Some renewable electricity projects in the United States have been financed using municipal green bonds. Richmond (Washington) aims to use a USD 3 million green bond issued by the state in 2019 to build a 1 MW / 4 MWh solar energy battery storage system and training facility.[141] In Sacramento (California), the community-owned, not-for-profit electricity provider issued a USD 400 million green bond in 2020 to fund solar PV, hydropower and infrastructure projects.[142]

By contrast, the main source of finance in the transport sector is federal, state and municipal grants or budget allocations, although projects often are supported by or are in partnership with a nonprofit or private sector partner.[143] In Los Angeles (California), a USD 400,000 grant is providing four zero-emission mobility pilots to the city and the surrounding county, including two EV carsharing projects, an EV charging project and an e-bike project charged by solar PV.[144]

CITY-SPECIFIC CHALLENGES TO INVESTING IN RENEWABLES

Regardless of their location, renewable energy projects face inherent financing challenges that raise the investment risks and related financing costs.[145] These challenges include higher upfront technology costs, information gaps and hard lock-ins (the idea that once infrastructure is built, "green" retrofits can be costly or technically impossible to implement before the end of the productive life cycle).[146] Barriers to innovation – in the form of design, products, and new institutions or practices – also are a source of perceived risk for both public and private investors who may be unwilling or unable to evaluate unfamiliar investments.[147]

Any city wishing to invest in infrastructure faces challenges in mobilising revenue and allocating budgets.[148] Before seeking investment, municipal governments also must finance the pre-feasibility stage and project preparation, which can represent more than 10% of the total project cost.[149] Governments often have limited budgetary flexibility and face multiple competing claims on their resources, including public safety, water supply, pension liabilities, unemployment, poverty, roads, bridges and waste management.[150] Rapid urbanisation has intensified these pressures.

Municipal governments also may struggle with soft lock-ins, which include limits to institutional capacity and institutional inertia.[151] Additional barriers relate to a lack of organisational capacity, knowledge of funding opportunities, and/or equity and debt instruments.[152] For example, even when a municipal or other actor has identified centrally managed EU funds for a given renewable energy project, it must submit an application in English (often not the mother tongue of the applicant country) and partner with organisations from EU Member States to receive these funds. Finding international partners and preparing applications requires time, human resources and often knowledge on technical information and risk assessment.[153] Local governments in South Africa have reported that the complexity of available international/intergovernmental grants and the high level of human resource investment with no guarantee of return can result in inaction or paralysis.[154]

Although higher levels of government can help cities accrue sufficient capital for renewable energy projects, barriers can exist in co-funding arrangements or in limitations to borrowing power. Local governments often depend on national governments to provide a significant amount of finance, which can be inadequate, unpredictable or declining. For example, in the EU more than half of small sub-national governments have reported a decrease in grants from their federal governments since 2010.[155] In terms of limitations to borrowing power, less than half of countries (42%) are recorded as having devolved fiscal or legislative powers to sub-national governments, and of these the depth of revenue-raising powers is highly variable.[156] Only 22 countries (14%) allow borrowing without restriction, and 56% forbid outright borrowing by local governments.[157]

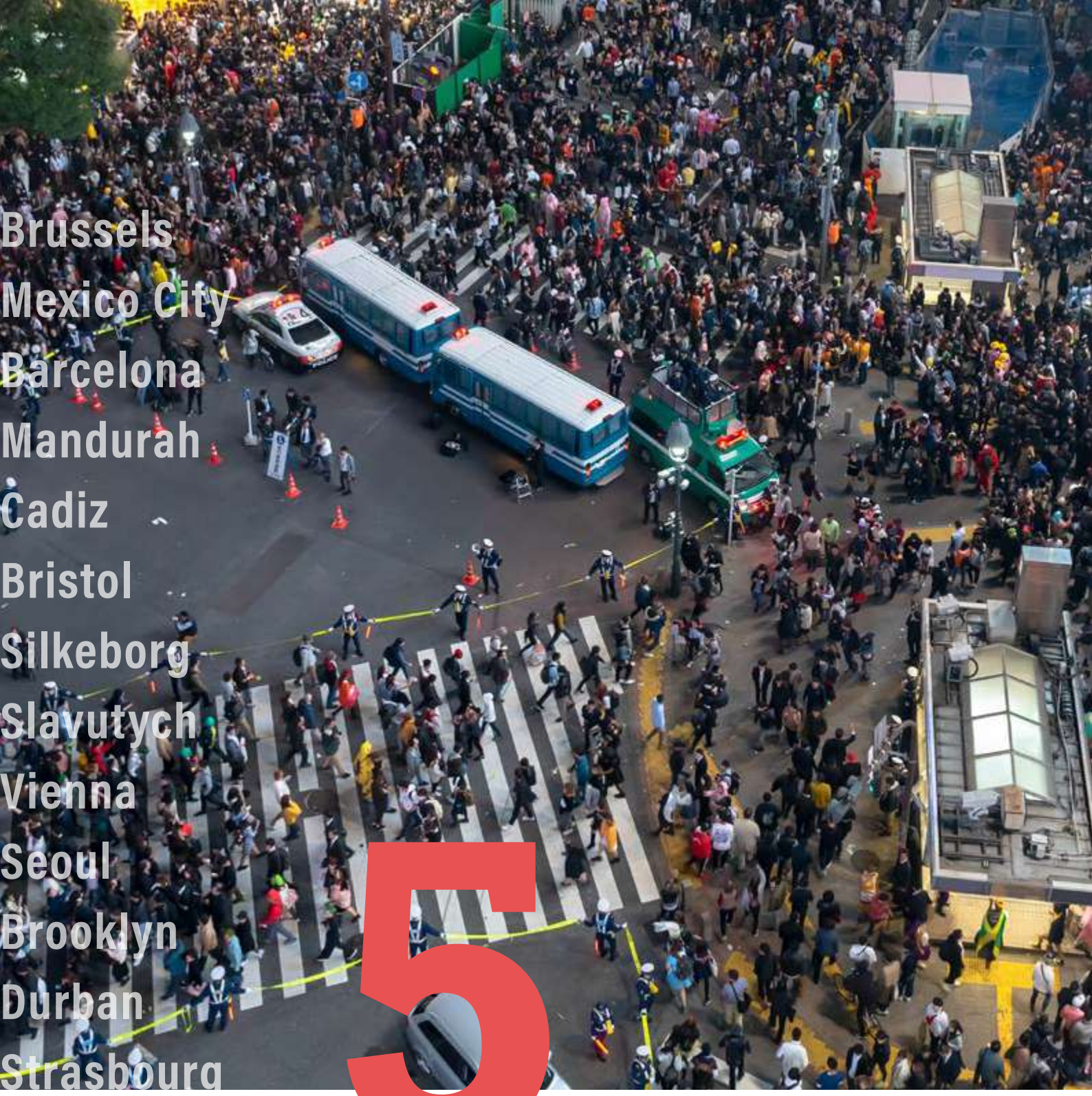
Cities in developing countries face additional barriers.[158] Poorer developing countries often suffer from a tax base that is inadequate to finance the cost of basic infrastructure.[159] Many developing-country cities are not perceived as creditworthy, making it more difficult for them to take out bonds and loans as well as to attract private investment.[160] Typically, cities that have lower credit ratings are charged higher interest rates to finance projects.[161] Of the 500 largest cities in developing countries, less than 20% are deemed creditworthy in their local context, and less than 4% are creditworthy in international capital markets.[162]

Los Angeles, United States

Any city wishing to invest in renewables faces

challenges

in mobilising revenue and allocating budgets.



Brussels
Mexico City
Barcelona
Mandurah
Cadiz
Bristol
Silkeborg
Slavutych
Vienna
Seoul
Brooklyn
Durban
Strasbourg

5

CITIZEN PARTICIPATION

Recife
Jakarta

CITIZEN PARTICIPATION

Citizen participation in renewable energy can be defined broadly as the different ways in which inhabitants are involved in planning, funding, managing, governing and/or executing the development of renewables in cities.[1] Citizens[i] can support the development of urban renewable energy by, for example:

- choosing to purchase energy from a provider that offers renewable electricity or heat, in cities where consumer choice, such as green tariffs, is an option;
- becoming individual prosumers[ii] by producing all or part of their own energy;
- getting together to form community energy projects;
- participating in setting the direction for the development of urban energy systems; and
- making their voices heard through bottom-up initiatives and campaigns in favour of renewables.

