TRENDS
COMMERCIAL BUILDINGS

# From efficiency to renewable energy generation: Commercial spaces in search of renewal favouring the low-carbon transition

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**The operation of buildings accounts for over a quarter of global GHG emissions, with non-residential buildings in turn accounting for a significant share of this. Due to the large surface areas they occupy, and their relatively larger energy demand, commercial buildings hold great potential to reduce energy demand, increase energy efficiency, and also increase the share of renewables – either through sourcing or through on-site generation. The commercial sector can also influence trends like e-mobility, by hosting Electric Vehicle (EV) charging stations, while also being home to green spaces on built areas.**

## DATA OVERVIEW

### Hot N' Cold: The increasing share of thermal energy use in building operations

In 2021, pushed by the reopening of the global economy, the operation of buildings accounted for about 30% of global final energy demand, increasing by 6% from 2020, and surpassing the peak achieved in 2019. The use of energy for heating, cooling, cooking, lighting and equipment use accounted for 27% of global energy-related $CO_2$ emissions, of 10 $GtCO_2$.[1] These emissions rose steadily at a pace of 1% between 2009 and 2019, followed by a dip in 2020 and early-2021 due to a decline in activities linked to the COVID-19 pandemic, which pushed the population from public and commercial buildings to the less energy-intensive residential ones.[2] The resumption of economic activities in 2021 has led to a rebound in building energy use, breaking the trend of 2020.[3]

The main energy end-uses in buildings can be divided into two: thermal (referring to the use of energy for space heating and cooling, water heating, and cooking), and electrical (covering the use of major appliances, lighting, and other minor demand). Out of the total, thermal energy accounted for more than three quarters (77%) of global building energy consumption.[4] This consumption is still largely dependent on fossil fuels, which makes it responsible for almost 45% of greenhouse gas (GHG) emissions from buildings, or almost 12% of global emissions.[5] The share of renewables (excluding traditional biomass) in heating and cooling of buildings rose slowly, touching 10.7% in 2019, up from 7.9% in 2009.[6] This increase is mainly driven by the electrification of heating systems[a], coupled with the rise of renewables in the global electricity mix **(SEE ENERGY SECTOR)**. In 2020, the sale of heat pumps and other renewable equipment like solar water heating systems accounted for 20% of overall installations; with nearly 190 million heat pumps in use in 2021.[7, 8] In 2021, the global heat pump market grew a further 15%.[9] At the same time, district heating and cooling networks are also growing in popularity, while evolving to include more renewable sources, and serve larger areas.[b] Up to 2020, there has been a steady decline in the use of coal, oil and natural gas in heating **(FIG. 1).**

At the same time, space cooling remains the largest growing end-use of energy in buildings, rising at an average 4% per year since 2000. This demand continued to grow in 2020, driven also by the lockdowns, which further pushed residential cooling demand.[10] Unlike heating, cooling in buildings is largely powered by electricity (with cooling accounting for 1885 TWh, or 16%, of final electricity consumption of buildings)[11], and thus depends greatly on the electricity mix of the region. The change in climate then entails not only ensuring more energy-efficient cooling, but also expanding access to cooling in the face of increasing global temperatures – in 2022, 1.2 billion urban and rural poor were identified as being at risk due to a lack of access to cooling **(SEE INDONESIA CASE STUDY).**[12]

