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RENEWABLES 2023
GLOBAL STATUS REPORT

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FOREWORD

The past two decades have seen renewables shift from an emerging trend to a legitimate alternative to fossil fuels. Driven by the ongoing energy crisis and by deteriorating climate conditions, the need to ensure a clean, stable and affordable energy supply has reshuffled the deck to one that now favours renewables. However, the energy transition is not happening at the rate required to meet energy needs and to prevent the planet from slipping deeper into climate crisis.

In 2022, a growing number of people worldwide were without access to needed energy services, underscoring the gaps among countries and regions and exposing the vulnerability of the current energy system globally. Despite undeniable growth in the use of renewables for power generation, other critical energy carriers such as renewable heat and renewable-based fuels remain neglected. Similarly, renewables are still facing significant barriers as they are unable to compete fairly against heavily subsidised fossil fuels.

For the first time, REN21's *Renewables Global Status Report* (GSR 2023) is being published as a collection of five modules, reflecting the fundamental changes in the global energy landscape. The *Global Overview* module explores the key topics of energy demand, energy supply, energy systems and infrastructure, as well as the socio-economic value creation of renewables, including contributions to GDP growth, employment, and access to clean cooking and electricity. The module takes stock of the current renewable energy landscape and outlines the wide range of bottlenecks that hinder the transition towards a renewables-based economy and society.

Today, the transition to renewable energy is more than a climate imperative; it is an economic and social opportunity to shape a more sustainable and prosperous future for all. I want to thank the REN21 team, authors, special advisors and contributors who have participated to this edition of the GSR. Their knowledge, passion and commitment have been instrumental in making the modular GSR 2023 collection a reality.

I am confident that across its five modules, the GSR will continue to serve as a valuable resource for policy makers, industry leaders and other stakeholders to inform effective decision making and drive the rapid transition to a future fuelled by renewable energy.

Rana Adib
Executive Director, REN21

REN21
RENEWABLES NOW

RENEWABLE ENERGY POLICY NETWORK FOR THE 21st CENTURY

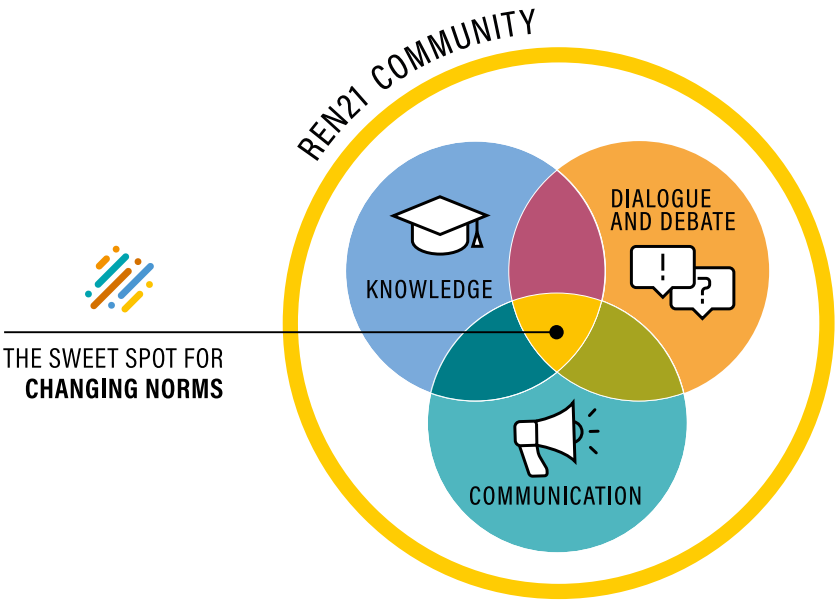
REN21 is the only global community of actors from science, governments, NGOs and industry **working collectively** to drive the rapid uptake of renewables – now!

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 co-operation 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 **4,000 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.



CROWD-SOURCED DATA AND KNOWLEDGE

REN21's data and knowledge collection method is built on a global multi-stakeholder community of experts. It is validated in a collaborative and transparent open peer-review process. It is made openly available to develop a shared language that shapes the sectoral, regional and global debate on the energy transition.

For more information, see the Methodological Notes section on data collection and validation.

RENEWABLES GLOBAL STATUS REPORT
2023 COLLECTION

Since 2005, REN21's *Renewables Global Status Report* (GSR) has spotlighted ongoing developments and emerging trends that shape the future of renewables. It is a collaborative effort involving hundreds of experts.

This year's edition (18th) has evolved in design and structure to reflect the fundamental changes in the global energy landscape. The new structure is in the form of a collection of five publications. In addition to presenting the trends in renewable energy supply, it also dives into the energy demand sectors, with dedicated modules on buildings, industry, transport and agriculture. It includes a publication on energy systems and infrastructure with renewables, as well as a publication on renewables for economic and social value creation, acknowledging the key role that energy plays across economies and societies. Collectively these five publications offer readers a systemic global overview of the current uptake of renewables.

This new structure makes the GSR a key tool in expanding the renewable energy discussion into key sectors and ecosystems, developing a shared language and driving a stronger integration of supply, demand, infrastructure, markets and investment.

UN environment programme

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Federal Ministry for Economic Cooperation and Development

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Comments and questions are welcome and can be sent to **gsr@ren21.net**.

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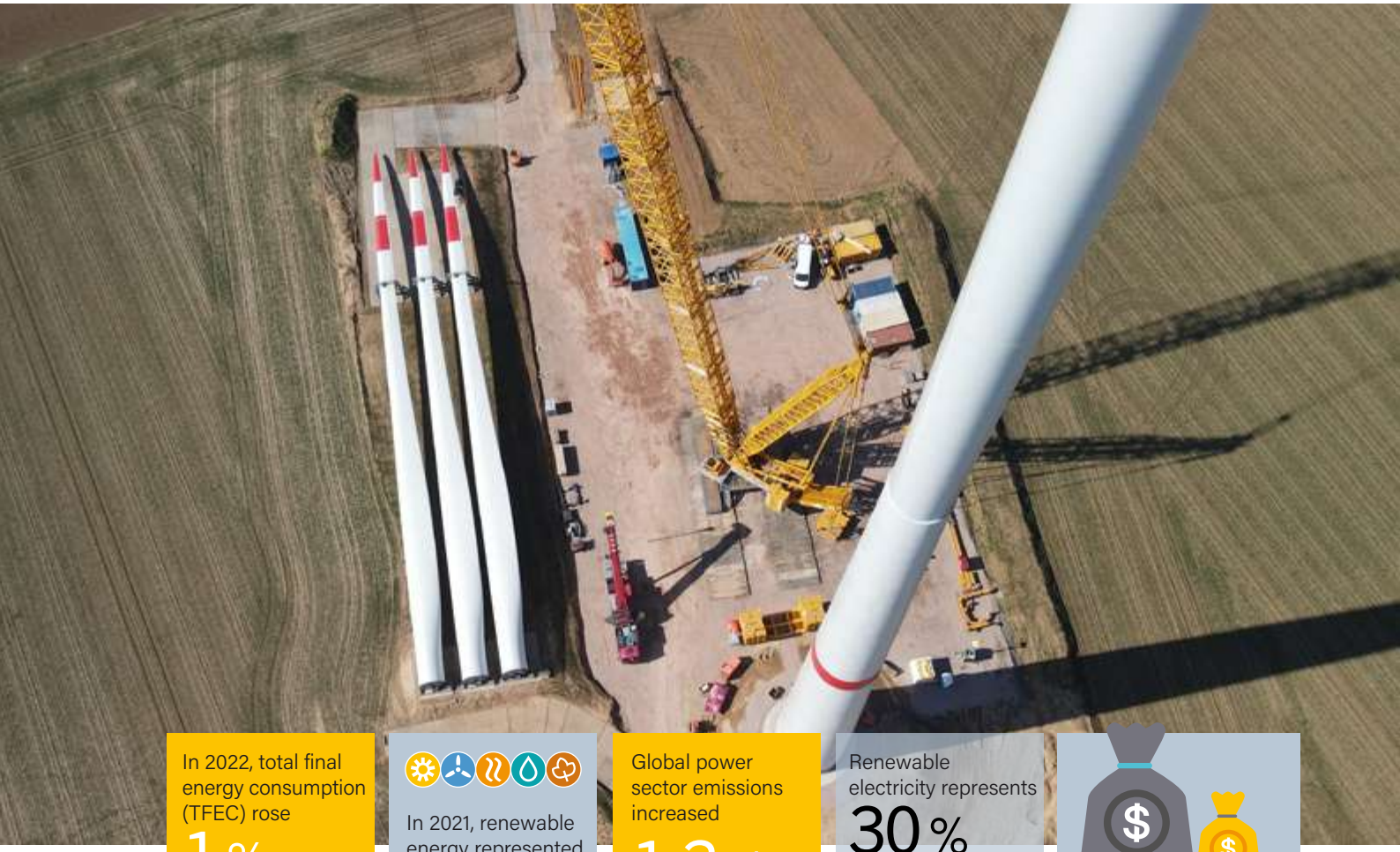
- → Data Collection and Validation
- → Methodological Notes
- → Glossary
- → List of Abbreviations

Reference Tables can be accessed through the GSR 2023 *Global Overview* Data Pack at
→ http://www.ren21.net/gsr2023-data-pack/go



In 2022, total final energy consumption (TFEC) rose

1 %

compared to 2021

In 2021, renewable energy represented

12.6 %

of TFEC

Global power sector emissions increased

1.3 %

in 2022

Renewable electricity represents

30 %

of total electricity generation

Global investment in renewables across the power and fuel supply and infrastructure is below

30 %

GLOBAL OVERVIEW

Module Overview | Policy | Investment

MODULE OVERVIEW

The year 2022 was a volatile and unpredictable time for energy markets. The rapid economic rebound following the COVID-19 pandemic (although moderate compared to 2021) and the Russian Federation's invasion of Ukraine in February led to further energy price increases.[1] (→ *See Box 1.*)

Rising oil and gas prices drove inflation of energy prices (including renewables) and of food and other essentials during the year.[2] To mitigate the inflationary effects, governments implemented policies such as the European Union's (EU) RePowerEU initiative and the US Inflation Reduction Act, which include substantial measures to foster energy efficiency and advance the adoption of renewables.[3]

Meanwhile, concerns about climate change were brought to the fore by extreme weather events, ranging from severe floods in Pakistan to extreme heat, drought and fires in China, Europe and the United States.[4] The short-term response of many countries was to increase subsidies for fossil fuels and to burn more coal, leading to the continued dominance of fossil fuels in global energy production and use.[5] Rising prices also slowed progress towards universal access to modern energy services.

BOX 1. Energy Prices in Europe, 2021-2022

Electricity and gas prices in the European Union reached record levels between the second half of 2021 and 2022. Average household electricity prices increased from EUR 23.5 to EUR 28.4 (USD 25.1 to USD 30.3) per 100 kilowatt-hours (kWh), while average fossil gas prices rose from EUR 7.8 to EUR 11.4 (USD 8.3 to USD 12.2) per 100 kWh. Factors contributing to the surge in prices included the global recovery from the COVID-19 pandemic, which boosted energy demand, geopolitical tensions between the Russian Federation and Ukraine, which threatened gas supplies, and the low levels of renewable energy production due to unfavourable weather conditions.

Between September 2022 and May 2023, Russian gas deliveries to the EU fell 80%, straining gas balances globally. This resulted in a shift in trade patterns, with decreased oil flows from the Russian Federation to the EU and North America and increased exports to alternative markets such as India, China and Türkiye. Europe met its winter heating demand through a combination of declining domestic production, pipeline imports, liquefied fossil gas and storage withdrawals. Policies and interventions by EU governments, such as reducing taxes and fees, providing lump sum support and vouchers to consumers, and applying regulated prices and price caps have contributed to the stabilisation of electricity and gas prices.

Source: See endnote 1 for this module.

The events of 2022 increased worldwide interest in the long-term shift away from fossil fuels to achieve energy and climate security goals. Many countries set new or more ambitious targets and support policies for renewables. At the 2022 United Nations Climate Conference in Sharm El-Sheikh, Egypt (COP 27), governments were urged to reassess and enhance their emission reduction targets for 2030 in national climate plans, to expedite reductions in coal power and to eliminate inefficient fossil fuel subsidies.[6] Governments emphasised the need to incorporate low-emission and renewable energy to diversify energy sources and systems.[7] Additionally, climate finance was a key topic at COP 27, with the final agreement highlighting the urgency of investing USD 4-6 trillion annually in renewable energy, technology and infrastructure to 2030 to reach net zero greenhouse gas emissions by 2050.[8]

Supply chain disruptions and geopolitical shifts have also spurred a greater emphasis on bolstering domestic energy supplies and manufacturing, including for renewable energy technologies and related components and minerals.[9] (→ *See Box 2.*)

ACCESS TO ELECTRICITY AND CLEAN COOKING

In 2021, 754 million people worldwide did not have access to electricity.[10] (→ *See Figure 1.*) Rising prices slowed progress towards universal access to modern energy services, and in 2022 the number of people without electricity access was projected to grow by 20 million (mainly in Sub-Saharan Africa), to reach an estimated 774 million.[11] Around 75 million people who recently acquired access to electricity may no longer be able to afford it, and in 2022 around 100 million people were projected to revert to using traditional biomass for cooking, with negative impacts on health and livelihoods.[12]

As of 2022, an estimated 2.4 billion people worldwide did not have access to clean cooking facilities, with 40% of them residing in Sub-Saharan Africa and 55% in developing Asia.[13] The number of people using traditional biomass, coal and kerosene for cooking was projected to increase in 2022 due to soaring fuel prices.[14]

BOX 2. Impact of Inflation on Renewable Energy Supply Chains

In 2022, the renewable energy sector faced numerous challenges that slowed the pace of wind and solar projects, including rising equipment costs, inflation and supply chain constraints.

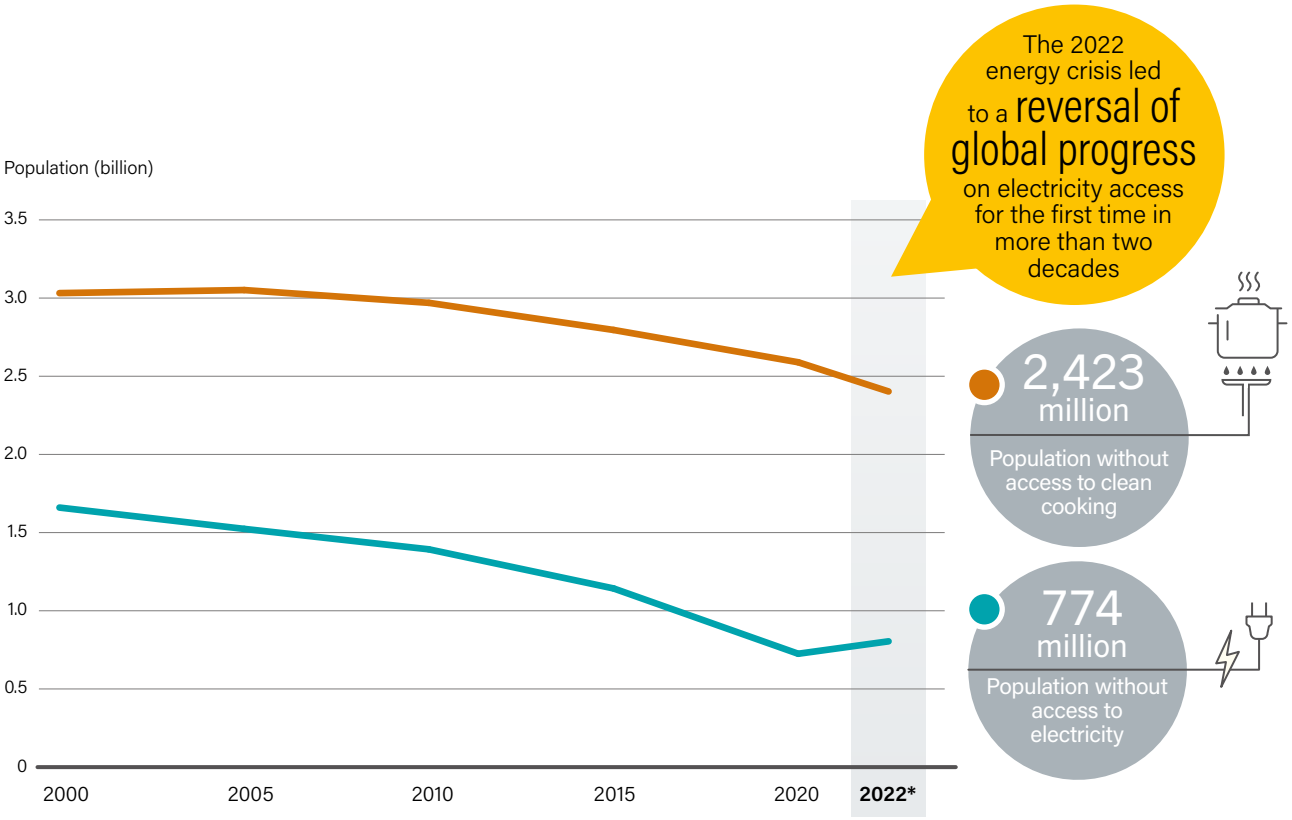
The prices of key inputs such as steel, copper, aluminium and polysilicon surged due to supply chain disruptions and increased demand during the post-COVID-19 economic recovery. The average monthly price of polysilicon increased four-fold between 2020 and June 2022. Steel prices, crucial for building utility-scale solar photovoltaic (PV) plants and onshore wind power plants, rose 160% in the United States and 270% in Europe, while China experienced a relatively lower increase of 75% during the same period. Copper and aluminium prices increased 60–80%, although these price surges began to moderate towards the end of 2022.