The active engagement of citizens in renewable energy development – as energy producers and as members of energy communities engaging in decision-making processes and wider campaigns – has been pivotal to the rising penetration of renewables[iii],[2] Citizen participation stimulates investments by individuals and local communities in renewable energy generation.[3] Citizen participation also is central to enabling a *just transition* to a decarbonised energy system that simultaneously considers the needs of impacted communities, addresses energy poverty and delivers on climate mitigation.[4]

Although citizen participation is usually based on bottom-up approaches and on the actions of inhabitants, municipal governments, because of their proximity to citizens, can play a strategic role in facilitating the involvement of citizens. Through their planning processes, municipal governments can include citizens in the design, ownership and management of energy systems to account for citizens in their positions as prosumers, owners of energy storage facilities, and holders of rights and entitlements to shape the development of urban energy systems.[5]

In return, engaging citizens at the local level increases public awareness about renewables and can accelerate cities' transitions to renewable energy. For example, the siting of renewable energy projects generally is easier if all stakeholders are involved in the planning from the beginning and understand the potential benefits.[6] Citizens also can play a central role in providing sites and investment for small-scale distributed projects. Further, citizen participation may address interlinked social issues relating to fuel poverty, health and well-being.[7] Decision-making processes that involve active citizen participation can increase trust in the local community and government.[8]

i Here, "citizens" refers to people living in a particular place, rather than to people holding specific legal rights due to their nationality. Usually, residents within a city (regardless of citizenship) are able to shape city-level energy transitions. See Oxford Learner's Dictionaries, "Citizen", https://www.oxfordlearnersdictionaries.com/definition/english/citizen, viewed 15 November 2020.

ii Both consumers and producers of energy. See Glossary for full definition.

iii For more information, see chapter on "Public support" in REN21's *Renewables 2020 Global Status Report*, available at www.ren21.net/gsr.

The ability of municipal governments to engage citizens at the city level is greatly conditioned by decisions at higher levels of government. In addition, intermediary organisations, such as energy offices, innovation hubs and private consultants, play central roles in promoting citizen participation in the development of urban energy systems. These organisations can, for example, act as liaisons between local governments and communities; support existing or potential prosumers or community energy co-operatives by providing information, advice and investment support; assist in the implementation of technologies; and defend the interests of adopters.

Engaging citizens at the local level increases **public awareness** about renewables and can accelerate cities' transitions to renewables.

CONSUMER CHOICE

For urban populations that have access to affordable electricity, the most basic way that citizens can participate in energy systems is through consumer choice, or allowing people to choose among different energy suppliers. While consumer choice is available outside the city context as well, it provides a key opportunity for urban residents to influence energy supply through their energy preferences. Consumer choice most commonly exists in the electricity sector, but it also can stimulate the uptake of renewables in the heating and cooling and transport sectors.[9]

One precondition for consumer choice is that energy markets have been liberalised, making it possible for consumers to select among a number of different suppliers that deliver energy to the city.[10] Although the ongoing liberalisation of energy markets supports the development of green tariff programmes – where utilities buy renewable energy to match a portion or all of the electricity bought by consumers – it does not ensure them, and these decisions generally are undertaken at the national or state level.[11] Municipal governments can support green tariffs through marketing campaigns that highlight the personal and societal benefits of renewable energy. Such awareness campaigns are particularly important for making green tariff schemes attractive to "light green" consumers who may have positive attitudes towards renewables but are not yet purchasing them.[12]

In some jurisdictions, interest in buying renewables has surged, often driven by the declining price of renewable power relative to other electricity sources, by awareness-raising on energy and climate issues, and in some cases by rising electricity prices.[13] In 2020, more than half (53%) of US residential consumers found it "extremely" or "very" important that renewable energy contribute a portion of their electricity supply, marking the first time in a US survey that renewables ranked higher than energy affordability.[14] A survey in the United Kingdom found that green tariff purchases motivated 19% of consumer switches between energy suppliers in mid-2020, up from only 9% in 2018.[15]

Consumer choice can manifest in different ways:

- **Green tariff programmes** typically allow consumers to choose among a variety of utility-offered plans that supply electricity or district heat generated fully or partly from renewables. Under "guarantee of origin" rules, the utilities are required to demonstrate the renewable energy content of this supplied energy.[16]
- **Pay-as-you-go (PAYGo) services** offer customers an alternative to contracting with utilities. These services are prevalent in cities where the electricity grid is not fully developed or lacks stability, or where electricity is expensive. Typically, the PAYGo electricity comes from decentralised solar PV systems.[17]
- **Peer-to-peer energy trading programmes** enable consumers in some cities to purchase renewable energy from other citizens or businesses rather than from utilities (→ *see Individual Prosumers section in this chapter*). Enabled by digitalisation, such programmes are becoming available for larger groups of consumers (→ *see Sidebar 7*).[18] Peer-to-peer trading is emerging as an important option for expanding renewable energy consumption in the future.[19]

One way that municipal governments seek to increase consumer choice opportunities for city inhabitants is by lobbying for the rights of citizens to be able to purchase renewable energy. In California (US), local officials in Los Angeles and San Jose have protested against exit fees[i] paid to incumbent utilities, which effectively disincentivise citizens from participating in community choice aggregation programmes (→ *see Urban Policy Landscape chapter*).[20] Cities can attract more citizens to such programmes by offering competitive tariff rates, greater shares of renewable energy, and a portfolio of incentives that provide environmental and economic benefits to participants, including small grants subsidising the purchase of solar PV equipment.[21]

Generally, green electricity markets have expanded in recent years, although no consolidated data on them exist at the city level, and data also are hampered by definitional differences (for example, in the types of green tariffs).[22] Among recent examples, in Ankara and Istanbul (both Turkey), a green tariff programme for 100% renewable energy became possible in 2020 following changes in national legislation.[23] In the United States, the share of households with access to green electricity purchasing increased from 14% in 2016 to 20% in 2020, and the share of households actually buying green electricity increased from 6% to 11%.[24] In the United Kingdom, more than 50% of the electricity tariffs available on the market in 2019 had renewable energy content, up from only 9% in 2016.[25]

However, not all countries with liberalised energy markets offer green tariff programmes for citizens. In Latin America, for example, the situation varies. In Argentina, Chile and Mexico, urban residents are able to purchase renewable power only if they buy a specified minimum amount of electricity, which effectively excludes much of the population from selecting renewable options.[26] In some cities, PAYGo models are filling the gap by offering a greater choice of providers and electricity sources.[27] In Medellín, Colombia, the public utility has a PAYGo offering that allows residential users to regulate their electricity consumption through pre-payment based on their real purchasing power.[28]

i Exit fees are intended to compensate utility companies for previous investments they have made in, for example, energy infrastructure such as transmission and distribution lines.

SIDEBAR 7. Digitalisation: Enabling Citizen Participation

Digitalisation refers to the increasing reliance of business models on digital technologies. In the case of renewable energy, digitalisation enables both consumer choice and prosumerism, allowing for increased flexibility and transparency for customers and greater profitability for prosumers.

On the consumer choice side, for example, the Australian company Power Ledger provides an energy trading platform to utilities, energy retailers and others that uses blockchain[i] technology to enable greater transparency in energy sourcing. Rather than simply choosing renewables, customers can fully design their own energy mix by selecting the specific projects that generate their electricity, from a certain wind turbine to a neighbour's solar PV installation[ii].

To support prosumers, peer-to-peer energy trading built on blockchain technology makes it possible for residential producers to supply other citizens with electricity, including in cities such as London (UK), Medellín (Colombia), New York (US) and Singapore. The municipal-level Brooklyn Microgrid in New York City, launched in December 2019, provides a digital platform for households to sell renewable energy to others. In New Delhi (India), communities in the Dwarka neighbourhood trialled group net metering solutions in 2020 whereby surplus solar electricity is sold to neighbours rather than fed into the grid. Such approaches can result in improved profitability for prosumers and in access to cheaper, renewable energy for neighbours.

Municipal governments can support pilot programmes that demonstrate the technical and commercial feasibility of new digital technologies. They also can provide financial incentives for deploying advanced metering infrastructure that allows two-way communication between prosumers and system operators. Such approaches help ensure that the data are used for the benefit of citizens by, for example, enabling people to better understand their energy use and the possibilities for reducing it or for shifting their time of use.

Source: See endnote 18 for this chapter.

i Blockchain technology is a distributed ledger technology that permits the storing of data on servers around the world while also allowing every network member to view all data stored on other members' servers.

ii Although consumers choose to support specific renewable energy projects, this does not mean that their electricity actually originates from these projects, as it is impossible to control where specific electrons go once they enter the grid.