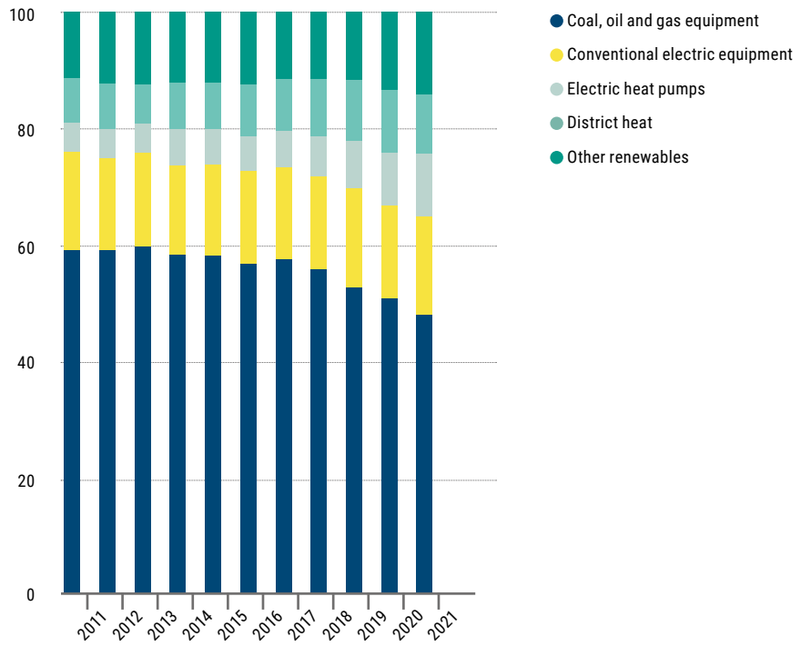
a See Observatory of Non-State Climate Action (2021). Global Synthesis Report on Climate Action by Sector. Climate Chance.

b *Idem*

**FIGURE 1**

SHARE OF HEATING TECHNOLOGY SOLD BETWEEN 2010 AND 2020 FOR RESIDENTIAL AND SERVICE BUILDINGS

*Source: IEA, 2021*




A regional overview based on 2019 data points to Asia as having the largest energy demand from buildings, followed by the Americas, and Europe, with Africa coming in last. As the move to "electrify everything" continues to spread, Europe showed the highest level of electrification at 48%, while Asia and the Americas stood at 33% and 27% respectively, while Africa touched only 8.4%.[13] Local governments have been particularly active in pushing for renewables in buildings, often using fiscal and financial incentives to encourage renewable energy uses in existing buildings, or putting in place restrictions on the use of fossils for space and water heating and cooking (59 cities had such measures in place, as of 2021).[14]

An important factor affecting the energy use, and in turn, the regulations and restrictions to which a building is subject is the purpose for which a building is used. Based on its usage or function, buildings are classified as being residential or non-residential.[c] In 2020, residential buildings accounted for 22% of global energy use and 17% of global energy-related emissions, while the non-residential sector accounted for 8% and 10% of these, respectively **(FIG. 2)**.[15]

While non-residential, particularly commercial buildings, have a relatively smaller share in energy-use and emissions compared to residential ones – a pattern that was furthered by the outbreak of the Covid-19 pandemic and following lockdowns – they hold a lot of capacity to improve energy efficiency, integrate renewables (or even generate them), and ultimately, reduce emissions from the building sector. Additionally, the reopening of economies in 2021 has also led to a visible rebound in the operation of non-residential buildings and associated emissions.[16]