Despite these challenges, wind and solar energy technologies remain more cost-effective than fossil fuels in most countries. In the Asia-Pacific region, the levelised cost of electricity for renewable power increased in 2021 but was still cheaper compared to fossil fuel power. In Europe, investments in wind energy fell in 2022 as orders for new wind turbines dropped 47%. US developers postponed offshore wind projects, such as the 1.2 gigawatt (GW) Commonwealth Wind project near the state of Massachusetts.

In Europe, some renewable energy auctions were undersubscribed in 2022. This can be partly attributed to the rising investment costs for wind and solar PV projects compared to previous years, coupled with unchanged auction ceilings and static reference prices. Recognising the evolving pricing landscape, some governments have taken steps to modify auction designs. Germany increased its auction ceiling prices, while Portugal made adjustments to contract prices to factor in inflation. Such changes aim to address the concerns of developers and to create a more favourable investment environment. Some developers turned to corporate power purchase agreements (PPAs) and opportunities in the wholesale market to be more economically attractive than participating in auctions, enabling them to access higher prices.

Source: See endnote 9 for this module.

FIGURE 1.
Population without Access to Electricity and Clean Cooking, 2022



Source: See endnote 10 for this module.

* Estimated value for 2022

TOTAL FINAL ENERGY CONSUMPTION

The growth in primary energy demand slowed in 2022, rising only 1.1% compared to the 5.5% growth of 2021.[15] Renewables (excluding hydropower) accounted for 7.5% of primary energy (up nearly 1% from 2021), while fossil fuels remained at 82%.[16]

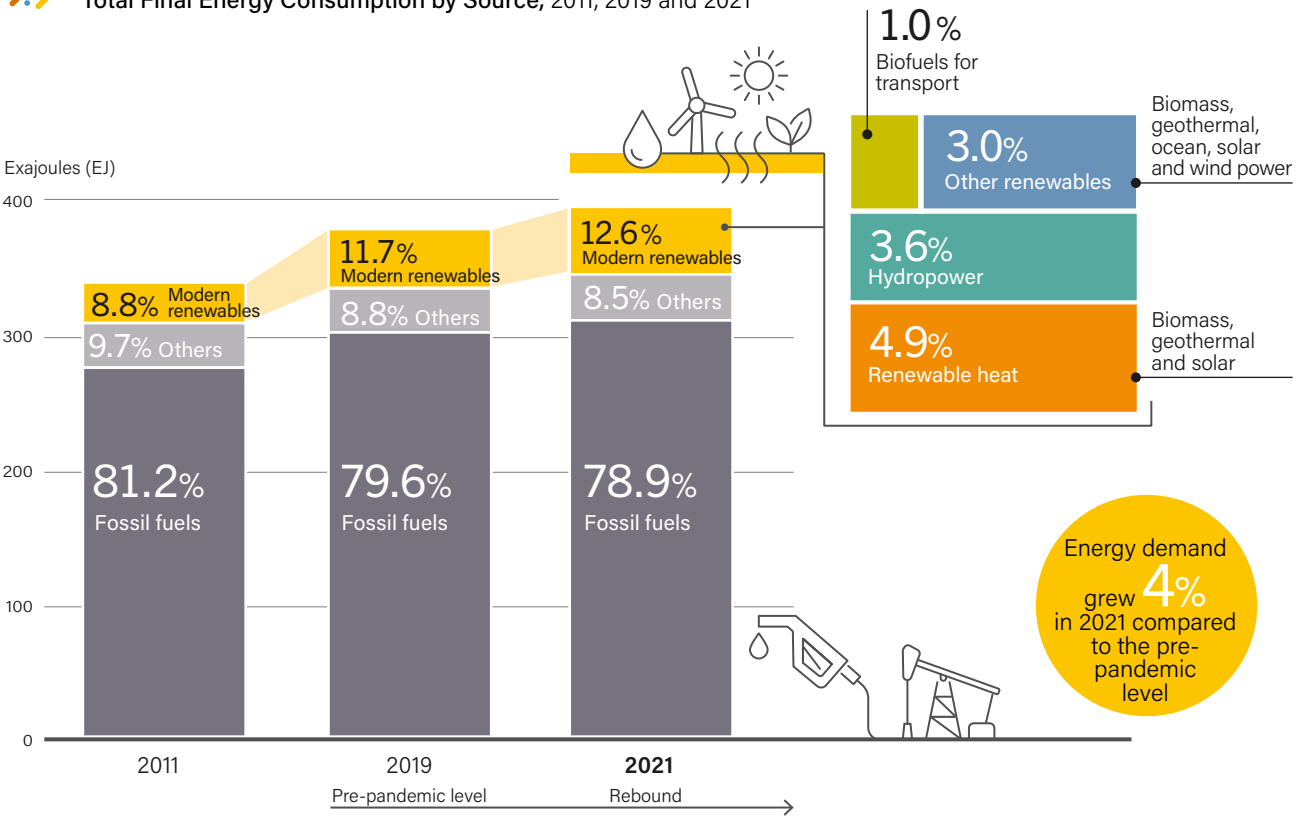
The risk of supply disruptions, as well as high fossil fuel price volatility, prompted more energy consumers worldwide to adopt on-site renewable energy systems and to switch to electrified technologies across the end-use sectors.

Between 2011 and 2021, the world's total final energy consumption (TFEC) grew 16%.[17] The amount of modern renewable energy in TFEC increased from 30 exajoules (EJ) in 2011 to 50 EJ in 2021.[18]

As the contribution of renewables increased, the share of fossil fuels in TFEC fell from 81.2% in 2011 to 78.9% in 2021; despite the lower share of fossil fuels in TFEC, the overall consumption of fossil fuels increased by 35 EJ during this period.[19] (→ *See Figure 2.*)

Iceland continued to have the highest proportion of renewable energy in TFEC in 2020, at 83%, followed by Norway with 74% and Paraguay with 73%.[20] (→ *See Figure 3.*) Lao People's Democratic Republic witnessed the largest growth in the renewable energy share in TFEC during 2010-2020 (up 20%), followed by Sweden (19%), Norway (18%) and Denmark (15%).[21]

FIGURE 2.
Total Final Energy Consumption by Source, 2011, 2019 and 2021



Source: See endnote 19 for this module.

Note: Others include nuclear energy and traditional biomass.

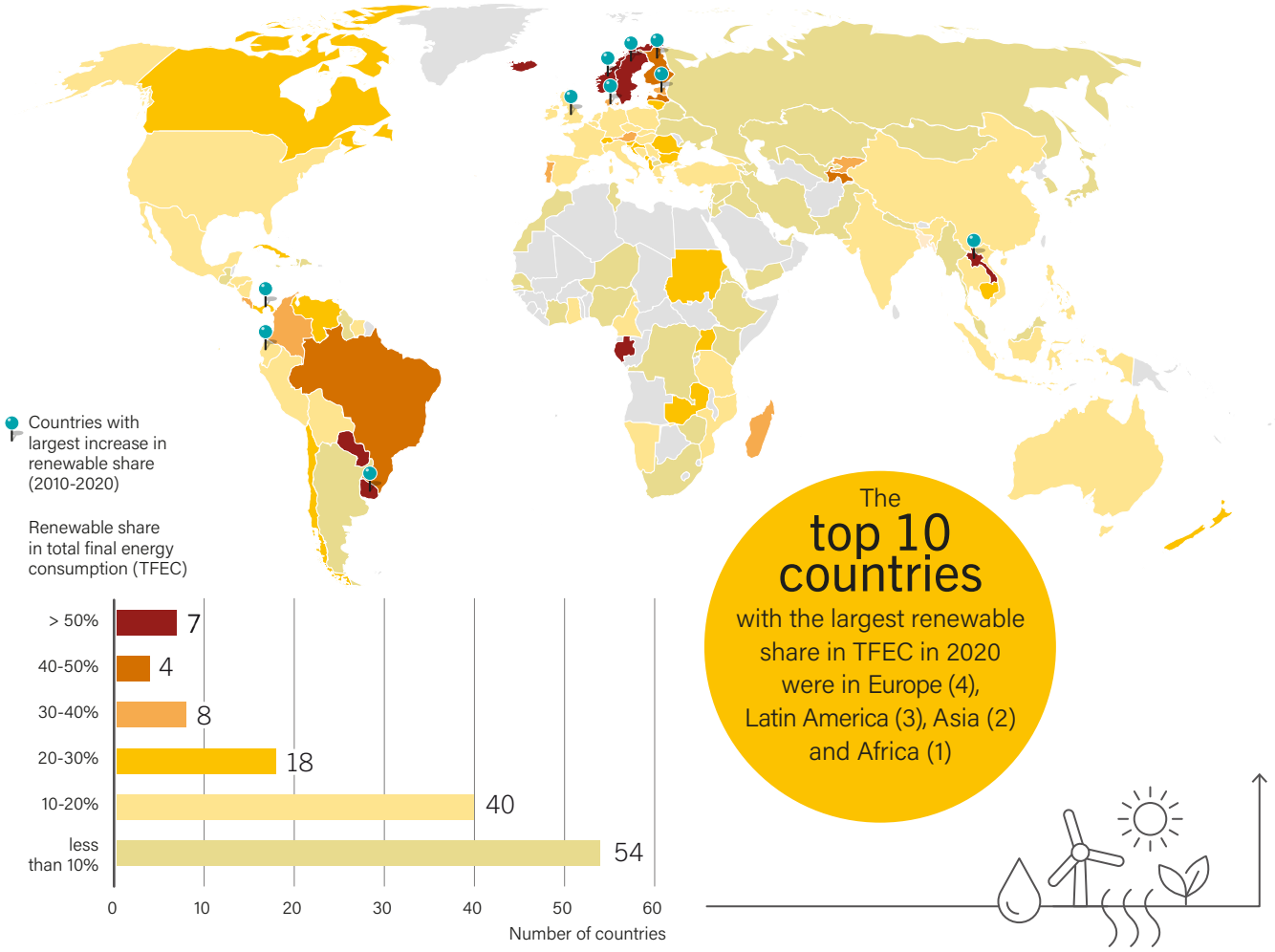
Heat energy accounted for the largest portion of the world's total final energy supply at 48.7% in 2020, up 4% from 2010 levels.[22] This was followed by transport (liquid and gaseous) fuel (28.6% share) and electricity (22.7%).[23] The uptake of renewables in transport and heating has been low compared to the electricity sector. Renewable heat accounted for just 11.5% of total heat demand in 2020 (excluding traditional biomass accounting for 13.1%), while renewable electricity accounted for an estimated 29.9% of total global electricity production in 2022.[24] Modern bioenergy, solar thermal and geothermal direct heat supplied most of the renewable heat (79%), with the rest from renewable electricity.[25] Biofuels supplied 3.6% of total fuel in the transport sector, while renewable electricity contributed 0.4%.[26]

Heat and transport are lagging behind electricity in terms of renewable energy uptake, despite accounting for

77.3%

of the global final energy supply.

FIGURE 3.
Renewable Share of Total Final Energy Consumption, by Country, 2020



Source: See endnote 20 for this module.

Note: The top 10 countries with the largest renewable share in TFEC in 2020 were Iceland, Norway, Paraguay, Lao PDR, Sweden, Gabon, Uruguay, Brazil, Finland and Tajikistan.

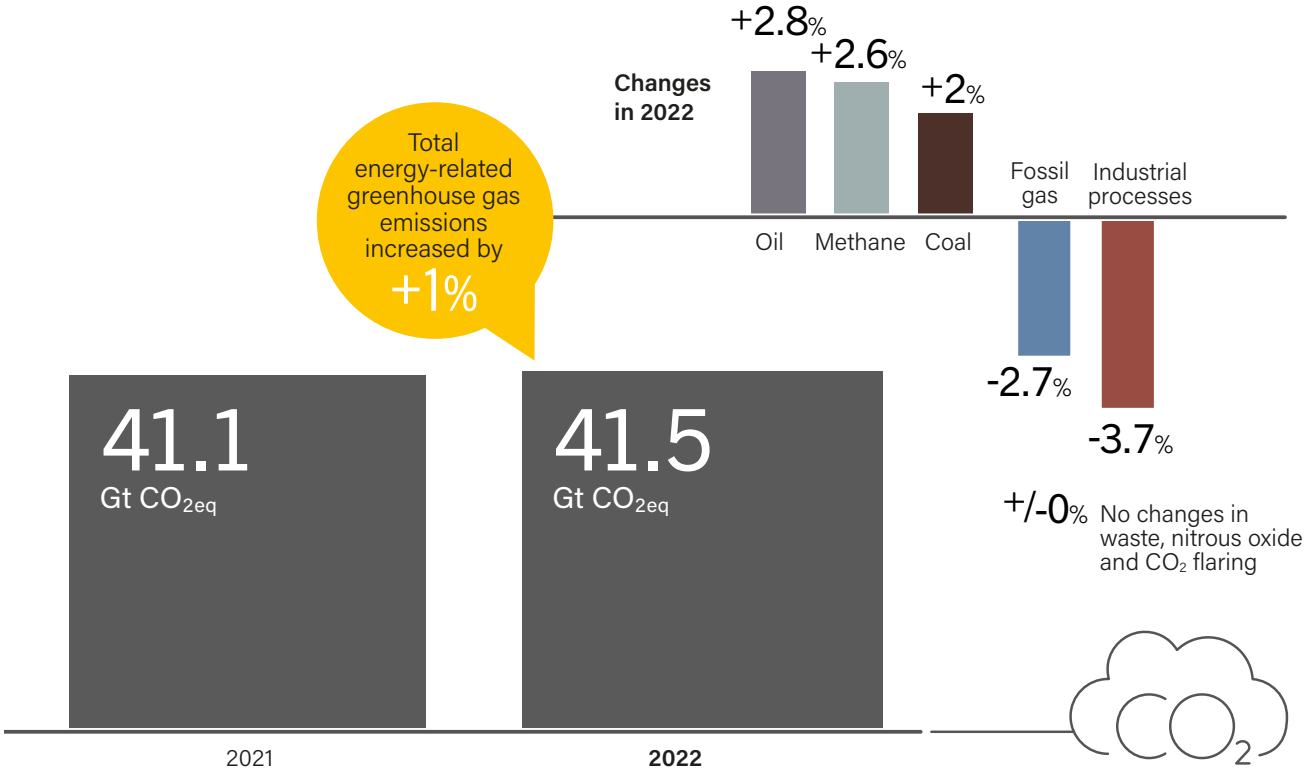
The top 10 countries with the largest increase in renewable share in TFEC (2010-2020) were Lao PDR, Sweden, Norway, Denmark, Finland, Estonia, Ecuador, Uruguay, Panama and the United Kingdom.