New Delhi, India

INDIVIDUAL PROSUMERS

In their decision to consume renewable energy, individuals, households and businesses may opt to produce part or all of this energy themselves, in their role as prosumers (both consumers and producers of energy).[29] Rooftop solar PV is the preferred technology choice, particularly in cities where space is limited, but prosumers also are adopting solutions ranging from micro wind turbines to wood pellet heating (connected to district heating systems).[30] Prosumerism is an attractive option in many places. In a 2020 survey in Brazil, 90% of respondents said they would like to produce electricity at home, typically from solar PV systems.[31] However, consolidated data on prosumers in cities remain scarce.

Many of the policies supporting prosumers – including feed-in tariffs, net metering schemes and policies ensuring full compensation for electricity or heat fed back to the grid – are adopted at the state or national level[i]. However, some examples exist at the city level (→ *see Urban Policy Landscape chapter*), and municipal governments support prosumers in a variety of ways. In Brussels (Belgium), the regional government provides low-interest loans for households to invest in renewable energy equipment.[32] Mexico City (Mexico) allocates USD 17.1 million annually for distributed solar capacity, with the aim of adding 350 MW by 2024.[33] Municipal governments also play an important role in co-ordinating consumer awareness campaigns.

Another emerging trend is solar leasing agreements, whereby developers or financing institutions cover the long-term leases for rooftop solar PV installations, and citizens then pay a periodic fee to use the generated power rather than having to invest in the system themselves. The resulting energy cost savings or the profit from feeding electricity into the grid are shared with the citizen. Although public authorities typically are not involved directly in solar leasing, city governments can promote it by ensuring the availability and comparability of information on related costs.[34] Solar leasing was first developed in the United States but is diffusing rapidly, including across India and Malaysia in Asia.[35]

Among other innovations emerging at the city level is the provision of collective energy storage. In the Meadow Springs suburb of Mandurah (Australia), the PowerBank Community Storage System enables 52 individual prosumers to store excess energy from their solar panels in a shared battery facility, and then withdraw up to 8 kWh of electricity per day for a daily fee of AUD 1 (USD 0.77).[36]

Municipal governments support prosumers and community energy projects in a variety of ways.

COMMUNITY ENERGY IN CITIES

Traditionally a rural phenomenon, community energy projects have increasingly made their way into cities. In its most basic form, community energy refers to energy systems that are managed by local people for the benefit of local people.[37] This generally entails collective local ownership along with decision-making power that lies with a group of local inhabitants. Most community energy projects are focused on renewable energy production, but projects also exist for energy storage, energy efficiency, mobility, sharing and trading, among others. Assessing the full scope of community energy initiatives in cities is challenging because of a lack of data and varying definitions of the term[ii].

The collective character of community energy sets it apart from "simple" prosumerism. Community energy usually brings local benefits such as job creation and improved societal welfare, greater energy security through cost savings and price certainty, and expanded awareness and public acceptance of renewable energy technologies – in addition to contributing to wider sustainable development objectives and emission reductions.[38] Because community energy arrangements depend on collective decision making by local inhabitants, this broadens participation in the energy system and strengthens local cohesion and democratic processes, often empowering citizens beyond the respective community energy projects.[39] Community energy makes participants conscious about their rights and responsibilities and adds to a sense of energy citizenship and energy democracy.[40]


Milan, Italy

i Worldwide, as of the end of 2019, feed-in policies were in place in 113 jurisdictions at the national, state or provincial levels. In 2019, the shift continued away from feed-in policies and towards mechanisms such as auctions and tenders. See REN21's *Renewables 2020 Global Status Report*, available at www.ren21.net/gsr. In the European Union, the recent Clean Energy Package has greatly empowered prosumers, including ensuring their right to receive compensation that reflects the market value of the electricity that they supply to the grid.

ii For example, two formal terms for community energy are "citizen energy community" and "renewable energy community." In Germany, community energy refers narrowly to citizen associations, whereas in the United States it includes projects for which electric utilities (not necessarily municipal utilities) or third-party providers sell "shares" to local consumers. Nevertheless, the trends show that renewable energy initiatives involving citizens are increasingly present in cities worldwide.

Community energy projects are most common in countries that have liberalised energy markets and where incumbent energy providers are less powerful. The number and character of community energy projects within cities varies widely: projects are more frequent in European countries such as Belgium, Denmark, Germany and the United Kingdom, as well as in the United States, but they also are emerging in Australia, Canada, Japan, the Republic of Korea and Thailand, among others.[41]

While many community energy projects originate at the grassroots level, local authorities often actively support these efforts through funding schemes, favourable procurement rules, and the provision of expertise as well as access to public spaces (such as public land or roof space on schools, courthouses and other public buildings).[42] In the EU, municipalities can legally become members of community energy projects.[43] Through such support, cities can tap into the creativity, expertise and financial resources of residents as a way to meet their own local renewable energy and climate goals and strengthen citizen support for renewables through direct participation.[44] Municipal governments and citizens thus become allies in the transition towards a renewable-based energy system.

Municipal governments around the world play various roles in supporting community energy projects:

- **Regulatory and policy enablers.** Governments create an enabling environment for community energy development by, for example: including targets for community ownership in municipal climate and energy strategies; making it mandatory for developers to offer community ownership options; securing partnerships with rural hinterlands to set up urban-rural projects; and using urban planning to steer new neighbourhoods towards community energy.[45]
- **Project partners and facilitators.** Governments directly support community energy projects by, for example: creating a dedicated body at the city level to provide projects with information and know-how; mapping the city's renewable energy potential; acting as a liaison to bring interested stakeholders to the table; helping to secure funding from municipal sources or third parties; and even becoming a member of a community energy project.[46]
- **Infrastructure operators.** Governments invite community involvement in energy infrastructure by, for example: allowing community participation in municipality-owned utilities; providing opportunities for participatory financing; and teaming up with community energy initiatives to advance remunicipalisation efforts, which open the door for further community energy projects (→ *see Remunicipalisation section*).[47]

In **Europe**, EU Member States are required under the 2019 Clean Energy for All Europeans package to provide legal definitions of community energy projects and to develop supportive legal frameworks.[48] The number of active community energy projects across Europe increased from some 2,400 in 2015 to more than 3,600 in 2019.[49] Around 1,500 projects are members of REScoop, the European association of community energy projects, which represents more than 1 million citizens and acts as both an intermediary and lobby organisation.[50] Most community energy


Madrid, Spain

projects are in Germany, Denmark and the Netherlands, although no coherent trend exists and the situation varies greatly among EU Member States.[51] Studies point to the region's large potential for citizen-financed community energy projects.[52]

The COVID-19 pandemic appears to have slowed the growth in community energy in Europe, with existing projects reporting lower turnover and delays in installing new equipment.[53] However, the emerging pandemic recovery packages and the European Green New Deal could have a positive influence on projects in cities and elsewhere. In Croatia, COVID-19 recovery funds enabled the construction of 1,000 community-owned solar PV systems in 10 cities, supported by the European Institute of Innovation and Technology and the Climate KIC Cities Accelerator Programme.[54]

In Spain, urban citizens are involved in community energy projects through several large regional co-operatives, including Som Energia (67,800 members) and GOIENER (more than 10,000 members).[55] The concept of collective self-consumption, introduced in 2019, allows citizens in densely populated areas to join together and become "off-site prosumers" by investing in solar PV installations near their homes and on neighbouring buildings, to the benefit of the wider community.[56] Municipal governments have spearheaded community energy projects in Spanish cities including Barcelona, Cadiz, Girona, Madrid, Pamplona, San Sebastian, Valencia and Valladolid.[57]

Germany has been a leading country in community energy development, with an estimated 1,750 projects in 2020.[58] Spurred by a strong domestic renewables sector and feed-in tariffs, many communities have benefited economically from renewable energy projects.[59] The number of new community energy projects in Germany peaked in 2011, with 167 initiatives added that year.[60] Since then, changes in national legislation – specifically, a shift from feed-in tariffs to an auction system – have created difficulties for community energy groups, and only 14 new projects were added in 2019.[61] Most of Germany's projects are

located in rural areas, but some are in cities, for example in Jena where communities act as shareholders with decision-making power over their local energy suppliers.[62]

Denmark has a long history of community energy development. Although community-owned wind power projects often are located in rural areas, solar-based district heating systems frequently occur in or near cities. In 2019, Denmark was home to 120 such plants, including in the town of Silkeborg.[63] In Marstal, on the island of Ærø, a solar district heating system supplies 55% of the total heat demand (the rest is from wood chips and a heat pump), and citizens collectively own both the plant and the heating grid.[64]

