NZE) by 2030 and for all buildings to be NZE by 2050. The Net-Zero Energy Commercial Building Initiative aims to achieve marketable NZE buildings by 2025 through public and private partnerships. 25 states are currently implementing energy efficiency resource standards, which are long-term, binding energy savings targets for utilities or third-party administrators. California mandated new low- and mid-rise homes to be NZE by 2020 through its Building Energy Code. New York City announced in 2016 a suite of new energy efficiency initiatives for buildings, including a new building energy code and acceleration of deep retrofits, to put the city on a pathway to an 80% emissions reduction by 2050. The code will also require solar-ready zones on roofs and a performance-based accounting paradigm to measure whole-building energy performance. The city of Cambridge recently adopted a plan to have the entire city be NZE by 2040, where all GHG emissions produced must be offset by carbon-free energy production.

European Union

The European Union (EU) put in place a high level target to reduce energy consumption by 20% by 2020, in coordination with the EU's 20% renewable target and effort to reduce GHG emissions by 20%. Specific legislation (the Energy Efficiency directive and the Energy Performance of Buildings Directive) set requirements to increase the energy performance of buildings across Europe. All new buildings in Europe must be nearly zero energy by 2021 and all EU Member States are required to develop national renovation strategies every 3 years to provide an overview of national building stock and identify policies to stimulate cost-effective renovation. Related to this and to encourage existing public buildings to lead by example, 3% of floor area of central government buildings must be renovated every year. Energy Performance Certificates, which provide information to consumers on buildings they plan to purchase or rent, including an energy performance rating and recommendations for cost-effective improvements, are also obligatory in all EU Member States. In the coming months, the European Commission is expected to come forward with revised policies and targets for 2030.

China

China has building energy codes for commercial buildings as well as residential buildings in four climate zones, which are mandatory in urban areas and voluntary in rural areas. China also has a green building labelling system, under which buildings are rated from 1 to 3 stars according to a set of environmental criteria, including energy performance. Energy performance certificates are issued based on both design and post-occupancy energy efficiency. China also has obligations for energy-efficient renovation of existing buildings with the aim to bring their energy performance to the levels of new building energy codes. This scheme required after 2011 a 10%-15% reduction for commercial buildings (depending on size) by the end of 2015. In 2016, the 13th Five-Year Plan for Housing and Urban-Rural Development (for 2016-2020) set an overall aim to tighten energy efficiency of building standards and increase the share of energy-efficient buildings and technologies. By 2020, over 50% of new buildings are to comply with the standards, and the share of green construction materials is to exceed 40%. The stringency of energy efficiency standards is also set to increase by 20% in 2020 over 2015 levels.

Building Energy Codes

Building energy codes and standards are regulatory instruments that set minimum requirements for energy efficiency and/or use of resources in buildings (e.g. requirements for energy sufficiency and renewable energy sources). Currently, both mandatory and voluntary building energy codes exist in more than 60 countries worldwide.

Requirements in codes can be set for different elements of a building (prescriptive codes) or for the whole building (performance-based codes). There is a general trend towards performance-based codes or towards combinations of both performance and prescriptive requirements.

Buildings energy performance is usually determined on modelling assessments during the design stage. However, some jurisdictions have started to follow an outcome-based approach requiring a specified performance to be achieved and then verified during building operation over a certain period.

Building energy codes are critical for new construction given the long lifespan of buildings, especially in developing countries, where increasing population, urbanisation and economic development are driving rapid growth in floor area in both residential and non-residential buildings. It is also typically more costly to build an inefficient building and then perform efficiency retrofit measures.

Regulation for energy performance of existing buildings is also crucial, and more and more countries are including energy performance requirements in regulations for existing buildings. Without such requirements, there is a risk of locking-in potential energy savings when existing buildings undergo regular maintenance and refurbishment.

Last, effective enforcement of codes, which can be ensured through compliance checks, incentives and other supporting instruments, is critical and remains an issue in a number of countries.

The examples listed here are non-exhaustive and illustrative of building energy codes from various regions.

California has a long history of building energy code development with a continuous increase in stringency and enforcement. California's building standards in 2016 (to be enforced as of 2017) set net-zero energy requirements for all new residential buildings by 2020, for new commercial buildings by 2030, for new state buildings and half of major retrofits by 2025, and for half of existing commercial buildings by 2030. The new standards include: a basic set of mandatory requirements for all buildings, a set of performance requirements that vary by building type and climate zone, and a set of prescriptive packages as an alternative to the performance-based approach.

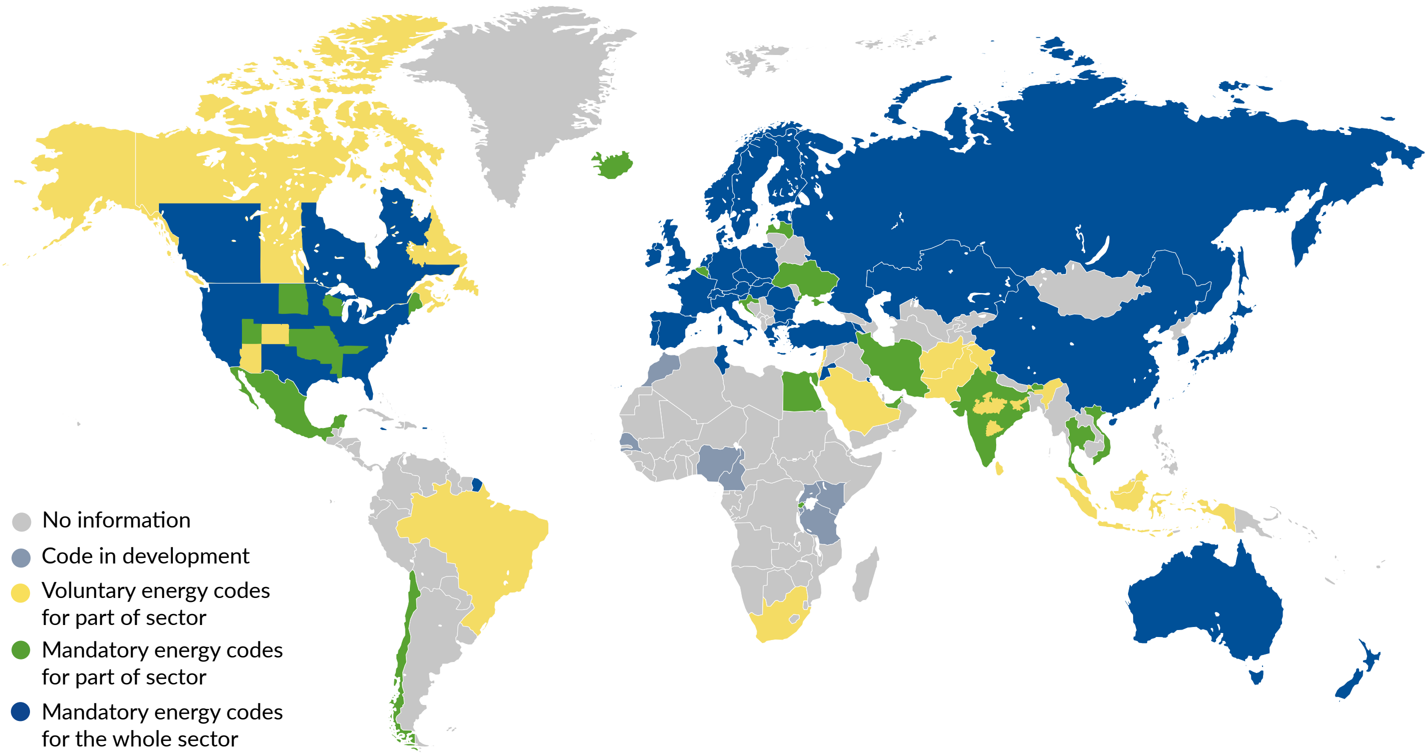
Morocco developed with the support of UNDP thermal regulations for buildings, which introduce minimum performance requirements in new residential and commercial buildings that optimise the need for heating and cooling while improving their thermal comfort. The implementation process of the regulation will start with development of additional decrees and technical specifications.

