

CLIMATE ACTION PATHWAY

Human Settlements

Executive Summary

HUMAN SETTLEMENTS PATHWAY CONTENT

The climate action pathway for human settlements addresses whole-life carbon mitigation, adaptation and resilience in the built environment, composed of buildings and infrastructure assets, as well as waste and consumption within human settlements, framed by zero-waste cities, 1.5°C living and social equity.

This document sets out a vision for human settlements in 2050, summarizes the required system transformation of the built environment and waste and consumption in human settlements, and provides milestone targets, a progress update and key facts and figures on built environment decarbonization and resilience.

VISION STATEMENT

By 2050 all human settlements are decarbonized, healthy places that are affordable, accessible and inclusive. Bold climate action from all levels of government, effective financial incentives, and deployment of appropriate technologies alongside business leadership and low carbon behaviours have transformed human settlements and ensure sustainable and harmonious living for future generations. People lead lives compatible with a 1.5°C world and have radically changed their consumption patterns thanks to the net-zero carbon infrastructure, food systems, housing, mobility products and services in cities. Buildings and construction have net-zero emissions across the whole lifecycle, cities conserve resources, are zero waste, and have social equity at the heart of climate action.

Cities enable and empower decarbonized living and development among all people and businesses. Radical collaboration across stakeholders has allowed for decarbonization of the built environment across the whole system, including all embodied and operational carbon emissions. Along the entire buildings and construction value chain there is a common vision, narrative and language that continues to drive policy and innovation, which are needed to continuously increase energy efficiency, renovate existing stock and operate cities sustainably. Similarly, deep behavioural change aligned with systemic change has boosted circularity: waste (including construction, food, and non-recyclables) is virtually non-existent in human settlements; water is operated on a closed loop without any loss from recovery and distribution, to consumption; transport is zero-carbon and accessible to all, and cycling and walking are prioritized and incentivized everywhere.

Human settlements now protect their citizens and economies by implementing climate-resilience strategies and facilitating adaptation efforts in all activities. All policy and investment decisions are considered under a climate change mitigation, adaptation and resilience lens holistically. There is clear understanding that the impacts of climate change on the built environment have severe consequences on human health and well-being; hence, cities adopt a cross-sectoral and integrated approach when undertaking upgrades to and/or new developments in city infrastructure. In addition, policies are developed, and investment decisions are taken, based on social equity considerations.



Co-creation with residents and local stakeholders is a key component to ensure that different needs are considered and that no one is left behind on the path to more climate-friendly urban environments.

A green economy enhances productivity and stimulates innovation, making human settlements attractive places to live and work. Sustainable lifestyles match the net-zero built environment that is now safe and healthy. Deaths from air pollution and heatwaves have been avoided, and cities thrive with jobs created by the new green and circular economy. All have access to a dignified living standard and are less vulnerable to climate shocks and disasters.

SYSTEM TRANSFORMATION SUMMARY

BUILT ENVIRONMENT

Currently the buildings and construction sector accounts for almost 40 per cent of global energy and process-related carbon emissions.¹ According to the Intergovernmental Panel on Climate Change (IPCC) special report on *Global Warming of 1.5°C*, restricting climate change to 1.5°C would need “rapid and far-reaching” changes around energy use, industry and buildings design, as well as the wider planning of cities and infrastructure. The built environment must also be resilient, as by 2050, over 970 cities could be subjected to extreme heat, 500 cities could suffer from lack of water availability, and over 570 cities could be impacted by sea level rise². In the face of this, around 40 per cent of buildings³ and 75 per cent of infrastructure⁴ that are predicted to exist in 2050 have yet to be built, and the built assets that already exist require retrofit to bring them to net-zero standards.

Action and collaboration are needed immediately from all stakeholders to achieve the paradigm shift to a net-zero and resilient built environment. If action is not taken today, we risk locking emissions and vulnerability into our buildings and infrastructure that will become increasingly costly to mitigate in the future.

