REN21

RENEWABLES 2024
GLOBAL STATUS REPORT

GLOBAL OVERVIEW

2024

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FOREWORD

We stand at a precipice, with the urgent need for a rapid transition to renewable energy underscored by escalating global crises and the encouraging targets set at COP28. The role of renewable energy as a key solution to climate, energy, and economic challenges is more apparent than ever.

This year's Renewables Global Status Report illuminates a complex landscape of progress tempered by persistent challenges. Despite record investments in renewables, reaching USD 622.5 billion in 2023, we are still far from what is needed to meet our climate and sustainable development goals. Estimates suggest that global investments need to reach at least USD 1.3 trillion annually between now and 2030 if we are to keep the 1.5°C target in reach.

The disparity in investment opportunities between high- and low-income countries, compounded by unequal access to capital, remains a major obstacle to an equitable energy transition. Interest rates in emerging economies remain significantly higher than in advanced economies, further hindering progress towards sustainability.

We find hope in the commitments made at COP28 – to triple renewable capacity and double energy efficiency by 2030. These pledges, however, risk becoming empty promises unless they are backed up with immediate, drastic action.

As we celebrate our achievements, we remain acutely aware that radical action is necessary to keep pace with ever-growing energy demand and significantly reduce greenhouse gas emissions. In 2023, renewable energy accounted for 86% of power capacity additions, a testament to progress. Yet renewables represented just 12.9% of total final energy consumption in 2022.

The shift towards renewable energy is not just a necessity but an opportunity to create a more sustainable, equitable, and prosperous future. To seize this opportunity, we must strengthen policies, increase investments, and foster technology and skill sharing at a global scale.

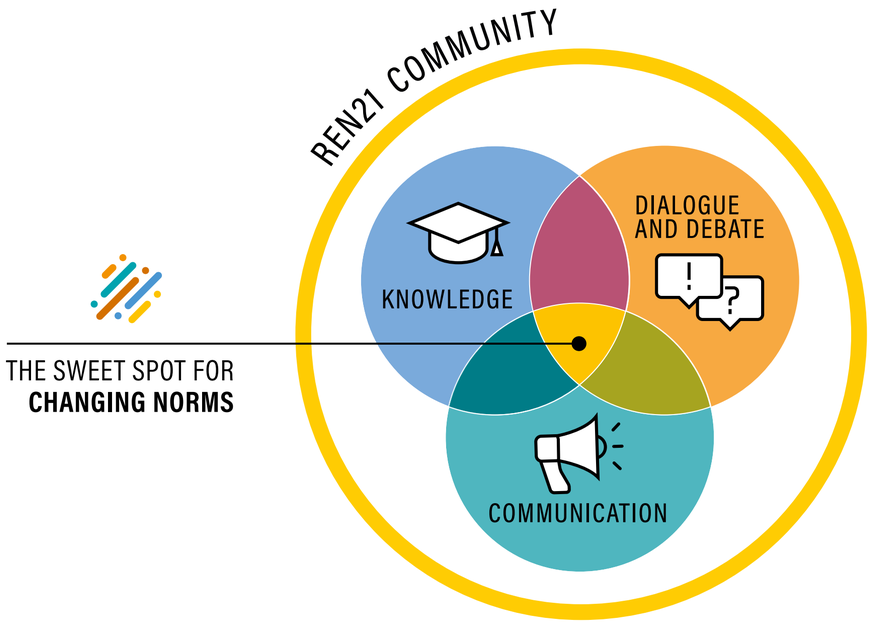
I extend my deepest thanks to the REN21 team and all contributors for their unwavering dedication and insight. As REN21 celebrates its 20 years. I want to particularly acknowledge the REN21 community's ongoing engagement in helping craft this comprehensive report. The GSR 2024 once again exemplifies our collective commitment to accelerating the renewable energy transition.

We must act fast. We must act together. Let us respond to the momentous challenges and opportunities that confront us with renewed determination and confidence that we can, and must, transition to renewables, now.

Rana Adib
Executive Director, REN21

REN21
RENEWABLES NOW

RENEWABLE ENERGY POLICY NETWORK FOR THE 21st CENTURY



REN21 is unique. It is the only global, **multi-stakeholder network** dedicated to renewables.

We create an **enabling environment to support renewable uptake**. Together, we build knowledge, shape dialogue and debate, and communicate this information to strategically drive the deep transformations needed to make renewables the norm.

Shifting to renewables is more than a fuel switch; it requires engaging with market players and society at large. **REN21 works in close cooperation with its community**, providing a platform for all stakeholders to engage and collaborate.

Through these collective efforts, REN21 builds bridges and amplifies positive and sustainable energy solutions. Our goal: enable decision-makers to **make the shift to renewable energy happen – now.**

20 YEARS OF REN21

This year marks two decades since the inception of REN21 – an opportunity to celebrate 20 years of instrumental contributions to the advancement, shaping and understanding of renewable energy worldwide.

Established in 2004, REN21 emerged from the collective vision of global pioneers who convened to call for accelerated commitments towards renewable energy adoption. For two decades, REN21 has been pivotal in elevating renewables to the forefront of global agendas for leaders and decision makers across all stakeholder groups, enabling knowledge exchange, dialogue and debate about the global transition to renewables.

The 20th-anniversary celebration of REN21 is also the occasion to acknowledge REN21's flagship knowledge product, the *Renewables Global Status Report*. Since the GSR's first release in 2005, REN21 has published 18 editions of the report, crafted annually with the most up-to-date insights, facts and stories from thousands of contributors spanning diverse regions and sectors. The GSR has been central to fulfilling REN21's mission, becoming a reference for many and positioning REN21 as the global trusted voice on renewables.

20 YEARS OF CROWD-SOURCED, CROWD-OWNED KNOWLEDGE AND DATA

REN21's data and knowledge collection method is unique, drawing upon the organisation's global multi-stakeholder community of experts. Contributors from across the globe are invited to submit data, insights and stories on annual developments in renewable energy technologies, market trends, policies and local perspectives, resulting in a comprehensive and diverse dataset.

REN21 performs rigorous data validation and fact-checking throughout the report's development, ensuring accuracy and reliability. Validation of the data is a collaborative and transparent process conducted through open peer reviews.

Collectively, hundreds of experts contribute to making the GSR one of the most authoritative and comprehensive publications in the field of renewables. Alongside its wealth of key facts and figures, the GSR is openly accessible, fostering a shared language that shapes the sectoral, regional and global debate on the energy transition.

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A large share of the research for this report was conducted on a voluntary basis.

RENEWABLES GLOBAL STATUS REPORT
2024 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. Structured as a collection of five publications, this year's 19th edition of the GSR reflects key trends in global energy.

In addition to providing a global overview of the renewables landscape, the GSR also presents developments in renewable energy supply and dives into energy demand sectors, with dedicated modules on buildings, industry, transport and agriculture. The collection further includes a publication on renewable energy systems and infrastructure as well as a publication on renewables for economic and social value creation, acknowledging the key benefits of renewables for economies and societies.

Collectively, these five publications offer readers a systemic global overview of the current uptake of renewables.

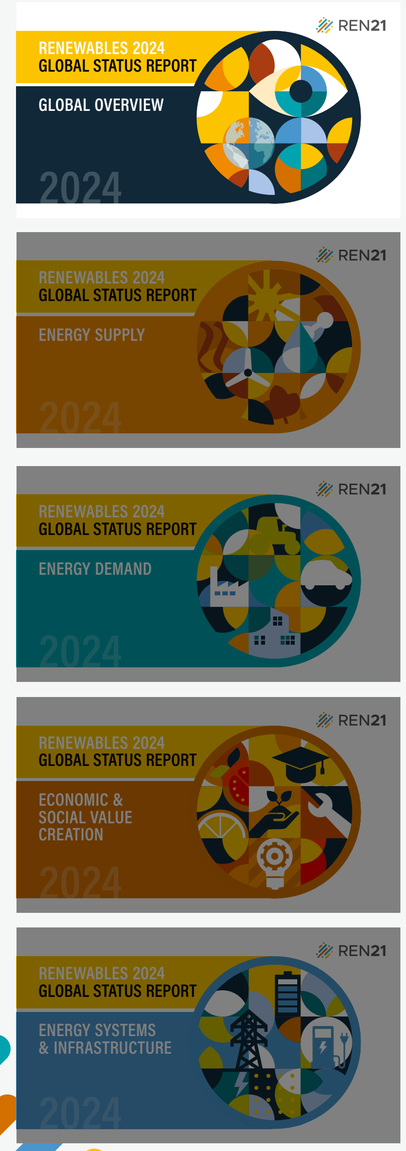

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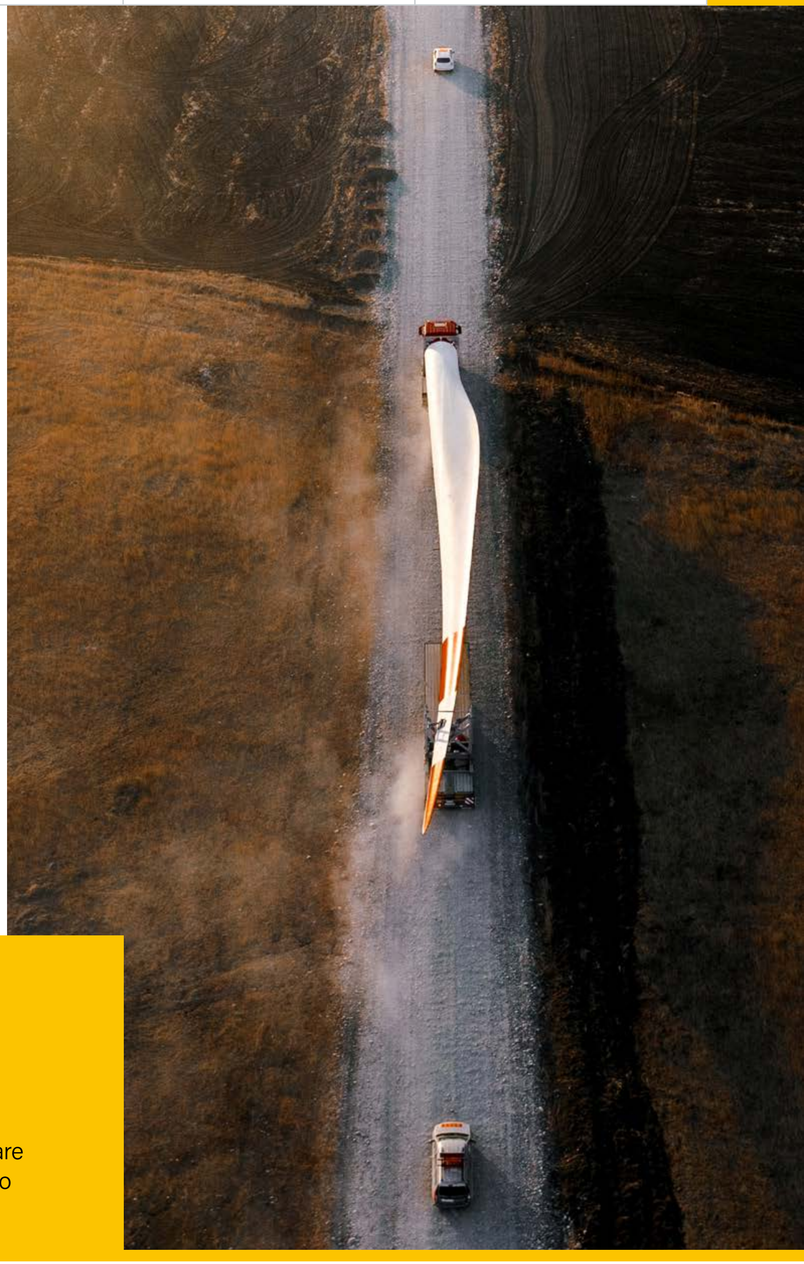
TABLE OF CONTENTS

GLOBAL OVERVIEW



For further details and access to the report, references and endnotes, visit **www.ren21.net/gsr-2024**

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

FIGURES

SIDEBARS

SNAPSHOTS

BOXES

LINKS TO MICROSITE

- → Energy Units and Conversion Factors
- → Data Collection and Validation
- → Methodological Notes
- → Glossary
- → List of Abbreviations

Reference Tables can be accessed through the GSR 2024 *Global Overview* Data Pack at
→ http://www.ren21.net/gsr2024-data-pack/go

GLOBAL STATUS REPORT 2024 COLLECTION
GLOBAL OVERVIEW

MODULE OVERVIEW

This overview sets the scene for the various modules in the *Renewables 2024 Global Status Report Collection*. It provides high-level trends on the status of renewables in the wider fossil fuel-dominated energy system in the context of global challenges such as climate change, development goals and the geopolitical landscape.

473 **gigawatts (GW)** renewable power capacity added in 2023

623 **billion USD** global new investment in renewable power and fuels in 2023

151 **countries** with net zero targets in place in 2023, compared to 90 countries with established renewable energy targets

KEY FACTS

- In 2023, **global additions to renewable power capacity increased an estimated 36%** to reach 473 GW, a new record for the 22nd consecutive year.
- At the 2023 United Nations Climate Change Conference in Dubai, **130 countries pledged to triple renewable energy capacity** and double the annual rate of energy efficiency improvements by 2030.
- As **countries reshaped trade and industrial policies** in 2023, the United States launched more than 250 clean energy manufacturing projects following the adoption of the Inflation Reduction Act, and the European Union proposed the Net-Zero Industry Act and launched the first phase of the Carbon Border Adjustment Mechanism.
- **Employment in the renewables sector increased 8%** in 2022 to reach 13.7 million jobs.
- The number of people **lacking electricity access globally fell from 756 million in 2022 to 745 million** in 2023.

