ACKNOWLEDGEMENTS (continued)

FOREWORD

As we launch the second edition of the *Renewables in Cities Global Status Report* (REC), we find ourselves in a period of global flux. Economic activity and public life have been disrupted around the world. But we have also witnessed an increasing consciousness and public pressure around the importance of clean and healthy living environments – particularly in cities. Citizens are engaging with renewable energy and pushing local and national governments to act. Many decision makers also are becoming aware of the opportunities that renewables offer for a green recovery.
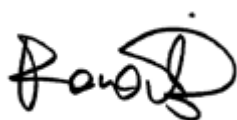
Despite the global challenges triggered by the COVID-19 crisis, we encountered many encouraging stories. Many city governments have installed, purchased or contracted for renewable energy to meet the demand of their own operations. They have also continued to adopt renewable energy targets and to implement policies to incentivise local consumption and generation of renewables, have set net-zero targets and have banned fossil fuels for various uses.

As inspirational as these stories are, we're still a far cry from what is needed. As United Nations Secretary-General António Guterres stated, "Cities are where the climate battle will largely be won or lost." Cities are high-impact areas: they are home to more than 55% of the global population and account for around three-quarters of global final energy consumption. Cities also are essential for accelerating the development of renewables in sectors that continue to lag behind, namely buildings and transport. Still, some national governments underestimate the value of cities to achieve national decarbonisation goals. And some city governments do not have the resources and expertise or just may not recognise their critical role in the shift to a renewables-based economy.

Some things don't change, even with an ongoing global pandemic. We need good, reliable/ trusted, and shared data and knowledge to create awareness, inform and convince decision makers, and tell the stories of renewables. At REN21, we collaborate with our international community to provide such data. REC 2021 has benefited from data, expertise and insights from more than 350 renewable energy and city experts, contributors, researchers and authors that have worked together to identify the trends and developments of renewables in cities.

On behalf of the REN21 Secretariat, I would like to thank all those who contributed to the successful production of REC 2021. Special thanks go to all chapter authors; Special Advisors Janet Sawin, Maryke van Staden and Peta Wolpe; Project Manager Lea Ranalder; and the entire team at the REN21 Secretariat. I would also like to thank the Advisory Committee for their guidance, continuous support and pioneering spirit to start building a continuous database to track advancement on renewable energy at the city level.

We hope that REC 2021 will contribute to an active exchange of views on renewables in cities and serve as an inspiration for continuous action to accelerate the uptake of renewables now.

Rana Adib
Executive Director, REN21

PURPOSE OF THIS REPORT

City governments around the world are taking action to accelerate the global uptake of renewable energy, both in municipal operations as well as city-wide. Municipalities have installed, purchased and contracted for renewable energy to meet the demand of their own buildings and vehicle fleets; adopted renewable energy targets and policies to incentivise the local generation and use of renewables; and supported urban community energy projects.

Traditionally, national governments have been the main entities tasked with governing the energy supply and driving the transition to renewables. Still today, many city governments continue to perceive the national government as the primary entity responsible for defining and implementing the energy agenda. However, city governments are uniquely positioned to lead locally in the shift from fossil fuel-based systems towards renewables, while curbing energy use and related greenhouse gas emissions. Decarbonising heating, cooling and transport, which together represent more than 80% of final energy demand, requires local solutions. Thus, cities – including their governments, inhabitants, and commercial and industrial actors – are essential to building a renewables-based economy, and their active participation is critical in helping to define and implement the energy agenda at the local, national and global levels.

REN21's *Renewables in Cities Global Status Report* (REC) series provides an overview of the status, trends and developments of renewable energy in cities, using the most up-to-date information and data available. The REC's neutral, fact-based approach documents in detail the annual developments in policies, markets, investments and citizen action, with a particular focus on renewables in public, residential and commercial buildings as well as public and private urban transport. The REC complements REN21's *Renewables Global Status Report*, which covers renewable energy market, industry and policy trends. Jointly, these reports contribute to making renewable energy visible in the global debate, drawing decision makers' attention to renewables and continuously providing better data and tracking to inform energy decisions worldwide.

REC 2021 is the result of a collaborative effort, building on REN21's unique data and reporting culture (→ *see Data Collection and Validation section*), with more than 330 data contributors and peer reviewers and over 30 individual interviews from around the world. The report is endorsed by an Advisory Committee of more than 20 organisations, including major renewable energy players and city networks. In this collaborative process, data are collected on hundreds of cities, ranging from mega-cities to small and medium-sized cities and towns. Collectively, this report aims to inform decision makers and to create an active exchange of views and information around urban renewable energy.