At least 300 community energy groups were active in the United Kingdom in 2019.[65] These groups were involved mainly in electricity generation (with fewer projects related to heat generation), installing more than 15.4 MW of new electricity in 2019 for a cumulative total of 264.9 MW.[66] Groups pushed to finalise community-owned electricity projects in anticipation of the ending of the feed-in tariff programme in March 2020[i].[67] Among community energy activities in UK cities, the Community Energy London Network, which connects 700 people involved in 30 projects, has resulted in 450 tonnes of CO_2 savings since the start of the network in 2018.[68] In Edinburgh (Scotland), the Community Solar Cooperative produces 1.1 GWh of electricity per year from 24 solar PV systems.[69] Community energy projects also exist in Brighton, Bristol and Bournemouth (all England) and in Cardiff (Wales).[70]

Community energy projects have grown in Belgian cities as well.[71] In 2019, citizens in Brussels installed a rooftop solar PV system on a public building – producing 36,000 kWh annually – and then connected it with a public electric vehicle charging station.[72] A community project in Leuven installed a 57-panel solar PV plant in 2020 with a capacity of 16 kW-peak, and the city also worked with co-operatives to install two rooftop PV installations that citizens can invest in that supply a local daycare and a community centre with 98,000 kWh and 11,500 kWh annually, respectively.[73]

Also in Belgium, Cooperative Energy Mouscron installed 100 solar PV systems on residential homes in the city of Mouscron, with a total of 1,145 PV panels producing an estimated 292 MWh per year.[74] In Eeklo, the municipality and local citizens formed a co-operative to build two wind turbines in 2011, and by 2020 the project was supplying some 48,500 members with renewable energy; citizens who cannot afford a co-operative share get access through municipality-held shares.[75] Another co-operative, Pajopower, active in the Flanders region, creatively supported the city of Halle in replacing 445 public street lights with LEDs by having citizens "adopt" the street light in front of their door, thereby raising the EUR 225,000 (USD 276,355) needed for the project.[76]

Elsewhere in Europe, citizens and companies in Almere (Netherlands) financed a project to repower the 320 MW Zeevolde wind park by replacing 220 old wind turbines with 91 new ones.[77] In 2019, the Solar Town project in Slavutych (Ukraine) installed 200 kW-peak of solar PV on local roofs, in an initiative co-owned by local residents and private investors and financed via crowdfunding.[78] In Vienna (Austria), between 2012 and October 2020, 6,000 citizens had taken part in a programme whereby the city-owned utility Wien Energie installs solar panels on buildings and then offers people the opportunity to buy the panels and lease them back to the utility for an annual return.[79] In Strasbourg (France), a community solar PV project started in 2020 aims to be more inclusive by making shares available for only EUR 100 (USD 122.8); it relies on a network of people to identify feasible new sites for solar PV, and the project managers negotiate with homeowners and facilitate the installation.[80]

In the **United States**, energy communities differ from those in Europe and elsewhere in that they generally invite members to only purchase the renewable energy[ii] produced from community projects, rather than buying shares outright. However, the set-up and ownership structure of US community solar projects usually resembles that in other parts of the world. The number of community solar projects in the United States has increased, with an estimated 297 new projects operating in 2019 and another 43 projects operating in 2020, for a total capacity of 566 MW-peak among these 340 projects.[81]

Bristol, United Kingdom

Municipal governments use participatory governance to

include citizens

in decision making related to energy and climate protection.

i The Coronavirus Amendment Order extended feed-in tariff accreditation to September 2020.

ii According to the National Rural Electric Cooperative Association, US co-operatives cover a territory equivalent to 56% of the country's landmass, powering more than 20 million businesses, homes, schools and farms across 48 states and serving 42 million people in more than 2,500 counties. Collectively, the 843 distribution co-operatives and 63 generation and transmission co-operatives generate 5% of all US electricity and deliver 12% of it. While 95% of the co-operatives include renewables in their energy mix, only 17% of the total energy they produce comes from renewable sources (10 GW). See National Rural Electric Cooperative Association, "America's Electric Cooperatives", June 2020, https://www.electric.coop/wp-content/uploads/2021/01/Co-op-Facts-and-Figures.pdf.

Among US projects in cities, the boroughs of Brooklyn and the Bronx in New York City deployed 20 and 16 new projects, respectively, between 2018 and 2020.[82] Based on a local ballot measure in 2018, Portland (Oregon) set up the Portland Clean Energy Community Benefits Fund, which supports renewable energy installations to benefit disadvantaged communities; it is anticipated to bring USD 44-61 million in new annual revenue for green jobs, healthy homes and a climate-friendly Portland.[83]

In **Asia**, many of the existing community energy projects were developed in response to Japan's 2011 Fukushima nuclear disaster, including initiatives in Japan and Thailand.[84] In the Republic of Korea, communities had established more than 100 renewable energy projects by late 2018, many of them in cities.[85] The country's first project, comprising five solar PV power stations built in leased public space, was installed in Seoul's Eunpyeong district in 2013, with a total capacity of 332 kW.[86] The community is planning another six or seven plants, totalling 600-700 kW, by 2021.[87] The surge in renewable energy communities in the Republic of Korea is attributed in part to the 2012 Cooperative Act, issued in response to the Fukushima disaster.[88]

Government funding for community energy in **Latin America** has tended to prioritise electrification projects in remote rural communities.[89] As a result, several urban areas have turned to crowdfunding to support community-based projects. The collective funding platform Red Giralsol connects small-scale investors with citizens and companies that want to invest in renewable energy projects in Mexico City and elsewhere.[90] In Brazil, community-owned solar systems sprung up after the National Energy Agency changed its regulations in 2015 to allow for shared distributed generation; by 2019, at least eight community energy initiatives were operating in the country, including solar options for urban residents who do not own the buildings they live in.[91] In 2020, a community solar PV project was started in Rio de Janeiro's *favela* (slum) that will supply 30 families with electricity from a 26 kW-peak solar PV system; the system will be refinanced by 50% of the savings on the energy bills of its members.[92]

In **Oceania**, community energy projects have emerged across Australia, supported by federal policies.[93] A solar garden in the Riverina region, which comprises 333 "virtual plots" of 3 kW each that will produce an estimated 4.2 MWh each per year, supports citizens who wish to become involved in renewable energy production but are unable to for various reasons (including living in an apartment, renting their property, heritage challenges or a lack of knowledge about solar panels).[94] The town of Yackandandah in Victoria state, in a community-led approach to bringing renewables to citizens, hosts three microgrids and a power storage project, all of which stem from a 100% volunteer-run initiative that aims to achieve energy sovereignty by 2022.[95] To the north, the renewable energy hub in Narrabri (New South Wales), established in September 2020, is one of 50 planned hubs in Australia to support new community energy projects.[96] The initiative demonstrates how cities can take an active role in supporting intermediaries and providing their services free of charge to community groups.


Tahara city, Japan

Community energy projects in **Sub-Saharan Africa**, where more than 600 million people still lack access to electricity, can help greatly to address this challenge.[97] Small-grant programmes enable citizens to invest in mini-grid solutions that bring electricity to low-income households in rural areas as well as in low-income urban areas with unreliable or no grid access.[98] Urban community energy projects help spread renewable installations in places that already have reliable grid access. In Cape Town (South Africa), where the local government facilitated the installation of an 84 kW solar PV system at Wynberg Girls High School, citizens who buy shares in the project receive a dividend over a 20-year period (→ *see Feature chapter*).[99]

PARTICIPATORY GOVERNANCE

Municipal governments have the opportunity to use participatory governance to include citizens in a range of decision making related to energy and climate protection – whether in planning, budgeting or policy development processes. Whereas at higher levels of governance, energy and climate planning have tended to occur without the involvement of civil society[i], municipal governments are generally closer to residents and thus have been able to use participatory governance more often to advance their sustainable development and energy transition goals (→ *see City Snapshot: Jakarta*).[100]

i Several European countries have introduced citizen assemblies to inform climate and energy policies. In France, the government set up a citizen assembly of 150 people in response to the 2018 yellow vest protests. This assembly, whose task is to suggest policies that can cut French emissions 40% by 2030 in a socially just way, will debate and propose laws in an approach that is "unfiltered" either by the French parliament or by referendum. Comparable bodies exist in Ireland, the United Kingdom and Spain, where the government set up the assembly after the country declared a climate emergency.

JAKARTA

INDONESIA

Land area (km^2)	Population size (2019)	Greenhouse gas emissions (CO_2 equivalent)
7,639	10.1 million	34.5 million tonnes

As the capital of Indonesia, Jakarta is taking effective action to reach its goal of reducing the city's greenhouse gas emissions 30% by 2030, a target set in 2012. The local action plan serves as a means to help achieve Indonesia's national emission reduction target of 29% by 2030, with a focus on renewable energy. Jakarta also committed in 2016 to reducing its water and energy consumption 30% and to achieving 30% renewables in its energy mix by 2030. To meet this latter target, the municipal government plans to increase its solar panel capacity by 600 kW-peak per year and to develop waste-to-energy plants.

