
BUILDINGS

N° 4 Decarbonization policies fall behind construction and renovation needs

- The global built-up area has been growing faster than energy efficiency gains in buildings. As a result, emissions from the sector have been on the rise since 2015.
- Energy consumption from buildings in non-OECD countries, pushed by new constructions and demographic growth, is growing faster than in the OECD, where renovation isn't at the needed level.
- In the North, despite gradual electrification, the slow decarbonization of the electricity mix is holding back the sector's decline in emissions. In Germany and the United States, social movements are contesting the phase-out of gas in new buildings by states and municipalities.
- In light of its energy vulnerability revealed by the war in Ukraine, "energy sufficiency" is making a concrete entry into European policies; its impact remains to be seen over time.
- In the South, the need for air-conditioning is rapidly increasing. Isolated initiatives are seeking to scale-up, based on traditional materials and know-how.

KEY FIGURES

Property construction is outpacing energy savings

- **+8.5% emissions** and +12.8% energy consumption from 2015 to 2022. **30%** – share of the building sector in total final energy consumption (Enerdata, 2023).
- **+16.2% built-up area** from 2015 to 2022, compared to -5.5% energy intensity over the same period (IEA, 2023a).

Heating cools down while cooling heats up

- **54.5% of fossil energy** in building consumption in 2022 (mostly for heating), compared to 60.5% in 2015 (IEA, 2023b.)
- **+11% heat pumps** sold from 2021 to 2022, +40% in Europe. (IEA, 2023c).
- **+4%/year energy demand** for space cooling since 2000. Emissions generated by air conditioning systems increased by 16% from 2015 to 2022 (IEA, 2023d).

Sourcing, bans, certification – three popular action levers

- **920 municipal renewable energy targets** for 2022 – of which 793 concern supply, generation or consumption of electricity; 170 concern heating or cooling (REN21, 2022).
- **125+ local governments and 11 states in the United States, representing 36 million people,** have banned gas or encourage electrification of new buildings (RMI, 2023).
- **4.2 billion m² of built-up area certified** in 2021, compared to 1.05 in 2016 (WorldGBC, 2022).

FURTHER READING

TRENDS

- Real estate players are re-examining their foundations to adapt to climate change (2022)
- From efficiency to renewable energy generation: Commercial spaces in search of renewal favouring the low-carbon transition (2022)
- In the face of global warming, air-conditioning is locked in a market model that is costly for the climate (2021)
- US Cities embark on an anti-gas battle to electrify buildings (2021)

CASE STUDIES

ANGERS • EnergieSprong, an industrialized zero energy renovation project, a lever for mass uptake (2022)

INDONESIA • Betting on reflective roofs to avoid air condition (2022)

THE NETHERLANDS • Long-term strategies of local authorities to phase out fossil fuels in heating (2021)

BRAZIL • Buildings: Local authorities and businesses, pioneers in a still weak national set-up (2019)

CANADA • The energy intensity of the residential sector becomes more efficient (2018)

TRENDS
BUILDINGS

Renovate the old, adapt the new, go all-electric: the three pillars of the building sector's climate strategy

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The world's building sector is facing a double challenge: renovate existing stock to make it more energy efficient, and build new, less energy-intense buildings that are more resistant to future climate risks. With the global built-up area growing faster than gains in energy efficiency, and with the concept of "sufficiency" only making a limited appearance at the European level, emissions from the sector are on the rise. The decarbonization of buildings depends on their electrification, and on the transition of the electricity mix, which is progressing slowly. Local governments are adopting building codes and fossil energy bans that are often stricter than those implemented by national governments. At the same time, the accent is increasingly on certification for ecological buildings and a move towards circularity.

There lies the rub: reducing emissions from buildings depends on the electricity mix

In 2022, the building sector represented about 30% of total final energy consumption in the world (up to 40% in Europe), a relatively stable figure since 2015.[1,a] Nevertheless, the energy consumption of buildings grew, in absolute terms, by 2% to 3% per year from 2015 to 2018, before slowing down in 2019 then plummeting in 2020 due to the pandemic. Since the start of recovery in 2021, building energy consumption has hit a new record (**FIGURE 1**).