Ukraine considers the adoption of new government regulations and standards in the area of design and construction, bringing them closer to European Union requirements.

Kenya is planning to adopt the European standards (Eurocode), which cover structural design of buildings, sustainable use of natural resources and other civil engineering works comprising of geotechnical aspects and structural features.

Indonesia has developed national standards that are key components to the green building codes in the cities of Jakarta and Bandung. Both cities have mandatory requirements for large buildings, while Bandung, announced on 27 October 2016, that it also has green building code requirements for small buildings and incentives for sustainability.

Figure 8 **Building energy codes and standards, 2015**



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Armenia introduced in 2016 a mandatory building energy code with the adoption of a new regulation "Thermal Protection of Buildings", which was developed based on Russian Building Energy Code from 2003 (updated in 2012) and European codes and methodologies. It links building envelope construction and heat loses with established energy limits, taking into account differences in climatic conditions. It also includes a requirement for a building energy passport and an energy efficiency label with energy efficiency classes.

Japan adopted the Act for the Improvement of the Energy Consumption Performance of Buildings in 2015, which will be fully enacted in 2017. It introduces energy efficiency standards for new large buildings (2 000 m^2 or more) and will expand the coverage to smaller-sized commercial and residential buildings by 2020. Building developers are also obliged to report plans for the design or refurbishment of residential and non-residential buildings with floor space above 300 m^2.

Flanders, a region in **Belgium**, has implemented a long-term roadmap of minimum energy performance standards for new residential buildings to guide the market towards all new buildings being nearly-zero energy building by 2021. The standards are strengthened regularly, allowing building owners and investors to plan ahead, and severe compliance controls are in place to enforce the standards. The standards are also combined with subsidies, encouraging performance that is higher than the minimum energy standard.

India has continued progress in shifting from a voluntary national code to locally adopted mandatory code in most states across India. This is enabling consistency across the market while also increasing the energy efficiency of buildings.

Building Energy Certification

The success of building energy certification (also referred to as energy rating or energy labelling schemes) lies with the market value of "green" features in buildings[21]. This is translated into an increased penetration of energy-efficient buildings through demonstration of best practices and by "pulling" the market.

The idea of building energy certification is similar to building energy codes, and they are often linked and/or introduced together to increase efficiency potential. While building energy codes define minimum energy performance requirements, certification enables recognition of higher performance.

Building energy certification policies vary across countries. They can include a singular certification (e.g. PassivHaus) or can be combined with a label (e.g. Green Pyramid Rating System in Egypt) and even with a mandatory display (e.g. European Energy Performance Certification). Certification programmes can include comparison labels that categorise buildings into classes (e.g. European Union energy performance labels or LOTUS in Viet Nam) or endorsement labels, which function as a 'seal of approval' (e.g. ENERGY STAR).

Disclosure of energy labels helps building owners, users and retailers to learn about the energy consumption of buildings. They aid purchase decisions when they are disclosed at the time of sale or renting of a building[22] and can help decision-making for renovation and construction (World Bank, 2015).

As of 2016, there are almost 40 countries with mandatory certification programmes (some are still at the legislation stage). Voluntary certification programmes are even more widespread, with over 80 countries using systems including LEED, BREEAM and others[23].

Building energy performance certification programmes that were developed in the past should be carefully examined from the perspective of carbon lock-in potential to reflect recent climate ambitions[24].

The examples provided here are illustrative of certification measures deployed in various regions, but do not represent all systems being applied globally.

21 *Erskine and Collins (1997), Eco-labelling: success or failure?, Environmentalist, Vol. 17, Issue 2. June.*

22 *Becqué et al. (2016), Accelerating Building Efficiency: Eight Actions for Urban Leaders, WRI, Washington D.C.*

