Photo: © Unsplash

CHAPTER 3
RENEWABLES

Main messages

- **Global trend.** In 2021, the global share of renewable energy sources in total final energy consumption (TFEC), including traditional uses of biomass, was 18.7 percent as TFEC rebounded after the disruption caused by the pandemic. This share had remained relatively steady over the previous three decades, increasing slowly in 2012–21 (+2.7 percentage points), mainly due to the accelerated deployment of renewables in the electricity sector. Excluding traditional uses of biomass, modern renewable sources had an only 12.5 percent share in TFEC in 2021, despite a doubling of consumption over the preceding 15 years. Trends differ across end uses. The largest increase in renewables' share continues to be in electricity generation, while transport and heat show only limited progress.
- **Target for 2030.** Ensuring access to affordable, reliable, sustainable, and modern energy for all requires rapidly increasing the use of renewable energy in electricity, heat, and transport. Target 7.2 of the Sustainable Development Goals (SDGs) is to "increase substantially the share of renewable energy in the global energy mix" by 2030.[15] The main indicator used to assess progress is the share of renewable energy in TFEC. While no quantitative milestone has been set, current trends indicate that progress is not sufficient to meet the target or accomplish international climate objectives. Significant action to boost energy efficiency and expand the adoption of renewable energy is needed, especially in heat and transport.
- **Recent trends.** Global renewables-based power capacity is growing faster than at any time in the past three decades and is expected to further increase two and a half times by 2030 under current policies and market conditions. This would, however, not be sufficient to triple renewables' share by 2030—an objective that more than 130 national governments committed to at the United Nations Climate Change Conference (COP28) in 2023. Appropriate tools and metrics will be key to track and monitor progress and support countries in achieving this objective in the electricity, heat, and transport sectors.
- **Electricity.** The use of renewables-based electricity grew more than 6 percent from 2020 to 2021, and by 23 percent from 2015. As of 2021, renewables made up 28.2 percent of global electricity consumption—the largest share among all end uses of renewable energy. Renewables-based electricity represented one-third of global renewable energy consumption, and half of modern uses of renewable energy. Continuous new capacity addition—mainly in wind and solar photovoltaics (PV), which together represented a 2.3 times larger share of electricity generation in 2021 than in 2015—is rapidly increasing renewables' share in electricity. Hydropower remains the predominant source of renewables-based electricity in the world, meeting 16 percent of global electricity demand.
- **Heat.** In 2021, renewable sources accounted for 23.5 percent of the world's use of energy for heat. Notably, over half of this renewables-based heat was via traditional uses of biomass (24 exajoules [EJ]), of which 95 percent was concentrated in Africa and Asia. The share of modern renewable energy use in global heat consumption increased marginally, reaching 10.4 percent in 2021, just 2.1 percentage points higher than a decade earlier owing to a simultaneous increase in global annual heat demand.

15 Detailed datasets with country data for the SDG 7 indicator discussed in this chapter can be accessed at no charge at https://trackingsdg7.esmap.org/downloads.