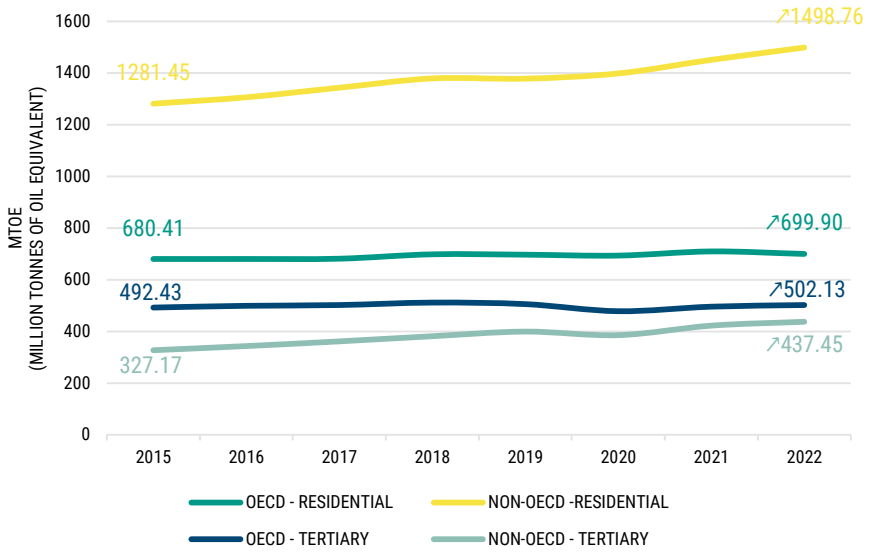
The energy consumption of buildings in non-OECD countries is higher, and pushed by a rising population, growing faster than in OECD countries. Nevertheless, the trend varies depending on the type of building – the energy consumption of residential buildings in the more populated non-OECD countries, is greater than in OECD countries, where commercial buildings constitute a bigger share than in emerging economies (**FIGURE 1**).[2]

a The data on energy and emissions featuring in this analysis are taken from the Enerdata Global Energy and CO_2 Database, unless otherwise indicated.

FIGURE 1

FINAL ENERGY CONSUMPTION IN RESIDENTIAL AND TERTIARY BUILDINGS, OECD VS. NON-OECD, 2015-2022

Source: Climate Chance, based on data from Enerdata

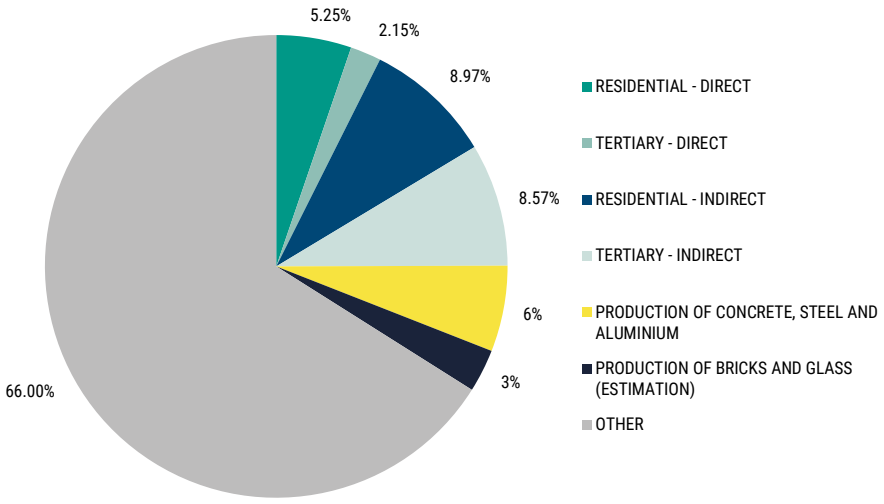


In 2022, building operations (energy uses like heating, cooling, cooking, lighting and other end-uses) were responsible for 9.5 $GtCO_2$, or a quarter of global energy-related emissions, an increase on its 2015 level of 8.8 $GtCO_2$ (+8.52%). The production of building materials (cement, concrete, bricks, aluminium, glass, etc.) represents an additional 9%, according to GlobalABC[3] (**FIGURE 2**).