GLOBAL CONTEXT

In 2023, renewable energy globally was on a path of recovery and progress, set against persistent challenges and disparities among technologies and regions. The energy crisis of the previous year continued to abate, with the world witnessing a remarkable boom in solar photovoltaics (PV) and a significant surge in energy investments.[1] Global additions to renewable power capacity increased an estimated 36% in 2023 to reach around 473 gigawatts (GW), a new record for the 22nd consecutive year.[2] Solar PV drove the increase and accounted for three-quarters of all the renewable power capacity additions in 2023.[3]

The progress in renewable power additions was global but varied across regions and technologies. In the United States, the only growth relative to 2022 was in solar PV, with its total installed capacity increasing more than 50% to nearly 33 GW, whereas wind power additions fell to their lowest level since 2014.[4] In the European Union (EU), solar PV capacity additions increased from 41 GW in 2022 to 56 GW in 2023, and wind power additions totalled 17 GW in 2023, up slightly from 2022.[5]

China continued to dominate the renewable energy sector, commissioning an amount of solar PV capacity in 2023 alone that was equivalent to the total global solar PV additions in 2022.[6] China also operated around 30 GW of offshore wind power by the end of 2023, roughly half the global capacity.[7] These developments were counterbalanced by China's strong increase in energy production and consumption overall, including of fossil fuels. In 2023, the country approved 114 GW of coal power capacity, up 10% from 2022.[8] In total, China approved 218 GW of new coal power plants in the two-year period from 2022 to 2023, more than the total installed power capacity of Brazil.[9]

The renewables sector also faced ongoing challenges in 2023. Geopolitical conflicts in Europe, the Middle East and elsewhere continued to disrupt supply chains and international transport, impacting energy markets. Global energy-related greenhouse gas emissions increased 1.1% to a record 37.5 billion tonnes of carbon dioxide (CO_2), with emissions from coal contributing nearly two-thirds of the increase.[10] The Earth's average surface temperature was reportedly around 1.2 degrees Celsius (°C) higher than in the pre-industrial era, and extreme weather events, including record temperatures and heatwaves, became more frequent.[11] The year 2023 also was defined by growing protectionism, especially in the renewable energy sector. The EU and the United States took steps to reduce their strong reliance on China for minerals and for renewable energy components and technologies.[12]

In many countries, concerns about energy security have accelerated the transition to renewables and energy efficiency; however, some other countries have opted to embrace fossil fuels for energy supply assurance.[13] Global investment in both fossil gas and coal infrastructure remains substantial.[14] Many developing countries have prioritised short-term economic growth over long-term energy transition.[15]

Opposition to renewables has continued to challenge the sector's development, despite advancements in technology and growing awareness of environmental concerns.[16] Progress in renewable energy deployment, policy and investment worldwide remains unevenly distributed geographically, and this disparity highlights the enduring issue of energy inequality.[17] With roughly half of the world's population expected to face elections in 2024, the outcomes of these contests will be crucial to renewable energy developments, either enabling positive progress or putting a halt to some of the policy momentum.[18]

ECONOMIC OVERVIEW

The global energy sector is navigating a complex macro-economic environment.[19] Although average inflation worldwide declined in 2023 – falling from a projected 8.7% in 2022 to around 6.9% – it was still well above the 2020 level of 3.2%.[20] Energy prices continued to shape the global economic landscape. In many countries, wholesale electricity prices remained high despite a notable drop in the prices of energy commodities such as fossil gas and coal in the first half of 2023.[21]

Global investment in renewables grew 8% during the year to reach USD 622.5, up from USD 576 billion in 2022.[22] However, the renewables sector, once propelled by falling costs, low interest rates, and political support, is now contending with supply chain issues and operating in a context of rising interest rates that have inflated prices and tested the commitment of consumers and governments, despite unprecedented investment and progress in recent years.[23] As a consequence of this financial shift, some of the more costly renewable energy projects have been cancelled or delayed.[24]

The solar PV industry experienced a year of low profitability and valuation. In the United States, the stock prices of major solar companies were down 37-46% in 2023 due mainly to high interest rates, rising material costs, delays in permitting, excess inventory and slowed revenue growth.[25] For the offshore wind market, issues related to supply chain delays and rising demand – as well as higher raw material costs, shipping costs, interest rates and inflation – led to projects not being delivered in time or in some cases being shelved.[26]

A renewable energy auction in the United Kingdom in the summer of 2023 failed to attract any bids from developers, and wind energy projects in the Netherlands, Norway and the United States also experienced extensive delays and price renegotiation.[27] After reporting a loss of USD 5 billion (EUR 4.6 billion) for the year, due mainly to quality problems at its Spain-based wind unit, Siemens Energy received loan guarantees from the German government and several banks for around EUR 12 billion (USD 13 billion).[28]

The rising **cost of capital**[i] is especially concerning for emerging markets, where high interest rates are pushing countries towards a debt crisis.[29] As the cost of financing becomes more burdensome, countries are increasingly getting stuck in a vicious circle known as the climate debt trap[ii] and must urgently tackle rising debt.[30] Central bank rate hikes, aimed at controlling inflation, have increased borrowing costs, hindering the financing of capital-intensive renewable energy projects globally.[31]

The adverse context of higher interest rates worldwide has exacerbated the financial challenges for developing countries, which play a crucial role in addressing global climate change but now face greater investment hurdles.[32] Efforts to restructure international finance have gained attention, including through the Bridgetown Initiative[iii]. There is a need for both enhanced short-term liquidity mechanisms and long-term sustainable development funding to better manage the immediate impacts of crises and drive more robust reform of the global financial architecture.[33]

90%
of solar PV manufacturing is concentrated in only 5 countries

RENEWABLES AND GLOBAL TRADE

Global renewable energy trade is increasingly marked by **protectionism**, as governments impose restrictions to bolster domestic industries. This includes the deployment of incentives and policies favourable to local manufacturing and local incentives, driven by initiatives such as the EU's Carbon Border Adjustment Mechanism and the US Inflation Reduction Act (→ *see Snapshot: United States*).[34]

Globally, the trade landscape is increasingly shaped by "friend-shoring", or the practice of relocating supply chains to, and sourcing inputs from, countries that are considered political and economic allies.[35] This trend is a response to the supply chain disruptions experienced in recent years, as well as a strategic move to align with countries that share similar commitments to climate and sustainability goals and to addressing concerns about human rights abuses.[36]

China continued to dominate renewable energy manufacturing in 2023, particularly for solar PV, and was also a major supplier and manufacturer of critical minerals.[37] The country hosts more than 80% of the world's solar panel manufacturing capacity and is home to ten leading suppliers of solar PV manufacturing equipment.[38] Although China's dominance in the solar industry has been key to reducing costs globally, this high geographic concentration of supply chain activities presents risks.[39]

Both the EU and the United States have expressed concerns about their over-reliance on Chinese renewable energy products: for example, China supplies more than 95% of the solar panels and parts installed in the EU.[40] The key aims of the EU's Net-Zero Industry Act and the Carbon Border Adjustment Mechanism are to incentivise local renewable energy manufacturing and impose a cost on carbon emissions for imported goods, thereby creating a financial incentive for non-EU countries to align with the region's climate goals.[41] The influx of inexpensive Chinese solar panels in Europe has boosted solar installations but also threatened local manufacturers with potential collapse, prompting the EU to consider protective measures.[42]

China's growing dominance in the renewable energy component industry has influenced trade policy in the United States, which has increasingly turned to the EU, India, Cambodia, Malaysia, Thailand and Viet Nam to import solar panels (in addition to boosting domestic solar manufacturing capacity).[43] US support for India's solar industry may have unintentionally enabled the entry into the United States of illegal Chinese solar components (banned due to forced labour issues) through Indian-assembled products.[44] The move towards friend-shoring and on-shoring[iv] is, in part, a reaction to these challenges, offering a way to strengthen supply chains and diversify the supply of renewable products.[45]

Critical minerals are essential raw materials used for manufacturing renewable energy technologies, electric vehicles and electricity networks.[46] In 2023, growth in the renewables sector drove surging interest in critical minerals – including a tripling in lithium demand, a 70% increase in cobalt demand and a 40% increase in nickel demand – as clean energy applications consume growing shares.[47] The market value of key energy transition minerals doubled in 2023 to USD 320 billion.[48] Despite overall price drops in 2023, many minerals remain costly for achieving energy transition goals.[49] Investment in critical minerals exploration and extraction has risen, with companies in China doubling their spending in 2022, and exploration activities booming across Africa, Australia, Brazil and Canada.[50] Investment in critical minerals increased 30% in 2022, with exploration spending rising 20%.[51]

i The cost of capital measures the cost that a business incurs to finance its operations. It measures the cost of borrowing money from creditors or raising it from investors through equity financing.

ii The climate debt trap refers to already indebted countries needing to borrow more as their climate vulnerabilities go up.

iii The Bridgetown Initiative is a policy proposal announced by the prime minister of Barbados at the United Nations (UN) Climate Change Conference in Sharm El Sheikh, Egypt, in 2022. It became a central discussion item during the 2023 Paris Summit for a New Global Financing Pact.

iv On-shoring is the process of sourcing or relocating production and manufacturing within domestic borders.

SNAPSHOT UNITED STATES

THE INFLATION REDUCTION ACT'S ONE-YEAR IMPACT ON US CLEAN ENERGY PROGRESS

At the one-year mark following the signing of the US Inflation Reduction Act (IRA) of 2022, the legislation continued to show mixed results. Although rules and regulations on how to unlock finance from the IRA were still being published as of August 2023, the clean energy sector in the United States had made positive strides. The country experienced a boom in solar PV installations nationwide, as well as a surge of project announcements and developments across various industries.

Private investors were showing great confidence in the US clean energy transition as of mid-2023, with USD 278 billion in new investments announced, linked to the creation of 170,000 new jobs. The roll-out of the IRA also unlocked USD 70 billion in grants, rebates and other non-loan funding. Manufacturing announcements included 272 new clean energy projects spanning a diverse range of sectors, including 84 wind and solar manufacturing projects, 91 battery manufacturing sites and 65 electric vehicle manufacturing facilities.

The IRA is expected to supercharge the shift to electric vehicles, with incentives for consumers as well as automakers. The US Postal Service alone received USD 3 billion for clean vehicles in 2022 as part of the IRA. Guidelines for home energy rebate programmes also were introduced, featuring substantial provisions targeting low-income households. In the power sector, announcements included plans to replace a coal-fired plant in Puerto Rico with a solar and storage plant, and plans by a Michigan utility for 15 GW of new solar and wind power capacity. Although incentives for hard-to-abate energy-intensive industries were not yet rolled out, funding was allocated for tax rebates and demonstration projects.

The US renewable energy landscape also experienced setbacks in 2023. Several large projects were cancelled or rescheduled; energy trading stocks plummeted in the second half of the year; and electric car sales did not reach targets. Plans for some offshore wind projects were cancelled, and automakers Ford, General Motors and Tesla announced scale-backs of electric vehicle plants. Chinese solar giants also entered the race to build factories in the United States, leveraging the IRA's subsidies to expand their manufacturing footprint and help meet America's clean energy goals, despite the US aim to reduce its reliance on foreign solar production.

Source: See endnote 34 for this module.

RENEWABLES MANUFACTURING CAPACITY AND EMPLOYMENT

Renewable energy manufacturing capacity has experienced robust growth.[52] In the decade between 2013 and 2023, solar manufacturing increased 10-fold globally, driven by rising demand for clean energy and by industrial policies that enabled economies of scale and spurred demand.[53] However, the solar manufacturing industry has grappled with a utilisation rate of around 40%, well below the 70% expected in a fully mature industry.[54] Inefficiencies are attributed to persistent supply chain bottlenecks and to more rapid growth in solar manufacturing capacity than in PV deployment.[55]

Solar manufacturing is highly concentrated geographically, with just five countries hosting more than 90% of the global capacity for producing solar modules.[56] China leads with around 80% of overall solar PV manufacturing capacity, followed by Viet Nam, India, Malaysia and Thailand.[57] China accounts for 60% of the global manufacturing capacity for solar PV, wind, and batteries combined, as well as 40% of electrolyser manufacturing.[58] Europe retains strong manufacturing capacity for wind turbine components.[59] In the case of critical minerals, supply chains remain highly concentrated in a handful of countries, posing a risk for future renewable energy deployments.[60]

In early 2024, manufacturers in Europe warned of potential closures of solar panel plants as less-expensive Chinese imports undercut local producers.[61] Europe's solar industry requires accelerated funding to support supply chain development, reduce reliance on Asian imports and foster new technologies.[62] EU leaders have sought to support and expand the region's solar manufacturing capacity through policies such as the Net-Zero Industry Act, which targets producing 40% of renewable components locally.[63] However, a shortage of skilled workers threatens these goals, as Europe struggles to meet the rising demand for solar products.[64]

Global employment in renewable energy grew

8%

in 2022 to reach 13.7 million jobs.

Global employment in the renewable energy sector grew 8% in 2022 (latest data available) to reach 13.7 million jobs.[65] This was double the number a decade prior and represents more than one-fifth (21%) of all jobs in the energy industry.[66] Two-thirds of renewable energy employment was based in Asia, and China alone was home to 41%.[67] Around one-third of all renewable energy jobs are in solar PV, totalling 4.9 million in 2022.[68] Hydropower jobs increased 2.3% in 2022 to 2.5 million, while biofuels maintained 2.5 million jobs (mainly in the agriculture sector).[69] Wind power employment was steady at around 1.4 million jobs, with most of the positions in China and Europe.[70] However, the renewable energy sector overall continued to face a shortage of skilled workers, as the number of workers obtaining relevant qualifications in renewables has not kept pace with demand.[71]

RENEWABLE ENERGY AND CLIMATE CHANGE

In 2023, the **impacts of climate change** were increasingly apparent around the world.[72] The year was deemed the warmest on record globally and was marked by devastating natural calamities, including massive floods, raging wildfires, severe droughts, landslides, cyclones and storms.[73] These disasters led to the displacement and deaths of tens of thousands of people worldwide.[74] Notable events included severe flooding in China, Hong Kong, Mexico, the Mediterranean region, and Western Europe, as well as extreme drought conditions in parts of the world including the Amazon rainforest.[75]

During the year, countries enhanced their collaboration on renewable energy and penned several related international agreements. The United States and India agreed to launch a renewable energy technology platform, with a focus on wind and geothermal energy, energy storage and hydrogen.[76] The United States and China, in a side negotiation at the G20 summit in Bali, Indonesia, reached a climate agreement to speed renewable energy development and accelerate the reduction of fossil fuels.[77] The We Mean Business Coalition, representing more than 130 companies with a combined annual revenue of nearly USD 1 trillion – including giants such as eBay, IKEA and Volvo Cars – pushed for a fully decarbonised power sector in developed regions by 2035 and in emerging economies by 2040, in an effort to end fossil fuel consumption and ramp up clean energy production.[78]

At the **2023 UN Climate Conference** in Dubai, United Arab Emirates (COP 28), the outcome for the renewable energy sector was complex and nuanced.[79] Notably, renewables and energy efficiency were mentioned in the conference's final text, aligning with global efforts to achieve sustainable climate, energy and economic objectives.[80] For the first time, countries agreed on the need to "transition away from fossil fuels to renewables".[81] In a key COP 28 commitment, 130 countries pledged to triple the world's renewable energy capacity and to double the annual rate of energy efficiency improvements by 2030, in a push to limit global warming to 1.5°C above pre-industrial levels by the end of the century.[82] The signatories collectively accounted for 40% of the global CO_2 emissions from fossil fuel combustion, 37% of the emissions from global energy demand and 56% of global GDP.[83] However, China and India, two of the largest emitters of greenhouse gases, were not among the pledge participants.[84] (→ *See Snapshot: China and India.*)

SNAPSHOT CHINA AND INDIA

WHY CHINA AND INDIA HAVE HESITATED TO SIGN THE GLOBAL PLEDGE TO TRIPLE RENEWABLES

As a side agreement at the UN Climate Conference (COP 28) in Dubai in November 2023, countries agreed on a new Global Renewables and Energy Efficiency Pledge, which aims to triple the world's renewable energy capacity to 11,000 GW and to double energy efficiency improvements by 2030. As of early 2024, 130 had signed the pledge; however, it continued to face challenges in garnering universal support, with both India and China abstaining from participation.

China has been the world's largest and fastest growing producer of renewable energy for the last decade, and in 2023 the country installed more new solar power capacity (up 55% from 2022) than all other countries combined, including the United States. India ranked fourth globally for renewables installed capacity in 2023, adding 13.5 GW during the year. Despite being key drivers of the global energy transition and dominant players in renewables, both India and China were notably absent from the tripling pledge.

Their abstention from the pledge was driven by several common concerns as well as by country-specific issues. The shared concerns related mainly to the two countries' stances on coal, in addition to financial considerations, national priorities and broader strategic perspectives on climate negotiations. Moreover, China is likely to face challenges achieving the ambitious energy efficiency target in the pledge, and India voiced concern about the lack of specifics regarding financial and technical support for developing countries.

Meanwhile, both China and India have committed to the goals outlined in the separate G20 New Delhi Leaders Declaration, adopted in September 2023. Similar to the Global Renewables and Energy Efficiency Pledge, the New Delhi declaration includes a significant aim to triple renewable energy capacity by 2030 and to double energy efficiency efforts. However, the Delhi agreement and the COP 28 pledge differ importantly in their approaches to the transition away from coal use.

The COP 28 pledge presents a more stringent set of requirements, calling for an end to all investments in unabated new coal-fired power plants. This would be a significant challenge for both China and India, globally the top coal-consuming countries. In 2023, these two nations collectively accounted for more than one-third (37%) of the total annual CO_2 emissions globally, and they are responsible for building most of the world's new unabated coal-fired power plants. Although the G20 agreement calls for phasing down unabated coal power, it emphasises the importance of supportive transitions tailored to national circumstances, rather than stringent commitments for all countries.

China is on track to achieve its 2030 target for 1,200 GW of renewable capacity five years early. However, doubts exist about the country's ability to realise the ambitious 4% annual energy efficiency improvement stipulated in the COP 28 pledge. This would require significant structural shifts in both China's power system and overall economy. Additionally, China is believed to have already maximised many of its opportunities for efficiency improvements, and recent

economic slowdowns will likely complicate progress. Finally, the country's preference for the UN Framework Convention on Climate Change (UNFCCC) as the primary platform for climate decision making has led to China's reluctance to endorse additional side commitments outside the UNFCCC framework, due to concerns about accountability and effective implementation.