- **Transport.** While remaining below 2019 levels, global final energy consumption for transport rebounded and grew 8 percent (+8.1 EJ) in 2021. The share of renewable energy in transport TFEC rose to 4.4 percent in 2021, up from 3.5 percent in 2015. Biofuels, primarily crop-based ethanol and biodiesel, continued to dominate renewable energy use in transport, registering 7 percent year-on-year growth in 2021. Remarkably, renewables-based electricity used in vehicles and trains grew 34 percent from 2015; this growth was driven by the rise of electric vehicle (EV) sales and a higher share of renewables in electricity for transport.
- **Regional highlights.** Sub-Saharan Africa leads among the regions where renewables constitute the largest share of energy supply because of widespread uses of traditional biomass for heating and cooking. When considering only modern uses of renewable energy, Latin America and the Caribbean lead, with the highest share of renewables in TFEC, owing to hydropower generation and to the consumption of bioenergy in industrial processes and biofuels for transport. In 2021, more than half of the global year-on-year increase in modern uses of renewable energy was in Eastern Asia—essentially China—where wind and solar PV dominated growth. Europe was the second market for renewable capacity in 2021. It accounted for more than 17 percent of the year-on-year increase in modern uses of renewable energy, led by solar PV.
- **Top 20 energy-consuming countries.** The share of renewable energy in TFEC varies widely across countries. Among the top 20 energy-consuming countries, Brazil and Canada continued to have the highest shares of modern uses of renewables in 2021 (respectively, 43 percent and 24 percent of TFEC), due to their considerable reliance on hydro for electricity, biofuels for transport, and biomass for extracting heat, specifically, in industry. In 2021, Australia, Mexico, and China recorded the largest year-on-year increase in the share of modern uses of renewables (+1.1, +0.7, and +0.5 percentage points, respectively). China alone accounted for more than a fifth of the global modern uses of renewable energy. Between 2010 and 2021, the United Kingdom and Indonesia showed the largest growth in the share of modern uses of renewables in TFEC (+9 and +7 percentage points, respectively); they were followed by China, India, and Germany. This growth was mostly possible thanks to the development of wind and solar PV, as well as a significant shift from traditional to modern uses of biomass in China, India, and Indonesia.
- **Installed renewable energy generating capacity in developing countries.** In 2022, the global share of installed renewable energy generating capacity[16] on a per capita basis peaked at 40.3 percent; 424 watts per capita of renewable capacity were installed. While renewables' share of installed capacity is almost the same in developed and developing countries, renewable wattage per capita differs vastly. Whereas developing countries had 293 renewable watts per capita installed in 2022 (almost double the figure of 2015), in developed countries, the amount was 3.7 times larger, at 1,073 watts per capita. These variations suggest considerable disparities in how renewables-based electricity serves the population in developing countries. This is particularly evident in the case of small island developing states (SIDS), where the renewable watts installed per capita grew from 93 in 2021 to 101 in 2022; in landlocked developing countries (LLDCs), where 102 renewable watts were installed per capita in 2022, from 98 in 2021; and least-developed countries (LDCs), where growth was more modest, from 37 watts per capita in 2021 to 39 watts in 2022. Greater efforts are thus needed to meet SDG indicator 7.b.1 to "expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing states and landlocked developing countries."

16 Installed renewable energy generating capacity corresponds to indicator 7.b.1/12.a.1 and means the installed capacity to generate electricity from renewable sources in net terms, divided by the population of an individual country/territory. This chapter uses various terms to refer to the above indicator, including "renewable capacity installed per capita."

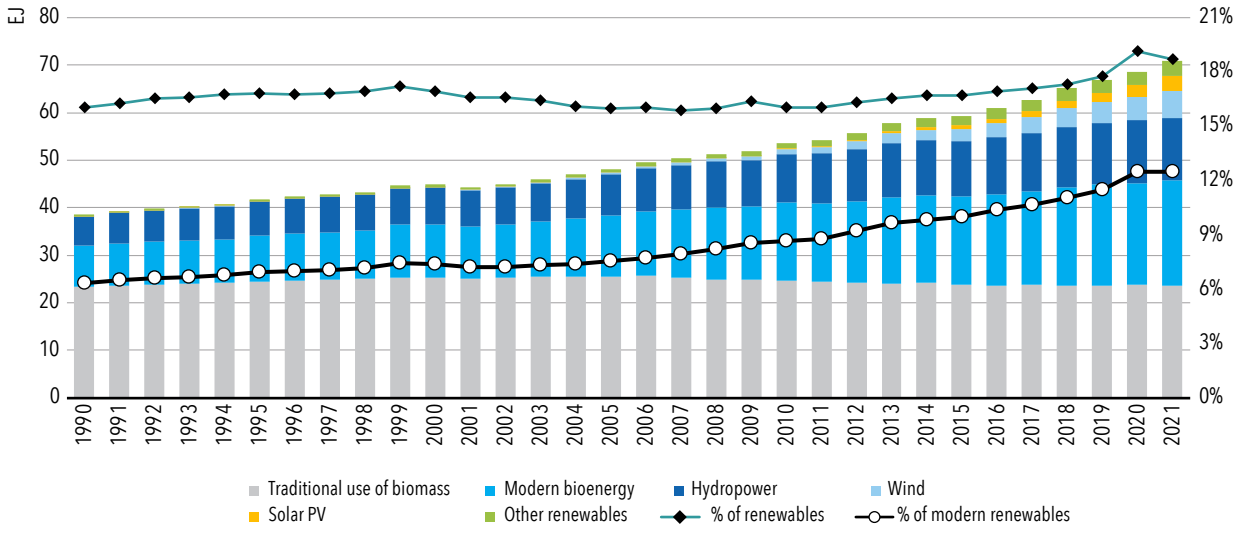
Are we on track?