FIGURE 2

SHARE OF EMISSIONS FROM THE CONSTRUCTION AND OPERATION OF BUILDINGS IN TOTAL ENERGY-RELATED EMISSIONS

Source: Climate Chance, based on Enerdata and GlobalABC, 2022



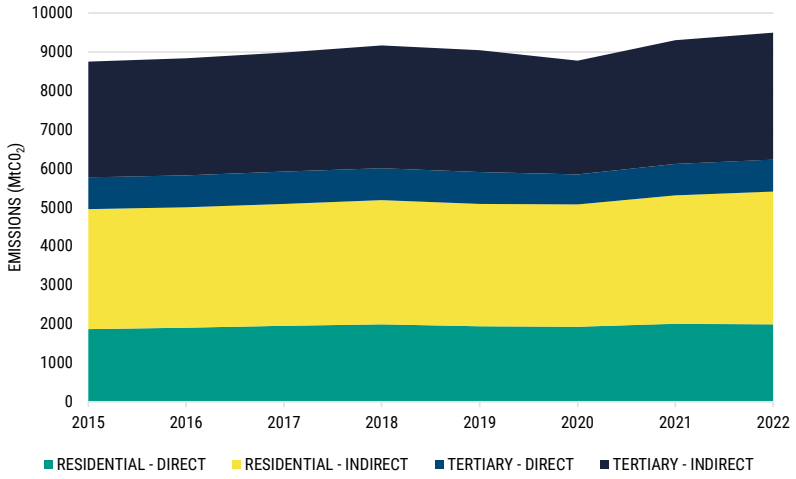
Direct emissions: heating makes its first steps to decarbonization

Direct emissions (2.8 $GtCO_2$ in 2022) from fuel combustion in buildings[b] are lower than indirect emissions (6.7 $GtCO_2$). The evolution is contrasted: after an initial peak in 2018, emissions from residential buildings dropped until the 2021 economic recovery. They then went on to exceed their 2018 level. In commercial buildings, direct emissions have maintained a general upward trend, although with a more marked drop in 2020 (-6.3%) and a stronger recovery since, but still remain below their peak of 2017 (**FIGURE 3**).

FIGURE 3

EVOLUTION OF DIRECT AND INDIRECT EMISSIONS FROM BUILDINGS

Source: Climate Chance, based on data from Enerdata



The biggest share of direct emissions from buildings comes from heating. According to the IEA, in 2022 more than 63% of energy demand for heating was met by fossil fuels (of which 42.12% natural gas), 14.34% by electricity (therefore depending on the country's electricity mix – **CF. "ELECTRICITY" TRENDS),** 11.04% by renewable energy,[c] and 11.27% by urban district heating (where the source of heat varies by country).[4] Electrification, and to a smaller extent renewable energy, have nevertheless surged, with the result that the share of fossil energy directly consumed in buildings went from 60.5% in 2015 to 54.5% in 2022.[5] The IEA analysis also shows that the carbon intensity of heated residential buildings dropped by more than one-third over the last two decades.

The heating transition is mainly driven by heat pumps, which have seen escalating growth: global sales rose by 11% in 2022, and 40% in Europe (mainly in France, Germany, and Italy, with a doubling of sales in Poland). China is the biggest producer, exporter and market for heat pumps.[6] The global share of electric heat pumps for heating needs went from 6% in 2015 to 11% in 2021, according to IEA data. Over the same period, the share of coal, oil and gas-fired equipment dropped from 57% to 48%.[7]

Despite rising rates of electrification, heating remains a major obstacle to building sector decarbonization in countries in the Global North. While the relative share of coal in energy consumption of buildings dropped by 23% from 2015 to 2022, the share of gas increased by 13.91%, and absolute consumption of fossil energy rose by 3.5% (**FIGURE 4**).

b Direct emissions from buildings result from the on-site combustion of fuel by equipment like boilers, furnaces and water heaters that use fossil fuels. Indirect emissions result from the off-site production of electricity employed in buildings for various appliances, lighting, and cooling, etc.

c Electricity here means heating supplied by the electric grid, whereas renewable energy designates the use of equipment like heat pumps and solar water heaters, which directly convert renewable energy into heat.

