



Global Alliance
for Buildings and
Construction



2020 GLOBAL STATUS REPORT FOR BUILDINGS AND CONSTRUCTION

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



2020 GLOBAL STATUS REPORT FOR BUILDINGS AND CONSTRUCTION

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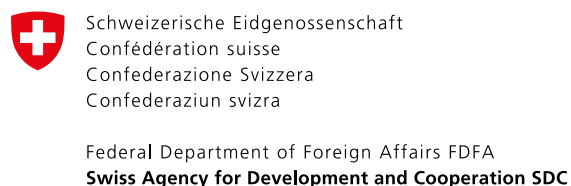
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FOREWORD





ABOUT THE GLOBAL ALLIANCE FOR BUILDINGS AND CONSTRUCTION (GLOBALABC)

Founded at COP21, hosted by the United Nations Environment Programme (UNEP) and with over 150 members, including 30 countries, the GlobalABC is the leading global platform for governments, private sector, civil society, research, and intergovernmental organizations committed to a common vision: A zero-emission, efficient and resilient buildings and construction sector.

The GlobalABC is a voluntary, international, multi-stakeholder partnership. It aims to serve as the global collaborative umbrella organisation for other platforms, initiatives and actors to create synergies between them, and increase scale, pace and impact of climate action towards decarbonization of the buildings and construction sector in line with the Paris Agreement goals. The GlobalABC aims at mobilising ambitious levels of international resources for efficient local operational solutions, aligning existing initiatives, commitments and programmes to achieve greater scale, and catalysing greater pace and impact of climate action in the buildings and construction sector.

The GlobalABC aims to:

- ▶ Be a global advocate for the importance of the sector for global climate action, provide a common language for discussion among decision makers and be a catalyst for action by leading actors in the buildings and construction sector.
- ▶ Provide an objective and trusted platform to set targets for decarbonisation, track progress, track action and share knowledge and good practices.
- ▶ Suggest key measures for countries to adopt, supporting them in setting priorities in their own strategies, based on their situation, e.g. using the GlobalABC regional and national roadmaps (see also section 7).

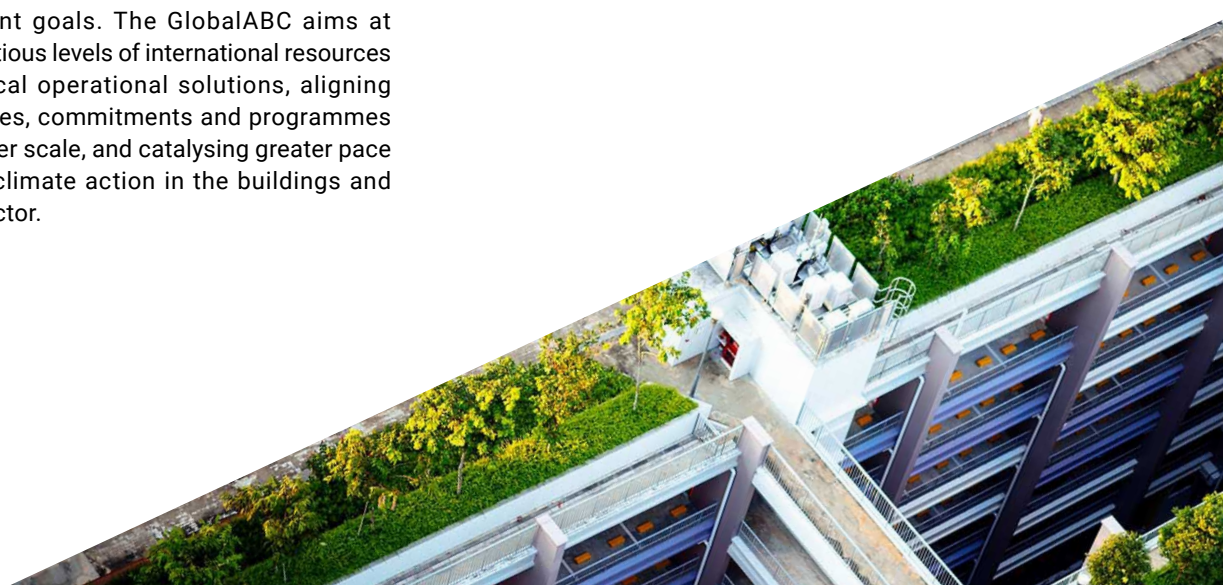


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EXECUTIVE SUMMARY

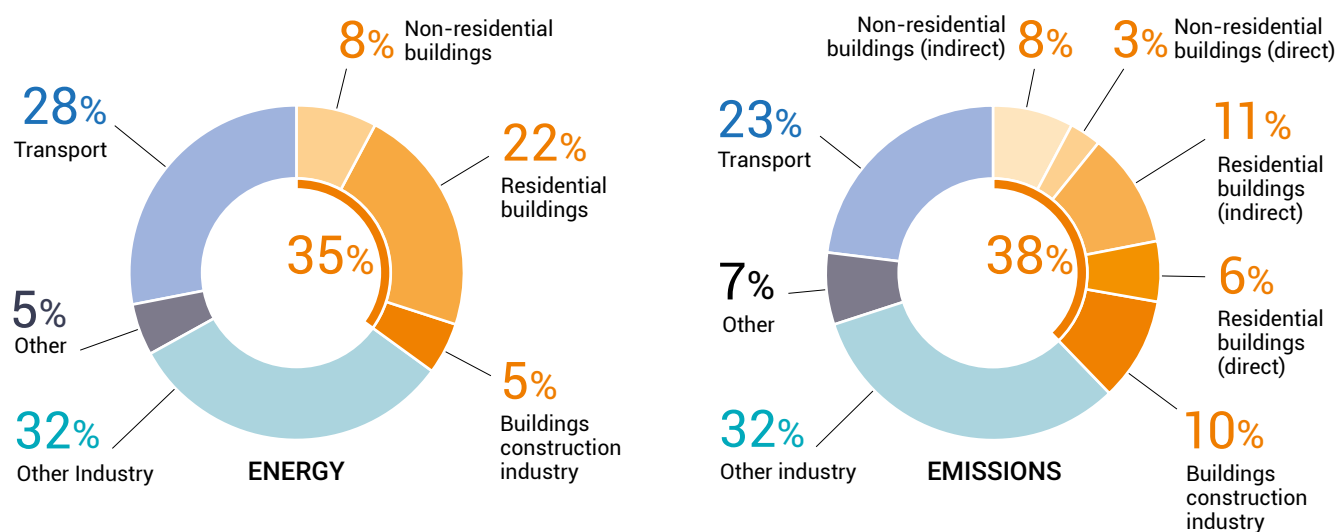
TRENDS OF 2019

CO₂ emissions from the building sector are the highest ever recorded.

While the total final energy consumption of the global buildings sector remained at the same level in 2019 compared to the previous year, CO₂ emissions from the operation of buildings have increased to their highest level yet at around 10 GtCO₂, or 28% of total global energy-related CO₂ emissions. With the inclusion of

emissions from the buildings construction industry, this share increases to 38% of total global energy-related CO₂ emissions. The slightly lower proportion of buildings emissions compared with the 39% seen in 2018 was due to the increases in transport and other industry emissions relative to buildings.

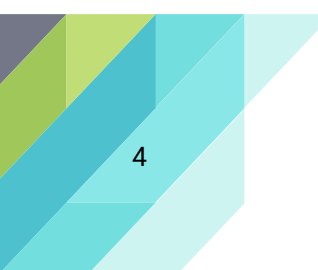
Global share of buildings and construction final energy and emissions, 2019



Notes: Buildings 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: (IEA 2020d; IEA 2020b). All rights reserved. Adapted from "IEA World Energy Statistics and Balances" and "Energy Technology Perspectives".

The buildings sector emission increase is due to a continued use of coal, oil and natural gas for heating and cooking combined with higher activity levels in regions where electricity remains carbon-intensive, resulting in a steady level of direct emissions but

growing indirect emissions (i.e. electricity). Electricity consumption in building operations represents nearly 55% of global electricity consumption.

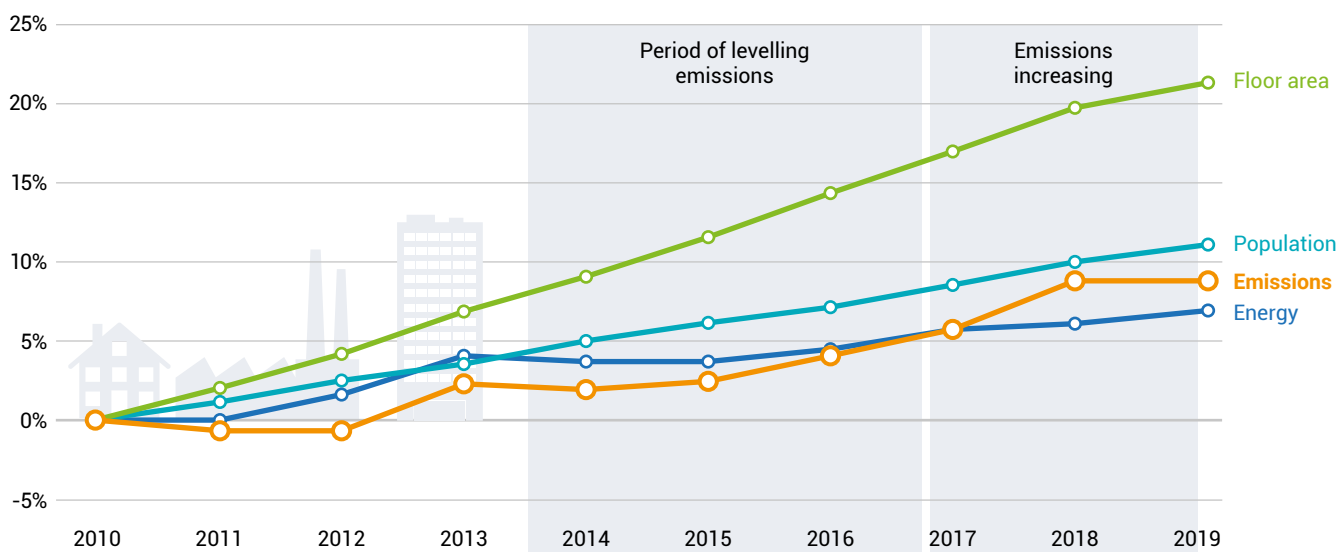


This underlines the importance of a triple strategy to aggressively reduce energy demand in the built environment while decarbonising the power sector and implementing materials strategies that reduce lifecycle carbon emissions, which together will drive down both energy demand and emissions.



Change in global drivers of trends in buildings energy and emissions 2010-2019

Change in growth since 2010



Source: IEA (2020b). All rights reserved. Adapted from "Energy Technology Perspectives 2020"

To be on track to achieving a net-zero carbon building stock by 2050, the IEA estimates that direct building CO₂ emissions would need to decrease by 50% and indirect building sector emissions decline through a reduction of 60% in power generation emissions

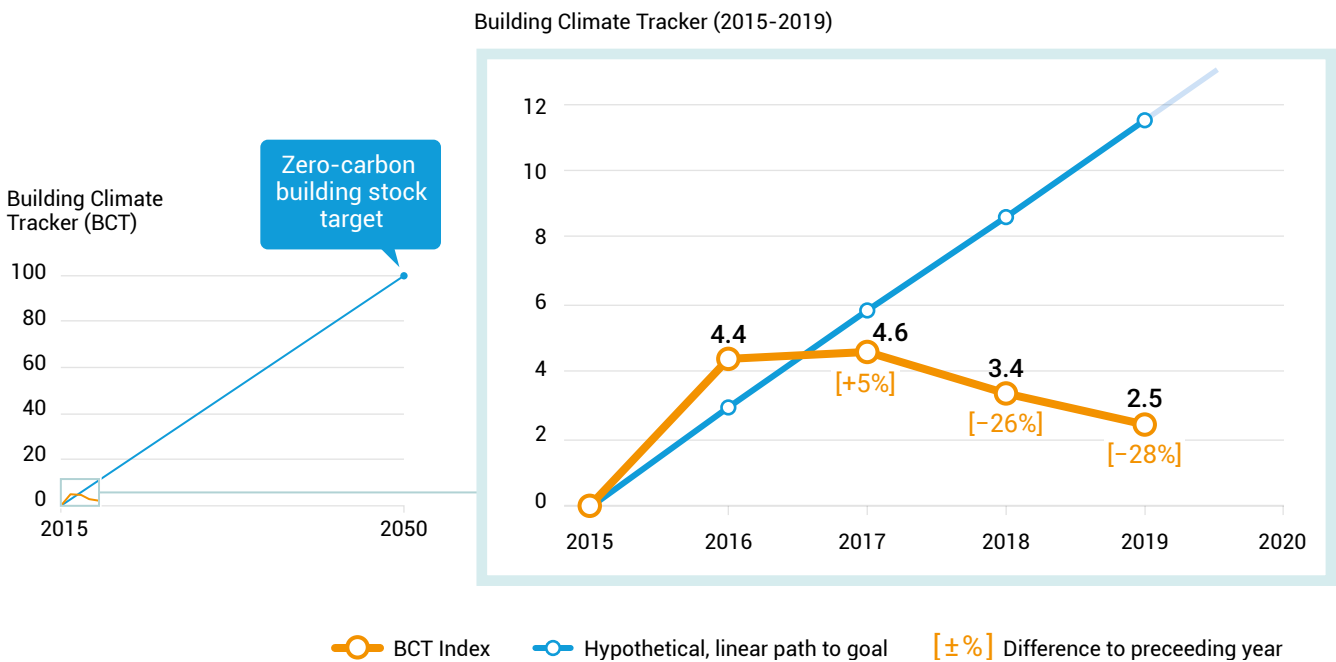
by 2030. These efforts would need to see building sector emissions fall by around 6% per year from 2020 to 2030. For comparison, the global energy sector CO₂ emissions decreased by 7% during the pandemic.

New GlobalABC tracker finds sector is losing momentum towards decarbonisation.

The GlobalABC's new Buildings Climate Tracker (BCT) tracks the sector's progress in decarbonisation worldwide. It uses data from seven global indicators (including incremental energy efficiency investment in buildings and Nationally Determined Contributions (NDCs) with building sector actions) to show progress since 2015 in an index, comprising indicators on actions and impact. The index finds that annual decarbonisation progress is slowing down and has, in fact, almost halved from 2016 to 2019. While the number of building sector CO₂ emissions reduction

actions are growing, the rate of annual improvement is decreasing. To get the buildings sector on track to achieving net-zero carbon by 2050, all actors across the buildings value chain need to contribute to the effort to reverse this trend and increase decarbonization actions and their impact by a factor of 5.

Buildings Climate Tracker (BCT): Decarbonisation index trend for buildings and construction



This Buildings Climate Tracker (BCT) is comprised of the following seven indicators: Incremental energy efficiency investment in buildings (global, \$bn); Building Energy Codes (number of countries); Green Building Certifications (cumulative growth); NDCs with building sector action (Number of Countries); Renewable Energy Share in Final Energy in Global Buildings (%); Building Sector Energy unit Intensity (kWh/m²); CO₂ emissions.

Nationally Determined Contributions, countries' long-term strategies and key regulatory measures are needed to spur faster and more ambitious action at scale.

Most countries have yet to submit their second NDC, and buildings remain a major area that lacks specific mitigation policies despite its importance to global CO₂ emissions. Of those who have submitted an NDC, 136 countries mention buildings, 53 countries mention building energy efficiency, and 38 specifically call out building energy codes, indicating the importance of building energy efficiency to our climate future. More buildings than ever are being constructed using building codes and sustainable certification standards. However, these need to be strengthened and expanded to increase action towards a zero-carbon building stock. Of surveyed countries, four are planning new or strengthened codes from 2021. There is significant opportunity to make use of codes, standards, and certification that drive towards zero-carbon emissions across the sector.

Investment in energy efficiency in buildings is picking up again but the speed of change lags behind overall building construction investment.

Spending for energy efficient buildings has shown an increase in 2019 for the first time in the past three years, with investment in building energy efficiency across global markets increasing to USD \$152 billion in 2019, an increase of 3% from 2018. However, this remains a small proportion of the USD \$5.8 trillion spent in the building and construction sector. Investment in energy efficiency hence lags behind investment in the sector as a whole and therefore more effort is needed to decarbonize buildings. Indeed, in the buildings sector, for every \$1 spent on energy efficiency, \$37 is spent on conventional construction approaches.



Yet, there are positive signs across the investment sector that building decarbonization and energy efficiency are taking hold in investment strategies. Finance institutions and property companies are realizing the strong growth potential and investment opportunities available with sustainable building investment. For example, of the 1,005 real estate companies, developers, REITS, and funds representing more than \$4.1 trillion in assets under management that reported to The Global ESG Benchmark for Real Assets (GRESB) in 2019, 90 percent align their projects with green building rating standards for construction and operations. Indeed, green buildings represent one of the biggest global investment opportunities of the next decade, estimated by the International Finance Corporation (IFC) to be \$24.7 trillion by 2030.

Governments play an important role in unlocking this opportunity, especially now. While the global pandemic brings many challenges, it also presents a moment for a paradigm shift: i.e. by systematically including building decarbonization measures into recovery packages, they can dramatically increase renovation rates, channel investment into zero-carbon buildings, provide jobs, and increase real estate value.

Buildings decarbonization commitments are growing. But they need to rapidly increase in scale and pace to achieve the Paris Agreement Goals.

Strategies to make buildings net-zero energy and zero-carbon are a key part of the global decarbonisation strategy and must become the primary form of building construction across all economies to achieve net zero emissions by 2050. Such initiatives include the World Green Building Council's *Net Zero Carbon Buildings Commitment* (Six sub-national states, 27 cities, and 79 businesses have committed to net zero buildings



operations by 2050 or earlier); the World Business Council for Sustainable Development's *Building System Carbon Framework*; the C40's *Clean Construction Forum*; Architecture 2030's *Achieving Zero*; the *Science-based target initiative for business* (with 1000 companies having signed up to reduce carbon emissions beyond their own operations by including other indirect carbon emission in their carbon reduction action plans); and many more.

Further, in 2020, GlobalABC published the *Regional Roadmaps for Africa, Asia, and Latin America for Buildings and Construction* which outline targets, timelines, and key actions needed to achieve a zero-emission, efficient, and resilient building stock between now and 2050 across the globe. These, alongside the above commitments, need to be implemented as part of the effort to a net-zero carbon building sector.

IMPACTS OF COVID-19 IN 2020

The impact of COVID-19 on the global construction industry has been severe and construction activities have dropped by 10–25% compared to 2019.

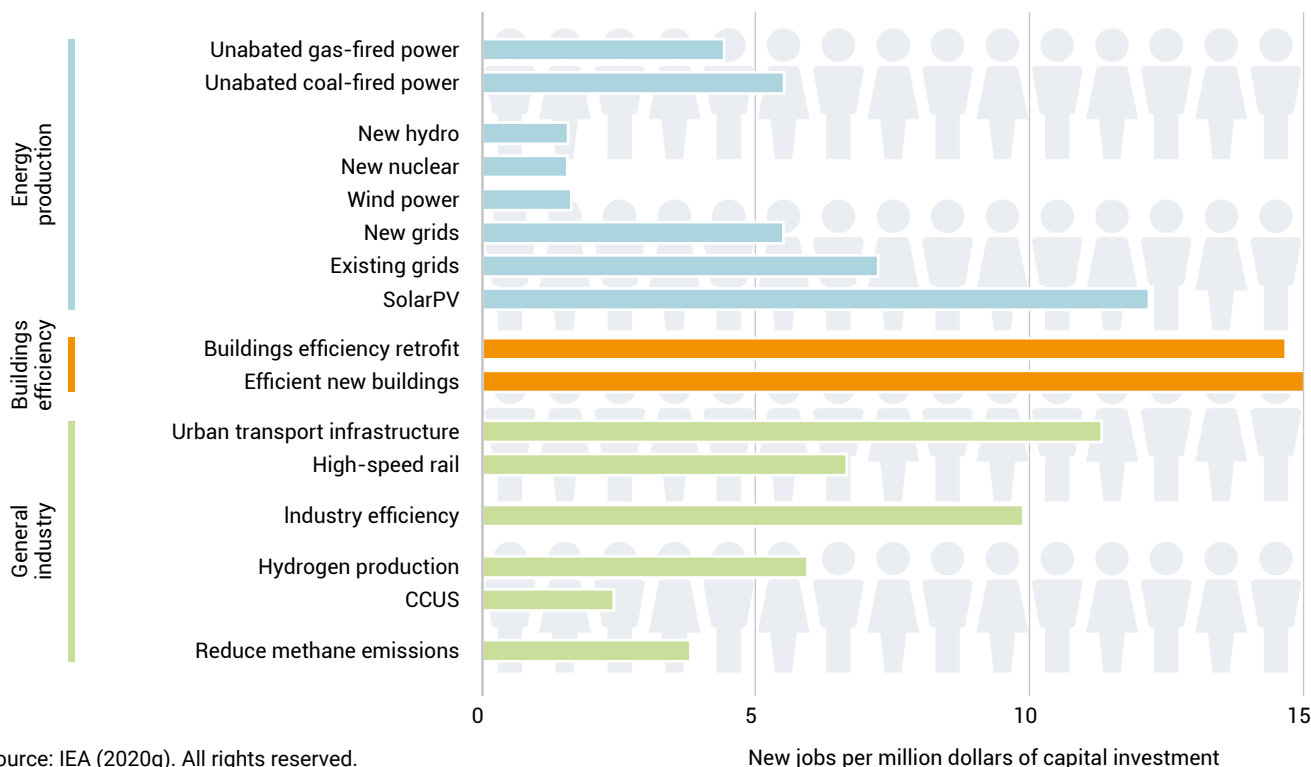
This marks a significant impact on construction with 10% of overall jobs being lost or at risk across the building construction sector. The latest estimates anticipate a drop of 6% in construction market value from 2019 levels. The IEA estimates that global energy demand and CO₂ emissions will have decreased by 5% and 7% respectively as a result of the global COVID-19 pandemic.

The global health crisis comes on top of a housing crisis, which it risks further destabilizing. While COVID-19 has impacted construction, healthy, adequate, and affordable buildings in their turn are essential for responding to the pandemic and for people's overall health. In 2018, it was estimated by the UNDP that 1.8 billion people live in inadequate housing including slums and informal and/or overcrowded settlements, making adequate hygiene, lockdowns, and social distancing challenging, thus exacerbating

the crisis. Indeed, as many people around the world are forced to spend an increasing amount of time indoors, well-ventilated, energy efficient buildings are critical for public health, air quality, affordable homes, and economic recovery. The slowdown of global construction will have a knock-on effect on sustainable building development but will also offer a moment for governments and private organisations to reset and re-align commitments to higher levels of sustainability going forward. Indeed, sustainable construction is essential for an economic recovery after the COVID-19 crisis. Under its Sustainable Recovery Plan, the IEA estimates that between 9–30 jobs in manufacturing and construction would be created for every million dollars invested in retrofits or efficiency measures in new builds. Stimulus programmes for the building and construction sector are a proven tool to respond to economic crises, as they create jobs, boost economic activity, and activate local value chains.



Jobs created per million dollars of capital investment and spending by measure



Source: IEA (2020g). All rights reserved. Adapted from "IEA Sustainable Recovery, 2020"

In September 2020, the GlobalABC issued a call to include building renovation and modernization in COVID-19 recovery plans in the form of a massive renovation wave, spurred by tailored support mechanisms, designed with national and local stakeholders, for making the existing building stock more energy-efficient. The Platform for REDESIGN 2020, an *Online Platform on Sustainable and Resilient Recovery from COVID-19* by the Japanese Ministry of the Environment, the UNFCCC, and the Institute for Global Environmental Strategies (IGES) highlights examples of such actions including the commitments by the European Union in the Renovation Wave, the United Kingdom in its Public Sector and Social Housing Decarbonisation schemes, and France in its support of public housing and public buildings.



OUTLOOK FOR 2021

The time for action to decarbonise the existing and future global building stock is now.

The coming year presents a pivotal moment:

First, as COVID-19 recovery packages to rebuild our economies are being adopted, they provide a unique opportunity to include deep building renovation and performance standards for newly constructed buildings.

Second, as the second round of NDCs is being formulated and submitted in the lead up to the COP26, they present an opportunity to sharpen measures and include more explicit measures in a sector that is responsible for 38% of total CO₂ emissions.

Time for radical collaboration, between public and private actors, across the entire value chain and across mitigation, adaptation and health agendas.

Governments along with public and private organisations must undertake evaluations of their contributions to carbon emissions and develop detailed strategies from which to support the transition to a sustainable, net-zero carbon global building stock. For building

owners and businesses, this means using science-based targets to guide actions, engage with stakeholders across the building design, construction, operation and users to develop partnerships and build capacity.

For investors, this means re-evaluating all real estate investment under an energy-efficiency and carbon reduction lens.

For national governments, this means stepping up commitments in countries' NDCs, in longer-term climate strategies and supporting regulation to spur uptake of net-zero emissions buildings. It also means prioritizing performance-based, mandatory building energy codes alongside wide-spread certification measures and working closely with sub-national governments to facilitate adoption and implementation.

For all other actors along the value chain, it means adopting concepts around circular economy to reduce the demand for construction materials and lower embodied carbon and adopting nature-based solutions that enhance building resilience. It means embedding principles of health into the development of new buildings and refurbishment of existing homes to protect occupants. Only then will we fully align with the Sustainable Development Goals; only then will we achieve a zero-emission, efficient, and resilient buildings and construction sector, ensuring our livelihoods are protected now and in the future.



1. GLOBAL BUILDINGS AND CONSTRUCTION STATUS

Key Message: Energy consumption in the buildings sector remained stable despite a slowing of growth in building construction through 2019, and CO2 emissions reached their highest level ever.

Buildings play a vital role in shaping and framing our livelihoods, society, and environment that we live, work, and interact within. In the transition to a low-carbon, resilient, and sustainable society, buildings play a dominant role in the use of energy and are among the largest sources of greenhouse gas (GHG) emissions in most countries.

New buildings are an important source for future emissions, especially in rapid economically developing countries with growing populations, where we will see most of the expected doubling of floor space addition by 2050. Yet in many middle and high-income countries the existing building stock will represent the majority of building floor area in 2050, making also action to improve existing buildings critical to a sustainable transition.

It is not yet clear what the impact of the COVID-19 pandemic will be for global energy demand and GHG emissions in buildings, but the International Energy Agency (IEA) estimates that overall global energy demand will drop by 5% in 2020 and energy-related CO2 emissions by 7% (IEA 2020a), which is largely due to industrial and transport related change in demand. This would be among the largest reductions in energy and greenhouse gas emissions seen in the past 30 years.

The longer-term implications of the global pandemic for the buildings sector remain to be seen. While energy demand in buildings may be less impacted than overall global energy demand due to the nature of building operations and lock-in effects of existing buildings, there may well be more drastic impacts on building design and use as well as integration with energy systems and other infrastructure. COVID-19's disruption in the buildings and construction sector will be felt for many years to come.

The focus of this Buildings Global Status Report (Buildings-GSR) is the relevance of buildings in attaining Paris Agreement goals as well as the sustainable development goals (SDGs). It provides an update on trends and actions that have occurred across the world over the past 18 months

since the previous Buildings-GSR 2019 (IEA 2019a), and it highlights important upcoming issues. It is the product of both extensive review of investment, energy, and CO2 data analysis from the IEA, as well as contributions from a wide range of stakeholders, including national governments, industry representatives, and research organisations.

