

RENEWABLE ENERGY DATA IN PERSPECTIVE



2022

Drawn from the
**RENEWABLES
2022 GLOBAL
STATUS REPORT**

REN21 MEMBERS

INDUSTRY ASSOCIATIONS

Africa Minigrids Developers Association (AMDA)
Alliance for Rural Electrification (ARE)
American Council on Renewable Energy (ACORE)
Associação Lusófona de Energias Renováveis (ALER)
Associação Portuguesa de Energias Renováveis (APREN)
Chinese Renewable Energy Industries Association (CREIA)
Clean Energy Council (CEC)
Euroheat & Power (EHP)
European Heat Pump Association (EHPA)
European Renewable Energies Federation (EREF)
Global Off-Grid Lighting Association (GOGLA)
Global Solar Council (GSC)
Global Wind Energy Council (GWEC)
Indian Renewable Energy Federation (IREF)
International Geothermal Association (IGA)
International Hydropower Association (IHA)
RE100 / Climate Group
RES4Africa Foundation
SolarPower Europe (SPE)
Union International de Transport Publique (UITP)
World Bioenergy Association (WBA)
World Wind Energy Association (WWEA)

SCIENCE AND ACADEMIA

AEE – Institute for Sustainable Technologies (AEE-INTEC)
Council on Energy, Environment and Water (CEEW)
Fundación Bariloche (FB)
International Institute for Applied Systems Analysis (IIASA)
International Solar Energy Society (ISES)
National Renewable Energy Laboratory (NREL)
National Research University Higher School of Economics Russia (HSE)
South African National Energy Development Institute (SANEDI)
The Energy and Resources Institute (TERI)
University of Technology Sydney – Institute for Sustainable Futures (UTS-ISF)
World Resources Institute (WRI)

INTER-GOVERNMENTAL ORGANISATIONS

Asia Pacific Energy Research Center (APEREC)
Asian Development Bank (ADB)
ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE)
Electric Power Council of the Commonwealth of Independent States (EPC)
European Commission (EC)
Global Environment Facility (GEF)
International Energy Agency (IEA)
International Renewable Energy Agency (IRENA)
Islamic Development Bank (IsDB)
Organización Latinoamericana de Energía (OLADE)
Regional Center for Renewable Energy and Energy Efficiency (RCREEE)
United Nations Development Programme (UNDP)
United Nations Environment Programme (UNEP)
United Nations Industrial Development Organization (UNIDO)
World Bank (WB)

GOVERNMENTS

Afghanistan
Austria
Brazil
Denmark
Dominican Republic
Germany
India
Republic of Korea
Mexico
Norway
South Africa
South Australia
Spain
United Arab Emirates
United States of America

NGOS

Association Africaine pour l'Electrification Rurale (Club-ER)
CDP
CLASP
Clean Cooking Alliance (CCA)
Climate Action Network International (CAN-I)
Coalition de Ciudades Capitales de las Americas (CC35)
Energy Cities
Fundación Energías Renovables (FER)
Global 100% Renewable Energy Platform (Global 100%RE)
Global Forum on Sustainable Energy (GFSE)
Global Women's Network for the Energy Transition (GWNET)
Greenpeace International
ICLEI – Local Governments for Sustainability
Institute for Sustainable Energy Policies (ISEP)
International Electrotechnical Commission (IEC)
Jeune Volontaires pour l'Environnement (JVE)
Mali Folkecenter (MFC)
Power for All
Renewable Energy and Energy Efficiency Partnership (REEEP)
Renewable Energy Institute (REI)
Renewables Grid Initiative (RGI)
SLOCAT Partnership on Sustainable, Low Carbon Transport
Solar Cookers International (SCI)
Sustainable Energy for All (SEforALL)
World Council for Renewable Energy (WCRE)
World Future Council (WFC)
World Wide Fund for Nature (WWF)

MEMBERS AT LARGE

Michael Eckhart
David Hales
Kirsty Hamilton
Peter Rae
Arthouros Zervos

PRESIDENT

Arthouros Zervos

EXECUTIVE DIRECTOR

Rana Adib
REN21



REN21
RENEWABLES NOW

RENEWABLE ENERGY POLICY NETWORK FOR THE 21st CENTURY

REN21 is the only global community of actors from science, governments, NGOs and industry working collectively to drive the rapid uptake of renewables – now!



REN21 works to build knowledge, shape dialogue and debate and communicate these results to **inform decision-makers** to strategically drive the deep transformations needed to make renewables the norm. We do this in close cooperation with the community, providing a platform for these stakeholders to engage and collaborate. REN21 also connects with non-energy players to grow the energy discourse, given the economic and social significance of energy.



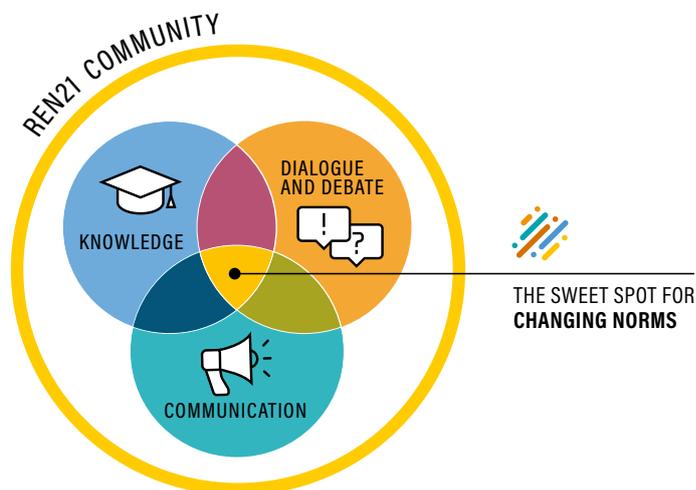
The most successful organisms, such as an octopus, have a **decentralised intelligence** and "sensing" function. This increases responsiveness to a changing environment. REN21 incarnates this approach.



Our more than **3,000 community members** guide our co-operative work. They reflect the vast array of backgrounds and perspectives in society. As REN21's eyes and ears, they collect information, share intelligence and make the renewable voice heard.



REN21 takes all this information to better understand the current thinking around renewables and change norms. **Our publications** are probably the world's most comprehensive crowd-sourced reports on renewables. Each is a truly collaborative process of co-authoring, data collection and peer reviewing.



"Record growth in renewables, but world missed historic chance for a clean energy recovery."

This document presents the overarching renewable energy trends and perspectives from 2021 so that policy makers and other decision makers can more easily understand the significance of the latest developments.

It outlines what is happening to drive the energy transition and details why it is not happening fast enough or as fast as possible. It draws on the meticulously documented data found in **REN21's Renewables 2022 Global Status Report**. See the endnotes and methodological notes in the full report for further details, at www.ren21.net/gsr.



KEY MESSAGES FOR DECISION MAKERS

2021 was
supposed to be
different – a new,
greener beginning

The year offered some bright spots of hope. After two years of the COVID-19 pandemic, the world was hoping for a green recovery to “build back better”. Bright spots in 2021 included: a record increase in global installed renewable power capacity and record investment in renewables; solar and wind power providing more than 10% of the world’s electricity for the first time ever; more than 135 countries having a target for net zero greenhouse gas emissions; and the International Energy Agency publishing its first net zero scenario mentioning the need to end fossil fuels and offering countries a blueprint to follow.



Yet the global energy transition is not happening. Aftershocks from the pandemic and a rise in commodity prices disrupted renewable energy supply chains and delayed projects in 2021. Also, a rebound in economic activity led to a roughly 4% increase in global energy demand, much of which was met by fossil fuels, resulting in record carbon dioxide (CO₂) emissions. The spike in energy prices in the second half of the year, followed by the Russian Federation’s invasion of Ukraine in early 2022, contributed to an unprecedented global energy crisis and commodity shock. In response, governments have implemented short-term measures to alleviate price spikes. This situation has exposed the world to ever more pressing climate disasters as well as to geopolitical and economic threats.

Rising energy
consumption

and a hike in fossil fuel
use outpaced growth
in renewables in 2021.

The year must serve as a turning point for the energy transition. The crisis facing our current fossil fuel-based energy system is alarming, and we urgently need to transition to renewables in all economic and societal activities. Renewable energy needs to be at the heart of the political response to the energy crisis. Only an energy-efficient and renewable-based economy can be a game changer for a more secure, resilient, low-cost – and sustainable – energy system.



We are facing the biggest global energy crisis in history

The year 2021 marked the end of cheap fossil fuels as we knew them.

Starting in September, prices of coal, oil and natural gas soared to their highest recorded levels, even surpassing those of the 1973 oil crisis. This was caused by resurgence of energy demand after COVID-19 lockdowns and supply crunch. By the end of the year, gas prices reached around ten times the 2020 levels in Europe and Asia and tripled in the US, leading to a spike in wholesale electricity prices in major markets by the end of 2021. Meanwhile, supply chain disruptions related to the impacts of COVID-19 continued, slowing the development of many renewable energy projects worldwide.

The biggest energy crisis in modern history began in the second half of 2021

and was exacerbated by the Russian Federation invasion of Ukraine, contributing to an unprecedented worldwide commodity shock. With national budgets already depleted by the pandemic, the energy crisis has caused severe economic damage and weighed heavily on growth globally, rattling more than 136 countries that rely on fossil fuel imports – with the poorest nations hit particularly hard.