THE OBSERVATORY'S LENS

## Commercial buildings: A cornerstone in the decarbonisation of the building sector

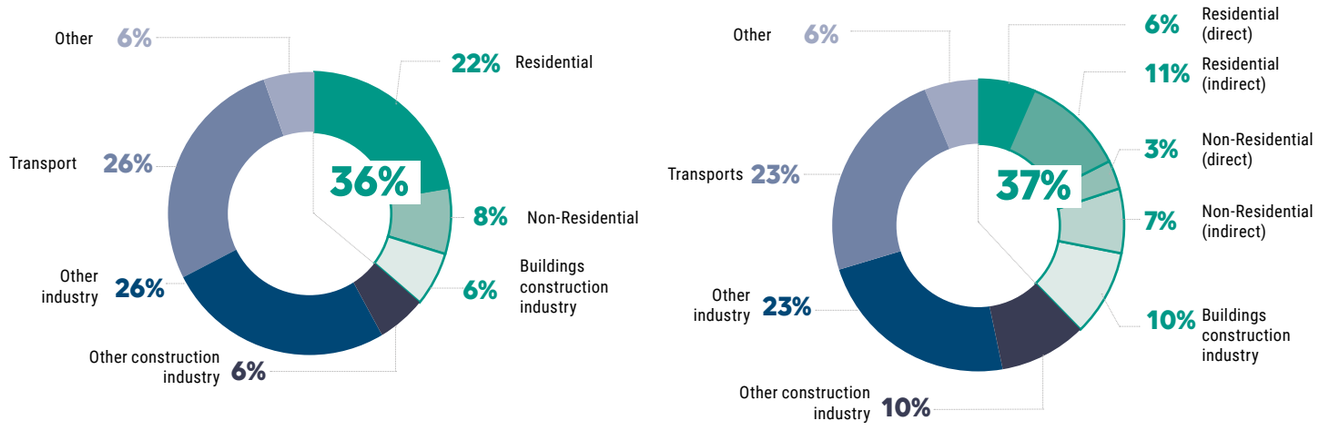
Commercial buildings often make up larger built areas depending on their purposes, and their typical operations also differ from residential ones in their scale, and duration in the day. They are also subject to different regulations under the local and national governments, while they use appliances or equipment that are subject to different performance standards. Reducing the climate impact of the commercial building sector, then, can be done through regulations that will apply to commercial buildings and their energy use. It can also be acheived through self-motivated action of private actors to reduce their energy demand and improve efficiency, generate and source their energy from renewables, and promote the

c In general, in order to enforce codes, buildings are classified based on their use and occupancy. Residential buildings are ones that provide accommodation for individuals, including apartments and houses. Non-residential buildings are an umbrella term covering all other types of built structures. Based on their uses, for the purpose of analysing buildings' energy use, the IEA for instance classifies activities related to "*trade, finance, real estate, public administration, health, food and lodging, education, and other commercial services*" as non-residential. The varying use-based classifications of non-residential buildings across regions or countries makes it harder to have data on them.

**FIGURE 2**

SHARE OF RESIDENTIAL AND NON-RESIDENTIAL BUILDINGS IN GLOBAL FINAL ENERGY USE AND ENERGY-RELATED EMISSIONS

*Source: GlobalABC, based on IEA data (2021)*




use of such energy for sustainable practices like e-mobility. The most prominent actions in commercial buildings have been observed in Europe and in North America, with a few emerging initiatives in developing countries.

### Regulatory frameworks for energy consumption in buildings

The European Union's proposed recast of the Energy Performance of Buildings Directive[17] as part of the Fit-for-55 package provides a relatively shorter timeline for non-residential buildings, including public-owned and commercial ones, to meet the minimum energy performance standards after renovation. Member states are required to ensure that non-residential buildings are at least class F by 2027, and class E by 2030.[d] Additionally, large non-residential buildings are required to have "Smart Readiness Indicators", a rating of the building's capacity to adapt to occupant behaviour, allowing owners and occupants to benefit from data about automation and electrification of technical services. The proposed directive also encourages the installation of infrastructure for charging Electric Vehicles (EVs) in car parks, and parking spaces for bicycles to encourage soft mobility. The EU Solar Energy Strategy,[18] as part of the REPowerEU plan to reduce dependence on Russian energy, also calls for the widescale deployment of solar PV, wherein large commercial centres and their parking spaces hold immense potential for rooftop installations. The European Commission has proposed a rooftop PV mandate for public and commercial buildings starting from 2027.[19]

The Energy Efficiency Directive[20] also recognises the role of energy efficient heating and cooling, and provides for the identification of heating and cooling technologies in use in non-residential buildings, including ones generating waste heat or cold, and their upgrading, and the energy renovation of non-residential buildings. The Renovation Wave Strategy lays down key principles to drive renovation in residential and non-residential buildings towards 2030 and 2050 objectives, including putting energy efficiency first, decarbonisation and the integration of renewables, and life cycle thinking and circularity, among others.[21]