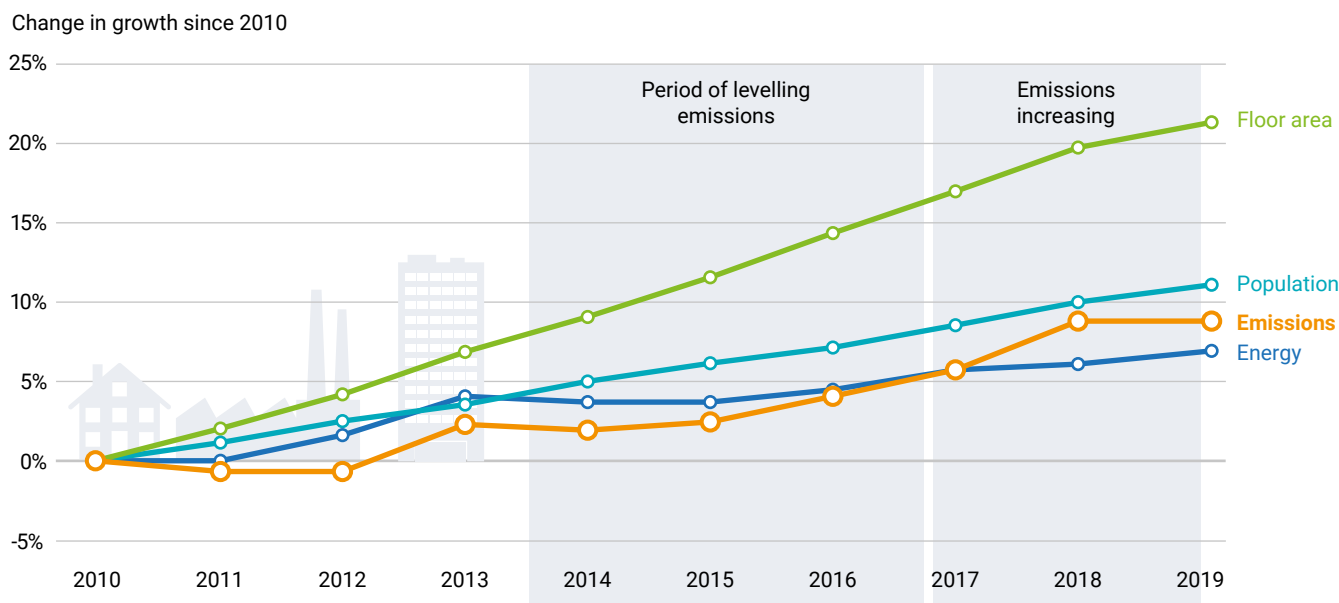
1.1 CONSTRUCTION ACTIVITIES GLOBAL AND REGIONAL

Key Message: Global building construction growth slowed to 2.6% in 2019 due to the lowest growth rates in North American and European markets recorded since 2008 and only modest growth recorded in Asia. The COVID-19 pandemic has led to a decline in investment activities throughout 2020.

In 2019, the global buildings and construction market value annual rate of change was estimated at around 2.6% per year in 2019, a significant rate but slower than the 2018 rate of 3.2% (GlobalData 2019). This overall change was notable by diverging trends across regions, with Asian markets and in particular China, seeing construction growth in the region at 4.4% per year (down from 5.1% per year from 2014-19), while the North American and European markets in 2019 maintained only a low rate of growth of 1.2% and 2.3% respectively.

The implications of the 2019 slowdown of construction was a reduction in the rate of added floorspace and consequently a slowing of energy demand growth for buildings services, though there was still an overall increase. Figure 1 shows the drivers of floor area and population continuing to add pressure on energy demand and global emissions. Over the past 10 years energy and CO2 emissions have increased by a slightly lower rate than population, and half the rate of floor space (e.g. floor space increased by 21% and energy around 9%), which further shows a decoupling of CO2 emissions.

Figure 1 - Change in global drivers of trends in buildings energy and emissions 2010-2019



Source: IEA (2020b). All rights reserved. Adapted from "Energy Technology Perspectives 2020"

In 2019, the global buildings and construction sector investment growth began to slow and will decline further in 2020 under the global pandemic (IEA 2020c). Most regions have experienced a contraction in the construction sector as both lockdowns have affected work sites and the global recession has suppressed demand for new buildings.

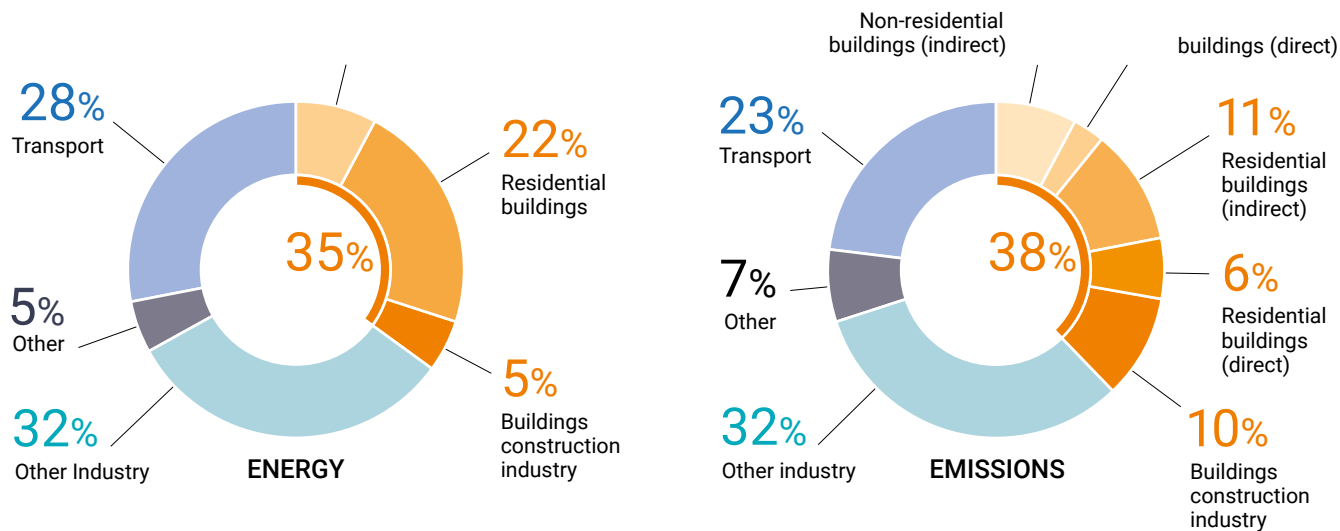
1.2 ENERGY IN THE BUILDINGS AND CONSTRUCTION SECTOR

Key Message: Global building energy use remained constant in 2019 at around 130 EJ and is responsible for 35% of global energy consumption. Buildings are now responsible for around 55% of total global electricity use.

Building construction and operations in 2019 accounted for the largest share of global total final energy consumption (35%) and energy-related CO₂ emissions (38%) in 2019 (Figure 2). Overall proportions of global energy and emissions of the building stock have maintained a stable level from 2018 (IEA 2020b). Note that when compared to the 2018 Buildings-GSR, the slightly lower proportion of buildings emissions compared with the 39% seen in 2018 was due to the increases in transport and other industry emissions relative to buildings.



Figure 2 - Global share of buildings and construction final energy and emissions, 2019



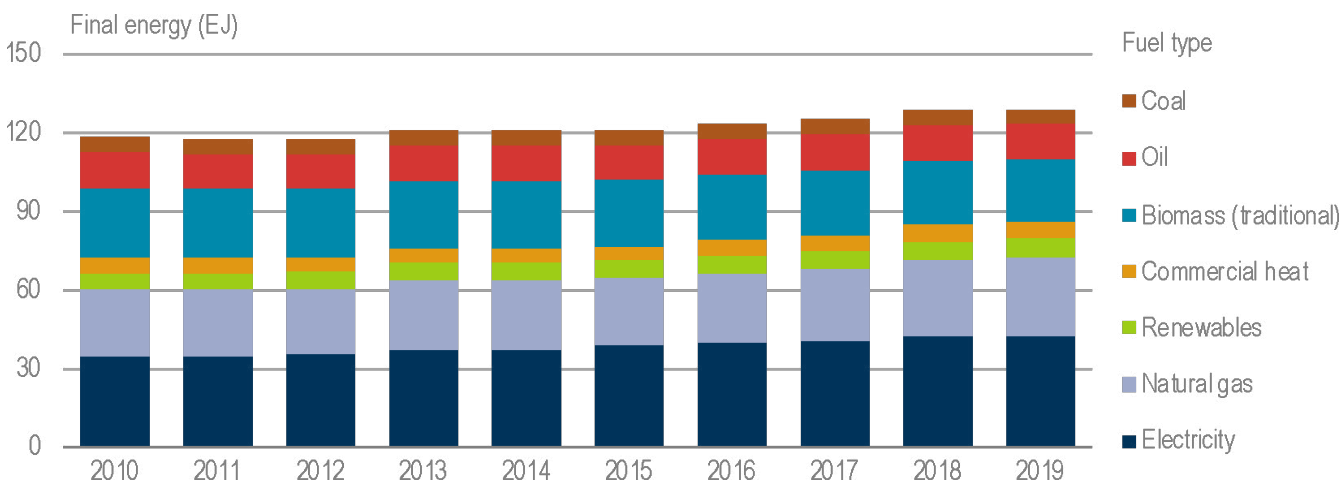
Notes: Buildings construction industry is the portion (estimated) of overall industry devoted to manufacturing building construction materials such as steel, cement and glass. Indirect emissions are emissions from power generation for electricity and commercial heat.

Sources: (IEA 2020d; IEA 2020b). All rights reserved. Adapted from "IEA World Energy Statistics and Balances" and "Energy Technology Perspectives".

Global final energy consumption for buildings operation was approximately 130 EJ (Figure 3), which is around 30% of total final consumption, and a further 21 EJ for buildings and construction or 5% of total demand. Electricity consumption in buildings now represents around 55% of global electricity consumption (IEA 2020b). 2019 marked a stable level of building energy consumption for the first time since 2012 and sees energy intensity of floor space improve (IEA 2020a).

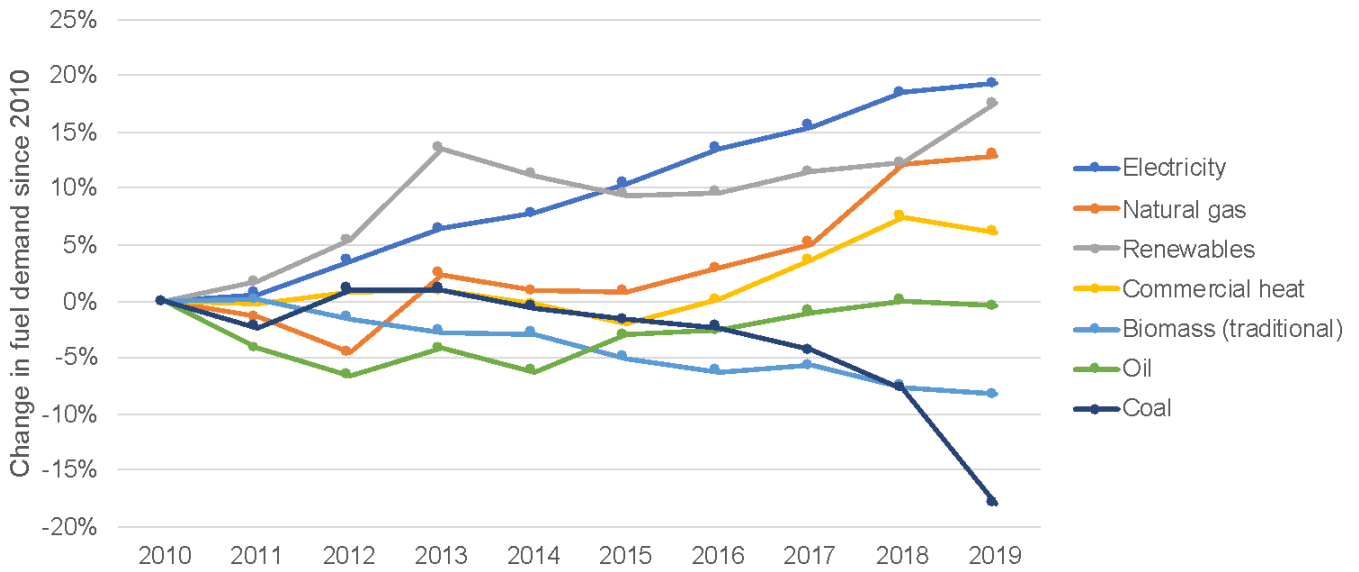
Energy demand was maintained in part due to a shift away from biomass, oil, and coal use to electricity and natural gas with assumed higher efficiencies (Figure 4). However, renewable energy use (including modern biomass) grew by around 6% since 2018 and marks a return to strong growth within the sector compared to previous years, overtaking coal as a fuel source (IEA 2020b).

Figure 3 - Global buildings sector final energy use by fuel type, 2010-19



Source: IEA (2020b). A

Figure 4 - Change in global buildings sector final energy use by fuel type, 2010-19



Source: IEA (2020b). All rights reserved. Adapted from "Energy Technology Perspectives 2020"

Across the globe, buildings energy use remains a significant proportion of overall energy demand. In 2019, buildings accounted for 57% of total final energy consumption in Africa, and 32% of total process-related CO₂ emissions. In ASEAN, China and India energy consumption in buildings accounted for 26% of total final energy consumption and 24% total process and energy-related CO₂. Buildings accounted for 24% of total final energy consumption in Central and South America, and 21% of total process-related CO₂ emissions.



Case Study 1: Digital solutions to save energy in buildings and construction

There is significant and largely untapped potential to use digital solutions for design, construction, operation, and refurbishment or demolition to make buildings more energy efficient. Digital tools can support energy efficiency throughout the lifetime of a building. A variety of tools are on the market, ranging from the highly sophisticated to the very simple, and cater to projects of different sizes, budgets, complexity, and digital readiness.

An overview of digital tools and solutions is provided in “Smart and Efficient – Digital solutions to save energy in buildings” (PEEB, 2019). Architects, engineers, building developers, construction companies, building owners, facility managers, and building users can benefit from these tools. While some tools or applications are more sophisticated and costly, and therefore suitable for larger or more complex building projects, others are simpler, more affordable, or even free of charge.

In building development, the design phase is crucial for energy efficiency, as many parameters of a building are defined and will remain ‘locked-in’ for its lifetime. From small houses to complex large buildings, such as hospitals or hotels, designing a building for its optimum future performance can leverage substantial energy and cost savings. Digital tools such as software for Building Energy Modelling (BEM) and Life-Cycle-Assessment (LCA) provide detailed methods for evaluating energy performance, and a range of simple web tools are available to help professionals to compare different design options. Digital tools can help to optimise energy performance, cost, and comfort, and visualise the results for a range of stakeholders.

During construction, digital tools can be used for construction management, quality assurance, and commissioning. By improving construction site logistics and supply chain management, they can reduce the environmental impact of on-site activities and keep CO₂ intensive material waste to a minimum. Smart Energy Monitoring and Agile Logistics, prefabrication and 3D printing, and virtual training are all emerging approaches.

The operation of buildings needs to be efficient to ensure optimal performance. Energy consumption and its drivers are often not visible or well-understood. Digital tools for the operational phase of a building mostly provide three functions: monitoring energy consumption, giving recommendations to influence the behaviour of users, or reducing energy consumption through intelligent controls. Tools range from apps to measure and optimise the use of energy or guide occupants to reduce energy use (‘smart home’ or ‘nudging’ apps), to software for professional facility management.

Existing building commissioning (EBCx) is a quality assurance process to improve energy performance and savings through operational improvements, monitoring and maintenance, and facility staff training. EBCx lowers energy bills and GHG emissions, and provides other benefits including increased comfort for building occupants, improved air quality, skills development, reduced maintenance, and longer lifecycles for building equipment. For the energy-efficient design goals of building codes to work, buildings need to be constructed and operated as intended and designed.

Refurbishment or demolition needs information about the properties of the building. After energetic refurbishments during their lifetime, buildings can be systematically dismantled, recycled, and reused at the end of their life – instead of landfilled. Data for deep energy retrofits, 3D scans of buildings, and the use of industrialised, prefabricated modular systems for deep energy retrofits offer many possibilities for embedding circularity concepts in the building sector that take us away from the present take-make-waste extractive economic model to an economy that is restorative and regenerative by design.

However, buildings do not need to become completely ‘smart’ to save energy. There is a tendency to increase the use of technology to try and make buildings more energy efficient, when sometimes ‘less is more’. Digital applications can help to optimise the energy performance and thermal comfort of a building – but they cannot replace good building design.



1.3 EMISSIONS IN THE BUILDINGS AND CONSTRUCTION SECTOR

Key message: Despite stable energy demand, energy-related CO₂ emissions from building operations and construction reached their highest level ever recorded in 2019. Together with manufacturing, transportation, and use of construction materials, they account for 38% of global CO₂ emissions.

Direct energy-related emissions from buildings rose to just over 3 GtCO₂ and at 6.9 GtCO₂ in 2019, while the combined direct and indirect energy-related emissions from buildings use rose to around 10 GtCO₂ in 2019 (see Figure 5), or around 28% of total global CO₂ emissions (IEA 2020b)¹. Additionally, the manufacturing, transportation and use of all construction materials for buildings resulted in energy and process-related CO₂ emissions of approximately 3.5 GtCO₂ in 2019, or 10% of all energy sector emissions (IEA

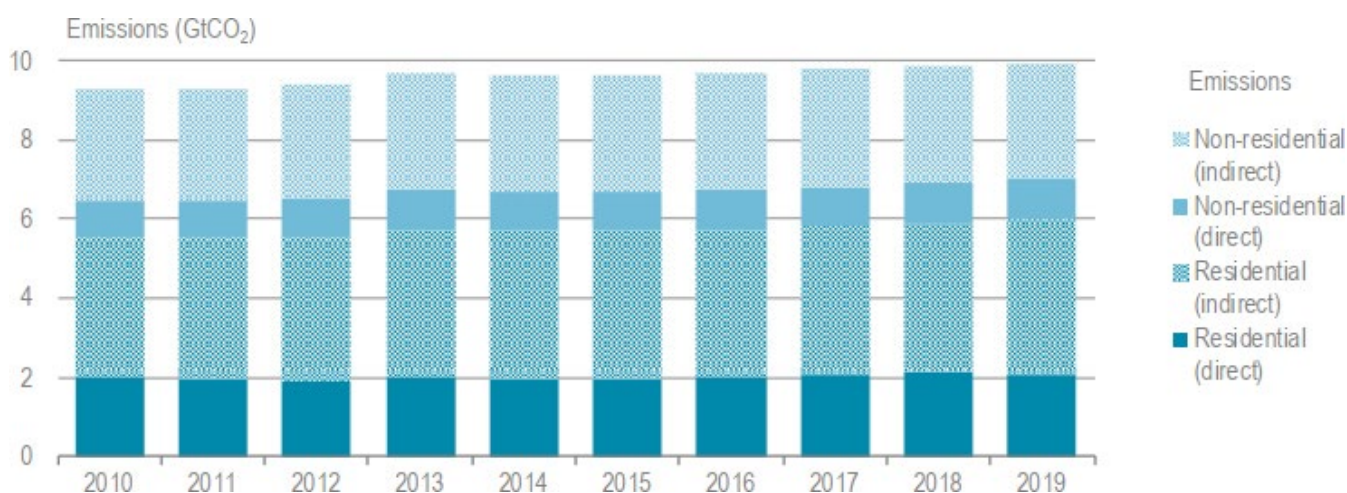
2020b). Combined, the IEA estimates building operation and construction industry energy-related emissions account for 38% of global CO₂ emissions.

The slightly lower proportion of buildings emissions compared with the 39% seen in 2018 was due to the increases in transport and other industry emissions relative to buildings.

The buildings sector emission increase is due to a continued use of coal, oil and natural gas for heating and cooking combined with higher activity levels in regions where electricity remains carbon-intensive, resulting in a steady level of direct emissions but growing indirect emissions (i.e. from electricity) (IEA 2020a). Although electricity has low direct emissions, it is still primarily sourced from fossil fuels, such as coal and natural gas.

12 Total global emissions from the building sector of around 9.95 GtCO₂ are derived from International Energy Agency analysis and covers energy sector and industrial process CO₂ emissions related to the building sector (IEA 2020a). Differences between total Fossil Fuel CO₂ emissions found in the UNEP Emission Gap Report 2020 and energy sector related CO₂ emission estimates from the IEA are notably due differences in scope and assumptions around change in fossil fuel demand (UNEP 2020).

Figure 5 - Global buildings sector energy-related emissions by building type and indicator, 2010-19



Notes: Direct emissions are those emitted from buildings, while indirect emissions are emissions from power generation for electricity and commercial heat.

Sources: IEA (2020d); IEA (2020b). All rights reserved. Adapted from "IEA World Energy Statistics and Balances" (database) and "Energy Technology Perspectives 2020"

Emissions from the production of buildings materials and their construction are largely driven by cement and steel manufacturing (see Table 1 below) (IEA 2020b), and their growth in use is a major driver of building related embodied carbon emissions. Building design and type, such as high-rise towers, have resulted in increased demand for steel and cement, though such buildings may have a longer lifespan as

a result. Globally, the buildings construction sector accounts for approximately 50% of the demand for cement and 30% of steel. These factors show the importance of extending the lifetime of buildings and reducing their use and replacing them with materials that have lower embodied carbon (see Section 5.2).

Table 1 - IEA Buildings operation and construction emissions estimates, 2019

	2019 (MtCO ₂)	Share
Buildings use phase	9953	
Coal	496	9% direct emissions
Oil	939	
Natural gas	1663	
Electricity and heat	6855	19% indirect emissions
Buildings construction	130	10% indirect buildings and construction value chain emissions
Construction energy use	130	
Material manufacturing	3430	
Cement- and steel- manufacturing for construction	2038	
Other	1391	
Buildings and construction value chain	13512	38% of total energy related emissions

Source:(IEA 2020b). All rights reserved. Adapted from "Energy Technology Perspectives 2020"

Box 1 - Low carbon emission buildings and construction

Recently a series of initiatives and commitments to achieve lower emissions in the buildings sector have been made by organisations in an effort to support the low carbon transition.

Prior to the COVID-19 pandemic, **Excellence in Design for Greater Efficiencies (EDGE)** certification reported strong growth in green homes in Mexico. In 2019, the construction company Vinte achieved 4000 EDGE certifications for its residential buildings. Financing of green buildings was also strong, with HSBC México and Sabadell México investing in Green construction. In addition, Vinte EDGE certified developments in Puebla, Queretaro, and Tecamac that have included induction cooking and solar thermal hot water systems have shown to reduce energy demand by up to 57%, water savings of 37%, and have 63% less embodied energy.

In July 2020, **South Korea** has committed \$61b to become a 'Net-Zero Society' in just five years, through the construction of zero-energy public facilities such as schools and shifting to an economy powered by solar, wind, and hydrogen.

The **Danish Climate Partnership** has estimated that across the 13 initiatives which it focuses on in the construction and energy industry, a total of 2.5 million tonnes of CO₂ emissions per year might be avoided. For example, in the estimate measures aimed at replacing oil burners would save 280,000 tonnes CO₂ per year by 2030, along with optimisation of heat pumps (70,000 tonnes CO₂ per year by 2025) and renovation of technical installations (70,000 tonnes CO₂ per year by 2025).

The **Building System Carbon Framework by WBCSD** (WBCSD 2019) has outlined a framework to "identify the best emissions-reduction strategies for their part of the value chain, using common metrics and a full life-cycle approach." The framework is neutral on materials and solutions and provides a framework to support stakeholders through a common approach.

The first **Net-Zero carbon community in China** is being constructed by the Qingdao Energy Group. Energy supplied to the site will be zero-carbon and continuous monitoring will ensure zero-carbon operation. It is estimated that over 8,600 tonnes of carbon per year will be saved.

Funding of £16m has been secured for a renewable heat network for public buildings in **South Wales**. The local council estimates that 5,600 tonnes of carbon will be saved each year by redirecting excess heat from local industrial plants.

Multiple Net-Zero carbon projects are planned for London. A new office block called The Forge aims to be the first UK office building to meet the UK Green Building Council's (UKGBC) net-zero buildings framework. A timber-frame office called The Paradise, designed by Feilden Clegg Bradley Studios, will be net-zero carbon and offset other buildings emissions using the carbon sequestered in the timber.

The **ACT (Assessing Low Carbon Transition) initiative**, which assesses how ready an organization is to transition to a low-carbon economy, was conducted in 2019 for 7 building sector firms (1 real estate, 3 construction companies, and 3 property developers around the world). It highlighted actions undertaken by companies to go further than commitments. The ACT initiative allows a holistic approach in order to assess a company's climate strategy and determine how ready a company is to transition to a low-carbon economy. The ultimate goal is to drive action by companies and put them on a 2°C to 1.5°C compatible pathway.

1.4 DECARBONIZING THE BUILDING SECTOR TOWARDS 2050

Key Message: Elimination of building emissions by 2050 is possible with existing technologies and the urgent adoption of supporting policies and investments.

Numerous analyses show that decarbonisation of the sector is possible, yet this requires clear pathways to be developed and implemented to accelerate the needed transition for buildings to achieve net zero carbon by 2050. There are numerous ways by which nations can support this transition including progressive building code implementation, market regulation, and supporting investment in energy efficiency for existing buildings.

Analysis from the Climate Action Tracker (CAT) has illustrated a need to further strengthen the reduction in emissions. In a recent report, emissions reductions from buildings need to be deep and occur quickly, with substantial reductions by 2030 and almost complete decarbonisation by

2040. Using the mean across all scenarios modelled by CAT, the total direct CO₂ emissions reductions from the sector should be at least 45% by 2030, 65% by 2040, and 75% by 2050 relative to 2020. Indirect emissions from the power sector should decrease more quickly.

The CAT analysis shows that using existing technologies, it is possible to completely eliminate emissions from buildings by 2050. Doing so, however, will require substantial investment in zero carbon heating and cooling sources and improvements to building envelopes.

Under the Sustainable Development Scenario, the IEA estimates that direct emissions fall by more than 30% in the SDS by 2030, and total direct and indirect emissions fall by 3.5 Gt CO₂ in the 2019-30 period (IEA 2020a). However, in the Net Zero Emissions by 2050 Scenario (NZE2050), which focuses on actions that would result in the energy sector reaching net-zero emissions by 2050, the IEA outlines that direct building CO₂ emissions would need to decrease by 50% and indirect building sector emissions decline through a reduction of 60% in power generation emissions by 2030 (IEA 2020a). These efforts would need to see building sector emissions fall by around 6% per year from 2020 to 2030. For comparison, the global energy sector CO₂ emissions are estimated to have decreased by 7% during the pandemic.

Box 2 - Country initiatives for GHG emissions reductions in buildings



South Korea

A standardized baseline (SBL) for residential buildings was approved for the Republic of Korea by the CDM (Clean Development Mechanism) Executive Board of UNFCCC in August 2020 (UNFCCC 2020).

The approved SBL provides a default value for baseline emissions (tCO₂/m²) for 18 building construction categories that consider climatic zone, gross floor area, construction year, and type of heating system.

The Korean benchmarking used the National Building Energy Database, an integrated database with energy consumption data and building characteristics data, which is enshrined under Article 10 of the "Act on Green Building Creation Support" and is a large-scale database that contains information on all buildings in the Republic of Korea.

Through this approval of SBLs, it is expected that improvements measurable, reportable and verifiable GHG reductions will become easier, thereby facilitating the opportunity for domestic carbon reduction in the building sector.



Chile

The District Energy in Cities Initiative (UNEP 2015) has been working in Chile over the last four years to raise awareness and unlock investments in modern district heating and cooling systems. In the city of Coyhaique, one of the most polluted cities in Latin America and one of the pilots of the initiative, an innovative approach is under development that combines improving energy efficiency of buildings with the installation of a district heating network.

The project of Escuela Agrícola aims at reducing local pollution by replacing individual wood stoves and diesel and liquefied gas boilers by a centralised, clean, and high-efficient biomass boiler that would provide heating and hot water to the community. The replacement of heating systems will be coupled by an improvement of the thermal insulation of the buildings. Around 1,095 people will benefit from this system that will help reduce emissions of fine particulate matter (PM 2.5) by 99.5% in the area of implementation. The project is part of the Ministry of Environment's Atmospheric Decontamination Plan and the 2018-2022 Energy Route, with support from the Regional Council and the regional secretary of the Ministry of Housing.

2. IMPACT OF COVID-19 ON BUILDING AND CONSTRUCTION TRENDS

Key Message: The impact of COVID-19 on the global construction industry has been severe and some estimates point to construction activities having dropped by 10-25% compared to 2019. Stimulus programmes for the construction sector are proven tools for economic recovery. Estimates point to between 9-30 jobs in manufacturing and construction that would be created for every million dollars invested in retrofits or efficiency measures in new buildings.

The latest estimates on the impact of COVID-19 on the global construction industry market value anticipate around a 6% reduction from 2019 levels, and an annual year-on-year future growth of 1.2% from 2020 (Research and Markets 2020), down from 3.1% annual future growth estimated in 2019 (GlobalData 2019). Yet some regional markets show stronger slow downs, for example: an estimated reduction of 4.4% in Germany (GlobalData 2020a) and 7% in Canada from 2019 levels (GlobalData 2020b), while India and Malaysia contract by 2.2% and 7.7% respectively. China, on the other hand, is still expected to see an increase in overall construction by 1.9% from 2019, which keeps the global estimate in a slight upward trend (GlobalData 2020c). Estimates for the building construction industry continue to project a return to stronger growth, potentially pushing annual growth rates to above pre-pandemic levels.