In response to high energy prices, many countries responded with short-term strategies

to diversify fossil fuel imports, ramp up production and subsidise energy use to shield consumers. China announced plans to increase coal production by 300 million tonnes (equivalent to 7% of current levels), the United States witnessed a boom in new fracking and drilling projects, and the European Union (EU) initiated a series of short-term measures. Most of these have benefited the fossil fuel industry, leading to rapidly rising profits and dangerously locking the world into a path of even faster global warming. This counters the dire calls by climate scientists to not only shelve new fossil fuel projects but also close existing extraction sites as part of the push to keep global temperature rise below 1.5 degrees Celsius.

Invasion of Ukraine exacerbated a **global energy crisis**, creating windfall profits for fossil fuel companies.



RENEWABLE ENERGY GLOBAL OVERVIEW

Global CO₂

Energy-related emissions account for three-quarters of global CO₂ emissions

Modern renewables account for **12.6%** of total final energy consumption (2020)

135 countries have some form of net zero target, covering **88%** of global emissions

A rebound in economic activity led to a **6% increase** in CO₂ emissions in 2021

Total final energy demand grew **19%** between 2009 and 2019

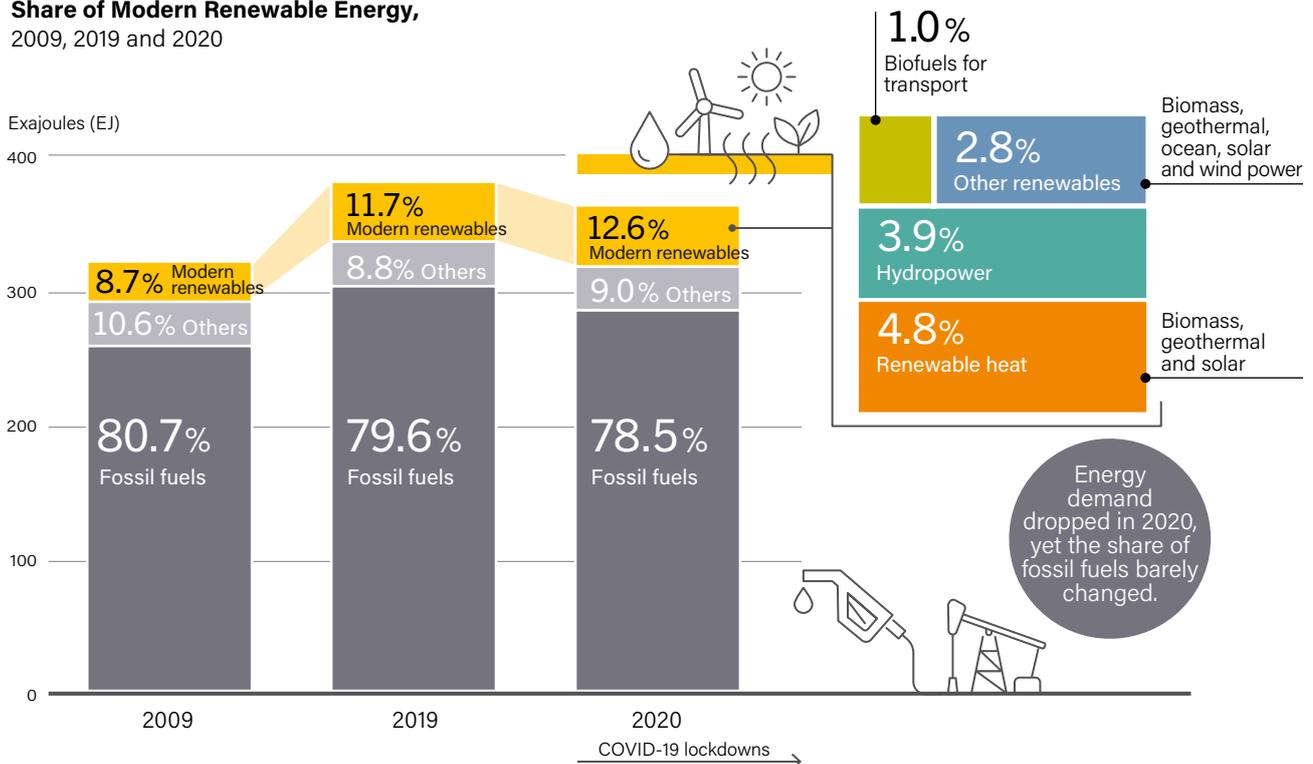
USD 366 billion was invested in renewables in 2021

Fossil fuel subsidies reached **USD 5.9 trillion** in 2020

equivalent to **USD 11 million per minute**

At the 2021 UN climate summit, countries agreed to a **phase-down** of unabated coal power

Share of Modern Renewable Energy, 2009, 2019 and 2020



Source: Based on IEA data.

Despite increased ambition, the energy transition is at a standstill

In the wake of COVID-19 and in light of rising evidence of climate-related disasters, 2021 was a year of increased ambition. Governments, corporations, cities and others gave stronger recognition to the role of renewables to address climate change, air pollution and development goals. In May, the International Energy Agency published its Net Zero by 2050 scenario, which supports growing momentum for energy efficiency and accelerated uptake of renewables and underscores the urgency of ending fossil fuel use.

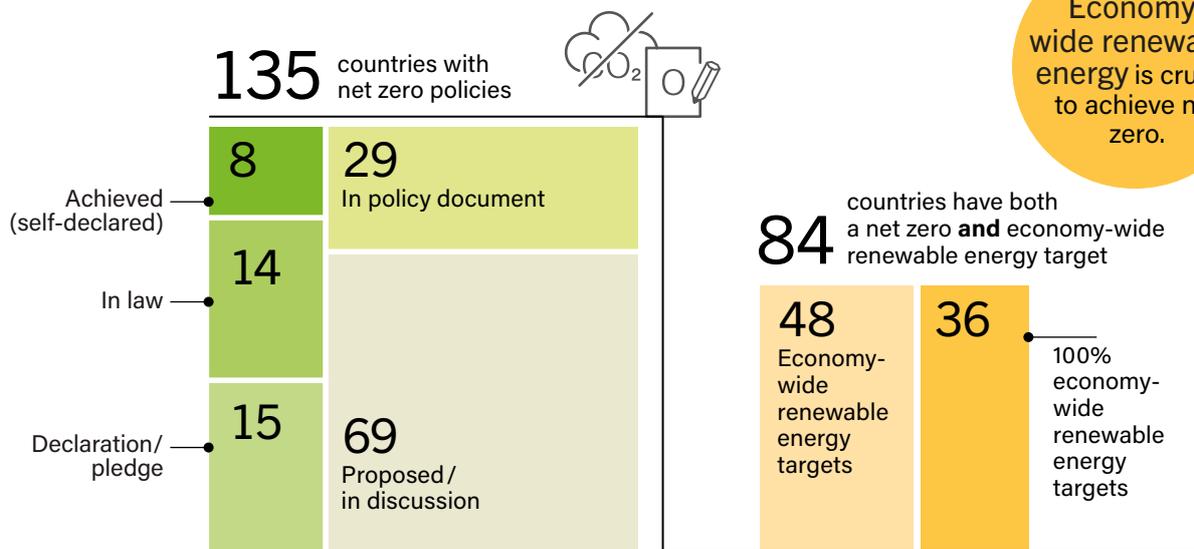
In the lead-up to the United Nations (UN) Climate Conference (COP26) in November, 151 countries submitted new and updated Nationally Determined Contributions towards reducing greenhouse gas emissions under the Paris Agreement. For the first time ever, the resulting climate pact made explicit mention of the need to reduce coal use. In addition, a record 135 countries pledged to achieve net zero emissions, typically by 2050 at the latest. However, the degree of implementation varies, as many net zero targets are not backed by specific legislation. Of the 135 countries with net zero commitments, only 84 had economy-wide renewable energy targets, of which only 36 countries had targets for 100% renewables.

Over the past few decades, the climate crisis and the UN Sustainable Development Goals have been prominent drivers of the shift to renewables. With the dramatic decline in renewable energy costs, and volatile fossil fuel prices, economics have become an additional driver. The costs of newly commissioned utility-scale solar photovoltaic (PV) projects fell 89% between 2010 and 2021, from USD 0.40 per kilowatt-hour (kWh) to USD 0.046 per kWh. The Russian Federation invasion of Ukraine also has shined a spotlight on the issue of energy security and energy independence, motivating the deployment of renewables. These realities should leave no further ground for the development of fossil fuels.

Yet the rebound in energy demand has been met mostly by fossil fuels. Following the pandemic-related decline in energy demand in 2020, worldwide economic activity rebounded in 2021, resulting in a 4% increase in global energy demand as well as in record CO₂ emissions. In China alone, final energy consumption rose 36% between 2009 and 2019. Most of the increase in global energy demand in 2021 was met with fossil fuels, contributing to the largest increase in global CO₂ emissions in history (up 6% after falling 5% in 2020 – an increase of more than 2 billion tonnes).

Political momentum
has not translated into action.

National Net Zero Policies and Status of Implementation and Renewable Energy Targets, 2021



Economy-wide renewable energy is crucial to achieve net zero.