Indirect emissions are rising – an inevitable result of increasing electrification

Outside OECD countries, the share of direct emissions in the total of all emissions from the sector went from 29% in 2015 to 26% in 2022, while the share of indirect emissions increased. The global trend also indicates a faster increase in indirect emissions than direct emissions, partly due to the growing use of electricity for air conditioning units and other domestic appliances. The share of electricity in buildings' energy consumption rose by 16.75% from 2015 to 2022. At a time when the drive for widespread electrification (known as "electrify everything" in the USA)[8] continues to spread round the world, Europe boasts the highest rate of electrification of buildings (48%), ahead of Asia (33%) and the Americas (28%). Only 8.4% of buildings are electrified in Africa.[9]

FIGURE 4

EVOLUTION OF ENERGY CONSUMPTION IN BUILDINGS BY FUEL

Source: International Energy Agency, 2022

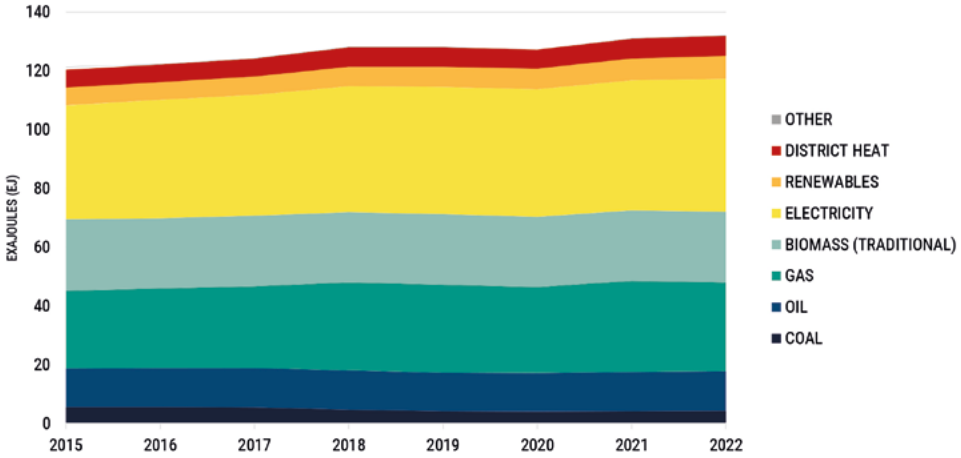
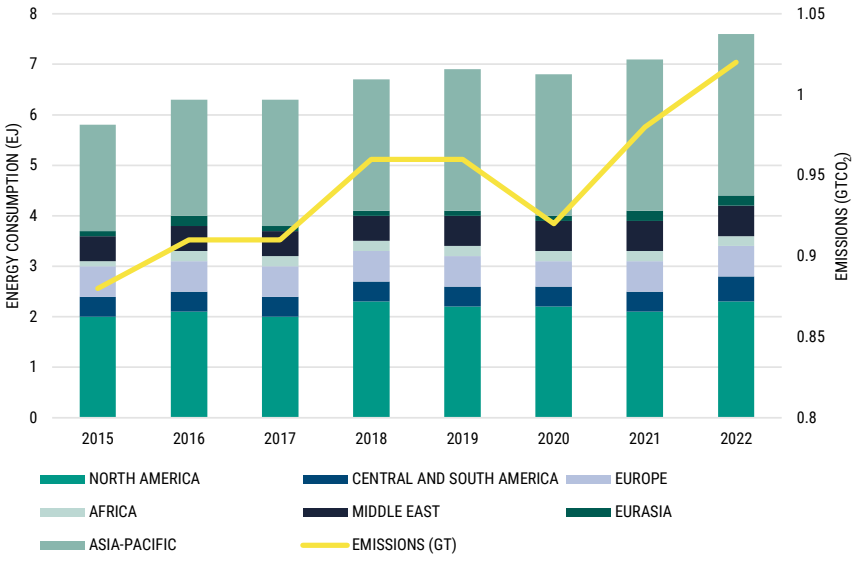


FIGURE 5

ENERGY CONSUMPTION AND EMISSIONS FROM SPACE COOLING

Source: International Energy Agency, 2023



The biggest growth in the final energy consumption of buildings comes from space cooling, which has grown by an average 4% since 2000. Emissions from air conditioning units went from 0.88 Gt in 2015 to 1.02 Gt in 2022 (+16%, **FIGURE 5**), and the number of air conditioning units operating in the world rose from 1.76 billion in 2015 to 2.27 billion in 2021 (+29%).[10] At the same time, rising global temperatures also call for wider access to cooling – in 2022, 1.2 billion disadvantaged rural and urban inhabitants of countries and areas subject to high temperatures were in danger of a lack of access to cooling, 28 million more than in 2021.[11] In Europe, from 1980 to 2020, 91% of deaths caused by meteorological incidents were due to heatwaves, which shows the rising need for access to air conditioning, even in countries in the North.[12]