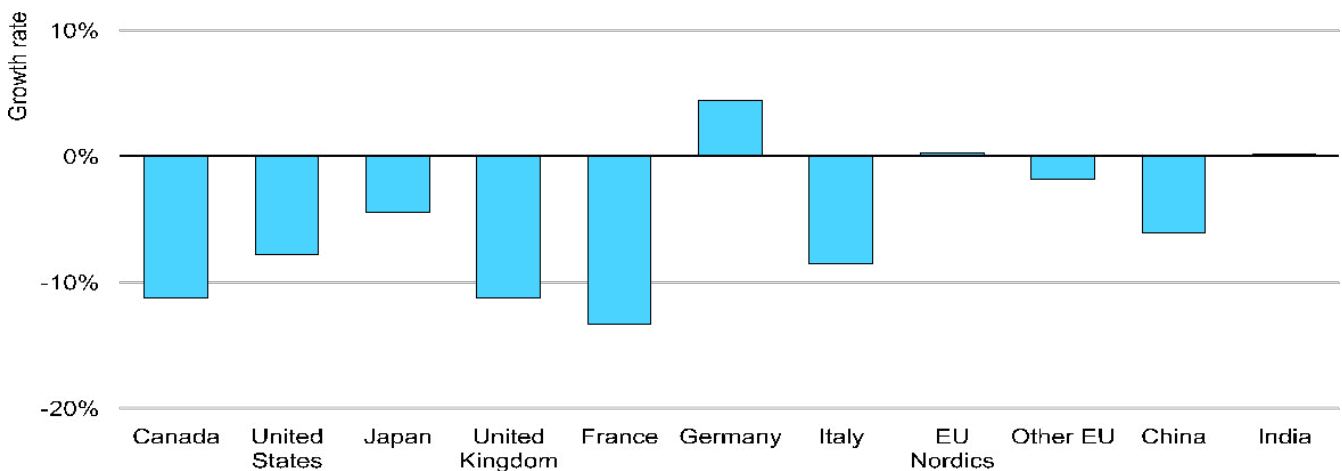
Global investment in energy efficiency in the buildings sector rose 2% to approximately USD around 152 billion in 2019 (IEA 2020c). At the start of the COVID-19 pandemic, the global building construction industry activity (i.e. number of new

and existing projects, onsite productivity, contract value) was estimated to have slowed by 24% since pre-pandemic levels along with a 12% slowdown of onsite working (RICS 2020a), though there has since been a rebound in activity with an annual slowdown estimate of around 10% (RICS 2020b).

The market for 'green' buildings is reportedly expected to grow and could outpace market growth for 'standard' buildings in the near future. Nevertheless, as with standard buildings, green building construction types and technologies have been affected by the pandemic, which has slowed demand in 2020. The 'green' building materials market² is expected to achieve an annual growth rate of 8.6% by 2027 (Global Industry Analysts, Inc 2020), down from 11.7% in 2019 (IMARC Services 2019), though it is anticipated that regions such as China and Latin America will continue to see a growing demand for what are considered 'green' buildings of 11.6% and 13% respectively.

During the course of the pandemic, many countries have reported a significant slowdown in buildings completions (see Figure 6). Many of those initial slowdowns in construction have, however, since begun to rebound, though the pickup in different countries is expected to still be down from initial 2020 projections overall. The IEA report that the effect of the pandemic on the construction sector might result in embodied emissions from buildings being around 5% lower in 2020 than the previous year (IEA 2020b).

² *N.B. The definition of 'green' buildings in these market reports are not necessarily aligned with the definitions of sustainable building definitions used by the GlobalABC.*

Figure 6 - Project year-to-year growth of residential construction activity in 2020

IEA 2020. All rights reserved

Notes: Buildings construction activity is estimated based on the average number of square metres under active construction for a given year, itself derived from construction starts and housing completions data. The EU Nordics country grouping includes Denmark, Finland and Sweden.

Source: IEA (2020b). All rights reserved. Adapted from "Energy Technology Perspectives 2020"

Modest progress was being made to improve building fabric performance. From 2015 to 2019, global total final energy consumption intensity per m² for buildings was changing at an annual rate of -0.5% from 330 kWh/m² to 320 kWh/m² and prior to COVID was projected to further reduce by

-0.9% pa to 300 kWh/m² by 2025 (IEA 2020b). The effect of the recession and the 24% drop in construction activities could have a knock-on impact on the energy efficiency improvement rate, lowering it to 0.7% pa to 2025 (IEA 2020e)

Box 3 - RICS Global Construction Survey Summary

The **RICS Global Construction Monitor** (RICS 2020a), a survey of close to 2000 industry professionals across the globe, highlights the scale of the impact of government lockdowns on construction activity in the second quarter of 2020. RICS's Global Activity Index, an amalgamated measure of current and expected construction market conditions came in at -24 indicative of both a sharp drop in activity across the sector as well as a generally subdued outlook.

Globally, around 25% of projects were reported to have been put on hold as a result of Covid-19 related lockdowns as workloads took a big hit. Even though activity does appear to have resumed somewhat, RICS's numbers suggest that it is unlikely that the non-residential sector will see much of recovery over the coming twelve months, while workloads in the private residential segment are also likely to remain broadly subdued.

Nevertheless, a consistent global theme emerging from feedback to the RICS survey is the expected expansion in activity in the infrastructure sector in the coming year. This could be a response to announcements by a number of governments around additional public spending in this area to stimulate economic recovery.

Feedback suggests that additional challenges could be in store for the sector with insufficient demand and financial constraints cited by the majority of respondents as significant impediments to construction activity at present.

For the projects that do go ahead, social distancing, health and safety precautions are expected to restrict activity. The majority of professionals globally believe that onsite productivity could slip by up to 20%.

Furthermore, 44% of respondents globally reported that they were receiving tender bids below realistic cost estimates. As a result of this, almost universally professionals have reported deteriorating profit margins in Q2, this is expected to persist in the coming twelve months while the majority of contributors globally also envisage a reduction in employees in the year ahead.

Box 4 - Impact of COVID on the construction sector



Colombia

In Colombia, in the first half of 2020 and due to the COVID 19 pandemic, the construction sector, that normally generates 1.5 million direct and 1.7 million indirect jobs, had 200 major construction sites shut down, equivalent to 7.8 million m² of floorspace. By analysing construction sector economic activity, it was shown there was a decline of 31.7% of its added value. This result is mainly explained by the negative annual value of buildings (-38.7%), the added value of specialized activities (-32.8%) and the added value of civil works (-18.8%). The impact of these effects, in the sustainable construction sector, is estimated at 30% (CAMACOL 2020). The construction sector represents about 4.5% of national GDP, including the financial, labour, technological and productive capacity effects of the construction sector that have negatively impacted the country's GDP. The general contraction of the country's economy was -7.4% for the first six months of 2020. The economic stimulation of this sector is a priority strategy for the national recovery plan.

2.1 BUILDING SECTOR GREEN RECOVERY ACTIONS

A key aspect of the response to the COVID-19 pandemic has been the use of government driven economic actions to address the impacts of lockdowns, where they were imposed. This section highlights the actions being undertaken by governments as part of their continued response to the pandemic and its economic impacts.

The construction sector is essential for an economic recovery after the COVID-19 crisis. In 2015, it accounted for 11-13% of global GDP and today involves far-reaching value chains of small and large businesses. The sector is a substantial provider of local jobs: 7% of total global employment or 220 million jobs depend on it (Buckley et al 2016). In 2020, in the wake of the COVID-19 crisis, more than 25 million jobs (or around 10%) across the sector have been lost or were at risk of being lost in the short term.

Stimulus programmes for the building and construction sector are a proven tool to respond to economic crises. They have large macroeconomic impacts, as many countries have a large need for new buildings and renovation of existing buildings, and because the sector has strong potential for activating local value chains (IEA 2020f). Construction projects are also less susceptible to offshoring to imports.

To support the decarbonisation of the building sector, stimulus packages for the construction industry should have "strings attached" and reward energy efficiency and environmental criteria. Green stimulus policies often have advantages over traditional fiscal stimulus packages, due to their possibility to address both the short and the long term (Hepburn et al. 2020).

2.1.1 BLUEPRINTS FOR SUCCESSFUL GREEN BUILDING PROGRAMMES EXIST

Many countries have successfully developed green building programmes to fight the 2008 economic crisis. The GlobalABC has started a database of best practice examples of green building programmes that used financial incentives effectively to stimulate investment and job creation (GlobalABC and PEEB 2020). A variety of instruments are described in the database, such as: green mortgages for households, bridging loans for developers, grants and concessional loans for homeowners, developers or housing associations. For example, in Peru, the Fondo MiVivienda used green mortgages to promote sustainable housing for low- and middle-income urban households. After 5 years, it's estimated that the programme resulted in 8000 jobs and saved 3.144 tons of CO₂ per year. Estonia used a grant and loan programme for deep energy retrofits of apartment buildings constructed before 1993. The first phase of the programme achieved a leverage factor of 3.8 for grants (€36 million attracting investment of €135 million), whereby 17 jobs were created for every €1 million used, ten jobs directly on the construction site, six in manufacturing, and one in consultancies.

2.1.2 GREEN BUILDING PROGRAMMES FOR ECONOMIC GROWTH, JOBS AND CLIMATE

Measures for energy efficiency in buildings often have short lead-times: existing efficiency programmes can be rapidly expanded, and new projects can be shovel-ready within weeks or months. Incentives that compensate for the slightly higher investment cost for green renovation or construction projects are key to stimulating investments into green buildings. In exchange, a "green conditionality" sets the bar higher for buildings that receive support, through simple principles such as rewarding performance with higher financial incentives or basing funding decisions on project certification and labelling.

To be able to quickly implement stimulus programmes for energy efficiency in buildings, the IEA recommends to (IEA 2020g):

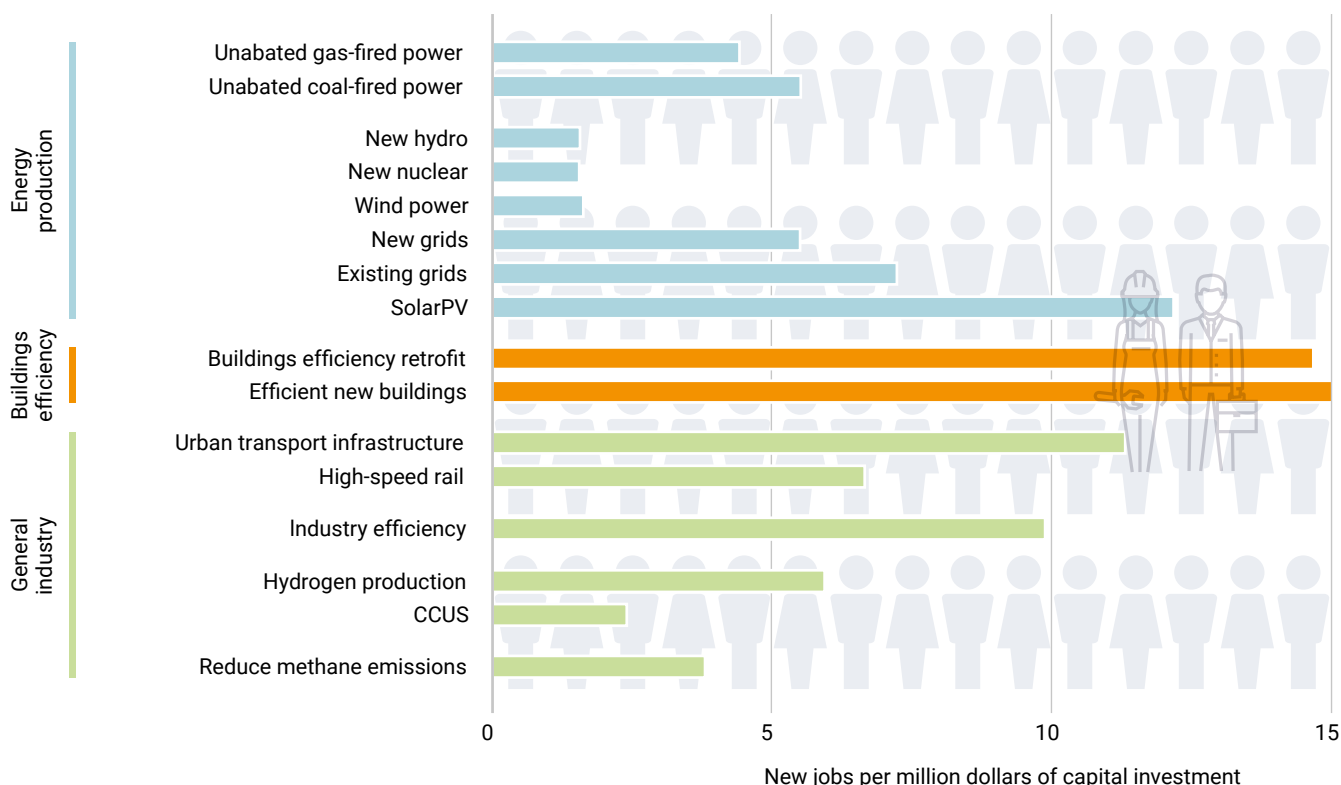
- ▶ Increase incentives for building efficiency improvements, smart energy management solutions, and on-site renewables, including by reducing administrative and processing times for approvals and addressing shortages of skilled providers.
- ▶ Target efficiency improvement measures to those households and businesses most impacted by the crisis, such as low-income households, small businesses, and hotels.
- ▶ Use public procurement to catalyse activity, for example by commissioning efficiency retrofits of public assets, such as social housing, schools, offices, and healthcare facilities.
- ▶ Provide guarantees to encourage energy service companies to invest in retrofits.
- ▶ Accelerate or expand existing and planned efficiency programmes.

2.1.3 JOB EFFECTS AND MACROECONOMIC POTENTIAL

Under its Sustainable Recovery Plan, the IEA estimates that between 9-30 jobs in manufacturing and construction would be created for every million dollars invested in retrofits or efficiency measures in new builds. Construction jobs would mostly be local, while manufacturing jobs in the wider industrial sector would be created by increased demand for building materials and equipment such as insulation, efficient glazing, and heat pumps (IEA 2020g). In the EU, during the 2008 financial crisis, an average of 18 jobs were created for €1 million invested in energy renovation of buildings (Figure 7).

This would bring multiple social benefits: lower energy bills for consumers and therefore reduced energy poverty, better health and comfort, and improved resilience in the face of climate events and price shocks (IEA 2020g).

Figure 7 - Jobs created per million dollars of capital investment and spending by measure



Source: IEA (2020g). All rights reserved. Adapted from IEA Sustainable Recovery, 2020

2.1.4 GREEN BUILDING PROGRAMMES TO RESPOND TO THE COVID-19 CRISIS

In 2020, numerous countries have implemented stimulus programmes that target the building sector to respond to the COVID-19 crisis. Stimulus actions across the world are being collected by the Platform for Redesign 2020, a UNFCCC initiative led by the Japanese government that showcases information on policies and actions taken by national governments to contribute to a sustainable and resilient recovery from COVID-19.

The GlobalABC conducted a survey among its members in mid-2020 and sought to identify examples of economic stimulus across member countries - see GSR Survey Section for details. Examples include Mexico, where the National Housing Commission aims to support renovation and extension activities in low-income Mexican households. The French “Reboot” plan earmarks major funding commitments for energy efficiency buildings measures as part of the

COVID-19 response. In England, a Green Home Grant scheme aims to fund domestic energy efficiency improvement measures, which will also stimulate the economy. In Morocco, projects valued at 1.18 billion dirhams (approx 131k USD) have been targeted at improving unsanitary housing. Survey respondents also highlighted schemes in Japan, Argentina, and the Second Corona Tax Aid Act in Germany.

The EU Commission has made the “Renovation Wave” a cornerstone of its strategy to fight the crisis, aiming to at least double renovation rates within ten years to increase energy and resource efficiency. By 2030, 35 million buildings could be renovated and up to 160,000 additional green jobs created in the construction sector.

In September 2020, the GlobalABC issued a call to include building renovation and modernization in COVID-19 recovery plans in form of a massive renovation wave, spurred by tailored support mechanisms, designed with national and local stakeholders, for energy-efficient existing buildings.

Box 5 - COVID stimulus recovery for buildings

The **Platform for Redesign 2020** is an online platform for sustainable and resilient recovery from COVID-19 that is cataloguing the policies and actions from countries across the world who are committing to sustainability as part of their economic recovery efforts.

The **United Kingdom** has announced a range of funding for low carbon investment and innovation in the buildings sector. From a £2 billion ‘Green Homes Grant’ design to support upgrading of housing energy performance, and a £50 million investment in scaling up social housing retrofits.

According to **COVID-19 Recovery: Investment Opportunities in Deep Renovation in Europe** €90 billion per year are required to trigger the necessary up-scaling in the rate of buildings renovations in Europe and support deep renovation of €243 billion in EU-27 (BPIE 2020). This would be made up of €73 billion/year for building renovation of €2.6 billion/year for technical assistance, and €13.8 billion/year for construction sector innovation.

A report by the **European University Institute (EIU)** found that 87% of COVID-19 response packages were short-term and that none directly encouraged measures to reduce building cooling demand, but that countries can incorporate energy efficiency into longer term packages (Cross 2020).

South Korea announced a stimulus response of \$130 billion USD between mid-2020 to 2025 that aims to support three pillars of energy transition, climate-resilient recovery, and transition to a greener economy. This entails constructing 230,000 energy efficient buildings alongside investment in renewables and electric vehicles.



3 SUSTAINABLE BUILDINGS AND CONSTRUCTION POLICIES

Key message: Most countries have yet to submit their second Nationally Determined Contribution (NDC), leaving significant opportunity to integrate specific mitigation policies for buildings and to make use of codes, standards, and certification that drive the sector towards zero-carbon emissions.

3.1 NATIONALLY DETERMINED CONTRIBUTIONS (NDCS)

At the outset of 2020, countries were requested to communicate their new or updated NDCs to the Secretariat of the United Nations Framework Convention on Climate Change, as part of the five-year cycle of reviewing their targets and commitments under the Paris Agreement. Unknown at the start of this period was how this review would now be taking place in the context of a global pandemic, and short-term COVID-19 recovery packages will have a significant role in contextualising longer-term climate change commitments.

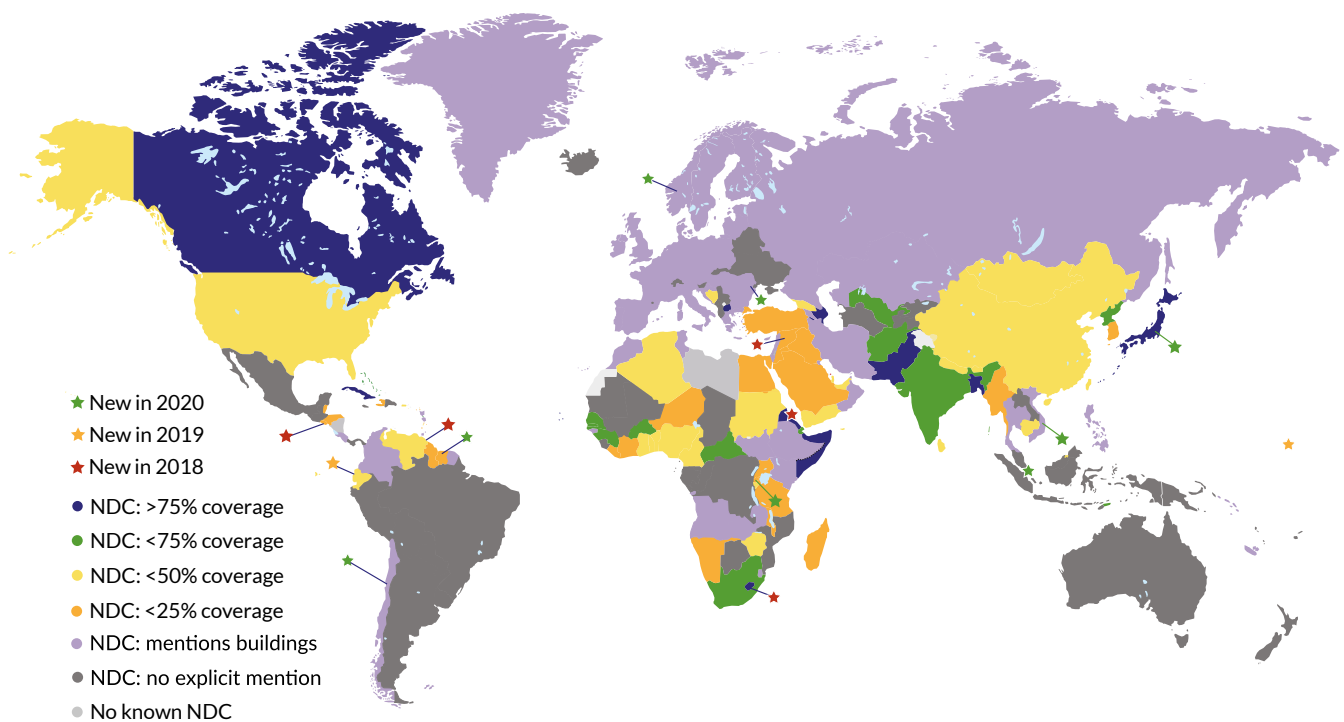
As of the end of October 2020, 186 countries had submitted an NDC, with 2 countries having submitted their second (Marshall Islands and Suriname) and 17 countries having provided an update to their first NDC respectively in 2019 and 2020 (Table 2). This leaves many countries in the position of needing to update their commitments before the next COP 26 in November 2021.

Overall, 136 countries mention buildings, 53 countries mention building energy efficiency, and 38 specifically call out building energy codes, indicating the importance of building energy efficiency to our climate future (Figure 8).

Those countries that have submitted revised NDCs have focused on an array of mitigation actions including reducing the carbon content of materials, avoiding the use of HCFC and other ozone disrupting gases, along with the encouragement of building integrated renewables. Examples of public policies are shown in Box 6.

Given the importance of buildings as a contributor to global and national GHG emissions, there is an urgent need for countries to adopt more explicit actions and pathways to decarbonize their building stock in line with the Paris Agreement.

Figure 8 - Buildings sector emissions coverage in NDCs, 2018-20



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.

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 GlobalABC/IEA/UNEP (2019). All rights reserved. Derived from UNFCCC (2020), "Interim NDC Registry".

Table 2 - Updated country NDCs with building focused actions

Country	Date	Description of measures relevant to buildings	Type
Chile	8 Apr 2020	<ul style="list-style-type: none"> • 57% of houses (70% of apartments) electric heating by 2050 • 1,800 GWh in distributed residential electricity generation • 20,000 houses/year renovated • 35 GWh Geothermal • District heating program 	Updated NDC
Cuba	16 Sep 2020	Increase of energy efficiency and saving for residential sector.	Updated NDC
Japan	31 Mar 2020	<ul style="list-style-type: none"> • Promotion of compliance of energy saving standards for newly constructed buildings • Energy efficiency and conservation buildings (remodeling) • Introduction of commercial-use water heater (latent heat collection water heater, commercial-use heat pump water heater, high-efficient boiler) • Introduction of highly efficient lighting • Introduction of refrigerant control technology (F-gases) • Improvement of energy efficiency and conservation performance of equipment by the top runner program, etc. • Thorough implementation of energy management in the commercial sector with BEMS and energy efficiency diagnosis • Promotion of nationwide campaigns (thorough promotion of Cool Biz/Warm Biz, repair of local government buildings) • Expansion of shared use of energy • Promotion of measures for energy efficiency and energy conservation/generation from sewage systems 	Updated NDC
Republic of Moldova	3 Mar 2020	Improve the energy performance of buildings through insulation and revision of building standards.	Updated NDC
Mongolia	13 Oct 2020	<p>Construction:</p> <ul style="list-style-type: none"> • Insulate old precast panel buildings in Ulaanbaatar city • Limit the use of raw coal in Ulaanbaatar city and switch to the use of improved fuel. <p>The above is estimated to save 830.1 Gg CO₂eq</p>	Update NDC
Norway	6 Feb 2020	Effort Sharing Regulation (ESR) covers buildings	Updated NDC
Rwanda	19 May 2020	<ul style="list-style-type: none"> • Installation of efficient lighting • Dissemination of modern efficient cook stoves to 80% of the rural population and 50% of the urban population by 2030 • 1.5 million households to be electrified using off-grid and rooftop solar PV. • 8 million USD for solar hot water programme. <p>Estimated building investments:</p> <ul style="list-style-type: none"> • 2020-25 = \$510m; • 2025-30 = \$150m; • 2030-35 = \$660m 	Updated NDC
Singapore	30 Mar 2020	For the buildings sector, Singapore has mandated minimum energy performance standards and developed the Super Low Energy Buildings Programme, which supports the research and adoption of cost-effective, energy-efficient and renewable energy solutions.	Updated NDC
Suriname	8 Dec 2019	A nation-wide energy efficiency program has commenced aimed at consumer awareness and usage of energy-saving light bulbs as well as promoting energy efficient designs for buildings. In addition, there has been the removal of tariffs on renewable energy products	Second NDC
Thailand	25 Oct 2020	Relies on the implementation of the National Energy Efficiency Plan B.E. 2558-2579 (2015-2036), which aims to reduce energy demand by 30% in 2036 compared to a business as usual trajectory.	Updated NDC
Viet Nam	10 Sep 2020	<ul style="list-style-type: none"> • Reducing GHG emissions by replacing construction materials and improving the cement and chemical production processes together with reducing the consumption of HFCs; • Improving, developing and applying technology in manufacturing construction materials; • Reducing clinker content and implementing other measures to reduce GHG emissions in cement production; and • Developing and using energy-saving construction materials and green materials in housing and commercial sectors. 	Updated NDC

Source:(IEA 2020b). All rights reserved. Adapted from "Energy Technology Perspectives 2020"

Box 6 - Public policy initiatives to support low carbon buildings

Vienna is creating new climate protection areas. Under this scheme, newly constructed buildings in these areas must be equipped with renewable energy or district heating. Around 80% of heating for these new buildings will be supplied under the scheme.

In Jan 2019, the Emirate of Ras Al Khaimah launched Barjeel, Ras Al Khaimah's Green Building Regulations, which was mandated on all new buildings in the Emirate starting 2020. Buildings following Barjeel are expected to consume 30% less energy and water.

The **Indian Cooling Action Plan** was introduced in early 2019. Under this plan, cooling energy demand would be reduced by 25-40% by 2037. The plan would also train and certify 100,000 technicians to achieve this aim.

Rwanda is also developing a low-carbon National Environment and Climate Change Policy (IEA 2020h). This policy will focus on delivering a low-carbon, climate resilient economy by promoting green mobility, green urbanisation and the circular economy.

3.2 BUILDING ENERGY CODES

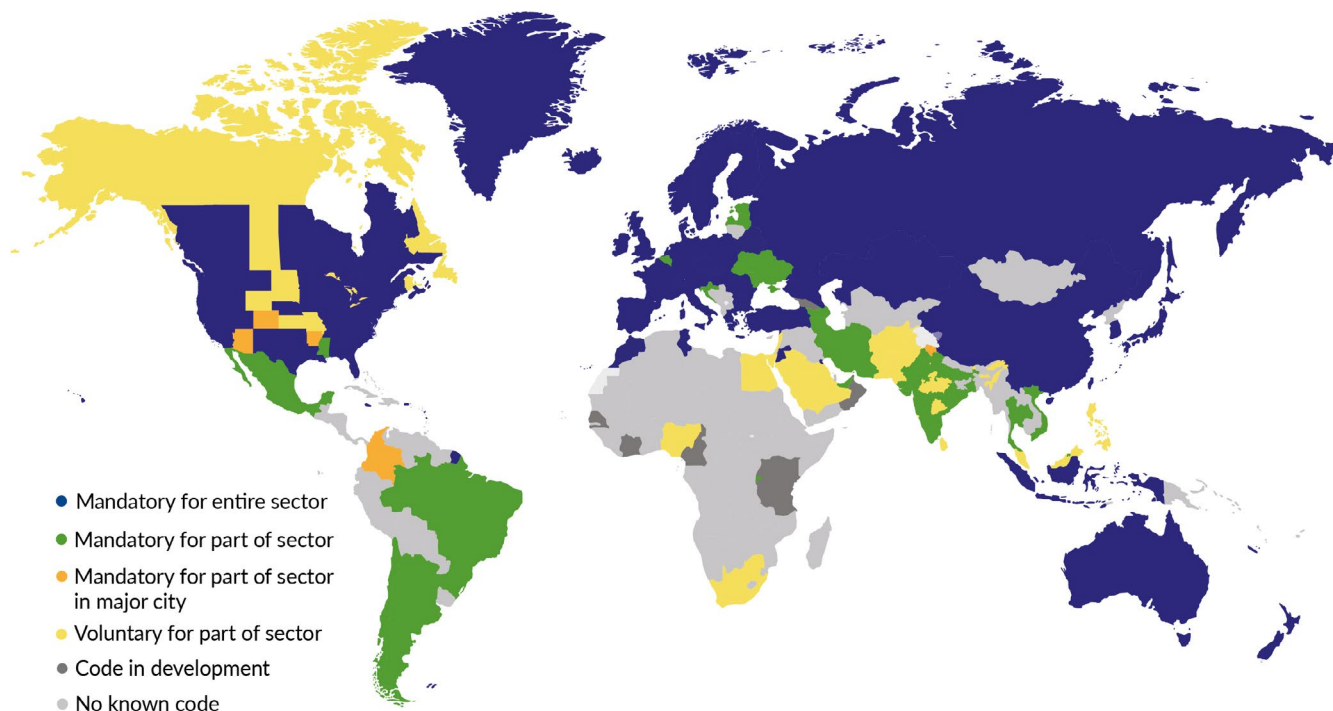
Key Message: In 2019, 73 countries had mandatory or voluntary energy codes and four countries have indicated that codes are being developed for 2021 onward.