Low-
Emission
Zone

EXECUTIVE
SUMMARY

EXECUTIVE SUMMARY

01 GLOBAL OVERVIEW OF RENEWABLES IN CITIES

Cities around the world are taking action to accelerate the global uptake of renewable energy. City governments increasingly recognise the potential of renewables to help create clean, liveable and equitable cities: overall, more than 1 billion people lived in a city with a renewable energy target and/or policy in 2020.

National governments typically are seen as the main bodies responsible for governing energy supply and infrastructure and for driving the transition to a renewables-based energy system. However, city governments are uniquely positioned to curb energy use and related greenhouse gas emissions while accelerating the uptake of renewable energy.

Cities are home to more than 55% of the world's population and contribute around three-quarters of the carbon dioxide (CO_2) emissions from global final energy use. In recent years, energy demand in cities has increased rapidly due to rising global population growth, urbanisation and urban economic activity. Although the urban electrification rate is high in most of the world, more than 176 million city dwellers continue to lack electricity access. Municipal governments can play a key role in expanding energy access and achieving other Sustainable Development Goals while contributing to the objectives of the Paris climate agreement by increasing the production and consumption of renewable energy.

Most of the energy in cities is consumed directly either for electricity, for heating and cooling buildings and industrial activities, or for transporting people and goods. City governments themselves use only a small portion of this energy for municipal buildings and fleets; the rest is used city-wide for residential and commercial buildings, industrial activities and private transport. Thus, achieving urban renewable energy targets depends not only on political commitment and municipal investment in renewables, but also on governments' ability to mobilise the wider uptake of renewables by other actors, including through comprehensive policies, awareness-raising and stakeholder dialogue.

Renewable energy action in cities often has progressed faster than trends and policy steps at the national level. During 2019 and 2020, municipal governments around the world demonstrated leadership on advancing the energy and climate agendas. Reporting on government operations and city-wide energy and climate targets increased, and several cities raised their ambition by adopting higher targets or setting earlier target years for reaching their goals. Strong sub-national leadership sends a signal to industries and service providers as well as to regional and national governments, and also helps to inform overall procurement processes that require clean services and products.

55% of the world's population lives in cities.

The possibilities and strategies for municipal governments to scale up renewables to achieve their climate and energy targets depend on a variety of factors. One decisive variable in a city's ability to advance the deployment and use of renewable energy is the degree of regulatory and financial power that national governments grant to city governments. Existing regulatory frameworks at the state/provincial, national and regional levels also influence local renewable energy production, target-setting and policy making. In addition, the ability of cities to scale up renewables is greatly affected by market rules, energy regulations and policies set by higher levels of government (including the political dynamics that shape these instruments) and by the degree of economic dependence on fossil fuels.

In 2020, the unfolding of the COVID-19 pandemic and the government-initiated lockdowns to slow the spread of infections had major impacts on both cities and the drivers for renewables. Economic activity fell sharply in the early months of the pandemic, reducing energy demand globally and severely affecting urban energy use, notably in the transport sector. These developments resulted in a shift in government (especially municipal) priorities, as efforts to ensure public health and well-being were pushed up the policy agenda. Images of blue skies and clearer air helped to increase societal pressure towards reduced pollution and a green recovery. Although COVID-19 recovery plans were still being prepared as of early 2021, initial proposals emphasised local economic development and job creation, with some municipal governments announcing green recovery packages – including renewable energy options – in line with similar plans proposed at the national and supra-national levels.

■ 02 URBAN POLICY LANDSCAPE

To achieve their energy and climate targets, municipal governments have procured renewables for their own operations, scaled up renewable energy generation on public buildings and for municipal fleets, and expanded their policy portfolios to encourage the uptake of renewables city-wide.

TARGETS

Globally, at least 834 cities in 72 countries, covering 558 million people, had adopted a renewable energy target in at least one sector by the end of 2020. Altogether, these cities had a combined total of 1,088 targets, including 653 targets for 100% renewable energy use either in municipal operations or city-wide. While municipal renewable energy targets have grown around the world, they are most common in Europe and the United States and remain less widespread in Asia, Latin America and the Caribbean, and Sub-Saharan Africa.