23 *IEA (2016), Policies and Measures Database.*

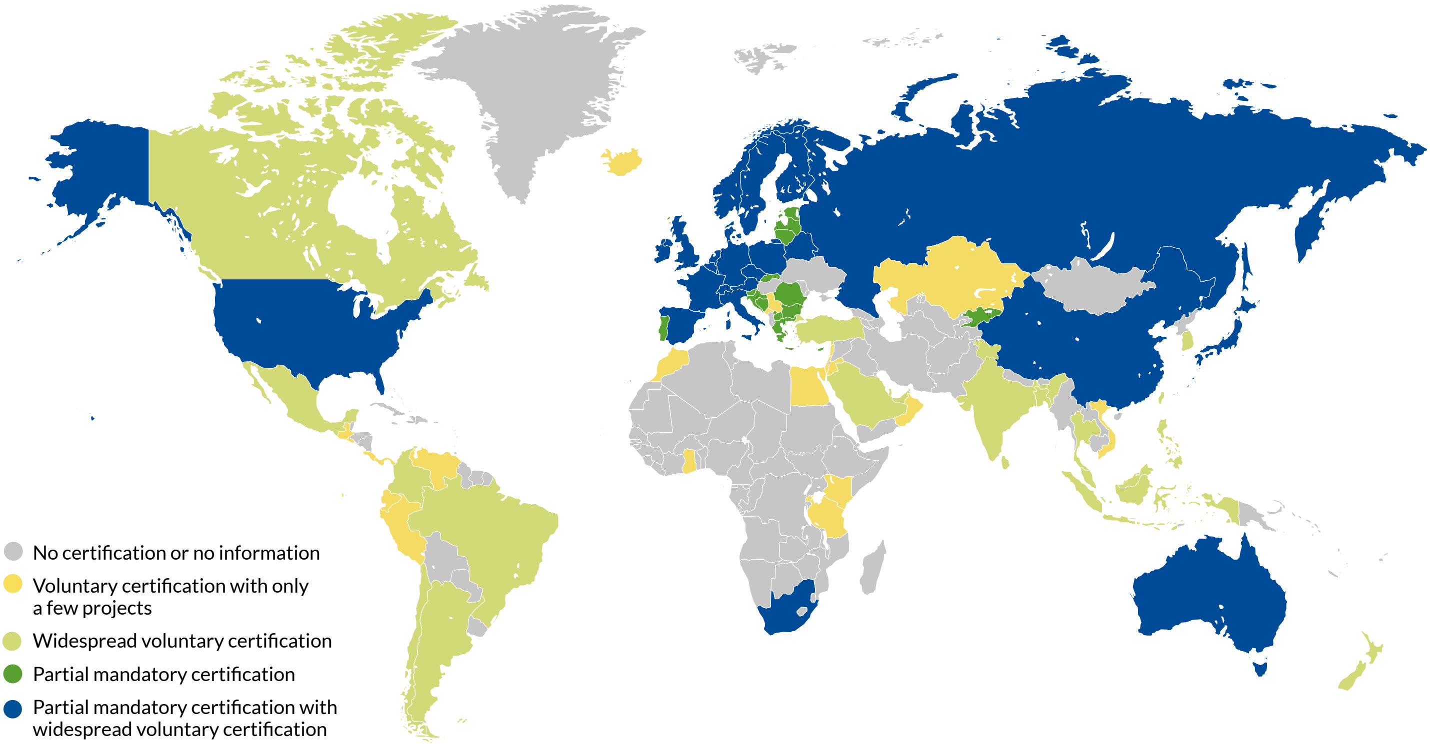
24 *Boza-Kiss et al. (2013), Evaluating policy instruments to foster energy efficiency for the sustainable transformation of buildings, Environmental Sustainability, Vol. 5, Issue 2, June.*

Russia adopted decree 399 in August 2016, which sets the rules for energy efficiency classes of apartment buildings. The energy efficiency class is determined based on comparison of the actual energy use (for existing buildings) and estimated energy use (for new buildings), with the base energy use value setdepending on the heating degree-days and the building height. The certification includes nine classes (A++ to G) and requires the building class to be presented in the energy passport and on the building façade. The A++ class presumes 60% energy savings in comparison to the base level. High energy efficiency classes cannot be given to a building that is not equipped with: an individual heat-supply station with automatic indoor temperature regulation, energy-efficient lighting of common areas and energy meters in each apartment. This certification system is envisioned to be mandatory; however, it is not yet enforced, and measures to stimulate compliance have not been developed yet.

Australia has multiple rating systems that include energy efficiency for buildings, including NABERS and NatHERS, administered by the government, as well as Green Star, which is administered by the Australian Green Building Council. NABERS rates residential and non-residential buildings on the scale from 0 to 6 stars, with 6 stars representing exceptional GHG performance and resource efficiency. NatHERS rates the energy efficiency level, based on building design and the predicted thermal performance of planned residential buildings and for major extensions, assigning a score of 0 to 10 stars. The Commercial Building Disclosure Program also mandates the disclosure of energy efficiency information for commercial office spaces. From July 2017, the minimum floor area threshold for eligible buildings will reduce from 2 000 to 1 000 m2.

The **International Finance Corporation** developed the EDGE (Excellence in Design for Greater Efficiencies) system to provide building and construction stakeholders in developing countries a simple and affordable means to quantify a building's energy and water efficiency. Designers using EDGE are presented with green options relevant to local contexts, allowing them to optimize a building's performance. With the EDGE software, users can develop designs meeting the EDGE standard of 20 percent efficiency in energy and water consumption, as well as embodied energy in materials, and determine any additional investment needs. IFC has seen strong market uptake with almost a million square meters certified and the adoption of EDGE as a green asset definition for green bonds and financial intermediaries in India, South Africa, Turkey, and Costa Rica.

Figure 9 **Building energy certification, 2015**



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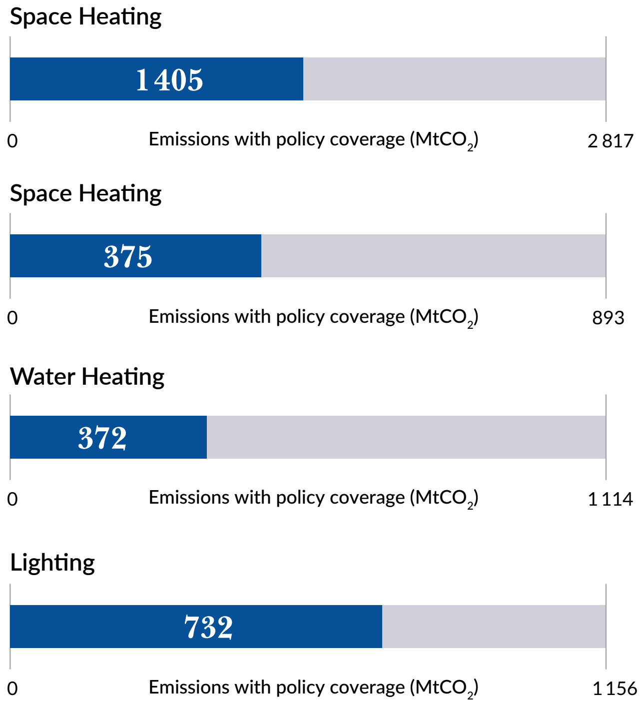
Singapore launched a voluntary building certification – Green Mark – in 2006. It provides an environmental rating of buildings based on a number of criteria, including energy efficiency. New and retrofitted buildings with a gross floor area above 5 000 m2 that achieve ratings of Green Mark Gold or above can benefit from monetary incentives.

The Green Mark was used as the basis for Singapore's mandatory building energy code (the 2008 Building Control Act). It was revised in 2013 and came into force in January 2014, introducing the requirement for existing buildings to comply with the minimum environmental sustainability standard (Green Mark Standard), submit energy efficiency audits of cooling systems periodically, and provide information on energy consumption. In 2015, the Green Mark was introduced to improve further the environmental sustainability of building envelopes.

South Africa set a new policy, SANS 1544, to audit and provide an energy performance certificate for all government buildings every three years. This policy included capacity building of a new auditor industry with 2 000 planned new auditors. Private sector buildings are not required to get certification; however, the expanded auditor industry and the Green Star programme, administered by the South Africa Green Building Council, is enabling more voluntary certifications.