Building energy codes are typically implemented by governments to regulate the construction and operation of buildings in order to minimise or control buildings energy use. Building energy codes can take many forms as building

energy use depends on numerous factors, from construction typologies and building fabric choices to the operation and efficiency of heating and cooling systems. They may also be implemented at either a national or subnational level.

Despite building energy codes being most prevalent in high income countries, substantial progress is being made across the globe to formalise and regulate the building sector. Though not focussing on the building itself, across sub-Saharan Africa and South Asia, countries are adopting Minimum Energy Performance (MEP) standards for domestic energy appliances, as detailed in Box 7 below. Recent changes to building energy codes are outlined in Box 8.

Figure 9 - Building energy codes by jurisdiction, 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.

Source: GlobalABC/IEA/UNEP (2019). All rights reserved. Adapted from "Energy efficiency policies: Buildings".

Box 7 - Minimum Energy Performance Standards (MEPS)

Alongside the IEA database³, the Buildings-GSR survey also pointed to developments in MEPS. This box outlines some of the highlights for 2020.



People's Republic of China

China's 2019 "Green and High-Efficiency Cooling Action Plan" raised MEPS for space cooling and set minimum energy efficiency levels for room air conditioners.



Nigeria

MEPS have been introduced for air-conditioning products under code "FDNIS ECOSTAND 071-2:2017EE".



India

India's Energy Efficiency Standards for a wide range of domestic appliances including air conditioners, refrigerators, tubular fluorescent lamps and washing Machines were updated between 2018 and 2020.



Canada

Energy efficiency regulations amendments were published in June 2019, updating or introducing requirements across nine product categories.



Egypt

MEPS for air conditioners and heat pumps based on ISO 5151/2017 have been implemented.



South Korea

A 10% refund for all citizens when purchasing high-efficiency home appliances came into effect in 2019.



Rwanda

June 2019 saw the definition of minimum standards for solar home systems. MEPS for air conditioners and refrigerators are due to be introduced in 2021



Viet Nam

2020 saw the deadline for the adoption of a wide range of MEPS and labelling across a wide range of domestic appliances, including televisions, washing machines, and fluorescent lamps.

³ The IEA maintains a database of national and regional energy building policies, including building energy code updates, aimed at regulating energy use in buildings. The most recent additions to this database are outlined in this section, along with additional programs not covered by the IEA (IEA 2020h).



Box 8 - Building Energy Codes Updates

Building energy codes continue to be updated worldwide. Recent developments have been highlighted by Buildings-GSR survey respondents and wider literature searches.



India

The state law of Himachal Pradesh is to be amended to incorporate the Energy Conservation Building Code 2018, which aims to reduce energy demand from buildings by 30%.



Azerbaijan

A new law on energy saving and energy efficiency was expected to come into force in 2019.



Oman

The UK's BSI to develop Oman's new National Building Code from 2021



Philippines

A new code is in development incorporating guidelines on energy conservation



Canada

New model national energy codes for new buildings are in the final stages of development for the 2020 code cycle. The codes will apply to small buildings and homes, as well as commercial and institutional buildings. The new codes go beyond a single improvement target and set out all tiers, or stepped performance targets, leading to "net-zero energy ready" performance for jurisdictions to adopt by 2030.

From the GlobalABC member survey (see GSR Survey Section for details), respondents highlighted key developments in both building energy codes and building energy certification schemes. A clear majority (79%) of respondents reported that their region or country had a building energy code in place, with 14% reporting they did not. However, 81% of Commonwealth countries have no mandatory energy code covering their residential sector, while 69% of Commonwealth countries have no mandatory energy code covering their non-residential sector (see Box 9 below).

Hong Kong building codes were updated in 2018 and came into force in 2019. The update focused mainly on lighting and air-conditioning in buildings. For example, air-conditioning units are now mandated to provide a coefficient of performance (CoP) in cooling mode of 3.45 for larger units and 3.6 for smaller units, over the previous requirement of 3.3 in the previous building energy code.

Within the context of Building Code legislation, the French buildings energy labelling scheme was updated with higher level requirements for residential buildings introduced in 2019, with non-residential buildings due to follow in 2020. Limits on life-cycle carbon emissions for buildings is currently voluntary in France but will become mandatory for new buildings in 2021.

The Japanese building energy conservation laws were revised in 2020. New mandatory requirements on energy saving in new domestic buildings are due to come into force in April 2021. The changes will also allow local governments to independently strengthen energy savings standards in their region. The survey also revealed that the national Mexican building codes will be updated in 2021-22. In Germany, a new code under the Building Energy Act will come into force by November 2020, which merges formerly separated requirements for use of renewable energies and energy efficiency in one code.

Box 9 - Survey of the Built Environment Professions in the Commonwealth⁴

Climate change and rapid urbanisation are among the most serious challenges facing the Commonwealth; challenges which have been compounded by the effects of the Coronavirus pandemic; and an analysis of the most recent projections produced by UN Habitat reveals that nearly 50% of the projected 2.5 billion increase in the world's urban population to 2050 will be in Commonwealth countries.

In addressing the concern of how well equipped built environment professions are to meet this challenge the four Commonwealth associations representing architects, engineers, town planners, and surveyors set out to answer in the Survey of the Built Environment Professions in the Commonwealth; the first such joint survey ever to have been undertaken.

The key findings of the survey reveal that:

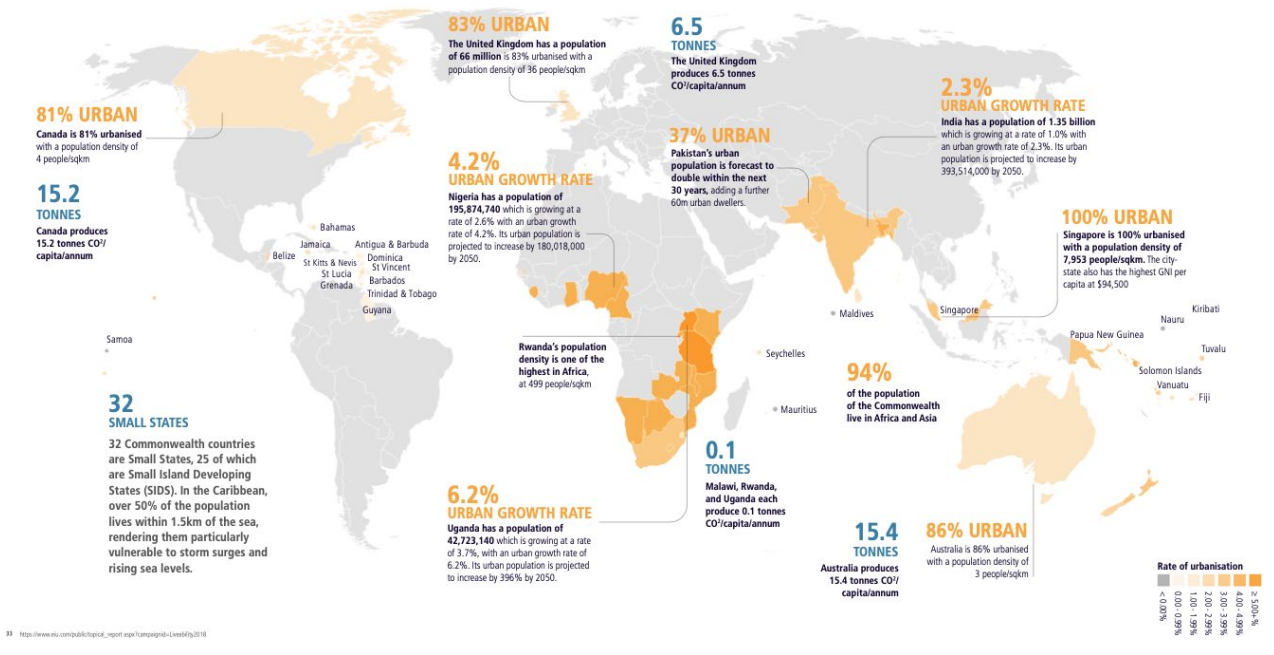
- There is a critical lack of capacity among built environment professionals in many of the Commonwealth countries which are rapidly urbanising and are among the most vulnerable.
- There is a lack of educational and institutional capacity to grow the professions fast enough in many Commonwealth countries.
- There is increasing recognition of weakness in built environment policy (e. g. planning policy and building codes) in many Commonwealth countries in terms of standards, implementation, and enforcement.

The findings of the survey are clearly important if the opportunities presented by agglomeration to increase prosperity and strengthen resilience are to be realised and the risks associated with poorly planned cities, such as inequality, informality, and vulnerability, are to be avoided.

CLIMATE CHANGE, RAPID URBANISATION AND THE COMMONWEALTH

Half of the top 20 global emerging cities are in the Commonwealth: New Delhi, Mumbai, Nairobi, Kuala Lumpur, Bangalore, Johannesburg, Kolkata, Cape town, Chennai and Dhaka. According to the Economist Intelligence Unit¹³, the Commonwealth includes 6 of the 10 Most Liveable Cities in the World and 5 of the 10 Least Liveable Cities in the World.

Nearly 50% of the projected urban growth to 2050 will be in the Commonwealth; that's an additional 1 billion urban dwellers in the next 30 years.



4 Oborn, P., and Walters, J (2020): Survey of the Built Environment Professions in the Commonwealth. <https://commonwealthsustainablecities.org/survey/>

As a way to embed good practice around implementing building energy codes, Knowledge Transfer Initiatives may be the most effective method of empowering built environment professionals. Conferences and lectures are not necessarily always effective in changing professional practice. The premise of knowledge transfer is that it shifts from the traditional approach of once professionals 'know', then they will 'do' to once they 'do', then they 'know'. Knowledge Transfer is an emerging field of research and education

that could be applied to the building industry to result in significant change in good practice adoption. An example of such an approach is a program in British Columbia, Canada which focuses on ways of undertaking knowledge transfer.

Building codes require a strong system of enforcement to ensure compliance. Many countries have adopted ambitious and comprehensive requirements for energy-efficient buildings. The challenge now is to ensure public and private developers implement these standards.

Case Study 2: Building code enforcement in Morocco

Morocco has sought to support enforcement of the Building Energy Efficiency Code for new buildings (known as RTCM), which entered into force in 2015. Achieving compliance and enforcement on a large scale is still a challenge, as many project developers are not familiar with the new regulations. In 2020, the general construction code was updated and now provides more clarity to the sector's actors. The certificate of conformity with the RTCM is now considered as one of the mandatory documents that need to be submitted to obtain a building permit.

Central, regional and local departments of the Moroccan Ministry of National Territory Planning, Urban Planning, Housing, and City Policy are among a number of essential actors to ensure the mandatory national regulations are respected. At the regional and local levels, housing and city policy departments of the Ministry are responsible for the compliance of state-supported social housing buildings with national standards. Building constructors must respect these standards to receive compliance certificates. Only then can they benefit from tax exemptions that are provided by the state to encourage investments in social housing. An excellent grasp of the legislative, institutional, and regulatory framework of energy efficiency in buildings in Morocco is essential for this task.

Training for a total of 100 employees were organised by the Ministry and the **Programme for Energy Efficiency in Buildings (PEEB⁵)** in 2019 to support technical staff working in the central and regional departments of Housing and City Policy. The training provided knowledge about the standards and actors in the field, as well as practical examples. As a result, staff feel confident to integrate energy efficiency measures in buildings. This is particularly relevant in the context of Morocco's national administrations exemplarity programme, which encourages public administrations to be a role model in implementing the national sustainable development strategy.

⁵ *The Programme for Energy Efficiency in Buildings (PEEB) is catalysed by the Global Alliance for Buildings and Construction (GlobalABC). The Programme supports the implementation of the Paris Agreement and GlobalABC roadmap "Towards low GHG and resilient buildings". It is initiated by the governments of France and Germany.*

3.3 BUILDING SUSTAINABILITY CERTIFICATION

Certification of a building's energy and/or sustainability performance highlights best practice construction efforts and provides a market signal to sustainability-conscious investors, tenants, policymakers, or consumers. Green or sustainable building certifications play an important role for building developers and owners to both distinguish their buildings within the market, but also to highlight their commitment to the principles of sustainable building construction and operation. The use of certifications offers

a comparative assessment of how well a building meets defined criteria for a standard and that relevant requirements are fulfilled.

The certification of buildings and districts has become an important tool for quality assurance during design, construction and operation. Due to the lack of holistic and ambitious legislations in almost all countries, and provided certification systems embrace Paris Agreement compatible levels of emissions, certification systems can fill the gap and work as a market transformation tool where it accelerates the movement of the market and all its stakeholders to a more ambitious building practice. With the increasing understanding and demand from the financial sector,

certifications can also be used to verify the requirements around sustainable finance practices such as the taxonomy initiative in the EU (see Case Study 2). In some low and middle income countries that lack or have outdated building codes, building certification is used as a de facto building code and can be an important tool for securing both financing and tenants. Green building certification should ultimately seek to advance the buildings market towards ever higher levels of improvement and transparency.

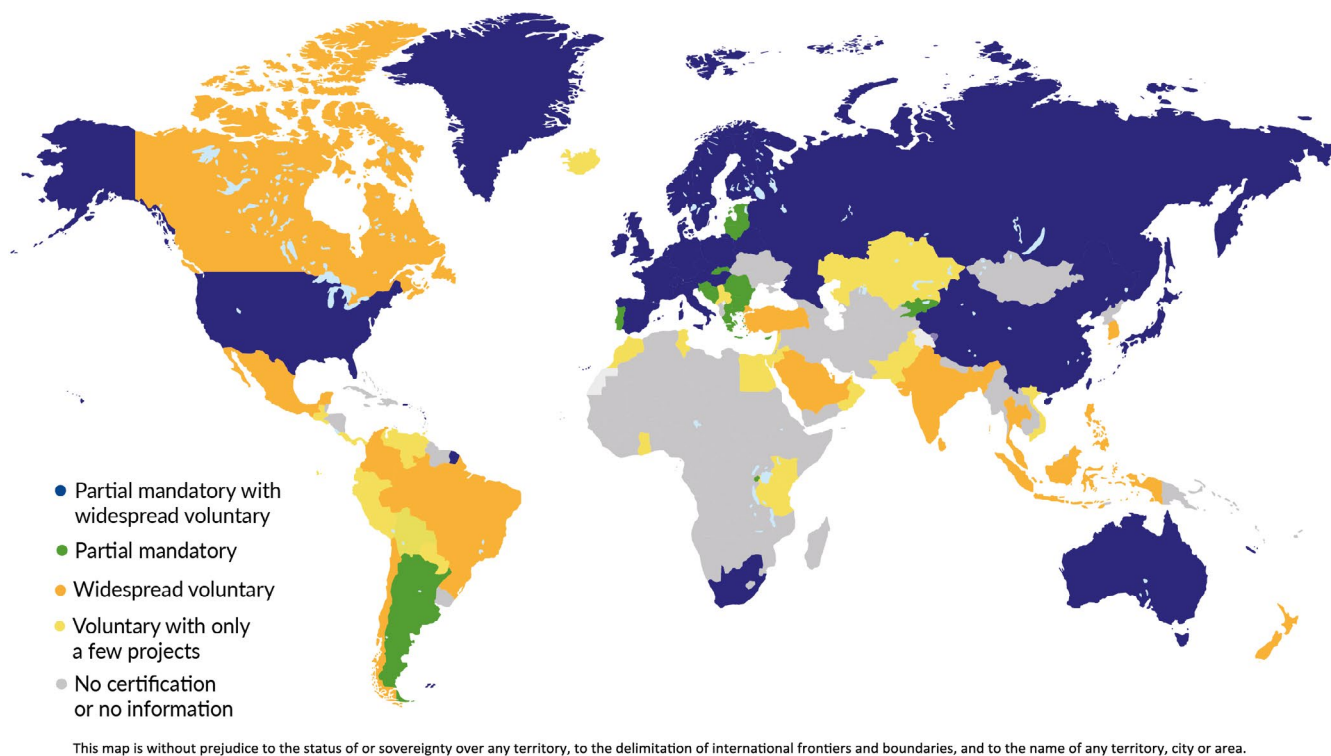
2020 has seen continued growth in the number of green/sustainable building certification standards (see Box 10) and more buildings than ever are being certified. Globally, major certifications such as LEED, BREEAM, Passivehouse, DGNB, and EDGE continue to be widely used. However, there are many regional and national level standards that are being applied, such as the newly developed CASA certification in Guatemala, the Estidama Pearl Certification in the UAE, Green Star in Australia, the Living Building Challenge 4.0 Standard (USA; with global scope) or Greenmark in Singapore. There are also regional rating systems, such as the Global Sustainability Assessment System (GSAS) in

the Middle East or the Green Building Index (GBI) used in Southeast Asia.

Green building certification and other sustainable certifications focused on low and nearly zero emission or energy buildings are an important ingredient in achieving low-carbon building stock, but must be based on common definitions alongside mandatory building codes and progressive policies. Many of these schemes have been released, certifying buildings that achieve net zero based on performance data, including nine standards from Green Building Councils including LEED Zero from USGBC, the EDGE Zero Carbon and ILFI Zero Carbon certifications. In October 2020, the Green Building Council of Australia released an update to their GreenStar tool, and buildings must now be net-zero, meaning fully electric, fossil fuel free and 100% powered by renewables, in order to score the highest possible 6 Star rating.

From the GlobalABC member survey (see GSR Survey Section for details), a quarter of respondents reported an update to their region’s building energy certification in 2019 or 2020, of which 75% were mandatory or partially mandatory.

Figure 10 - Building energy certification programmes by jurisdiction, 2017-18



Source: IEA (2019b). All rights reserved. Adapted from “Energy efficiency policies: Buildings”

Box 10 - Energy labels and certification actions

The IEA database provides information on recent energy labels and certification schemes have seen expansion in 2019/20. This box highlights some recent developments in the area.



Argentina

Santa Fe became the first Argentine province to implement a mandatory Energy Efficiency Label of residential buildings. The program introduces the Energy Efficiency Label as an instrument that provides information to users about the energy performance of a home. It provides an additional decision tool when carrying out a real estate operation, evaluating a new project or carrying out interventions in existing homes.



Australia

An update to the energy label and testing requirements for air conditioners and heat pumps was introduced in 2019.



China

Passivehouse certification continues to grow with over 500,000 total floor area (TFA) m² being certified with the standard. The first 30-storey residential Passivehouse in China was certified in 2019 in Tianjin, which included passive designed exterior walls, high efficiency HVAC systems and an airtightness level of 0.5 air change per hour (ACH).

From 2015 to 2019, 13 cities in nine provinces and autonomous regions in China have issued 28 policy documents to promote the development of nearly zero energy buildings (NZEBs). China Association of Building Energy Conservation is responsible for the management and promotion of the NZEB certification and by the end of 2019, 18 projects nationwide had obtained the ultra-low, nearly zero and zero energy building labels.



Mexico

A new COVID-19 hospital has received preliminary EDGE certification in Puebla, Mexico. The total floor space is over 1,500 m² and the projected CO₂ savings of EDGE certification are estimated at 23 tCO₂/year.



Colombia

The country usually uses EDGE, LEED and its own CASA Colombia, certification systems from 2015. The City of Medellin is focused on improving its own levels and certifications system for popular housing projects 2020.



Peru

Peru GBC, in collaboration with the IFC launched in 2018 a green buildings incentive program with a local municipality. The program aimed to award building developers, both commercial and residential, who decided to build green on the district by complying with a set of sustainable construction requirements and an international certification system such as LEED or EDGE. Project developers were awarded extra floor area, translated into additional stories for their buildings. This program was a success and has been replicated in three other local municipalities and two cities.



Brazil

GBC Brasil signed a MOU with the State Government of Paraná (Paranacidade) and Agência Fomento Paraná creating the local Net Zero Energy Building Program that aims to transform all public buildings from the State in NZEB, starting by public schools. A pilot project began with 212 public buildings from seven different municipalities with retrofit projects for energy efficiency that include lighting and HVAC retrofit and onsite photovoltaic energy generation.



Jordan

The Izzat Marji Group (IMG) headquarters in Amman, Jordan an 8,700 square meter office building is the first in Jordan to receive the Jordan Green Building Guide (JoGBG) Certificate with the highest level "A", and the first commercial building in Jordan to receive Platinum rating under the Leadership in Energy and Environmental Design (LEED) certificate provided by the U.S. Green Building Council (USGBC).



Guatemala

In 2020, the Guatemala Green Building Council launched its first certification for sustainable housing, after two years of being in the pilot stage, called CASA Guatemala. The first CASA certification was an affordable, multifamily building comprising 72 apartments located in the center of Guatemala City, called Trasciende. The development is the first MUVIS: Modulos Urbanos de Vivienda Integrada Sostenible (Urban Modules of Integral and Sustainable Housing), which promotes an inclusive mixed housing income approach.

4 INVESTMENT AND FINANCING FOR SUSTAINABLE BUILDINGS

4.1 INVESTMENT ACTIVITIES

Key Message: In 2019, spending for energy efficient buildings increased for the first time in the past three years. Yet, at an increase of just 3%, it remains outpaced by investment in conventional buildings and construction.

The incremental investment in building energy efficiency across global markets was around USD 152 billion in 2019, an increase of 3% from 2018 (IEA 2020c)⁶. This is a positive change compared to the flat investment in 2017 and 2018, which was approximately \$148 billion. However, this rate is less than the rate of growth of the investment in construction of buildings which was 4.9%, corresponding to \$USD 5.9 trillion. Indeed, in the buildings sector, for every \$1 spent on energy efficiency, \$37 is spent on conventional construction approaches.

This increase in energy efficiency investment is driven by both the increase in construction industry investment activity across the global market, with a rise of 4.9% from 2018 levels, and a continued effort in policies, especially among European countries and in China to direct greater investment in building energy performance.

Between 2014 and 2018 the annual rate of growth in energy efficiency in buildings, measured as the improvement in energy intensity, was at 3.5%, which is aligned with the 3% growth – a rate required to deliver the Paris goals and the Sustainable Development Goal 7. However, this rate is less than the rate of growth of the investment in construction of buildings, which is 4.5% over the same period. This means that energy efficiency investment growth is not keeping pace with the construction of buildings globally, leading to little change in final energy use in global buildings stock (see Figure 11). Recovery plans for the sector after the COVID-19 crisis should clearly seek to have energy efficiency investment growth outperform floor area growth for gaining net reductions in final energy use.

For energy efficiency investments, the slowing of the construction industry in late 2019 put further pressure on government-oriented programmes, and is likely to be exacerbated by the exceptional uncertainty across the global

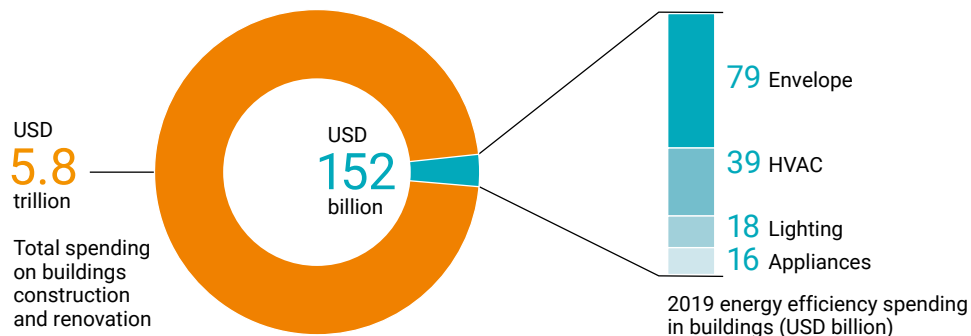
construction industry related to the COVID-19 crisis and sudden economic slowdown from March 2020.

Across the global market, investment activities around energy efficiency were focused on economies that had either continued growth demands, such as China and India, or that had introduced new policies that spurred investment in energy efficiency, such as in Canada, Norway, Switzerland, and Spain (see Box 11).

In Europe, investment growth in energy efficiency, though moderate, tended to outpace construction activities (IEA 2020c). In the United Kingdom, efficiency investment increased by 8% from 2018, while construction investment saw no growth. This trend of growth in efficiency outpacing construction was also shown in Italy and Switzerland. By comparison, Germany saw a reduction in energy efficiency investment of 12% in real terms from 2018, but at the same time saw a modest growth in construction investment.

⁶ *The incremental investment for new or renovated buildings is the change in cost for services (e.g. design, delivery and installation) and products (e.g. lighting, equipment and materials) that achieves increased energy efficiency beyond the investment required for the minimum performance legally allowed. For building types and products that do not have energy efficiency requirements, this cost is the incremental spending on energy-efficient services and products beyond what would have otherwise been spent (which, in some cases, is no spending). For the incremental investment in buildings achieved due to the improvement in energy efficiency policies, this cost is the incremental spending required to achieve the new energy performance requirements beyond the previous level to which the market had already adapted. (GlobalABC 2018)*

Figure 11 - Building construction and energy efficiency investment and breakdown



Source: IEA (2019b). All rights reserved. Adapted from "Energy efficiency policies: Buildings"

Box 11 - Public sector building energy efficiency investment activities

In **Canada**, the 2019 budget included additional investments of nearly \$1B (CAD) in the Green Municipal Fund to provide funding for Canadian municipalities to increase energy efficiency in homes and buildings. This new investment is supporting three initiatives launching in 2020:

1. Community Efficiency Financing to support municipalities in offering innovative financing programs for homeowners;
2. Sustainable Affordable Housing to fund affordable housing developments targeting both retrofits and new builds that work toward Net Zero Energy standards; and,
3. Collaboration on Community Climate Action, which will create a network of seven low carbon climate centres in major cities across Canada and establish a new funding stream to reduce GHG emissions from large community buildings and other infrastructure in communities.

In **India**, energy efficiency investment continued to increase at a moderate rate (7%), which was aligned with its overall construction activity of 8%. Across India, the ongoing process to develop and implement more stringent standards for commercial and residential buildings (such as the Eco-Niwās Samhita building code and the Energy Efficiency Label for Residential Buildings). Fully adopting these codes at the state level in the same manner as the Energy Conservation Building Code should leverage further investment in coming years.

In the **EU**, the recently announced 'Renovation Wave' initiative for public and private buildings has set an aim of substantially increasing the renovation rates across the EU and to provide a framework for renovation to support the green recovery (European Commission 2020). The plan states that the additional investment needed to reach EU 2030 energy and climate targets is around 325 billion annually, with approximately EUR 250 billion for residential and EUR 75 billion for public buildings. A similar magnitude of annual investment levels are needed from 2030 to reach net zero emissions by 2050.

New Zealand has recently committed an additional \$500m for housing retrofits. The funds are aimed at improving the energy efficiency of up to 1,500 homes by 2022. Improvements such as insulation and double-glazing aim to deliver energy savings and a healthy indoor living environment.

Between 2019 and 2023 the energy efficiency of **Moroccan** government buildings will be improved. The first phase was financed with \$23m by the German bank KfW. Action on home energy efficiency targeted at low- and middle-income households is under development through the National Appropriate Mitigation Action (NAMA) Facility. An estimated 160,000 tonnes of CO₂ will be mitigated over the project's 5-year duration.



Box 12 - Private sector investment in energy efficiency

Google's parent company Alphabet has issued a \$5.75b green investment bond for an array of climate progressive actions, including green buildings, the circular economy and clean energy. Projects eligible for funding will need to conform to the Green Bond Principles, as defined by ICMA in 2018.

CITI Group has launched a \$250b environmental finance goal. The target was launched as a part of the group's Environmental and Social Policy Framework. CITI's previous goal from 2015 stood at \$100b.

HSBC has created a dedicated environmental, social and corporate governance unit. The unit recently supported a £743 million green loan agreed to build an electricity connection between the UK and Denmark.