The local government also is actively engaging citizens and stakeholders in the formulation of the Ikhtiar Jakarta ("city promise") initiative, which outlines Jakarta's commitments in the areas of energy, green buildings, transport, clean water, waste and disaster management. Six public consultations with a total of 300 attendees were conducted in 2018-19 to promote sustainable lifestyles and support the initiative. Jakarta also is developing a Regional Energy Plan (RUED-P), which contributes to achieving the targets set in the National Energy General Plan (RUEN) and the National Energy Policy (KEN).

In 2019, Jakarta implemented Governor Instruction No. 66, which mandates the city's Transmigration, Manpower and Energy Agency to install rooftop solar on large public buildings, including all schools, sport facilities, hospitals and government buildings during 2019-22. In 2019, a total solar capacity of 2,060 kW-peak was installed on 98 schools, bringing the combined rooftop solar capacity on schools and government buildings to 2,675 kW-peak and showcasing the great potential to minimise local carbon footprints.

Source: See endnote 100 for this chapter.

In Jakarta
citizens have actively helped
shape the city's climate action plan.

Municipal governments have a variety of tools at their disposal to increase citizen participation in decision making. Cities around the world invite citizen feedback by permitting ordinary people to review policies before they enter into force. Through **participatory planning**, cities enable citizens to develop and choose among different options for urban energy plans. Some cities also support participatory budgeting, through which citizens are granted the ability to allocate a share of the city budget following open and democratic deliberation. Although no consolidated data exist on participatory governance at the municipal level, the approach is being used increasingly in cities in Europe and the United States, among other places.[101]

The COVID-19 pandemic has negatively affected traditional approaches to participatory governance by limiting the ability to hold in-person meetings, which has raised concerns about community voices not being heard.[102] In response, some municipal governments have used digital tools such as apps and online forums to gather ideas from citizens. For example, Edinburgh (Scotland) initiated the Edinburgh Climate Talks to encourage citizens to get involved in developing local recovery plans and to support efforts to reach the city's net-zero emissions goal by 2030.[103]

In 2019 and 2020, several municipal governments involved their citizens in **developing climate and energy plans**. In Ii (Finland), the municipality and nearly 500 citizens jointly created a plan to reduce greenhouse gas emissions 80% by 2030 (from 1990), based on energy efficiency measures, the use of renewables in all public buildings and switching the municipal fleet to electric vehicles.[104] By 2020, they had already achieved a 62% reduction in greenhouse gas emissions.[105] In Münster (Germany), 1,200 local citizens helped draft the city's 2050 climate roadmap, which targets a 95% reduction in greenhouse gas emissions by 2050.[106] Citizens In Sønderborg (Denmark) participated in developing the city's 2025 energy roadmap.[107] In Amsterdam (Netherlands), citizens were invited to contribute to the city's heat transition vision for a fossil-free heating system by 2040, which was open to public comment until May 2020.[108] Citizens in Ghent (Belgium) contributed to designing the new mobility concept of the Dampoort neighbourhood in consultations through December 2020.[109]

Many cities and municipalities in the United States rely on a participatory governance model, holding town halls, city council hearings and other fora to hear from community members. This has pushed forward the development of community choice in energy provision as well as cleaner transport measures (such as electrification of urban transport infrastructure and electric vehicle charging). In Savannah (Georgia), high turnout and interest in the February 2020 town hall meeting led to the goal of switching the city to 100% renewable electricity by 2035.[110] Under California's community choice aggregation programmes, which are municipally owned and operated, citizens have a say in how the utilities conduct business and what they prioritise by virtue of influencing municipal climate action.[111]

South Africa's planning processes are by law open to comment from citizens. eThekwini municipality, which includes the city of Durban, aims to achieve at least 40% renewable energy supply by 2030 and 100% by 2050.[112] The Draft Energy Policy, which outlines how the municipality plans to reach these goals, was open to public comment until 15 January 2021 on the municipality's website.[113] Also in South Africa, the social enterprise iShack has helped disadvantaged communities in Stellenbosch and Cape Town, among other cities, electrify in a participatory manner. iShack's projects in various locations provide households that lack grid access with funding to install off-grid solar PV systems to meet basic energy needs.[114] In 2018, GreenCape's Witsand Informal Settlements project in Cape Town used a participatory co-design approach to identify people's energy needs, leading to the provision of 50 solar-powered streetlights and Wi-Fi hotspots in 2020.[115]

Cities in Europe increasingly have introduced **participatory budgeting**. Paris (France) reserves 5% of its investment budget for this purpose, with one-fifth of this funding, or EUR 100 million (USD 122.8 million), earmarked for climate-friendly investments.[116] Mouscron (Belgium) initiated a project In 2017 – financed through a participatory budgeting process that began in 2016 – to install solar panels on school buildings in low-income neighbourhoods; it then sold 55% of the shares in the panels to local residents at favourable rates to form a community energy project.[117] In Latin America, participatory budgeting is used in Bogotá (Colombia) and Porto Alegre (Brazil), but whether and how these governance mechanisms influence the deployment of renewables in these cities is unclear.[118]


Cape Town, South Africa

Several municipal governments have **involved their citizens** in developing climate and energy plans.

BOTTOM-UP INITIATIVES AND CAMPAIGNS

Rising public awareness and concerns related to climate change have increased citizen engagement in energy issues. During global climate strikes in 2019 and 2020, millions of citizens in cities around the world filled the streets demanding action to address climate change and shift energy systems away from fossil fuels.[119] In response to rising public pressure, cities have adopted climate and energy plans, and many have strengthened existing plans. Against the backdrop of increasing public awareness of sustainability and energy concerns and mounting public pressure, municipal as well as regional, national and supra-national governments have adopted more ambitious climate and energy strategies, remunicipalised local utilities and declared climate emergencies.

Many citizen groups target their local municipalities through bottom-up climate and energy initiatives. In the Netherlands, the group Lochem Energie is pushing for the city of Lochem to achieve "energy autarky" by 2030, meaning that all energy in the municipality is to be produced by citizens, companies or public suppliers within local borders.[120] In the United Kingdom, citizens successfully campaigned in Leicester and Eastbourne to have these cities adopt ambitious climate plans.[121]

Public demands also have helped address environmental problems related to fossil energy projects while simultaneously supporting renewables. Citizen pressure in Chile led to closure of the Ventanas 1 coal power plant and to the creation of an urban development plan for Puchuncaví and Quintero in 2020 that includes renewable energy and energy efficiency measures.[122] Also in Chile, following public demand, the coal power plant in Concepción will be taken out of service by 2022, and the city aims to expand its renewable energy capacity through hydropower and other renewables.[123]

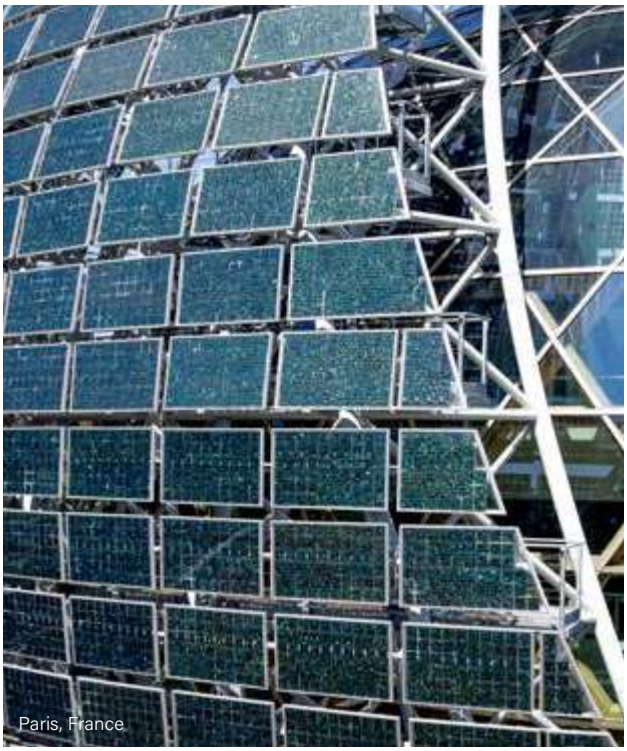
A growing number of residents have joined efforts with their municipalities to regain control over key municipal infrastructure. In the last decade, **(re-)municipalisation** campaigns have pushed more cities to take control of local power suppliers and grids. These campaigns frequently are a reaction to disappointment with the outcomes of previous privatisations in the energy sector.[124] (Re-)municipalisation has been seen as an important tool to advance renewable energy in cities, in addition to achieving broader objectives such as local economic growth and re-industrialisation.[125]