ENERGY-RELATED EMISSIONS

Total energy-related greenhouse gas emissions increased 1% in 2022, reaching a record 41.5 gigatonnes of carbon dioxide (CO_2) equivalent.[27] (→ *See Figure 4.*) However, this was slower growth than the rebound of more than 6% in 2021.[28] Energy combustion and industrial processes contributed 89% of energy-related emissions, which were dominated by CO_2.[29] Energy combustion emissions increased by 423 million tonnes, while emissions from industrial processes fell by 102 million tonnes, due mainly to curtailed industrial production, particularly in China (10% decline in cement production and 2% decline in steel manufacturing).[30]

Methane emissions from energy combustion, leaks, and venting accounted for 10% of energy-related greenhouse gas emissions, originating mainly from onshore oil and gas operations and steam coal production.[31] Despite the increased cost-effectiveness of methane abatement technologies, methane emissions rose around 2.6% in 2022.[32]

FIGURE 4.
Energy Sector Emissions by Source, 2021-2022



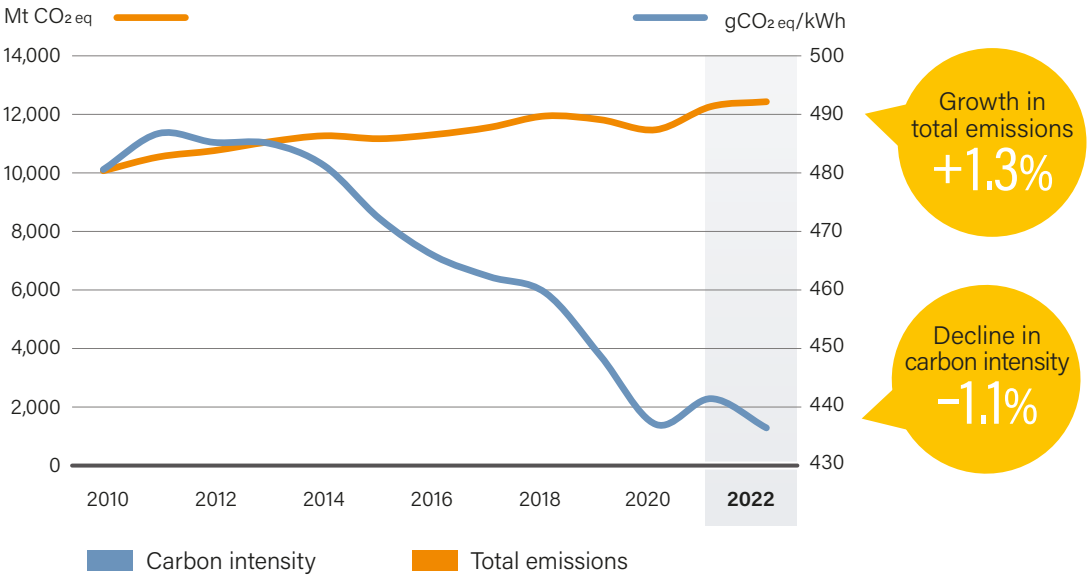
Source: See endnote 27 for this module.

Global power sector emissions rose 1.3% to hit an all-time high in 2022; however, the average carbon intensity[i] of electricity generation fell to a record low of 436 grams of CO_2 per kWh globally.[33] (→ *See Figure 5.*) This decline is explained by the significant growth of wind power and solar PV in the global electricity mix.[34] In China, despite the growing demand for electricity, the emission intensity of the power sector decreased notably in 2022, falling 2.5%.[35] The countries with the highest power sector emission intensity during the year were Kosovo, Mongolia and South Africa.[36]

The emission intensity of the power sector in China decreased **2.5%** in 2022.

i Carbon intensity refers to the amount of emissions released to produce one unit of electricity.

FIGURE 5.
Power Sector Emissions and Emissions Intensity, 2010-2022



Source: See endnote 33 for this module.

ELECTRIFICATION AND SECTOR COUPLING

The electrification of end-use sectors gained momentum. The share of electricity in total final energy consumption rose from 15.3% in 2010 to 18.9% in 2020.[37] Agriculture was the most electrified sector in 2020, at 26.7%, followed by industry (25.3%) and buildings (23.6%), while transport lagged significantly at only 1.4%.[38] The growing share of electricity in end-use sectors has allowed for greater incorporation of renewable energy sources.[39] In the power sector, newly installed renewable power capacity increased 10% in 2022.[40]

In 2022, global electricity demand rose nearly 2.5% despite the impacts of the energy crisis.[41] With more frequent heatwaves, the need for cooling poses additional challenges to rapid electrification, greatly driving up electricity demand[i].[42] In 2022, three countries – Barbados, Cambodia and Nigeria – released National Cooling Action Plans, bringing the total number of countries with such plans to 14, while another 16 countries had plans in process.[43]

Electricity is projected to become the dominant energy carrier, accounting for more than 50% of total final energy consumption by 2050, to achieve the global net zero targets.[44] This shift is driven by increased deployment of renewables, improvements in energy efficiency and further electrification of various end-use sectors.[45] Electric car sales surged in major markets in 2022, but the expansion of charging infrastructure needs to be accelerated.[46] Meanwhile, the electrification of buses and heavy-duty vehicles has slowly gained traction, although the market share and model availability are still limited.[47]

Heating and cooling technologies, particularly heat pumps, hold promise for electrification in the buildings sector. In 2022, heat pumps grew 11% globally, notably in Europe where they increased 38%.[48] In the United States, annual sales of heat pumps eclipsed fossil gas furnaces for the first time.[49] In the industrial sector, electrification is focused primarily on lower-temperature heat applications, demonstrating slower deployment. An indirect form of electrification is hydrogen, which shows potential in heavy industry. Demonstration projects such as Sweden's Hybrit project have generated widespread interest, particularly in the production of green steel.[50]

i In 2022, both India and China experienced significant heatwaves, leading to increased electricity demand, prolonged blackouts and reduced production in some industries.

Sector coupling presents numerous opportunities for the integration and storage of renewable energy. Excess power generation at off-peak times can be stored to optimise the overall system operations and increase efficiency.[51] This is achieved mainly through linking the power sector with heating/cooling to meet thermal needs, and with transport to charge electric vehicles. However, other applications such as power-to-hydrogen transformations are also being explored.[52]

Renewable hydrogen is attracting growing global attention due to a range of potential benefits, including the ability to mitigate curtailment of variable renewable energy technologies, as well as to decarbonise challenging sectors such as transport (road and shipping) and industry (e.g., ammonia), effectively replacing the need for fossil fuels. Nevertheless, by the end of 2021, only around 4% of hydrogen was generated through electrolysis.[53] Renewable energy accounted for an average of around 30% of global electricity production in 2022, indicating that merely 1% of the total hydrogen output was produced using renewable sources.[54]

Despite progress in hydrogen production, critical challenges remain, with the lack of infrastructure presenting a major obstacle; this includes pipeline networks, production facilities and fuelling stations. Additionally, the establishment and harmonisation of certification systems are seen as crucial steps towards scaling up the hydrogen economy and fostering global collaboration.[55]

In recent years, many countries have adopted national hydrogen strategies to promote its use and development. In 2020, the European Commission adopted the EU Hydrogen Strategy, which emphasises the crucial role of hydrogen in decarbonising various sectors including industry, transport, power generation, and heating, in order to achieve a climate-neutral Europe.[56] By 2020, more than half of European countries had either published their strategies or were in the process of developing them.[57]

WHAT IS HOLDING BACK THE SHIFT TO RENEWABLE ENERGY?

Planning and permitting barriers are among the greatest challenges for renewable energy projects, resulting in delays at various stages of development. In the United States, renewable energy generation projects have an average permitting time of 2.7 years, causing many projects to be abandoned due to burdensome delays.[58] Across EU Member States, the duration of permit acquisition can vary greatly, with ground-mounted solar projects typically taking 1–5 years and onshore wind projects ranging from 3 to 9 years.[59]

These prolonged timelines, caused by intricate and slow authorisation procedures, have negative consequences such as reduced participation in renewable energy auctions, higher expenses and a decline in the financial viability of power plants. In both Italy and Germany, auctions did not receive enough participants in 2022.[60] To address this issue, the EU released policy recommendations on permitting of renewable projects as part of its REPowerEU Plan.[61] Meanwhile, in China the deployment of renewables is not reported to be greatly affected by administrative processes.[62]

A lack of **grid capacity** has contributed strongly to delays in the deployment of renewable energy technologies. The insufficient investment in grid infrastructure is a global challenge, impacting the growth of new wind and solar PV capacity and the effective use of existing power plants.

China has made significant investments in its grid, averaging USD 75 billion annually since 2010.[63] This has reduced the curtailment of variable renewable energy sources (mainly wind and solar power) from 16% in 2012 to less than 3% in recent years.[64] Contributing factors included improving the interconnection capacity linking provinces in the north and northwest with high-demand load centres in the south and east.[65]

In the United States, the **interconnection queues** for large-scale electric generation and storage projects have grown significantly, with more than 1,400 GW of total capacity seeking connection to the grid as of 2022.[66] The average time that projects spend in the connection queue has increased from 2.1 years in 2010 to 3.7 years in 2021.[67]

Estimates indicate that to meet decarbonisation targets, the United States must build transmission infrastructure equivalent to three times the capacity of 2022.[68] However, the lengthy environmental review and permitting processes for long-distance transmission lines impose limitations, often taking 5 to 10 years or more.[69]

Some solar and wind power projects have experienced delays caused by **supply chain challenges** (due to increased demand and disruptions in the supply of materials), volatile raw material prices and shipping delays during 2021-2022.[70] The biomass supply chain also was affected, impacting business continuity and biomass fuel supply, pushing the industry to explore new co-operation opportunities. Supply chain disruptions in the wind industry in India led to delays in project execution and slower-than-expected installation of wind power capacity in 2021.[71] However, most manufacturing plants in Europe managed to continue their operations.[72]

Meeting global targets for net zero carbon emissions and achieving the energy transition requires a significant increase in the production and international trade of critical raw materials. The prices of materials such as polysilicon, aluminium and copper reached record levels in 2022 due to the COVID-19 pandemic, trade tensions, and the aftermath of the Russian invasion of Ukraine, causing supply chain challenges.[73] Nevertheless, material prices started to fall by the end of 2022.[74]

Building societal support for renewable energy projects requires genuine consultation in developing targets, policies and programmes.[75] Additionally, raising awareness and education about the benefits of renewables – including job creation, inclusion, improved health, energy security and financial reward – can minimise opposition to projects.[76] Societal opposition can arise from a variety of drivers including political ideology, views about climate science or economic growth, poor social safeguards and heightened environmental risks of projects.[77]

ELECTRICITY

In 2022, total **electricity generation** worldwide increased 2.3% to reach 29,165 terawatt-hours (TWh), a growth rate close to pre-COVID levels and below the 6.2% rebound of 2021.[78] Renewable energy sources contributed 92% of the increase, while the rest was covered mainly by nuclear, fossil gas and coal.[79] Electricity generation from nuclear power declined 0.7% and from oil fell 4.4%.[80] By comparison, in 2021 the increase in electricity generation was covered mainly by coal, fossil gas, and nuclear power sources (a combined 64%), whereas renewables (excluding hydropower) accounted for only 32% of this growth.[81]

The growth in electricity demand has not been uniform across the world, with China accounting for 54% of the global increase in 2022, whereas electricity demand in Europe fell 2.5% (by 136.5 TWh); this included declines of 27.5% in Ukraine, 15.3% in Slovenia and 14.5% in Latvia.[82] India had the highest growth in electricity demand globally at 8.4%.[83]

Overall, the renewable share in global electricity generation increased 8.1% in 2022, to reach 29.9%.[84] The combined share of wind and solar power in the global electricity generation mix was 12%, continuing a steady increase since 2015.[85] Corporate power purchases have played a growing role in the rising worldwide demand for renewables.[86] (→ *See Sidebar 1.*)

In 2022, the world's total **power generation capacity** (from all sources) grew 4.1%, similar to the growth in 2021.[87] The energy transition towards renewables has focused mainly on a handful of technologies in the power sector. Wind and solar power accounted for 23.9% of the total installed generation capacity in 2022, 2.4 percentage points above 2021 levels.[88] The installed capacity of solar power reached 1,185 GW and wind power 906 GW.[89]

Overall, renewable energy has demonstrated resilience despite the rise in renewable power prices in major global markets due to supply chain challenges, construction delays, higher costs of raw materials, parts and labour, as well as inflation, higher interest rates and interconnection delays.[90]

Solar PV accounted for 70% of the total **capacity additions** of renewable power (348 GW) in 2022, followed by wind power 77 GW (22%) and hydropower 22 GW (6.3%).[91] The top three countries with the highest capacity additions of solar and wind power were China, the United States and India.[92]

Solar capacity additions reached 243 GW (up around 37% compared to 2021), 44% of which was installed in China, while the United States and India each had 8% shares.[93] Wind power capacity additions totalled 77 GW (down around 17% compared to 2021), with 47.7% installed in China and 15.6% in the United States.[94] Hydropower capacity additions were 22 GW in 2022, well below the estimated 30 GW needed annually to keep temperature below 2 degrees Celsius in 2050.[95] (→ *See GSR 2023 Renewables in Energy Supply Module.*)

Fossil fuel power capacity continued to grow during 2022. China approved 106 GW of new coal power capacity in response to electricity shortages during the summer of 2021 that were caused by a historic drought, heatwave, and challenges related to outdated grid management.[96] This was a four-fold increase from 2021 and the highest new coal capacity permitted since 2015.[97] China and India are positioning themselves to continue operating coal power plants, and in India coal generation experienced the largest absolute increase among all sources, rising 7.2% (92 TWh) in 2022.[98] This increase met 74% of the country's growing power demand for the year.[99]

Wind power and solar PV's combined share of total installed generation capacity increased

2.4

percentage points

in 2022.

SIDEBAR 1. Corporate Renewable Power Purchasing

Various financial mechanisms exist for private companies to support, invest in, and purchase renewable energy, such as through power purchase agreements (PPAs), debt/equity financing, green bonds, renewable energy certificates (RECs), participation in joint ventures/partnerships and leasing.

Corporate renewable energy procurement through PPAs is on the rise globally. In a corporate PPA, the company agrees to purchase renewable energy directly from a project developer. The terms of the agreement, including the duration, price, and quantity of energy to be purchased, are negotiated between the corporate buyer and the renewable energy seller.

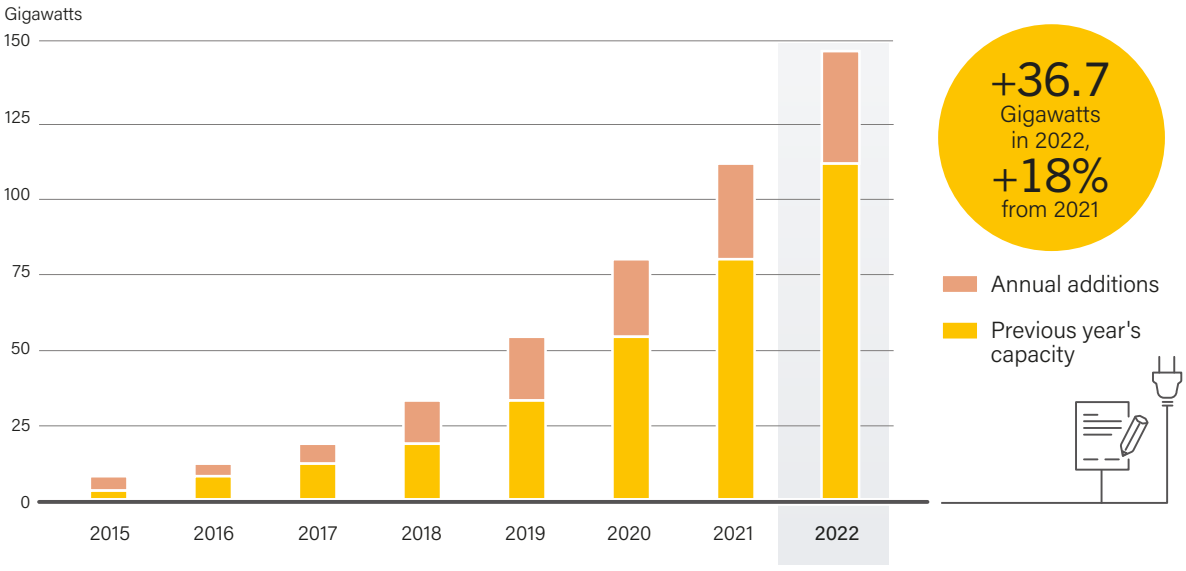
In 2022, companies committed to buy 36.7 GW of clean power through long-term contracts (→ *see Figure 6*), with strong growth in the Americas and the Asia-Pacific region, marking an 18% increase from 2021 despite challenges posed by a global energy crisis, supply chain disruptions and high interest rates. In the United States and Latin America, contracts for clean power projects increased 18% to reach a record 24.1 GW.