A recent report from **United Kingdom Green Finance Institute (UK GFI)** entitled "Stimulus actions for a greener and more resilient property sector" recommends that the net-zero building retrofit sectors might be reformed and given stimulus actions in response to the COVID-19 pandemic (Green Finance Institute 2020). Such action would shift construction activities toward low-carbon targets and also provide health and economic co-benefits.

Case Study 3: Standards for measuring investment

Sustainable investment initiatives and taxonomies should increase the allocation of financial resources for efficient and resilient buildings

Since 2015, a number of new initiatives for sustainable finance have been launched at international and regional levels. June 2020 saw the publication of ISO standards dealing with Environmental performance evaluation for green debt instruments and the European Union regulation 2020/852 for the establishment of a framework to facilitate the use of a sustainable investment taxonomy. These two initiatives will enable the removal of a substantial barrier in the building and construction sector related to the lack of standards to account for sustainable investment in the buildings sector.

The ISO/DIS 14030 are standards for environmental performance evaluation of green debt instruments that comprise four parts, including standards related to the taxonomy of activities: Part 1 - Process for green bonds; Part 2 - Process for green loans; Part 3 - Taxonomy; and Part 4 - Verification.

Part 3 of these standards on Taxonomy describes the eligible activities for the building and construction sector and also construction and real estate activities. Economic activities which are covered by this section are: Construction of new buildings; Renovation of existing buildings; Individual renovation measures, including installation of on-site renewables and professional, scientific, and technical activities; Acquisition and ownership of buildings.

At the European level, regulation 2020/852 for the establishment of a framework to facilitate sustainable investment provides the basis for financial resource allocation towards energy efficient and environmentally sustainable and resilient buildings.

The regulation describes an investment as environmentally sustainable, when an economic activity:

- ▶ contributes substantially to one or more of the key environmental objectives set out in the regulation;
- ▶ does not significantly harm any of the key environmental objectives;
- ▶ is carried out in compliance with the minimum sustainable development safeguards laid out in the regulation;
- ▶ complies with technical screening criteria that have been established by the European Commission.

The taxonomy distinguishes four economic activities and defines consistent mitigation criteria that enable assessment of the eligibility of investments in construction and real estate on the basis of their potential impact on building energy performance and carbon emissions.

In Europe, all member states have to implement this regulation, while other countries may have their own regulations or a voluntary framework such as proposed by the ISO standards. In the context of COVID-19 recovery plans, initiatives for financial resources – either via loans or grants – can provide a structured framework to support the ambition of the GlobalABC Roadmaps.

In addition, many stakeholders have begun to take their own actions to address the carbon emissions and sustainability of their building stock. While much of the focus is on government stimulus and investment, private companies continue to take important steps towards investing in their building assets or in those of others.

4.2 INVESTMENT FLOWS BY DESIGN: THE FINANCING OF GREEN BUILDINGS

Key message: Sustainable building investment represents one of the biggest global investment opportunities of the next decade – an estimated \$24.7 trillion by 2030.

According to the IFC report, Green Buildings: A Finance and Policy Blueprint for Emerging Markets, green buildings represent one of the biggest global investment opportunities of the next decade, estimated to be \$24.7 trillion by 2030 (IFC, 2020). Most of this investment potential – \$17.8 trillion – lies in emerging market cities in East Asia, the Pacific, and South Asia, where more than half of the world's urban population will live in 2030. Further, according to the World Resources Institute, there is a shortfall around the world of 330 million homes, which is expected to jump to 440 million homes by 2025. This means that the investment opportunity is mostly in new residential buildings, which at \$15.7 trillion represents 60 percent of the total market (King et al. 2017).

Real estate investors and financiers hold tremendous influence in shaping and accelerating this multi trillion-dollar business opportunity through a focus on green buildings finance. These include commercial banks, such as HSBC and Standard Chartered Bank, institutional investors including pension funds and sovereign wealth funds, and national and

multinational development finance institutions, and which are all eager to create a dynamic that frees up capital.

There are promising signs that the wider financial sector has the interest to build back better after the COVID-19 pandemic, smoothing the transition to a lower-carbon economy. Financiers in even the toughest markets now recognize that green buildings have higher value than standard structures as they have lower fiscal, regulatory, and reputational risks. They also have a much lower incremental cost than previously understood, that is typically 1% of capital expenses. In short, it is now more widely accepted that maximizing returns goes hand-in-hand with minimizing environmental impact.

Major banks that are focused on innovation are gaining access to new sources of capital through green bonds, green credit lines, green securitizations, and impact funds, which enable them to offer green construction finance and mortgages. By offering better financing terms, banks are driving both the supply and demand sides, enticing developers to green their buildings while sparking interest from commercial tenants and homebuyers.

The key ingredient to unlocking investment flows is green building certification, which helps serve as a verification instrument for facilitating the issuance of green bonds and other forms of sustainable finance. Standardized metrics and reporting requirements are essential for financiers to catalyse investment at the scale required to green the construction market. Certification provides investors with assurance that their investments are quantifiably green, which supports both financial viability on a project basis as well as enabling a more strategic view towards portfolio alignment.

Box 13 - Real estate investment trusts (REITs) as a vehicle for energy efficiency

Of the 1,005 real estate companies, developers, REITs, and funds representing more than \$4.1 trillion in assets under management that reported to The Global ESG Benchmark for Real Assets (GRESB) in 2019, 90 percent align their projects with green building rating standards for construction and operations. Only 45 percent, however, require a specific level of certification for more than three-quarters of their projects under development. Green building certification is projected to play an even greater role in the future as a qualifier for investment. – Green Buildings: A Finance and Policy Blueprint for Emerging Markets (IFC 2020)

In their recent Green Buildings Report, the IFC (2020) focused on the combination of new green buildings and retrofits as a major business opportunity and an avenue to reduce the intensity of energy and water usage and the output of carbon emissions (see Box 14). While IFC's role and that of other multinational development finance institutions is small in absolute terms, together they play a critical role in blending

concessional finance and catalysing markets in emerging economies. In addition, many of the financial institutions that IFC works with have now decided to adopt these green lending practices by adopting green lending practices, despite the negative macro-economic environment triggered by the pandemic.

Box 14 - Private sector investment actions

Bancolombia was one of the first major commercial banks to capture a greater slice of market share by offering more competitive rates for both green construction finance and green mortgages. The bank has undertaken an extensive outreach campaign to generate awareness for its green construction financing rate of up to 100 basis points lower than market rates. In tandem, Bancolombia offers green mortgages to qualifying home buyers who purchase certified properties at a discounted rate of 65 basis points. To gain access to the capital needed to make this happen, Bancolombia issued green bonds by securitizing the assets of its clients. As a result of its holistic approach, Bancolombia won the title “the most sustainable bank in the world” by the Dow Jones Sustainability Index, demonstrating that such leadership gets noticed.

Davivienda, another leading bank in the **Colombian** market, responded by offering green construction finance at a maximum of 100 basis points lower while further enhancing its offer by covering 50 percent of certification costs for clients. Together Bancolombia and Davivienda comprise more than 40 percent of commercial banking activity in Colombia’s real estate sector. They have helped to drive 55 percent of total market penetration for certified buildings, which includes nearly 11,000 homes either registered or certified with IFC’s EDGE.

Banco Pichincha in Ecuador was next to offer a slightly different incentive, providing complimentary certification to developers for smaller projects along with free training and technical support on the certification process. In turn, Banco ProCredit in Ecuador created its own promotional bundle to attract developers, with a reduction of 50 basis points from its typical lending rate, an extra four years for loan tenor, complimentary technical assistance, and coverage of up to 80 percent of certification costs.

As banks increasingly divert their investments towards green buildings, they are reaping the benefits of green bonds. But banks are not the only entities operating in the green bond space, which is estimated to reach \$350 billion in 2020 (up from \$257.7 billion in 2019), according to the Climate Bonds Initiative. Developers can also raise capital, utilizing the same principles of either the Climate Bonds Initiative (residential and commercial) or the International Capital Markets Association (GBP Impact Reporting Working Group 2019).

Mexico’s Vinte, a young and profitable company that attracted an IFC equity investment in its early stages, has since listed on the Bolsa Mexicana de Valores (BMV). Vinte provides shared value through well-organized and secure communities that include health clinics, parks, and schools. Their homes feature solar technologies, state-of-the-art induction stoves, and smart meters while still being at an affordable price.

In 2018, Vinte became the first housing developer in Latin America to issue a sustainability bond, which combines social and green impacts. Mexico CO2, a subsidiary of BMV, attracted investors eager to create a ready-made market for Vinte. With plans for several thousand more homes, Vinte issued another sustainability bond in 2019 and committed to certification to win investor buy-in. As the bonds were oversubscribed, the result has been better pricing for Vinte and the ability to raise debt despite a local market with a low appetite for real estate investment.

In **Kenya**, **Acorn Holdings** became the first organization in Kenya to issue a green bond in the amount of \$43 million with proceeds financing EDGE-certified student accommodations. Acorn created their own green bond framework before successfully issuing their bond, proving the viability of the concept ahead of local banks (Acorn Holdings 2019). Several thousand units in six developments across Nairobi will be constructed for rental by university students and young professionals.

There are signs that the green mortgage industry is also rapidly developing in Africa. Balwin Properties, the largest provider of sectional title properties in South Africa, is an example. The developer created a pipeline of certified green homes, then turned to Absa, a financial institution with which it has had a 25-year commercial relationship. The result was a first-to-market proposition for customers who now benefit from a lower borrowing rate through an “eco home loan.” Balwin Properties and Absa share values based on a customer-centric focus and environmental sustainability, that have made this collaboration a success.

Also in **South Africa**, significant progress has been made in the financing of affordable green homes through International Housing Solutions (IHS), a real estate investment firm that requires its property developer clients to certify their projects green to gain access to finance. So far, 7,000 homes have been either registered or certified to date. IHS both manages the rental properties that it builds and sells homes to buyers, pre-installing smart meters so residents are empowered to manage their energy and water consumption throughout the day. The smart meters demonstrate to residents that annual utility savings are typically equivalent to saving one month of rent. Investment management firms like IHS, which include Paladin Realty in Latin America and Asia Green Real Estate in China and Indonesia, understand high returns for their clients – mostly institutional investors that have interests in making a profound social impact – can only be realized if the projects they invest in are certified green.

Property developers are starting to shift their strategies to take advantage of preferential financing that’s slowly being made available. While progress is patchy and relies on competitive forces at play, banks are starting to screen assets for certification to ensure higher-value and lower-risk portfolios, while gaining better access to global capital markets. These actions will lay a foundation to stimulate supply and demand for green buildings in support of low-carbon growth as part of the recovery after the health crisis.

Over the next decade, making major strides towards zero-carbon emissions buildings will be critical to achieving science-based targets and avoid catastrophic climate change. The World Green Building Council has challenged the financial sector to commit \$1 trillion in investment by 2030. Given the investment opportunity that exists and the progress that is being made in pockets around the world, this ambition has a chance of being realized.

5 2020 BUILDINGS–GSR 2020 FOCUS AREAS

The following sections provide a further in-depth review of several focus areas that deserve further attention and were therefore selected by the GlobalABC for this year's Buildings GSR.

5.1 NET-ZERO BUILDINGS

Key message: Commitments to net-zero energy and zero-carbon emissions buildings are gaining traction. Certification organizations and Green Building Councils across the world are developing market capacity to deliver net zero carbon buildings at scale.

5.1.1 INTRODUCTION

As part of the global decarbonisation strategy, net-zero energy and zero-carbon buildings must become the primary form of building construction across all economies by 2050.

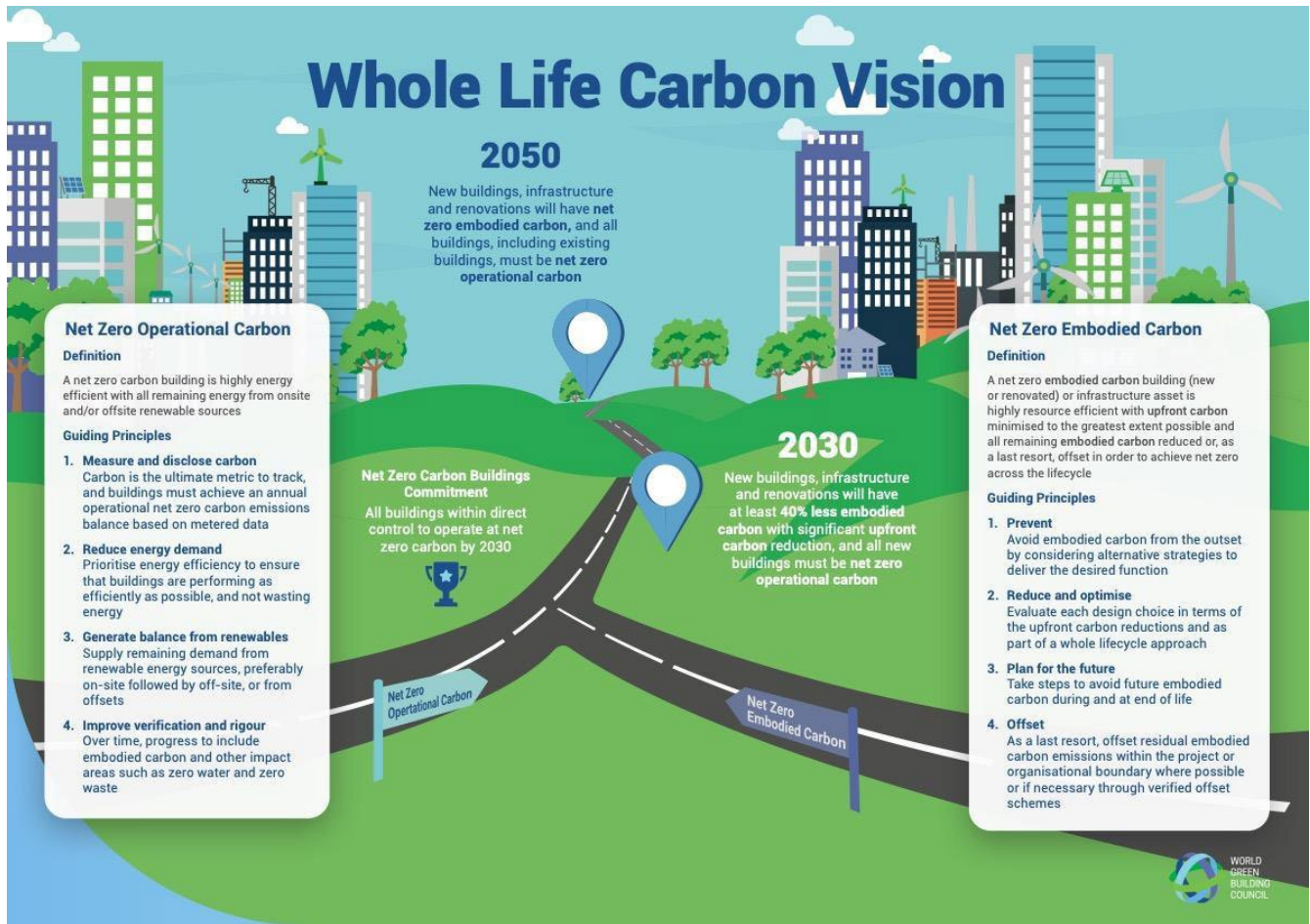
The concepts of net-zero-energy or zero-carbon emission buildings do not have a widely recognised standard definition (Buildings Energy Efficiency Task Group 2018). However, what most definitions have in common are the following

elements: very low energy buildings that aim to achieve zero-energy or zero emissions over the course of a year, where any energy consumed or carbon emitted is offset by using renewable sources, usually at the building site (though it may also be done offsite to achieve the remaining zero carbon emissions). Electricity source certifications may be a further tool in reducing emissions as power production shifts away from fossil fuel generation.

Organizations around the world are working with developers, financing organizations, and building occupants to promote and accelerate the uptake of net zero buildings. For example, the World Green Building Council (WGBC) is supporting net zero buildings through its Advancing Net Zero (ANZ) project (World Green Building Council 2020) and its new, whole life vision for total decarbonisation of the built environment (Figure 12). By aligning with the ANZ framework, which includes guiding principles for achieving net zero operational and embodied carbon, WGBC's schemes and programmes can achieve commonality, whilst enabling the flexibility to adapt and adjust key concepts as appropriate to the local market. Snapshots outlining the programmes from several GBCs can be found here.



Figure 12 - Whole life carbon vision



Source: (WorldGBC, 2020). All rights reserved.

At a regional level, GBCs are collaborating on projects to develop solutions to specific regional challenges, such as developing a foundational Embodied Carbon Primer document for the Asia Pacific region; the BUILD UPON2 project in Europe, developing national deep energy efficient renovation strategies towards decarbonisation; and the Cities Climate Action project in the Americas.

In order to stimulate the market solutions necessary to deliver this vision and to send strong industry demand signals to policymakers, the Net Zero Carbon Buildings Commitment recognises business, organisations, cities, states, and regions which are taking leadership action through an advanced trajectory for net zero buildings across their own portfolio by 2030, and/or enacting regulations for new buildings to be net zero by 2030, and all buildings, including existing, to be net zero by 2050. To-date 6 sub-national states, 28 cities, and 81 businesses have joined the commitment. In 2019-20, the Commitment has doubled the number of signatories and expanded significantly in terms of impact.

Next to commitments, organizations are also developing frameworks towards net zero. For instance, the United Nations Economic Commission for Europe (UNECE) recently updated its Framework Guidelines for Energy Efficiency Standards in Buildings, which highlights the need for an efficiency first and holistic design approach to reach net-zero. It is crucial to ensure that energy needs are sufficiently reduced “to permit renewable energy or zero carbon sources to meet most or all of the remaining space conditioning energy requirements.”

5.1.2 MAKING NET-ZERO BUILDINGS THE NORM

In the wake of the COVID-19 pandemic, stimulus packages offer an opportunity to promote net-zero buildings

Through collaboration with industry organisations, business, and government, significant progress is being made to ensure buildings are recognised as a critical component in achieving the Paris Agreement goals. Multiple initiatives are underway to enable a market transformation towards complete decarbonisation.

Organisations contributing towards the vision include WBCSD (Building System Carbon Framework), C40 (Clean Construction Forum), Architecture 2030 (Achieving Zero), the Carbon Leadership Forum, and many more, including new initiatives to decarbonise specific supply chains. Additionally, the PHI and the International Living Future Institute (ILFI) partnered to release a common pathway of efficiency first with reliable planning and quality assurance to achieve verifiable net zero energy performance.

Box 15 - Science based targets initiative

Companies establishing detailed action plans to reduce their carbon emissions is an essential part of achieving the construction sector's 2030 objectives. Such action plans must cover the entire building life cycle, including emissions from constructing and operating buildings.

When setting action plans, the individual company's carbon reduction targets have to go hand in hand with those of partners along the construction value chain. It is critical to create a direct link from a supplier's carbon reduction achievement to a customer's carbon reduction target. Passing through carbon reduction measures along the value chain creates a common incentive across all players: It drives innovation among different companies at different stages of the construction value chain to jointly reach out for further carbon reduction potential.

The Science Based Targets initiative (SBTi) is validating leading companies efforts in setting themselves ambitious corporate climate actions in line with the Paris Agreement . With over 1000 companies signed up to using SBTi, these organisations are enhancing their carbon reduction scope beyond their own operations by including other indirect carbon emission (a.k.a. scope 3 emissions from electricity) in their carbon reduction action plans.

Examples of scope 1, 2 and 3 SBTs interacting for addressing embodied carbon in construction*:

1. Real estate developer
Mahindra Lifespace Developers Ltd., has committed to reduce absolute scope 3 GHG emissions by 20% by 2033 compared to 2018 as base-year.
2. Construction and engineering
Construction-services business **Royal BAM Group** has committed to reduce scope 1 and 2 GHG emissions by 50% per Euro revenue by 2030 compared with a 2015 base-year. Royal BAM Group commits to reduce absolute scope 3 GHG emissions 20% by 2030 compared with a 2017 base-year.
3. Construction material
LafargeHolcim has committed to reduce scope 1 and scope 2 GHG emissions 21% per ton of cementitious materials by 2030 compared with a 2018 base-year.

*The initiative is incentivizing cross-company interaction, as well as cross-sectoral collaboration to save carbon jointly, as the construction investors' and developers' scope 3 emissions are the scope 1 and 2 emissions of companies supplying goods and services to a construction project.

Box 16 - Benefits of implementation of Passive House Standards in Sri Lanka

The **Star Garments Innovation Center** is a product development facility in Sri Lanka. By renovating an obsolete building to the performance based Passive House standards, the project dramatically reduced the waste, carbon emissions, and fossil fuels typically required for demolition and a new build, while maintaining high standards in social, environmental, ethical and safety compliance within the global fashion industry. Monitoring results confirm that annual energy consumption has been cut by over 60% compared with a conventional “efficient” modern industrial building.

Solutions to prevent around 70% of the exterior heat and humidity from entering the building through the fresh air flow include: wall and roof insulation, solar protective double glazing and suitable shading, the avoidance of thermal bridges, an improved airtightness, and the use of ventilation units with heat and humidity recovery. A wrap-around heat pipe system helps to further reduce the dehumidification demand. All this enables workers to enjoy year-round comfort in a workspace that provides abundant natural light, low humidity, filtered fresh air, and maintains temperatures near a constant 24°C at low energy expenditure.

5.2 MATERIALS AND CIRCULAR ECONOMY

Key Message: Innovation and enabling frameworks are urgently needed to close material loops and reduce the demand for virgin materials for the built environment, which jointly with infrastructure currently use ~50% of resources extracted globally.

5.2.1 INTRODUCTION

In addition to its contribution to global greenhouse gas emissions, the built environment puts significant pressure on global resources, and materials production for buildings itself is a major contributor of GHG emissions across a building’s lifecycle (Material Economics 2020).

Global material use is expected to more than double by 2060, and the materials used in the building and construction sector will comprise a third of this rise. GHG emissions will also increase as a result of material use. Concrete alone is expected to contribute to 12% of global GHG emissions in 2060, (OECD 2020). Between 40% to 50% of resources extracted for global materials are used for housing, construction and infrastructure (de Witt et al. 2018)

The annual consumption of materials by the global construction industry amounts to an estimated 43 gigatonnes (Gt) of construction minerals (nearly half of all resource extraction, Krausmann et al 2018), including more than 4 Gt of CO2 intensive cement (Andrew 2018), as well as aggregate, asphalt, brick, plasterboard, stone and glass. A further 0.6 Gt of steel, and other metals such as aluminium

and copper, which are intensely polluting in their extraction and energy intensive in their production (Cullen et al. 2012).

The buildings and construction sector also greatly depends on virgin materials. For sand and unbound materials (e.g. crushed stone, crushed slag or concrete, or slate) for example, we need to extract 30 billion tonnes of sand per year or around 4 tonnes per person, mostly from rivers and coastlines, which can exacerbate existing vulnerabilities of coastal regions (WBCSD, 2018) Approximately 0.9 billion m3 of wood products, which consume vast amounts of forests and with only limited use of forest certification standards that indicate the use of sustainable harvesting.

Alongside these, large quantities of other materials are used with environmental impacts that are disproportionate to the quantities consumed, including: asbestos, plastics in window frames and architectural profiles, floor and wall coverings pipes, thermal and electrical insulation, composite materials, advanced fabrics, adhesives, coatings, paints and varnishes.

Annual material losses in construction, and demolition are rising, and result in end-of-life materials, or waste materials, equivalent to nearly 40% of mass when extracted. In the European Union (EU), current construction and demolition (C&D) waste accounts for approximately 25-30% of the total waste generated which and consists of numerous materials, including concrete, bricks, gypsum, tiles, ceramics, wood, glass, metals, plastic, solvents, asbestos, and excavated soil, many of which can be recycled (Iyer-Raniga and Huovila 2020)

Metals are well-recovered from construction and demolition waste everywhere because of their high value, and some countries report high recycling rates for mineral-based construction materials (EEA 2020). Most of this is downcycling, with loss of materials quality and value, and does not account for the embodied impacts from their production and manufacturing (CLC 2020).

A circular built environment is based on an emerging economic model that covers both techniques and business models to keep materials and resources in use as long as possible, and ideally forever, in a closed cycle of extended use, reuse, and recycling – where the potential for reuse of materials is huge.

Transforming the linear built environment into the circular built environment offers significant opportunities for the sector to lower its material and emissions footprint. Research for the European Commission found that for aluminium, emissions savings can be up to 90-95% (Moya et al. 2015), and for steel it can be up to 85-90% (Pardo et al 2012). Similarly, research for the US Environmental Protection Agency found that recycling glass and paper could reduce emissions by 1/3 compared to primary production (U.S. EPA 2019). According to the International Resources Panel, material efficiency strategies could reduce the whole life-cycle emissions of residential buildings by up to 35-40% in Group of Seven (G7) countries (IRP, 2020).

A Circular Economy, which keeps materials in use at high value, can therefore make an important contribution to achieving multiple the Sustainable Development Goals in particular SDG 12 (Responsible Consumption and Production), but also 11 (sustainable cities and communities), 9 (industry, innovation, and infrastructure), and 13 (climate action) (Iyer-Raniga and Huovila 2020) .

5.2.2 MATERIAL STOCKS, FLOWS AND IMPACTS

A dynamic understanding of the stocks of construction materials in the natural and built environment, and their use and flows in the construction industry over their entire life cycles (Figure 13) is needed. Information about construction material quantities must be complemented by data about their technical and other qualities, including their distribution over time and space, and their environmental, social and economic impacts. This information will enable: a) prioritisation of flows and processes for intervention, by identifying sources of supply and demand, failures of linear approaches, and barriers and opportunities for circularity, b) scenario analysis, to examine the potential consequences, benefits and trade-offs associated with material substitutions and changes in policy and technology, c) identification of connections with other systems, such as energy and water.