Beyond its stance on a coal phase-out, India's decision not to sign the COP 28 pledge stemmed from a focus on addressing national priorities and securing additional funding support. Although India emphasises its ambitious renewable energy targets, it has hesitated to commit to actions that might hinder national development, since energy access and security are top priorities in the country's energy transition. India also emphasised the need for greater financial and technical assistance from developed countries to help developing countries achieve ambitious renewable energy targets. In India, as in much of the developing world, the financial demands required to attain global renewable targets (such as the International Energy Agency's net zero scenario) greatly exceed the country's current investment and funding capacities.

Source: See endnote 84 for this module.

Several efforts during COP 28 were aimed at **phasing out fossil fuels**. Nine additional countries – Cyprus, the Czech Republic, the Dominican Republic, Iceland, Kosovo, Malta, Norway, the United Arab Emirates and the United States – joined the Powering Past Coal Alliance, bringing the total number of signatories to 60.[85] In addition, Kenya, Samoa and Spain joined the Beyond Oil and Gas Alliance, for a total of 19 members.[86] At COP 28, Colombia became the first major oil-exporting country to sign the fossil fuel non-proliferation treaty, bringing the number of signatories to 11 countries.[87]

During the Dubai event, 50 fossil fuel companies, representing 40% of the global production, signed the Oil and Gas Decarbonization Charter, pledging to end gas flaring by 2030 and to reach net zero emissions in their operations by 2050.[88] However, the charter was widely criticised for being a prime example of greenwashing, as it said nothing about eliminating emissions from global fossil fuel use.[89]

Such commitments, while significant, underscore the need for a co-ordinated approach that includes a rapid phase-out of fossil fuels to achieve a fully sustainable energy system.[90]

Other noteworthy outcomes from COP 28 included the Supercharging Battery Storage Initiative to support innovation for better energy storage solutions (backed by Australia, Canada, the European Commission and the United States) and the launch of the Utilities for Net Zero Alliance, gathering 31 partners including major utilities.[91] Such initiatives highlight the rise in international co-operation and action on renewables, despite the challenge of aligning all major emitters under unified commitments.[92]

TOTAL FINAL ENERGY CONSUMPTION

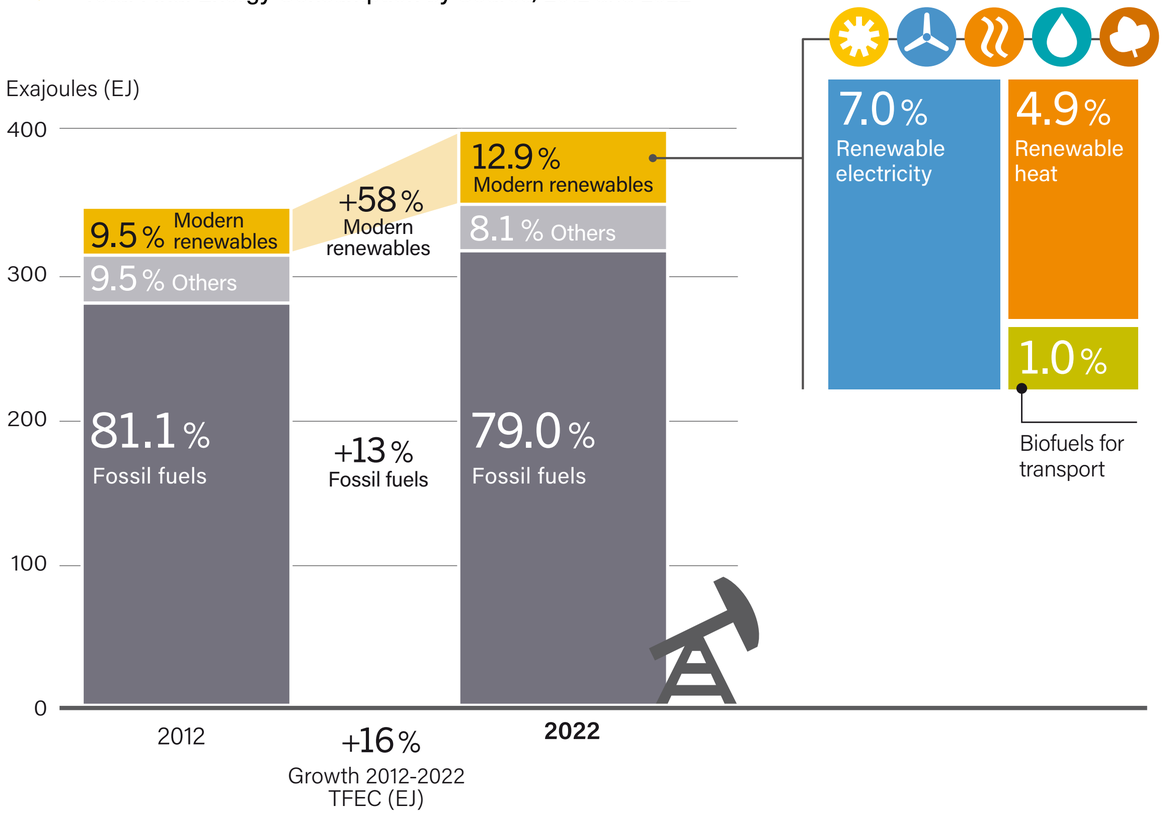
The world's total final energy consumption (TFEC[i]) grew 5% in 2022 to 399 exajoules (EJ), reflecting widespread economic recovery from the impacts of the COVID-19 pandemic.[93] Modern renewables[ii] represented 13% of the global TFEC in 2022, the same share as in 2021.[94] (→ *See Figure 1.*) Oil and coal use have also increased. Fossil oil consumption averaged 101.1 million barrels a day in 2022, slightly above the pre-pandemic record of 101.0 million barrels a day.[95] Coal consumption rose 1.4% in 2023 to surpass 8.5 billion tonnes annually for the first time ever.[96] For fossil gas, the annual

Modern renewables represented

13%

of the global TFEC in 2022, the same share as in 2021.

FIGURE 1.
Total Final Energy Consumption by Source, 2012 and 2022



Source: IEA, REN21. See endnote 94 for this module.

i Total final energy consumption (TFEC) is the sum of energy used by the end-users across all sectors, including industry, transport, residential, commercial and agriculture. It represents the energy that consumers directly utilise for heating, manufacturing, driving, cooking and other processes after it has been converted from primary energy sources into usable forms such as electricity, refined fuels and thermal heat. TFEC excludes the energy used for conversion processes and losses incurred during energy production and energy transport.

ii Modern renewables does not include traditional uses of bioenergy such as direct burning of wood fuels, agricultural by-products and dung burned for cooking and heating purposes.

growth in consumption has slowed from an average of 2.5% in 2017 to an average of 1.6% during 2021-2022.[97]

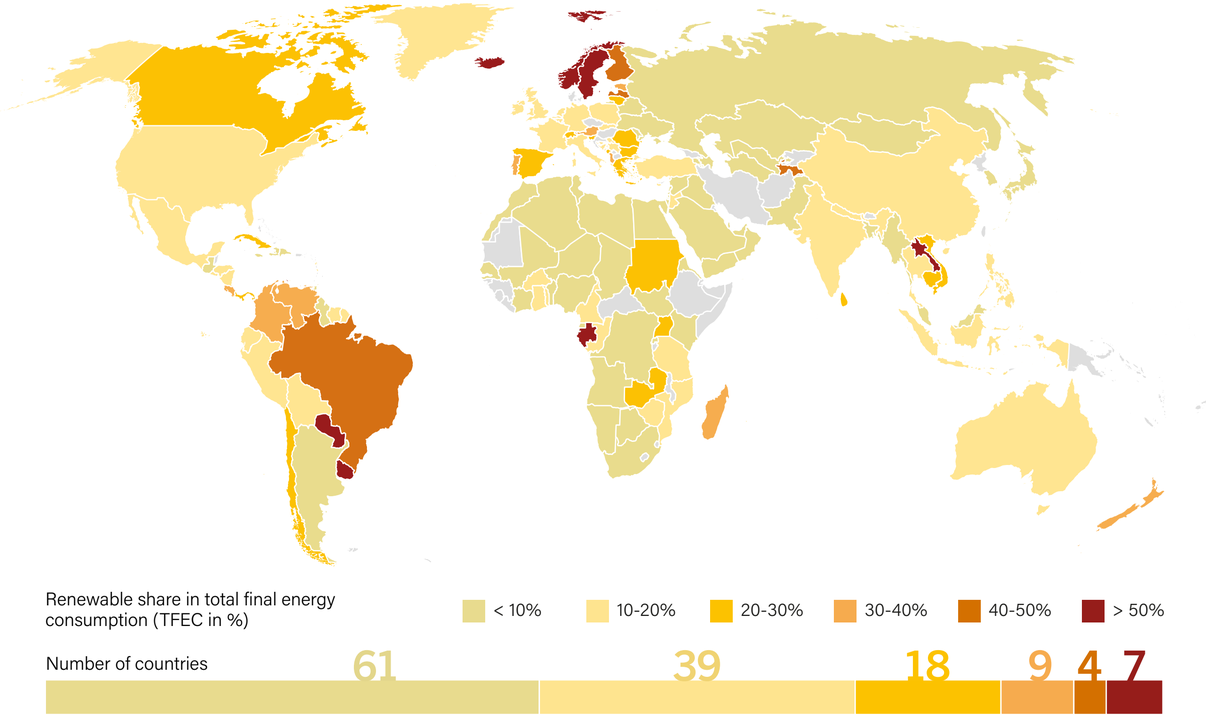
Global energy-related CO_2 emissions continued their upward trajectory in 2023 (following a brief decline early in the pandemic), rising by 410 million tonnes (1.1%) to reach 37.4 gigatonnes.[98] Emissions from coal combustion accounted for more than two-thirds of the increase (71%), followed by oil (25%) and fossil gas (4%).[99] By sector, CO_2 emissions in 2023 increased in the transport sector by 239 million tonnes (58% of the total increase), in the power sector by 197 million tonnes and in the industry sector by 39 million tonnes; in contrast, emissions decreased in the buildings sector, falling by 92 million tonnes due to efficiency gains and mild winters.[100]

The distribution of TFEC varies across sectors and end-uses. In 2022, the industry sector accounted for 34% of TFEC, followed by the buildings sector (30%), transport (26%), other[i] (6%) and agriculture (3%).[101] The industry sector remained the largest consumer of energy, particularly in energy-intensive sub-sectors such as iron and steel, chemicals, and non-metallic minerals.[102] Renewables represented nearly 17% of the industry sector's TFEC in 2021.[103]

In the buildings sector, energy consumption increased 1% in 2021.[104] Modern renewables represented nearly 16% of the sector's TFEC.[105] The transport sector grew a robust 7% in 2021, due mainly to a 20% increase in the energy demand for aviation.[106] (Despite this surge, as of 2021 aviation's energy consumption had not fully rebounded to pre-pandemic levels.[107]) Renewables represented only 4% of the transport sector's TFEC.[108] Energy consumption in the agriculture sector increased 4.4% in 2021, surpassing 2019 levels by 1%, with renewables representing 16% of TFEC in 2021, similar to 2020.[109]

In 2021, Iceland remained the country with the highest share of renewable energy in TFEC, at 83%, due to the strong presence of hydropower and geothermal; it was followed by the Lao People's Democratic Republic (PDR) (73%) and Gabon (66%), both of which rely heavily on hydropower.[110] (→ *See Figure 2.*)

FIGURE 2.
Renewable Share of Total Final Energy Consumption, by Country, 2021



Iceland continues to have the highest share of renewable energy in TFEC, at 83% in 2023, with a strong reliance on hydropower and geothermal.

Note: The top 10 countries with the largest renewable share in TFEC in 2021 were Iceland, Lao PDR, Norway, Gabon, Paraguay. Sweden, Uruguay, Finland, Brazil and Latvia. Some countries with over 30% renewable energy in TFEC do not yet have universal energy access. As of 2022, Lao PDR (97%), Gabon (93%) and Madagascar (32%) did not have universal access to electricity.

The top 10 countries with the largest increase in renewable share in TFEC (2011-2021) were Lao PDR, Albania, Sweden, Uruguay, Finland, Gabon, Norway, Nepal, Estonia and Montenegro.

Source: IEA, REN21. See endnote 110 for this module.

i „Other" includes energy consumption that has not been specified elsewhere, including energy use for military purposes.

ELECTRICITY

Electricity generation worldwide increased an estimated 2.5% in 2022, to reach 28,294 terawatt-hours (TWh).[111] The sector's modest yet steady growth reflects the continuous expansion in global electricity needs.[112] Renewable electricity generation grew an estimated 8% in 2022 to 8,540 TWh; the combined growth in wind and solar PV generation was enough to meet 80% of the increase in the total global electricity demand for the year.[113] This significant growth reflects the shift towards greater use of renewables, which supplied around 30% of the world's total electricity generation in 2022.[114]

Wind and solar PV experienced record generation growth to achieve a combined 12% share in the global electricity mix in 2022, up from 10% in 2021.[115] Solar PV was the fastest growing electricity source for the 18th consecutive year, soaring 24% in 2022.[116] Wind power followed closely with a 17% increase in generation.[117] The expansion of renewables was widely distributed globally, with 60 countries generating more than 10% of their electricity from wind and solar power in 2022.[118]

Global renewable power capacity increased 36% in 2023, adding 473 GW globally to reach a cumulative total of 3,870 GW by year's end.[119] Wind and solar PV together accounted for 97% of the renewable capacity additions, and renewables represented 86% of the total power capacity additions (from all energy sources) in 2023.[120]

ELECTRICITY DEMAND

Electricity demand varies greatly by sector. In recent years, the **buildings sector** has shifted towards a higher share of electricity use, driven by the adoption of electric heating, cooling, and cooking solutions and other appliances. Electricity consumption in the sector increased 2.5% in 2022.[121]

In the **transport sector**, electricity demand surged in 2022, particularly in road transport where electricity use has grown 60% since 2019.[122] The rapid integration of electric vehicles has signalled the shift towards lower-carbon transport modes.[123] Nearly 14 million electric and plug-in-hybrid vehicles were sold worldwide in 2023, a 31% increase from 2022.[124] These vehicles accounted for nearly 15.8% of all vehicle sales globally, up from 13% in 2022.[125] Emerging markets account for only a fraction of electric vehicle sales, but these have experienced notable growth, especially for electric two- and three-wheelers.[126] India, Indonesia and Thailand were among the fastest growing markets for electric vehicles in 2022.[127] In some developed markets, electric vehicles now account for up to half of all cars sold, a significant milestone in the transition towards lower-carbon transport.[128]

The **industry sector** has shown a similar trend towards electrification, especially for less energy-intensive industries that have lower thermal requirements. Between 2011 and 2021, the share of electricity use in industry increased from 22% to 26%.[129] In the **agriculture sector**, electricity accounted for nearly 30% of the energy use in 2021, with 9% of total energy consumption coming from renewable electricity.[130]

ACCESS TO ELECTRICITY AND CLEAN COOKING

After setbacks during the COVID-19 pandemic, access to electricity globally appears to have improved, with the number of people without electricity access falling from 756 million in 2022 to an estimated 745 million in 2023.[131] In sub-Saharan Africa, the population without electricity access grew for three consecutive years but was projected to level off in 2023.[132] Across Africa overall, only 58% of the population had electricity access as of 2022.[133] Globally, a total of 113 countries still lacked universal access to electricity that year, and 59 of them had no targets for electricity access.[134]

Finance remains a barrier for countries to implement energy access solutions. In 2022, development finance for renewable energy generation was USD 7.8 billion, representing only a tiny fraction of the total amount invested in all renewables globally (USD 576 billion).[135] (→ *See Sidebar 2 on page 30.*)

As of 2023, one in three people globally still used traditional biomass, coal and kerosene for cooking.[136] This has severe repercussions for people's health and the environment.[137] Although access to clean cooking has increased in Asia and Latin America, nearly 1 billion people in Africa – almost 70% of the continent's population – lacked clean cooking facilities in 2022.[138]

The number of people **without access to electricity** fell from 756 million in 2022 to an estimated 745 million in 2023.