To decarbonise the built environment, whole-life carbon emissions (operational and embodied) must be assessed and tracked on all new and existing developments to determine how best to minimize emissions while ensuring resilience for the future. System decarbonisation requires demanding less material, minimising energy use, and implementing low-carbon and renewable heating, cooling, material and construction technologies at scale, while promoting the decarbonization of the energy, transportation, and material manufacturing sectors (e.g. steel and cement) in parallel. These sectors have their own themes and respective pathways in the Marrakech Partnership structure. The interventions needed to reach net zero will vary from project to project and can range from using ultra-low-impact refrigerants for cooling, implementing passive design measures, installing electric building energy systems powered by renewables and reusing existing materials.

¹ Global Alliance for Buildings and Construction (GlobalABC). 2019. Global Status Report for Buildings and Construction

² C40 Cities. 2018. The Future We Don't Want

³ Carbon Trust. 2009. Building the future, today

⁴ Global Infrastructure Basel. 2014. 4th Summit Report

The built environment has great inertia due to its complexity and fragmented value chain. Therefore, radical collaboration across all stakeholders at the project and sector scales is needed to find solutions that will transform it. The supply chain must align around zero-carbon solutions and work in collaboration to deliver them. Many of these solutions already exist, but finance and policy intervention are needed to support their implementation.

In most countries, **policies** that regulate or drive net-zero carbon solutions in the built environment are severely lacking. More than two thirds of the buildings constructed between now and 2050 are expected to be built in countries that do not have any building energy codes. All countries need to include specific measures in their nationally determined contributions (NDCs), introduce or strengthen building codes, and implement policy that creates appropriate financial instruments and incentives, while upskilling the workforce, to drive down emissions and embed resilience in buildings and infrastructure. Progressive emission targets and regulations must be based on real operational performance and construction emissions from assets and deep energy retrofit must be increased and incentivized. Countries, cities and regions need to undertake comprehensive risk and vulnerability mapping to support resilience strategies which ensure the adaptation of existing built assets and the integration of resilience measures into all new construction. **Local governments** must also implement planning policy that prioritizes reuse and refurbishment of existing assets, avoids demolition, and ensures that any new development provides high social value, embeds resilience and minimizes whole-life carbon as standard practice.

In **finance**, investors are beginning to realize the value of low-carbon and resilient assets as they are less risky, yet this growing interest has not yet filtered into the project delivery chain. Investors must advocate for government action through policy and regulation, which are needed to make the transition to net-zero investible. In the meantime, financial institutions must set investment criteria based on whole-life carbon emissions and resilience, invest in low-carbon technologies to bring them to scale, and create financial mechanisms that stimulate demand for energy-efficient retrofit and net-zero carbon buildings. Maximizing the value of existing assets, materials and products in the built environment through reuse and refurbishment as part of a circular economy presents great emission reduction and investment potential that the financial market should capitalize on.

Businesses have a growing desire, and awareness of the need, to shift to a net-zero built environment. Business-led initiatives to push this agenda forward are growing in size and number, yet many businesses are risk-averse, which can prevent them from leading change and innovating. Support from finance and policy is needed to mitigate financial risk and provide incentives to accelerate the transformation businesses are capable of delivering. In the meantime, businesses must demand zero-carbon buildings, invest in low-carbon technologies, influence collaborators, advocate for policy, upskill their workforce in low-carbon construction, assess, minimize and track emissions, and embrace circular economy principles on all projects. As an immediate step, businesses must commit to achieving net zero across their activities, supported by clear targets and transparent progress reporting, and collaborate across the sector to achieve system transformation.

In **civil society**, all individuals must be educated on the contribution of the operational emissions of the buildings they use to their carbon footprint, what behaviours they can change to reduce this and

what the associated financial and well-being co-benefits are if such behaviour changes are adopted at scale. These changes in behaviour need to penetrate all sectors that service society, such as healthcare and education, and could be achieved by tracking and displaying live operating carbon emissions and cost performance (e.g. using smart meters). Minimizing demand on energy and water in buildings must become the new daily normal, and those who can must demand electrification and low-carbon, deep energy-efficiency retrofit of their existing buildings.

By **2030**, 100 per cent of new buildings must be net-zero carbon in operation, widespread energy efficiency retrofit of existing assets must be well underway, and embodied carbon must be reduced by at least 40 per cent, with leading projects achieving at least 50 per cent reductions in embodied carbon. By **2050**, all new and existing assets must be net zero across the whole life cycle, including operational and embodied emissions.