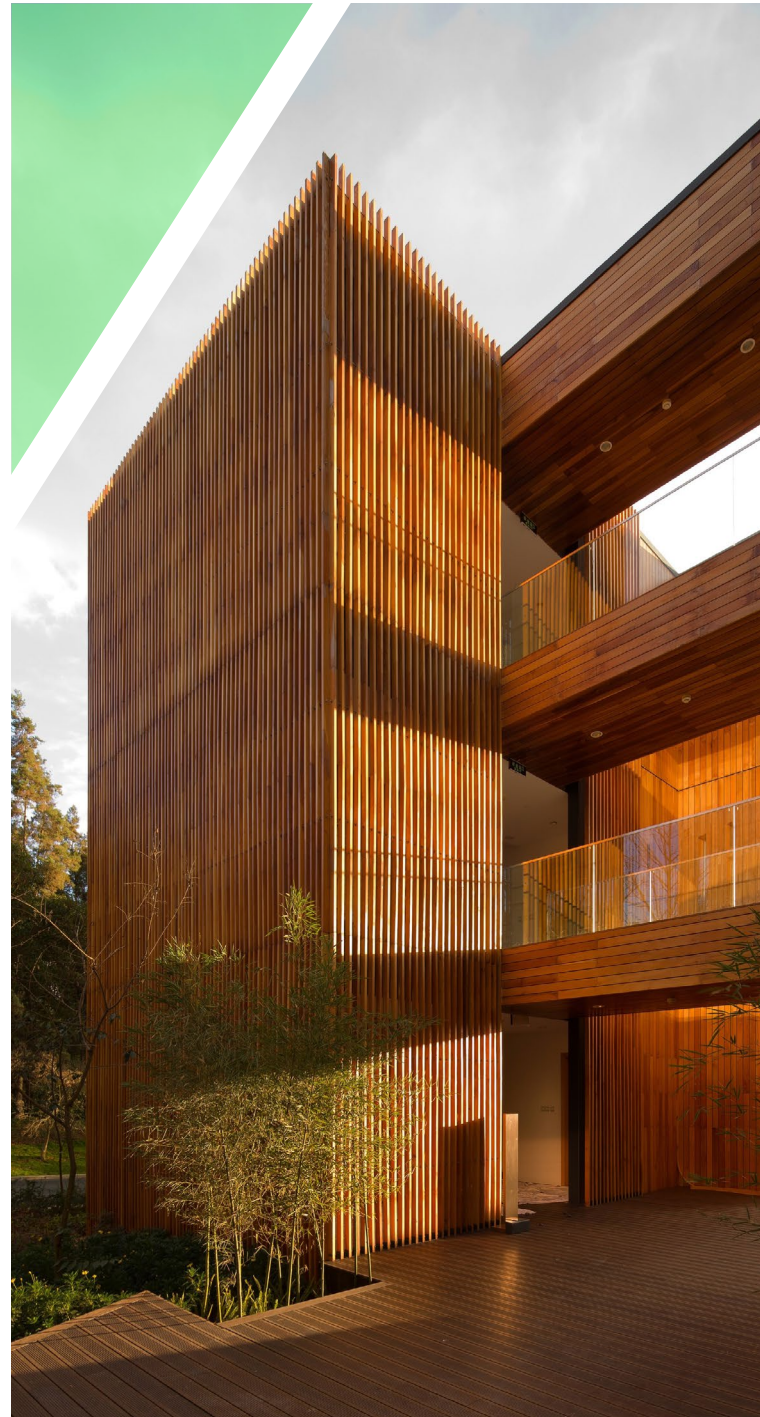
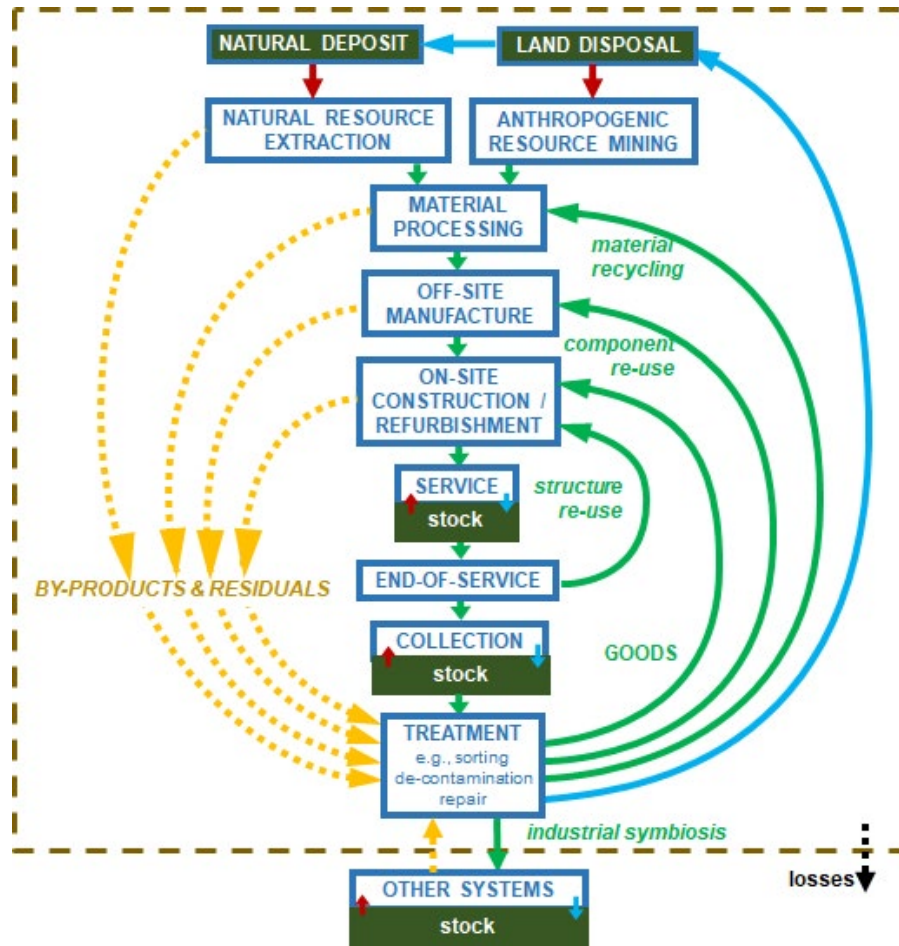


Figure 13 - Circular Materials Flows in Construction (red arrows show extractions from stocks; blue arrows show deposits to stocks; green arrows show flow of feedstocks; yellow arrows show flows of wastes)



Source: Julia Stegemann (from Author). All rights reserved.

5.2.3 TECHNOLOGY DEVELOPMENT & INNOVATION

Development and implementation of new technologies are needed to reduce the demand for construction materials and enable their circularity and contributions to resilience. This includes designing innovative circular materials and products that can be fully recovered in closed-loop processes; smart selection of materials for components and structures with minimised life cycle impact using material libraries; right-sizing and lightweighting of components and structures; consideration of thermal properties of construction materials in relation to regional needs; structures with extended lifespans, suitable for deconstruction and reuse of materials and components.

It is equally important to include material processing and fit-for-purpose cements based on local feedstocks produced with less energy, emissions, and impacts; closed-loop production cycles. Activities such as manufacturing and construction use of digital systems to track materials, and prevent their excessive use. Adopting off-site (modular) construction for disassembly and enhancing additive manufacturing with closed-loop materials for waste avoidance will further result in material efficiencies.

In addition, further actions for closing the loop around recovery of components and materials from existing structures for reuse at a higher value include remote sensing and geophysics for characterisation of materials in the existing built environment and legacy sites for material recovery; recovery of composite materials.

5.2.4 ENABLING FRAMEWORKS

Enabling frameworks are needed to reduce business risks and other barriers, and create market support for adopting more resource efficient construction materials, technologies and practices, including:

- ▶ New business approaches for a Circular Economy- alternatives to lowest-price procurement practices that consider other aspects of sustainability in awarding construction contracts; servitization business models for construction materials and products, including modular construction, that are compatible with the wide range of product and material lifespans in this sector; commercialisation of open-source products; building development, ownership and operation models that incentivise resource efficiency; integration of social enterprises in supply chains; use of blockchain technology for smart contracts to eliminate the high transaction costs of an integrated circular supply chain with reverse logistics, and material marketplaces to encourage industrial symbiosis.
- ▶ Accounting and finance tools- inclusion of circularity in sustainability accounting; new investment instruments to attract investment in circular economy projects; facilitation of investment transitions to avoid stranded assets.
- ▶ Standards, policy and regulation that will support circular economy practices- codes of practice, quality protocols, performance-based technical standards, harmonised classification of primary and secondary resources, certification procedures for reuse of structures, components and materials; regulation to enable construction materials recovery and industrial symbiosis, while maintaining environmental protection.
- ▶ Addressing perception issues through behavioural change approaches

5.2.5 ACTIONS GOING FORWARD

Going forward, there are a number of actions that businesses and governments can take to support the improvement of the sustainability of the construction sector, including:

- ▶ Conduct material flow analysis for construction materials at different scales (building, city, region, country, global).
- ▶ Level the playing field between primary and secondary materials resources by including environmental and social aspects as well as economic and technical considerations in resource classification, e.g., using the United Nations Framework Classification for Resources (UNECE 2018).
- ▶ Develop material libraries that capture the relevant properties of construction materials for technical, social and environmental assessments.

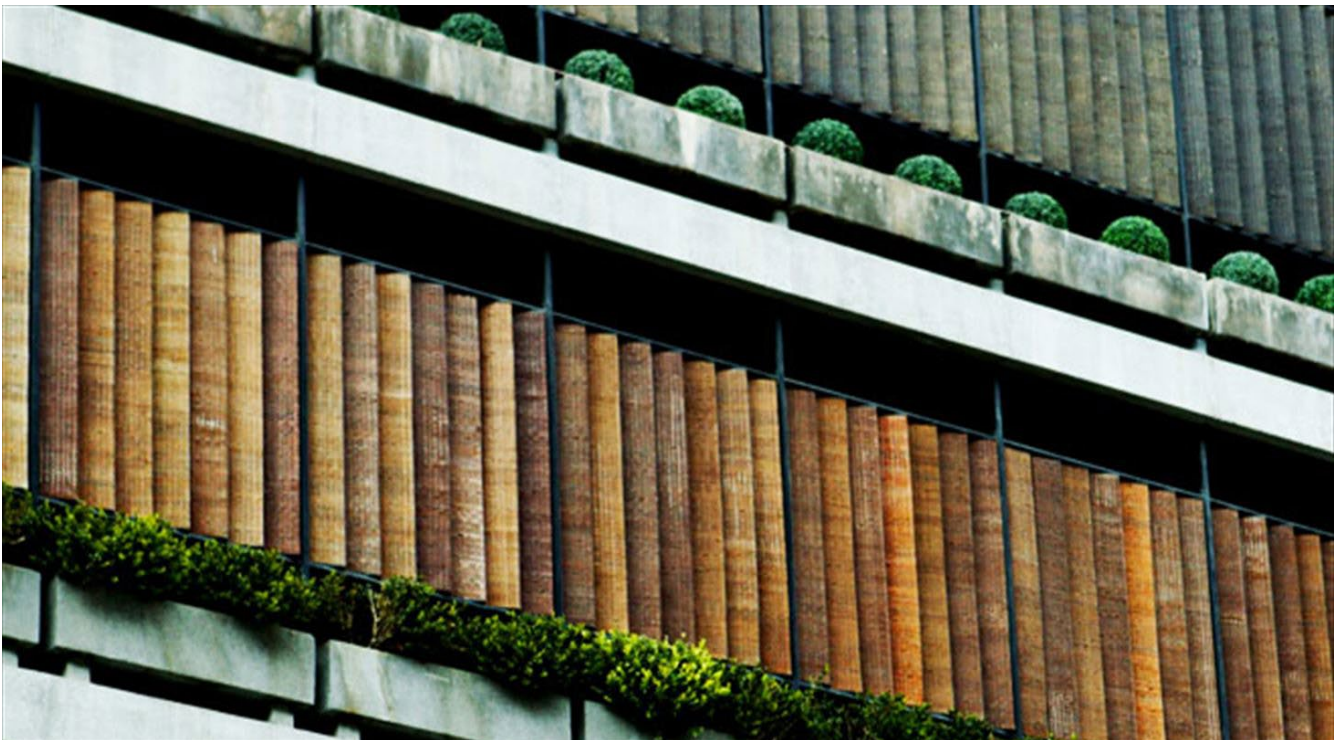
- ▶ Base component and structure design on assessment of social and environmental impacts at each life cycle stage, including the whole supply chain.
- ▶ Develop standards for Building Information Modelling (BIM) that require collection of detailed information related to building disassembly and material properties.
- ▶ Collect such information centrally for use in planning of material harvesting.
- ▶ Avoid cross-contamination between different materials in demolition.
- ▶ Design for mono-material building elements and avoid excessive layering of products and materials
- ▶ Develop standards for modular structures that are assembled on-site from components manufactured off-site to support safe and rapid deconstruction and material reuse.
- ▶ Develop awareness raising programmes, incentives and standards for the widespread uptake of sustainable biomaterials.
- ▶ Avoid using more materials, or materials of a higher quality, than required for the purpose.
- ▶ Use local alternatives to carbon-intensive cement and steel.
- ▶ Consider trade-offs in material substitutions, e.g., impacts on forest stocks.
- ▶ Develop systems to enable cycling of timber at higher value before energy recovery.
- ▶ Include planning of systems for industrial symbiosis and circular use of construction materials in international development.
- ▶ Develop platforms for selling and buying already used building materials and components
- ▶ Advocate for proper deconstruction planning in order to develop concepts on how to reuse or distribute the deconstructed materials and elements
- ▶ Implement policies to minimize complete deconstruction and preserve existing building materials

Box 17 - Material sustainability

LafargeHolcim has launched its 'green concrete' in the U.S. The product is reported to have between 30% and 100% less CO2 emissions compared to standard concrete.

Medellin, Colombia is committed to recycling construction materials and using materials that do not have toxic or hazardous content. Nanotechnology research aims at identifying materials that prevent and promote heat transfer, bactericidal paints, bricks for the generation of solar energy, among others.

The newly created company headquarter for **Alnatura** offers space for approx. 500 employees and focuses on natural aesthetics, light-flooded interiors and low tech. It is Europe's largest office building with facades made from rammed earth and received a platinum DGNB certification as well as the prestigious German Architecture Sustainability Award. During the planning phase, care was taken to ensure that passive measures keep the costs for technical systems as low as possible. The result is a high-performance, energy-efficient building with optimized interior comfort made of recyclable or natural materials such as the structure of the gable roof made of wood and the clay facades. A large part of the material for the façade elements made of rammed earth comes from the Stuttgart21 tunnel construction site.



Case Study 4: Bio-based materials

Global raw material extraction and production of construction materials, such as metals and concrete, causes a wide range of environmental impacts (OECD 2019). By reducing the need for mining of construction minerals and extractive processes, biomaterials offer an alternative construction product which is typically biodegradable at the end-of-life helping to regenerate natural systems. Certain bio-based materials have the potential of sequestering CO₂ emissions while growing, helping to regenerate soils in between cultures and during the life of the building, biomaterial construction can act as a carbon storage (UNECE 2019).

In a scenario where bio-based materials become the 'raw materials' for the production of construction materials, ensuring sustainable land use in the sourcing of 'raw biomaterials' is imperative. That involves preventing the exploitation of land for biomaterial resources and avoiding competition for land which is marked for agricultural food production. Incentivizing small to medium scale localized production of biomaterials can prevent land exploitation and competition while enabling sustainable land use. Additionally, the use of agricultural by-products (e.g. rice, straw, corn, and coconut husk) and growing plants which help fertilize fields for agriculture (e.g. hemp) can encourage sustainable sourcing of raw biomaterials while also supporting circular economy practices.

By diverting waste from post agricultural waste streams to become resources in the production of new construction materials, biomaterials support a circular economy. They offer disruptive new solutions to the need for immediately available building materials. During the construction phase of the building life cycle, biomaterials are compatible with new innovative, digitization and productive methods of designing for fabrication off-site with final assembly on-site - from prefabrication and modular construction to design for manufacturing and 3-D printing.

The multi-faceted benefits of biomaterials are most advantageous when used locally. Local, bio-based renewable materials are 'climate specific' offering effective performance characteristics in climate responsive design, while providing additional income streams and employment to local economies. From a life cycle perspective, the use of local materials reduces embodied energy and carbon costs associated with transportation. In addition, diversifying building materials can ultimately support the resilience of the construction industry against price inflations due to scarcity of construction minerals such as sand.

In terms of human health, biomaterial building products can contribute to occupants' comfort with healthier indoor conditions in terms of air quality, temperature control and humidity regulation (Collet et al. 2017). Bio-resins, such as mycelium, used in biomaterials-manufacturing offer a substitute to synthetic glues and resins and other harmful toxic chemicals which are believed to negatively impact human health and wellbeing by altering the indoor air chemistry (Xiong et al. 2016).

Despite the multi-faceted benefits of biomaterials, their widespread adoption in the construction sector is hampered by various factors including social acceptance. Socio-cultural perceptions often associate local biomaterials and vernacular design with undesirable or 'old-fashioned' aesthetics, rather than modern or contemporary lifestyles which are often linked to concrete, steel and glass. The promise of biomaterials in the global south is investigated in detail from environmental, economic, and social viewpoints in Keena et al. (2020)



5.3 NATURE-BASED SOLUTIONS

Key Message: A combination of targeted investments in R&D, incentives, locally tailored policies, and consumer awareness can drive the uptake of nature-based solutions in buildings and construction, increasing their sustainability, circularity, and liveability.

5.3.1 INTRODUCTION

As the world population grows and becomes increasingly urbanized, new developments threaten natural habitats and push nature further away from human communities. The environmental impacts of buildings and constructions are expected to grow in the coming decades, intensifying current urban challenges and possibly generating new ones (Almenar et al. 2021).

The integration of well-designed nature-based solutions (NbS) into buildings and construction can help bring nature back into human developments, increase the sector's sustainability, and bring with them a wide range of health and resilience benefits (Enzi et al. 2017).

What counts as a nature-based solution remains an open concept (Almenar et al. 2021). Nature-based solutions can be broadly defined as actions addressing challenges through the protection and restoration of natural processes and ecosystems. However, there is wide agreement that NbS can help restore the connection between humans and nature and contribute to the solution of ongoing urban challenges by introducing the benefits of ecosystem services into the built environment.

Research shows that the use of vegetation on and around buildings can improve thermal comfort, mitigate the Urban Heat Island Effect (UHI), reduce operational energy needs in buildings, increase the liveability of the built environment (ESMAP 2020a), as well as improve air quality and rainwater management (Alexandri and Jones 2008).

The benefits of bringing back nature to human settlements and buildings are not a new discovery, but their recognition and the need to accelerate the transition to low-carbon and inclusive construction has led to bold action to support and implement nature-based solutions by some cities and developers.

5.3.2 APPLYING NATURE-BASED SOLUTIONS IN BUILDINGS: EXAMPLES FROM CITIES AROUND THE WORLD

While they are not (yet) mainstream, policies to incentivize, or even mandate, the installation of green infrastructure on buildings and constructions are present in multiple cities around the world and drive NbS implementation in the sector.

The City of Berlin launched the 1000 green roofs initiative (Versini et al. 2020), which reimburses installation costs for green roofs for a maximum value of 60 €/m² and 60,000 €/building, for a total investment of 2.7 million euros until 2023.

The City of Toronto has imposed similar policies and incentives with its Green Roof Bylaw, which requires between 20% and 60% of available roof space of buildings to be greened for areas with larger than 2,000 m².

Under the "Sponge City Initiative" the city of Shanghai, China, set a goal to reach 2 million m² of green roofs by 2020 to address heat, pollution, and flooding challenges (ESMAP 2020). The city combined incentives and requirements to reach this target, currently offering subsidies for certain buildings of up to US\$29/m² for green roof and wall installations.

Within its Greening the City initiative, the City of Melbourne has launched the Green Factor Tool, a green infrastructure assessment tool developed to help with designing and constructing new buildings that are environmentally friendly and include green infrastructure.

Singapore is also investing in green facades and sky gardens (ESMAP 2020a), using available space on buildings to increase heat resiliency, and aiming to double its current sky garden coverage to 200 hectares by 2030. The uptake of these NbS in Singapore is driven by the Landscaping for Urban Spaces and High-Rises (LUSH) policy, a set of building regulations that requires on-site greenery equivalent to the size of the site being developed.

Earlier this year, the Thammasat University's Urban Rooftop Farm became the largest urban rooftop farm in Asia. The 22,000 sq. m. (236,806 sq. ft.) living roof acts as a green space for the building users, a source of organic food, a source of solar power for the building, and an outdoor classroom for the university's students. This green roof also works as an effective water management system: the structure can collect up to 11,718 Cubic meters of rainwater, reducing runoff and effectively adapting to current runoff challenges and due to potential climate impacts in Thailand.

5.3.3 ACTIONS GOING FORWARD

Taking up nature-based solutions can increase the construction sector's sustainability and circularity, while improving liveability of the built environment. Cities supporting the uptake of NbS for buildings through policies and incentives are driving change on the ground.

More can be done to accelerate the adoption of nature-based solutions in buildings. Increasing the availability of information on the benefits of NbS for buildings' owners and users, as well as sharing best practices for their integration among experts could help transition to the sector to more sustainable construction practices and designs.

Box 18 - Nature inspired buildings

Beyond nature-based solutions, nature can act as an inspiration to construct more efficient buildings, decreasing the carbon footprint and embedded carbon of infrastructure and taking advantage of passive designs.

Using biomimetics and biomimicry, developers can solve human challenges through nature-inspired building techniques that emulate models, systems, and elements of biology.

The **Eastgate Centre in Harare, Zimbabwe**, for example, was designed based on how termites construct their nests to maintain temperatures constant independently from outside weather. The result is a design peppered with holes all over the building's envelope that requires minimal active cooling and ventilation for thermal comfort.

The **Gherkin building in London, United Kingdom**, takes inspiration from sea sponges to increase structural strength and drastically reduce energy requirements for ventilation, cooling and heating. Like in sponges, open shafts were constructed between each to enable passive heat exchange and the penetration of sunlight deep into the building (Nkandu and Alibaba 2018).

The **Bio-Intelligent Quotient (BIQ) House in Hamburg, Germany** is another example of nature-inspired building design: the passive house generates energy using algae biomass harvested from the building's façade built of water filled windows. The façade then absorbs the light that is not used by the algae to generate heat for hot water and heating.

Case Study 5: CityAdapt – San Salvador - Building climate resilience in urban systems through NbS

Latin America and the Caribbean (LAC) is the most urbanized region in the world, with more than 8 out of 10 inhabitants living in urban centres. Many urban areas are vulnerable to climate change impacts: According to the Climate Change Vulnerability Index, 48% of the capital cities in LAC are at "extreme risk" to the effects of climate change.

Between May 31 and June 6, 2020, tropical storms Amanda and Cristóbal particularly hit El Salvador, Guatemala and southern Mexico in rapid succession, causing rains, strong winds and damage to urban and periurban homes, infrastructure and roads. In El Salvador 29,968 families were directly affected by landslides and floods.

The CityAdapt project modeled the flood risk for the city of San Salvador, with a focus on the Arenal Montserrat micro-basin and then established and implemented an NbS strategy based on infiltration trenches and riparian vegetation restoration for ecosystems affected and for preventing new storms impacts and sustainable water management in the city. Examples of the tool can be seen here.

Infiltration ditches allow infiltrating the soils which helps slowing the flow of water and reducing peak flow while decreasing soil erosion and improving crop productivity the soils and improving the livelihoods of coffee producers, benefitting 115,000 inhabitants living in San Salvador. Riparian vegetation stabilizes water flow on slopes of streams.

NbS in San Salvador proved to be cost-effective and provided diverse co-benefits like increasing cities' resilience and decreasing the vulnerability of urban communities.

5.4 HEALTH AND WELLBEING⁷

Key Message: Our houses affect our health now more than ever. Building and ensuring access to sustainable, healthy homes can improve public health outcomes, reduce inequalities, mitigate carbon and improve urban sustainability and resilience.

5.4.1 INTRODUCTION

Global trends like urbanization, demographic and climate changes create a growing demand for housing that meets the needs of today's and future societies. The housing sector faces major challenges such as 3 billion people requiring access to adequate housing by 2030, a doubling of the world's population aged 60 years and older by 2050 (WHO, 2015) and the more frequent occurrence of extreme weather events associated with climate change.

Housing is a central element of people's lives – it is “at home” where people live, sleep, and now more than ever, work. As such, housing is an important determinant of human health. Healthy housing can save lives, prevent disease, and enhance residents' well-being. The intersectoral nature of healthy housing makes it relevant to the achievement of the Sustainable Development Goal on health (SDG 3) and reduced inequalities (SDG 10) together with its role in achieving clean energy (SDG 7), sustainable cities (SDG 11), and climate action (SDG 13).

The World Health Organization (WHO 2012) considers four dimensions as relevant to healthy housing: the dwelling's structure, the social environment of the home, its neighbourhood, and the community.

Poor housing conditions can significantly increase the risks of both communicable and non-communicable diseases. For example, housing that is difficult or expensive to heat contributes to poor respiratory and cardiovascular outcomes. For 11 European countries with available mortality data, it was estimated that cold homes cause about 38,200 deaths per year (WHO 2011) and as such account for 30% of all excess winter deaths. Meanwhile, high indoor temperatures can cause heat-related illnesses and increase cardiovascular mortality as was observed in Ahmedabad, India, during the May 2010 heat wave with an estimated 43.1% increase of all-cause mortality (Azhar et al. 2014).

Poor indoor air quality is associated with a number of cardiovascular and respiratory diseases including pneumonia, stroke and lung cancer. Household air pollution

from burning solid fuels such as dung, wood and coal in inefficient stoves or open hearths for cooking, heating and lighting caused 3.8 million deaths in 2016, equalling 7.7% of the global mortality. Radon, a naturally occurring radioactive gas, is responsible for between 3-14% of all lung cancers, making it the most important cause for lung cancer after smoking (WHO 2009).

Adequate housing also includes the access to safe water and sanitation services. However, in 2017, 1.4 billion people still lacked a handwashing facility with soap and water at home and 10% of the world's population did not have access to at least basic drinking water services (WHO 2019). Missing access to adequate water, sanitation, and hygiene were responsible for 829,000 deaths from diarrhoeal disease worldwide in 2016.

Dwellings with structural deficiencies lead to home injuries as residents are more likely to slip or fall. Worldwide, about 646,000 individuals die each year from falls and more than 37 million falls require medical attention. Poor accessibility to their house puts especially older people and those with disabilities at risk of injury, stress and isolation. For instance, in the United Kingdom, 72% of adults with mobility problems reported that the entry to their housing was not properly accessible.

Crowding, a state in which the number of occupants exceeds the capacity of the available dwelling space, is associated with an increase of infectious diseases such as tuberculosis or the flu (Evans 2003). In Kyrgyzstan, for example, household crowding causes 18.13 tuberculosis-related deaths per 100,000 per year (WHO 2011).

Buildings and especially the indoor environment is important in light of the ongoing pandemic response. An “increased ventilation rate through natural or mechanical means, preferably without recirculation of the air”, is considered “an important factor in preventing the virus that causes COVID-19 from spreading indoors”. Ventilation in housing can be considered, therefore, a key component of providing population resilience to future pandemics.

7 Disclaimer: The authors are staff members of the World Health Organization. The authors alone are responsible for the views expressed in this article and they do not necessarily represent the decisions, policy or views of the World Health Organization. The Case Studies shown are not provided by the WHO are in no way affiliated with the WHO.

5.4.2 ADDRESSING HOUSING INEQUALITIES

Housing conditions are furthermore one of the mechanisms through which environmental and social inequality translates into health inequality. Across the globe, people with a low-income are more likely to live in housing that exposes them to increased health risks (WHO 2008). This includes environmental exposures such as indoor air quality, toxic building materials, structural deficiencies or the condition of the neighbourhood. In addition, socioeconomic factors influence whether residents are able to afford and maintain safe and healthy housing. Maintenance costs relate, for instance, to the purchase of safe drinking water and electricity or other fuels for cooking, heating and lighting at home. Fuel and water poverty as well as tenure insecurity can have a direct effect on physical and mental health. An increased health burden caused by unhealthy housing conditions such as excess cold or overcrowding, translates again into social inequalities like decreased educational attainment or income generation due to higher absenteeism from school or work. Indeed, in 2018, it was estimated by the UNDP that 1.8 billion people live in inadequate housing including slums and informal and/or overcrowded settlements, that make adequate hygiene, lockdowns, and social distancing challenging, and which can exacerbate the current health crisis (UN 2020).

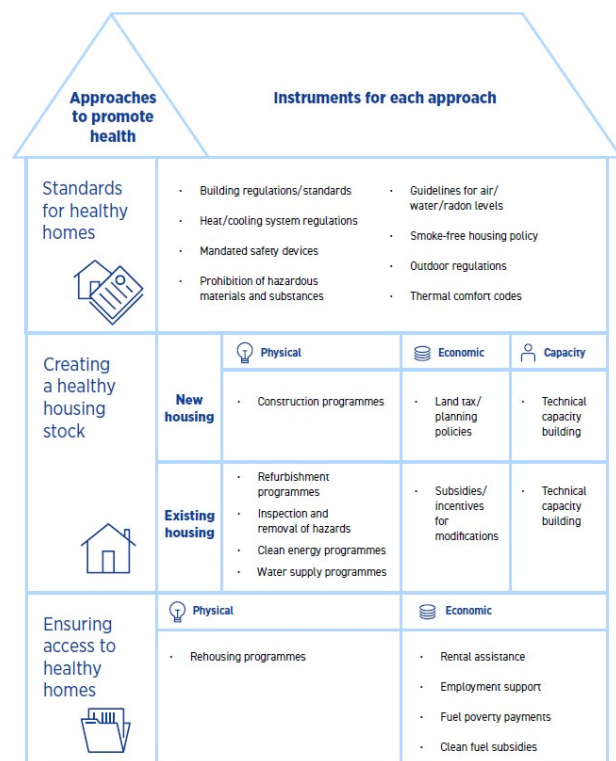
The manifold pathways through which housing affects health make it an important entry point for intersectoral public health programmes and primary prevention. A review of policies with the potential to promote healthy housing (WHO forthcoming) identified three main approaches and related instruments that can be applied at the national, regional and local level to improve housing conditions: (i) formulating standards, (ii) creating a healthy housing stock, and (iii) ensuring access to healthy homes (see Figure 14). Policies and interventions aimed at improving health through housing often produce significant co-benefits. For example, installing efficient and safe thermal insulation can improve indoor temperatures that support health, while also lowering expenditure on energy and reducing carbon emissions. Similarly, the evaluation of the Green and Healthy Homes Initiative in the United States of America found a reduction of asthma symptomatic episodes, emergency room visits and hospitalizations for children who benefited from the initiative, while also showing improvements in school and parents' work attendance (Norton and Brown 2014).

The delivery of effective healthy housing policies and programmes requires intersectoral collaboration. This includes, amongst others, stakeholders working in research, policy, and practice from the health, buildings and construction, urban planning, finance, and energy sectors as well as cooperation across all governmental levels. A holistic approach to improve housing is crucial to achieve

sustainable development, producing positive effects for health, equity and climate change mitigation.