Although renewable energy target-setting has focused heavily on the power sector, targets have grown in the heating and cooling and transport sectors. Several cities have adopted detailed plans to transition to renewables in their heating systems, while the number of cities adopting targets to increase renewables in the transport sector and to expand the use of battery electric or hydrogen vehicles (which can be powered by renewables) has grown. By the end of 2020, at least 67 cities had e-mobility targets, up from 54 in mid-2019, creating opportunities for wider use of renewables in transport.
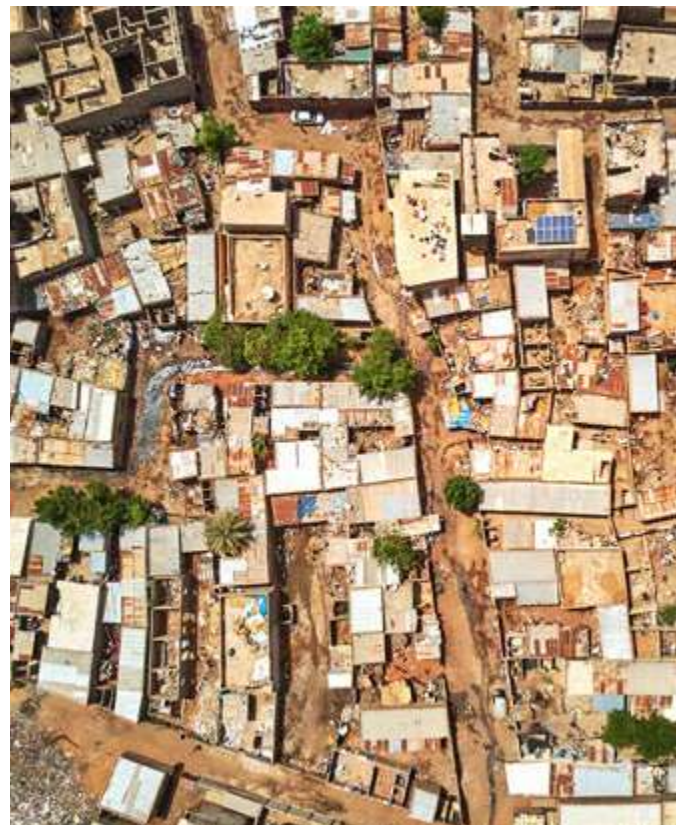
These sector-specific targets are being adopted alongside municipal targets to reduce CO_2 emissions, which, along with energy efficiency measures, enable the uptake of renewables. By the end of 2020, more than 10,500 cities had passed CO_2 emission reduction targets, and around 800 cities had committed to net-zero emissions, with the number of such net-zero targets increasing roughly eight-fold from 2019. Only a small number of cities had action plans or binding legislation to achieve their net-zero targets, and it remains to be seen how municipal governments specify a role for renewables.

POLICIES

For municipal governments that have direct control over city infrastructure, increasing the share of renewables in their own operations, buildings and fleets often has been a first step towards expanding the use of these technologies city-wide. To achieve their energy and climate targets, municipal governments have supported renewable energy progress either by procuring energy from renewable sources for their own operations or by investing in on-site/distributed renewable generation capacity on public buildings (such as schools, hospitals, sport centres and social housing) and for municipal transport fleets.

However, the success of meeting urban renewable energy targets relies not only on political commitment and municipal investments in renewables, but also on the decisions of individual households, communities, businesses and other urban actors. Municipal governments have expanded their policy portfolios to encourage and support the broader uptake of renewables. By the end of 2020, at least 799 municipal governments had in place regulatory policies, fiscal and financial incentives as well as indirect support policies to enable the uptake of renewables in buildings and transport city-wide (for a combined total of 1,107 policies, with some cities having more than one policy). Most of the cities with policies were in the United States and Europe, followed by Asia and Latin America and the Caribbean.

In the **buildings** sector, municipal governments differentiate their policy approaches between new and existing buildings, as well as by building type (residential, commercial, industrial, public). The number of building codes and mandates that include renewable energy for electricity or heating (usually solar photovoltaics (PV) or solar thermal) has grown. These codes typically apply to new buildings; for existing buildings, renewables often are encouraged via financial and fiscal incentives such as grants, rebates and low-interest loans. Compared to the power sector, city-level policies to increase the share of renewables in heating and cooling in buildings have been less widespread, although these sectors have attracted growing attention, notably in the European Union. Several cities also have adopted policies to support both power and heating (typically for solar PV and solar thermal).

At least
1,107 policies
were supporting renewables in cities, mostly concentrated in the United States and Europe.

In the heating sector, municipal governments increasingly use fossil fuel bans and restrictions that enable the deployment of energy efficiency and renewable energy solutions. By the end of 2020, a total of 53 cities spanning 10 countries had either introduced or planned a ban or restriction on the use of natural gas, oil or coal in buildings for space and water heating purposes, up from only a handful of countries in 2015. In addition, municipal governments are facilitating the integration of renewables into their district energy networks, often in co-operation with public or private partners.