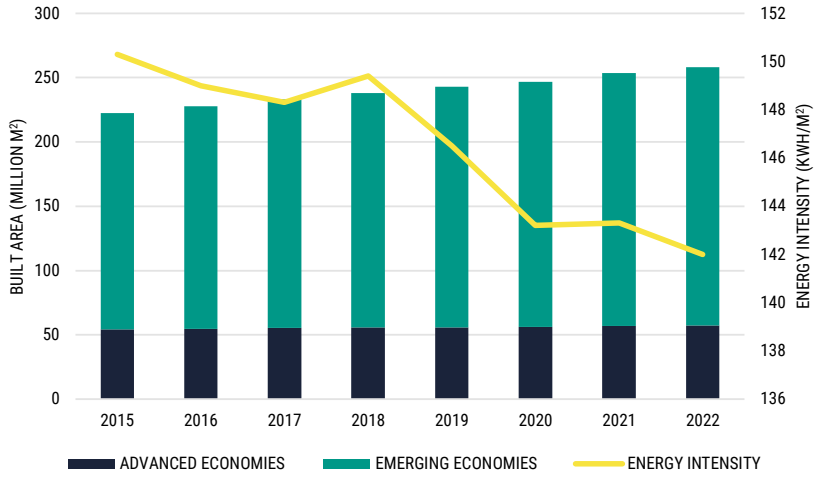
The never-ending quest for energy efficiency

Another key issue is the energy efficiency of buildings and their envelopes, and of end-use equipment. 90% of end-uses like heating and cooling, and 80% of lighting, are covered by mandatory minimum energy performance standards.[13] Yet, according to the IEA, the expansion of the built-up surface in the world (+16% in 2015-2022), which is particularly fast in emerging economies, wipes out the drop in global energy intensity of buildings (**FIGURE 6**).

FIGURE 6

EVOLUTION OF BUILT AREA AND ENERGY INTENSITY OF BUILDINGS

Source: International Energy Agency, 2022



At global level, the annual renovation rate is about 1%.[14] This figure disguises contrasting realities, because the challenge of renovating existing buildings is higher in industrialized countries where most of the building stock has already been constructed. Thus, in Europe, the energy renovation rate of buildings is 1%, while the rate of "deep" renovation, which improves the energy performance of buildings by 60% or more, levels out at 0.2%.[15] Annual investments in renovation in the EU went up by 13.2% from 2015 to 2019, but remain below the amounts required to reach climate neutrality in 2050.[16] Global investments in energy efficiency and the electrification of buildings have risen since 2018 and reached a record $285 billion in 2022, mostly in Europe, the United States and China (**FIGURE 7**).