In recognition of the importance of housing for public health, WHO has developed the WHO Housing and health guidelines (WHO 2018). The guidelines provide evidence-based recommendations on how to address inadequate living space (crowding), low and high indoor temperatures, injury hazards in the home, and accessibility of housing for people with functional impairments. In addition, the guidelines summarize existing WHO guidelines and recommendations related to housing, with respect to water quality, air quality, neighbourhood noise, asbestos, lead, tobacco smoke, and radon. The implementation of the guidelines at national and sub-national levels will make a substantive contribution to the provision of healthy and sustainable housing for all.

Figure 14 - Approaches to health and housing



Source: (WHO, forthcoming). All rights reserved.

Case Study 6: Healthy Homes Barometer 2020⁸

Green Recovery through healthy and climate-friendly buildings

The **Healthy Homes Barometer 2020 by Velux** (2020) and focusing on housing within the EU is a fresh compilation of facts, research, and insights from the Healthy Homes Barometers from 2017, 2018, and 2019 framed by the recent Covid-19 pandemic and the notion of a Green Recovery published by the EU Commission. The Healthy Homes Barometer 2020 will be published at the end of 2020.

The aim of the Healthy Homes Barometer is to present credible, comparable, scientific evidence to raise awareness and to inform decision-making for all parties involved in the provision of housing. The report also aims at creating political awareness about the vast challenges and opportunities within the European building stock.

Summary

The world is facing an unprecedented health and economic crisis caused by the Covid-19 pandemic. The unusual situation calls for fast and determined political action to mitigate short-term and long-term effects.

Since around 90% of the EU building stock in 2030 has already been built, the renovation of these buildings offers a huge potential in the plans for a Green Recovery presented by the EU. As recently stated in an IEA report on sustainable recovery (IEA 2020g), building renovation provides a unique combination of opportunities to create many jobs rapidly, meet climate targets, and produce a healthier building stock.

The Healthy Homes Barometer 2020 is dedicated to exploring the role of homes, schools, and office buildings in the Green Recovery. Initially planned to be published in spring 2020, the revised timeline has sought to capture important issues from the COVID-19 pandemic and to compile relevant facts and insights from the last three years, which would serve as inspiration for a renewed focus on healthy and climate-friendly buildings.

Highlights

One out of six EU citizens reports living in a home that is damp, dark, too cold, or too warm. Living in an unhealthy home has negative health effects for all family members, but children are especially at risk. One out of three European children under the age of 15 lives in an unhealthy home that may cause respiratory diseases, allergies, or skin diseases that can persist into adulthood. Children living in suburban single-family homes are especially at risk due to factors like leaky roofs, mould, and inadequate thermal comfort.

In most EU countries, about two thirds of the residential housing stock was built before the first European thermal building regulations came into effect (i.e. before 1979). This means that only about 10% of the current building stock is rated A or B in energy performance rating schemes. At the same time, 49 million Europeans face the 'eat or heat' dilemma every time they wake up to a cold day. The consequences of energy poverty can be poor health; in fact, twice as many people living in cold homes report poor health.

Investing in good quality social and affordable housing can significantly improve the overall health of society. Inadequate housing costs EU economies nearly €194 billion per year in terms of healthcare, social costs, and lost productivity. Bringing the standard of housing up to an acceptable level across Europe are estimated to cost about €295 billion. This implies that the investment could be repaid within just 18 months.

Poor indoor climate in schools and day-care centers caused by lack of daylight, dampness, indoor pollutants, or poor ventilation can be linked to serious health conditions. European children miss over 250,000 school days due to respiratory conditions, about 365,000 days due to asthma, and almost 1,100,000 days because of issues related to eczema. Improved air quality can lead to reduced student absence and could boost student performance by up to 15 percent with a positive effect on working speed, attention level, and concentration.

Lessons learned

Renovation of the worst performing buildings offers a huge potential in the plans for a Green Recovery presented by the EU.

⁸ The Case Studies shown are not provided by the WHO are in no way affiliated with the WHO.

5.5 COOLING FOR RESILIENCE AND ADAPTATION

Key Message: Rising global temperatures will dramatically increase the need for cooling, especially in tropical and hot climates – home to 2.8 billion people. Building codes and NDC targets need to integrate passive design and low-energy cooling strategies, including in low-income housing, to ensure ‘cooling for all’ and to reduce energy poverty.

5.5.1 INTRODUCTION

Over the coming 30 years, energy needs for space cooling could triple (IEA 2018), especially in hot and tropical countries, and residential buildings are responsible for over two thirds of this increase. Global sales of air conditioning (AC) systems per year have nearly quadrupled since 1990. Approximately 2.8 billion people live in places with average daily temperatures above 25°C all year and only 8% of them are estimated as having AC (GlobalABC 2018, IEA 2018). This trend is set to continue and intensify, driven by rising incomes, the expected doubling of building floor area by 2060 (IEA 2019a), and a warming planet with higher temperatures and more frequent heat waves.

There remains a critical challenge to address cooling demands going forward due to the vast amount of building space around the world being constructed with little adaptive capacity to the surrounding climate. Using steel, concrete and glass, without proper thermal breaks, shading, ventilation, or insulation, poorly designed buildings can be prone to overheating. As a result, to provide thermal comfort, they need an excessive amount of energy for mechanical cooling.

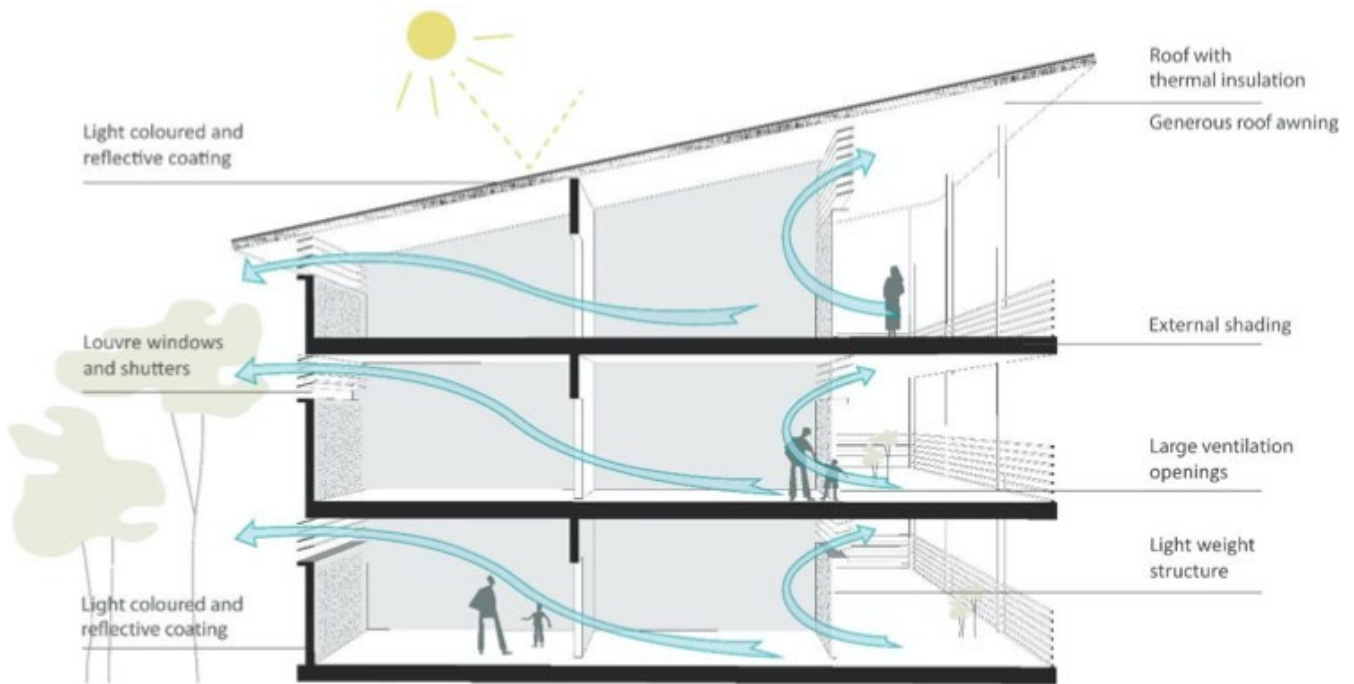
5.5.2 COOL BUILDINGS CAN BE A SOLUTION

Better building designs can reduce or even avoid the energy demand for space cooling. Climate-adapted building envelopes, exterior colours, windows, natural ventilation, orientation and vegetation offer large possibilities to reduce the energy demand for cooling, for example:

- ▶ **Orientation:** Appropriate solar orientation of buildings provides an important design approach to reduce solar gains by aligning building facades, overhangs and glazing to optimise solar and daylight levels indoors, thus avoiding unwanted solar gains.

- ▶ **Roof coatings (IEA 2018):** High-quality white roofs can reflect 80% of the sun’s energy compared to black roofs that reflect only 5% to 10%. Projects selected by the Million Cool Roofs Challenge, a global initiative to accelerate access to affordable, sustainable cooling through rapid deployment of cool roof materials, show that cool roofs can lower temperatures on factory floors, as well as indoor temperatures, by 10 degrees Celsius.
- ▶ **Envelopes (Fraunhofer Institute 2018):** High-performance thermal building envelopes (foundations, external walls, roofs, and external doors) can reduce the cooling demand by 30% to 50%.
- ▶ **Windows (IEA 2019c):** Low-emissivity glass reflects infrared solar radiation without affecting the entry of visible light and reduces cooling demand by at least 20% compared with conventional glass. Windows should be shaded (preferably with external shading devices) and the window-to-wall ratio should be adapted to the climate zone, while still ensuring enough natural daylight.
- ▶ **Ventilation (IEA 2019c):** A survey of office buildings in China shows that the use of natural ventilation can reduce the overall number of hours of air conditioning needed by as much as 40%, while achieving the same indoor comfort level. Analyses in office buildings in Thailand show that natural ventilation can reduce the energy demand for cooling by 8% (Fraunhofer Institute 2018).
- ▶ **Landscape and vegetation (IEA 2018):** In residential areas, it is estimated that well-designed landscapes could save 25% of the energy used for cooling.
- ▶ **Efficient lighting and appliances to reduce internal heat gains that add to cooling loads**
- ▶ **5.5.3 Design strategies to curb the rising energy demand for cooling: Avoid-shift-improve**
- ▶ **If buildings are adapted to the local climate and use passive cooling techniques, they can keep cool naturally.** Variations depend on the climate zone, the local building culture, and building use (see Figure 15). While there are many variations, the following principles apply:
 - ▶ **In humid climates, light- to mid-weight structures and open, spacious layouts allow for constant natural ventilation.**
 - ▶ **In dry climates, buildings should be massive to block the heat during the day and naturally cool down at night.**

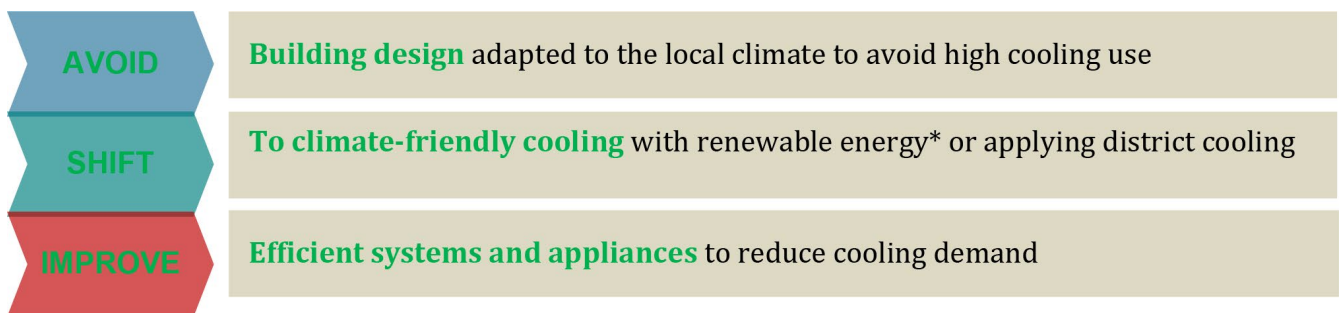
Figure 15 - Building in a hot and humid climate without air-conditioning



Source: PEEB (2020a), *Better design for cool buildings*

Three steps are needed for cool low-carbon buildings: avoid, shift and improve (PEEB 2020a):

Figure 16 - Energy efficient approach to cooling management



Note: whenever possible in the respective local socio-economic context
 Source: PEEB (2020a), *Better design for cool buildings*.

The approach of 'avoid-shift-improve' which was first used in the sets out a clear hierarchy of action: "Cool buildings" with building design adapted to the climate is the essential step, as this can avoid unnecessary demand for energy for cooling.

There are cases where due to the local environment passive cooling will be insufficient to meet appropriate thermal comfort conditions. For these remaining cooling needs, e.g. during temperature peaks, or in buildings with special cooling needs, we need to shift to more climate-friendly cooling with renewable sources of energy or applying district cooling, and lastly improve the efficiency of conventional cooling systems and appliances, such as air-conditioners.

Box 19 - Cooling as a Service and District Cooling

Cooling as a Service (CaaS) models are innovative solutions for cooling buildings that place ownership and operation of cooling equipment with a service provider rather than building owners or users (ESMAP 2020b). Consumers pay for the availability or use of the cooling they receive, rather than investing in the physical product or infrastructure that delivers the cooling. CaaS models can help reduce cooling over-consumption by building users while pushing suppliers to procure the highest efficiency cooling solutions.

District cooling is the main and most implemented example of CaaS with an emphasis on providing a high-quality, extremely reliable utility service, just like water, power, and gas utilities. District cooling systems are easier to implement in greenfield projects especially with dense and varied cooling demands. However, district cooling is achieving notable successes in brownfield projects and existing cities, and benefits from the reduced cooling load risk of connecting existing buildings as essentially a retrofit solution.

District cooling systems provide the infrastructure to maximize efficiency for cooling (UNEP 2015), switch refrigerants and connect waste heat and renewables that cannot be utilized at an individual building level. Such systems are best designed alongside robust building efficiency policies at the neighborhood or building level - numerous buildings are achieving the highest building certifications by using the primary energy efficiency benefits of district cooling. There is a growing interest in district cooling for residential buildings and countries globally are increasingly turning to district cooling to provide flexibility and resilience to local power systems that risk being overwhelmed by growing energy demand for cooling (IEA 2020i).

District cooling is not a new technology. Paris is home to Europe's largest and first district cooling network, operating under a concession model from the city since 1991. The Climespace network is over 75 km long, replacing air conditioners and chillers for 700 buildings, delivering more than 486 GWh per year of cooling with 50 percent improvements in energy efficiency (UNEP 2016), 35 percent reduction in electricity consumption, and 50 percent fewer CO₂ emissions (UNEP 2018). The network is completely underground, with 60 percent running through the sewage system, which enabled reaching scale and lower development costs. Three of the network's cold-water production sites use the city's Seine River to pre-cool water before it enters electric chillers (ESMAP 2020a).

New commissions for district cooling systems are being announced around the world. In the last few years, district cooling has rapidly developed in the United Arab Emirates. District cooling systems now serve Downtown Dubai, Dubai Metro, Dubai International Financial Centre, the International Media Production Zone, as well as multiple hotels and landmarks. In the South of China, 30 million square meters of construction area on Hengqin Island will be served by a Combined Cooling, Heating, Power (CCHP) district energy system. This will help reduce the amount of electricity used for cooling by 400 million kilowatts per year and the use of 180,000 tons of standard coal. The CCHP system will help reduce total investment in cooling equipment for single buildings by 2 billion yuan.

In 2017, ENGIE Services Philippines, one of the entities under ENGIE South East Asia, partnered with Filinvest Land Inc. to form a joint venture, the Philippine DCS Development Corporation (PDDC) to help meet the energy demands of the growing Business Process Outsourcing (BPO) sector in the Philippines. Located in Alabang, Muntinlupa City, Northgate District Cooling System (DCS) is the country's first and largest District Cooling System. Since its implementation, the DCS has provided 24/7 cooling for office buildings that host BPO operations at Northgate Cyberzone, helping customers improve their energy efficiency by 39%, while delivering 18,400 tons of CO₂ savings a year.

More recently, in October 2020, the City of Rajkot, in the state of Gujarat, India, is the first pre-existing city in India to tender a district cooling system and the first city under the Government of India's Smart Cities Mission. With support from the UNEP-led District Energy in Cities Initiative Rajkot's district cooling will be a lighthouse project for delivering efficient, sustainable district cooling in India's rapidly growing cities. In November 2020, the Minister of Housing of Egypt announced that the new city of El-Alamein will use a deep-sea district cooling system, an initiative supported by the work of the UNEP-led District Energy in Cities Initiative and the Kigali Cooling Efficiency Programme.

5.5.4 ACTIONS GOING FORWARD

Policies to curb cooling demand often concentrate on promoting the use of efficient cooling technologies and appliances. However, this is not enough. There is a need to foster improved building designs which take into account the climatic and cultural context. Policies should focus on both aspects: better building designs and efficient cooling technologies and appliances.

The stimulus and recovery packages in light of the ongoing economic crisis, as well as bulk procurement, present an opportunity for the transition to efficient and passive

buildings at scale. Targeted incentives and investments can help accelerate action, as well as help innovative cool building technologies reach an economy of scale.

An example is the French recovery plan, published September 3rd, 2020 that includes €6.7 billion for buildings energy efficiency renovation. Improving the thermal insulation of buildings is essential for the more efficient use of cooling, decreasing cooling needs. Out of the €6.7 billion, €4 billion will be channelled to the renovation of public buildings, with the aim to better adapt them to rising heat through passive cooling measures.

6 BUILDINGS CLIMATE TRACKER (BCT)

Key Message: Decarbonising the buildings and construction sector has backtracked since 2017. The urgency to act is increasing – we need to speed up the annual decarbonisation of buildings by a factor of 5.

6.1 INTRODUCING THE TRACKER

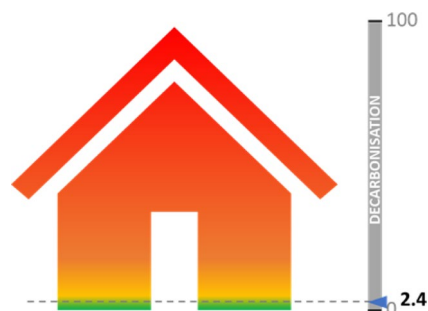
This chapter shows the results of a newly developed index that tracks decarbonisation in the buildings and construction sector worldwide. A set of indicators is used to identify trends in decarbonisation action and impact. The method is based on the OECD approach for composite indicators and applied to data from the existing GlobalABC Global Status Reports and other sources to create the Buildings Climate Tracker or 'decarbonisation index', a composite indicator. A composite indicator is formed when individual indicators are compiled into a single index. The approach and methods are described and discussed in a separate methodology paper (BPIE 2020).

This is the first time such a global tracking index has been developed for buildings and construction, with its first presentation given in this chapter. The results are calculated for two key aspects: (i) decarbonisation impact (e.g. CO₂ emissions, energy unit intensity, renewable energy share) and (ii) decarbonisation action (e.g. policy action, green building certifications, energy efficiency investments). This chapter describes what the tracker shows, how the buildings and construction sector is progressing towards decarbonisation, and how the tracker was created.

6.2 RESULTS – WHAT THE TRACKER SHOWS

To track climate action in the sector, the decarbonisation index shows how far the sector has come on the way to decarbonising buildings and construction since 2015. The index in 2020 has a calculated value of 2.5 on a scale between 0 and 100, where 0 is the reference for 2015 and 100 is the decarbonisation goal for 2050. The decarbonisation index shows how much progress has been made on decarbonisation towards 2050. Figure 17 illustrates the current level of decarbonisation using the index value indicating the progress with green colour.

Figure 17 - An illustration for decarbonisation index tracking.

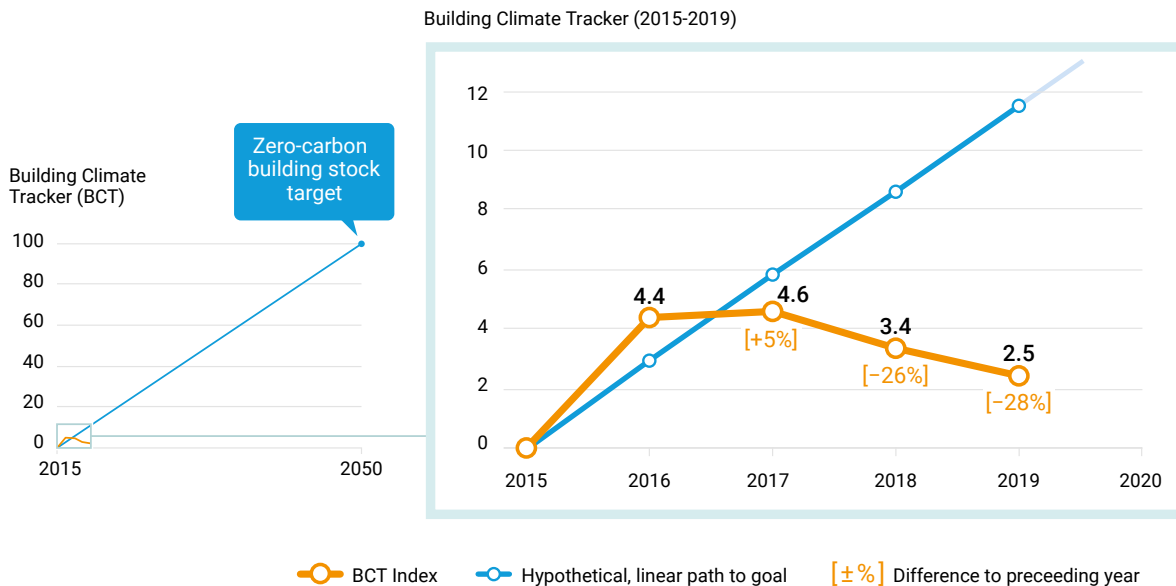


Source: Buildings Performance Institute Europe (BPIE), developed for the 2020 Buildings-GSR

Figure 18 illustrates the development of the decarbonisation index since 2015 against a hypothetical path to 2050 goal. In 2016 the index recorded a value of 4.4. While in 2017, the index improved to a value of 4.6, it has since then decreased, showing a loss of the earlier achievement. The annual improvement of the decarbonisation index is not only slowing down but in fact moving away from decarbonisation since 2017, at an increasing 'negative speed' per year of -26% in 2018 and -28% in 2019.

This is an alarming trend showing that decarbonisation in the sector is falling further behind and it should serve as a wake up call.

Figure 18 - Decarbonisation index trend for buildings and construction

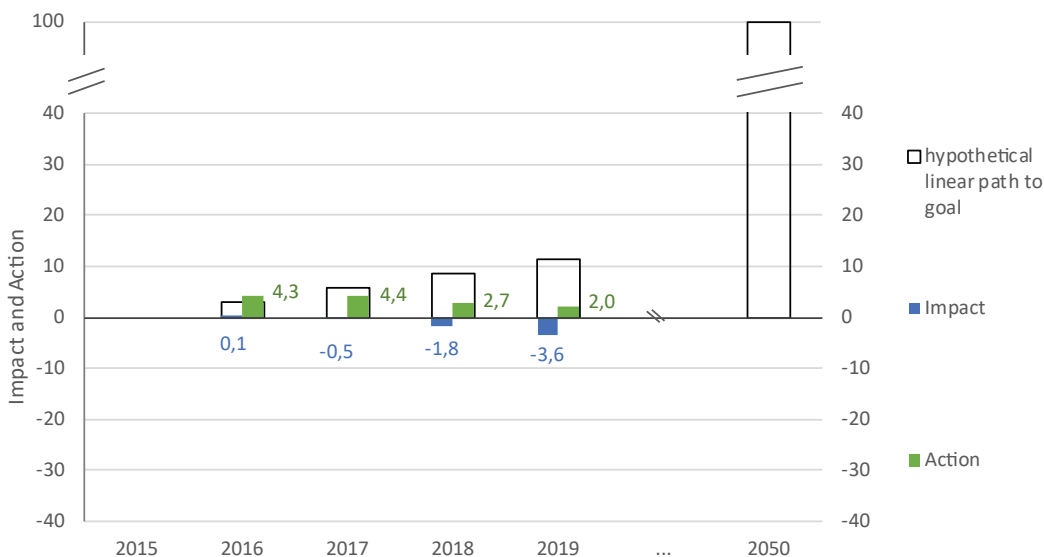


Source: Buildings Performance Institute Europe (BPIE), developed for the 2020 Buildings-GSR

Further breakdown of the index analysing the decarbonisation action and decarbonisation impact separately reveals that the initial progress of the decarbonisation index until 2017 was due to increased actions in the sector in the previous

years (see Figure 19). The action values show that after a small growth from 2016 to 2017, it has been declining. Correspondingly, the impact is also decreasing since 2017.

Figure 19 - Breakdown of decarbonisation index into Impact and Action



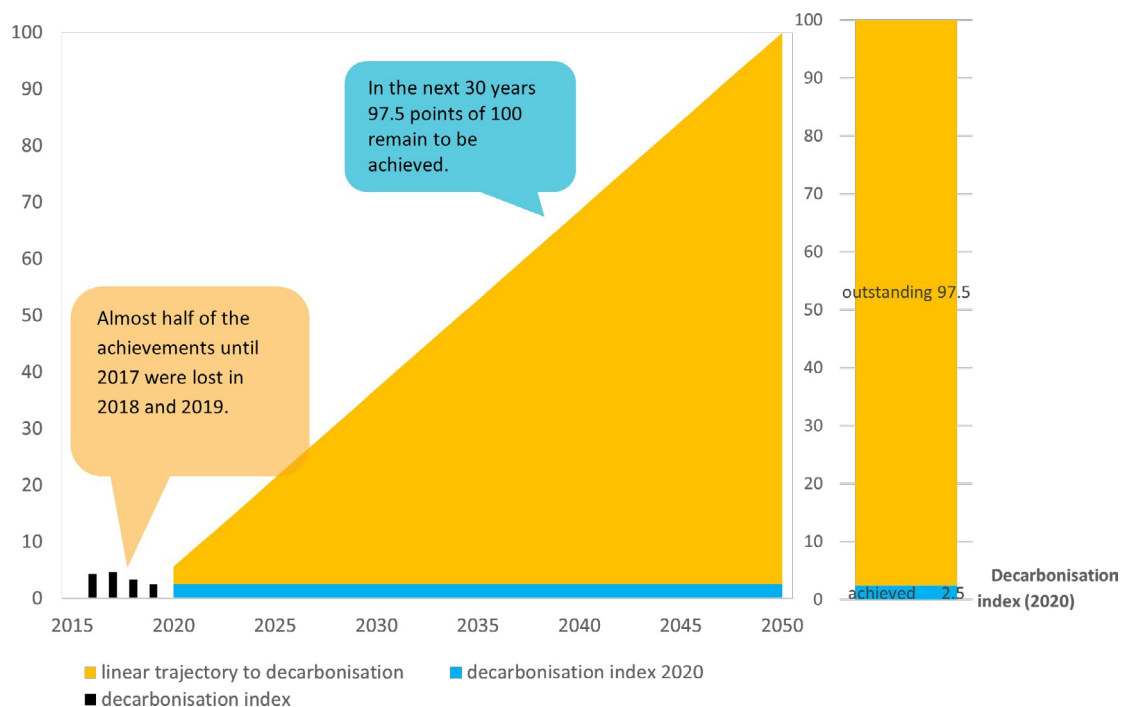
Source: Buildings Performance Institute Europe (BPIE), developed for the 2020 Buildings-GSR

6.3 DECARBONISATION IMPACTS ARE BEHIND AND DIMINISHING

As outlined in section 1, emissions from the buildings and construction sector amount to 38% of global CO₂ emissions, which denotes the urgency and challenge faced to reduce the sector’s climate change impact. Yet, progress on decarbonisation almost halved from 2016 (4.4) to 2019

(2.5). This clearly shows that the sector is not on track to lower its climate change impact. Comparing the progress of decarbonisation on a timeline since the Paris Agreement (2015) (see Figure 20) in relation to the objective, it becomes clear that the speed of change needs to increase drastically, in particular as the index trajectory moved in the wrong direction in the recent years (2018 and 2019) and nearly 2 index points were lost.

Figure 20 - Comparing the tracker with its goal of full decarbonisation by 2050 (left) and a proportional view (right)



Source: Buildings Performance Institute Europe (BPIE), developed for the 2020 Buildings-GSR

In a linear projection of the decarbonisation scenario, the orange triangle illustrates a much-needed steady increase beyond 2020 to achieve decarbonisation in 2050. The steepness of the slope shows that to reach the goal in 2050 with outstanding 97.5 index points, the annual change of the index should be 3.2 index points per year, which represents the speed of the decarbonisation. The urgency to act is increasing: the annual average decarbonisation progress should increase by factor 5 compared to the average of the past years since 2015.