Some member states have set targets that go further, such as the Netherlands, which requires all office buildings to be class C by 2023 and class A by 2030. In France, as part of its long-term renovation strategy, a progressive set of measures was adopted target poor energy-performance buildings (*passoires énergétiques*), starting with a rent increase on such buildings in 2021, a ban on renting them from 2023, and obligation to renovate them from 2028.[22] The French Climate and Resilience Act, passed in 2021 following the Citizen Convention, also promotes "efficient renovation" (*rénovation performante*), through the construction and housing code. Following the Covid-19 crisis, the government's recovery package also contained large amounts of financing for the building sector, including 4 billion euros for the renovation of public buildings and 200 million euros for the renovation of tertiary buildings of very small businesses and small and medium-sized enterprises.[23]

Germany's Building Energy Act of 2020 set the standards for energy performance of buildings, of energy performance certificates, and the use of renewables in buildings.[24] Though final energy consumption[e] reduced by 17% between 2008 and 2018, it fell short of the federal target of a 20% decrease.[25] In 2022, with the Russian invasion of Ukraine, in order to reduce

d The EU's Energy Performance of Buildings Directive requires member states to have a system of Energy Performance Certificates (EPCs), which rates the energy performance of a buildings compared to minimum performance requirements, on a scale of A to G, with A being the best performing and G the worst.

e In the case of non-residential building, the "final energy consumption" is calculated as the total use of energy for heating, cooling, the heating of water, and lighting.

its dependence on Russian gas, the State announced several energy-related measures – including updating the Building Energy act, to apply the "Efficiency Standard 55" for all new buildings from 2023, to promote at least 65% renewables in heating, to promote the use of heat pumps.[26] Reacting to the situation in Ukraine, Austria too announced measures related to building heating, banning gas boilers in all new buildings from 2023.[27]

In the United States, while commercial building codes vary from state to state, the Federal Department of Energy conducts research and works with businesses to improve the energy efficiency and reduce the cost of operating buildings, for instance, through the Better Buildings Initiative – having a repository of over 3,000 solutions from various partners, which can be replicated, while also helping businesses find financing to implement these.[28] The Environment Protection Agency (EPA)'s ENERGY STAR programme also helps businesses work on improving their energy efficiency, with buildings that have a superior energy performance earning the ENERGY STAR certification.[f] The recent Inflation Reduction Act of 2022, dubbed the Climate Act, also provides tax incentives for green buildings, and also contains measures to promote the electrification of buildings and the use of renewable-sourced electricity – including commercial and public buildings.[29] Some states in the US have been more proactive in promoting electrification, be it through EV readiness codes coupled with renewable energy obligations, or in the movement to electrify heating and move away from gas, which lead to a tug of war between the federal, and state and city governments.[g]

A trend of municipal action has also been observed in the buildings sector, with more and more cities leveraging building codes and other requirements to increase the share of renewables in their territory. More than 920 cities in 73 countries have set targets in renewable energy in at least one sector – including power (793), and heating and cooling (170). The momentum to decarbonise heating and cooling is also growing. The city of London, for example, has set a target of having 2.2 million heat pumps in operation by 2030. Municipalities have also tried to encourage private action by setting examples, acting on their own building stock, notably through on-site renewable generation – either on building facades or through rooftop PV, or alongside the buildings (George municipality, in South Africa, for instance, installed a 300-kW solar plant to cover the electricity use of its principal building).[30]