WASTE AND CONSUMPTION

Currently, cities operate based on the take-make-waste model. By 2050, cities must become “**zero waste**”, with no discharges to land, water or air that threaten the environment or human health by means of responsible production, consumption, reuse and recovery of organic waste, products, packaging and materials without burning.

For this to happen, cities in collaboration with businesses have to implement five main circular economy strategies: (i) recover (collection, segregation and recycling based on proper waste management); (ii) reduce (resource efficiency in industry and manufacturing); (iii) reuse (repairs, remanufacturing), (iv) redesign (facilitating sustainable product design and circular business models; and (v) regenerate (regenerative urban development, nature based solutions).⁵

Recent studies illustrate the scale of the “**1.5 Degree Living**” challenge: the need for reductions in greenhouse gases of over 80 per cent by 2050 from today’s intensity of lifestyles. This is our sustainable living ambition to achieve a net zero world and limit global warming to 1.5°C. We need to aim for lifestyle carbon footprint targets of 2.5tCO₂e by 2030, 1.4 by 2040, and 0.7 by 2050. Even developing countries need to reduce footprints by 23 per cent to 84 per cent, depending on the country and the scenario, by 2050.⁶ Several cities are acting on this opportunity to enable a shift in everyday life practices⁷ by engaging with the youth through campaigns⁸ and supporting sustainable business models and infrastructure development.

A growing political consensus is globally forming that climate action needs to systematically incorporate **social equity** considerations. Use of equity frameworks in climate mitigation and

⁵ ICLEI. 2020. [Putting the circular economy into action in cities.](#)

⁶ Institute for Global Environmental Strategies (IGES), Aalto University, D-mat Ltd., Sitra, KR Foundation. 2019. 1.5 Degree Lifestyles: Targets and options for reducing lifestyle carbon footprints. Technical Report. Institute for Global Environmental Strategies, Hayama, Japan.

⁷ ICLEI. 2020. [Key learnings for cities to enable 1.5-Degree Lifestyles.](#)

⁸ City of Turku. 2020. [Take Part in the 1.5-Degree Life Video Competition!](#)



adaptation will increase social acceptance and the effectiveness of policy measures. By 2050, collaboration with residents and local stakeholders should become a key component to ensure that different needs are considered and that no one is left behind on the path to more climate-friendly urban environments.

For this, three dimensions need to be addressed: (i) Access – Local governments seek to ensure more equal access to low-carbon public services and infrastructures for all local residents, independent of factors like age, neighborhood, income, social group or language; (ii) Participation – The more that programmes are designed with rather than for residents, the better. This can be ensured through active outreach and citizen-led engagements like co-creation, as well as by increasing public acceptance and ownership; and (iii) Opportunity – This involves equal access to quality education early-on, provision of career perspectives through training and support programmes, and increased diversity in employment in public institutions and through procurement tools and stakeholder cooperation.⁹

⁹ Urban Transition Alliance (UTA). 2020. [3 Dimensions to Advance Social Equity in Sustainability Planning](#). Bonn, Germany.

MILESTONES TOWARDS 2050

BUILT ENVIRONMENT



- Companies across the built environment value chain set net-zero commitments and collaborate within the system towards achieving a net-zero built environment
- Countries enhance their NDCs addressing whole-life cycle emissions and resilience in the built environment, specifying actions to achieve net zero emissions
- All built environment stakeholders have a strong baseline and alignment of action required to accelerate towards net zero across the whole system
- All countries have national roadmaps for decarbonizing the built environment
- The majority of countries, cities and regions have introduced regulations, codes and planning policy which require new buildings to operate at net- zero carbon by 2030, increase net-zero-ready renovation rates, reduce embodied carbon, report emissions performance, and address resilience
- Emissions reductions, circularity and resilience are prioritised in all financial and procurement decisions
- All new buildings operate at net- zero carbon and are resilient to future projected climate shocks
- All new buildings, infrastructure and renovations have at least 40 per cent less embodied carbon, with leading projects achieving at least 50 per cent reductions in embodied carbon
- Renovation rates to net-zero carbon standards (or net-zero ready) have increased significantly to at least 3% per year
- The majority of existing buildings have undergone deep retrofits to align to net- zero carbon standards
- Circular economy principles are integrated across all projects, where the reuse of materials is the norm