»KEY SUSTAINABLE BUILDING TECHNOLOGY SOLUTIONS

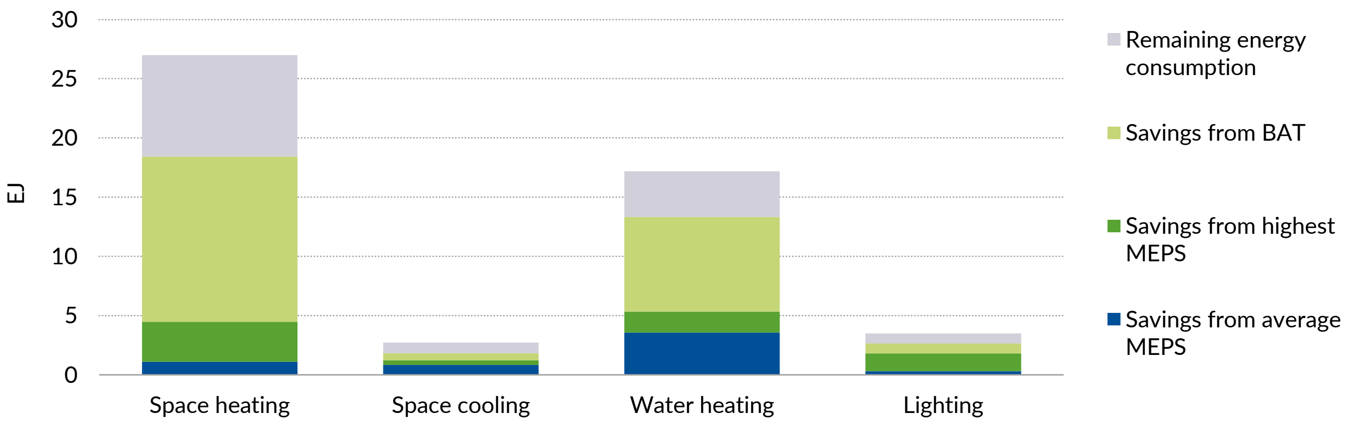


Two-thirds of global building energy use is still not subject to minimum energy performance standards (MEPS)[25]. Globally, the energy savings potential in 2015 would have been of the order of 6 EJ (1.67 x 106 GWh), or 6% of global residential energy consumption, had average standards been implemented across all countries for space cooling, space heating, water heating and lighting. Implementing the highest current minimum energy performance standards globally would have saved 13 EJ (3.6 x 106 GWh), or nearly 15% of global residential energy consumption. If best available technology (BAT) had been installed globally, the savings would have result in savings of more than two-thirds.

Key point

Existing technologies can save more than two-thirds of major end-use energy consumption in buildings.

Figure 10 **Energy savings in 2015 if all installed stock had met minimum energy performance standards**



Note: Estimates do not take into account product lifetimes or saturation rates in the energy savings potential.
Source: IEA (2016), Energy Efficiency Market Report 2016.

25 *IEA (2016) Energy Efficiency Market Report 2016, IEA/OECD, Paris.*

Table **IEA recommendations on global building technology policy**[26]

Policy action area	*Near-term action (through 2025)*	*Long-term objective (2025 to 2050)*
Whole building systems	Enforce building energy codes in all regions and strive for near zero-energy buildings (nZEBs) in new construction. Implement policies to drive uptake in deep energy renovation in existing buildings.	Develop advanced building energy codes in all regions with high energy performance standards (e.g. nZEBs or better) for all new construction and low-energy targets for existing buildings.
Building envelope	Promote very high performance envelopes, including air sealing, insulation, highly insulating windows and cool roofs. Include requirements for building envelopes in mandatory building energy codes.	Achieve highly insulated, integrated building envelopes (e.g. nZEBs or better) at negative life-cycle cost. Mandate minimum energy performance for building envelope components through enforceable building energy codes[27].
Space heating and cooling equipment	Increase promotion of solar thermal and heat-pump technology. Prohibit the use of electric resistance heaters as main heating source in buildings. Mandate minimum performance standards above 120% efficiency for heating equipment and above 350% for cooling equipment.	Achieve integrated energy solutions for heating and cooling with net-zero emissions. Pursue low-cost solar cooling technologies. Mandate minimum performance standards above 150% efficiency for heating equipment and above 400% for cooling equipment.
Water heating	Encourage uptake of heat-pump water heaters or instantaneous systems. Continue R&D on low-cost solar thermal systems.	Mandate minimum performance standards < 150% efficiency for electric equipment. Achieve solar thermal systems that meet ≥ 75% annual water heating load.
Lighting	Ban all traditional incandescent and halogen light bulbs. Continue R&D and promotion of solid state lighting (SSL) and other innovative designs.	Implement minimum lighting energy performance criteria above 100 lumens/ watt.
Appliances and cooking	Mandate minimum energy performance standards for appliances and equipment to achieve clean, energy-efficient cooking solutions.	Bring to market highly efficient appliance technologies and mandate minimum energy performance standards for all electric plug-loads.

26 Adapted from IEA (2016), Energy Technology Perspectives 2016, IEA/OECD, Paris.
27 For more information on building envelope technologies, R&D and energy performance targets, see www.iea.org/publications/freepublications/publication/technology-roadmap-energy-efficient-building-envelopes.html.

Figure 11 **Energy efficient technologies and trends**

USA, Los Altos | e+ Office

David and Lucile Packard Foundation

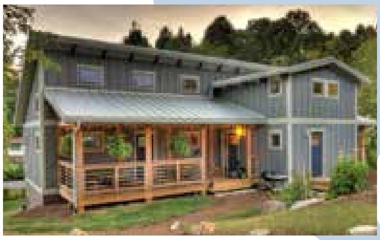
High Performance Envelope: The design team selected triple-paned windows in order to reduce the thermal bridges throughout the envelope.

Climate Responsive Cooling: A cooling tower provides chilled water to a storage tank that is passively cooled during the night. The water is circulated throughout the building to chilled beam exchangers.

Daylighting: By configuring two narrow office wings around a central courtyard the design team maximized the building's daylighting potential.

© Velux

Single Family House / France



© Vandemusser Design

Single Family House
North Carolina, USA

Israel, Ramat-Gan

NZEB Residential / ***Team Israel***

Building-integrated photovoltaics designed for climate control and vertical solar harvesting. Designed to maximise entry of indirect natural sunlight.

© William SheHall

Leon County Extension / Florida, USA

Brazil, San Paulo | NZEB-Stadium

Estádio Nacional

Stadium includes strip of solar panels encircling the roof, which is semitransparent, allowing natural light to filter through to reduce lighting costs.