By the end of 2022, a total of 326 companies had contracted a combined 77.4 GW of renewable energy, including 45 GW of solar and 28.8 GW of wind power. The Asia-Pacific region, led by India and Australia, experienced a significant surge in corporate PPA activity, more than doubling to 4.6 GW. PPA activity in Africa, Europe and the Middle East fell 7% to 8.1 GW in 2022.

US firms accounted for more than half of the record 37 GW of PPA contracts signed by corporations globally in 2022. Many of these companies have high demand for electricity due to their data centres, cloud services, artificial intelligence and other digital products. In addition, companies have set ambitious goals towards net zero emissions as well as sustainability commitments that necessitate increasing their use of renewables. Amazon, a frontrunner in signing renewable energy deals, aims to be 100% powered by renewables by 2025, five years ahead of its earlier target of 2030; in 2022, the company signed 10.9 GW of renewable energy contracts.

Source: See endnote 86 for this module.

FIGURE 6.
Corporate Renewable Energy PPAs, Global Capacity and Annual Additions, 2015-2022



Note: Data are provided in direct current (DC) and include only off-site power purchase agreements (PPAs).

RENEWABLE ENERGY MANUFACTURING CAPACITY AND SKILLED WORKFORCE

Technology manufacturing capacity and the availability of a skilled workforce are important for meeting existing renewable energy targets. (→ *See GSR 2023 Renewables for Economic & Social Value Creation Module.)* Although certain sectors are on track to achieve or even surpass the capacity needed by 2030 to align with targets for net zero greenhouse gas emissions, other sectors are falling behind and require far greater ambition to meet capacity deployment goals. Data for 2022 show strong growth in solar PV manufacturing capacity, at 39%, but lower growth for wind energy, at 2%.[100] Technologies that enable the integration of renewables also experienced growth in manufacturing capacity, including batteries (72%), electrolysers (26%) and heat pumps (13%).[101]

Solar PV manufacturing capacity has gained significant momentum in the last decade, achieving a compound annual growth rate of 25% during 2010-2021; this is estimated to exceed the rate of deployment needed to achieve global net zero targets.[102] However, significant gaps remain for wind energy manufacturing capacity.[103] Manufacturing operations for renewables and enabling technologies are highly concentrated geographically, with China dominating in both manufacturing and trade. Such concentration in global supply chains poses challenges and vulnerabilities, with tight supply chains leading to higher technology prices in recent years, raising the cost of the energy transition. Rising prices of critical minerals such as cobalt, lithium, and nickel have led to higher battery prices, and wind turbine prices also have risen due to higher input costs.[104]

In the solar industry, the global manufacturing capacity of polysilicon and other key components such as wafers and modules is projected to increase significantly by 2025, surpassing anticipated demand for solar panels.[105] In the wind sector, price inflation affecting materials (steel, neodymium and copper), as well as disruptions in the shipping sector, caused delays in the delivery of components and materials, and in turbine transport to project sites.[106] As the availability of components improves, prices are expected to decrease.

The renewable energy industry is attempting to strengthen its supply chains through vertical integration, forging long-term partnerships, making targeted acquisitions, collaborating with suppliers to in-source critical components, and expanding existing facilities or creating new ones. For example, Ørsted has partnered with the German steel producer Salzgitter AG to supply hydrogen and zero-carbon electricity for green steel production, reducing the need for additional capacity.[107]

The resilience of the supply chain can be jeopardised by supply disruptions and price fluctuations of raw materials. In 2020, China supplied 79% of the world's polysilicon, a crucial material for solar cell wafers.[108] Between 2020 and June 2022, the price of polysilicon increased 350%, driven by disruptions related to COVID-19 lockdowns, factory accidents and floods.[109] However, the growth in available production capacity for polysilicon helped to moderate this trend by late 2022 and early 2023.[110]

The wind power sector was similarly impacted by fluctuations in raw material prices. To mitigate future disruptions, wind turbine manufacturers from Europe and North America opted to expand their supply chains to ensure a reliable source of components.[111]

India has become the second largest hub in the Asia-Pacific region for turbine assembly and the production of essential components.[112] While most wind industry suppliers are still located in the Asia-Pacific region, Europe, and the United States, new participants have emerged in the Middle East and North Africa.[113]

In the United States, the Inflation Reduction Act has supported the diversification of supply chains for clean energy, including helping to scale up domestic battery manufacturing capacity.[114] Between August 2022 and March 2023, 47 manufacturing facilities for utility-scale clean energy were announced in the country (including 27 for solar PV and 10 for wind power).[115] In the EU, the REPowerEU plan was designed with the aim of increasing the regional production of renewable energy from 40% to 45%.[116] India's Production Linked Incentive scheme also aimed to increase the domestic manufacturing capacity of renewable energy and enabling technologies. (→ *See GSR 2023 Renewables in Energy Supply Module.)*

The growth of renewables relies on the availability of skilled and experienced employees. In 2021, employment in renewable energy worldwide increased 5.8% to reach 12.7 million.[117] The majority of these jobs (nearly two-thirds) are in Asia, with China alone contributing 42% of the global total.[118] From 2022 to 2030, the global renewable energy sector is projected to require the recruitment of around 1.1 million additional workers in hands-on roles for developing and building wind and solar power plants.[119] An estimated 1.7 million workers will be needed to operate and maintain these plants once they are operational.[120]

POLICY

Governments are setting renewable energy targets and implementing policies that indirectly promote the uptake of renewables, including climate change policies, economic and green recovery plans, fossil fuel phase-outs and targets for net zero greenhouse gas emissions. Such policies can impact the economy on both the demand and supply sides. Recent events such as the Russian Federation's invasion of Ukraine and rising inflation have led policy makers to prioritise energy security, resulting in comprehensive policies such as the RePowerEU package and the Inflation Reduction Act. These measures create more favourable market conditions for renewables, driving innovation, reducing costs and emissions, providing economic opportunities and enhancing global energy security.

Renewable energy targets, coupled with legislation and committed funding for implementation, illustrate the level of ambition that countries have to accelerate the energy transition. By the end of 2022, 128 countries had in place economy-wide targets for renewable energy, although only 31 countries had targets for 100% renewables, most of them for the year 2050.[121] (→ *See Figure 7.*)

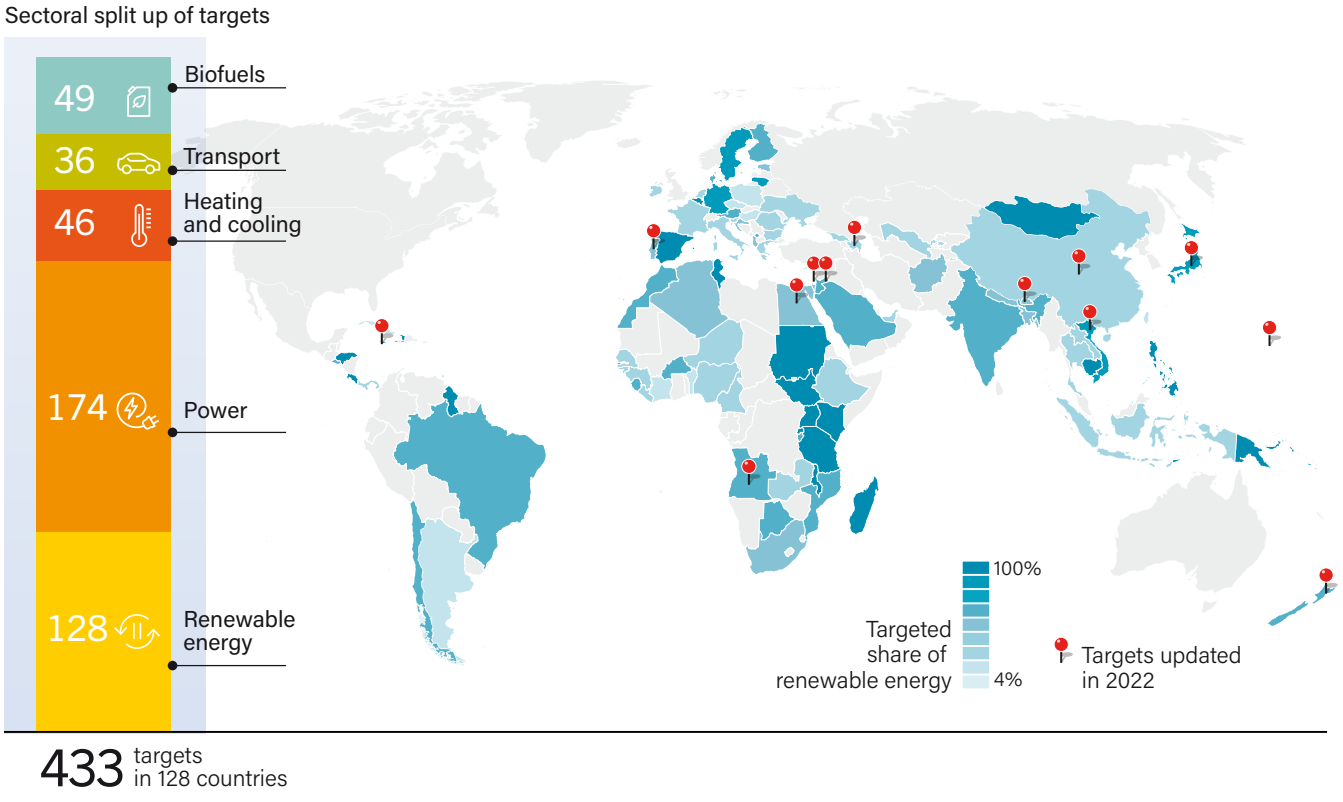
Thirteen countries revised or announced new economy-wide targets for renewables in 2022, with new targets announced in seven countries (Azerbaijan, Bhutan, Egypt, Jamaica, New Zealand, the Federated States of Micronesia and Vietnam) and targets revised in five countries (Angola, China, Israel, Jordan and Portugal).[122] Sector-specific renewable energy targets were aimed mainly at the power sector, with targets announced in 133 countries and 41 sub-national jurisdictions.[123]

POLICIES FOR RENEWABLES IN ENERGY DEMAND

On the demand side, several notable policy trends and developments occurred over the year. In buildings, the global focus on renewable heating and cooling was supported through national target-setting and specific support policies. The EU's Renewable Energy Directive set a goal for Member States to increase the share of renewables in heating and cooling annually.[124] The European Parliament even proposed raising this target to 2.5%.[125]

Many countries also introduced technology-based targets for renewables in buildings. Germany, Ireland, and the United Kingdom, for example, announced national targets for heat pump installations that are significantly higher than previous years.[126] China implemented its Building Energy Efficiency and Green Building Development Plan, which aims for substantial solar PV and geothermal heat coverage.[127] (→ *See GSR 2023 Renewables in Energy Demand Modules: Buildings in Focus.*)

FIGURE 7.
Countries with Economy-wide Renewable Energy Targets, by Sector and Targeted Share, 2022



Source: See endnote 121 for this module.

Policies related to the industry sector have focused primarily on energy efficiency and energy management rather than on renewable energy requirements. However, progress has been made in promoting renewable heat, carbon pricing mechanisms and the policy attention given to renewable hydrogen.[128] Factors driving these policies include energy crises, energy security concerns, net zero commitments and the rise of the hydrogen economy.[129] Despite these developments, the lack of comprehensive national-level data has hindered effective policy design for renewables in the industry sector. (→ *See GSR 2023 Renewables in Energy Demand Modules: Industry in Focus.*)

Policies for the transport sector aim to increase the use of renewable energy, with a focus on biofuels and electric vehicles. However, the emphasis is more on decarbonisation than on the penetration of renewables. In 2022, a few countries revised their targets for the share of renewables in transport: Portugal and the Netherlands raised their targets, while Italy lowered its target.[130]

Biofuel blending mandates remain the most common policy for promoting renewable fuels in transport, although the number of new biofuel policies has remained stagnant.[131] Electric vehicle incentives and targets have gained increasing interest. In the aviation, rail, and shipping sectors, there is a growing emphasis on sustainable aviation fuel (SAF) to decarbonise these industries.[132] The EU and the United States have implemented policies for SAF, including blending mandates and tax credits.[133] (→ *See GSR 2023 Renewables in Energy Demand Modules: Transport in Focus.*)

Overall, policies promoting the uptake of renewables in agriculture have increased. Some governments have introduced targets, requiring a certain share of energy in the sector to come from renewable sources. Four countries – including Bangladesh, India, the Republic of Korea and Zambia – had renewable energy targets in agriculture by the end of 2022.[134] Financial incentives such as subsidies, tax credits and funding programmes are the most common policies for renewables in agriculture. By the end of 2022, a total of 26 national and sub-national jurisdictions had renewable energy policies for agriculture, led by efforts in the United States, India and Bangladesh.[135] (→ *See GSR 2023 Renewables in Energy Demand Modules: Agriculture in Focus.*)

POLICIES FOR RENEWABLES IN ENERGY SUPPLY

Global energy policy has been shaped by the need for a reliable energy supply and accelerated decarbonisation efforts. Major policy developments in 2022 included the US Inflation Reduction Act, the EU's Fit for 55 and RePowerEU packages, Australia's Climate Change Bill, Japan's GX Green Transformation, and China's 14th Five-Year Plan.[136] These policies reflect increased investments and spending on the energy transition.

Many jurisdictions have set renewable energy targets for electricity generation, with Bolivia, Chile, the EU and sub-national jurisdictions in Canada announcing new or revised targets. Solar and wind power have dominated technology-specific targets.[137]

Feed-in tariffs and premiums have been widely used to support renewables, with revisions and re-introductions in various countries.[138] Net metering policies incentivise self-consumption and surplus electricity sale. Auctions and tenders have attracted private sector investments, and financial and fiscal policies, such as tax credits and incentives, have been implemented to promote renewables. However, adjustments to auctions and tenders have been challenging due to inflation and rising costs.

Among recent policies, the US Inflation Reduction Act stands out with substantial subsidies and tax credits, providing confidence to the market.[139] Other jurisdictions, such as the EU, Canada, and South Africa, have introduced financial incentives to align with the US efforts.[140] (→ *See GSR 2023 Renewables in Energy Supply Module.*)

DECARBONISATION POLICIES

Renewable energy was at the heart of discussions at the 2022 United Nations Climate Change Conference (COP 27) in Sharm El-Sheikh, Egypt, and renewable-based energy systems are seen as the single most effective way to realise a net zero carbon world.[141] Through their Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, countries have established clear targets and commitments for reducing greenhouse gas emissions and are incentivised to invest in and prioritise the development of renewables. Such plans are crucial in efforts to keep global temperature rise below 2 degrees Celsius and highlight the critical role of renewables in the transition to a low-carbon economy.