Note: Numbers exclude sub-national targets.
Source: Climate Watch and REN21 Policy Database.

The rise in global energy demand has offset the growth in renewable energy deployment.

As a result, the share of fossil fuels in total final energy consumption (TFEC) has remained almost the same since 2009. Renewables met just over 12.6% of global final energy demand in 2020, up only slightly from 8.7% in 2009. Even the share of renewables in final electricity demand stagnated in 2020, compared to 2019. Despite record additions to renewable power capacity in 2021, the surge in global electricity demand was met mostly with fossil fuels. For electricity generation, coal use grew 9%, compared with a 5% increase in generation from renewables. Also, progress has been uneven across regions. As of 2019, only 3 countries out of 80 – Iceland, Norway and Sweden – had renewable shares

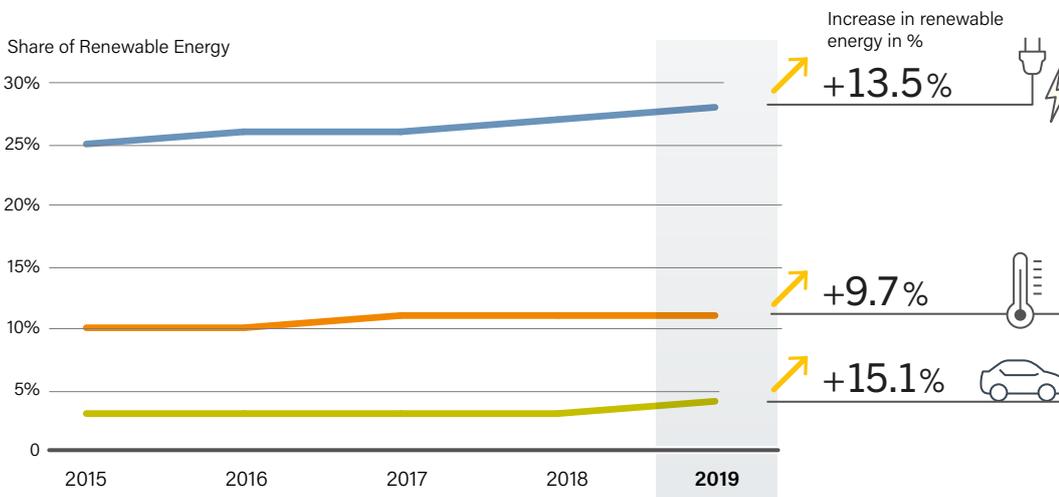
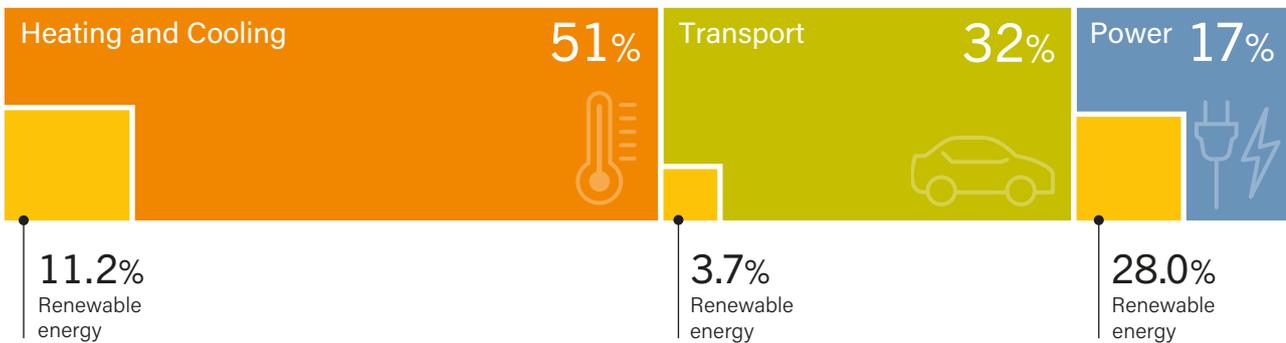
in TFEC above 50%, and 20 countries, mostly in Europe and Latin America, met at least a quarter of their total final energy consumption with renewables.

Progress has been uneven across sectors. Progress in renewable energy deployment occurred mainly in the power sector, where the share of renewables is the highest, at 28% (although stagnating). (→ See Figure below.) The growth in renewable power capacity hit an all-time record – up 11% from 2020 – and generation rose 6%. However, the power sector represents only 17% of the world’s final energy consumption, well below other sectors. Heating, cooling and transport together account for more than 80% of final energy demand, yet their shares of renewables are much smaller, at 11.2% for heating and cooling

(used mainly in buildings and industry) and only 3.7% in transport.



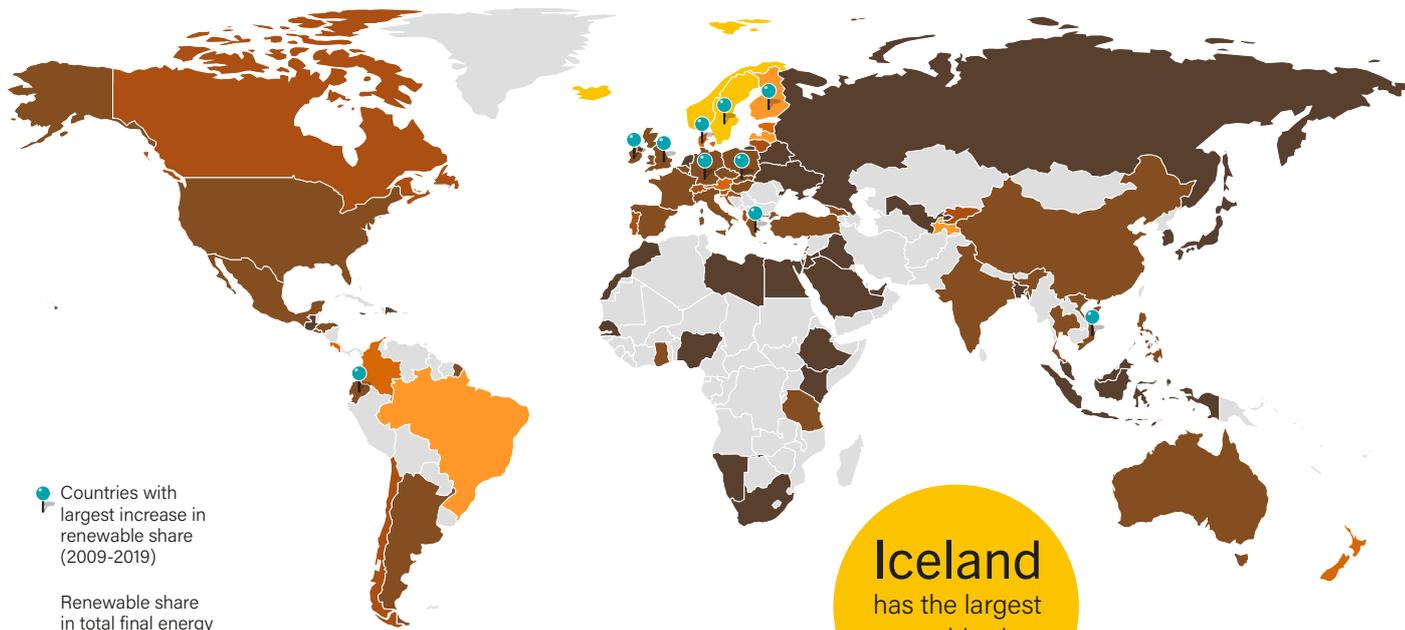
Renewable Energy in Total Final Energy Consumption, by Final Energy Use, 2019



Note: Data should not be compared with previous years because of revisions due to improved or adjusted methodology. Source: Based on IEA data.

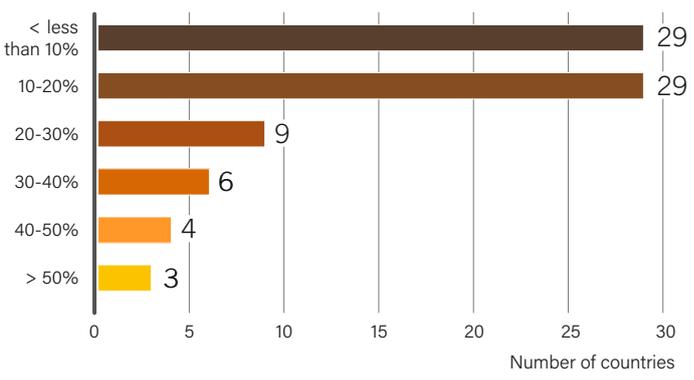


Renewable Energy Shares in Total Final Energy Consumption for Selected Countries, 2019

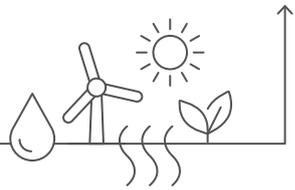


Countries with largest increase in renewable share (2009-2019)

Renewable share in total final energy consumption (TFEC)



Iceland has the largest renewable share in TFEC



Note: Selected countries are among the largest energy-consuming countries in the world.
Source: Based on IEA data.

Despite strengthened commitments to climate change and net zero, fossil fuel subsidies continue.