ENERGY SYSTEMS AND INFRASTRUCTURE

The world's energy systems and infrastructure have continued to face both complex challenges and opportunities as system operators and energy planners adapt to new realities.[139] Traditional business models that have long served the generation sector have proved inadequate for the evolving needs of electricity grids and transmission and distribution networks, which rely heavily on public finance.[140] Globally, an estimated 3,000 GW of renewable energy projects were still awaiting connection to the grid as of 2023, signalling a growing bottleneck.[141] (→ *See Sidebar 1.*)

SIDEBAR 1. Tackling the Bottleneck of Renewable Energy Connection Queues

The global transition to renewable energy is facing a critical bottleneck at the grid connection stage, with at least 3,000 GW of projects (half in advanced stages) awaiting integration. This backlog is equivalent to five times the total capacity of solar PV and wind power added in 2022. Despite soaring investments in renewables (growing 19% annually on average since 2020), global funding for grid infrastructure has stagnated (up 3% annually on average). In 2023, grid investments totalled around USD 300 billion, a level insufficient to accommodate the burgeoning demand for new renewable connections. In the United Kingdom, developers are facing connection queues of 10–15 years.

Of the 3,000 GW of projects awaiting grid integration globally, an estimated 1,500 GW are in advanced stages, located mainly in the United States, Spain, Japan, Brazil, Italy, the United Kingdom, Germany, India, Australia, Mexico, Chile and Colombia. Around one-third of these projects (500 GW) have a high chance of connecting to the grid within five years, as they are in the final stages of signing connection agreements. For the remaining 1,000 GW of advanced projects under review, the need for grid enhancements could delay or halt progress.

Meanwhile, projects in the earliest stages of development may face prolonged feasibility assessments and financial constraints. Of the 1,500 GW of early-stage projects, many reflect only a preliminary expression of interest from private developers. In some countries, the grid queue application process involves minimal documentation, yet projects still require time-consuming feasibility studies and permitting processes.

To address the connection backlog, expansive grid upgrades are needed. Among recent measures taken to mitigate these issues, the EU has mandated full compensation to project developers for grid-related curtailment; the UK system operator has imposed milestones to manage speculative project applications; and France and Germany both require planning permissions before developers can apply for connections. Additionally, efforts like the EU's Action Plan for grids and a new ruling from the US Federal Energy Regulatory Commission aim to streamline grid connections, indicating a concerted effort to tackle the queuing challenge.

Source: See endnote 141 for this module.

Globally, **deployment time spans** for essential grid infrastructure such as high-voltage transmission lines can extend up to 15 years.[142] Substantial investment is needed in grid infrastructure for reliable energy supply, as the current pace of grid development lags behind the requirements for a successful energy transition.[143] Developing economies are faced with compounded financial challenges, where utilities need to invest in grid expansions while also strengthening their existing grids, all in a context of limited resources and a cost of borrowing several times higher than in advanced economies.[144]

Regional interconnections enable the efficient transmission of renewable energy sources, enhancing grid stability and supporting the integration of larger shares of renewables across regions and continents. In August 2023, as a side initiative at the 41st ASEAN Ministers on Energy Meeting, four Southeast Asian countries – Lao PDR, Malaysia, Singapore and Thailand – agreed to a Power Integration Project, signing a memorandum of understanding on 18 potential locations to set up cross-border transmission lines.[145]

The market for **energy storage** has also expanded.[146] Pumped storage remains the most widely deployed storage technology (with 10.5 GW added in 2022, bringing the total to 175 GW), and utility-scale battery storage is growing rapidly (with 11.1 GW added in 2022, bringing the total to 28 GW).[147] The battery storage sector faces challenges related to rising costs, strained supply chains and the burgeoning demand for similar resources from the electric vehicle market, which could complicate expansion.[148] Utility-scale battery storage systems have experienced a strategic shift towards diverse revenue streams, such as ancillary services and capacity auctions[i].[149]

Residential energy storage, the smallest segment, is expected to increase alongside the growing interest in energy independence and self-consumption.[150] Lithium-ion batteries have gained market share due to their lower cost and high efficiency, while alternatives such as sodium-ion batteries are reaching commercial scale.[151]

The development of public infrastructure for electric vehicles has remained strong. By the end of 2022, around 2.7 billion public charging points had been installed globally, up 55% from 2021.[152] Battery swapping[ii] has emerged as a viable option in some countries, offering advantages in both charging time and cost.[153] China leads in this technology, having installed large numbers of swapping stations for two- and three-wheelers as well as trucks and passenger cars.[154]

Global hydrogen demand grew 3% in 2022 to 95 million tonnes.[155] However, the uptake of **renewable hydrogen** has been slow, accounting for just 0.7% of total hydrogen demand that year.[156] This modest growth reflects the large economic challenges facing the industry, with sharply higher costs for renewable hydrogen in 2023 due to factors such as higher labour and material costs, an increase in the cost of capital of 3 to 5 percentage points, and a 30% surge in the cost of renewable power.[157]

Globally, China has emerged as a leader in the deployment of electrolysers used to produce hydrogen.[158] Driven by large-scale projects, the country's share of the global electrolyser capacity was expected to increase from less than 10% in 2020 to 50% by the end of 2023.[159] In 2023, China accounted for more than 40% of the projects that had reached the final investment decision stage.[160]

Hydrogen's potential as a decarbonisation solution has increased with ongoing discoveries of white hydrogen, or hydrogen that can be found naturally and has the capacity to replenish.[161] The environmental benefits of renewable hydrogen depend critically on how it is produced and which sectors it is used in.[162] The use of clean hydrogen can be strategically targeted towards those industries and activities where direct electrification is not feasible, such as certain manufacturing processes, heavy transport and energy storage.[163]

Sector coupling refers to the linking of the electricity sector with other end-uses such as thermal energy for buildings and industry, and the transport sector. This can be a strategic way to integrate higher shares of variable renewable electricity into energy systems while also increasing the share of renewables in non-electricity sectors. It can minimise the curtailment of renewable energy generation by increasing system flexibility, using the surplus electricity from other end-use sectors and storing it for later use (whether in batteries, or as thermal energy or renewable hydrogen).[164] Sector coupling has gained momentum globally but is concentrated mainly in Europe and North America.[165]

Among new players in the sector coupling market in 2023, a German start-up began developing reactors for the direct conversion of renewables into e-fuels and green chemicals, and a US start-up offered a power-to-heat conversion technology that uses refractory bricks to store and deliver heat, providing industries with a low-cost electrification option.[166] Municipal utilities in Germany have shown interest in sector coupling as a way to avoid lost earnings from overproduction or a lack of grid integration.[167] In Denmark, the world's largest e-methanol plant came online in 2023 to produce green fuels and to supply excess heat to local district heating, benefiting 3,300 households.[168] The plant is directly connected to a solar park and will produce green methanol and renewable hydrogen.[169]

i Ancillary services are all services required by transmission or distribution system operators to enable them to maintain the integrity and stability of the system as well as the power quality. Capacity auctions are competitive procurement mechanisms to secure electricity supply and safeguard against possible blackouts.

ii Battery swapping allows battery electric vehicles to quickly exchange a discharged battery pack for a fully charged one.

POLICY AND TARGETS

Geopolitical shifts and crises of previous years have brought increased policy attention to the renewable energy landscape. While there is no shortage of commitments and pledges aimed at a more sustainable energy future, the real challenge lies in turning these promises into concrete results.

90 countries had nationwide renewable energy targets as of 2023

170 countries had a renewable energy target for electricity generation

151 countries had net zero targets in place

KEY FACTS

- At the UNFCCC's COP28, **130 countries pledged to triple the world's renewable energy capacity** and double the annual rate of energy efficiency improvements by 2030.
- The revised **EU Renewable Energy Directive of 2023 sets a new target of 42.5% of renewable energy by 2030** and aims for 45%. Member States have since submitted their renewable energy targets for sub-sectors including transport, buildings and industry.
- **China is the only country on track** to meet its renewables target, for a 28% share by 2030.
- **Renewable hydrogen strategies had been adopted by 41 countries by the end of 2023**, with the EU launching a European Hydrogen Bank to support the regional market with EUR 800 million (USD 862 million) in subsidies.
- Carbon pricing mechanisms continued to be a popular measure globally, with **39 countries implementing such policies** by the end of 2023.

POLICY CONTEXT

The renewable energy landscape in 2023 was shaped largely by policy decisions and targets adopted in previous years, particularly measures responding to the COVID-19 pandemic, the Russian Federation's invasion of Ukraine and the subsequent energy crisis.[170] The ambition and effectiveness of these policies helped stimulate large increases in renewable energy investment and in the number of projects announced and commissioned during the year.[171]

Geopolitics has played a growing role in the renewables sector.[172] Ambitious policies such as the US Inflation Reduction Act and RePowerEU have proven influential in encouraging both individuals and businesses to invest in renewable energy capacity.[173] These policies are promoting energy independence, diversifying supply chains to more countries and countering the dominance of key players such as China in the global energy market.[174]

Many countries have strengthened their commitment to renewables by setting **targets**. By the end of 2023, 90 countries had in place economy-wide targets for renewable energy, although only 7 countries had targets for 100% renewables (most of them aimed at distant time horizons).[175] During the year, three countries announced new or updated renewable energy targets.[176]

Despite ambitious targets, countries will continue to fall short of their renewable energy goals if they do not adapt strong policies and regulations. As of December 2023, China was the only country on track to meet its renewable energy target (for 28% renewables in the energy mix by 2030), and China was also ahead in its annual requirements for renewable capacity additions.[177] The EU, despite ongoing efforts, remained off track to meet its target of 42.5% renewables in the energy mix.[178] The wide gap between ambition and achievement in most countries globally highlights the need for more effective action to bridge this divide.

As of 2023,

7 countries

had 100% economy-wide renewable energy targets.

POLICIES AND TARGETS IN ENERGY DEMAND

The global energy landscape is being reshaped by targeted policy interventions across diverse demand sectors. In the agriculture sector, policies to advance the uptake of renewables remain scarce, whereas in the transport sector policies are being crafted to boost renewable energy use across road, air, rail and shipping modes. Similarly, the buildings sector is focused on policies to promote renewables for on-site electricity generation, energy-efficient appliances, as well as heating and cooling.[179] The industry sector is shifting towards an emphasis on decarbonisation and energy efficiency, underpinned by comprehensive policies that integrate climate goals with energy and industrial strategies.[180]

Few dedicated policies exist to promote renewable energy in agriculture. Established technologies include biogas and solar-powered water pumps, while the emerging agrivoltaics sector (which combines agriculture and solar PV to maximise land-use efficiency) is maturing rapidly. Fiscal and financial policies are still widely used to advance renewables in the agriculture sector. In 2023, Greece offered grants of up to 60% for farmers to install solar PV systems, and the EU allocated EUR 1.7 billion (USD 1.84 billion) to support agrivoltaics in Italy.[181]

By the end of 2023, a total of 43 national and sub-national jurisdictions had renewable energy policies for **agriculture**, and 18 countries enacted new policies during the year.[182] In addition, the EU adopted the 2023-2027 Common Agricultural Policy, which aims to use energy efficiency and precision farming to enhance resource management, and to add 1,556 MW of renewable capacity through investment support for nearly 180,000 farms.[183]

In the **transport** sector, 28 countries announced new policies in 2023 to support demand for renewables in road transport, aviation, rail and shipping.[184] This brought the total number of countries with renewable energy policies for transport to 65.[185] The EU's New Renewable Energy Directive, adopted in October 2023, includes the option for Member States to choose between a binding target to reduce the greenhouse gas intensity of transport 14.5% by 2030 through the use of renewables, or a binding share of at least 29% renewables in the transport sector's final energy consumption by 2030.[186]

Electric vehicle policies continued to lead in road transport. During 2023, at least 13 countries – including China, France, Iceland, Indonesia and Poland – announced fiscal and financial incentives for electrified transport, which are relevant for the uptake of renewables when coupled with ambitious renewable energy targets.[187] Some countries, such as South Africa, increased their biofuel blending mandates.[188] Others, continuing the trend observed in 2022, reduced their blending mandates amid the ongoing cost-of-living crisis.[189] In aviation, the ReFuelEU initiative set a mandate for 2% sustainable aviation fuel in all planes at EU airports by 2025, with a gradual increase to 70% by 2070.[190]

Policies in the **buildings** sector have focused mainly on heating and cooling. In 2023, several EU countries – including Croatia, Cyprus, Denmark, Estonia, Germany, Italy, Latvia, Portugal, Romania and Slovenia – announced new or updated renewable energy targets in the sector.[191] The EU's New Renewable Energy Directive includes an indicative target of at least 49% renewables in buildings by 2030.[192] Heat pumps continued to benefit from favourable policies in 18 countries.[193] Germany adopted contentious legislation calling for the replacement of all fossil fuel heating systems by 2045.[194]

As of December 2023, 10 countries had new or updated renewable energy policies in the **industry** sector, bringing the total to 37 countries.[195] Policies in the sector continued to be driven by the need to decarbonise, with a primary focus on energy efficiency. Some countries have increasingly adopted an integrated approach, merging their climate, energy security and industrial policies into broader, more cohesive strategies, such as the US Inflation Reduction Act, the RePowerEU package and Japan's Green Transformation Program.[196] In South Africa, the new South African Renewable Energy Master Plan (SAREM) was announced in July 2023; the plan calls for increased investment in industrialisation, localised manufacturing and skilled labour.[197] (→ *See Snapshot: South Africa.*)

As part of the EU's Green Deal plan, the Net-Zero industry Act was under negotiation in 2023 and includes provisions to boost the manufacturing capacity of net zero technologies (such as renewable energy and renewable hydrogen) by 2030.[198] The United Kingdom also published its Net Zero Growth Plan, which includes strategies to achieve the country's commitment to net zero emissions through renewable energy investment and other measures.[199] Renewable heat continued to gain momentum in the industry sector, with new targets announced in Italy, Latvia and Slovenia.[200]

SNAPSHOT SOUTH AFRICA

HOW TRANSFORMATIVE POLICY IS SHIFTING SOUTH AFRICA'S RENEWABLE ENERGY LANDSCAPE FROM CRISIS TO OPPORTUNITY

Coal mining is crucial to South Africa's economy. The sector accounted for around 100,000 jobs nationwide in 2021, and in 2023 coal contributed more than 70% of the country's energy supply and 85% of its electricity generation.

Since 2008, the national energy supply has been unable to meet demand, resulting in year-round electricity "load-shedding". In addition to costing South Africa an estimated USD 53 billion, this power supply crisis has deterred investor confidence, hindered development, and exacerbated inequality, forcing many residents to rely on costly diesel generators for energy security, which most people cannot afford.

Motivated by the pressing need for new generation capacity, as well as by international pressure to decarbonise, South Africa has put massive efforts into research and planning for a "just energy transition" that suits the local context.

Renewable energy deployment has accelerated since 2011 with the launch of the government-led Renewable Energy Independent Power Procurer Procurement Programme (REIPPPP), a competitive tender process that was designed to facilitate private sector investment in grid-connected renewable energy generation. During 2011-2015, the REIPPPP, along with the Risk Mitigation Independent Power Producer Procurement Programme (RMIPPPP), successfully secured 11,590 MW of renewable energy technologies and 415 MW of battery storage capacity, providing valuable lessons for other countries in organising competitive tenders for grid-connected independent renewable power production.

In 2023, South Africa experienced a critical juncture in its energy sector, marked by a series of policy developments aimed at addressing the pressing challenges posed by the ongoing energy crisis. Policies included the following:

South African Renewable Energy Master Plan (SAREM): Building on a 2022 draft, the plan focuses on unlocking market demand, driving industrial development through localisation efforts, ensuring inclusive growth, and building local capabilities in skills and technological innovation. The first such plan for the country, the SAREM sets a clear strategy for energy storage uptake while emphasising the maximisation of local value chains. To leverage South Africa's already developed manufacturing and assembly industries, the country will likely raise its tariffs on imported solar panel mounting structures (which can also be made with locally sourced steel) and on fully assembled lithium-ion battery packs. Although the plan provides few details on the country's stance on mining and the critical minerals required for the energy transition, it outlines an alignment between the steel, automotive and battery minerals masterplans to improve the competitiveness of local minerals and materials. The SAREM highlights South Africa's plans to use public procurement to add 22.9 GW of utility-scale renewable energy and battery storage during 2022-2030.