PROGRESS

The built environment is responsible for almost 40 per cent of energy- and process-related emissions globally.¹⁰ Operational emissions (from energy used to heat, cool and light buildings) account for 28 per cent, and the remaining 11 per cent are embodied carbon emissions associated with the production of materials used in construction over the whole building life cycle. Decarbonizing the built environment across the entire life cycle is therefore critical to meeting the 1.5°C target. However, the sector is not currently on track. Buildings-related CO₂ emissions rose, reaching an all-time high of 10 GtCO₂, in 2019.

There is a critical need to improve the adaptation and resilience of the built environment to protect communities from the natural hazards in the future caused by projected climate change. In 2019

¹⁰ GlobalABC. 2019. Global Status Report for Buildings and Construction

alone, natural disasters affected 95 million people, claimed over 11,000 lives, and caused USD 103 billion in economic losses, much of which may have been mitigated by more resilient infrastructure and buildings.

In **policy**, 136 countries have mentioned buildings in their NDCs, yet few detail explicit actions to address emissions within the sector to achieve a net-zero built environment.¹¹ In addition, less than one third of countries have mandatory building energy codes or certifications in place and more than two thirds of the buildings to be constructed between now and 2050 are expected to be built in countries that do not have any building energy codes. Despite the importance of resilience, only 10 per cent of NDCs currently include resilience targets. In 2020, NDCs under the Paris Agreement are due for revision, which presents an unmissable opportunity to prioritize the decarbonization of the sector through specific targets and policy actions. Nevertheless, there are several examples of increasing ambition. The European Commission announced its *Renovation Wave Strategy*, which aims to at least double renovation rates in the next 10 years and ensure that renovations lead to higher 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.

28 cities have signed the *C40 Net Zero Carbon Buildings Declaration*, pledging to enact regulations and/or planning policy to ensure that new buildings operate at net-zero carbon by 2030 and all buildings by 2050. Cities are also beginning to address embodied carbon in the built environment, with over 30 cities now participating in C40's *Clean Construction Forum*. Used in cities around the world, the *City Resilience Index* is a tool that allows cities to understand and measure resilience and provides a framework for building resilience in a systematic way. The Global Alliance for Buildings and Construction (GlobalABC) has developed a set of *Regional Roadmaps* (Africa, Asia and Latin America), which present a comprehensive methodology with policy and technology targets and timelines, as well as key actions under eight priority areas. These roadmaps can be used at all jurisdictional levels and support the built environment's transformation to net zero by 2050.¹²

There is growing ambition from **businesses** across the built environment value chain, with leading companies announcing net-zero commitments, but more is needed globally. Many businesses and organizations have already signed the World Green Building Council's *Net Zero Carbon Buildings Commitment*; committing to only owning and occupying net-zero carbon buildings by 2030 and to advocate for wider system transformation. In addition, thousands of architects, engineers and contractors in countries around the world have committed to minimizing the whole-life carbon of their projects as part of the *Construction Declares* initiative since it was launched in 2019. More broadly, thousands of companies have committed to bold climate action by joining the *Race to Zero* campaign, committing to achieving net-zero emissions by 2050 at the very latest, which will have implications for the offices, manufacturing facilities, logistics warehouses and retail spaces these companies use. In addition to setting individual decarbonization targets and pathways, companies increasingly look to align their efforts to achieve full decarbonization across the entire built

¹¹ GlobalABC. 2019. A Guide to Incorporating Buildings Actions in NDCs

¹² GlobalABC. 2020. Regional Roadmap for Buildings and Construction in Africa, Asia and Latin America



environment, from individual buildings to the full system. The *Building System Carbon Framework* presented by the World Business Council for Sustainable Development (WBCSD) enables this alignment across all the stakeholders of the system to accelerate towards a net-zero built environment.

The **technology solutions** to transition to a net-zero built environment exist. Estimates suggest that around 70 per cent of cumulative CO₂ emission reductions could be achieved from the deployment of solutions that are available on the market today.¹³ However, innovation is still required to fully integrate across the diversity of climates and building types, and these solutions are not being adopted at sufficient scale and pace.