Globally, (re-)municipalisation of energy infrastructure peaked in 2016, but the upward trend has continued.[126] At least 1,408 cases of remunicipalisation of critical infrastructure[i] were recorded as of late 2020, including 369 energy-related cases (13 of them occurring between 2018 and late 2020).[127] The bulk of these cases (305, or around 80%) were in Germany, followed by Spain (18), the United Kingdom (13) and the United States (11).[128]

The case of Eau de Paris, the water utility in Paris (France), is an example of how city governments can use local utilities to support the development of renewables in a cross-sectoral manner. After taking water provisioning back into public hands in 2009, citizens of Paris did not simply benefit from lower tariffs for drinking water. In addition, the democratically elected board of Eau de Paris installed solar PV panels (generating 17,500 MWh of electricity in 2018) and decided to set an internal goal of 95% renewables in the company's power mix by the end of 2020.[129]

In Wolfhagen (Germany), citizens initiated a process of remunicipalisation of the local power supplier in 2012, and by 2020 the city together with a citizen co-operative owned the power provider. The co-operative has a 25% ownership share, effectively granting it two of the nine seats on the company board.[130] In the last decade, a number of UK municipalities attempted to set up publicly owned energy providers to address energy poverty in the country by offering low tariffs for struggling citizens. However, two of the main municipal-owned companies – Robin Hood Energy in Nottingham and Bristol Energy – were sold after severe financial losses.[131]

In Spain, the cities of Barcelona, Cadiz, Madrid and Zaragoza all initiated remunicipalisation projects that returned critical energy infrastructure into public hands, giving local politicians the chance to retain profits from energy sales and to set up local projects, such as an energy poverty fund in Cadiz.[132]Barcelona's publicly owned power provider, Barcelona Energía, buys renewable energy directly from small-scale producers in the region and sells it to citizens in the city, offering value-added tax reductions and favourable tariffs for disadvantaged citizens to ensure that all people can benefit from renewables.[133]



Paris, France

i Including water, transport, energy and waste.

In the Middle East, remunicipalisation took place in the city of Hebron (State of Palestine), where the publicly owned Hebron Electric Power Company is developing solar PV on all municipal buildings and an additional 500 rooftop PV systems on schools, for a total capacity of up to 35 MW.[134]

In another example of bottom-up action, by the end of 2020 more than 1,850 municipal governments in 29 countries (up from around 1,400 governments in 2019) had declared a **climate emergency**, representing 980 million citizens around the world.[135] Several national governments and supra-national institutions[i] have since followed suit. In 2020 alone, 411 municipal governments issued climate emergency declarations, many of them in Canada and the United Kingdom but also cities such as Barcelona (Spain), Boston (Massachusetts, US), Mülheim (Germany) and Osaka (Japan), along with the national assembly of mayors representing 226 local authorities in the Republic of Korea.[136] Municipal governments in Europe dominated these efforts, with a total of 826 declarations, followed by Canada (504), the Republic of Korea (228), the United States (127) and Australia (98).[137]

Climate emergency declarations have been leveraged to initiate or halt projects based on their climate performance.[138] Many municipal governments have issued **climate action plans** that complement their emergency declarations (→ *see City Snapshot: Recife*).[139] Although by the end of 2020, only 231 municipal governments had submitted a climate action plan alongside their declaration, the total number of governments doing so increased rapidly.[140] Between the middle and end of 2020, the number of action plans almost doubled, driven largely by UK municipal governments which added 87 plans in September alone.[141] Further action plans are expected in the near future, as emergency declarations usually include initiating a process to develop an action plan and then reporting back to council within three to six months.[142]

It remains to be seen how municipal governments will implement their climate emergency plans in their policy documents and specify a role for renewables. Of the more than 1,850 municipal governments with climate emergency declarations, over 180 had already passed a renewable energy target as of late 2020, either specified as part of their climate action plan or as an independent target.[143] Cities that have issued both climate declarations and renewable energy targets are mainly in Europe (115) and North America (55) but also include Newcastle (Australia), Seoul (Republic of Korea) and Wellington (New Zealand) (→ *see Figure 17*).[144] Among these, some 61 cities had a climate action plan as well, in particular UK cities including Bristol, Edinburgh, Glasgow and Leeds, but also Auckland (New Zealand), Barcelona (Spain), Melbourne (Australia), San Diego (California, US), and Vancouver (Canada).[145]

More than 1,850 municipal governments in

29 countries

have declared a climate emergency, representing 980 million citizens around the world.

Barcelona, Spain

i In November 2019, the EU parliament declared a climate emergency.

Figure 17. Cities with Climate Emergency Declarations and Renewable Energy Targets, 2020

Of all 1,852 cities that have signed climate emergency declarations,

10%

have renewable energy targets.


Seoul, South Korea

Source: See endnote 144 for this chapter.

RECIFE

BRAZIL

Land area (km^2)

218

Population size (2018)

1.6 million

Greenhouse gas emissions (CO_2 equivalent)

GHG

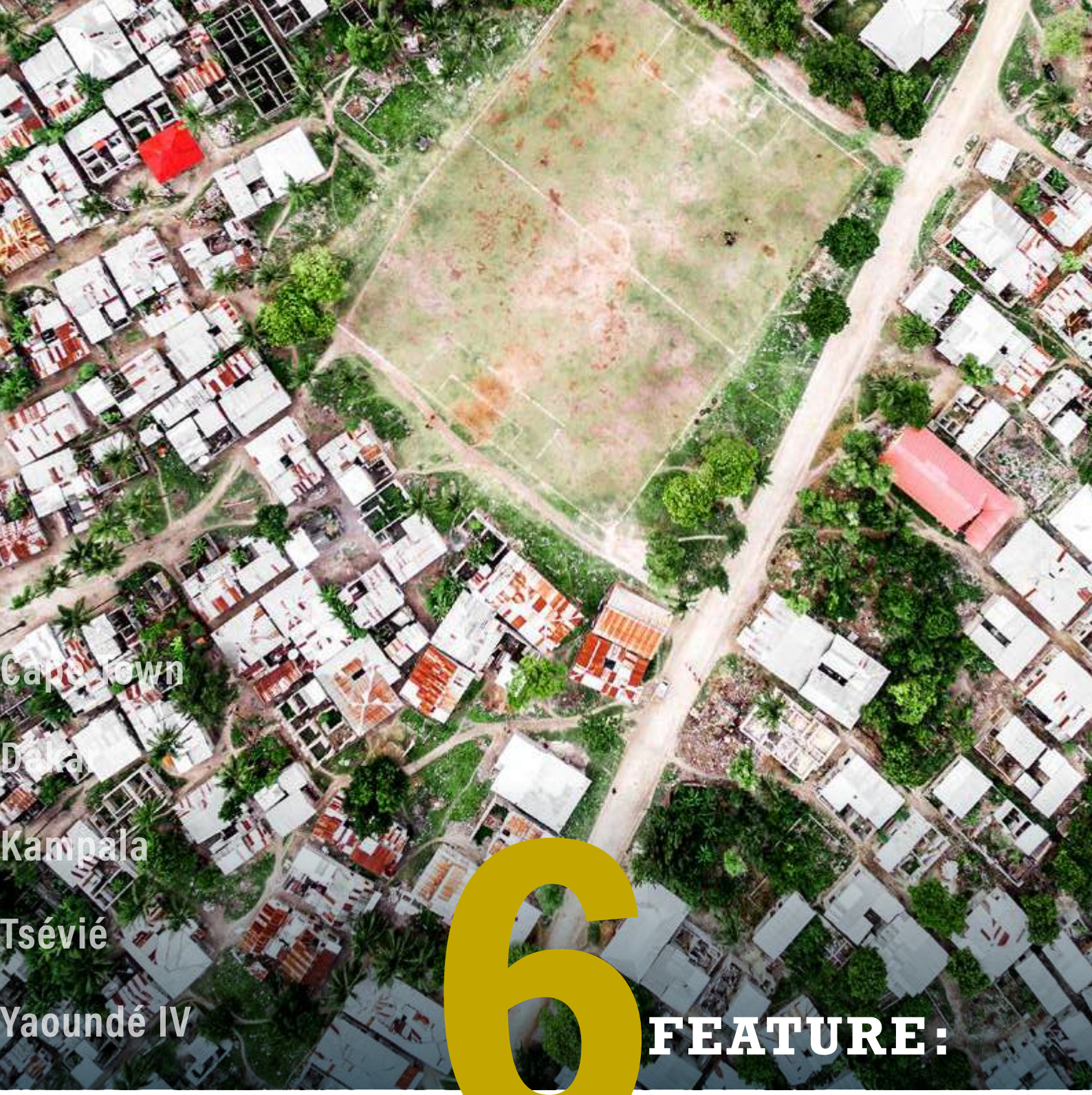
2.9 million tonnes

Recife, an Atlantic seaport in north-eastern Brazil, is the first city in the country to formally declare a climate emergency. According to the Intergovernmental Panel on Climate Change, Recife is the 16th most vulnerable city in the world to climate change. Drastic changes in the local weather have motivated the local government to make commitments towards a low-carbon future. In 2019, in response to its climate emergency declaration, Recife committed under the City Climate Action Plan to becoming carbon neutral by 2050. The local government also aims to achieve 100% renewable energy in city-wide operations by 2037.