INDICATOR 7.2.1 • RENEWABLE ENERGY'S SHARE IN TOTAL FINAL ENERGY CONSUMPTION

Globally, renewables have had a relatively steady share in TFEC over the past three decades; the share grew slowly in the most recent decade (+2.7 percentage points), mainly due to the accelerated deployment of renewables in the electricity sector.

In 2021, the recovery of social and economic activities, transport, industrial production, and services from the worldwide disruptions caused by COVID-19 led demand to rebound significantly; global final energy consumption grew 5.1 percent year-on-year. Global renewable energy consumption, including traditional uses of biomass,[17] reached 70.8 EJ, allowing renewables to reach 18.7 percent of TFEC in 2021; this share was, however, slightly lower than that of the year before (figure 3.1).[18]

FIGURE 3.1 • RENEWABLE ENERGY CONSUMPTION AND SHARE IN TFEC BY TECHNOLOGY—MODERN AND TOTAL RENEWABLES—1990–2021



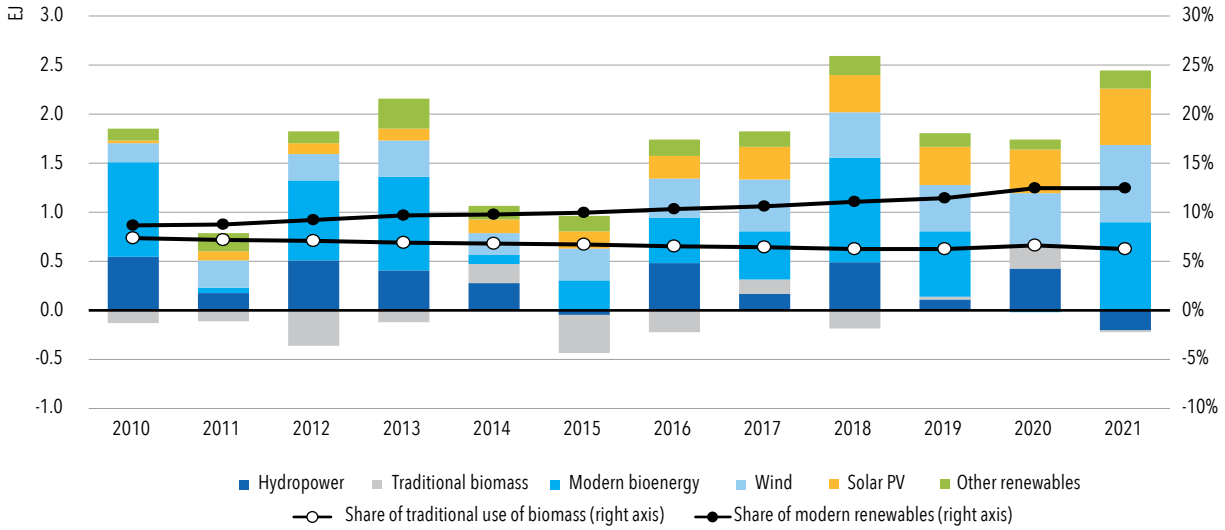
Source: International Energy Agency and United Nations Statistics Division.
EJ = exajoule; PV = photovoltaics.

17 The term "traditional uses of biomass" refers to the use of local solid biofuels (wood, charcoal, agricultural residues, and animal dung), burned using basic techniques and solutions, for example, traditional open cookstoves and fireplaces. The low conversion efficiency of such solutions can generate adverse environmental effects, besides indoor pollution, which poses health hazards. Because of their informal and noncommercial nature, it is difficult to estimate the energy consumed in such practices and with such solutions, which remain widespread in households in parts of the developing world. For the purposes of this report, "traditional uses of biomass" refers to the residential consumption of primary solid biofuels and charcoal in countries outside the Organisation for Economic Co-operation and Development (OECD). Although biomass is used with low efficiency in OECD countries, as well (e.g., in fireplaces burning split logs), such use is not included in the traditional uses of biomass cited in this report; instead, it is being reported here under modern use. Modern bioenergy—along with solar PV, solar thermal, geothermal, wind, hydropower, and tidal energy—is one of the "modern renewable" sources analyzed in this report.

18 The data in this report reflect revisions from last year's edition. Final consumption of renewable energy in transport was revised down 0.16 EJ (4 percent) globally for 2020, mainly due to changes in the United States (-0.12 EJ, -9 percent) and China (-0.05 EJ, -16 percent). Global final renewable electricity consumption was revised up 0.10 EJ (+0.4 percent), with China (+0.04 EJ, +0.6 percent) and Mexico (+0.03 EJ, +15 percent) being the main contributors to this change.
The regional groupings discussed in this section follow the United Nations' M49 regional classification (https://unstats.un.org/unsd/methodology/m49/ https://unstats.un.org/unsd/methodology/m49/).