National Wheeling Framework: A report released in July 2023 outlines steps for municipalities to enable electricity wheeling and introduced a national wheeling framework that is under development. Wheeling involves delivering energy from producers to end-users via a distribution network, enabling independent power producers to sell electricity directly while paying for grid use.

Electric Vehicle White Paper: In line with the global shift towards lower-carbon transport, South Africa introduced a White Paper on electric vehicles in 2023. As Africa's largest producer of cars and second largest exporter, South Africa faces significant challenges due to international bans on the export of internal combustion engine vehicles. To support a just transition, the paper outlines a technology-agnostic approach, investment support and incentives for the localisation of the automotive supply chain.

These emerging policy developments indicate a pro-active and strategic response to the energy challenges facing South Africa. In 2022, a substantial increase in renewable energy project registrations occurred, with 1.6 GW reported to the National Energy Regulator of South Africa (NERSA), up sharply from the 86 MW recorded in 2021. The momentum continued in the first quarter of 2023, with the registration of 2.5 GW. In December 2023, the Ministry of Mineral Resources and Energy launched a seventh round of the REIPPPP, expecting to allocate 1.8 GW of solar PV capacity to add to the existing 5,826 MW at the end of 2022.

Source: See endnote 197 for this module.

POLICIES AND TARGETS IN ENERGY SUPPLY

Integrating renewables into energy supply encompasses a diverse range of policy goals, from the promotion of renewable electricity generation to support for renewable heating. Policy measures include setting targets, employing auction mechanisms, leveraging fiscal and financial measures, and adopting renewable portfolio standards.

With the sustained growth in renewable generation capacity worldwide, more countries have updated their targets. In 2023, 31 countries – including Brazil, Côte d'Ivoire, Egypt, Ireland, Italy and Uganda – announced new or revised targets for the renewable share in electricity generation, bringing the total number of countries with economy-wide renewable energy targets to 90.[201] (→ *See Figure 3.*) During the COP 28 event, the Latin America and Caribbean Renewables Hub raised its 2030 target for the share of renewables in the region's total electricity generation from 70% to 80%.[202] The region also aims for 36% renewables in its total energy supply.[203]

By the end of 2023, a total of 170 countries had a renewable energy target for **electricity generation**.[204] Solar, wind and hydropower have dominated technology-specific targets.[205]

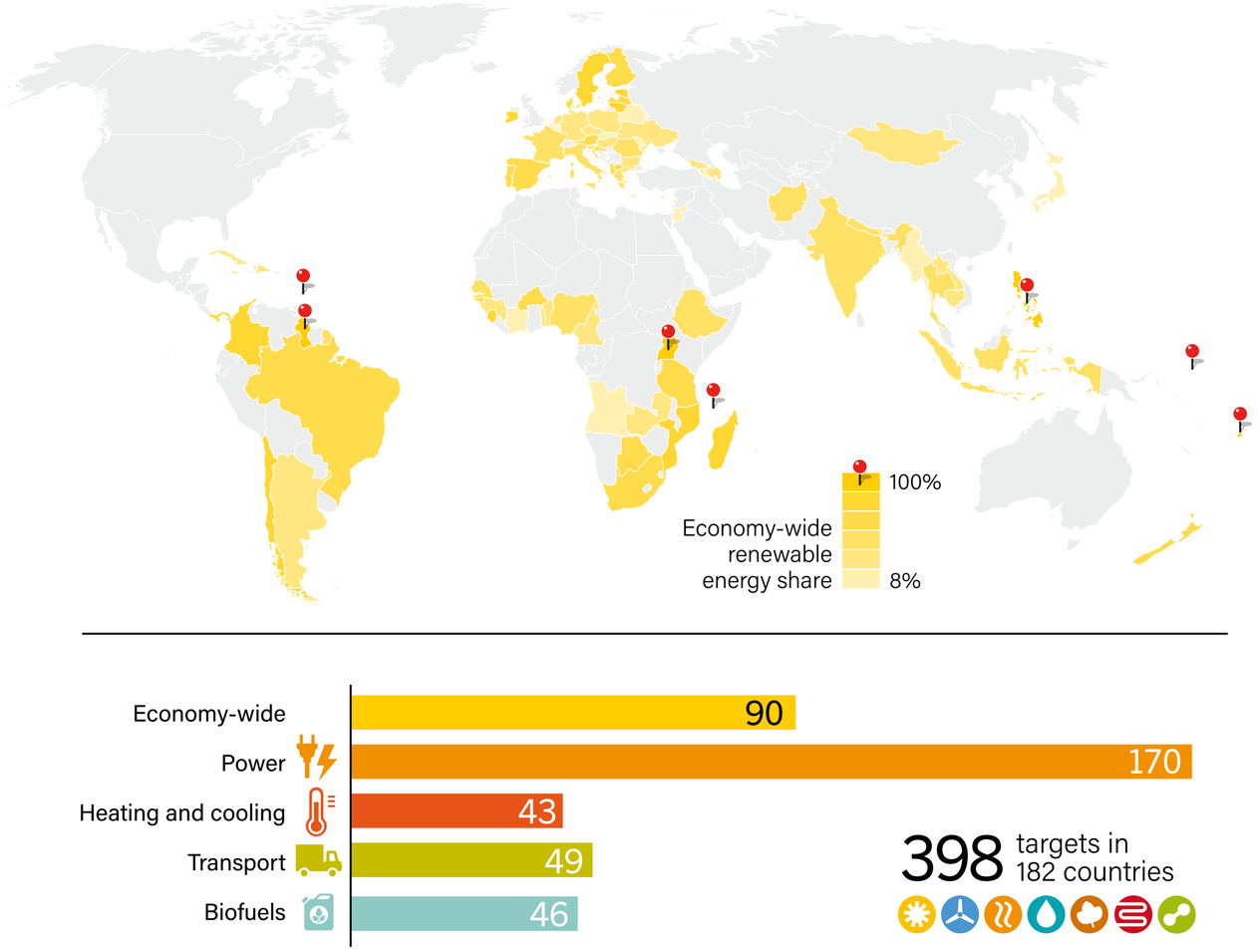
Feed-in tariffs remained popular in 2023, and several countries – including France, Serbia and Türkiye – announced new tariffs for systems of various sizes.[206] Auctions and tenders were still in wide use for wind and solar PV, and were increasingly being used for renewable hydrogen (including in Albania, Algeria, Greece, India and Romania).[207]

Fiscal and financial policies for renewable power supply, such as tax credits and financial incentives, remained prevalent. Among the countries that announced fiscal and/or financial policies related to renewable power in 2023 were Austria, Brazil, China, Egypt, Greece, Indonesia, Poland and Switzerland.[208] Switzerland allocated USD 682 million (CHF 600 million) in subsidies for small and large-scale solar PV.[209]

Renewable portfolio standards (RPS)[i] continued to be a cornerstone of state-level energy policy in the United States. As of 2022, 30 US states had established RPS, with 17 of the policies targeting 100% clean or renewable electricity by 2050.[210] Connecticut announced a goal of 48% renewable electricity by 2030, and Illinois increased its targets to 50% by 2040 and 100% by 2050.[211]

Renewable heat supply gained growing policy attention in 2023. This ranged from supports for district heating (in Croatia, the Czech Republic, Denmark and the United Kingdom) to bans on fossil fuel use for heating (in Austria, France, Germany and the US state of New York).[212] Heat pumps and solar water heaters continued to attract interest, including in Kenya where it has now become mandatory to equip all residential buildings, schools, health-care institutions and commercial buildings with solar water heaters.[213] Ireland announced its intention to introduce a renewable heat obligation by 2024.[214]

FIGURE 3.
Renewable Energy Targets, by Country and by Sector, as of 2023



Source: REN21. See endnote 201 for this module.

i A regulation that requires the increased production of energy from renewable energy sources.

POLICIES IN ENERGY INFRASTRUCTURE

Policies aimed at improving the penetration of renewables in energy systems typically require long-term planning, yet they remain scarce.[215] The EU has made progress on electricity market design, including a proposed two-way Contract for Difference[i] mechanism that aims to create a buffer between electricity markets (which are heavily dependent on global fossil fuel prices) and consumer bills.[216] Energy producers receive payments if market prices fall below a certain level, and must pay back when prices exceed a certain level, ensuring revenue stability and encouraging investment in renewables.[217]

Under the 2022 EU Trans-European Network for Energy – a policy aimed at connecting the energy infrastructures across EU Member States – projects were selected in 2023 among 11 priority corridors and 3 thematic policy areas.[218] The EU also updated its rules for cross-border energy infrastructure in 2022.[219] In addition, the European Commission presented a New Grid Action Plan, a comprehensive strategy to enhance the efficiency and expansion of regional electricity grids in light of rising demand for and integration of renewables in order to achieve the EU Green Deal and "green" the economy.[220]

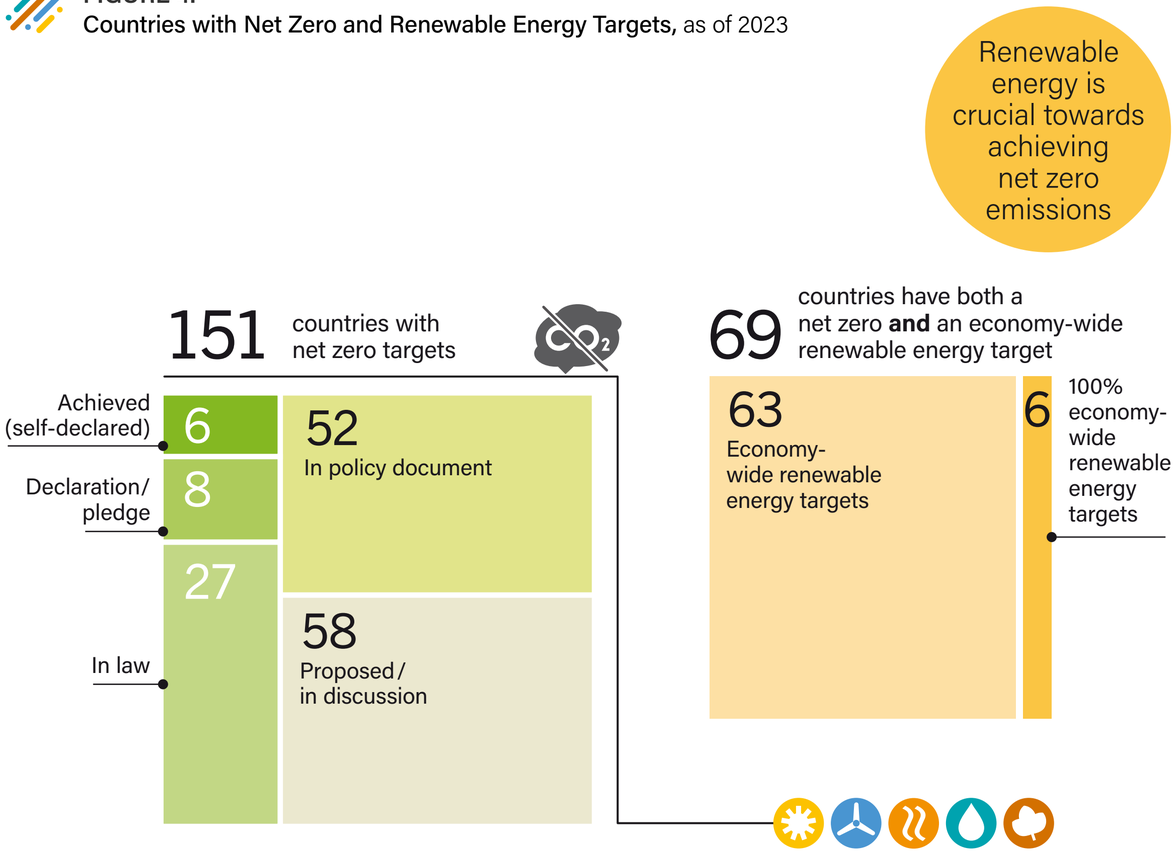
Renewable hydrogen gained policy attention during 2023, with 41 countries having in place a renewable hydrogen strategy or roadmap by year's end.[221] Several countries – including Argentina, Estonia, India, Oman and Türkiye – announced new strategies.[222] Denmark launched a tender for up to 6 GW of electrolysis capacity by 2030, with an emphasis on "power-to-X".[223] This entails linking the electricity sector with other sectors (such as heating, cooling, transport and industry) to increase the integration of variable renewable electricity, while also storing the surplus electricity from other sectors (in batteries, as thermal energy or as renewable hydrogen) for later use.

Among advances in hydrogen in 2023, Italy allocated EUR 300 million (USD 328 million) to develop a renewable hydrogen-based railway system, including the generation plants and hydrogen-powered trains.[224] The EU launched the European Hydrogen Bank to initiate the regional market, with EUR 800 million (USD 875 million) in subsidies for renewable hydrogen production.[225] The United States issued regulations on the Clean Hydrogen Production Credit under the Inflation Reduction Act.[226] The United Kingdom released details on a 15-year support mechanism for low-carbon hydrogen production to make up the gap in operating costs between low- and high-carbon fuels.[227] Despite rising policy attention, renewable hydrogen deployment has lagged globally due to high production costs and weak demand.[228]

ENERGY AND CLIMATE POLICIES

As of December 2023, 151 countries had in place **targets for net zero emissions** (→ *see Figure 4*), covering 88% of global greenhouse gas emissions.[229] In 2023, Georgia adopted its Long Term Low Emission Development Strategy 2050, which sets the stage for reaching the country's net zero target for 2050.[230] In addition, 20 countries submitted new or updated Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, bringing the total available submissions to 168; Eritrea became a new signatory to the agreement.[231] Countries are expected to submit their second NDC updates by 2025.[232]

FIGURE 4.
Countries with Net Zero and Renewable Energy Targets, as of 2023



Note: The Philippines has a 100% RE target, but no net-zero target.

Source: REN21. See endnote 229 for this module.

i A type of derivative product that is used to speculate on the future direction of a market price.