### Actions of the commercial towards demand reduction and renewable generation

There are several initiatives that group together various private actors, committing to improve the sustainability of their operation. The Retail Forum for Sustainability[31], for instance, is a platform that brings together major retailers in Europe under the impetus of the European Commission, launched in 2009. Under the Retailers' Environmental Action Programme (REAP), the initiative lists the actions taken by the major retailers under three categories: *What we sell*, *How we sell*, and *Communication*. The *How we sell* category includes measures that affect the physical locations of the retailers and their building operations, and lists measures adopted such as reducing $CO_2$ emissions from coolant production, emissions generated from stores, increasing the share of renewables in energy consumption, a rollout of sustainable cooling, reducing lighting energy consumption, increasing energy efficiency of stores, increasing the eco-labelling of buildings, and installing independent renewable generation. Out of the 201 listed actions that are being put in place, over 45 are fall in the *How we sell* category, and under the domain of "Emissions and (alternative) energy".[32]

Both the products sold and how they are sold affect the carbon footprint of retailers, by affecting emissions both upstream and downstream of their value chains – for retailers with a physical presence, the emissions from their stores and warehouses (*i.e.,* their buildings) have a large impact on this, along with transport. **(SEE BOX 1)**

BOX 1 • **KEYS TO UNDERSTANDING**

## RETAILERS' CARBON FOOTPRINTS: BUILDINGS AS AN AREA OF ACTION

Though the retail sector was relatively late in beginning to set targets to decarbonise their value-chains, the number of large retailers setting such targets has increased over fivefold between 2019 and 2021. Analyses of the strategies to decarbonise their operations has shed light on the potential for reduction of retailers' emissions across Scopes 1, 2 and 3. For most retailers, Scopes 1 and 2 represent about 20% of their total carbon footprint, and fall under their direct control, while Scope 3 emissions accounted for the rest, and depend on suppliers and consumers. Emissions from the extraction and production of goods sold, and their transportation to the distribution centres and stores were the largest sources of upstream Scope 3 emissions, while the transportation used by consumers and the use of the sold products were the largest sources of downstream Scope 3 emissions.

As for Scopes 1 and 2, these include direct emissions from the retailers' properties, and their purchased electricity, steam, heating, and cooling. A traditional retailer counts 18% of its emissions from its properties – its stores, warehouses, and offices. For an e-commerce retailer, this figure stands at 15%. While this represents a relatively smaller share, it has been identified as "low hanging fruit", as retailers can directly act to reduce these emissions – by improving energy efficiency of lighting, of heating and cooling, and by incorporating more renewables in their energy use.

*Sources: Bhargava, A. Hoffman, S., & Jakic, N. (2022); MIT Real Estate Innovation Lab, 2021.*

Initiatives of private actors to reduce their carbon footprint also exist at the national level – in France, the Féderation

f The ENERGY STAR certification, given on an annual basis, indicates that a building has scored better than at least 75% of similar buildings nationwide. It is based on a score of 1 to 100, calculated based on energy use.

g See Observatory of Non-State Climate Action (2021). Global Synthesis Report on Climate Action by Sector. Climate Chance.

Perifem is an interlocutor of public authorities with all the actors of the retail sector working to create a sustainable commercial sector.[33] In the face of predicted energy shortages for the winter of 2022, the federation has defined certain "common and concrete" measures to be adopted by 15 October, such as turning off the lighted signboards as soon as the store closes, systematic reduction in the intensity of lighting by reducing by reducing the lighting of sales areas by 50% before the public arrives, and by 30% after periods of critical consumption. Other measures announced also include reducing air circulation at night, and shifting the production of ice.[34] These measures have been put in place by major retailers like E.Leclerc, Carrefour, Système U, Les Mousquetaires Intermarché, Auchan, Casino, Franprix, Monoprix, Lidl and Picard.[35] SPAR Austria is also adopting a similar measure, reducing the hours of storefront advertising across all its outlets, with the intention of reducing annual energy consumption by 1 million kilowatt hours. Belgian retailers like Colruyt and Ahold have no short-term measures planned, but are relatively insulated from incoming energy shocks due to existing measures such as avoiding illuminated signs, closed freezers and such.[36]