Progress is hampered by continued fossil fuel subsidies. Numerous factors have constrained the uptake of renewables in heating and transport, including: high sectoral dependence on fossil fuels, insufficient renewable energy policy support and enforcement, and slow developments in new technologies (such as advanced biofuels). Crucially, despite renewed climate commitments, governments have continued to heavily subsidise the production and consumption of fossil fuels. In 2020, they spent a whopping USD 5.9 trillion – 7% of global gross domestic product

(GDP) – on direct and indirect fossil fuel subsidies, sometimes in parallel with reductions in support for renewables (as in India). More recently, fossil fuel subsidies have been the go-to choice to mitigate the effects of rising energy prices – highlighting a worrying gap between renewable energy ambition and action.



Policy support for renewables is not strong enough

Policy support for renewables remained strong in 2021 but was directed mainly to the power sector.

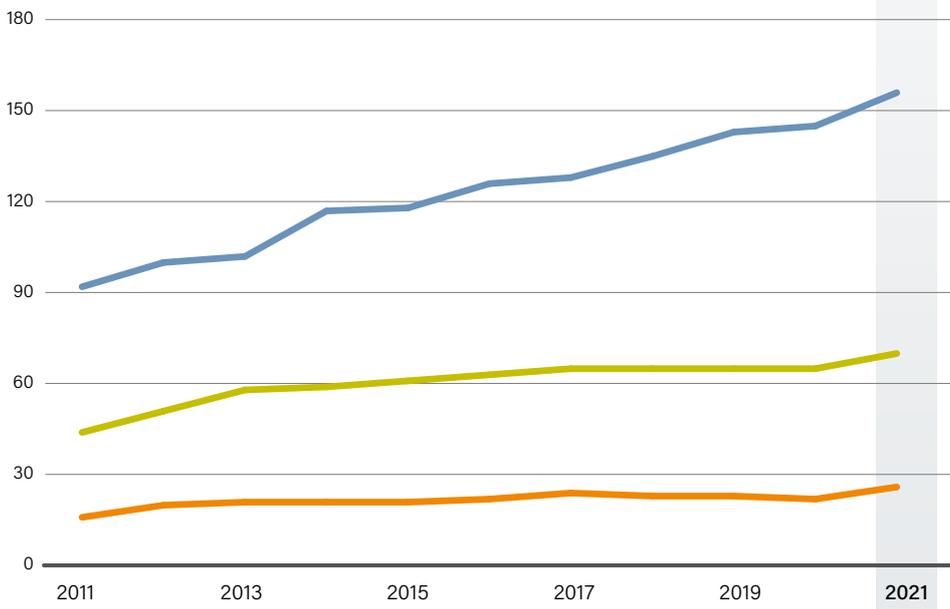
Although nearly all countries worldwide had a renewable energy support policy in place by year's end, most of these policies continued to focus on the power sector. Fewer efforts were made to accelerate renewables in buildings,

industry and transport, even though these sectors are responsible for the largest share of final energy demand and growth, as well as CO₂ emissions. It is worrying to see that many renewable energy targets in the transport, heating and cooling sectors expired in 2020, yet only a few countries have passed new targets since then to replace them.



Number of Countries with Renewable Energy Regulatory Policies, 2011-2021

Number of Countries



- 156 countries**
Power regulatory incentives/mandates
- 70 countries**
Transport regulatory incentives/mandates
- 26 countries**
Heating and cooling regulatory incentives/mandates

Note: The figure does not show all policy types in use. In many cases countries have enacted additional fiscal incentives or public finance mechanisms to support renewable energy. A country is considered to have a policy (and is counted a single time) when it has at least one national or state/provincial-level policy in place. Power policies include feed-in tariffs (FITs)/feed-in premiums, tendering, net metering and renewable portfolio standards. Heating and cooling policies include solar heat obligations, technology-neutral renewable heat obligations and renewable heat FITs. Transport policies include biodiesel obligations/mandates, ethanol obligations/mandates and non-blend mandates.



Fossil fuel bans are driving renewable energy deployment.

Limiting the use of fossil fuels is a way to drive the structural shift towards a more efficient and renewable-based energy system, especially for sectors or regions that rely heavily on fossil fuels. In 2021, the number of proposed and passed bans on fossil fuels surged, particularly bans on coal-fired power generation. In addition, several national and sub-national jurisdictions announced bans on the use of fuel oil and natural gas in buildings, and on internal combustion engine vehicles in the transport sector. Coupled with this, the electrification of end-uses such as heating and road transport emerged as a focus for decision makers.

Climate change policy commitments accelerated in 2021.

As countries announced pledges and targets for net zero emissions in the lead-up to COP26, the growing attention to decarbonisation became an increasingly important driver of renewable energy support policies. By the end of 2021, at least 135 countries and the EU had some form of net zero target in place, covering nearly 85% of the world's population; however, not all of these jurisdictions have economy-wide renewable energy targets.

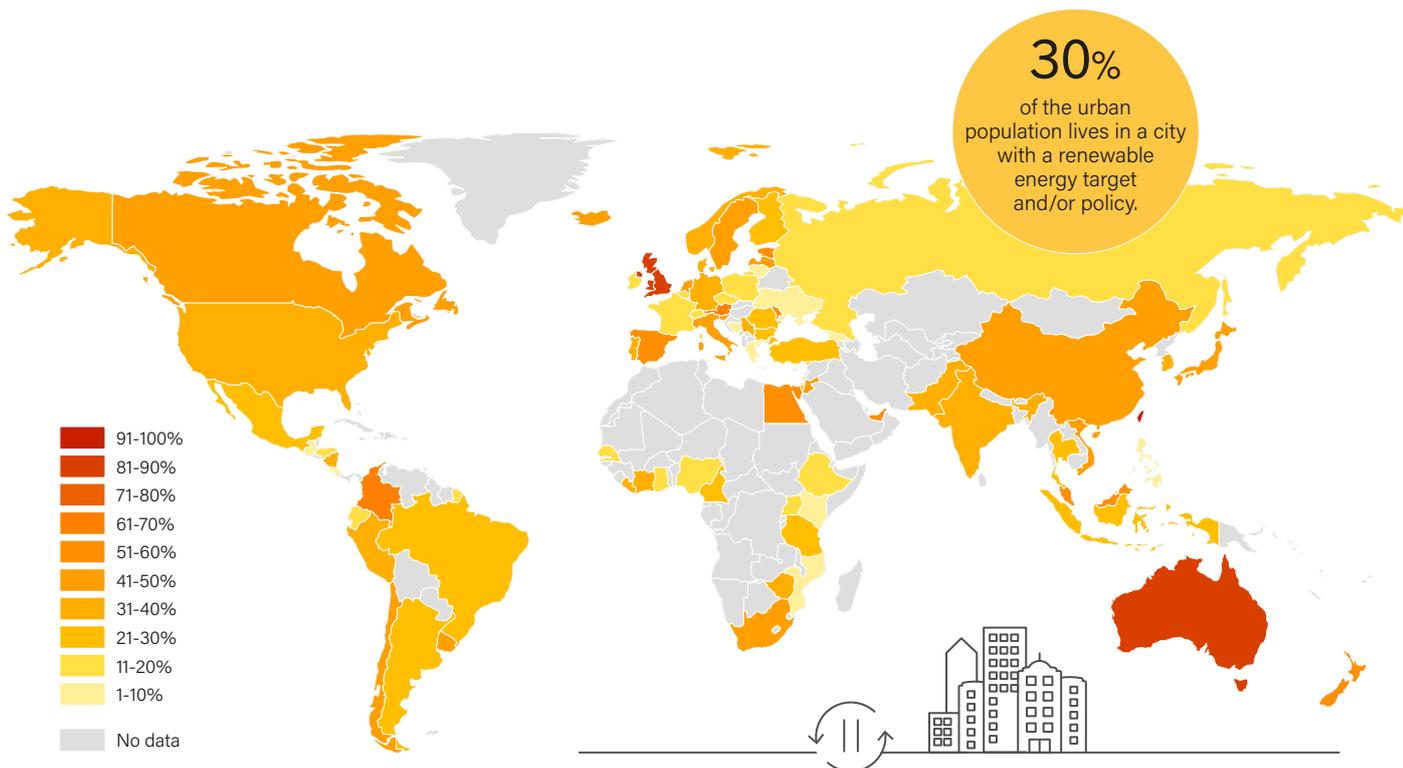
Policy action on energy and climate increased at the city level.

By the end of 2021, around 1,500 cities had renewable energy targets and/or policies, collectively covering more than 1.3 billion people, or 30% of the global urban population. In line with global trends, net zero announcements skyrocketed, with targets present in more than 1,100 cities by year's end. However, implementation has lagged, as many measures either are still under discussion or have no status update available, highlighting the critical need for master plans and the deployment of renewables.

Bold policy making is needed to drive structural changes.

Supportive policy frameworks are critical to build efficient, renewable-based energy systems. Barriers to the expansion of low-cost renewable energy production have included a lack of regulatory policies for renewables, inconsistent policies and lengthy permitting processes. To accelerate the shift to renewables, short- and long-term targets, supportive policies and plans are needed, coupled with clear end dates for fossil fuels. Given energy's strategic role in the economy and society, ambitious policies and programmes are needed at all levels of government, in all sectors, and at the heart of economic and industrial policies. A successful transition also requires (re)skilling engineers, installers and workers for new technologies and uses.