From 2020 to 2021, modern uses of bioenergy, wind, and solar PV made the largest contributions to the growth of renewable energy use, followed by geothermal and solar thermal, whereas traditional uses of biomass and hydropower had declining contributions (figure 3.2). The global decrease in hydropower in 2021 (coming mostly from North America and Latin America) was the largest since 2001.

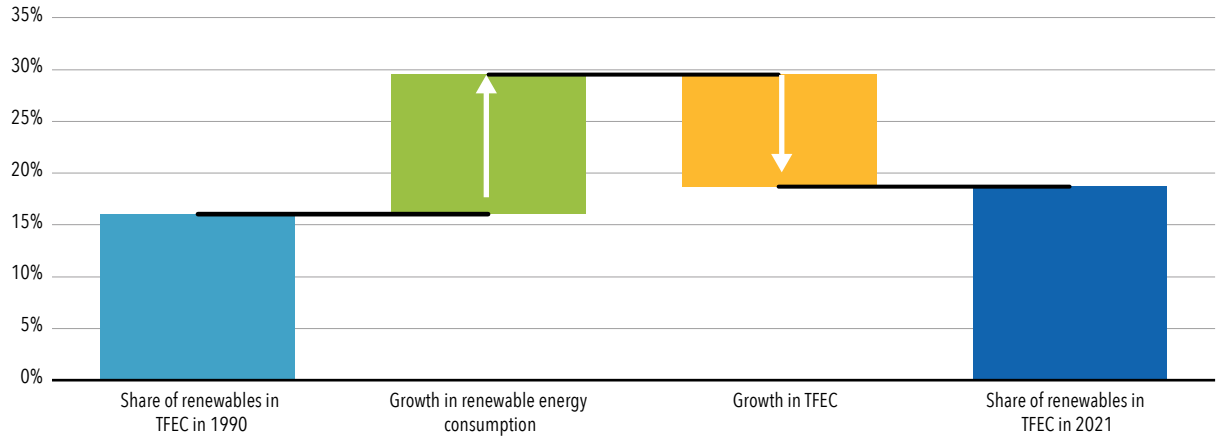
FIGURE 3.2 • GROWTH IN RENEWABLE ENERGY CONSUMPTION BY TECHNOLOGY, AND SHARE OF MODERN USES OF RENEWABLE ENERGY AND TRADITIONAL USES OF BIOMASS IN TFEC, 2011–21



Source: International Energy Agency and United Nations Statistics Division.
Note: In 2021, the share of modern uses of bioenergy remained stable as declining consumption in the residential and transport sectors offset increasing consumption in the electricity and industry sectors.
EJ = exajoule; PV = photovoltaics.

From 1990 to 2021, global renewable energy consumption grew 84 percent while TFEC grew 58 percent. As a result, the share of renewable energy in TFEC remained relatively steady (figure 3.3). Two trends coexisted in that time period. The share of modern uses of renewables—excluding traditional uses of biomass—in TFEC progressively increased, from 8.8 percent in 2011 to 12.5 percent in 2021, with the strongest growth in the electricity sector. Meanwhile, traditional uses of biomass declined to 6 percent from their highest point in 2006, albeit stabilizing in 2016.

FIGURE 3.3 • IMPACT OF TFEC GROWTH ON THE EXPANDING SHARE OF RENEWABLES IN TFEC GLOBALLY, 1990–2021



Source: International Energy Agency and United Nations Statistics Division.
TFEC = total final energy consumption.