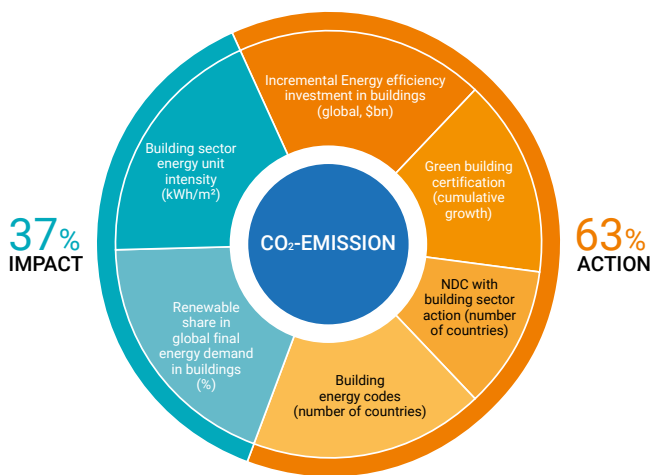
6.4 EXPLAINING THE TRACKER METHODOLOGY

The objective of the tracker is to show the progress towards decarbonisation of buildings worldwide. The development of the tracker went through several stages. In a first step, forty-seven individual data topics were collected from the GlobalABC Global Status Reports 2016-2019. In a second step, they were reviewed to identify those that contain an indication on progress, provide sufficient quality and availability of data, and contribute to the tracking objective. As a result of this review, the third step identified seven data topics as suitable for tracking progress in decarbonisation.

In the fourth step, a weight for each indicator was defined on the basis of the tracker objective. The fifth step applied a normalization and aggregation process for the chosen data by defining the base year values and the target values equivalent to full decarbonisation. In the sixth and final step, the index was calculated and illustrated with the graphs shown in Figures 18 and 19.

Figure 21 illustrates the seven identified key indicators for tracking the progress of decarbonisation based on quality and availability of data and the possibility for quantified tracking, and their weight for compiling the index.

Figure 21 - Identified indicators and their weighted contribution to the decarbonisation index



Source: Buildings Performance Institute Europe (BPIE), developed for the 2020 Buildings-GSR



7 GLOBALABC 2020 BUILDING ROADMAPS

Key Message: Decarbonising and future-proofing new and existing buildings requires effective policies and regulations that cover the entire building lifecycle, from design through decommissioning, and that go beyond site boundaries through neighbourhood planning and clean energy.

To support the shift of the buildings sector towards targets that will help achieve the goals of the Paris Agreement, key actions from high-efficiency lighting and building design to low-cost building envelope measures can result in substantial global energy savings and emissions reductions per year between 2020 and 2050. This requires radical collaboration of all actors along the buildings value chain, including clear and ambitious policy signals to address market failures, new business models aiming at economies of scale, building product innovation, and innovative financing solutions.

Launched between July and October 2020, the GlobalABC Global and Regional Roadmap for Buildings and Construction for Africa (GlobalABC/IEA/UNEP 2020b), Asia (GlobalABC/IEA/UNEP 2020c), and Latin America (GlobalABC/IEA/UNEP 2020d) focus on targets and timelines needed to achieve a zero-emission, efficient, and resilient building stock by 2050 in eight key areas: urban planning, new buildings, existing buildings, building operations, appliances and systems, materials, resilience, and clean energy (GlobalABC/IEA/UNEP 2020a). For each of these proposed key actions, targets for policies and technologies, and key enabling actions in the short, medium, and long term are recommended to facilitate the delivery of these targets.

The Roadmaps outline a common vision for decarbonising the buildings and construction sector and supports the development of national or subnational strategies and policies, including for example, NDCs.

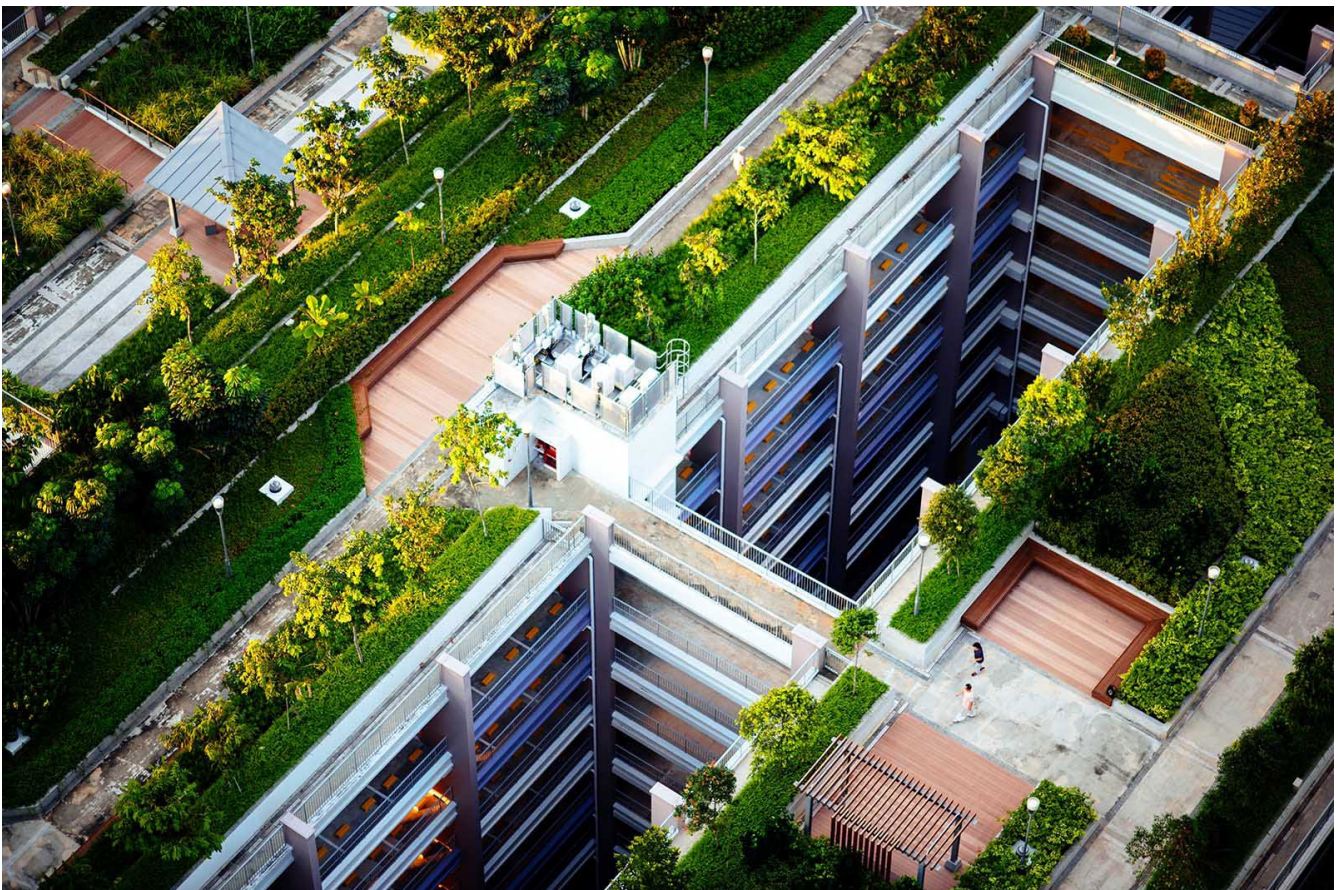
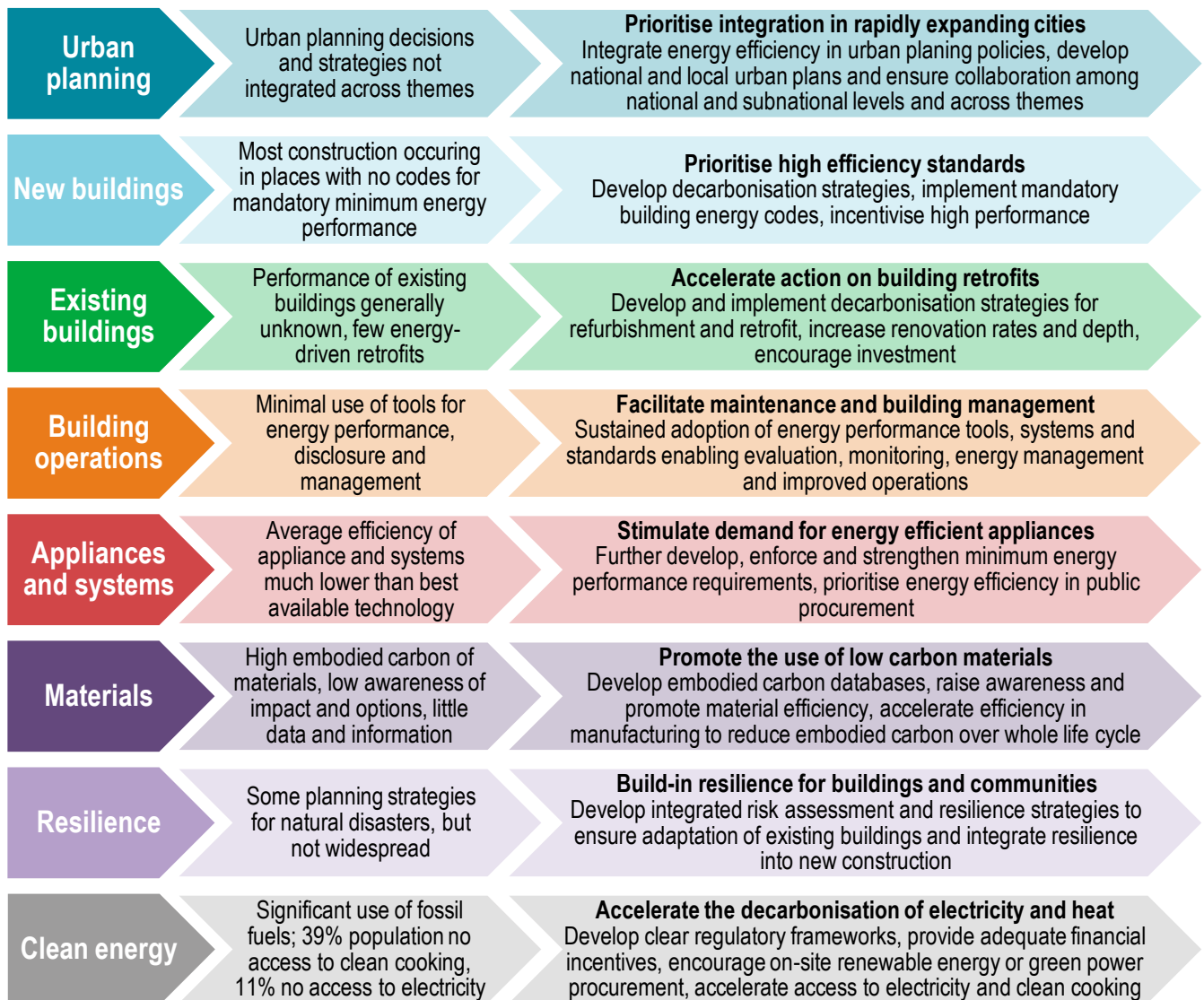


Figure 22 - Global Roadmap



ENABLERS: capacity building, finance, multi-stakeholder engagement

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Source: Global Roadmap for Buildings and Construction (GlobalABC, 2020)

7.1 GLOBAL ROADMAP KEY ACTIONS

The following actions are critical to achieve a sustainable buildings stock.

- ▶ Develop integrated urban planning policies that take into account the long-term goal of decarbonising the buildings and construction sector. These should include urban planning frameworks that cover land use efficiency, transit-oriented design, green spaces, and district energy planning. Implementing these through collaboration between national, sub-national, and local agencies will ensure urban planning and sustainable energy buildings are more highly integrated and more effective.
- ▶ Implement and enforce mandatory progressive building energy codes, striving for near-zero energy and net-zero emissions in new construction in the coming decade for as many countries as possible. For new buildings, require high energy performance envelope components and measures, including air sealing, insulation, insulating and low-emissivity windows, and cool roofs. Policies should be backed by a performance-based approach with enforced quality assurance measures.
- ▶ Work with stakeholders to set clear energy performance targets for existing buildings and promote passive and bioclimatic designs to reduce energy demand. Develop national and local strategies to decarbonise the existing building stock and increase the annual energy efficiency renovation rate to reach 4% by 2050.
- ▶ Put in place systems to enable rating of building performance and to develop benchmarks to evaluate building energy performance and ensure they are accessible and disclosed to facilitate comparison. Promote the use of regular energy performance auditing to ensure systems are being maintained and operating efficiently making use of advanced energy management systems and smart controls.
- ▶ Promote the use of Building Passports as a system for regular information collection related to buildings system operations and energy use. Passports will support the availability and access to buildings information to current and future owners and those who work with the buildings in the future.
- ▶ Develop, review and enforce Minimum Energy Performance Standards (MEPS) that set product quality and performance requirements. Expand and update MEPS to cover all major appliances and major systems and set energy performance requirements for networked devices.
- ▶ Promote investment in buildings construction to adopt high performance systems for space and water heating, cooling and ventilation, and lighting, especially by governments who can develop policies and procurement practices for their own buildings and thereby lead by example.
- ▶ Reduce demand for materials with high embodied carbon and increase energy efficiency in major building materials production alongside the decarbonisation of energy used in materials production. Adopting material efficiency strategies in addition to promoting circular economy concepts in buildings using life-cycle approaches to design, construction and end of life, reuse of construction materials, and phasing out the use of global warming potential refrigerants.
- ▶ Improve the resilience of the building stock through increased use of risk assessments, risk mapping, and resilience planning for emergency response and the long term. Consider, in the development of new urban plans, potential changes in climatic conditions related to flooding, wind, storm water and heat and how buildings need to be designed for resilience in the future. Map and build strategies for existing buildings on how they must be adapted to mitigate against extreme climate events.
- ▶ Promote the use of on-site, and buildings integrated renewable energy including solar PV, solar thermal, geothermal, micro-wind and advanced biofuels where appropriate and possible. Support this by developing a clear regulatory framework that defines operational rules, remuneration schemes, incentives allocation, integration mechanisms and goals at national and local level.

7.2 REGIONAL ROADMAP ACTIVITIES

Comprising detailed stakeholder-led strategies for developing a net-zero carbon, energy efficient, and resilient building stock, the Regional Roadmaps for Africa (GlobalABC/IEA/UNEP 2020a), Asia (GlobalABC/IEA/UNEP 2020b), and Latin America (GlobalABC/IEA/UNEP 2020c) were the product of more than 850 contributions, detailed survey and analysis of trends, and expert interviews and consultations.

Across the three regions, to support the decarbonization of new and existing buildings, effective policies and regulations need to cover the entire building life cycle, including the design, development, operation and decommissioning stages, and also act beyond site boundaries through neighbourhood planning and clean energy. To accelerate action, greater collaboration involving a range of stakeholders is needed, including policy makers, urban planners, architects, construction companies, materials suppliers, utility companies, developers, and investors.

The Table 3 below provides a highlight of the key actions for each region.

Table 3 - Key messages for the GlobalABC Regional Roadmap for Buildings and Construction in Africa, Asia, Latin America

AFRICA	LATIN AMERICA	ASIA
<p>Governments should partner with key stakeholders to develop metrics which include energy performance benchmarks and sector targets and data collection mechanisms that include the use of materials with low embodied carbon, building energy performance, building ratings systems, and building resilience.</p> <p>City-level actors should collaborate across sectors and government levels to develop integrated urban planning policies and frameworks that address development patterns, land-use efficiency, transit-oriented design, access to green spaces, resilience and district clean energy planning.</p> <p>National and subnational governments, industry coalitions and civil society should promote the multiple benefits that zero-emission, energy-efficient and resilient buildings have for different stakeholders.</p> <p>Ministries should also develop national and local renovation and financing strategies to accelerate implementation and achievement of decarbonisation and efficiency goals, such as increasing the annual energy efficiency renovation rate to 2% by 2040.</p> <p>Overall, there is a need to raise the level of ambition on actions that can support improved building performance and construction methods so that it matches the scale of development change.</p>	<p>25 Oct 2020 National ministries and city agencies should develop ambitious, comprehensive strategies and roadmaps to outline the pathway to a zero-emission, efficient, and resilient buildings and construction sector.</p> <p>Regulators can reduce future energy demand in new buildings through ambitious and progressive mandatory energy codes that focus on highly efficient and net-zero carbon emissions for new construction within the next decade.</p> <p>Governments and large organisations can take leadership in zero-carbon procurement and standards to promote investment in low-carbon building construction and renovation and encourage the adoption of efficient technologies at scale.</p> <p>All stakeholders should address key information gaps by collecting data and evidence to support actions to decarbonise and improve the efficiency of buildings. Across Latin America, information is largely lacking on a range of building-related activities, which limits actions.</p>	<p>Updated NDC Ministries should develop national and local renovation and financing strategies to accelerate implementation and achievement of decarbonisation and energy savings goals, such as increasing the annual energy efficiency renovation rate to 2% by 2040.</p> <p>Regulators should focus on residential buildings and develop standards for nature-based solutions and efficient design and cooling solutions, as well as expand minimum energy performance standards (MEPS) to set ambitious product energy performance requirements covering all major appliances and systems.</p> <p>National and local agencies should develop ambitious regulatory and incentive frameworks to increase investment in energy efficiency improvements or reduce carbon emissions from the production of major building materials.</p> <p>Governments should promote the use of regular energy performance auditing and data collection to ensure the effectiveness and performance of building energy performance interventions and encourage active engagement with building rating schemes.</p> <p>Overall, there is a need to raise the level of ambition on actions that can support improved building performance and construction methods that match the scale of development change. There is a reported lack of ambition in advancing the use of spatial planning approaches, bioclimatic design principles and low-energy building system technologies; and building code adoption and compliance.</p>

Case Study 7: National Alliances for Buildings and Construction - Long-term partnerships for the energy transition

National Alliances for Buildings and Construction (PEEB 2020b) can play a vital role in the buildings and construction sector's efforts towards decarbonising the built environment. They bring all stakeholders of a given country (e.g. policy makers, manufacturers, architects & designers, and real estate developers) around one table jointly working on priorities and measures for decarbonizing buildings. In several cases inspired by GlobalABC, national alliances have been established, including in France, Germany, Mexico, Morocco, and Tunisia,

National alliances play a central role in mobilising real estate actors towards the energy transition. They have great potential for uniting different professions through common goals, lead to a better regulatory framework through fostering public private dialogue, support the development of highly innovative industry products, contribute to and drive voluntary commitments, and support and initiate capacity development.

National alliances are developing around the world. Depending on the national context, they can be public or private sector driven, and range from volunteer-based alliances to formalised structures. Some national alliances already have a track record of over 10 years of activities, while others have just been created following GlobalABC regional roundtables

and the development of regional roadmaps. Some may not even have been identified as such yet.

National alliances succeed thanks to a variety of factors. They most often prosper when they develop a common mid- to long-term vision and goal championed by leading experts, set up a simple and engaging organisational structure, and communicate jointly with clear messages to a wider audience.

The collective experience of the five national alliances included in this publication shows the following key success factors / lessons learned for national alliance building:

Developing a common vision and goal:

- ▶ Thinking the mid- to long-term perspective is necessary to provide a vision to members, while action still needs to be taken now
- ▶ Rallying the public and private sector to become founding members ensures broad ownership
- ▶ Ensuring that the national alliance is led by or associated to a champion in the field/public persona helps injecting momentum and leveraging cross-sector dynamics
- ▶ Providing enough room for flexibility allows for accommodating the sector's new and changing challenges

Setting up a simple and engaging organisational structure:

- ▶ Basing the functioning of the alliance on a voluntary participation of members rather than an obligation ensures the right motivation of all concerned actors
- ▶ Establishing a clear and simple organisational structure will facilitate day-to-day activities
- ▶ Providing opportunities for members to engage in alliance activities increases the identification of members with the alliance
- ▶ Finding the common ground among private, public and civil society sectors provides the basis for constructive discussions and effective change.

Advocating jointly with clear messages:

- ▶ Contributing to GlobalABC activities is an excellent way to support the process of regional roadmap development and adapting those to national needs.
- ▶ Rallying the private sector to provide a balanced and well-founded opinion and new proposals for public policies is a great help for public-private co-creation of regulation
- ▶ Connecting with international organisations and national partners working for the same topic increases networks and leverage
- ▶ Bringing in academia and the private sector to discuss sustainable development goals extends the reach of national alliances
- ▶ Delivering coherent messages to the public is key to reaching the target groups



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9 ACRONYMS, ABBREVIATIONS AND UNITS OF MEASURE

9.1 ABBREVIATIONS

	BPIE	Building Performance Institute Europe
CO ₂		carbon dioxide
COP		Conference of the Parties
CoP		Coefficient of performance
EU		European Union
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
NAMA		National Appropriate Mitigation Action
MEPS		minimum energy performance standards
NDC		Nationally Determined Contribution
NGO		non-governmental organisation
PEEB		Programme for Energy Efficiency in Buildings
PV		photovoltaic
R&D		Research and development
SBT		Science-Based Targets
SDG		Sustainable Development Goal
TFA		Total floor area
UCL		University College London
UNFCCC		United Nations Framework Convention on Climate Change
USD		United States dollar
WBCSD		World Business Council for Sustainable Development
ZEB		zero-energy building

9.2 UNITS OF MEASURE

ACH	air change per hour
EJ	exajoule
GtCO ₂	gigatonne of carbon dioxide
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

10 METHODS

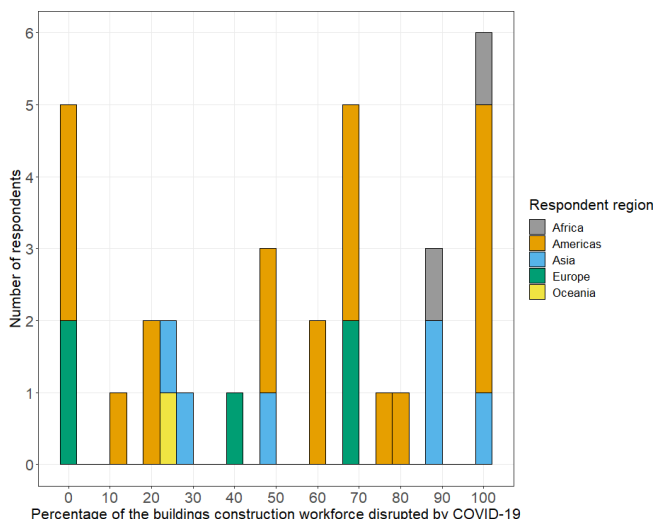
10.1 2020 GLOBAL BUILDINGS-GSR SURVEY

During the summer of 2020, all GlobalABC members were given the opportunity to fill out the Buildings-GSR survey. This knowledge gathering exercise provided members a chance to feedback their activities and insights for inclusion in the report. Alongside the general findings highlighted below, this year’s Buildings-GSR survey focused on two major themes. First, the COVID-19 pandemic and recovery and how it has impacted the buildings and construction sector. Second, the global status of buildings energy performance certification and building energy codes.

10.2 COVID-19 VIEWS FROM GLOBALABC MEMBERS

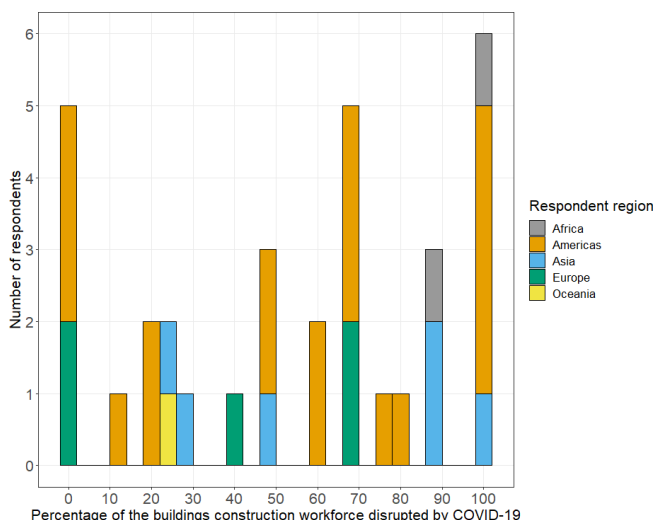
The Buildings-GSR 2020 survey sought perceptions from stakeholders on both the impacts of COVID-19 on global construction activities and the amount of time expected activities return to normal. As Figure 23 shows, there is no clear regional pattern regarding the extent to which construction activities have been affected. However, a large share of respondents said the construction workforce had been disrupted in some way, many even saying the disruption concerned more than 50% of the workforce.

Figure 23 - Survey respondent perceptions of the percentage of the construction workforce that has been disrupted by COVID-19



Source: Authors, developed for the 2020-Buildings-GSR

Figure 24 - Survey respondent perceptions of the number of months that will elapse before buildings and construction activities will take to return to pre-COVID-19 levels.



Source: Authors, developed for the 2020-Buildings-GSR

Figure 24 gives the expectations by survey respondents regarding the amount of time that will elapse before construction activities reach a pre-COVID-19 level. Generally, respondents from countries in the Americas expect the disruption to be more short-lived, although some respondents are less optimistic about a return to typical activity levels within the next two years.

A total of 50 respondents from 25 countries returned the 2020 Buildings-GSR survey. There was good global coverage, with every continent represented. Mexico had the highest number of respondents at 14, followed by Pakistan (4), France (3) and Switzerland, the UK, Canada, Columbia and Japan each having 2.

A plurality (43.5%) of respondents represented civil society organisations, research institutions or intergovernmental organisations. Those working in the private sector constituted the next largest portion of respondents (23.9%), followed by national government representatives (19.6%).

As discussed in section 2 of this report, 2019 and 2020 have seen multiple updates to the NDCs as the path towards sustainable development is charted. The year's survey found that 50% of respondent's countries did not update their NDCs, whereas 33% did. The survey revealed specific action on Brazil's space cooling equipment, lighting & appliances with respect to their NDC. Similar NDC developments were outlined by respondents from Mexico.

The survey also provided stakeholders the opportunity to highlight any relevant developments in their nation. The survey revealed the intention of Hong Kong to focus on retro-commissioning of its buildings with a view to improving energy efficiency in the city state. Development of Africa's first 'eco-city' is underway in Zenata, Morocco as well as a national building label for energy performance. In Germany, the "individual building renovation passport" has recently been developed. The Japanese Government has implemented a requirement that new buildings will need to have less-than-average energy consumption by 2030, and that new houses must have net negative emissions over their entire lifecycle.

10.3 BUILDING CLIMATE TRACKER LIMITATIONS – WHAT THE TRACKER DOES NOT SAY

The tracker does not contain information on societal aspects such as the housing situation, nor does it include economic impacts such as on building sector employment. Also, it excludes the end of life of buildings regarding waste management, for example. The focus of the tracker is decarbonisation through climate mitigation, although some aspects of climate resilience and adaptation can be found in some indicators that are contained in the tracker, mostly indirectly for example in the building code. However, more specific indicators to address resilience and adaptation, such as flood protection and insurance cases, may find their place in the tracker in the future. A consultation of relevant stakeholders is recommended to review the scope and the composition of the tracker, refine its objective and expand its messages to increase its usefulness for policymakers.

The tracker is retrospective and does not consider future developments, such as demography, climate change impacts or urbanization trends in its calculation. These developments may, however, make it easier or harder to decarbonise buildings. The idea of their exclusion is to make the tracker straight forward and avoid assumptions and uncertainties about the future.

Widening the tracker scope includes adding new and broadening existing indicators. To add new indicators such as material efficiency, smart metering coverage, and PV coverage suitable data sources with global coverage need to be researched. The same holds true for broadening existing indicators by adding additional data. For example, the building energy certification indicator in current Global Status Report for Buildings and Construction is based on policy actions listed in IEA database. However, there are large datasets available from building certification systems (LEED, BREEAM, PASSIVE HOUSE etc.) that could be added into the tracker calculation to supplement the actual information and develop into a more comprehensive indicator.

11 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.

11.1 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.

11.2 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 2021 on how the building industry is readjusting.

11.3 MARKET TRANSFORMATION

This Work Area aims to support 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 (SBT4 buildings) project led by the World Business Council for Sustainable Development (WBCSD).

11.4 FINANCE

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 also aims to 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.

11.5 BUILDING MEASUREMENT, DATA AND INFORMATION

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. The Work Area aims to promote overall sectoral data transparency, consistency and information exchange; provide guidance to enhance policy and track investments in the buildings and construction sector; and facilitate accessibility, transparency, understanding and comparability of energy use through the development of practice-orientated building data, measurement, and standards in the buildings and construction sector.



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