Share of Urban Population with a Renewable Energy Target and/or Policy, 2021



Note: Calculations based on population in cities with renewable energy targets and/or policies and their share of the national population. Excludes cities with energy efficiency, electric vehicle and/or net zero targets. Data not available for some countries.



Towards a new energy order

As the old energy order collapses, we must work towards a more sustainable, secure and just energy system. The findings of the *Renewables 2022 Global Status Report* showcase the existing challenges but also highlight the opportunities. The current energy crisis must be a wake-up call to replace fossil fuels with renewables. We must seize this historic moment to usher in a systemic transformation of the global economy and society as we know it. In doing so, we can address the climate challenge while building a resilient, secure renewable-based energy system with reliable and affordable energy.

Decentralisation is key for a resilient and secure energy system. Contrary to centralised and capital-intensive fossil energy production, renewable energy systems build on local renewable resources – wind, solar, water/hydro, biomass, geothermal – and allow for decentralised generation (assuming access to renewable energy technologies). It is thus possible to build a local and decentralised, but interconnected and more resilient, energy system.

A shift towards diversified energy governance is happening. With the right regulatory framework, the decentralised nature of renewable energy enables a diversity of players – including city governments, companies and citizens – to become energy producers. In 2021, corporate power purchase agreements increased 24% to more than 31 GW (compared to an 18% increase to 24.7 gigawatt (GW) in 2020). Community energy projects also have emerged across the globe – from Japan and Germany to Nigeria and the United States – and more than 1,500 cities had renewable energy targets and/or policies in 2021, up from 1,300 in 2020.

Reducing import dependence and strengthening energy security and sovereignty are key. Some countries rely heavily on energy imports to cover demand: for example, India imports 90% of its crude oil requirements, and the EU imports 97% of its oil and petroleum needs and 84% of its natural gas needs. Developing renewable generation makes it possible to reduce or even replace fossil fuel imports and to limit the vulnerability to fluctuating and rising fossil fuel prices. Strong industrial and economic development policies that focus on renewables are required to develop local economic value chains.

The potential to transforming value chains and stimulate local economic development is vast. Renewables create jobs throughout the energy value chain, from manufacturing to installation to maintenance. More than 12 million people work in renewable energy jobs, and (re)skilling engineers, installers and workers as drivers of the energy transition offers massive economic and human development opportunity.

Renewables can jointly tackle the air pollution and climate crises. In addition to slowing climate change, the transition from fossil fuels to a renewable-based energy system can improve air quality and human health. Each year, more than 8.7 million people die due to outdoor air pollution, and 3.8 million die from indoor (household) air pollution. In 2021, the World Health Organization updated its Air Quality Guidelines, slashing the limit for the most damaging air pollution by half and highlighting the urgent need to improve public health and well-being.

We need to support a more just and inclusive energy system. Low-income countries and communities can benefit massively from renewable energy technologies. Renewables provide access to affordable, reliable and modern energy services; safeguard communities against the impacts of climate change; and contribute to improved health and well-being. This can result in reduced energy vulnerability and help to drive global and local socio-economic development that is inclusive, fair and equitable.

RENEWABLE ENERGY IN POWER

Renewables are strongest in the power sector – but not strong enough



Energy demand for power accounts for less than a fifth of total final energy consumption

The greatest success for renewables in 2021 was in the power sector. During a year of tentative economic recovery, a record 314.5 GW of new renewable power capacity was added – enough to power every household in Brazil. The global installed renewable power capacity reached 3,146 GW, a record high.

The biggest success stories are solar PV and wind. Together, these two sources accounted for nearly 90% of all new renewable power additions. Solar PV represented more than half of additions (around 175 GW) and wind power another 102 GW. Alongside supportive regulatory and policy frameworks, rapid cost declines played a key role in the surge in installations. In comparison, only 26 GW of hydropower capacity was brought online in 2021, and for the first time concentrating solar thermal power (CSP) experienced a decrease in installed capacity.

A system is more than ‘just’ renewable power generation. Regional and sectoral integration is key to build a renewable power system, that is a pillar of a renewables-based energy systems. Energy system integration requires expansion of infrastructure, like storage, transmission grids, district energy networks, charging infrastructure and pipelines to facilitate the distribution of

green gases. It also means adapting the operations with building greater demand-side flexibility. Integrated infrastructure planning, investment in infrastructure as well as policies and regulatory frameworks adapted to high shares of renewables need to happen more. Many countries, spanning from Denmark to Uruguay, Ireland, Australia and Chile show that the grid can manage high shares of up to 60% of variable renewable electricity.

More countries are becoming renewable power players. The market diversified globally in 2021, and at least 40 countries had more than 10 GW of renewable power capacity in operation by year’s end. China became the first country ever to exceed 1 terawatt of installed renewable energy capacity.

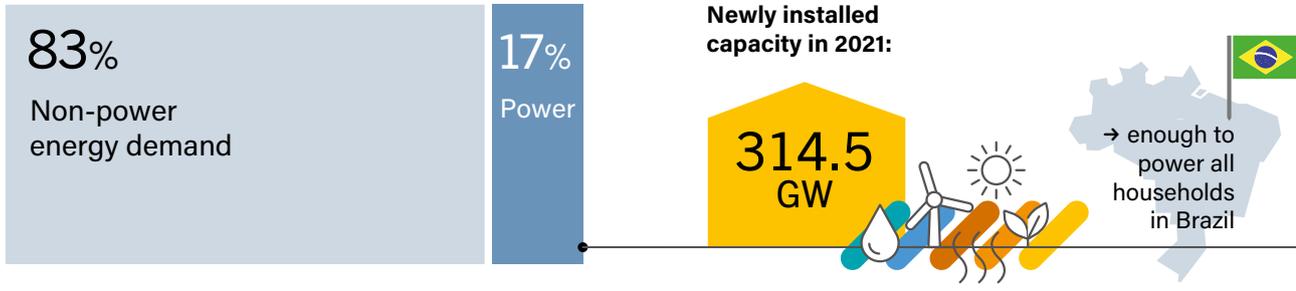
Renewable power success has been supported by strong regulatory frameworks. The number of countries with renewable power policies increased in 2021, continuing a multi-year trend. As in prior years, auctions, tenders and other competitive pricing strategies continued to overtake administratively set pricing policies, such as feed-in tariffs.

Yet significant challenges remain to achieving net zero. Current deployment of renewable power is still far from what is needed to keep the world on track to reach net zero emissions by 2050. With the growing focus on electrifying heating and transport, global electricity demand is set to triple by 2050. To reach the average milestones set by major net zero scenarios, annual renewable power additions must triple (adding around 825 GW each year until 2050). Transmission bottlenecks remain, and in some countries stalled network expansion has held back the accelerated deployment of renewables. Projects also have been disrupted by supply chain issues and shipping delays in the aftermath of COVID-19, and prices for key renewable technologies have increased due to rising commodity prices, putting pressure on the sector and companies.



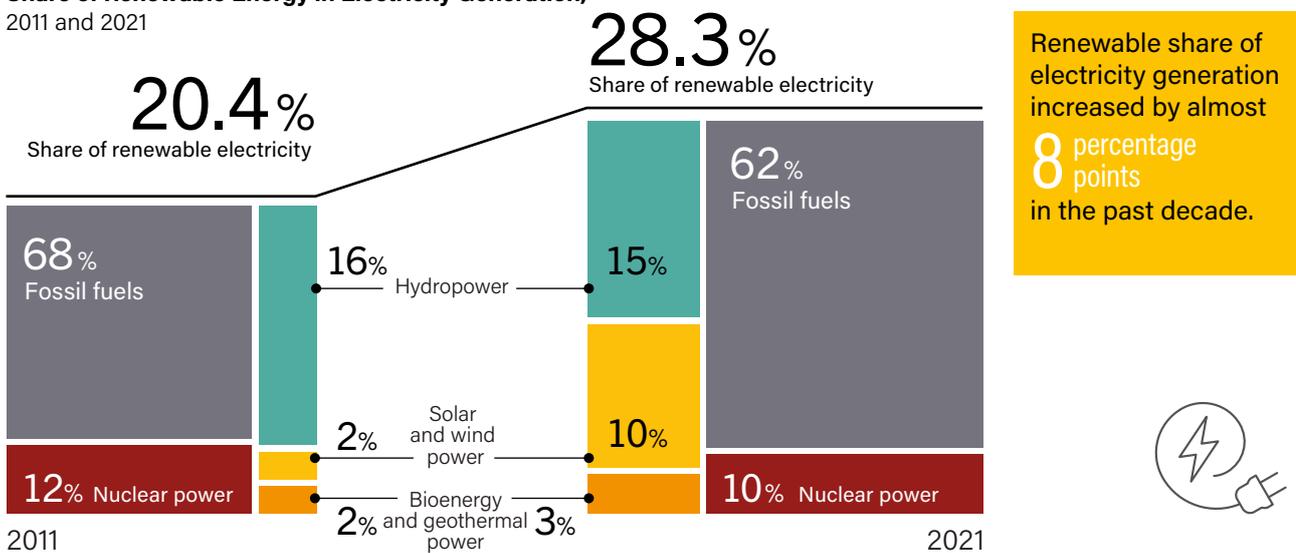
RENEWABLES IN POWER

Energy demand for power accounts for less than one-fifth of total final energy consumption



- 135** countries have renewable power targets
- 156** countries have renewable power regulatory policies
- 3,146 GW** of global installed renewable power capacity
- Levelised costs of onshore wind power and solar PV **are now cheaper** than fossil fuels on average
- More than **50%** of climate mitigation finance is allocated to hydropower, solar PV and wind power

Share of Renewable Energy in Electricity Generation, 2011 and 2021



Source: Based on IEA data.