To facilitate this transition, a significant scale-up in **investment** will be needed to unlock the benefits associated with zero-carbon, energy-efficient and resilient buildings. Realizing sustainable buildings requires capital flows to increase by an average of USD 270 billion a year over the next decade – a relatively small addition to the USD 4.9 trillion dollars already invested each year in buildings globally.¹⁴ As part of the *Zero Carbon Buildings for All* initiative, multilateral development banks and private financial institutions have come together with the goal of mobilizing USD 1 trillion in “Paris-compliant” building investments in developing countries by 2030. In addition, through the *Net-Zero Asset Owner Alliance*, the world’s largest pensions funds and insurers, responsible for directing more than USD 2.4 trillion in investments, have committed to carbon-neutral investment portfolios by 2050.

Finance and businesses can also enable increased and accelerated action towards improving the resilience of the built environment. The *Taskforce on Climate-Related Financial Disclosures* (TCFD) provides recommendations to enable markets to address the financial impact of climate change by increasing transparency on climate-related risks and opportunities to promote more informed financial decision-making. Support for this taskforce has grown to over 1,440 organizations, representing a market capitalization of over USD 12.6 trillion.

¹³ International Energy Agency (IEA). 2020. *Energy Technology Perspectives*

¹⁴ IEA. 2019. *The Critical Role of Buildings*

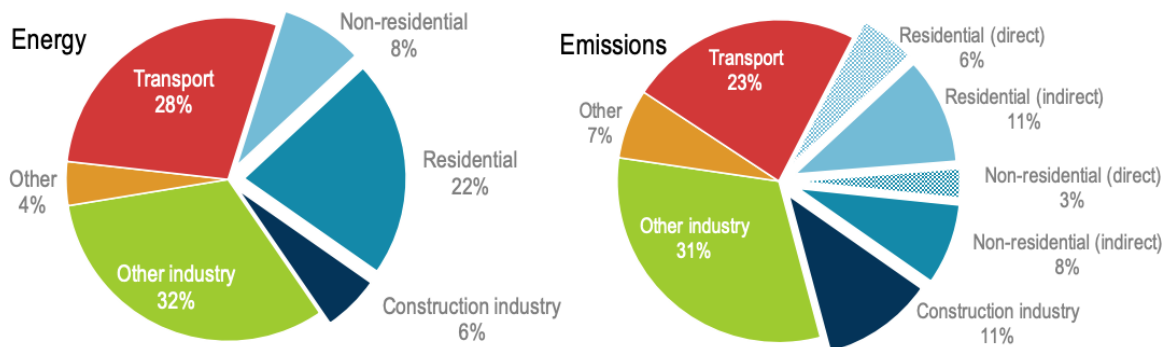


FACTS & FIGURES

BUILT ENVIRONMENT

Source: 2019 Global Status Report for Buildings and Construction – GlobalABC

Global share of buildings and construction final energy and emissions, 2018

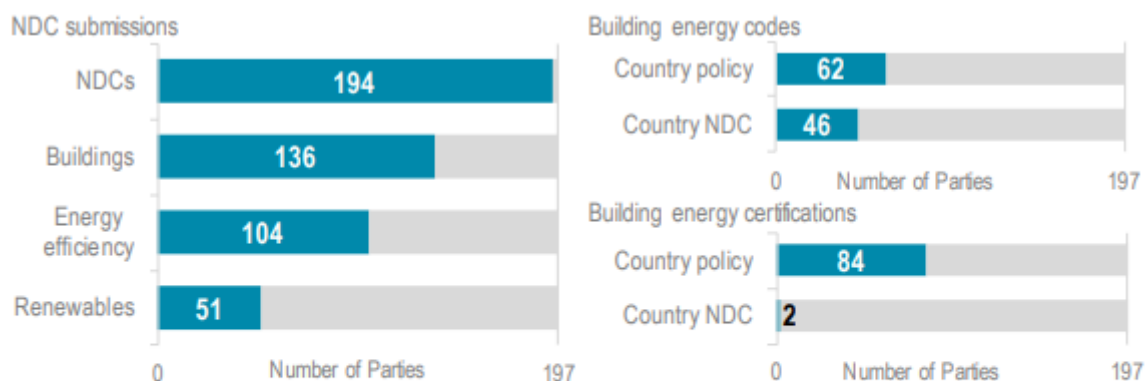


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Notes: *Construction industry* is the portion (estimated) of overall industry devoted to manufacturing building construction materials such as steel, cement and glass. Indirect emissions are emissions from power generation for electricity and commercial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