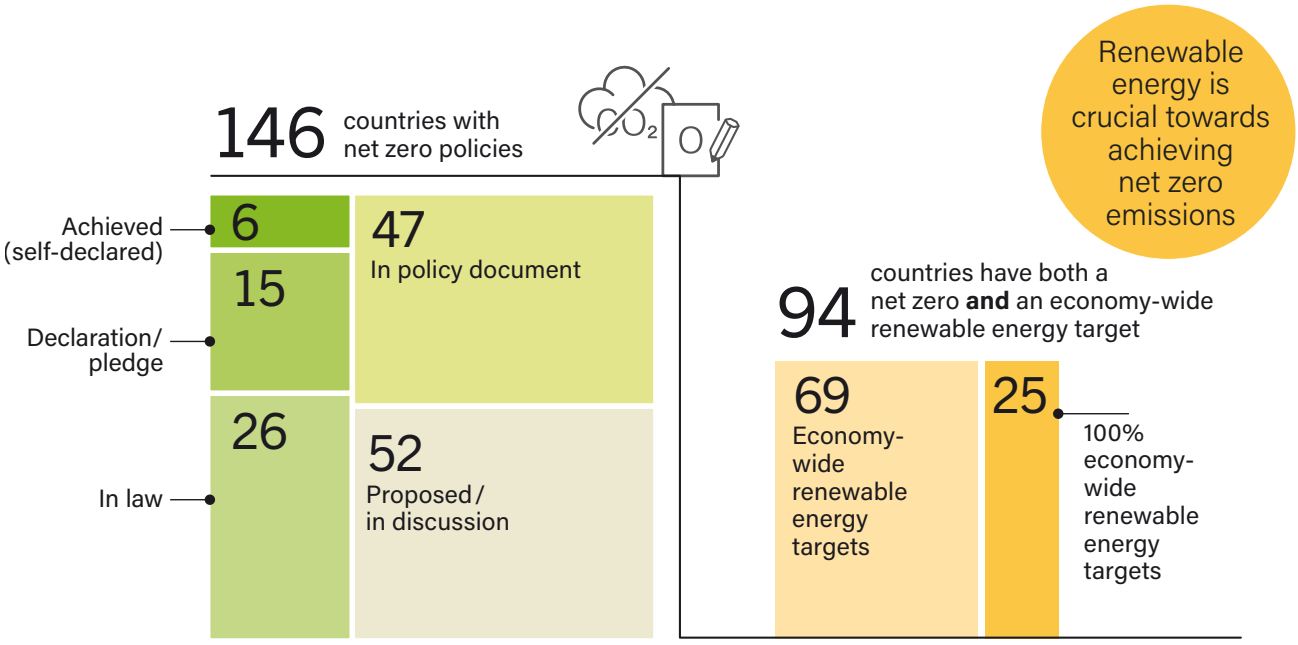
Since the signing of the Paris Agreement, 194 Parties have submitted NDCs to the United Nations Framework Convention on Climate Change (UNFCCC), outlining their plans to reduce emissions and increase renewable energy uptake.[142] In 2022, 35 countries submitted updated NDCs, although not all countries include targets for the deployment of renewables in their NDCs.[143] As of 2022, 183 Parties included renewable energy components in their NDCs, but only 143 of these had a quantified target.[144]

Policies aimed at decarbonisation indirectly promote the use of renewables and include targets for reducing greenhouse gas emissions, pledges for climate neutrality and policies for net zero emissions. As of May 2023, 146 countries had announced or adopted a net zero target.[145] (→ *See Figure 8.*) The net zero target was included in a law in 26 countries and the EU, in a policy document in 47 countries, in discussion or proposed in 52 countries, and had a declaration or pledged in 15 countries. Renewable energy is crucial towards achieving new zero emissions, and 94 countries have both a net zero and an economy-wide renewable energy target.[146]

Six countries (Benin, Bhutan, Comoros, Gabon, Guyana and Suriname) declared that they had achieved their net zero targets as of 2022. In March, the Republic of Korea's Carbon Neutrality Bill and Green Growth Act for Climate Change entered into force, requiring the government to cut emissions 35% by 2030 and to reach net zero by 2050.[147] However, as of December 2022 the UNFCCC reported only 57 submissions of long-term low-greenhouse gas emission development strategies, with 11 countries having submitted their strategies during the year (Argentina, Canada, the Gambia, Germany, India, Lithuania, the Russian Federation, Singapore, Thailand, Tunisia and Zimbabwe).[148] Such strategies outline a country's long-term vision for decarbonising its energy system, reducing emissions and promoting renewable energy uptake.[149]

Carbon pricing policies put a price on carbon emissions to encourage a shift towards low-carbon technologies, thereby reducing greenhouse gas emissions. Adopted by governments and/or regional organisations, the policies can take the form of carbon taxes or cap-and-trade systems. They can help raise revenue for investments in renewables and other low-carbon technologies and provide incentives for companies to reduce their carbon footprints.

FIGURE 8.
Countries with Net Zero and Renewable Energy Targets, 2022



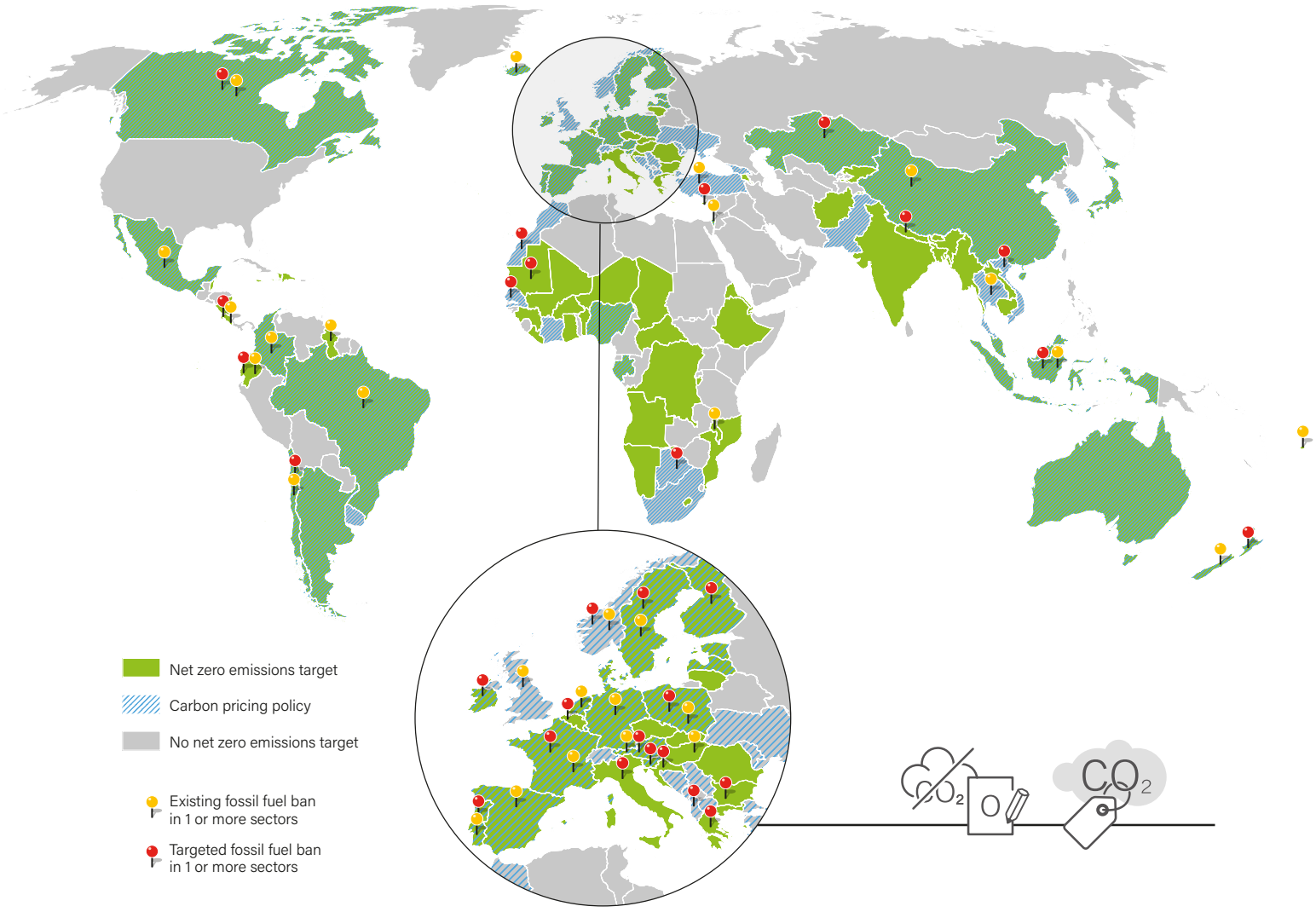
Source: See endnote 145 for this module.

By early 2023, a total of 55 countries had either implemented or were considering carbon pricing policies.[150] (→ *See Figure 9.*) Out of these, 24 countries had either implemented or were considering a carbon tax, while 21 countries had implemented or were considering an emission trading system (ETS).[151] A further 10 countries had both a carbon tax and an ETS in place or under consideration.[152] Two countries, Australia and Vietnam, had plans to implement an ETS at a later date.[153] Among the 55 total countries, 37 had both a carbon pricing policy and either an existing or planned ban on fossil fuels in one or more sectors such as power, heating or transport.[154] Out of these 37 countries, 19 also had set a net zero target.[155]

Only five countries (Australia, Austria, Indonesia, Montenegro and Uruguay) scheduled or implemented carbon pricing policies in 2022 and early 2023.[156] In a notable breakthrough, the European Council and the European Parliament agreed in December 2022 to implement the EU Carbon Border Adjustment Mechanism, which will apply a carbon price on certain imported goods from countries that do not have carbon pricing policies.[157]

The EU is in talks to introduce the EU ETS 2, covering emission trading for buildings, road transport and smaller industries.[158] The EU ETS 2 is aimed at regulating fuel suppliers upstream, potentially starting in 2027, and would include a Social Climate Fund to support vulnerable households and microenterprises.[159] The scheme would update the EU ETS, the world's oldest and largest carbon pricing system, which is in its fourth phase since 2021. In 2022, Mexico also updated its General Law on Climate Change to clarify implementation of the Mexican Emission Trading System.[160] In a reverse move, in 2023 Slovenia abolished its carbon tax policy, first implemented in 1996.[161]

FIGURE 9.
Countries with Climate Change Policies, by Type of Measure, 2022



Source: See endnote 150 for this module.

PHASE-OUTS AND BANS ON FOSSIL FUEL SUBSIDIES

In 2022, fossil fuel prices reached unprecedented highs and volatility following the Russian Federation's invasion of Ukraine, particularly as the Russian fossil gas supply to Europe was reduced sharply.[162] Various policy measures were implemented to shield consumers from surging prices and fuel poverty, maintaining the competitiveness of fossil fuels compared to low-emission alternatives. As a result, global subsidies for fossil fuel use surpassed USD 1 trillion, the highest annual value ever recorded.[163]

Many countries have Implemented temporary measures to shield end-consumers from rising fossil fuel prices, particularly in the transport and electricity sectors.[164] Egypt, El Salvador, France, Peru and Thailand have put in place price caps or have fixed prices for fossil fuels for electricity and/or transport.[165] Belgium, Guyana, South Africa and the United Kingdom have implemented exemptions on fossil fuel taxes and levies.[166] Germany, India and the Republic of Korea have enacted compensation mechanisms for different consumer groups.[167]

All of these measures can be categorised as fossil fuel subsidies, effectively hampering the uptake of renewables by distorting end-user energy prices for fossil fuels.[168] Policies supporting fossil fuels, including subsidies for exploration, production, and consumption, distort the market and are strong roadblocks to the deployment of renewables.[169]

Among efforts to slow fossil fuel growth, Colombia, an oil-producing country, announced in early 2023 that it would not approve new oil and gas exploration projects.[170] In 2022, Indonesia signed a Just Transition Partnership with the Group of Twenty (G20) countries and the EU to phase out coal.[171] Brazil entered a Just Transition Partnership to phase out coal use in the Santa Catarina region.[172] India led the call to phase out fossil fuels at COP 27.[173] Climate ministers in the Group of Seven (G7) countries agreed to speed the phase-out of unabated fossil fuel by 2050 at the latest.[174] At the sub-national level, Quebec, Canada voted to ban new fossil fuel exploration and to shut down existing drill sites within three years.[175] On the other hand, Norway approved new oil and gas projects worth USD 18.6 billion in 2023.[176]

RENEWABLE ENERGY FOR ECONOMIC DEVELOPMENT AND RECOVERY

Amid the current global energy crisis, countries have developed recovery plans mentioning renewables (on both the supply and demand sides), usually targeting specific sectors such as industry and transport. In October 2022, the EU approved the National Recovery and Resilience Plans of the 26 Member States, which allocate a total of EUR 34 billion (USD 36.3 billion) in clean energy investment.[177] Under the plans, Member States intend to invest in a range of renewable technologies, including solar (Austria, Bulgaria, the Czech Republic, Greece, Italy, Lithuania and Spain), offshore and onshore wind (Belgium, Finland, Greece, Italy and Poland), biomass (Austria, Croatia and Sweden), hydrogen (17 Member States) and energy infrastructure (Estonia, Latvia and Romania).[178]

In August 2022, the United States launched the Inflation Reduction Act with the objective of reducing inflation while also tackling climate change, allocating more than USD 370 billion to clean energy measures.[179] At the sub-national level, Puerto Rico announced a USD 1 billion energy resilience relief package with dedicated funds for residential renewables.[180] Greece's post-pandemic recovery plan allocates EUR 200 million (USD 213.5 million) for residential solar with storage.[181] However, NIMBY ("not-in-my-back-yard") movements and opposition to renewable energy are still very present; in the United States, at least 121 local policies block or counteract the adoption of renewables in 31 states.[182]

ENERGY EFFICIENCY

Energy efficiency policies are instrumental in driving the energy transition in all sectors (including buildings, heating and cooling) and complement renewable energy policies. Many existing recovery plans, such as in Canada, Europe, and the United States, include an energy efficiency component to tackle energy security.[183] In an update to Japan's energy efficiency law for buildings, starting in 2025 energy efficiency standards will become compulsory for all new residential and non-residential buildings, in addition to the current coverage of non-residential buildings with a floor area of 300 square metres or more.[184] Singapore has launched an Energy Efficiency Grant Program to help businesses invest in energy-efficient solutions to mitigate rising energy costs.[185] In 2022, Cambodia announced a National Energy Efficiency Policy aimed at setting long-term energy transition objectives for the energy sector.[186]

As of May 2023,
146 countries
had announced or
adopted a net zero target.

TABLE 1.
Renewable Energy Indicators, 2022

		2022
INVESTMENT		
New investment (annual) in renewable power and fuels[1]	billion USD	**495**
POLICIES[2]		
Countries with renewable energy targets	#	**174**
Countries with renewable energy policies	#	**166**
Countries with 100% renewable heating and cooling targets	#	**3**
Countries with 100% renewable transport targets	#	**2**
Countries with 100% renewable electricity targets	#	**37**
Countries with regulatory policies in buildings (power, heating and cooling, transport)	#	**21**
Countries with biofuel mandates[3]	#	**56**
Countries with feed-in policies[4]	#	**83**
Countries with net metering policies[4]	#	**92**

1 Data are from BloombergNEF and include investment in new capacity of all biomass, geothermal and wind power projects of more than 1 MW; all hydropower projects of between 1 and 50 MW; all solar power projects, with those less than 1 MW estimated separately; all ocean power projects; and all biofuel projects with an annual production capacity of 1 million litres or more. Total investment values include estimates for undisclosed deals as well as company investment (venture capital, corporate and government research and development, private equity and public market new equity).

2 A country is counted a single time if it has at least one national or state/provincial target or policy.

3 Biofuel policies include policies listed in Reference Table R3a in the GSR 2023 Demand Module Data Pack, available at https://www.ren21.net/gsr2023-data-pack.

4 Data reflect all countries where the policies have been used at any time up through the year of focus at the national or state/provincial level. See Reference Table R5 in the GSR 2023 Supply Module Data Pack, available at https://www.ren21.net/gsr2023-data-pack/supply.