RENEWABLE ENERGY IN BUILDINGS

Heating and cooling in buildings is the overlooked giant in the energy transition



Energy use in buildings accounts for around **one-third of global final energy demand.**

Using renewables to heat and cool our homes remains vastly underprioritised. Energy use in buildings accounts for around one-third of global final energy demand, yet renewables are progressing only slowly in the sector. In 2019, renewables accounted for 14.7% of energy use in buildings, representing only a 4 percentage-point increase from a decade before.

Demand for cooling is increasing as the climate warms. With temperatures hitting new highs in many regions, for example a record-breaking 49.6°C in Lytton, British Columbia (Canada) and more than 60°C in India, cooling demand is the fastest growing energy end-use in buildings (up 4% per year) and a significant driver of rising electricity demand. Countries' capacities to respond vary widely, with an estimated 1.1 billion people lacking access to cooling, especially in Bangladesh, India and Nigeria. To assess the risk and the demand, 6 governments have developed national action plans for cooling, and 26 governments are developing them.

Policy developments to support renewable heating and cooling remain scarce. The slow growth in renewable energy use in buildings and the large share of emissions in the buildings sector has attracted government attention to renewable heating and cooling. Yet despite the enormous opportunity for renewables, supportive government policies often exist alongside incentives for fossil fuel appliances, potentially undermining the

effectiveness of renewable energy policy. Bans on fossil-based heating in some countries have triggered interest in the electrification of heating, with several countries setting targets and offering support for heat pump installations.

Markets for renewable heating and cooling technologies are growing. While most of the demand for renewables in buildings is met by modern bioenergy, rising electrification has boosted markets for renewable heat technologies, especially electric heat pumps. In 2020, for the first time, fossil fuel appliances (e.g., boilers) comprised less than 50% of global sales, whereas sales of renewable heating systems (including electric heat pumps) reached 25%.

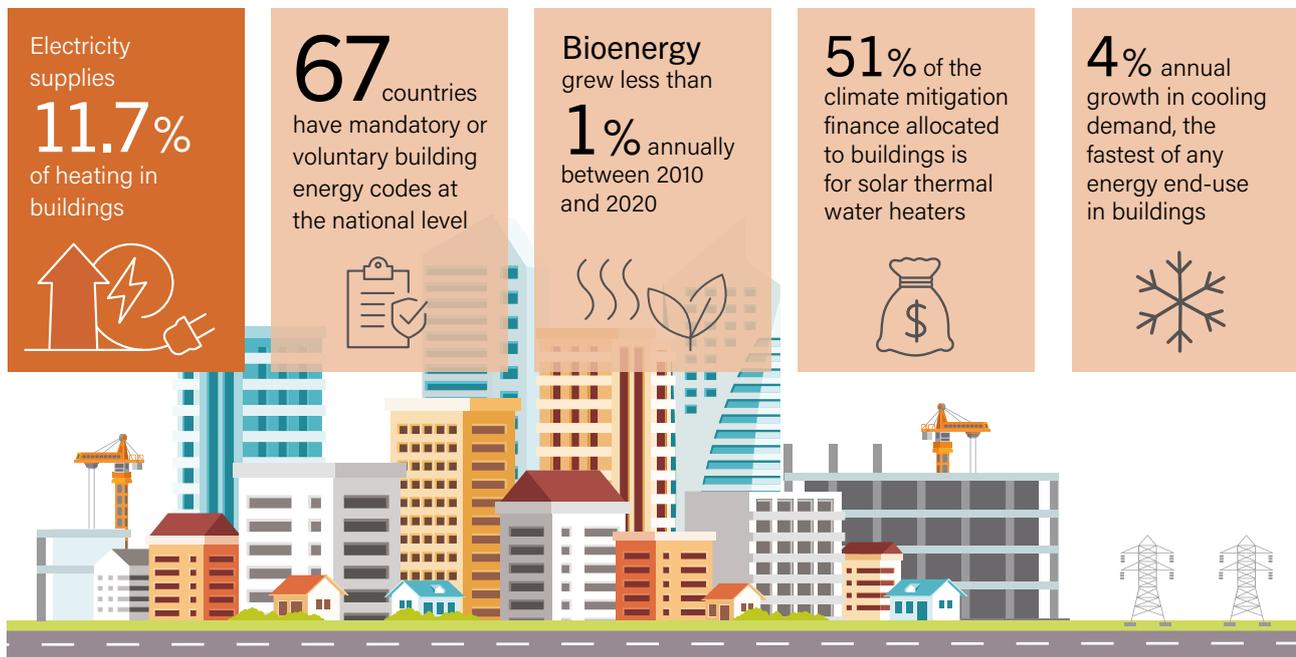
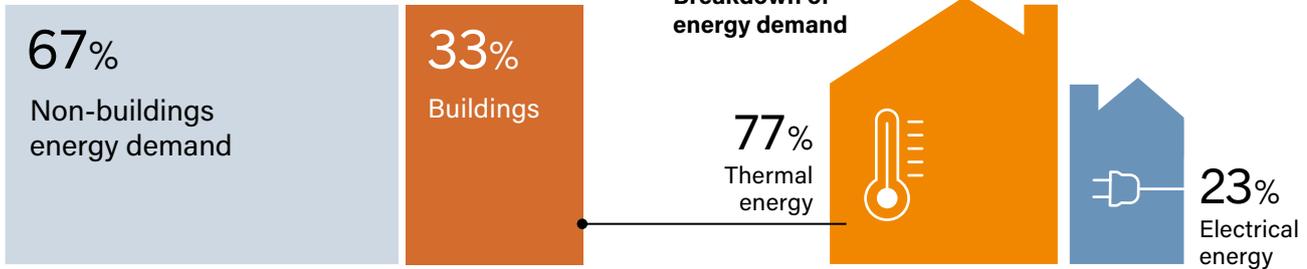
Global policy efforts have contributed to a slight decline in the energy intensity of buildings. Yet this progress is pulverised by the overall rise in energy use in buildings (1% per year), attributed to a growing building stock (driven by growing wealth and economic opportunities in developing and emerging economies) and to increasing floor area use per person, especially in industrialised countries.

Several challenges impede faster uptake of renewables in buildings. Barriers include the higher upfront costs of renewable heating and cooling technologies (particularly where fossil gas boilers are more affordable), surcharges and taxes that make operating renewable heat systems more expensive, persisting subsidies for fossil fuels, low renovation and heating system replacement, and the lack of a skilled workforce in renewable heat and energy efficiency installations, despite large job potential.

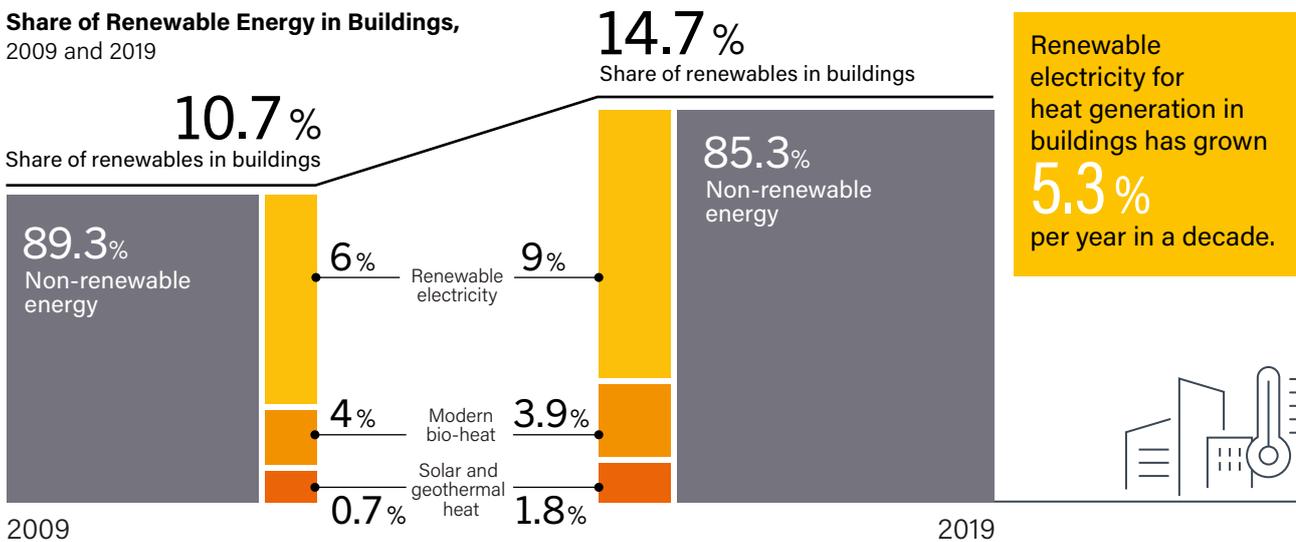


RENEWABLES IN BUILDINGS

Energy demand for buildings accounts for one-third of total final energy consumption



Share of Renewable Energy in Buildings, 2009 and 2019



Source: Based on IEA data.