At the same time, in Germany, France, Italy, Spain, Switzerland, Denmark, Sweden, Finland, the Netherlands, Austria, and Greece have all seen the adoption of measures reducing heating and cooling requirements, notably in public and office spaces, by increasing the range of temperature in which there is no heating or cooling activated. In Spain, while heating is mandated to be set at 19 °C throughout winter, hotel rooms, restaurant kitchens, hair salons, gyms, schools and hospitals stand to be exempted. With Greece set to offer financial incentives to organisations that monitor and curb energy consumption, actors are resorting to temperature control and systematised reduction in the use of lights and computers.[37]

According to the US Energy Information Administration, the country counts about five million commercial buildings, of which retail buildings have the largest energy cost. The ENERGY STAR database lists 39,153 commercial buildings (excluding industrial plants and data centres) that have the ENERGY STAR certification.[38] Retail giant Walmart was the first retailer, in 2016, to take up an emissions reduction plan, setting an objective of -18% emissions from their own operation by 2025.[39] In 2020, the chain counted a 17.5% reduction in Scope 1 and 2 emissions from the 2015 baseline, through the adoption of efficient design measures in terms of lighting, heating, ventilation and air conditioning (HVAC), refrigeration, etc. in new stores, and upgrades and retrofits of equipment in existing stores.[40] In another example, the ENERGY STAR administration cites clothing and home retailer JCPenney being the first to earn an ENERGY STAR in 2007, and continuing to improve on energy efficiency – realising a gain of 5.6% in energy intensity in 2019, and increasing focus on efficiency of HVAC systems.[41]

At a municipal level, the NYC Carbon Challenge brings together the New York mayor's Office of Environmental and Climate Justice and stakeholders representing universities, hospital organizations, commercial owners, commercial offices, residential property management firms, and hotels. The initiative covers around 10% of built surface area in the city, and has led to the annual reduction over 600,000 $tCO_2$ to date, through measuring and reducing energy use, and controlling plug loads, lighting, refrigeration, and HVAC use, and improving building envelopes.[42,43]

As far as the sourcing of renewable energy by the commercial sector goes, the trend is the strongest in Europe and North America, with Power Purchase Agreements (PPAs) and unbundled Energy Attribute Certificates (EACs) being the most preferred instruments.[44] In the United States, the EPA states that the green power use of the top retailers part of the Green Power Partnership[h] as of July 2022 amounts to 8,300 GWh[i], with Walmart, Target and Starbucks coming in the highest.[45] In 2021, Europe saw 11.2 GW contracted through PPAs, come online across more 140 deals – with the retail sector being led by Amazon, sourcing renewables for its data centres in the continent,[46]

On-site generation of renewables, while accounting for a lower share compared to other instruments of sourcing, is particularly relevant for commercial buildings with larger surface areas. The EPA lists Green Power Partners using on-site generation in the US, totalling 1,900 GWh, and including retailers like Target, Ikea, Aldi, and Kohl's among the top 30.[47] Ikea has also contributed to the on-site generation trend in Europe, a large number of its outlets and warehouses producing their electricity on-site. All of its operations (stores, warehouses, factories and offices) are 100% renewable in about 20 European countries, either through sourcing or through on-site generation. The Ingka group, the largest IKEA franchisee installed over 935,000 solar panels on the rooftops of stores and warehouses.[48] Decathlon has committed to sourcing 100% of its electricity from renewables by 2026, and had achieved a level of 82.6% at the end of 2021, with a large share of this coming generation through on-site PPAs in Spain, Portugal, Italy and France, where a third-party owns and operates the on-site renewable energy installation.[49,50] In Belgium, for instance, 27% of the electricity consumed by Decathlon stores was generated on-site.[51]

In South Africa, the country's largest retailer, the Shoprite Group has been deploying solar across its outlets, also using on-site PPAs as its instrument of choice, currently having an installed capacity of 26.6 MW from the on-site plants.[52]