TABLE 2.
Renewable Energy Targets and Policies, 2022

Country	Targets		Regulatory Policies				Fiscal Incentives and Public Financing		
	Renewable energy in INDC or NDC	Renewable energy target	Net zero target	Feed-in tariff/ premium payment	Net metering/billing	Biofuel blend, renewable transport obligation/mandate[2]	Renewable heat obligation/mandate, fossil fuel ban	Reduction in sales, energy, CO_2, VAT or other tax	Investment or production tax credits	Public investment, loans, grants, capital subsidies or rebates
High Income Countries										
Andorra	☆		☆	●						
Antigua and Barbuda	●	P, T	☆		●					
Argentina	●	E, P	☆	●	●	★, ●	◖	●[12], ●	●[12]	●, ●[12]
Australia	☆	E*, P*	●, ◖	●*, ●	◖	◖	●, ●[9], ★[10]		●, ◖, ★[13], ★*[13]	●, ◖[12]
Austria	●	E, P, HC, T	●	●		●	●[9], ★[10]	●[12]	●[12]	★[12], ◖
Bahamas, The	☆	E, P	●							
Bahrain	●	E, P	●		●					●
Barbados[1]	●	E, P	●	●	●			●		●
Belgium	●	E, P, P[6], HC, T	☆	●	●, ◖	●	★*, ★[10]	●[12], ●	●	◖
Brunei Darussalam	●	E, P					●[9]			
Canada	●	E*, P*(N), P*[6](N), HC*(R)	●	☆*		●, ◖	◖[9], ★*[10]	●[12], ●, ★	●[12], ★[13]	●, ●[8], ★[12]
Chile	●	E, P(N), P[6], HC	☆		●		●[10]	●[12], ●	●[12], ●	●, ●[12]
Croatia	●	E, P, P[6], HC, T	●	●		●	●[10]			●[12]
Cyprus	●	E, P, HC, T	☆	●	☆	●	●[10]		★, ●	●, ★[12]
Czech Republic	●	E, P, HC, T	★	●		◖	★[10]	●[12], ●	●, ★	●[12]
Denmark	●	E, P, HC, T	●	●	●	●	●[10], ●[11]	●[12], ●	●, ★[12]	●[12]
Estonia	●	E, P, HC, T	●	◖		●			★, ●	●, ●[12]
Finland	●	E, HC, T	☆	◖		★, ●	●[10]	●[11], ●, ●[12]	★[12], ★[13], ●	●, ●[12]
France	●	E, P, P(N)[6], HC, T, T*	●	●		●	●[10]	●[12], ●	●[2], ★[12]	●[12]
Germany	●	E, P, P(N)[6], HC(N)	●	●		●	●[9], ●[10], ★	●	●	●[12], ●, ★
Greece	●	E, P, P(N)[6] HC, T	☆	●	●	●	●[10], ●[11]	●[12], ●	●[12], ★[13]	●, ●[12]
Hungary	●	E, P, HC, T	●	◖	●	●	●[10]	●, ●	●	●[12]
Iceland	●	HC, T(N)	☆							
Ireland	●	E, P, P(N)[6], HC, T	●	●		●	●[10], ●[11]	●[12]	●	●[12], ●[8], ★
Israel	●	E(R), P	☆	●	●		●	●[12], ●		●
Italy	●	E, P, HC, T	●	●	☆	●	◖, ●[10]	●	●[12]	●, ●[12], ●[8]
Japan	●	E(N) E(R), P	●	●			●	●		●, ●[12]
Korea, Republic of	●	E, P, P[6]	●	◖	●	★, ●	●, ●[10]	●	●	●, ●[12]
Kuwait	●	P								
Latvia	●	E, HC, T	●	◖	☆	◖		●	●	
Liechtenstein	●			●			●, ●[10]			
Lithuania	●	E, HC, T	●	●	●	●	★[9], ●[11]	●[12], ●	●	●, ★[12]
Luxembourg	●	E, P, HC, T	☆	●		●	●[10]	●	●	●, ●[12], ★[12]
Malta	●	E, HC, T	●	●		●		●	●	●[12]
Monaco	●		●							
Netherlands	●	E, P, HC, T	★	●, ☆*	◖	●	★[9], ●[10], ●[11]	●[12]	●[12], ★[12]	★[12]
New Zealand	●	E(N), P	●	◖	◖	●	●[10]	●	●	●, ★[12]
Norway	☆	P, P(N)[6], HC		●		●, ●[8]	●, ●[10]	●		●[12]
Oman		P	★	●						
Palau	●	P(R)	●							
Panama	●	E			●	●		●	●	
Poland	●	E, P, HC, T		●		●	●[10]	●	●	●[12], ★[12]
Portugal[2]	●	E(R), P, P[6], HC, T(N)	●	●		●	●, ●[10]	●	●	●, ●[12]
Qatar	●	P, P[13]								
San Marino				●						
Saudi Arabia	●	E, P	☆	●	●					
Seychelles	●	E, P	●		●			●	●	●
Singapore	☆	P, HC	●				●[10]			●
Slovak Republic	●	E, C, T	☆	◖		●	★[10]	●, ●[8]	●	●[12]
Slovenia	●	E, HC, T	●	●	☆	●	●[10]	●	●	●[12]
Spain[3]	●	E, P, P*[6](N), HC,T	●	◖	●	●	●[9], ●[10]	●	●, ★[12]	●[12], ★[12]
St. Kitts and Nevis	●	P	★	☆						
Sweden	●	E, P, HC	●	●		●	●[10]	●	●	●, ●[12]
Switzerland	●	P	☆	◖			◖	●		●[12]
Trinidad and Tobago	●	E, P	●	●				●	●	
United Arab Emirates	☆	E, P, P*[6]	☆		◖					◖
United Kingdom	☆	P, P*[6](N), HC, T*	●	◖, ◖		●	★[10], ●[10], ●[10], ●[11]	●	★, ★*[12], ★[13], ●	●[12], ●[8], ◖, ★, ★[12]
United States[4]		E*, P*	●, ◖	◖, ◖	☆*	●, ◖, ◖*	★*[9], ●, ◖[10]	●	●, ●[8], ●[8]*, ★, ★*, ★[13]	●[12], ●[8], ◖, ◖[12]
Uruguay	☆		●	●	●	◖	●	●		●[12], ★

Note: Please see key on last page of table.

TABLE 2.
Renewable Energy Targets and Policies, 2022 (continued)

Country	Targets		Regulatory Policies				Fiscal Incentives and Public Financing		
	Renewable energy in INDC or NDC	Renewable energy target	Net zero target	Feed-in tariff/ premium payment	Net metering/billing	Biofuel blend, renewable transport obligation/mandate[12]	Renewable heat obligation/mandate, fossil fuel ban	Reduction in sales, energy, CO_2, VAT or other tax	Investment or production tax credits	Public investment, loans, grants, capital subsidies or rebates
Upper-Middle Income Countries										
Albania	●	E, HC, T		●	●			●	●	●
Algeria	●	E, P		◔						●
Armenia	●	E, P, P[6]	●	●	●					●[12]
Azerbaijan	●	E(N), P		●			●[10]			●
Belarus	●	E		●				●		●
Belize	●	P, P[6]	●							
Bosnia and Herzegovina	●	HC		●						
Botswana	●	E		●	●		●[10]	●		●
Brazil		E, P, P[6]	☆	◔	●	★, ●	◗	●	●	●
Bulgaria	●	E, P, HC, T	●	●		●	●[9], ◔		★[13]	●[12]
China	☆	E(R), P, P(N)[6]	●	◗, ◔		●	★, ●[9], ★*[9]	●	●	●, ●[12], ●[13], ◔
Chinese Taipei		E, P, P[6]		●		◔			●	
Colombia	●	E, P, P[6]	☆			★, ●		●	●, ★[13]	●
Costa Rica	●	E, P	●	◔	●	●	●[10]	●[12], ●		
Cuba	●	E, P								
Dominica	☆		★							
Dominican Republic	●	P	●	●	●			●	●	●
Ecuador	●	P, P[6], T	●	◔		●	●[10]	●		●
Equatorial Guinea	☆									
Fiji	☆	E, P	☆					●	●	
Gabon	☆		★							
Grenada	●	P	●		●			●		
Guatemala	☆	P			●			●	●	
Guyana	●	E, P	●[7]					●		
Iran	●			●				●	●	●
Iraq	●	P, P[6]		◔						
Jamaica	●	E(N), P	●		☆	●		●	●	
Jordan	●	E(R), P		◔	●		●	●		●, ●[12]
Kazakhstan	●	E, P	☆	◔			●[10]			●
Lebanon	●	E, P, HC	☆		●			●[12], ●		●[12]
Libya		P(R)						●		
Macedonia, North	●	E, P, HC, T		●				●[12]	●	●[12]
Malaysia	●	P	●	☆	●			●		●
Maldives	●	E, P	☆	●	●		●			
Marshall Islands	●	E	●					●		
Mauritius	☆	P	●	☆	●		●[10]	●		●[12]
Mexico	☆	P, HC	★		●	★, ●		●	●	●, ●[12]
Montenegro	●	HC		◔	●			●		
Namibia	●	E, P	●	◔	●		●			
Nauru	●	E	●							
Paraguay	●					●		●		
Peru	◔	P	☆	●	●	◔		●		●
Romania	●	P(R), P[6], HC, T	★		☆	●	●[10]		●, ★[13]	●, ●[12]
Russian Federation	●	P	☆	●	●					●
Samoa	●	E, P	●							
Serbia		P, HC(N)		●						●
South Africa	●	P	●	☆		●	●	●	●, ★[13]	●, ●[12]
St. Lucia	●	P	★					●		
St. Vincent and the Grenadines[1]	●		●	●	●					
Suriname	●	P	●[7]							
Thailand	☆	E, P, HC	☆	●	●	★, ●		●		●, ●[12], ●[13]
Tonga	●	P	●							
Türkiye	☆	P, HC	●	●	●	●	★[9], ●[11]			●, ●[12]
Turkmenistan	☆									
Tuvalu	☆	E, P	☆							
Venezuela	●									

Note: Please see key on last page of table.

TABLE 2.
Renewable Energy Targets and Policies, 2022 (continued)

Country	Targets		Regulatory Policies				Fiscal Incentives and Public Financing		
	Renewable energy in INDC or NDC	Renewable energy target	Net zero target	Feed-in tariff/ premium payment	Net metering/billing	Biofuel blend, renewable transport obligation/mandate[2]	Renewable heat obligation/mandate, fossil fuel ban	Reduction in sales, energy, CO_2, VAT or other tax	Investment or production tax credits	Public investment, loans, grants, capital subsidies or rebates
Lower-Middle Income Countries										
Angola	●	E(R), P	●	●	●	●		●		●
Bangladesh	●	E, P, T	☆					●		●
Bhutan	●	E(N)	●[7]							
Bolivia	☆	P(R)			●	●		●		●
Cabo Verde	●	E, P	☆					●	●	
Cambodia	●	E, P	●	●						
Cameroon	●	E, P						●		
Congo, Republic of	●									
Côte d'Ivoire	☆	E, P, P[6]					●[10]	●		
Djibouti	●	E	★							
Egypt	☆	E(N), P, T		●	☆		●[10]	●[12], ●		●
El Salvador	☆	E, P						●	●	●
Eswatini	●	P								
Georgia	●	E, HC		●	★					●, ●[12]
Ghana	●	E, P, P6	★	●	☆			●		●
Honduras	●	E, P		◗	●			●	●	
India	☆	E, P, P(N)[6], P*(N)[6]	●	●	◖, ◖, ☆	★, ●	●[9], ◖[9]	●	●, ★*[12]	●*, ◖, ●[12]
Indonesia	☆	E, P	●	●	●	★, ●		●	●	●
Kenya	●	E, P		●	☆		●	●		●
Kiribati	☆	E, P	●							
Kosovo		E, HC		●						
Kyrgyz Republic	●		★	●				●		●
Lao PDR	●	E, P, P(N)[6]	☆							
Lesotho	●	E	●	●	●			●	●	●
Mauritania	●		●				●, ●[10]			
Micronesia, Federated States of	☆	E(N)	☆							
Moldova	●	E(N), HC		●	●					●
Mongolia	●	E, P		●				●		
Morocco	●	E, P			●		●[10]			●, ●[12]
Myanmar	●	E, P	●					●		
Nicaragua	●	P	●	●				●	●	●
Nigeria	●	P	☆	●	●	●		●		●
Pakistan	●	E, P	●	●	●			●		●
Palestine, State of[5]	●	E		●	●			●		
Papua New Guinea	●	E, P	☆							
Philippines	●	E, P		●	☆	●	●[10]	●	●	●, ●[12]
São Tomé and Príncipe	●	E, P, P[6]	●							
Solomon Islands	●	E, P	●							
Sri Lanka	●	P	☆	●	●		●[10]	●		●
Sudan	☆	E, P	●			●				
Timor-Leste	☆	E	●							
Tunisia	●	E, P	★		●			●		●[12]
Ukraine	●	E, P, HC	●	●		●		●		●[12]
Uzbekistan	●	P(R)							●	
Vanuatu	●	E, P	☆	●				●		
Vietnam	☆	E(N), P, P(N)[6]	☆	●		●		●	●	●
Zambia	☆	E	●	●			●[10]	●		●

Targets

- **E** Energy
- **P** Power
- **HC** Heating and cooling
- **T** Transport
- * Sub-national target
- **(R)** Revised
- **(N)** New

Policies

- ● Existing national (could include sub-national)
- ◖ Existing sub-national (but no national)
- ● Removed
- ★ New (one or more policies of this type)
- ★* New sub-national
- ☆ Revised (from previously existing)
- ☆* Revised sub-national

Note: Please see key on last page of table.

TABLE 2.
Renewable Energy Targets and Policies, 2022 (continued)

Country	Targets		Regulatory Policies				Fiscal Incentives and Public Financing		
	Renewable energy in INDC or NDC	Renewable energy target	Net zero target	Feed-in tariff/ premium payment	Net metering/billing	Biofuel blend, renewable transport obligation/mandate[12]	Renewable heat obligation/mandate, fossil fuel ban	Reduction in sales, energy, CO_2, VAT or other tax	Investment or production tax credits	Public investment, loans, grants, capital subsidies or rebates
Low Income Countries										
Afghanistan	●	E	●							
Benin	●	E	●[7]							
Burkina Faso	●	E, P	●					●	●	
Burundi	●	E, P	●							
Central African Republic	☆		●							
Chad	●		●							
Comoros	●	E	●[7]							
Congo, Democratic Republic of	●	E	★							
Eritrea	●	P	●							
Ethiopia	●	E, P	●			●				
Gambia	●	E, P	☆					●		
Guinea	●	E	●					●		
Guinea-Bissau	●	E, P								
Haiti	☆	E, P	☆							●
Korea, Democratic People's Republic	●									
Liberia	●	E, P, P[6]	☆					●		
Madagascar	●	E, P		●				●		
Malawi	●	E, P	●	●		●	●	●	●	●
Mali	●	E, P, T	●					●		●
Mozambique	●	P, HC	●	●		●		●		●
Nepal	●	E, P, P[6]	●	●			●[10]	●	●	●
Niger	●	E	●					●		
Rwanda	●	E, P	●	●				●	●	●
Senegal	●	E, P	●		●		●[10]	●	●	
Sierra Leone	●	P	●							
Somalia	●		●				●[10]			
South Sudan	●	E	●							
Syria	●			●				●	●	
Tajikistan	●			●				●		●
Tanzania	●	E, P, HC, T	●	●	●			●		●
Togo	●	E	●					●		★[13]
Uganda	☆	E	●	●				●		●
Yemen	●	P	●							
Zimbabwe	●	P		●	●	●		●		●

1 Certain Caribbean countries have adopted hybrid net metering and feed-in policies whereby residential consumers can offset power while commercial consumers are obligated to feed 100% of the power generated into the grid. These policies are defined as net metering for the purposes of the GSR.
2 FIT support removed for large-scale power plants.
3 Spain removed FIT support for new projects in 2012. Support remains for certain installations linked to this previous scheme.
4 State-level targets in the United States include Renewable Portfolio Standard (RPS) policies.
5 The area of the State of Palestine is included in the World Bank country classification as "West Bank and Gaza".
6 Installed capacity power targets (see Reference Table R4 in the Renewables in Energy Supply Data Pack).
7 Declared achievement of net zero target.
8 Aviation, maritime or rail transport.
9 Heating policy applies for buildings and not heating and cooling sector as a whole. Policy may include power, water heating or renewable energy technology installation mandates in buildings.
10 Fossil fuel heating ban.
11 Heat FIT.
12 Includes renewable heating and/or cooling technologies.
13 Investment or tax credits are for renewable energy storage.

Notes: (INDCs) are Intended Nationally Determined Contributions and (NDCs) are Nationally Determined Contributions. Multiple entries refer to multiple policies; see Reference Tables in the REN21 Policy Database for the GSR 2023 Collection.