RENEWABLE ENERGY IN INDUSTRY AND AGRICULTURE

Structural dependence on fossil fuel limits the shift to renewables in industry

Despite large potential, little progress has been made on renewables. The industry sector is the largest energy user, accounting for more than a third of global final energy demand. Yet despite large potential to meet industrial energy demand with renewables (especially for low-temperature process heat), little progress has been made on shifting the sector to renewables. The share of renewable energy in industry increased only 3.6 percentage points between 2011 and 2019, to reach 16.1%. Meanwhile, energy use in the sector grew 1% annually on average during 2010-2019.

The industry sector remains structurally dependent on fossil fuels. Industries depend on fossil fuels for use as raw materials and to produce energy, as well as to heat and power industrial processes and infrastructure. Weak regulatory frameworks, fossil fuel subsidies, and the risk of stranded assets across the sector limit the development of renewables. In the steel sector alone, replacing coal-fired blast furnaces with electric arc furnaces represents an estimated USD 70 billion in stranded assets. High costs for high-temperature process heat present a challenge to decarbonising some hard-to-abate sectors.

Sectoral roadmaps and policies are essential but remain limited. Decarbonisation has spurred governments' interest in renewable energy in the industry sector. Roadmaps and policies are essential to drive emission reductions via carbon pricing, energy efficiency and renewable energy policies. Direct renewable energy policies in industry were limited in 2021 and focused mainly on renewable heat

applications. However, economy-wide carbon reduction policies also impact the industrial sector. For example, the EU's proposed carbon border adjustment mechanism will apply a carbon price to specified goods imported into the region, including cement, iron and steel, aluminium and fertilisers.

Industrial clusters based on efficiency and renewables can reduce emissions and energy costs. Several countries and city governments have developed industrial clusters to decarbonise the sector. China has created 52 low-carbon industrial clusters since 2013, and in early 2022 four cluster sites in Australia, Spain and the United Kingdom joined the initiative Transitioning Industrial Clusters towards Net Zero.

Interest in renewables is picking up in agriculture. The installed global capacity of agri-voltaics – the shared use of agricultural land and solar PV – reached more than 14 GW as of mid-2022. Several countries have passed policies aimed specifically at increasing the share of renewables in the sector.

Hydrogen: Hope or Hype?

Numerous hydrogen projects and roadmaps were announced in 2021. In many sectors that cannot be electrified directly and are "hard-to-decarbonise", hydrogen is considered the best alternative to fossil fuels. Developing renewable-based hydrogen also allows replacing fossil fuelled hydrogen in production processes, for example as feedstock in fertiliser production or as a reducing agent in iron making.

Hydrogen can be used for both industry and transport. Hydrogen is seen as a solution to decarbonise heavy industries such as steel and cement, as well as long-distance trucking and trains. Renewable hydrogen also can play a key role in the overall energy system, as it complements variable renewable electricity from wind and solar, providing storage and dispatchable electricity as well as possibly transport energy. Even power plant operators are eyeing hydrogen, with a first plant in the Netherlands slated for connection in 2025. The Republic of Korea is vying to become the first hydrogen society, with plans to convert three cities entirely to hydrogen for use in cooling, heating, electricity and transport.

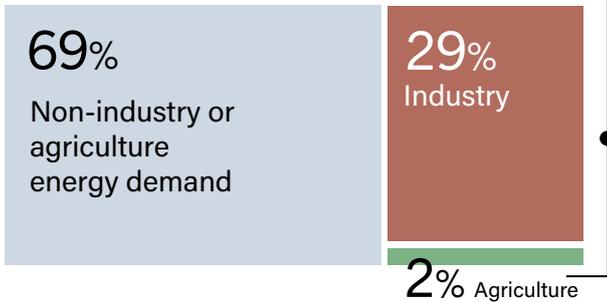
Despite the race to develop hydrogen strategies, hydrogen production

remains fossil-based. Hydrogen strategies are in place in at least 38 countries and the EU. Australia, Chile, Denmark, Namibia and South Africa are among the countries launching renewable hydrogen strategies with the ambition to boost their economies by becoming major energy exporters. As of 2020, however, 95% of the world's hydrogen was still produced from fossil fuels, and many hydrogen projects are not yet cost competitive.

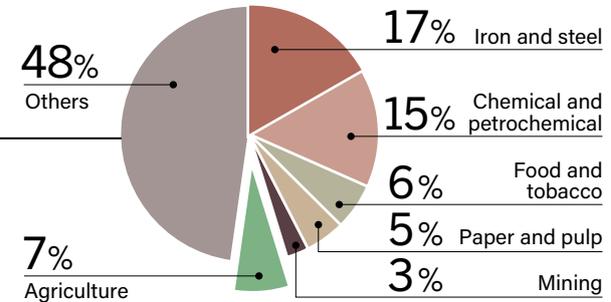
Renewable electricity for hydrogen needs to grow massively. Due to the energy-intensive production process, producing large quantities of hydrogen would likely eat up significant shares of renewable electricity generation, which then would not be available to other sectors. Thus, renewable power capacities need to multiply accordingly.

RENEWABLES IN INDUSTRY AND AGRICULTURE

Energy demand for industry and agriculture accounts for 31% of total final energy consumption



Breakdown of energy demand



95% of hydrogen is currently produced by fossil fuels

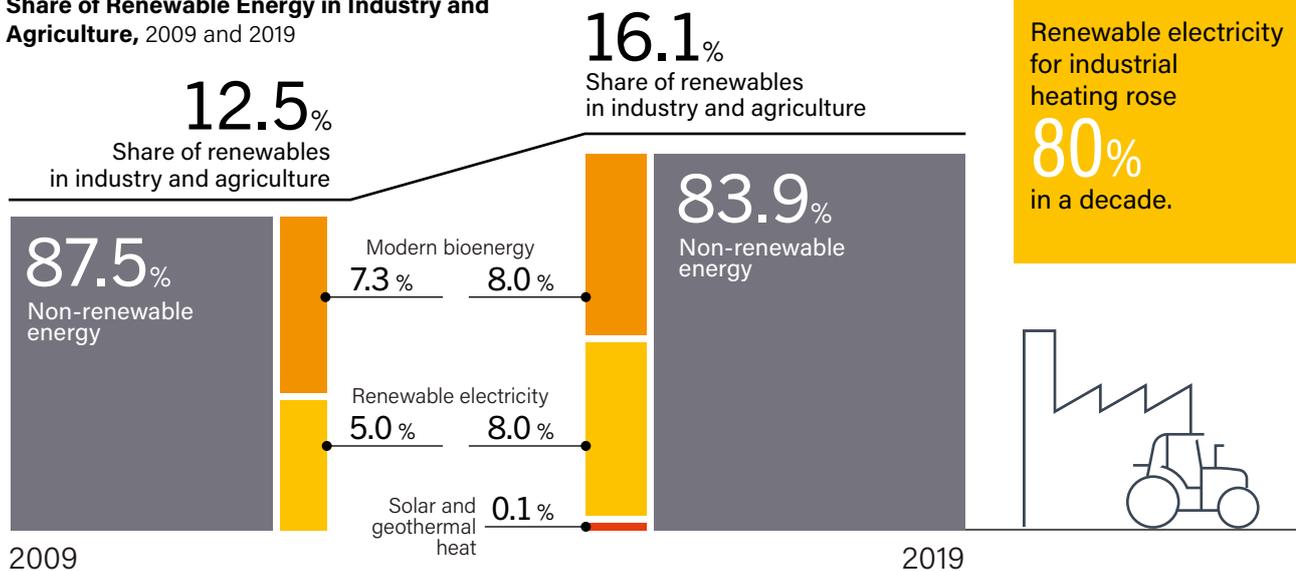
38 countries plus the EU have roadmaps for hydrogen production

The industry sector represents **28%** of GDP; agriculture represents around **4.3%** of GDP

Six countries have passed agri-voltaic policies

Agri-voltaic capacity totals more than **14 GW**

Share of Renewable Energy in Industry and Agriculture, 2009 and 2019



Source: Based on IEA data

RENEWABLE ENERGY IN TRANSPORT



The lack of progress in the transport sector is particularly worrying as it accounts for nearly a **third of global energy consumption.**

Switching to renewable fuels and electricity is critical to decarbonise transport



The transport success story was another record year for electrification.

A record 6.6 million electric cars were sold in 2021, a 109% increase from the year before. Even so, electric vehicles still account for only around 1% of the global fleet. The positive growth trend also is outweighed by the rising popularity of heavier (and thus less energy-efficient) cars: more than half of the electric car models on the market in 2021 were sport-utility vehicles (SUVs). Despite the electric vehicle boom, biofuels continue to account for the overwhelming renewable energy contribution in the transport sector.

Aviation, shipping and long-haul transport remain hard to decarbonise.