- A total of 136 countries have mentioned buildings in their NDCs. Only 10 per cent of NDCs currently include resilience targets.

Source: 2019 Global Status Report for Buildings and Construction – GlobalABC



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

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

- About 70 per cent of cumulative CO₂ emission reductions in the built environment could be achieved from the deployment of solutions that are available on the market today.¹⁵

Demand growth

- The world has added about 50 billion m² of new floor area over the last decade, the equivalent of adding a new Empire State Building every 25 minutes.¹⁶
- Buildings-related CO₂ emissions rose, reaching an all-time high of 10 GtCO₂, in 2019.
- A total of 40 per cent of buildings¹⁷ and 75 per cent of infrastructure¹⁸ that are predicted to exist in 2050 have yet to be built. About 200 billion m² of building floor space is projected to be added by 2050, mostly in Africa and Asia.
- In 2018, the number of people living in slums or informal settlements grew to over 1 billion. About 3 billion people will need adequate and affordable housing by 2030.¹⁹

Finance

- Green buildings are a huge investment opportunity. Default rates on “green” mortgages are low and the International Finance Corporation estimates that USD 24.7 trillion out of the approximately USD 30 trillion required for climate transition needs to go towards green

¹⁵ IEA. 2020. *Energy Technology Perspectives*

¹⁶ We Mean Business. 2020. *We Mean Business, better future faster*, Built Environment

¹⁷ Carbon Trust. 2009. *Building the future, today*

¹⁸ Global Infrastructure Basel. 2014. *4th Summit Report*

¹⁹ World Bank (blogs). 2016. *Let’s build the infrastructure that no hurricane can erase*



buildings. However, only about 8 per cent of the USD 5 trillion spent on building construction and renovation is used for energy efficiency.²⁰

- Realizing sustainable buildings requires capital flows to increase by an average of USD 270 billion per year over the next decade – a relatively small addition to the USD 4.9 trillion dollars already invested each year in buildings globally.²¹
- Green bonds that are tied to low-emission or zero-carbon buildings are expected to amount to 40 per cent of the green bonds market over the long term.²²

Buildings energy use

- A 30 per cent energy intensity reduction is needed by 2030 to put the sector on track to meeting the Paris Agreement goals. Instead, final energy demand in buildings has risen by 5 per cent since 2010, with the impact from growth in floor area and population outpacing the impact of energy-efficiency improvements.²³
- Final energy consumption in residential buildings made up more than 70 per cent of the global total in 2018, with growth resulting primarily from floor area and population increases, while floor area alone remains the main driver of higher consumption in non-residential buildings.²⁴
- About 80 per cent of economically viable energy savings in buildings remain untapped.
- A major source of energy use and emissions from buildings is electricity, the use of which has increased more than 19 per cent since 2010, generated mainly from coal and natural gas.

²⁰ International Finance Corporation. 2019. Green Buildings: A Finance And Policy Blueprint For Emerging Markets