Policy efforts to increase the share of renewables in urban **transport** systems have expanded in recent years, and while biofuels – especially locally produced biofuels – still play a role in some cities' transport decarbonisation plans, momentum is shifting rapidly towards electrification. Several cities have adopted mandates for installing electric vehicle (EV) charging infrastructure in new buildings, which provide a critical entry point for higher uptake of renewables in transport, especially if combined with renewable electricity policies.

In addition to public procurement and direct investment by municipal governments, the transition in the transport sector has been driven mainly by subsidies, grants and rebates for battery electric and fuel cell vehicles. The growing numbers of low-emission zones and of bans/restrictions on certain fuels or vehicles – in place in 249 and 14 cities, respectively, as of late 2020 – also have implications for the use of electricity and renewable fuels in urban transport. A few cities have developed local strategies for the production and use of renewable hydrogen in fleets.

Many cities rely on financial incentives and other support policies set by national and/or state governments to complement the limited resources they themselves have to spend on renewable energy programmes. Policy coherence and integration across different levels of government is key to enable a timely and cost-effective transition to a renewables-based energy system.

▪ 03 MARKETS AND INFRASTRUCTURE IN CITIES

Cities are both consumers and producers of energy. Because cities – their governments, inhabitants, and commercial and industrial entities – account for around three-quarters of global final energy use, they have the potential to drive a substantial amount of renewable energy deployment.

No city is an island in the context of energy procurement and use, with each linked in some measure to its surroundings via power grids, fuel pipelines or other regional supply networks. As the renewable component of the regional energy supply rises, generally so does the share of renewables in a city's energy mix. In addition, more and more cities around the world are taking active steps to increase their local use of renewable energy.

City governments tend to focus first on addressing their own municipal energy demand, where they typically can control procurement criteria, and then on enacting policies and programmes that aim to reshape the broader urban supply and demand structure. The private sector (including individuals and businesses) also plays an important role in advancing renewables in urban areas.

BUILDINGS AND INDUSTRY

In cities around the world, municipal governments and other urban actors are producing and procuring renewable electricity to power building systems (including street lighting) and run all forms of commercial and industrial activity. The available options vary according to the local context and can include: installing renewable power generation systems at or near the point of demand (on-site); purchasing renewable electricity through green tariff programmes; and signing power purchase agreements with developers for projects within and outside of urban areas.

Where these options are not available or are insufficient, city governments are pursuing alternative avenues, such as partnering with stakeholders (including utilities and other cities) to engage with national- or state-level legislators and regulators to remove barriers. Many city governments are pursuing community aggregation or the municipalisation of utilities to facilitate direct control of renewable energy supply.

For thermal applications, municipal governments and other city entities are deploying modern renewable energy systems for space and water heating in buildings, and for process heat in industry. Although generally not at the scale of renewable electricity use in cities, a growing amount of direct thermal renewable capacity is being installed for use on-site, in stand-alone applications for individual buildings, and to feed into district energy systems. Direct thermal renewable energy is derived from the combustion of sustainable biofuels as well as from geothermal and solar thermal sources; renewable electricity also is used for thermal applications, powering appliances such as heat pumps.

Kuala Lumpur, Malaysia

TRANSPORT

In many cities, transport consumes more energy than do buildings or industry, and globally urban transport accounts for around 40% of total transport-related CO_2 emissions. The share of renewables in global transport remains low, at 3.7% (the majority provided by biofuels), but many cities are working to increase the penetration of renewable energy in the sector at the local level.

In response to calls for a "green recovery" amid the pandemic, several cities initiated or strengthened efforts in 2020 to ensure that communities have access to safe, reliable, affordable and sustainable transport. Cities continued to lead on vehicle electrification and EV charging infrastructure (facilitating greater penetration of renewables in transport) and were scaling up efforts to increase local production and use of renewable carriers in transport.

Electrification has expanded beyond rail to all modes of urban transport, including buses, cars, vans, two-/three-wheelers as well as some trucks and ferries. In some cases, renewable power capacity is being installed, purchased or contracted to cover the demand of electric vehicles in cities. Biofuel blends and renewable hydrogen are used mostly in heavy-duty transport such as buses and trucks.

The shares of renewables in
transport and buildings
remain low, especially compared to the electricity sector.