© Crossways Farm Village

House Rhino / South Africa

Denmark, Solhuset | e+ School

Solhuset (The Sun House)

Building Design: Shape, orientation and windows are optimised in relation to the plot and the sun to make maximum use of daylight and solar heat throughout the day and year.

Renewable Energy: A combined solar and geo-thermal system provides the necessary energy for space heating and hot water while solar cells convert solar energy into electricity.

China, Shanghai | e+ Residential

Passive Design: Strict design of thermal insulation performance, and an outside facade for increased shading coefficient.

Energy System: The energy system includes a solar collector system, the HVAC&DHW system, an indoor terminal unit (heat recovery ventilator) and the renewable energy power system.

India, New Delhi | NZEB Office

Indira Paryavaran Bhavan

Solar passive design: The design reduces heat ingress in building envelope and allows for 75 % of natural daylight to be utilised to reduce energy consumption.

HVAC: Energy-efficient chilled beam system of air-conditioning and geothermal heat rejection for the cooling towers of HVAC system.

Renewable Energy: On site solar photovoltaic cells to meet total energy demand

Two stall office building

© University of Wollongong

Illawarra Flame / Australia

© United Nations Environment Programme

UN Environment Headquarters / Nairobi, Kenya

Key point

Net-zero energy and energy-positive buildings are applicable in various locations, climate zones and building types, often at low additional costs and demonstrating high levels of building energy performance through energy efficiency measures and integration of renewable energy supply.

» INVESTMENT AND FINANCE TO ENABLE TRANSFORMATION

Total spending on energy-efficient products and services in buildings was USD 388 billion[28]. Incremental energy efficiency investments in buildings, including appliances and lighting was USD 118 billion in 2015. This is less than 8.5% of the USD 4.6 trillion spent on construction and renovations of new and existing buildings globally. The building envelope, primarily with insulation and windows, accounts for the largest share of investments in building energy efficiency at USD 237 billion.

Overall, there is increasing evidence that points to the positive links between a buildings sustainability and financial performance. For instance, a study commissioned by ClimateWorks Foundation on the role of energy efficiency in reducing abatement cost to achieve a below 2°C target at global level showed that cumulative energy savings of USD 2.5 to 2.8 trillion (constant 2005) could be achieved by 2030[29].

Yet, to date, sustainability data, such as building energy efficiency performance, remain insufficiently considered in risk assessments and for resulting investment decisions. A crucial reason for this is that existing data on sustainability performance is often not considered as a reliable and accurate proxy for a building's actual performance. Current regulatory and voluntary standards, labels and third party verification also do not typically provide enough indication on the underlying information's reliability.

The resulting uncertainty of currently available data cannot create the chain of trust that is needed for investments and loans to be directed at the sustainable and energy-efficient buildings and construction market. An improved investment process with reliable, trusted tools to assess building sustainability is needed and should include collaboration with the end-users of this process (e.g. risk managers) to increase the availability, transparency and quality of the data through a qualitative assessment on the extent to which the data captures the actual building performance.

Once quality information on building performance and investments is made available, it can be connected to financial analysis, evaluation and risk assessment methods to enhance the systematic integration of sustainability indicators into real estate financing decisions in the investment, banking and insurance industries. Over time, this improved process will lead to higher levels of data availability, data quality and improved confidence in relation to both the financial and energy performances of building investments.

Defining, deploying and implementing a robust policy framework to encourage energy efficiency deployment and investments in low-carbon buildings are essential. Sound policy frameworks need sound baseline data, strong understanding of the construction value chain, specific technical instruments (e.g. standards on construction materials, testing & certification, etc.) and training of multiple actors, from architects to construction workers. All of these come with a cost.

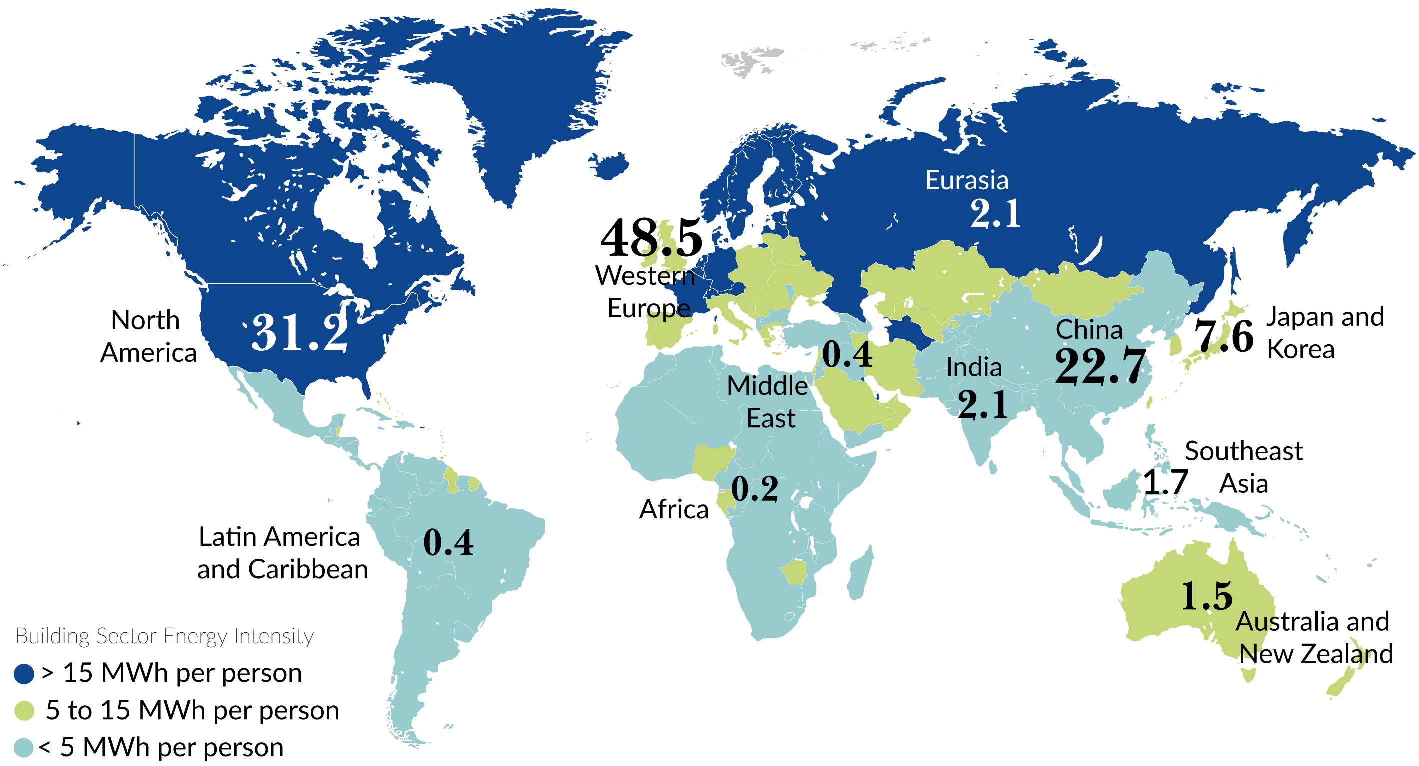
Technical assistance is essential to support capacity building, and global funds are ideally positioned to provide the funding for energy efficiency needed to transform the buildings and construction sector. Increased funding for energy efficiency in buildings and to enable tracking on global progress are also needed.