Countries are organised according to annual gross national income (GNI) per capita levels as follows: "high" is USD 13,205 or more, "upper-middle" is USD 4,256 to USD 13,205, "lower-middle" is USD 1,086 to USD 4,255 and "low" is USD 1,085 or less. Per capita income levels and group classifications from World Bank, "Country and Lending Groups", http://data.worldbank.org/about/country-and-lending-groups, viewed June 2023. Only enacted policies are included in the table; however, for some policies shown, implementing regulations may not yet be developed or effective, leading to lack of implementation or impacts. Policies known to be discontinued have been omitted or marked as removed or expired. Many feed-in policies are limited in scope of technology.

Source: This module is intended to be only indicative of the overall landscape of policy activity and is not a definitive reference. Generally, listed policies are those that have been enacted by legislative bodies. Some of the listed policies may not yet be implemented, or are awaiting detailed implementing regulations. It is difficult to capture every policy change, so some policies may be unintentionally omitted or incorrectly listed. This report does not cover policies and activities related to technology transfer, capacity building, carbon finance and Clean Development Mechanism projects, nor does it attempt to provide a comprehensive list of broader framework and strategic policies – all of which are still important to renewable energy progress. For the most part, this report also does not cover policies that are still under discussion or formulation, except to highlight overall trends. Information on policies comes from a wide variety of sources, including the International Energy Agency and International Renewable Energy Agency Global Renewable Energy Policies and Measures Database, the US Database of State Incentives for Renewables & Efficiency (DSIRE), press reports, submissions from REN21 contributors and a wide range of unpublished data. Table 2 is based on numerous sources cited throughout this module and the sources listed in the REN21 Policy Database Data Packs for the Renewables in Energy Demand, Renewables in Energy Supply and Global Overview found on the REN21 website and through the modules' interactive online version.

INVESTMENT

ENERGY SYSTEM INVESTMENTS

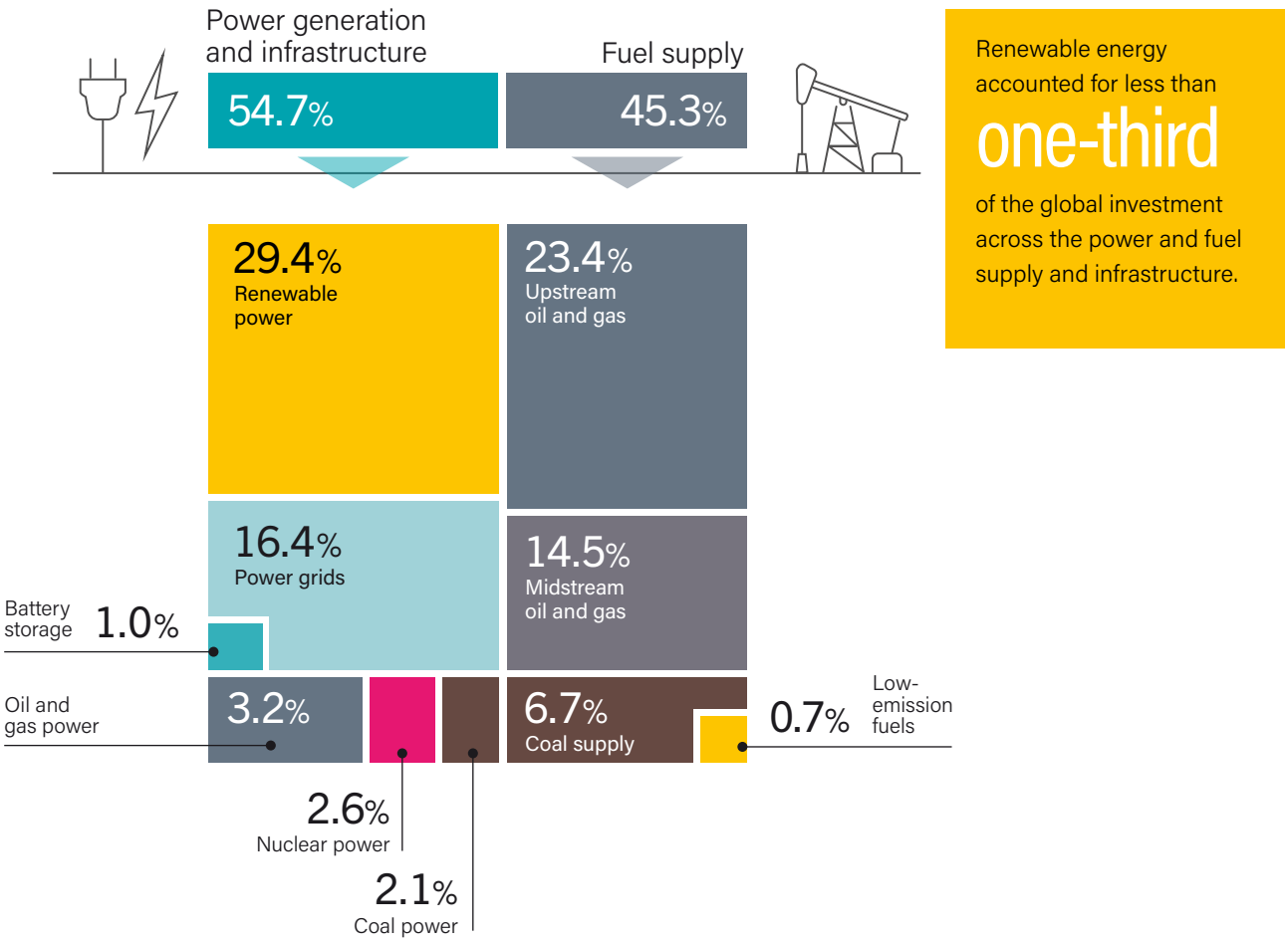
Global new investment in renewable power and fuels[i] reached a record high of USD 495.4 billion in 2022.[187] (→ *See GSR 2023 Renewables in Energy Supply Module.*) However, this was less than one-third (29.4%) of the total global investment committed across the power and fuel supply and infrastructure (including fossil fuels and nuclear) during the year.[188] (→ *See Figure 10.*) Investment in renewable power and fuels increased 17.2% from 2021, due largely to the global rise in solar PV installations.[189]

Investment varied by region, rising in Brazil, China and India but falling in Europe and the United States. China continued to account for the largest share of investment, at 55%, followed by Europe (11.3%), Asia-Oceania (excluding China and India; 10.8%), the United States (10.0%) and all other world regions, which accounted for 4% or less of the total.[190]

Spurred in part by high prices, global investment in the fossil fuel supply increased in 2022, although it did not return to pre-pandemic levels.[191] In many parts of the world, the Russian Federation's invasion of Ukraine drove up fossil gas prices to record levels and oil prices to levels not seen in a decade or more.[192] Higher investment in coal – mostly in China and India – was driven by robust demand and high prices.[193] These trends resulted in record net profits from fossil fuel sales.[194] (→ *See Sidebar 2.*)

i Renewable power and fuels does not include hydropower projects larger than 50 MW. In addition, these estimates do not include investments in renewable heating and cooling technologies, for which data are not collected systematically.

FIGURE 10.
Global Investment in the Energy Sector, by Type, 2022



Source: See endnote 188 for this module.

Note: "Low-emission fuels" include modern liquid and gaseous bioenergy, low-emission hydrogen and low-emission hydrogen-based fuels.

SIDEBAR 2. Are the World's Big Fossil Fuel and Financial Players Supporting the Energy Transition?

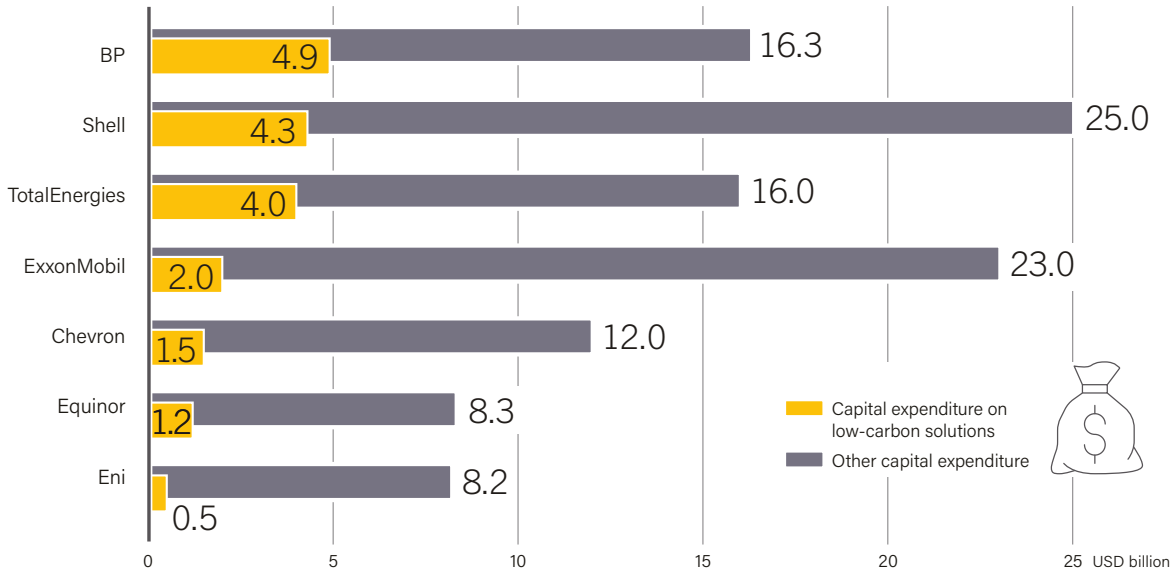
Fossil Fuel Companies Are Failing to Transition

Fossil fuel companies are increasingly rebranding as "energy companies", as awareness about climate change grows and societal acceptance of fossil fuel use plummets. At the same time, some governments have shifted their political priorities in a push to phase out oil and gas production, although fossil fuels remain heavily subsidised. In one example of high-level political action, the Beyond Oil and Gas Alliance (BOGA) brings together key players in the international arena – including the governments of Costa Rica, Denmark, France, Tuvalu and Vanuatu – in a call for a "massive increase in energy efficiency and renewable energy investment".

Many oil companies have designed internal scenarios for net zero emissions by 2050 to showcase their commitments to long-term decarbonisation and to guide their strategic decision making. However, most companies continue to rely heavily on fossil fuels as the main component of their business portfolio. A 2022 study found that scenarios by BP, Equinor and Shell were inconsistent with the emission reduction goals outlined in the Paris Agreement. Scenario updates in 2023, such as Shell's Sky 2050, show that to keep global temperature rise below 1.5 degrees Celsius, oil and gas production need to stop growing, and solar PV and wind power must ramp up significantly, adding an estimated 950 GW of solar PV and more than 90,000 wind turbines annually by 2050.

But fossil fuel companies are not ambitious enough. In 2022, in the context of the global energy crisis, the five biggest western fossil fuel companies – Chevron, ExxonMobil, Shell, BP and TotalEnergies – earned their **highest profits ever, totalling USD 195 billion, or 120% more than in 2021**. Despite widespread commitments towards net zero emissions by 2050, as of 2022 low-carbon solutions averaged only 17% of the total capital investment of the top seven fossil fuel companies (→ *see Figure 11*) and accounted for only 1.13% of total global investment in clean energy, while investments in renewables are not clearly disclosed.

FIGURE 11.
Share of Total Capital Investment of Fossil Fuel Companies Dedicated to Low-Carbon Solutions, 2022



Note: Equinor defines "low carbon" as renewable energy and low-carbon solutions, including hydrogen and carbon capture, utilisation and storage; BP defines it as transition growth investment (including power trading and marketing); Shell uses the term low carbon energy solutions, ExxonMobil uses low carbon solutions, and TotalEnergies refers to low carbon energies (excluding new molecules).

Source: See endnote 194 for this module.

> Continued next page

SIDEBAR 2. Are the World's Big Fossil Fuel and Financial Players Supporting the Energy Transition? (continued)

In 2022, the average capital expenditure of the top five fossil fuel companies increased to USD 16.1 billion (up from USD 12.4 billion in 2021), yet the share of low-carbon investment, of which renewable energy is only a fraction, did not increase. This indicates that new investment was not channelled towards long-term net zero targets, but rather towards growth in fossil fuel projects, dividends, share buybacks and debt repayment. Moreover, these companies each invested nearly USD 7 billion annually in fossil fuel exploration, signalling a long-term commitment to fossil energy sources.

Fossil fuel companies lack transparency in their communications around renewable energy, as reporting on capital expenditure is not disaggregated. Renewable energy is often part of the larger category of low-carbon solutions that can comprise carbon capture, utilisation and storage (CCUS), hydrogen and energy efficiency. Shell, for example, reports in its annual acounts on "renewables, energy solutions and downstream business", combining renewables, electric vehicle charging services, and the portion of its chemicals production that turns oil into diverse products. Thus, the share of capital expenditure on renewable energy is smaller than the overall low-carbon expenditure.

Financial Flows Are Still Locked In

The flow of liquid capital investment from banks to fossil fuel projects is still significant and far exceeds the flows towards renewable energy projects. The financial sector plays a critical role as both a lender and an investor. Financial institutions support large-scale fossil fuel projects through loans and underwriting as well as through investments in bonds and shares (equity ownership).

Institutional investors (such as commercial banks, hedge funds and pension banks) hold a large amount of **bonds and shares** in fossil fuel companies[i], totalling more than USD 3 trillion in 2022. Just two players – Vanguard and Blackrock – held 17% of these shares, and US-based institutions held 64% of them. Around 40% of the investments were held by members of the Glasgow Financial Alliance for Net Zero (GFANZ).

On the lending side, the top 60 financial institutions are contributing to a financial lock-in to fossil fuels, as only 12% of the loans and underwriting to energy project finance in 2021 (and 7% in 2022) went to renewables. (→ *See Figure 12.*) In a broader assessment, BloombergNEF found that 44% of energy loans went to low-carbon energy supply projects. However, even when this low-carbon category includes nuclear and clean energy manufacturing, it still falls short of the 80% in low-carbon loans needed by 2030.

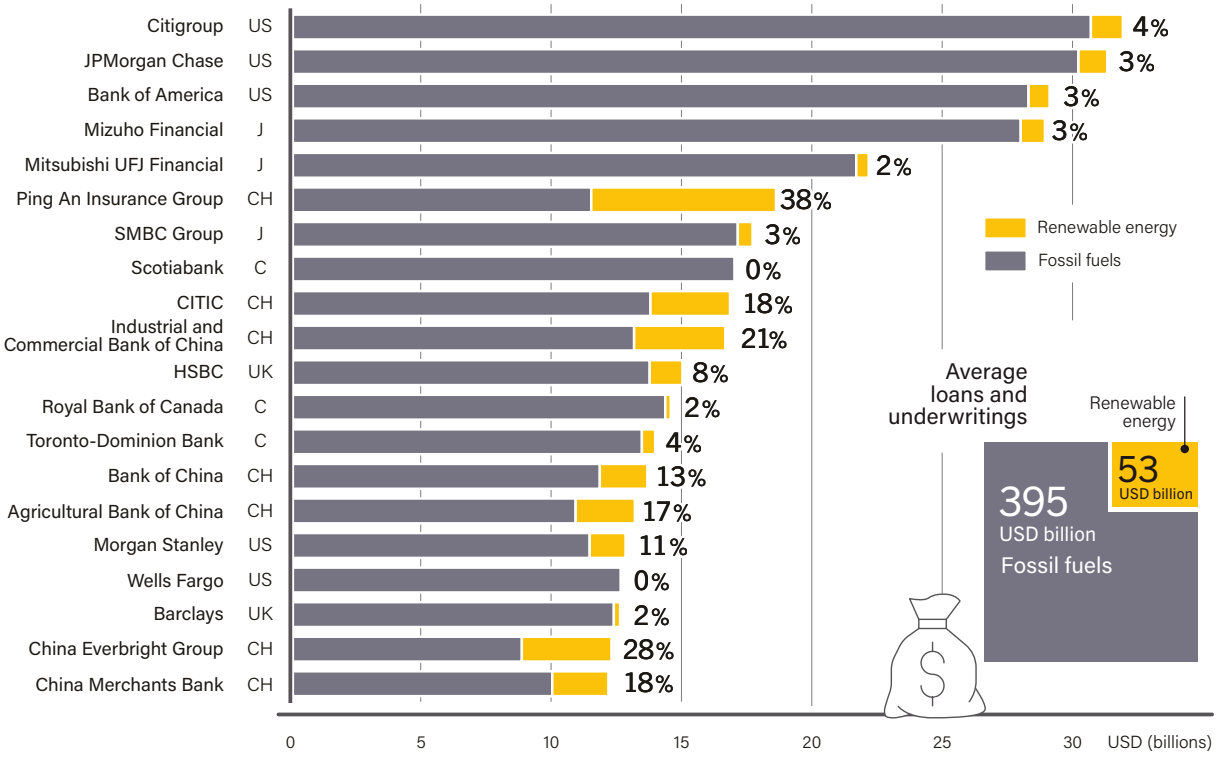
As of July 2022, only 11 financial institutions had portfolios comprising 100% renewable energy, with BTG Pactual leading with a total of USD 167 million. Huatai Securities was the largest funder of renewable energy (representing 69% of its energy portfolio), but it still lent USD 895 million to fossil fuel projects.