Despite rising interest in decarbonisation, many G20 countries have increased their direct **subsidies to fossil fuels**, bringing the G20 total to a record USD 1.3 trillion in 2022.[233] This was more than double the amount in 2019, prior to the COVID-19 pandemic and the global energy crisis.[234] Globally, total fossil fuel subsidies (direct and indirect) reached USD 7 trillion in 2022, with China contributing the most (USD 2.2 trillion) followed by the United States (USD 760 billion), the Russian Federation (USD 420 billion), India (USD 350 billion) and the EU (USD 310 billion).[235] Most of these were direct subsidies, in addition to investments by state-owned enterprises and lending from public financial institutions.[236] In a different approach, Canada banned subsidies to the oil and gas sector starting in July 2023 in an effort to comply with the 2009 G20 commitment to phase out inefficient fossil fuel subsidies.[237]

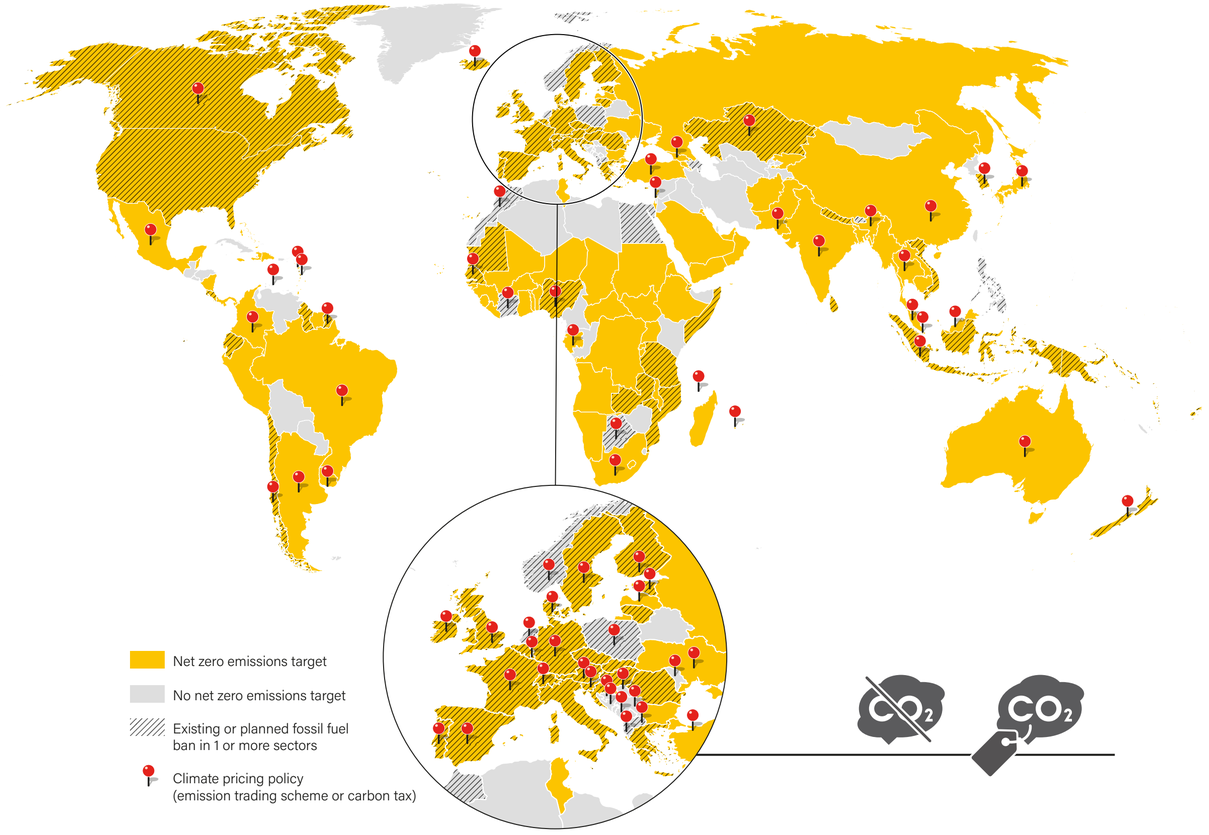
Carbon pricing policies continued to gain traction in 2023, in the form of either carbon taxes or emission trading systems. A total of 39 countries were implementing a carbon pricing mechanism by year's end.[238] (→ *See Figure 5.*) Indonesia launched the Indonesia Carbon Exchange (IDX Carbon) on its stock exchange, and Australia updated its carbon pricing mechanism to target the most polluting industries.[239] The United Kingdom announced that it would introduce a domestic carbon tax by 2027.[240]

The EU's Implementing regulation for the Carbon Border Adjustment Mechanism, which entered into force in October 2023, covers cement, iron, steel, aluminium, fertilisers, electricity and hydrogen.[241] The mechanism is designed to counteract carbon "leakage" by imposing a cost on carbon emissions associated with imported goods, and aims to level the playing field between EU producers (which are subject to stringent climate policies) and non-EU producers (which may face less strict environmental standards).[242]

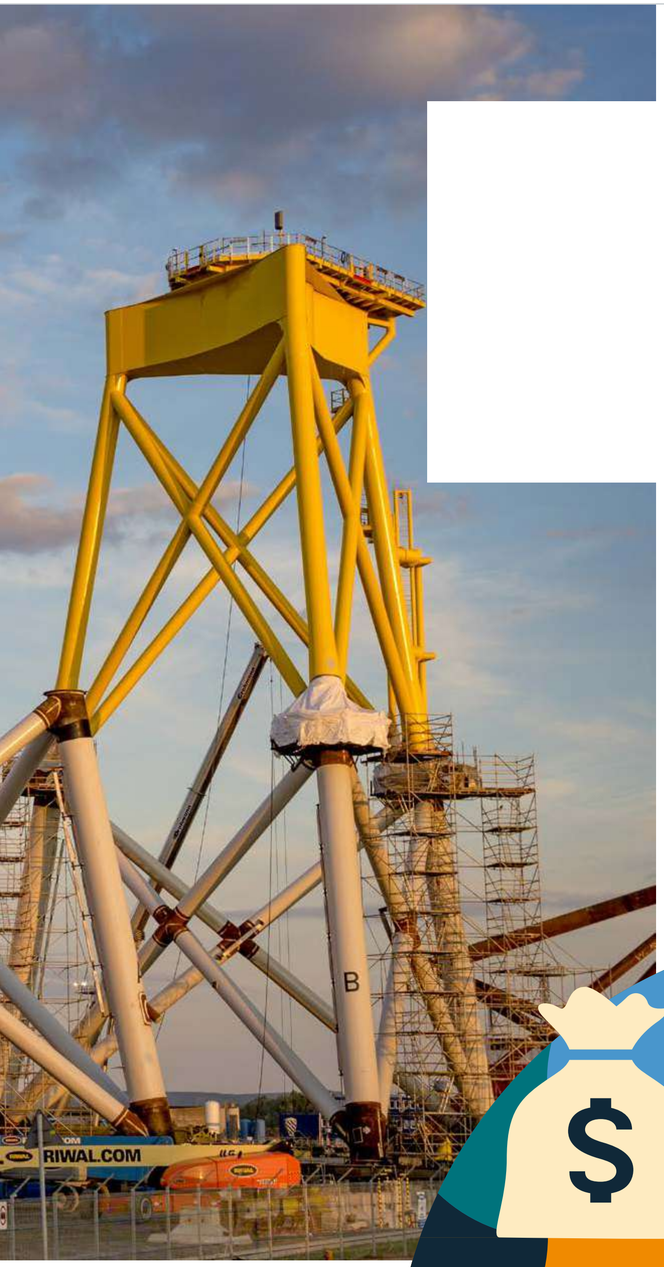
Increasingly, policy makers have recognised the role of **energy efficiency** in bolstering energy security, reducing costs and aiding the energy transition.[243] By the end of 2023, nearly all countries were implementing efficiency standards for air conditioners, and the number of countries with standards for industrial motors increased three-fold in the last decade.[244] At least 16 countries implemented new or updated energy efficiency policies in 2023.[245]

Several Eastern European countries allocated large grants for energy efficiency, including Bosnia and Herzegovina (BAN 12.6 million or USD 13.7), Croatia (EUR 40 million or USD 43 for public buildings) and Estonia (EUR 80 million or USD 87 for buildings).[246] Singapore and the United States announced plans to update their minimum energy performance standards.[247] Türkiye issued a 2030 Energy Efficiency Strategy and Action Plan, which aims to reduce energy consumption 16% and to prevent 100 million tonnes of emissions by 2030.[248] As noted earlier, the final text from COP 28 called for doubling the rate of global energy efficiency improvements by 2030, with 130 countries committing to the target.[249]

FIGURE 5.
Countries with Climate Change Policies, by Type of Measure, as of 2023



Source: REN21. See endnote 238 for this module.



INVESTMENT AND FINANCE

Global investment in renewable power and fuels reached a new record high in 2023, of USD 622.5 billion. This was achieved despite high interest rates (outside of China) and challenging market conditions worldwide. The ongoing increase in investment has resulted from alignment between climate change policy ambition, energy security goals and industrial strategies as well as actions in response to the global energy crisis and ongoing recovery from the COVID-19 pandemic.

623 **billion USD** global new investment in renewable power and fuels in 2023

x2.36 annual investment increase required from 2024 to 2030 to meet the BNEF Net Zero Scenario

43% **of mitigation finance** was allocated to renewable energy in 2022

KEY FACTS

- In 2023, **global investment in renewable power and fuels increased 8.1%**, to reach USD 622.5 billion.
- In 2022, the **cost of capital for onshore wind in low-income countries was 6.5 percentage points higher** than in high income countries.
- The private sector is increasingly becoming a channel for **implementing development finance projects** for renewable energy.
- Issuance of **green bonds rebounded in 2023** following a decline in 2022 related to geopolitical tensions.
- Estimates of the **annual investment in renewable power needed by 2030 to achieve the Paris Agreement goals** are in the range of USD 1,300 billion to USD 1,350 billion.

ENERGY SYSTEM INVESTMENT

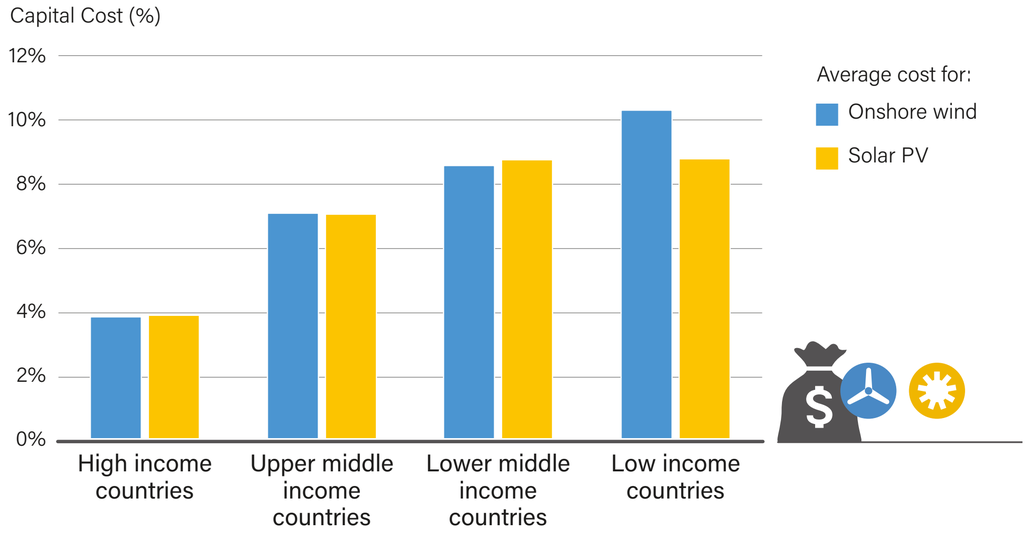
Global investment in renewable power and fuels[i] increased 8.1% in 2023 to reach USD 622.5 billion.[250] (→ *See Renewables in Energy Supply Module.*) This represented a new global high and was achieved despite high interest rates (outside of China) and challenging market conditions worldwide. Renewable energy projects are harder to finance when interest rates are high because investors must rely more on expensive equity, potentially decreasing their return on a given project.[251] Higher input costs for key raw materials including critical minerals further complicated the investment environment.[252] However, cost pressures along supply chains started to ease during the year, particularly in key regions such as China, Europe and the United States.[253]

The increase in renewable energy investment in the last few years has been in response to the global energy crisis and the ongoing recovery from the COVID-19 pandemic, and as a result of an alignment between climate policy ambition, energy security goals and industrial strategies.[254]

In the developing world, **costs of capital** remain higher than in developed economies, impeding financing for renewable energy projects.[255] (→ *See Figure 6.*) Costs of capital tend to be higher in developing countries because of concerns about the rule of law and about currency fluctuations and convertibility, among others.[256] As a consequence, public finance (including from development finance institutions) accounts for around half of the financing for clean energy projects in developing and emerging economies, whereas in developed countries this share is closer one-fifth.[257] (→ *See Sidebar 2.*)

Global investment in renewable power and fuels reached an all-time high in 2023 despite high interest rates and challenging market conditions worldwide.

FIGURE 6.
Weighted Average Cost of Capital for Onshore Wind Power and Solar PV, by Country Income Level, 2022



Note: The weighted average cost of capital (WACC) is the average rate a business pays to finance its assets. It is calculated based on the cost of debt and equity. The country division is based on the World Bank country classifications by income (Fiscal Year 2024). Each income bracket includes the countries for which data are available in the IRENA database.

Source: IRENA. See endnote 255 for this module.

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.

SIDEBAR 2. Development Finance for Renewable Energy

Countries are not delivering adequately on their development finance[i] commitments. Under the United Nations Sustainable Development Goals (SDG 17[ii]), developed countries committed to allocate 0.7% of their gross national income (equivalent to USD 411 billion in 2022) in funding to support less-wealthy countries. However, as of 2022 only 0.36% of GNI was being channelled into such aid, a shortfall of USD 200 billion.

Development finance flows for **renewable energy generation**[iii] projects totalled USD 7.8 billion in 2022, an amount that pales in comparison to the USD 576 billion invested in renewables globally. This misalignment is even more alarming in the context of the high cost of capital for renewable energy projects and the need for clear roadmaps and support for the energy transition in developing economies.

Even so, finance for renewable generation projects globally has increased steadily, with disbursements more than doubling from USD 3.5 billion in 2013 to USD 7.85 billion in 2022. However, the bulk of development finance for these projects is in the form of loans or equity investment, with grants representing only 35% of total government-driven assistance and 20% of the total development finance (including other official flows and private development finance).

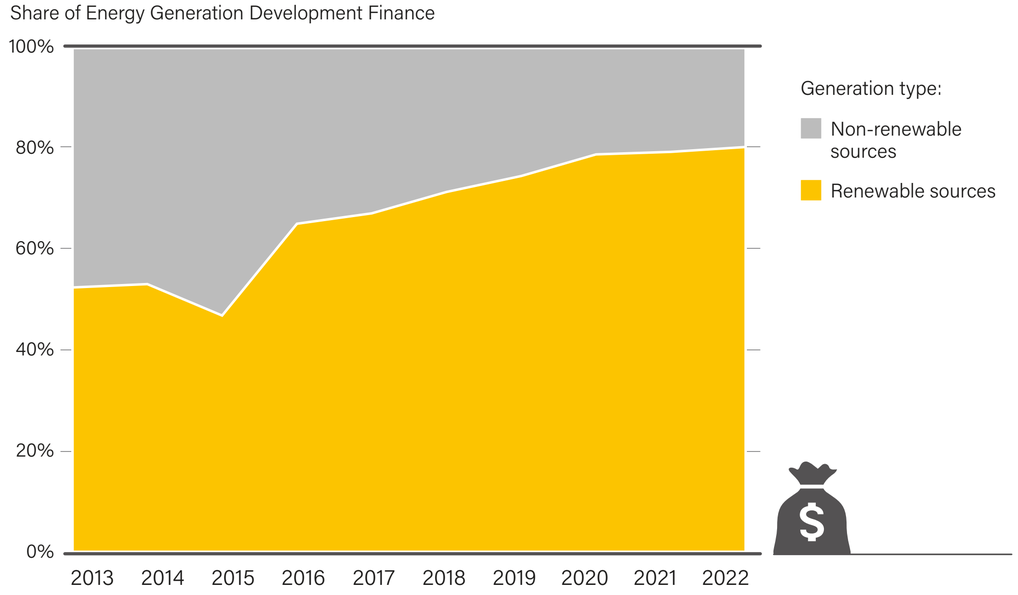
Renewables are not the only recipient of development finance for energy generation. In 2022, more than USD 1.9 billion was disbursed for non-renewable energy projects (mainly fossil fuels). Yet the share of non-renewables in total energy generation finance has declined steadily. (→ *See Figure 7.*) This is in part because multilateral development banks have increasingly adopted policies that exclude support for fossil fuels such as coal and oil, although fossil gas remains a key aid recipient.

i Development finance or "development assistance" is defined as aid that promotes and targets economic development and welfare in developing countries and flows mainly from members of the OECD's Development Assistance Committee (DAC) and from multilateral organisations into developing countries categorised as eligible based on an income threshold. See endnote 257 for this module.

ii See, for example, SDG 17.2: Partnerships for the Goals. Development assistance as a catalyst for progress.

iii Development finance flows are classified into sectors with unique purpose codes. For example, energy aid is split into: energy policy, energy generation (renewable), energy generation (non-renewable), hybrid energy plants, nuclear energy plants and energy distribution.