To accelerate investment in energy efficiency in the building sector, the Environmental Defense Fund and the Green Business Certification Inc. recently set a strategic vision to develop, deliver and promote the Investor Confidence Project[30] as the premier global underwriting standard for energy efficiency projects.

Building on an existing body of empirical evidence regarding the link between a building´s environmental performance levels and financial performance and on available professional guidance, the RenoValue

28 *IEA (2016) Energy Efficiency Market Report 2016, IEA/OECD, Paris.*
29 *Fraunhofer (2015), How Energy Efficiency Cuts Costs for a 2-Degree Future, Karlsruhe, Germany.*
30 *www.eeperformance.org*

Figure 12 **Energy efficiency investment by region, 2015 (USD Billion)**



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consortium[31] has developed dedicated capacity building material for real estate assessors on how to reflect energy efficiency and renewable energy features within valuation reports to raise awareness and demand amongst their clients. Originally funded by the Intelligent Energy Europe Programme and covering seven EU member states, the consortium is now rolling out the training a globally through strategic partnerships, starting with adaptation of the material in Australia.

The International Partnership for Energy Efficiency Cooperation (IPEEC) Energy Efficiency Finance Task Group has also developed Voluntary Energy Efficiency Investment Principles[32] that provide a high-level framework for enabling policies that are essential for enhancing capital flow to energy efficiency investments. These principles were welcomed by energy ministers and are embedded in the 2016 G20 Energy Efficiency Leading Program.

To date, investors with a cumulative USD 4 trillion under management have signed the G20 Energy Efficiency Investor Statement, recognising the need to fully embed energy efficiency into their investment process. 117 banks have also signed the Statement by Financial Institutions on Energy Efficiency, thereby pledging to work towards increasing energy efficiency financing.

31 www.renovalue.eu
32 IPEEC (2016), Voluntary Energy Efficiency Investment Principles for G20 participating countries, Paris.

» PATHWAYS TO SUSTAINABLE BUILDINGS

Building sector energy demand is expected to increase by 50% by 2050[33]. Even with announced policy measures to increase the energy efficiency across end-use technologies (e.g. heating and cooling equipment, lighting and appliances), global building energy consumption is still expected to grow to nearly 160 EJ (44.4 x 106 GWh) in 2050 (30% higher than 2013).

There is no below 2°C scenario without a full mobilisation of low-carbon action in the building and construction sector. Effective action to improve building energy efficiency is needed to limit building energy demand to 2013 levels.

There are opportunities to bring buildings and construction on a low-carbon pathway in every economy, particularly through:

- Improved adoption and enforcement of building energy codes for new building construction are critical to curb space heating and cooling energy demand growth, especially in developing countries and emerging economies.
- Assertive measures to address the energy performance of existing buildings will be critical to achieve below 2°C ambitions, especially in developed countries.

Under a 2°C trajectory or below, global energy savings in the building sector would reach 55 EJ (15.3 x 106 GWh) in 2050, equivalent to the total final energy consumption for nearly all of Africa, the Middle East and Latin America in 2014. Those savings would lead to an 85% reduction in total global building energy-related CO_2 emissions in 2050 – or a potential cumulative savings of 84 gigatonnes of CO_2 ($GtCO_2$) from energy efficiency, fuel switching and renewable measures in buildings. When paired with increased investments in low-carbon power generation, those cumulative saving are nearly 250 $GtCO_2$.

Energy efficiency measures in the building sector will play a key role in supporting carbon abatement in the power sector, representing more than one-third of the total[34] CO_2 emissions reduction to 2050 related to the global building sector. Those energy efficiency improvements also play a vital role in reducing capacity and investment needs in power generation[35].

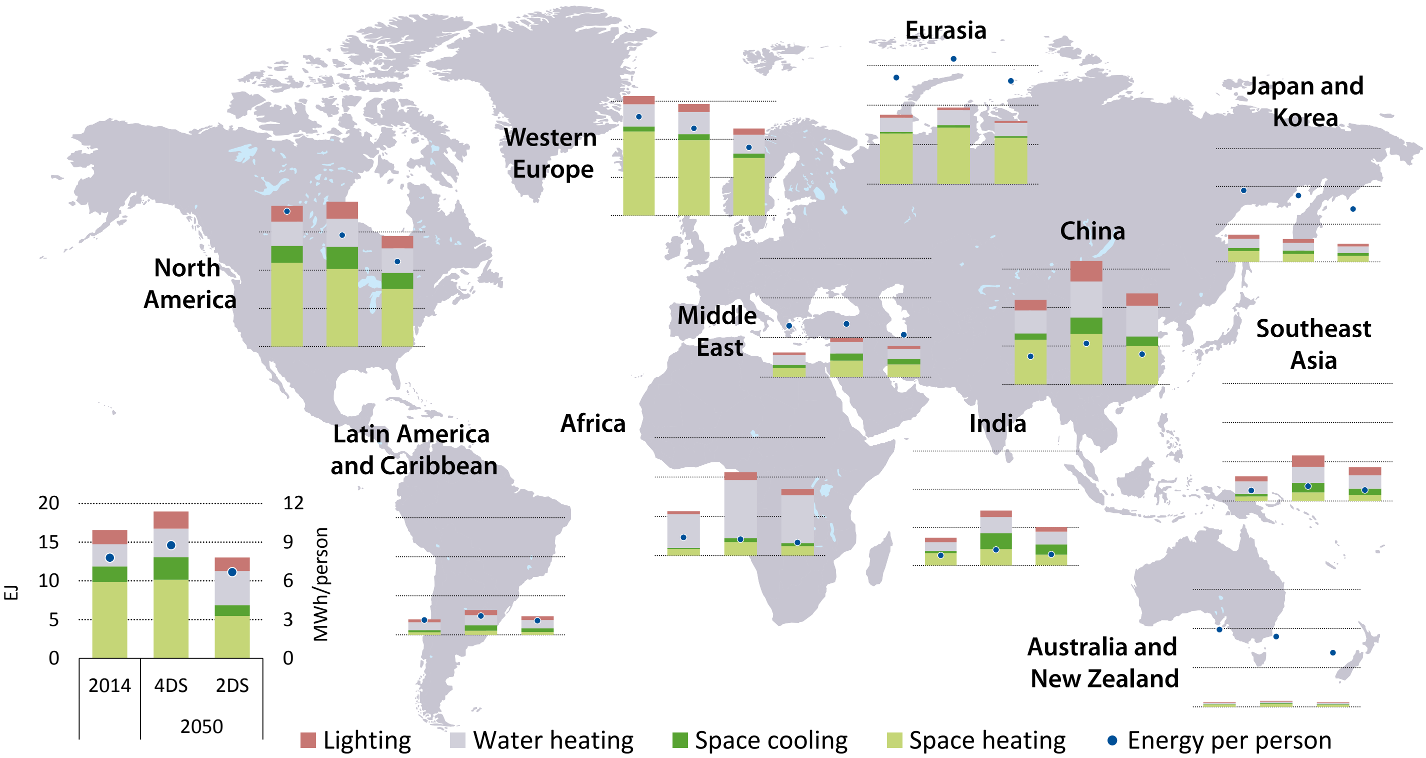
Capturing the enormous energy and emissions saving potential in the global building sector would deliver a broad range of benefits, including lower electricity and fuel costs for businesses and households, greater reliability in meeting energy demand without costly infrastructure and vulnerability to grid disruptions, and reductions in GHG emissions and other pollutants that pose a threat to human health.