By country of origin, Chinese banks are the biggest renewable energy funders, providing USD 51 billion in 2021 and 2022, but this was still only 22% of total energy finance in the country. US institutions are the second largest source of energy finance and provided USD 6 billion in 2021 and 2022 for renewable energy, accounting for only 4% of total national energy finance. Among the top 20 home countries of investors, other than China, only institutions in Switzerland, Italy, Norway and Australia dedicated more than 10% of their energy finance to renewables.

Source: See endnote 194 for this module.

SIDEBAR 2. Are the World's Big Fossil Fuel and Financial Players Supporting the Energy Transition? (continued)

FIGURE 12.
Loans and Underwriting for Renewable Energy versus Fossil Fuel Projects, Top 20 Banks, 2021



C = Canada / CH = China / J = Japan / UK = United Kingdom / US = United States

Note: Fossil fuel companies are defined by Urgewald in the Global Coal Exit List and the Global Oil and Gas Exit List. Data from Profundo in 2022 extend up to July 2022.

DIVESTMENT

Since 2011, growing numbers of institutions worldwide have divested from, or sold off their financial interests in, fossil fuel companies. By October 2022, around 1,559 institutions, with estimated total assets of around USD 40.5 trillion, had committed to fossil fuel divestment[i].[195] However, there were fewer new divestment announcements in 2022 than in 2021, when a flood of announcements were made in the lead-up to the UN Climate Change Conference (COP 26) in Glasgow, Scotland.[196]

Among key divestment moves in 2022, Princeton University in the United States announced that it was disassociating itself from 90 companies that are involved in thermal coal or tar sands segments of the fossil fuel industry.[197] In September, HSBC, one of the world's largest banking and financial services organisations, announced a policy to phase out coal-fired power and thermal coal mining from its listed holdings.[198] Later in the year, HSBC announced that it would also stop funding new oil and gas fields.[199] In July, with support from the Vatican, 35 faith-based institutions from six countries – with combined assets of more than USD 1.25 billion – announced divestment from fossil fuel companies.[200]

Some have argued that the broader divestment movement is largely ineffective, based on the view that only a small portion of investors divest their holdings, and that divested shares are bought by other investors.[201] However, others have noted that, on a country-level, in years that more assets are committed to fossil fuel divestment, the oil and gas sector fundraises less compared with its historical average.[202] Yet at the same time, oil and gas financing across countries has continued to increase.[203]

Funds divested from fossil fuel companies are not necessarily re-invested in companies associated with renewables.[204] However, the global network DivestInvest links the two by providing guidance to organisations and individuals during the divestment process and encouraging them to establish climate-friendly criteria for their investments (for example, by investing in renewable energy companies, low-carbon transport, and sustainable agriculture and forestry options).[205]

SHIFTING FRAMEWORKS FOR INVESTMENT IN RENEWABLES

Investors wishing to address climate change and to support renewables are increasingly turning to sustainable finance options, in consideration of regulatory requirements, risk management imperatives and/or changes in demand and asset allocation strategies.[206] (→ *See Box 3.*) Three frameworks that are increasingly relevant for renewable energy finance and investment are: 1) the development of sustainable finance taxonomies at the national and regional levels to provide information on the environmental and/or social performance of enterprises and financial products; 2) green bonds, the proceeds of which may go to renewables; and 3) systems that rate the performance of enterprises according to environmental, social and governance criteria to help assess the suitability of a company, activity or fund for investment.[207]

By late 2022, institutions with assets of around

USD 40.5 trillion

had committed to divesting from fossil fuels.

i Through fossil fuel divestment, an institution makes a binding commitment to exclude any fossil fuel company (coal, oil and fossil gas) from either all or part of its managed asset classes, or to selectively exclude companies that derive a large portion of their revenue from coal and/or tar sands companies. Organisations also may commit to some form of an exclusion policy based on different criteria, such as whether the company is aligned with the goals of the Paris Agreement.

BOX 3. The Asian Development Bank's New IF-CAP Programme for Climate Financing

The Asian Development Bank (ADB) has announced the Innovative Finance Facility for Climate in Asia and the Pacific (IF-CAP), a ground-breaking programme aimed at bolstering support for the region in the fight against climate change. The programme, unveiled during the ADB's 56th Annual Meeting, involves partnerships with countries including Denmark, Japan, the Republic of Korea, Sweden, the United Kingdom and the United States. These partners are discussing providing grants for project preparation and guarantees for portions of the ADB's sovereign loan portfolios. The reduced risk exposure from the guarantees will enable the ADB to allocate more capital for new loans dedicated to climate projects, potentially creating up to USD 15 billion in loans with an initial ambition of USD 3 billion in guarantees.

IF-CAP's financing aligns with the ADB's target of USD 100 billion from its own resources for climate change efforts between 2019 and 2030. The ADB is actively engaging with potential partners, including bilateral and multilateral sources, the private sector, and philanthropies, to stimulate climate investments. The ADB's overarching commitment is to achieve a prosperous, inclusive, resilient, and sustainable Asia and Pacific region while continuing its endeavours to eradicate extreme poverty.

Source: See endnote 206 for this module.

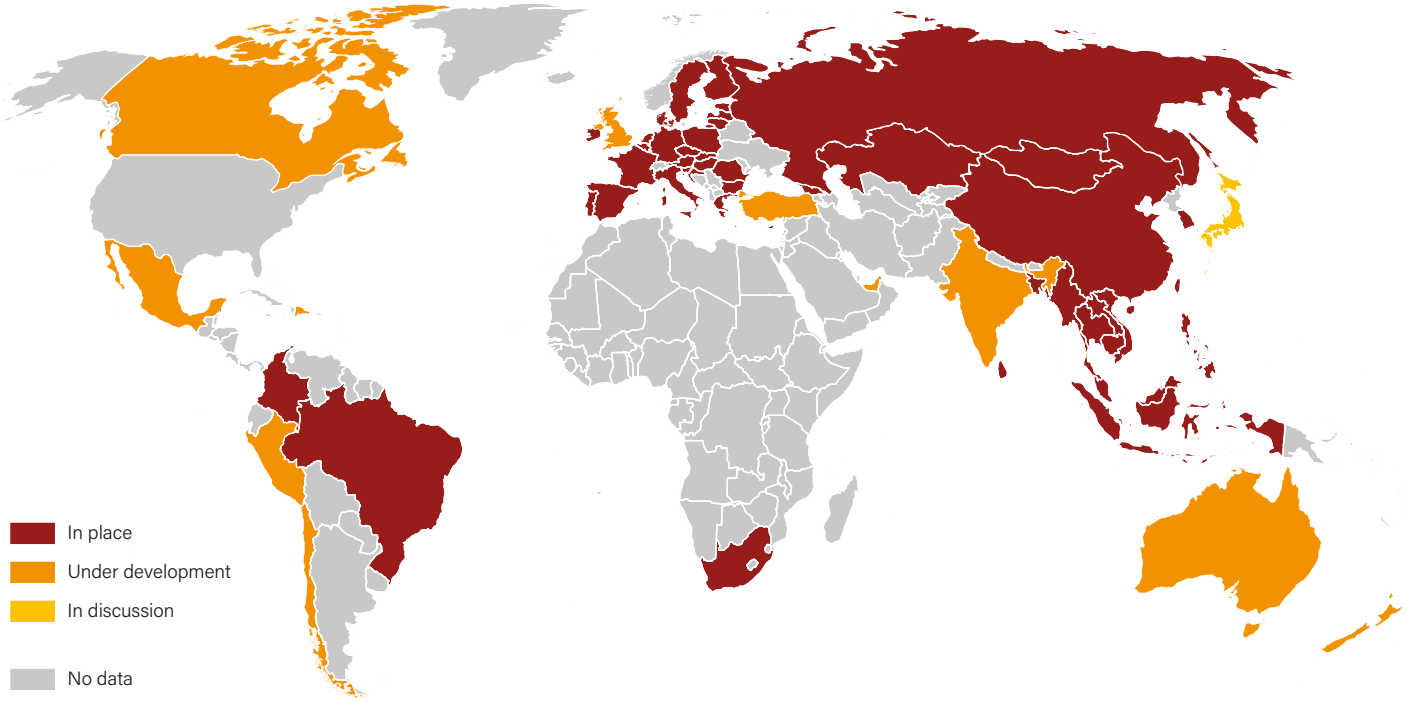
SUSTAINABLE FINANCE TAXONOMIES

Sustainable finance taxonomies provide a classification of economic activities with the aim of clarifying which investments and/or activities may be defined as sustainable or "green".[208] Such taxonomies can be relevant for renewables in two main ways: 1) for companies producing or manufacturing renewable energy technologies; and 2) for the owners or operators of renewable energy assets (such as a utility that operates a wind farm as part of its broader portfolio).[209] For example, renewables-related economic activities may be coded "green"; fossil fuel-based activities that adhere to certain standards may be coded "yellow"; while other activities may be "red", similar to a traffic light system.[210]

The number of sustainable finance taxonomies in use or under development has increased rapidly since the Paris Agreement was signed in 2015.[211] (→ *See Figure 13.*) In 2022, Peru announced its intention to develop a Green Finance Taxonomy by 2025.[212] In December, the Taiwan Sustainable Taxonomy was released, which encourages companies to voluntarily disclose information on the alignment of their primary economic activities with the taxonomy.[213] In Hong Kong, work began on proposing a structure and core elements for a local green classification framework.[214]

The vested interests in each country's definitions make creating a harmonised taxonomy across jurisdictions challenging.[215] Although a global, harmonised taxonomy is not yet on the table, diverse regional initiatives are under way that may provide the first steps towards standardisation.[216] In July 2020, China and the EU began developing a Common Ground Taxonomy (CGT) through a working group of the International Platform on Sustainable Finance, identifying commonalities and differences in their approaches.[217] In June 2022, a version of the CGT was published that covered 72 jointly recognised climate mitigation activities.[218] The Association of Southeast Asian Nations (ASEAN) released the second version of its joint taxonomy in early 2023, classifying economic activities based on their grade of alignment, thus establishing a framework within which member states can develop national taxonomies.[219] In 2022, a common framework for sustainable finance taxonomies was officially initiated across Latin America and the Caribbean, with co-operation from seven organisations across the region.[220]

FIGURE 13.
Sustainable Finance Taxonomies Worldwide, In Place, Under Development and In Discussion, 2022



Source: See endnote 211 for this module.

In specific situations, sustainable finance taxonomies may divert or discourage investment from renewable energy when its relative cost of capital is higher. This could happen, for example, if companies are allowed to be labelled as aligned with a particular taxonomy category (for example, having a certain threshold of greenhouse gas emissions for fossil power production), when in fact the category has not been defined to accurately reflect scientific requirements (such as to reach substantial emission reduction requirements that align with the goals of the Paris Agreement).[221] In this way, investment may be channelled away from companies or projects that more fully support renewable energy deployment.[222]

The number of
sustainable finance taxonomies
in use or under development has increased rapidly since 2015.

GREEN BONDS

Among the various instruments available to finance renewable energy projects, green bonds have become especially prominent in recent years.[223] Green bonds differ from traditional bonds in that the proceeds are earmarked for qualifying investments in renewable technologies or in various forms of climate adaptation and mitigation. Investors obtain a certain interest rate over a stipulated time period, and the funds must be used for the purposes for which the bond was issued. This provides investors with greater visibility over the actual use of the funds than is the case for traditional bonds.

In 2022, USD 649 billion in green bonds was issued, or 7% less than in 2021.[224] This decline occurred in all world regions except Asia, where green bond issuance grew 8% in 2022.[225] China leads the Asia and Pacific region, accounting for 67% of the green bonds issued.[226] Although the total number of green bonds declined in Europe, the region remains the largest issuer with around half of the total supply.[227]

In late 2022, macroeconomic conditions posed challenges for issuers of green bonds. European growth forecasts were downgraded, inflation forecasts were revised upwards, and the Euro was heading toward parity with the US dollar.[228] Although issuers continued to visit the bond market, caution was illustrated by multi-day periods with no new issuance and reports of deals being pulled at the last minute.[229]

ENVIRONMENTAL, SOCIAL AND GOVERNANCE (ESG) CRITERIA

The use of ESG criteria has shifted from being a niche focus to becoming a component of mainstream finance in many member countries of the Organisation for Economic Co-operation and Development (OECD).[230] Net inflows of investment into ESG funds in 2022 totalled USD 89 billion, down 78% from USD 405 billion in 2021.[231] This decline reflects fund relabelling developments in Europe, stricter standards in Asia, and debates on the definition of ESG in the United States, where ESG has become highly politicised and some states have redirected funds away from large asset managers with ESG priorities.[232]

The categorisation of an organisation or its activities as ESG may be based on a risk perspective (for example, how environmental risks may affect a company) and/or by an impact perspective (for example, the impact that a company or activity has on the outside world).[233] Companies that rate and value ESG funds more from a risk perspective have been criticised for using methodologies that ignore the larger (environmental) impact of a company on the planet.[234] As the impact perspective becomes increasingly relevant to investors aiming for net zero carbon or clean energy goals, a "double-materiality concept" is arising, which incorporates both the risk and impact perspectives.[235] This approach may have more relevance for renewables.[236] Relatedly, ESG products increasingly are being used to assess a company's commitments and actions to transition to renewable energy.[237]

CHALLENGES AND OPPORTUNITIES

Towards the uptake of renewable energy

CHALLENGES

- The lack of robust data and co-ordination across some demand sectors, such as agriculture, hinders progress tracking, policy development and effective integration of renewable energy solutions.
- The capital-intensive nature of renewable energy investments, coupled with the cost of replacing existing infrastructure, poses affordability challenges.
- Inadequate policy frameworks and incentives for renewables adoption, as well as the siloed nature of energy policies, impede the widespread uptake of renewables.
- Persistent resistance from fossil fuel companies slows the transition to renewables in multiple sectors, hindering progress towards sustainable energy systems.
- Technological limitations and high upfront costs for renewable solutions in high-temperature industrial processes, long-haul transport and certain building types pose challenges in achieving widespread decarbonisation.
- Investments in grid infrastructure development and permitting policies are current bottlenecks for the integration of renewables in electric grids.

OPPORTUNITIES

- Adoption of renewables in all demand sectors can reduce dependence on fossil fuels, protecting them from price volatility and supply shocks.
- Rising fossil fuel prices, declining renewable costs, and increased international funding for energy transition projects provide opportunities for accelerated renewables uptake in all sectors. Sectors can benefit from cost savings, improved sustainability practices and increased competitiveness by embracing renewables.
- Integration of renewables offers opportunities for cost reduction, energy savings, and improved resilience, particularly for low-income households.
- Enhanced co-ordination among government ministries and stakeholders can lead to improved policy frameworks and incentives, fostering the adoption of renewables across sectors. Renewables create social value through generating employment opportunities, improving energy security and access, bringing considerable health benefits, reducing gender inequalities and strengthening local value chains. (→ *See GSR 2023 Economic & Social Value Creation Module.*)
- Regional interconnections and improved storage solutions can help integrate a higher share of renewables into the energy system.

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NOTES

ENDNOTES – GLOBAL OVERVIEW

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