²¹ IEA. 2019. The Critical Role of Buildings

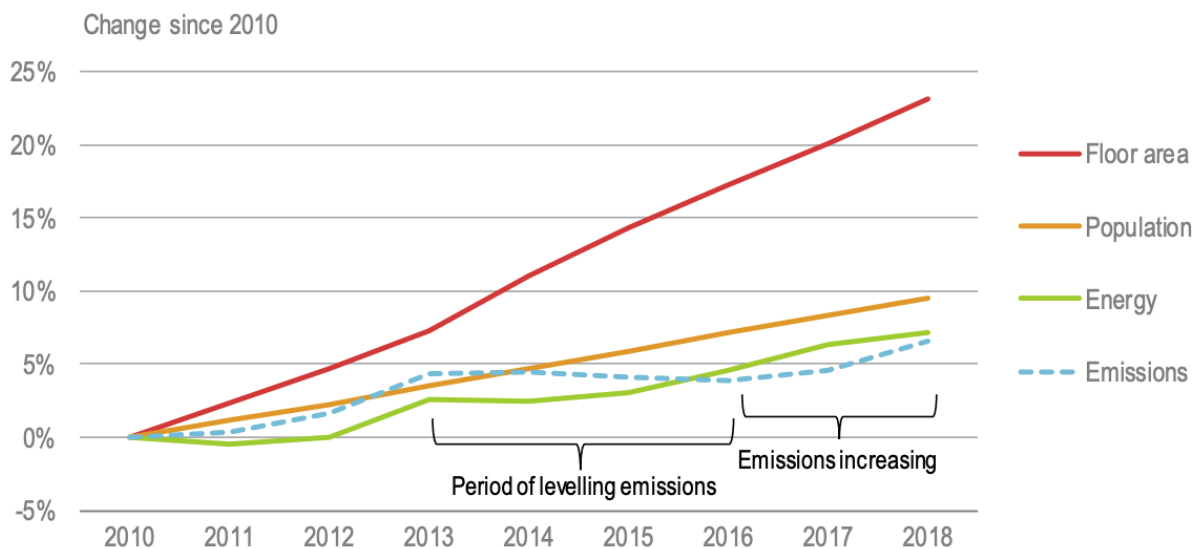
²² Climate Bonds Initiative. 2020. The Building Criteria Climate Bonds Standard

²³ GlobalABC. 2019. 2019 Global Status Report for Buildings and Construction

²⁴ GlobalABC. 2019. 2019 Global Status Report for Buildings and Construction

Source: 2019 Global Status Report for Buildings and Construction - GlobalABC

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



IEA (2019). All rights reserved.

Cooling

- Energy demand for cooling systems and air conditioning is rising sharply. Space-cooling energy use has increased by 25 per cent since 2010 and is growing in energy intensity per unit floor area.
- Only 8 per cent of the 2.8 billion people living in places with average daily temperatures above 25°C have an air conditioner, meaning there could be a drastic increase in demand in the coming years.
- Improving residential cooling equipment performance by 2025 would save an amount almost equivalent to the total electricity use in India in 2015.²⁵

Materials & resource consumption

- Construction material use has grown by a factor of 34 between 1900 and 2005 (for comparison, overall material use has grown by a factor of 8), yet 10 to 15 per cent of building materials are wasted, and 54 per cent of demolition materials end up in landfill.

²⁵ GlobalABC. 2017. Global Status Report 2017



- Looking at the whole building life cycle, material efficiency strategies could reduce emissions in 2050 from the construction, operations and dismantling of homes by 35 to 40 per cent in the Group of Seven (G7)^{26, 27}.
- The built environment is responsible for 25 per cent of global water use.

Cities

- Three quarters of resource-use and greenhouse gas emissions currently come from cities, and trends in urbanization, population and economic growth will further drive up these numbers if we don't reduce consumption and production.
- By 2050, over 970 cities could be subjected to extreme heat, over 490 cities could be subject to extreme heat and poverty, over 500 cities could suffer from lack of water availability, over 1,600 cities could suffer from food insecurity, over 570 cities could be impacted by sea level rise, and over 230 cities' power supply could also be vulnerable to sea level rise.²⁸
- Savings in the order of 30 to 60 per cent, for both resource use and greenhouse gas emissions, can be realized by leveraging connections, interactions and resource-sharing across multiple urban systems.²⁹
- Many cities face serious air and water pollution; both are a direct result of unsustainable consumption and production patterns, making citizens' health a key driver for action.

²⁶ The G7 is an informal forum of seven countries (UK, Canada, USA, Italy, Germany, France and Japan) representing around half of global economic output.

²⁷ International Resource Panel. 2020. Resource Efficiency and Climate Change

²⁸ C40 Cities. 2018. The Future We Don't Want

²⁹ International Resource Panel. 2018. Weight of Cities

CLIMATE ACTION TABLE - STRUCTURE