In 2013, Recife created two municipal fora, Comclima and Geclima, to formulate climate change and sustainability policies. As a part of the Urban LEDS project, the city also has developed measures to reduce its greenhouse gas emissions. Under the Urban LEDS network, Recife was selected to receive support from the climate finance laboratory to install a pilot 17 kW-peak solar PV system at the Women's Hospital of Recife (HMR), which is expected to be operational by 2021. In addition, Recife City has approached a local energy company, Companhia Energética de Pernambuco (CELPE), to finance an initial investment of EUR 200,000 (around USD 225,000) to help define model financing for energy efficiency measures, distributed generation and replicability of actions in other buildings in the municipality.

To assist the city's sustainable development efforts, the Energy Efficiency Program (PEE) – promoted by CELPE in the regulations of the National Electrical Energy Agency (ANEEL) – provides 0.4% of the net operating revenue of local energy companies to fund research and development projects and the implementation of energy efficiency and renewable energy measures in the city. To promote greater citizen participation, CELPE holds public hearings where it presents the plans and results of renewables and efficiency projects in the region. Through public calls, it seeks partners to promote the development of new technologies, transform energy efficiency markets and create rational habits and practices for the use of electricity.

Source: See endnote 139 for this chapter.



6 FEATURE: RENEWABLE ENERGY IN SUB-SAHARAN AFRICAN CITIES

FEATURE:

RENEWABLE ENERGY IN SUB-SAHARAN AFRICAN CITIES

Sub-Saharan Africa was home to an estimated 1.1 billion people in 2019, with around 40% of this population living in urban areas.[1] The region contains 27 of the world's 28 poorest countries and had an average poverty rate of 41% in 2018.[2] Major barriers to reducing poverty in Sub-Saharan Africa include conflict, a lack of robust institutions, and inadequate access to basic infrastructure services (such as drinking water, sanitation and electricity).[3] The region also is home to the world's most rapidly urbanising cities: Africa's urban population increased more than 16-fold between 1950 and 2018, from 33 million to 548 million.[4] This rapid urban growth is a key driver of energy consumption, with average annual energy use on the continent increasing 3% between 2000 and 2010 and 2.5% between 2010 and 2018.[5]

Even so, energy consumption in Sub-Saharan Africa remains among the lowest in the world, at around 17 GJ per capita per year in 2018 (excluding Nigeria and South Africa), nearly five times below the world average (84 GJ per capita per year).[6] Traditional biomass, mainly wood and charcoal, accounts for 66% of total final energy consumption region-wide and is used across all non-transport sectors, making Sub-Saharan Africa the only region in the world with such heavy reliance on biomass.[7] Despite the abundance of local renewable energy resources, renewables accounted for only 7% of the total primary energy supply, 8% of total final energy consumption and 26% of power generation in the region as of 2018.[8]

Meanwhile, many Sub-Saharan African governments have made great strides in integrating renewable energy into regional, national and even sub-national planning. By 2018, of the 53 African countries that had submitted Nationally Determined Contributions for reducing greenhouse gas emissions under the Paris Agreement, 45 had adopted quantified renewable energy targets.[9] Regionally, the Economic Community of West African States (ECOWAS) has set a target for 48% renewable electricity by 2030, and the East African Community (EAC) aims for 21% renewables in the power generation mix by 2038.[10]

City governments play a key role in shaping the energy landscape of Sub-Saharan Africa.

City governments play a key role in shaping the energy landscape of Sub-Saharan Africa, including meeting country-level renewable energy targets. However, legislative, financial and technological constraints – such as weak fiscal decentralisation, limited municipal mandates across key sectors and capacity constraints to executing municipal functions – continue to impede wider adoption of renewables.[11] Nonetheless, many cities in the region have joined global clean energy initiatives. For example, signatories to the Covenant of Mayors in Sub-Saharan Africa have voluntarily committed to implementing climate and energy actions in their communities, and the Climate Action Planning Africa Programme, led by C40 Cities, brings together 11 megacities in Sub-Saharan Africa – including Accra (Ghana) and Nairobi (Kenya) – that have pledged to become net-zero carbon by 2050.[12]

These locally driven ambitions have led to positive outcomes. In 2019, Nairobi enforced a national regulation that requires large buildings to use solar PV for water heating to reduce pressure on the electricity grid.[13] Rwanda is developing Africa's first "green" city – within the capital Kigali – to be powered completely by renewable energy, and in 2017 Accra initiated an incentive programme that reduces building permit fees by 10% if applicants include a 20 kW solar PV system in the design.[14] In Nigeria, Eko Atlantic City in Lagos State secured its first-ever EDGE (Excellence in Design for Greater Efficiencies) green building certification from the International Finance Corporation in January 2020, giving homeowners the assurance that their homes are designed and built to be resource efficient.[15]

The following sections provide an overview of the status of renewable energy in five Sub-Saharan African cities, highlighting existing practices as well as opportunities for scaling up deployment.

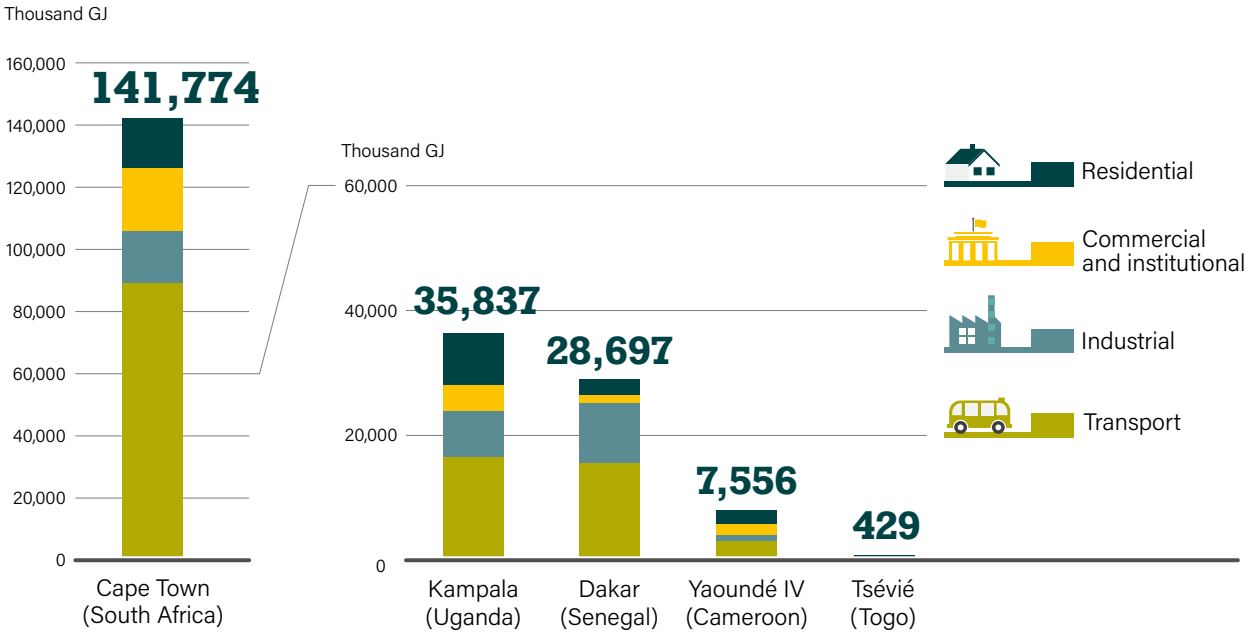
STATUS OF RENEWABLES IN SUB-SAHARAN AFRICAN CITIES

Cities in Sub-Saharan Africa differ widely based on their national context, area and population size, level of urbanisation, level of socio-economic development, access to energy and more. These factors directly influence their total energy demand and energy use by sector. The following sections explore renewable energy trends in five cities – Cape Town (South Africa), Dakar (Senegal), Kampala (Uganda), Tsévié (Togo) and Yaoundé IV (Cameroon) – selected[i] mainly because of their geographic and socio-economic diversity as well as the availability of primary (field-based) data.[16]

Cape Town has a much higher energy demand than the other four cities, reflecting its larger population as well as the relative economic advancement of South Africa. In the smaller cities (such as Tsévié), where the commercial and industrial sectors are less extensive, the residential sector accounts for a higher share of energy use. Meanwhile, in the bigger cities (Cape Town, Kampala and Dakar), where there is greater movement of people and goods, the transport sector plays a more prominent role in energy consumption (→ *see Figure 18*).[17]

i The selected cities, while not wholly representative of the vast environmental and historical contexts of Sub-Saharan Africa, depict the varying socio-economic and energy development realities of the region as well as the diversity of challenges and opportunities experienced in its cities.