84 $GtCO_2$

Cumulative global emissions savings potential in the global building sector from measures in buildings.

33 IEA (2016), *Energy Technology Perspectives 2016*, IEA/OECD, Paris.
34 This includes direct emissions as well as indirect emissions from power generation for electricity and commercial heat consumption in the building sector.
35 IEA (2016), *Energy Technology Perspectives 2016*, IEA/OECD, Paris.

Figure 14 **Global building sector final energy consumption (EJ) and energy intensity per person (MWh/person) by carbon scenario**



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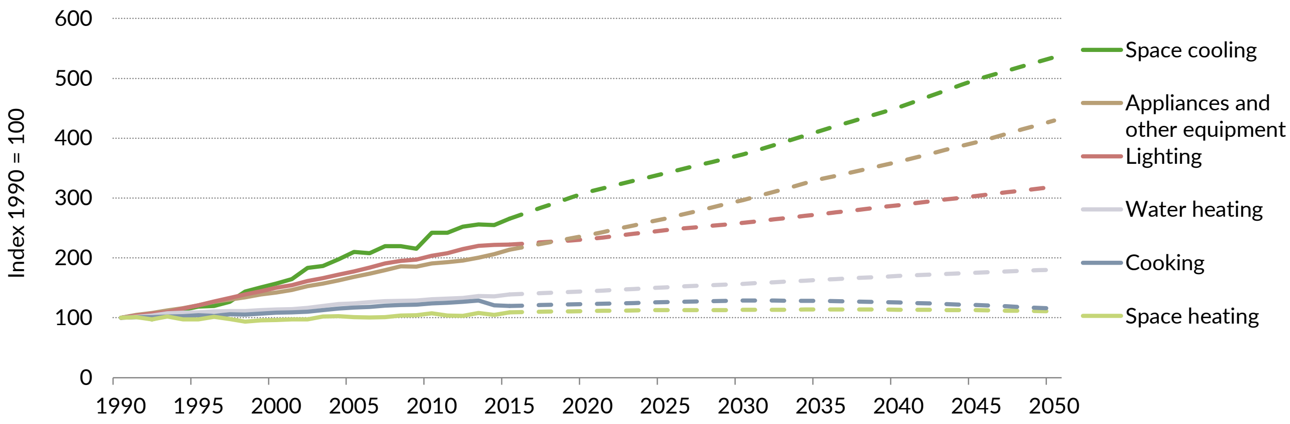
Note: Final energy demand represents energy consumption for space heating, water heating, space cooling and lighting in buildings. It does not include cooking, appliances or other building energy services. The 4°C scenario (4DS) represents a global energy and emissions trajectory that takes into account recent pledges by countries to limit emissions and improve energy efficiency, which help to limit average global temperature rise to below 4°C. The 2°C scenario (2DS) lays out an energy systems deployment pathway and emissions trajectory that is consistent with a 50% change of limiting average global temperature increase to 2°C.

Source: IEA (2016), Energy Technology Perspectives 2016, www.iea.org/etp.

Key point

Global building energy use is expected to increase by another 30% over 2013 levels, despite announced policy measures to increase energy efficiency in buildings. Assertive action is needed to address the energy performance of both new and existing buildings as well as the efficiency of energy-consuming equipment.

Figure 15 **Global buildings sector end-use energy consumption, 1990-2050**



Note: Index represents change in final energy demand for building sector end-uses.

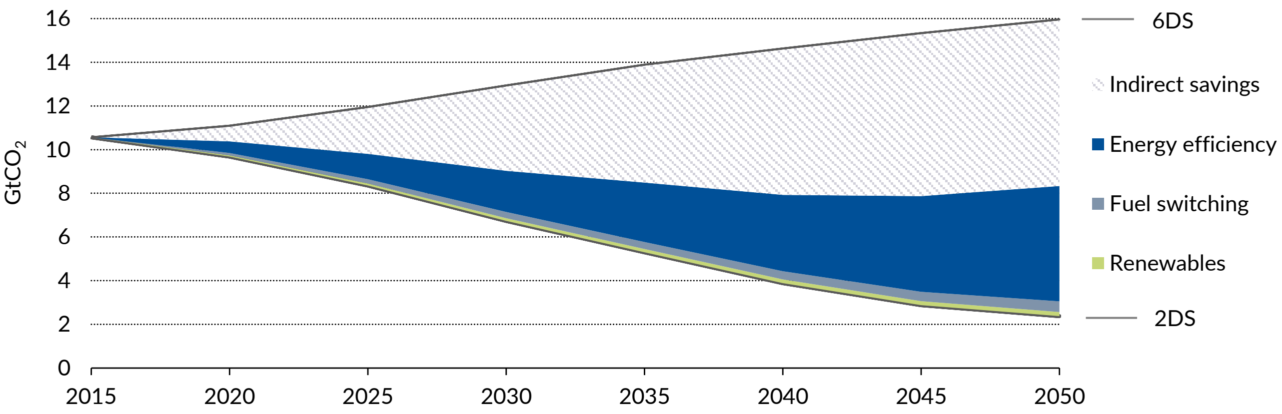
Key point

Space cooling has been and will continue to be the fastest growing building end-use to 2050.