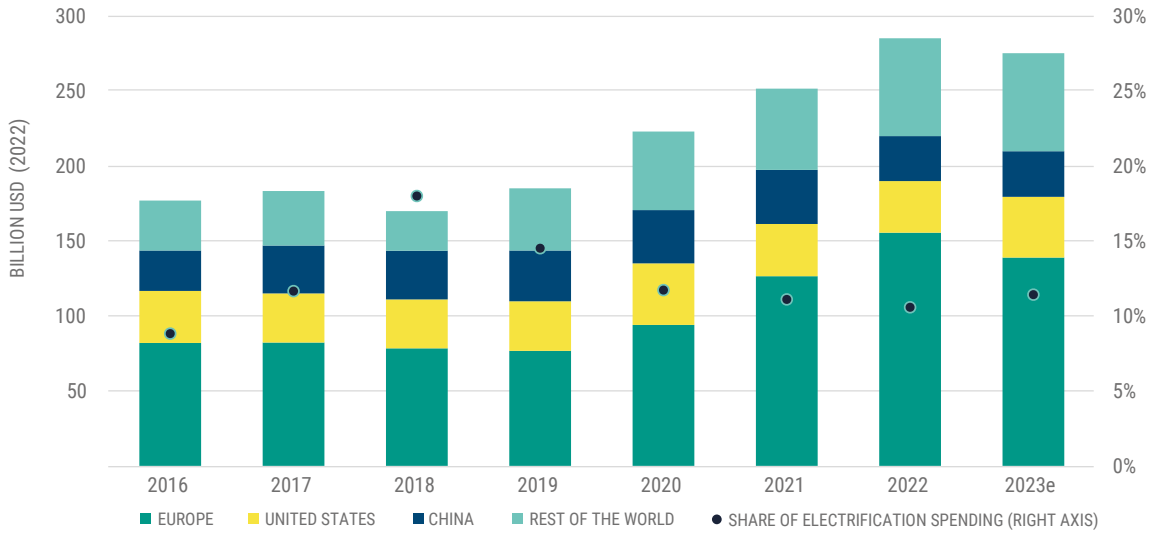
An Enerdata analysis[17] on the evolution of energy consumption in European residential buildings highlights a slowdown in progress on energy efficiency after 2014. While recent, more energy-efficient constructions have diminished, deep renovation rates have remained low, and behaviours have been more energy-intensive. In the light of the energy vulnerability revealed by the war in Ukraine, sufficiency is making a timid but concrete entry into national and local policies in Europe – France, for example, implemented an energy sufficiency plan in the last quarter of 2022 which, during a mild winter, enabled a 15% reduction in emissions from the building sector.[18] Behavioural factors contributed to reducing gas consumption in buildings in Europe in 2022, combined with a mild winter, and fuel poverty which forced some households to consume less.[19]

In emerging economies, where the built surface area is expanding rapidly, the challenge is more to guarantee the energy performance of new buildings, and adapt them to forthcoming climate changes. The number of countries with energy regulations applying to at least one type of building (residential or commercial) rose from 62 in 2015 to 79 in 2021, of which 51 apply to all buildings.[20] More recently, the EU and countries like the United Kingdom, Turkey, Japan, China, India and Australia have strengthened standards relating to the energy performance of buildings,[21] but not without some obstacles:[22] in the United Kingdom, a lack of awareness or funding, and the ageing state of a large proportion of buildings, makes them harder to renovate; in the United States, renovation is held back by conflicting municipal, state and federal targets, combined with overlapping jurisdictions for the codes on fire prevention, energy and construction, which compound bureaucracy and create problems when training workers.

FIGURE 7

INVESTMENTS IN ENERGY EFFICIENCY ANF ELECTRIFICATION BY REGION, 2015-2022

Source: International Energy Agency, 2022



Certification, circularity... consideration of climate change in the building sector is moving forwards

Local public policies catalyse action

Often, public policies for the decarbonization of buildings start at the national level – with a rising wave of legislation, such as the revision of the EU Energy Performance of Buildings Directive, and the "Renovation Wave" strategy that is part of the Green Deal in Europe; and in the United States, the "Build Back Better Act" and the "Inflation Reduction Act". In parallel, building and energy codes exist, as well as minimum performance requirements (which for example take the form of energy performance certificates; **CF. ABOVE**).

When it comes to implementation, local governments tend to take the initiative, drawing on building codes to increase the share of renewable energy on their territory. **In 2022, over 920 cities in 73 countries had set targets for integrating renewable energy sources into at least one sector – such as electricity supply, production or consumption (793), heating and cooling (170).**[23]

Since 2015, numerous European towns have successfully demonstrated their capacity to accelerate energy renovation on their territories, from municipal buildings – as the Observatory highlighted in its case study on Alba Iulia[24] – to the mass energy renovation of buildings, through programmes like EnergieSprong (the city of Angers being an example).[25] European cities have also taken initiatives to progressively eliminate the use of fossil fuels for heating thanks to the promotion of new technologies, as in Vienna,[26] or to develop and improve district heating and cooling systems, as in the Netherlands with the adoption of regional strategies to decarbonize heating and their application in cities like Heerlen.[27]

Civil society also plays a key role at national and local levels, working both to promote the transition through advocacy actions against energy poverty and for stricter energy efficiency requirements in Europe,[28] or against the transition. This is the case of demonstrations against laws on heating in Germany, when the ambitions of public policies are limited by local protests,[29] or the prohibition of gas cookers in the United States, which incited considerable debate.[30]