FIGURE 7.
Share of Development Finance from Official and Private Donors for Renewable and Non-Renewable Energy Generation Projects, 2013-2022

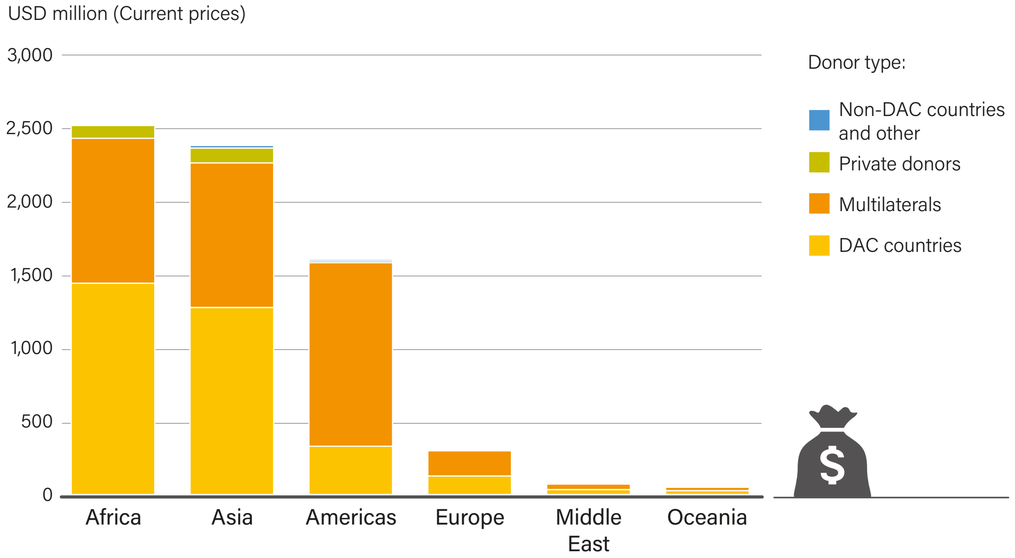


Note: "Renewable sources" includes the following categories: multiple technologies, hydro-electric power plants, solar energy for centralised grids, wind energy, marine energy, geothermal energy, bofuel-fired power plants, solar energy for isolated grids and stand-alone systems and solar energy – thermal applications.

Source: OECD-DAC Creditor Reporting System (CRS) Database. See endnote 257 for this module.

Most development finance for renewable energy generation is provided via two key donor sources. Countries that are members of the Development Assistance Committee (DAC)[i] of the Organisation for Economic Cooperation and Development (OECD), as well as multilateral organisations, together accounted for 95% of development finance flows in 2022. Meanwhile, non-DAC countries and private donors contributed only 5%, mainly to Africa and Asia. Multilateral banks are the main donors for renewables in the Americas and Europe, whereas in Africa and Asia, bilateral funding from DAC countries dominates. (→ *See Figure 8.*)

FIGURE 8.
Development Finance for Renewable Energy Generation by Donor and Recipient Region, 2022



Note: In 2022, USD 858 million was not assigned to the aforementioned regions. This amount is not reflected in the figure above. Multilaterals include EU institutions, the International Monetary Fund, regional development banks, the United Nations, the World Bank and others.

Source: OECD-DAC Creditor Reporting System (CRS) Database.
See endnote 257 for this module.

In 2022,
78%
of development finance for the Americas came from multilateral organisations.

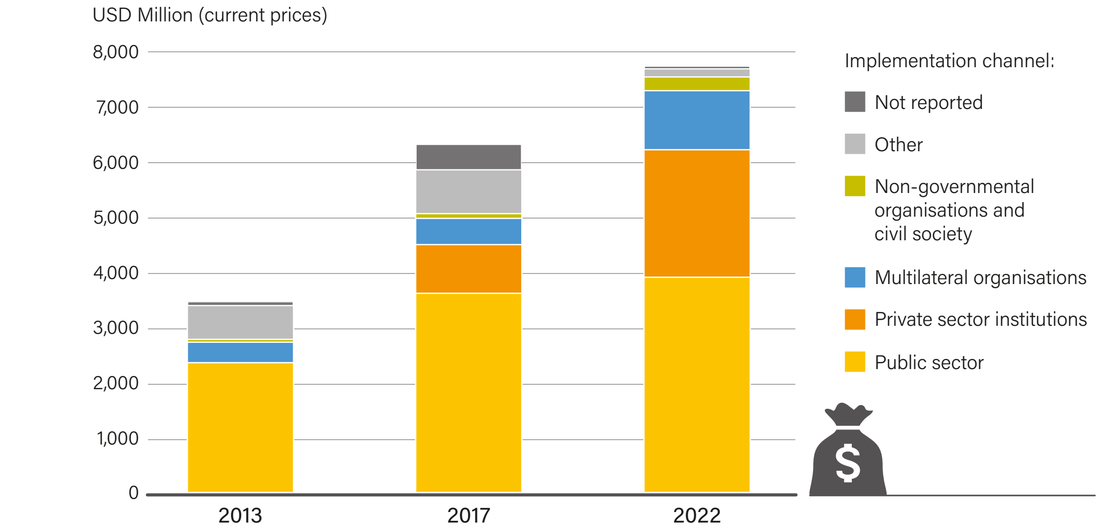
i DAC members are: Australia, Austria, Belgium, Canada, Denmark, the European Union, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

Over the past decade, a major shift has occurred in aid implementation channels. (→ *See Figure 9.*) Whereas in 2013 the public sector delivered more than two-thirds of development finance (67%), by 2022 this share had fallen to 50%. Meanwhile, funding directed at private sector institutions has increased rapidly, rising from near zero in 2013, to 14% in 2017 and 30% in 2022[i]. Multilateral organisations also increasingly lead on project implementation, with their share rising from 7.5% in 2017 to 13.8% in 2022.

Private delivery of development projects has become more popular mainly because it is viewed as a dynamic and agile funding vehicle, as well as a key source of income and employment. The private sector is also seen as a multiplier of development funds to mobilise further private investment.

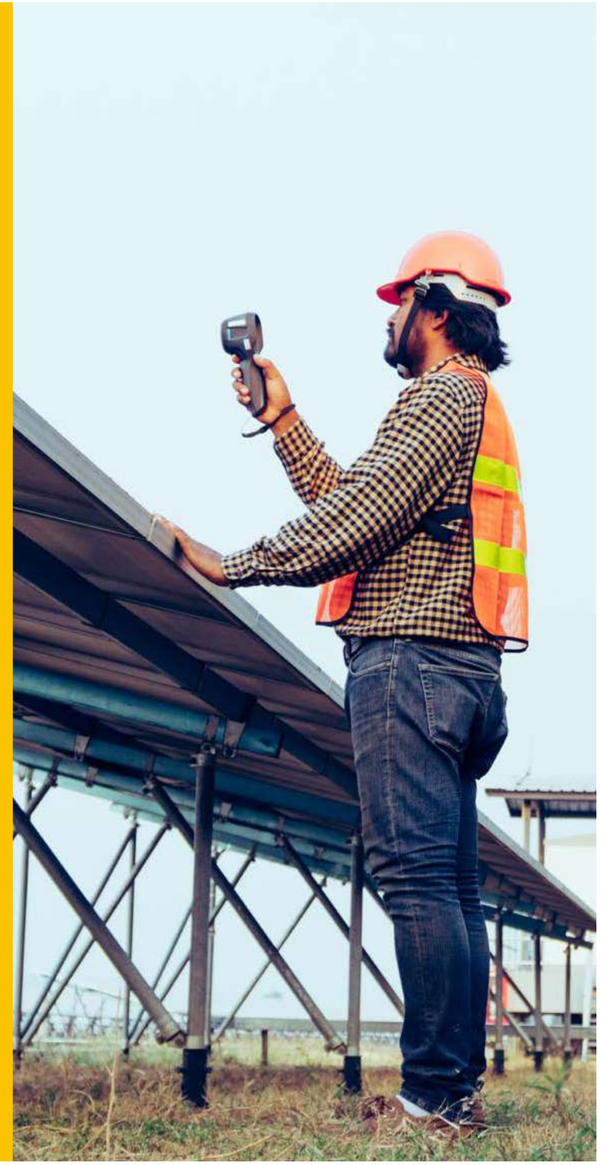
Source: See endnote 257 for this module.

FIGURE 9.
Development Finance for Renewable Energy Generation by Channel, 2013, 2017 and 2022



Note: "Other" includes the group "other", public-private partnerships, and teaching institutions, research institutes or think-tanks.

Source: OECD-DAC Creditor Reporting System (CRS) Database. See endnote 257 for this module.



i The lack of finance flowing through private sector institutions in 2013 may be due to a shift in methodology.

SHIFTING FRAMEWORKS FOR INVESTMENT IN RENEWABLE ENERGY

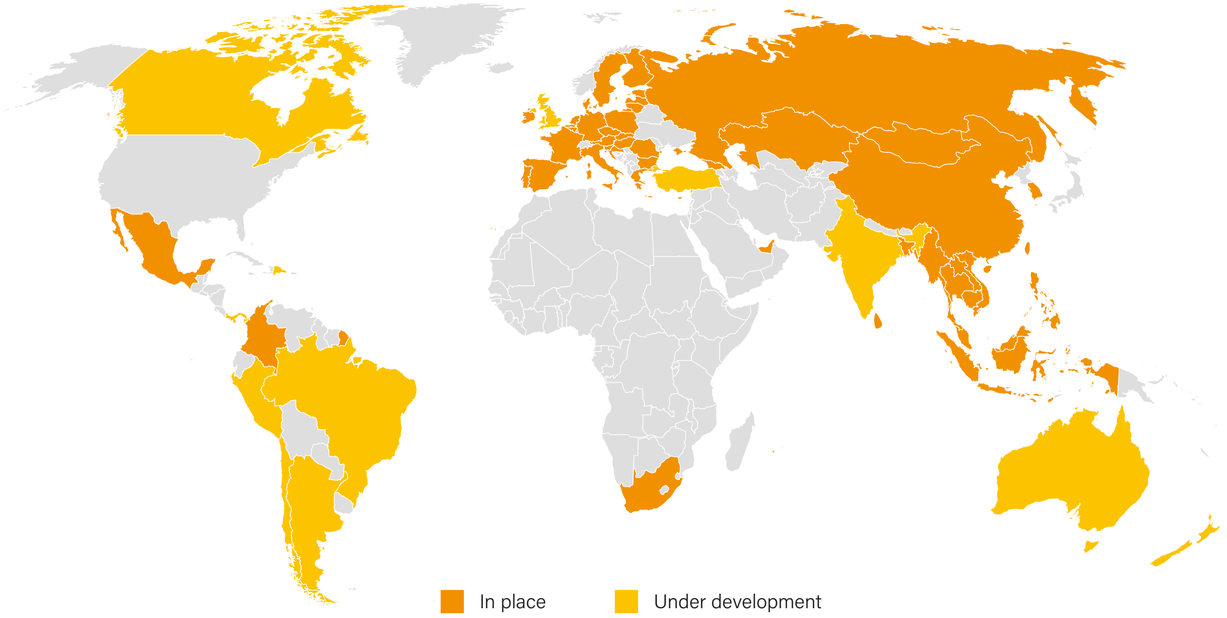
Investors wishing to address climate change and support renewables are increasingly turning to "sustainable finance" options as they consider growing regulatory requirements, risk management imperatives, and/or changes in demand and asset allocation strategies. Three frameworks are increasingly relevant for renewable energy finance and investment: 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 renewable energy; and 3) systems rating the performance of enterprises according to *environmental, social and governance (ESG)* criteria to help assess the suitability of a company, activity or fund for investment.[258]

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".[259] 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).[260] For example, renewables-related economic activities may be coded "green", fossil fuel-based activities that adhere to certain standards may be coded "yellow/amber", and other activities may be coded "red", similar to traffic light systems.[261]

The number of sustainable finance taxonomies in use or under development has increased rapidly since the Paris Agreement was signed in 2015.[262] (→ *See Figure 10.*) This trend continued in 2023, with several announcements related to new or developing taxonomies. In the United Arab Emirates, the Abu Dhabi Global Market began implementing its sustainable finance regulation.[263] In Latin America, Argentina published a Roadmap for a National Strategy of Sustainable Finance, which includes the development of a taxonomy.[264] Mexico published its Sustainable Taxonomy in March and announced plans to implement a test programme and make regular updates, while in Panama the Taxonomy Oversight Committee began drafting a taxonomy.[265] In Asia, the Monetary Authority of Singapore officially launched the Singapore-Asia Taxonomy, and Thailand launched Phase 1 of its Taxonomy, which covers the energy and transport sectors.[266]

FIGURE 10.
Sustainable Finance Taxonomies in Countries Worldwide, in Place and Under Development, 2023



Source: REN21. See endnote 262 for this module.

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

Creating a harmonised taxonomy across jurisdictions can be challenging due to the vested interests in each country's definitions.[267] Although a global, harmonised sustainable finance taxonomy is not yet on the table, several regional initiatives are under way that aim to achieve comparability and interoperability.[268] In 2021, China and the EU published a Common Ground Taxonomy (CGT) through a working group of the International Platform on Sustainable Finance, identifying commonalities and differences in their respective approaches.[269] The EU has continued working individually, approving a new set of criteria for its Taxonomy in 2023.[270] The Association of Southeast Asian Nations (ASEAN) released the second version of its joint taxonomy during the year, classifying economic activities based on their grade of alignment and establishing a framework within which member states can develop national taxonomies.[271] For Latin America and the Caribbean, a common framework of sustainable finance taxonomies was published as a guiding document in the region.[272]

In some situations, sustainable finance taxonomies have the potential to divert or discourage investment in renewable energy when its relative cost of capital is higher. This can occur, for example, if the taxonomies allow companies to be labelled as aligned with particular taxonomy categories (e.g., having a certain threshold of greenhouse gas emissions for fossil fuel-based power production), when in fact the category has not been defined to accurately reflect scientific requirements (e.g., to reach substantial emission reduction requirements that align with the temperature goals of the Paris Agreement).[273] In this way, investment could end up being channelled away from companies or projects that more fully support renewable energy deployment.[274]

Issuance of green bonds rebounded in 2023, led by **Europe and China**.

GREEN BONDS

Although various instruments are available to finance renewable energy projects, green bonds have become especially prominent in recent years.[275] 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.

Issuance of green bonds rebounded in 2023 following a decline in 2022 related to geopolitical tensions (such as the Russian Federation's invasion of Ukraine) and inflation challenges across major economies.[276] A total of USD 575 billion in green bonds was issued in 2023, surpassing the high of USD 573 billion in 2021.[277]

Europe remained the largest regional issuer, with around half of the green bond supply.[278] In late 2023, the EU approved new voluntary standards for companies wishing to issue green bonds, addressing transparency challenges and helping investors avoid greenwashing claims.[279] The Italian government facilitated the largest individual green bond sale of the year, at USD 10.8 billion (EUR 10 billion).[280]

China remained the top green bond issuing country globally.[281] In July 2022, China published its Green Bond Principles to harmonise domestic and international definitions, and it ultimately required 100% of proceeds to go to green projects (up from the 50–70% previously stipulated).[282] Green bond sales also increased in Japan and Hong Kong.[283] In the United States, corporations scaled back their issuance of green bonds in 2023, reflecting higher interest rates as well as emerging political resistance to sustainable investment strategies.[284]

ESG

Environmental, social and governance (ESG) criteria has shifted from being a niche focus to becoming a component of mainstream finance in many OECD member countries.[285] Challenged by the macroeconomic environment, global net inflows of investment in ESG funds continued to fall in 2023, reaching around USD 63 billion (down from USD 89 billion in 2022 and USD 405 billion in 2021).[286]

Europe remained the world's largest ESG fund market, although subscriptions in 2023 were much lower than in past years due to high interest rates, which led investors in the region to favour government bonds.[287] This was coupled with concerns about greenwashing and the evolving regulatory environment.[288] In June 2023, the European Commission proposed new rules for ESG rating providers, ultimately aimed at improving reliability and transparency.[289] The European Council and Parliament reached provisional agreements on this proposal in early 2024.[290]

In the United States, the Securities and Exchange Commission (SEC) proposed rule changes in 2023 that require new disclosures for ESG funds; the SEC also hosts an enforcement division that penalises any ESG-related misconduct.[291] ESG continued to be highly politicised in the country, with many US states introducing "anti-ESG" legislation that, for example, redirects state funds away from large asset managers with ESG priorities.[292] These bills expanded in both scope and reach, albeit with mixed success.[293] The politicisation has negatively affected the demand for ESG funds in the country.[294]

Following an announcement in early 2024 that the bank JP Morgan would be leaving the Climate Action 100+ investing group, a debate continued on the backlash to ESG investing and whether it has prompted high-profile firms to downplay or even disguise their sustainability efforts.[295] At the same time, many institutions worldwide are opting to "divest" their assets from fossil fuel companies and others investments that are not aligned with the goals of the Paris Agreement.[296] (→ *See Box 1.*)

In Asia, assets in ESG funds in China were down for the year, with some investors concerned about regulatory risks and others about definitions, which vary from European standards.[297] China released new ESG disclosure rules in early 2024 for its biggest companies to help reduce greenwashing risk.[298]

Elsewhere in the region, Chinese Taipei was a top performer, with its ESG fund assets surging nearly 50% during 2023, helped by the performance of the local market and the country's technology sector.[299]

In the ESG realm, developing economies tend to be at a disadvantage because of systematically lower ESG scores and low investment allocations from ESG funds.[300]

BOX 1. Divestment from Fossil Fuels

Since 2011, institutions worldwide have increasingly divested from, or sold off their financial interests in, fossil fuel companies. By late October 2023, around 1,612 institutions, with estimated total assets of around USD 40.6 trillion, had committed to fossil fuel divestment[i].