While these sub-sectors can in principle be powered by renewable electricity or renewable electricity-based fuels (synthetic fuels, hydrogen), biofuels or biomethane, the transformation requires significant investments in new infrastructure.

Despite advances, renewables are not making sufficient strides in the transport sector.

The reality remains that global transport systems and infrastructure continue to favour motorised fossil fuel-based transport. Meanwhile, consumers have shown a preference towards larger vehicles and a reluctance to change their behaviour, supported by strong lobbying efforts to maintain the status quo. Population and economic growth, particularly in developing and emerging countries, have led to energy demand growing much faster in the global transport sector than in other sectors. Policies to reduce the overall demand for private vehicles remain scarce, and cost-effective solutions are lacking.

Progress in the transport sector remains slow.

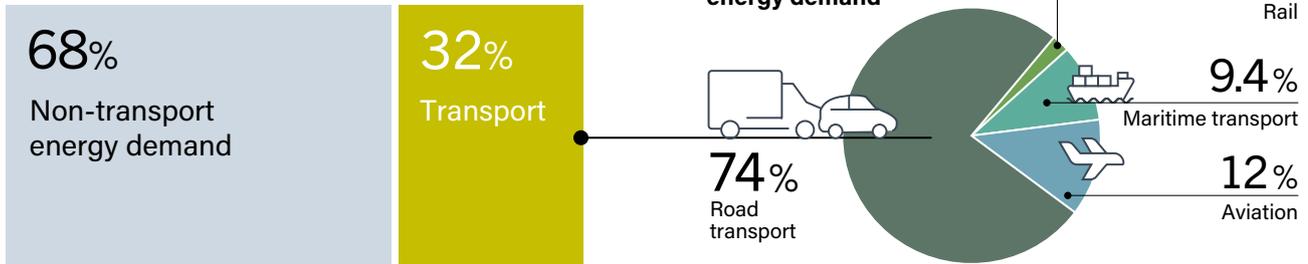
The share of renewables in the sector's final energy consumption grew only 1.2 percentage points between 2011 and 2019, to 3.7%. Despite a temporary reduction in transport energy demand related to COVID-19, the overall trend is towards rapidly rising demand (especially from road transport), with a whopping 24% increase during the decade.

Attention to renewables in transport is rising, but slowly.

Despite growing attention to the need to transform energy use in the sector, only 1 in 10 countries outlined emission reduction measures for transport in their Nationally Determined Contributions under the Paris Agreement. In addition, many renewable energy targets, including those referring to biofuels and advanced biofuels, expired in 2020 and have not been replaced by new ones.

RENEWABLES IN TRANSPORT

Energy demand for transport accounts for nearly one-third of total final energy consumption



Only **28 countries** have targets for renewable energy in transport



11 countries and 20 cities have targeted bans on sales of fossil fuel/ICE vehicles



31% of climate mitigation finance allocated to low-carbon transport



16 million electric cars on the world's roads, around **1%** of the global fleet

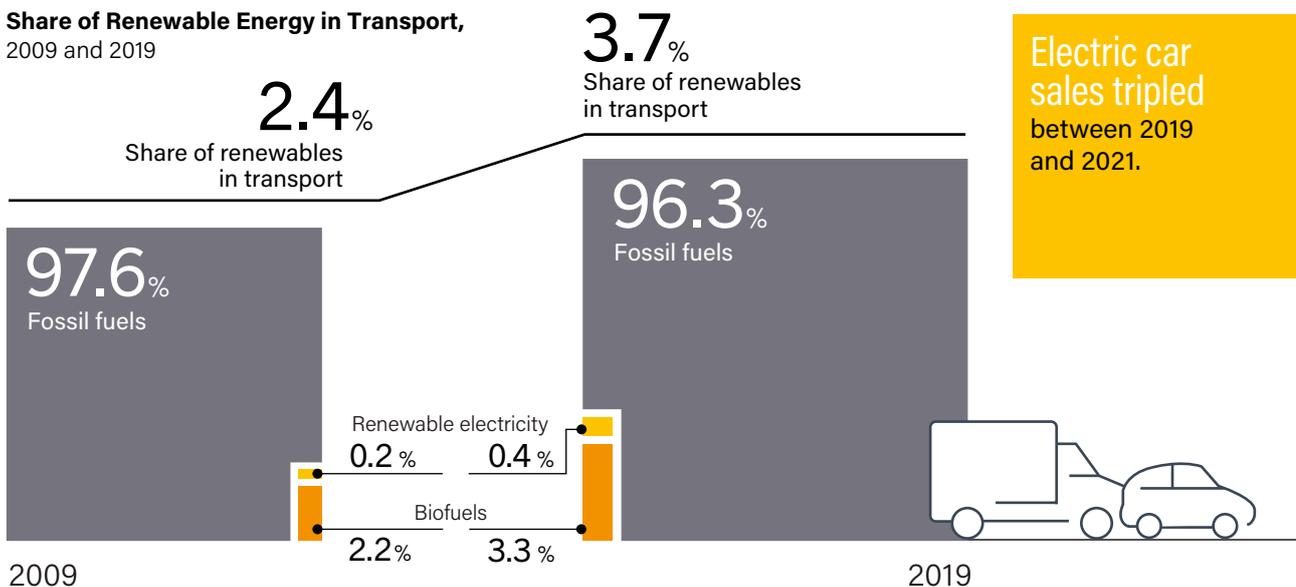


40% growth in electric bus sales in 2021, to total 4% of the global bus stock





Share of Renewable Energy in Transport, 2009 and 2019



Source: Based on IEA data.

RENEWABLES 2022 GLOBAL STATUS REPORT



For further details and access to the report and references, visit www.ren21.net/gsr

See Endnotes and Methodological Notes in the full GSR for further details on the information presented in this document.



Over **650 experts** contributed to GSR 2022, working alongside an international authoring team and the REN21 Secretariat.



More than **2000 sources** have been used to write GSR 2022.



Photo Credits

- page 04:** © LeoPatrizi; istock
- page 05:** © Lame Photographer; istock
- page 06:** © hsun337; istock
- page 09:** © ljubaphoto; istock
- page 11:** © Extreme Media; istock
- page 11:** © onurdongel; istock
- page 13:** © Oke Oluwasegun; istock
- page 13:** © Sky_Blue; istock
- page 14:** © Frank Wagner; istock
- page 14:** © yangna; istock
- page 14:** © nimis69; istock
- page 14:** © adamkaz; istock
- page 20:** © SimonSkafar; istock
- page 23:** © simonkr; istock

The REN21 Secretariat has produced this document to highlight the important trends that have occurred in 2021 and to put them in perspective of the global energy transition. It draws on elements from REN21's Renewables 2022 Global Status Report.

Authoring: Lea Ranalder, Yasmine Adb El Aziz (REN21), Sabine Froning, Niels Reise (Communication Works)

GSR 2022 PRODUCTION AND AUTHORING TEAM

REN21 RESEARCH DIRECTION TEAM

Duncan Gibb
Nathalie Ledanois
Lea Ranalder
Hend Yaqoob

SPECIAL ADVISORS

Adam Brown
Janet L. Sawin (Sunna Research)

CHAPTER AUTHORS

Hagar Abdelnabi
Adam Brown
Toby D. Couture (E3 Analytics)
Ahmed Elguindy
Bärbel Epp (Solrico)
Nicolas Fichaux
Duncan Gibb (REN21)
Fanny Joubert (Ecotraders)
Nathalie Ledanois (REN21)
Rachele Levin
Hannah E. Murdock (REN21)
Lea Ranalder (REN21)
Janet L. Sawin (Sunna Research)
Kristin Seyboth (KMS Research and Consulting)
Jonathan Skeen (The SOLA Group)
Freyr Sverrisson (Sunna Research)
Glen Wright (IDDRI)

RESEARCH AND PROJECT SUPPORT (REN21 SECRETARIAT)

Nicolas Achury, Thomas André (REN21), Ines Benachir (REN21), Aishwarya Dhar (REN21), Stefanie Gicquel (REN21), Vibhushree Hamirwasia (REN21), Gözde Mavili, Peter Stalter, Nematullah Wafa (REN21), Yu Yuan-Perrin (REN21)

COMMUNICATIONS SUPPORT (REN21 SECRETARIAT)

Yasmine Abd-El-Aziz, Janice Chantre Raposo, Joanna Croft, Assia Djahafi, Vincent Eke, Jessica Jones-Langley, Tammy Mayer, Laura E. Williamson

EDITING, DESIGN AND LAYOUT

Lisa Mastny
Kelly Trumbull
weeks.de Werbeagentur GmbH

PRODUCTION

REN21 Secretariat, Paris, France



REN21 is committed to mobilising global action to meet the United Nations Sustainable Development Goals.

DISCLAIMER:

REN21 releases issue papers and reports to emphasise the importance of renewable energy and to generate discussion on issues central to the promotion of renewable energy. While REN21 papers and reports have benefited from the considerations and input from the REN21 community, they do not necessarily represent a consensus among network participants on any given point. Although the information given in this report is the best available to the authors at the time, REN21 and its participants cannot be held liable for its accuracy and correctness.



KEY MESSAGES

2022



2022

REN21 Secretariat

c/o UN Environment Programme
1 rue Miollis
Building VII
75015 Paris
France

www.ren21.net