Aside from retail, other service sector buildings also hold great potential to make the sector less energy-consuming, through energy efficiency and renewable generation measures. RE100, the global corporate renewable energy initiative that brings

h The Green Power Partnership is a voluntary programme under the US EPA that promotes the procurement of 'green power', defined as a subset of renewable energy providing the highest level of environmental benefit, and including solar, wind, geothermal, biogas, biomass, and low-impact small hydroelectric.

i This is the equivalent of the annual electricity consumption of 770,000 average U.S. homes.

together businesses working towards to 100% renewable energy, notes that over 60% of its members worldwide produce renewable electricity for their own consumption, with solar accounting for a large majority of these on-site installations. In an example from India, Mindspace REIT, which owns and operates one of the country's largest real estate portfolios, uses rooftop solar arrays in two of its business parks, making use of the large surface area available.[53]

### Commercial buildings promoting e-mobility, and other sustainable practices

Alongside the measures taken to reduce their own footprint, actors in the commercial sector have also been active in promoting sustainable practices among their staff and consumers, making use of the large built areas under their management. The most notable of these is the provision of EV charging stations in the parking lots of commercial buildings, with publicly available EV charging points having gone up by 40% in 2021.[54] A large number of commercial establishments offering EV charging stations often power them using renewables, most commonly solar PV.[55]

For instance, following a commitment made in 2018, Walmart and Electrify America installed over 120 ultra-fast charging stations across Walmart stores in the US in 2019, with further collaboration between the two companies expected to make Walmart one of the largest retail hosts to EV charging stations.[56] Joining enterprises like Walmart and Starbucks, French retailer Carrefour also announced the installation of over 700 charging stations and 5,000 charging points across its hypermarkets by 2025. [57] In Europe, countries like Austria, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, Poland and the UK have incentives for commercial entities that install charging stations for EVs, in the form of various tax rebates or grants.[58]

While the rollout of EV charging infrastructure worldwide has been accelerating, it hasn't always been welcome – in the US, while cities like Los Angeles are considering banning the construction of new petrol pumps in order to encourage the transition to electric mobility, the states themselves remain divided. Petaluma, a Californian city, became the first to enact such a ban, with its initial reasoning being to stop large supermarkets and retail centres from using mega petrol pumps to lure in customers.[59]

In addition to on-site generation and EV charging facilities, another weakly emerging trend is the use of surfaces occupied by large commercial buildings and attached spaces for greening and promoting local biodiversity. Green roof requirements for commercial and service sector buildings have resulted in the uptake of rooftop gardens, often sites for pollinator habitats and small-scale urban farming. American energy bar company Clif Bar, in its site in Idaho, has a two-hectare, on-site solar array, that is also a pollinator habitat populated with native flowering plants.[60] In another example, an Ikea outlet in Vienna was designed as a park to allow area residents to access the park, even without entering the store.[61] Malls in Malaysia and Singapore have seen the introduction of urban farms on their rooftops, with produce being used for food or even beauty products.[62,63]

## KEY TAKEAWAYS

**While non-residential buildings account for a significant share of energy consumption and emissions, there is a lot of potential for action, which is beginning to take place. Under the threat of a looming energy crisis in Europe, retailers are resorting to demand-side measures to reduce their energy consumption, by reducing lighting use or controlling artificially maintained temperatures, while also investing in more energy efficient equipment. The same applies in the United States, where the trend however is that of continuing business as usual, while resorting to energy efficiency measures and expanding renewables-sourcing and on-site generation. The most popular option for on-site renewable generation is rooftop solar, owing to the availability of larger surface areas. The functions of the large commercial surfaces also extend to low-carbon services, by providing access to EV charging stations. The footprint of these sites on land artificialisation remains significant and poorly studied: attention given to biodiversity is still marginal.**

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