Several important divestment-related announcements were made during the year. Notably, the San Diego Diocese became the first church in the United States to divest all of its direct holdings in fossil fuels. This continued a trend globally in which hundreds of adherents to Catholicism (nearly all outside the United States), following the lead of Pope Francis, have announced plans in recent years to divest from fossil fuels. Several additional US universities also announced divestment plans during 2023, including Seattle University (with USD 285 million in assets) and New York University (with a USD 5 billion endowment).

The broader divestment movement has been called insignificant by some, based on the argument that only a small portion of investors divest their holdings, and that divested shares are bought by other investors. Other commentators point to a noteworthy impact of the divestment movement: 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. However, although country-level investment may be impacted, oil and gas financing has continued to increase across countries.

Funds divested from fossil fuel companies are not necessarily re-invested in companies associated with renewables. The global network DivestInvest works to address this 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, or sustainable agriculture and forestry options).

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.

Source: See endnote 296 for this module.

The categorisation of an organisation or its activities as ESG may be based on a risk perspective (e.g., how environmental risks may affect a company) and/or by an impact perspective (e.g., the impact that a company or activity has on the outside world).[301] Companies that rate and value ESG funds more from a risk perspective have been criticised for using methodologies that ignore the larger impact of a company on the planet.[302] As the impact perspective becomes increasingly relevant to investors aiming for net zero carbon or clean energy goals, a "double-materiality concept"[i] is arising, which incorporates both the risk and impact perspectives.[303] This approach may have more relevance for renewables.[304] Relatedly, ESG products are increasingly being used to assess a company's commitments and actions to transition to renewable energy.[305]

Increasingly, critics have questioned the commitment of oil and gas companies to the energy transition, as many companies continue to increase fossil fuel production and to reward their shareholders with returns from substantial profits.[306] (→ *See Box 2.*)

RENEWABLE ENERGY AND CLIMATE FINANCE

Climate finance entails any financing that seeks to support either climate change mitigation actions (for example, renewable energy generation, energy efficiency or low-carbon transport) or adaptation actions (for example, disaster risk management, waste and water, or resilient infrastructure). Nearly USD 1.3 trillion in annual climate finance was allocated on average in 2021/2022[ii], almost double the amount of the previous two-year period.[307] Most of the increase was in mitigation finance, with the greatest growth occurring in renewable energy and transport.[308]

Climate finance flows were concentrated mainly in East Asia and the Pacific (44% of the total, led by China), followed by Europe (26%, up from only 17% in 2019/2020) and the United States and Canada (14%).[309] Mitigation activities continued to represent most of the total flows, at around 91% or USD 1.15 trillion.[310] Investment in renewables, dominated by solar PV and onshore wind energy, accounted for 43% of mitigation finance in 2021/2022, well below the high of 59% in 2020[iii].[311] (→ *See Figure 11.*)

BOX 2. Oil and Gas Companies' Investment in Renewables

The oil and gas industry had a record year in 2023. For the first time, a fossil fuel industry CEO assumed a role at the highest level of climate diplomacy, as ADNOC CEO Ahmed Al-Jaber took the helm at the COP 28 Presidency. Moreover, the "Big 5" companies – BP, Shell, Chevron, ExxonMobil and TotalEnergies – distributed more than USD 100 billion in shareholder profits in 2023, nearing an all-time record. Although profits tumbled towards the end of the year, fossil fuel companies have signalled strong confidence in a rapid recovery through their substantial shareholder returns.

Despite their climate diplomacy engagements and record returns, oil and gas companies are not delivering on their commitments to the energy transition. In 2022, fossil fuel companies spent a mere 2.5% of their capital in 2022 on clean energy (including renewables and electric vehicle charging) and contributed to only 1% of global clean energy investment. A change in leadership at Shell led to an announcement that in 2024 the company would cut at least 15% of its jobs in low-carbon solutions. In response, civil society and corporate investors, led by Amundi (a group of 27 investor groups) demanded that the company commit more strongly to an emission reduction target aligned with the Paris Agreement. In France, four environmental organisations initiated legal action against TotalEnergies over the impact of the company's oil projects.

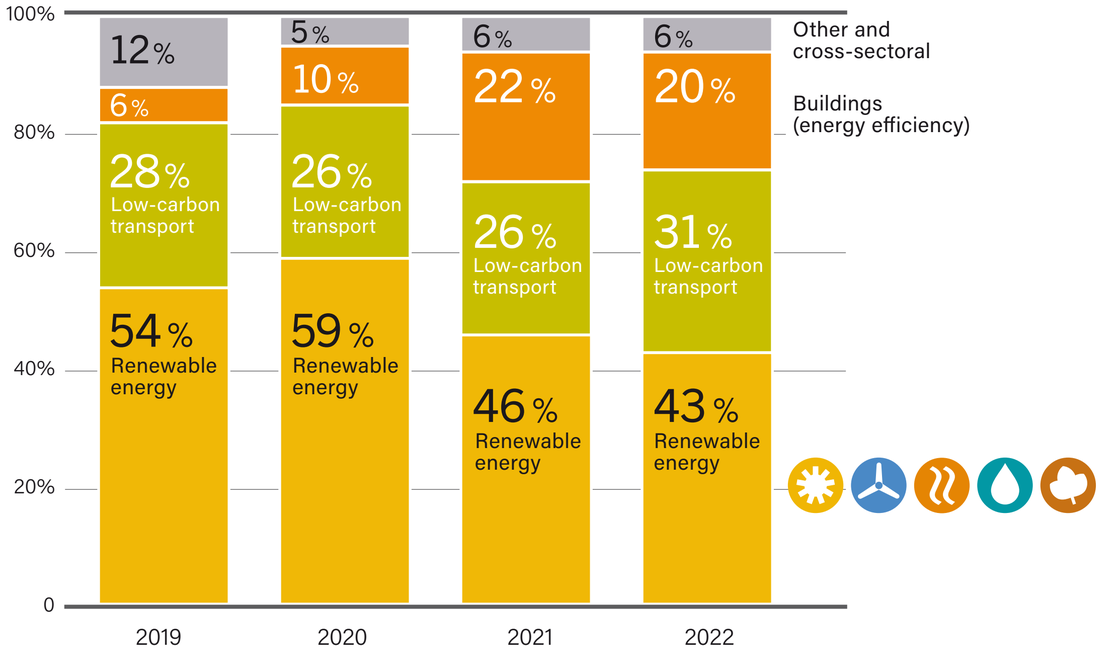
Source: See endnote 306 for this module.

i Double materiality refers to sustainability reporting that acknowledges the impacts on companies by sustainability issues ("outside-in") and how the companies' activities impact society and the environment ("inside-out").

ii This is the most recent available value and is an average of 2021 and 2022 data, expressed in nominal (current) US dollars.

iii Values for 2021 and 2022 were also influenced by data improvement, particularly for the buildings (energy efficiency) sector.

FIGURE 11.
Estimated Share of Mitigation Finance by Sector, 2019-2022



Note: The "Other and cross-sectoral" category includes: Agriculture, Forestry and Other Land Use (AFOLU), Industry, Information and Communications, Waste, and Water and Wastewater.

Source: CPI. See endnote 311 for this module.

Although the share of renewable energy investment in mitigation finance decreased, the total investment in renewables reached a **record high.**

Even as investment in renewables has increased, mitigation finance funds have diversified, with growing shares being allocated to transport and energy efficiency.[312] Finance for low-carbon transport accounted for 29% of total mitigation finance in the 2021/2022 period.[313]

The landscape of climate finance flows is multi-faceted, interconnected and evolving. As of 2021/2022, public finance – including funds provided by development finance institutions, governments and climate funds – supplied around 51% of total climate finance, at USD 640 billion, while private finance supplied the remainder.[314] Renewable energy continued to attract higher shares of private finance than other sectors during this period.[315] Commercial financial institutions provided most of the private capital for climate finance (around USD 235 billion per year), followed by corporations and households (such as for purchases of electric vehicles or residential solar PV systems).[316]

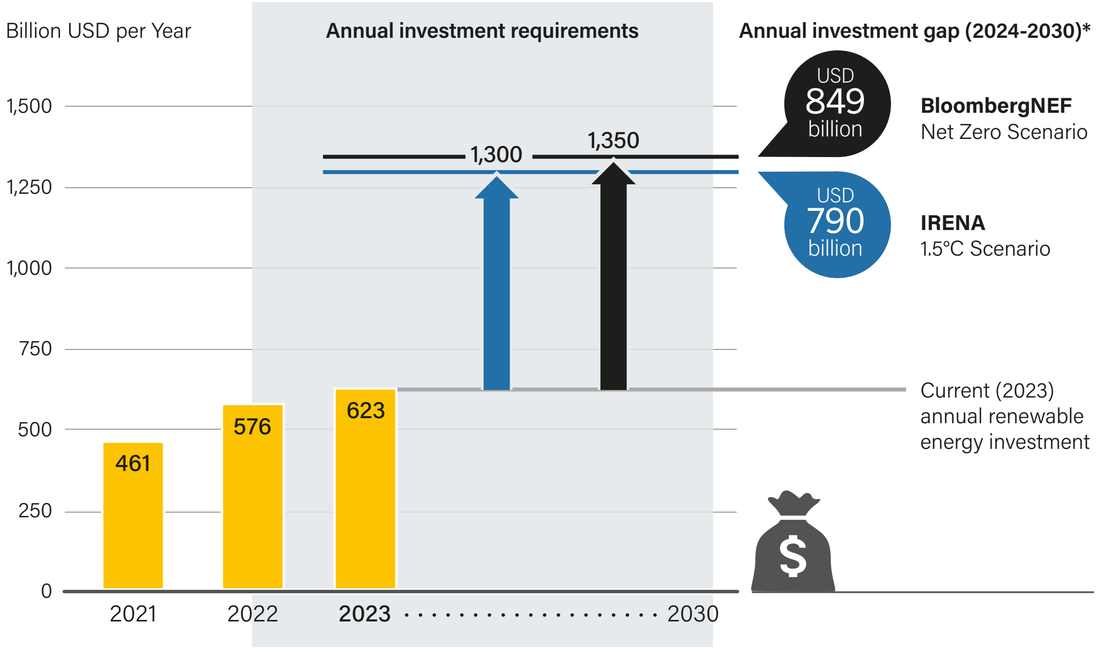
Public support came mostly from development financial institutions (USD 364 billion per year), followed by state-owned enterprises (USD 110 billion) and governments (USD 100 billion).[317] Most (USD 238 billion) of the funds from development finance institutions were for domestic commitments, led by East Asia and the Pacific.[318]

The Paris Agreement (in Article 2.1c) highlights the need to make finance flows consistent with the goal of limiting global temperature rise to 1.5°C.[319] Achieving this goal would require large growth in overall renewable energy investment compared to the last decade. Estimates of the annual investment in renewable power needed by 2030 to achieve the Paris Agreement goals are in the range of USD 1,300 billion to USD 1,350 billion.[320] (→ *See Figure 12.*)

In side events at the UN Climate Conference in Dubai in late 2023, a flurry of new climate finance initiatives were introduced, many of which blended finance from the private sector with contributions from government-funded multilateral development banks and philanthropic funding.[321] The newly launched investment platform Allied Climate Partners will begin with USD 800 million in four funds focused in India, Africa, Southeast Asia, and the Caribbean and Central America.[322] The Green Climate Fund discussed plans to create a green guarantee company to provide guarantees for climate bonds in developing countries.[323] The Glasgow Financial Alliance for Net Zero (GFANZ) launched a new Latin America and Caribbean Network; GFANZ began in 2021 with the aim of bringing together existing and new net zero finance initiatives by mobilising private capital for emerging markets and developing economies through private sector investments and public-private collaboration.[324]

Achieving the **goals** laid out in the Paris Agreement would require large growth in renewable energy investment compared to the last decade.

FIGURE 12.
Range of Annual Renewable Energy Investment Needed in Climate Change Mitigation Scenarios, Compared to Recent Investments



Note: These scenarios quantify renewable energy differently than the BloombergNEF historical basis used in this module. The scenario estimates are for renewable power only, whereas the historical basis includes power and renewable fuels.

*The annual investment required for 2030 is calculated by REN21. It takes into consideration investment in 2023 not meeting the annual investment requirements of the scenarios and distributes it equally from 2024 to 2030..

Source: See endnote 320 for this module.

CHALLENGES AND OPPORTUNITIES

Trade, markets, energy demand, infrastructure development, investment and policies are changing.

The shifting macroeconomic and geopolitical conditions create huge challenges and opportunities for the uptake of renewable energy.

CHALLENGES

- **Investment in renewable energy in 2023 was complicated** by high interest rates and challenging market conditions worldwide. Higher input costs for key raw materials including critical minerals further affected the investment environment.
- **High capital costs and rising interest rates**, especially in emerging markets, have challenged the financing of renewable energy projects – potentially slowing the global transition to renewables – and have amplified energy inequality.
- **Ongoing geopolitical conflicts and international tensions** continue to disrupt global supply chains and impact the energy landscape, making the renewable sector vulnerable to international disputes and logistical constraints. The heavy reliance on a few regions for renewable energy components and critical minerals presents a risk of supply chain disruptions and geopolitical dependencies.
- Despite ambitious clean energy targets, many **countries have fallen short of their goals**, highlighting a significant gap between policy ambition and actual achievement in renewable energy deployment.
- **Fossil fuel subsidies continue to increase globally,** contradicting global commitments to decarbonise.
- The renewable energy sector faces a **shortage of skilled workers**, with the demand for qualified personnel outpacing the deployment of renewable energy technologies.

OPPORTUNITIES

- **The global agreement at COP 28 to triple renewable energy capacity**, with 130 countries committing to a collective target of at least 11 terawatts by 2030, demonstrates a strong international commitment to renewables.
- **Energy security goals and industrial strategies** are helping to boost renewable energy investment.
- **Countries are consistently updating their renewable energy policies and targets**. New and updated renewable energy policies in the demand and supply sectors represent an opportunity to boost the uptake of renewables in heavy industry and heavy transport.
- The concurrent solar PV and electric vehicle booms present an opportunity for creating **integrated energy ecosystems** where solar PV powers electric vehicle charging stations, fostering a self-sustaining cycle of clean energy. This synergy enhances energy independence and drives innovation in smart grid and storage technologies.
- The development and deployment of **sector coupling solutions** helps integrate renewable energy across multiple sectors such as heating and transport. It helps improve overall system efficiency and opens new markets for renewable energy technologies.

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