DISTRIBUTION INFRASTRUCTURE

Virtually all cities are physically tied to or otherwise reliant on a larger regional and global network of energy systems, infrastructure and supply lines. All cities depend on their surrounding territories not only for the bulk of energy supply, but also to manage and balance the flow of energy with the pulse of activity within the city. The larger the city, the larger must be the consideration for interactions with wider energy systems and infrastructure.

As cities pivot their energy procurement towards renewable sources, originating from both within and outside of city boundaries, their interactions with and requirements from regional energy systems and infrastructure may change, with implications that go well beyond city boundaries. Likewise, external changes in supply and infrastructure affect cities in ways beyond their control.

In 2019 and 2020, cities took steps including: addressing challenges to local and regional electricity distribution infrastructure (for example, by upgrading existing assets or deploying battery storage capacity); expanding existing district heat networks or commissioning new systems that rely (at least in part) on renewable thermal energy or on heat pumps powered by renewable electricity; and installing EV charging stations, including some that deliver 100% renewable electricity.

Moscow, Russian Federation

■ 04 FINANCING AND INVESTMENT IN CITIES

Global investment in renewable energy capacity has trended upward for the last decade, and the COVID-19 pandemic has not hampered this sustained growth.

Global investment in new renewable energy capacity, including power and fuels (but not including hydropower projects larger than 50 megawatts) totalled USD 282.2 billion in 2019, up 1% over 2018. In the first half of 2020, global investment in new renewable energy capacity rose 5% relative to the first half of 2019. Although the exact share of investment in renewable energy projects within urban boundaries is unknown, a combined 171 renewable energy projects were reported in the pipeline in cities worldwide in 2019, with total project costs of USD 31.2 billion.

Each city operates within a distinctive framework that affects the financial power of city governments and, consequently, the amount and type of renewable energy financing and investment available. Variables include the policies and regulations that govern city actions, the nature of relationships with higher levels of government, partnerships with the private sector, and ownership rights of the electric grid, among others. Municipal governments are responsible for only a small share of the total financing that occurs within a city.

Municipal governments and private actors in cities that aim to increase the shares of renewables in the power, heating and cooling, and transport sectors have many options for financing such projects. These options can be grouped into three general categories:

- the actors may have their own capital available for funding renewable energy projects;

- if they do not have their own capital available, they may be able to raise funds through bonds, or make use of funds provided by other levels of government or external actors (such as local or domestic banks and development banks); and

- they may participate in agreements such as public-private partnerships or power purchase agreements to leverage external funds for a given project.

Regardless of their location (in cities or elsewhere), renewable energy projects face inherent financing challenges, including higher upfront technology costs, information gaps and hard lock-ins – all of which raise the investment risks and related financing costs. Municipal governments may face limited budgetary flexibility, multiple competing claims on their resources and soft lock-ins including limits to institutional capacity and institutional inertia. Barriers also can exist in co-funding arrangements with higher levels of government or limits to borrowing power. Cities in developing countries may face additional barriers to investing in renewable energy projects, such as insufficient tax bases or inadequate perceptions of creditworthiness.

■ 05 CITIZEN PARTICIPATION

Citizens have been increasingly active in engaging in the energy transition, as well as in creating markets for renewable energy at the local level. Among other steps, they have strengthened their roles as prosumers, formed urban community energy projects and participated in urban energy and climate planning.

Individual citizens have supported renewables in cities by choosing green tariffs, purchasing energy from green pay-as-you-go schemes and getting energy from peer-to-peer energy systems, which typically are based on renewable energy generation. Deregulation and technological progress have enabled many city dwellers to become "prosumers" (both consumers and producers of energy) by setting up their own renewable energy systems connected to the grid.

Previously mainly a rural phenomenon, community energy projects have gained more footing in cities. In such projects, citizens come together to collectively manage and often own renewable energy installations. Many municipal governments have supported community energy projects, for example by providing roof space on public buildings such as schools or town halls, and some even have become partners in such projects by providing funding and becoming a shareholder. In 2020, Europe remained a hotspot for community energy projects, but many other countries around the world were joining the trend, including the Republic of Korea, South Africa and the United States.

Increasingly, citizens have made their voices heard in urban energy planning and development, often by invitation from city administrations that include local citizens in planning, budgeting and policy development processes. Against the backdrop of rising global climate movements during 2019-20, citizens also have exerted pressure on their city (and national) governments to push for stricter local climate and energy policies. Partly in response to this, by the end of 2020, a record 1,852 municipal governments in 29 countries had issued climate emergencies and 231 municipal governments had submitted a climate action plan alongside their declaration, in some cases using this to outline and financially support renewable energy deployment.

Citizens have put

increasing pressure

on governments to adopt more ambitious climate and energy targets and policies.