To achieve this important ambition, policy action is needed to promote building energy efficiency measures and to ensure that they are standard practice across the global building market.

Governments need to work together and with key stakeholders to ensure that manufacturers, building designers, constructors, owners and occupants all maximise energy efficiency potential and limit the costs of future change by taking action today, particularly as most buildings and many building technologies have long lives. This is especially true in rapidly emerging economies, where there is a window of opportunity to ensure construction of high-efficiency new buildings over the coming decades. Significant effort is also needed now to promote deep energy renovations of existing buildings, especially as it may take ten to 15 years in some markets to ensure that deep energy renovation measures are viable, cost-effective and standard practice.

Figure 16 **Global building sector emissions saving potential to 2050**



Note: Indirect savings represent CO_2 emissions reduction from power generation for electricity and commercial heat in the building sector.
Source: IEA (2016), Energy Technology Perspectives 2016, www.iea.org/etp.

Key point

The global building sector has enormous potential to reduce energy-related GHG emissions, especially through energy efficiency measures that will support decarbonisation of the power sector.

» KEY FINDINGS

This Global Status Report reconfirms the significance of building energy consumption as a contributor to global GHGs. It also shows that efforts to decarbonise the building sector through the implementation of comprehensive policy frameworks and the deployment of existing energy-efficient technologies and building design approaches can deliver positive economic, social, health and environmental benefits.

The effective implementation of building energy policies, technologies and efficient building designs and renovations relies on reliability and accessible data as a basis for decision-making, technical-professional capability and increasing the level of awareness and demand for energy-efficient and low-carbon buildings.

Some progress is being made, however the pace and scale of actions does not match the need nor urgency of the challenge. To realize the potential of the sector requires policy, technology and finance measures which will accelerate efforts in all regions.

1. Increased deployment of building energy **codes and policies,** along with increased use of energy-efficient technologies, has helped to offset increases in total building energy consumption since 1990, despite the huge increase in the global built area. However, global building energy consumption per capita has remained practically unchanged in that period. This requires further effort in policies that spur technology improvements as well as behavioural changes of building owners and users.

2. Harnessing the energy savings and GHG mitigation potential of the building sector is recognised as essential to achieving and exceeding the climate goals of **NDCs** and non-state actors. 88 countries to date have recognised the role of the building and construction sector in their INDCs. Although, this still represents only about half of all nations.

The NDCs provide a unique opportunity for countries to set actions and targets for improvement of energy efficiency in the building sector. Governments should ensure these actions and targets are reflected in national policies.

More needs to be done to encourage all countries to engage the building and construction sector in implementing NDCs.

3. **Investment** in energy-efficient buildings is increasing rapidly, but to scale up funding, more needs to be done to further strengthen the existing evidence base of building energy performance and return on investments. More systematic capture and management of quality data is necessary to give investors the needed confidence to double current levels of investment by 2030 and to bridge the investment gap necessary to achieve a below 2°C target.

This Global Status Report identifies the necessity for global funds, such as the Green Climate Fund and development banks, to increase funding for quality, high-impact projects. Financing for capacity building and market development is also needed to move an efficient, low-carbon buildings and construction market forward.

4. Actors beyond national governments have a critical role to play, in partnership or concertation with the former. **Many cities and businesses** are already committed to achieving ambitious building energy and climate goals. More can be done to facilitate the engagement of the public and private sectors in local markets to develop market transformation action plans that support NDCs.

5. In addition to energy efficiency, it is critical to incorporate renewable energy and the **full array of climate mitigation and adaptation strategies** in building policies and commitments.

6. We have a **unique window of opportunity.** Given the fast pace of urbanisation and the longevity of buildings, failing to address building energy use, or setting only moderate energy and climate mitigation goals, will lead to a lock-in of higher-than-necessary energy demand and emissions from buildings and construction. This also risks locking in poor access to energy services and sustainable energy, which in turn undermines the achievement of sustainable development goals.

The next stage for countries, relevant local authorities and non-state actors is to fully detail a **roadmap** that engages the building sector in achieving and exceeding climate goals communicated in their NDCs. A number of supporting actions have been identified in this report that are needed to enable implementation pathways and roadmaps to sustainable buildings and construction that contribute to meeting the below 2°C target. These are:

1. Subscribe to a common Global Roadmap paving the way for transition towards low-energy, low- GHG and resilient buildings in line with the well below 2°C target, while also framing and/or facilitating the collaboration of countries and non-state actors of the building sector.

2. Develop and implement comprehensive policy-packages, involving all stakeholders, that incorporate ambitious energy performance requirements in building codes, together with complimentary incentive measures and voluntary programs that drive demand and build the capacity to deliver near- or net-zero energy in new buildings or at a system level in a cost-effective manner, and increase demand for deep energy retrofitting of existing buildings.

3. Increase finance and funding available to jurisdictions engaging in transformative building sector climate actions, notably for capacity building and technical assistance, such as those noted Pathway to Sustainable Buildings highlighted in this report, through international climate finance incentives, regulations and mechanisms such as the Green Climate Fund and development banks.

4. Mainstream sustainable building education & training. Curriculum for sustainability and/or energy efficiency is more frequently offered in professional degrees and building trade education. However, the impact of this curriculum on professional or trade practices is not always evident in building and construction activity. Sustainable building education and training must be structured as a life-long learning and should be required in continuing professional development programmes. The UN Environment Policy Guide to Sustainable Building Education provides policy and learning strategies for both formal and informal education.

5. Build an evidence base. There is no shortage of information and knowledge published on- and offline by researchers and practitioners regarding building energy and climate policy and goals. However, despite the significant body of research findings demonstrating positive impacts of sustainable performance, the quality of information or data on the performance of buildings needs to be standardised. Improving transparency in the measurement, reporting and verification of the impact of policies and other climate actions is necessary to support investors and financiers. Currently, the evidence base in the built environment is diffused and not specifically targeted to key stakeholder groups. This must be addressed.

6. Track contributions made by the building sector to keep global warming well below 2°C. Building sector progress toward achieving its significant energy and CO_2 mitigation potential is critical to monitoring global progress toward keeping global warming well below 2°C. In this regard, the indicators set out in this Global Status Report and in the Global Roadmap are a base for discussion to design a reporting framework by countries and relevant non-state actors, which should be monitored and communicated through subsequent Global Status Reports.

Members worldwide

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Ministère de l'Environnement, de l'Énergie et de la Mer

Global Alliance for Buildings and Construction

GBPN Global Buildings Performance Network

iea International Energy Agency Secure Sustainable Together

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