Figure 18. Total Final Energy Consumption in the Five Selected Sub-Saharan African Cities, by Sector



Note: Data are from various years.

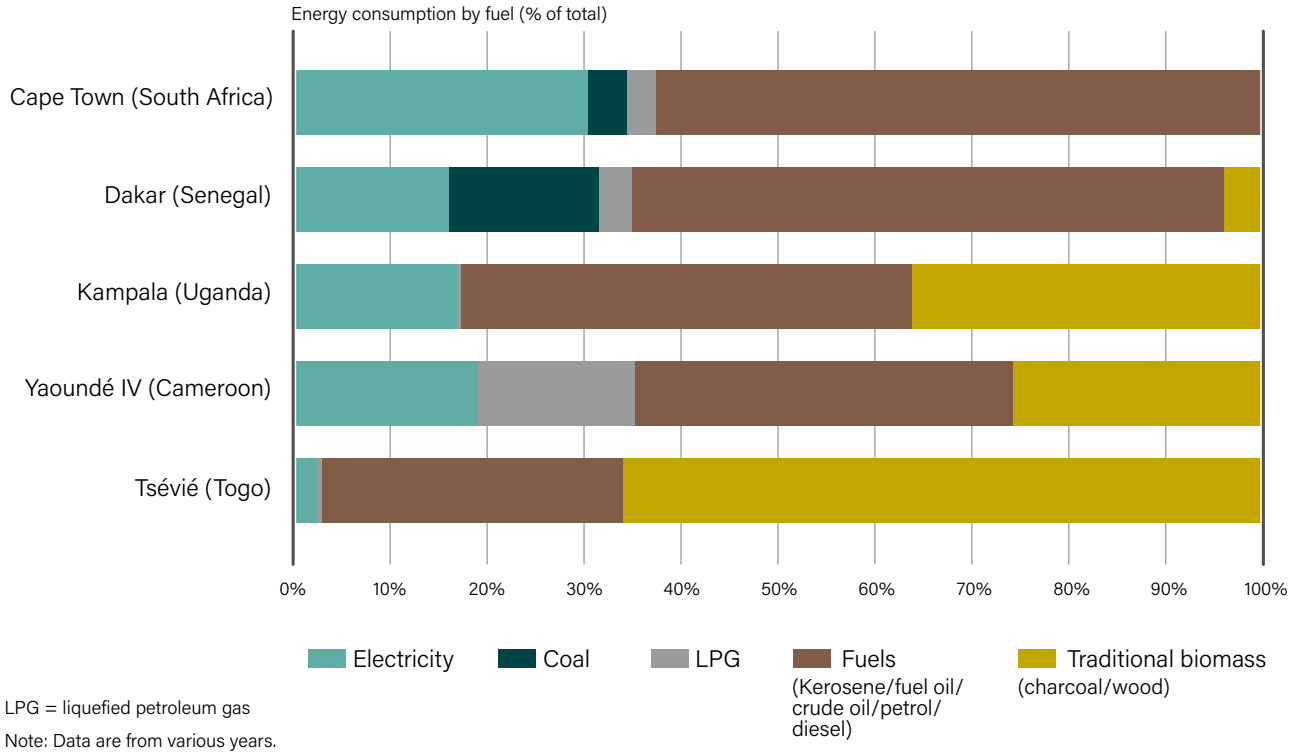
Source: See endnote 17 for this chapter.

The large urban economies also tend to have substantial transport infrastructure, a wealthier populace (resulting in higher car ownership) and greater economic activity (leading to increased freight).[18]

Because of the inefficient use of carbon-intensive diesel and petroleum fuels, the transport sector accounts for the highest share of greenhouse gas emissions in the five cities.[19] Vehicle emissions also are a major source of air pollution, as Sub-Saharan Africa's vehicle fleet consists largely of ageing vehicles (mainly from Europe and North America) that no longer meet emission standards in their countries of origin.[20]

In the less-urbanised cities of the region, high shares of residential energy use (in the case of Tsévié, representing up to 73% of final energy consumption) reflect the low levels of industrialisation of these economies.[21] Overall, the residential sector accounts for 65% of total final energy consumption in Sub-Saharan Africa, compared to only 22% globally.[22] In Tsévié, traditional biomass (wood and charcoal) represents more than 50% of final energy consumption, mainly for cooking (→ *see Figure 19*).[23]

Figure 19. Shares of Energy Use by Carrier in the Five Selected Sub-Saharan African Cities



LPG = liquefied petroleum gas

Note: Data are from various years.

Source: See endnote 23 for this chapter.

CAPE TOWN

SOUTH AFRICA

Land area (km^2)	Population density (per km^2)	Population size	Total final energy demand (million GJ)
400	1,700	4.2 million	145.3

Cape Town is South Africa's second largest economic hub, with a population of around 4.2 million in 2018 and a land area of more than 400 square kilometres.[24] Cape Town contributed 9.8% of the national economic output in 2018 and is dominated by the service sector, with significant finance, insurance, real estate and business activities.[25]

Coal contributed 83% of South Africa's electricity generation capacity in 2016 (latest available data), with nuclear power and natural gas representing 4% and 5% respectively and renewable energy making up the remaining 8%.[26] The government aims to increase the renewable share in the generation mix to around 40% by 2030 through various policy instruments, as promulgated in the Integrated Resource Plan (IRP)[i] of 2019.[27]

The City of Cape Town has taken an active leadership role in renewable energy deployment, emphasising not just technology change but also the need to improve governance and institutions and to engage key players in the energy transition, from national government to business and civil society.[28] The decoupling of electricity demand from economic growth in the Metropolitan Municipality over the last decade is attributed to energy efficiency and renewable energy interventions in the face of soaring electricity prices and insecure electricity supply in South Africa.[29]

The transport sector, which relies almost exclusively on petrol and diesel, accounts for 62% of Cape Town's total final energy demand and contributes a third (32%) of the Metro area's greenhouse gas emissions.[30] The sector's high energy use is largely a result of the city's sprawling and segregated form, which reflects the legacy of apartheid's spatial planning.[31] The commercial sector is the second most energy-intensive sector (14% of total final energy demand) followed by households (12%) and industry (12%) (→ *see Figure 18*).[32]

Electricity is the main energy carrier in Cape Town's non-transport sectors, and because most of the electricity in South Africa comes from high-carbon coal-fired power plants, the built environment accounted for 55% of the city's greenhouse gas emissions in 2018.[33] Residential electricity use in Cape Town is split largely across cooking, lighting and space heating applications, while in the commercial sector electricity use is dominated by lighting, heating and ventilation in office buildings.[34]

The City of Cape Town has been a pioneer in providing more affordable and secure energy access and in reducing the city's carbon footprint while also tackling rapid urbanisation and associated energy poverty, urban sprawl and vulnerability to climate change. Cape Town's long history of renewable energy efforts includes the establishment of a dedicated energy and climate change unit.[35] As early as 2000, an energy advisor was seconded to the City as part of the Sustainable Energy for Environment and Development (SEED) programme of Sustainable Energy Africa (SEA), bringing an energy lens to City operations and service delivery.[36] In 2003, with technical support from SEA, Cape Town completed its first *State of Energy* report, and in 2006 it became the first African city to approve a municipal Energy and Climate Change Strategy, setting an initial target for 10% renewable and clean energy by 2020.[37]

The city benefited from learning by doing. Catalysed by the Energy Efficiency and Demand Side Management Programme, launched by South Africa's Department of Mineral Resources and Energy, Cape Town began an extensive and ambitious drive in 2008 to improve

i The IRP provides a medium-term plan for expanding electricity generation in South Africa. It aims to guide sector investment to allow the country to meet its forecasted electricity demand at the least cost and accounting for considerations such as environmental sustainability and water use. The plan incorporates objectives such as affordable electricity, reduced greenhouse gas emissions, diversified generation sources, localisation and regional development.