Apart from municipal and residential buildings, land occupied by commercial and tertiary buildings is increasingly used to produce on-site electricity, for example by installing solar panels on the roof, and promoting other low-carbon end-uses, such as mandatory charging stations for electric vehicles or bicycle parks, as the Observatory shows in its analysis of commercial buildings.[31] Most on-site production initiatives currently comprise photovoltaic solar panels. The introduction of municipal feed-in tariffs has also boosted the production of on-site electricity in industrial, commercial and residential buildings.[32]

In the United States, cities and states are engaged in a tug of war to prohibit the use of fossil energies in buildings and electrify end-uses.[33] According to the Rocky Mountain Institute,[34] in the USA, 125 local governments, 10 state governments and Washington, DC, covering 36 million inhabitants, have a policy to encourage or impose the electrification of buildings. The State of New York was one of the latest to vote to ban gas-fired cookers and heaters in new buildings by 2029.[35]

Another emerging move is the adaptation of buildings and the built environment in cities. This takes the form of green roofs in urban areas,[36] more reflective surfaces to mitigate increased heat,[37] the construction of waterproof infrastructures to tackle flooding (like "sponge cities" in China), and the use of local, bio-sourced materials.

Certified sustainable buildings: still in the minority, but growing fast

According to an analysis by the World Benchmarking Alliance (WBA) of 50 of the largest construction, property development and management companies,[38] 54% (27 companies) did not have a transition plan. Only 11 companies had "net zero" objectives covering all emission scopes, and only three of them had SBTi-approved targets – even though most emissions from the sector come under Scope 3. Four out of 50 companies had targets for embodied emissions, which result from the production of materials employed in construction work. However, 32 of the 50 companies owned or managed buildings certified as "green".

The certified built surface area has quadrupled, going from 1.05 to 4.2 billion square metres from 2016 to 2021,[39,40] but still represents less than 2% of the global built-up area. This figure is based on data reported by different green building councils in the world, and covers programmes for energy efficiency, such as LEED certification by the US Green Building Council and the French HQE certification. In addition, the surface area covered by passive house certification – buildings with very low energy consumption and high insulation requiring very little heating or cooling – went from a little more than 1.5 million m^2 in 2015 to about 3.5 million m^2 in 2022, most of it in Europe (~2.8 million m^2, or 80% of the total), far ahead of Asia, followed by the Americas which together represent about 800,000 m^2.[41]

The Net Zero Carbon Buildings Commitment gathers 175 signatories representing an annual turnover of $400 billion, including 29 cities, six states and sub-national regions, and 140 companies, possessing about 98 million m^2 of land surface. The signatories have declared an average annual drop of 12% in emissions intensity, according to the latest individual figures communicated.[42]

Back to the drawing board: reflections on design and circularity

The growing focus on the impacts of climate change, which take the form of extreme weather events and latent transformations, has forced building stakeholders to take a fresh look at their resilience. **According to SwissRE, since 2017, annual insured losses caused by climate events amount to at least $110 billion, and are going up by 5-7% per year.**[43] The real value of losses is in fact much higher: in Europe,[44] only a quarter of the financial losses related to hydrometeorological phenomena from 1980 to 2020 were insured. Integrating climate statistics in building codes has already begun, but the rapid pace of change in weather patterns and the use of historical data means that codes can lag behind actual events by up to a decade.[45] The biggest opportunity for change has been identified as designing new buildings to integrate sustainable design principles, such as energy efficiency, improved ventilation, and insulation based on traditional knowledge (with several examples from Asia and Africa).[46]

Traditional methods are increasingly popular with architects, as shown by the use of passive ventilation in the work of Diébédo Francis Kéré, by Middle Eastern and North African architecture featuring

traditional interior courtyards and strategically placed windows,[47] and by cool roofs covered in "ultra-white" paint, inspired by whitewashed Mediterranean towns.[48] This movement is accompanied by a return to local materials, like typha, rammed earth (*pisé*), wood and stone. Inspired by nature, the principles of biomimetics have also had an impact on new constructions, although still in its early stages[49].

As more and more countries take the complete lifecycle of buildings into account (nine countries in Europe in 2021),[50] the circularity of materials used in buildings is also gaining ground, through initiatives like materials passports like in Chile, "materials banks" of existing buildings in Europe,[51] and extended producer responsibility programmes in the sector, like in France.[52]

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