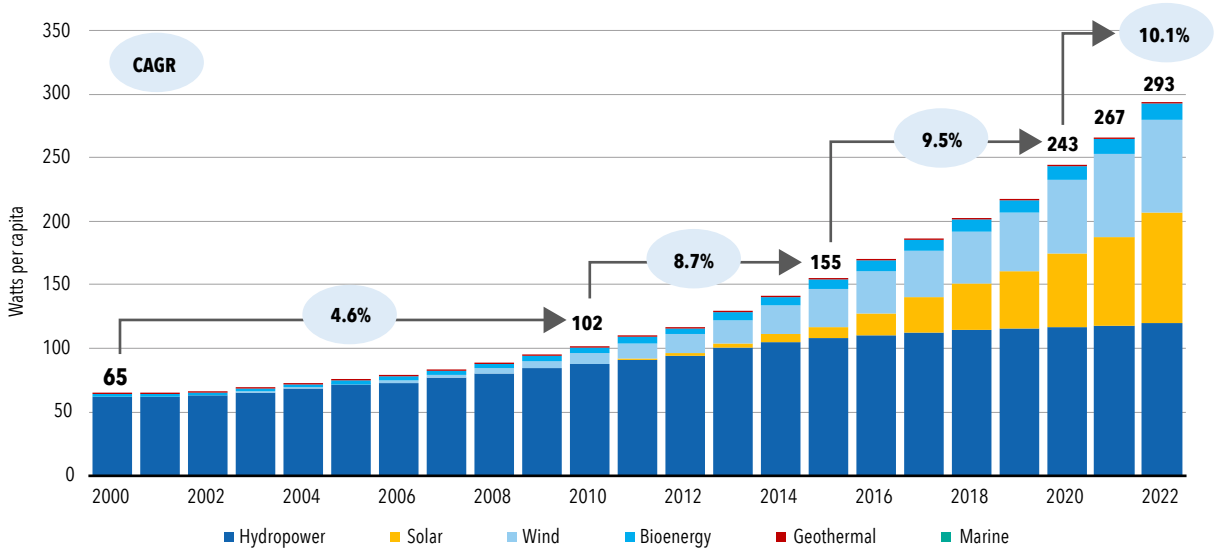
In 2012–21, modern uses of bioenergy accounted for almost one-third (+5.8 EJ) of the increase in modern uses of renewable energy—the largest absolute increase among renewable sources. Solar PV and wind, although starting from a smaller base, recorded the fastest growth rates, averaging 32 percent and 16 percent, respectively. Overall, bioenergy, including traditional uses of biomass, remained the largest renewable source of energy, representing 12 percent of global final energy consumption, and almost two-thirds of the renewable portion in 2021, followed by hydropower, wind, and solar PV.

INDICATOR 7.B.1 • INSTALLED CAPACITY FOR GENERATING ELECTRICITY FROM RENEWABLE SOURCES IN DEVELOPED AND DEVELOPING COUNTRIES

Installed renewable capacity per capita is progressing and continues to grow. In 2022, it reached 424 watts per capita globally; it had more than doubled over the previous 10 years, with 1,073 watts per capita installed in developed countries and 293 watts per capita installed in developing countries, as highlighted in table 3.1 and figure 3.4.

The global average is close to the figure for developing countries, as these countries are home to more than two-thirds of the global population. Renewable energy generating capacity grew 8.5 percent, from 391 watts in 2021, outgrowing the compound average growth rate (CAGR) of 7.8 percent between 2017 and 2021. This showcases that not only are the watts per capita increasing every year, but they are also increasing faster; watts per capita presented a trend of 8.1 percent CAGR over the five-year period (2018–22). Nonetheless, much larger growth rates are needed, and there are significant disparities among development groups. Developed countries experienced lower annual growth, of 7.2 percent from 1,001 watts per capita in 2021, with a five-year CAGR of 6.9 percent. Developing countries drove global growth in 2022, rising 10.1 percent from 2021, and saw a five-year CAGR of 9.5 percent.

FIGURE 3.4 • GLOBAL INSTALLED RENEWABLE ENERGY GENERATING CAPACITY PER CAPITA, 2000–22; AND CAGR FOR SELECTED PERIODS



Source: International Renewable Energy Agency.
CAGR = compound annual growth rate.

Developing countries accounted for most of the growth in renewable capacity per capita in 2010–22, given the proliferation of solar and wind energy deployment in the 2010s (table 3.1).

TABLE 3.1 • GLOBAL INSTALLED RENEWABLE ENERGY GENERATING CAPACITY PER CAPITA, ANNUAL GROWTH AND CAGR, 2010–22

YEAR	GLOBAL			DEVELOPED			DEVELOPING		
Year	Renewables per capita	Annual growth (%)	Five-year CAGR (%)	Renewables per capita	Annual growth (%)	Five-year CAGR (%)	Renewables per capita	Annual growth (%)	Five-year CAGR (%)
2010	175	6.3	5.0	500	6.5	4.7	102	7.0	6.2
2011	188	7.4	5.8	539	7.9	5.7	109	7.7	6.8
2012	202	7.2	6.4	582	7.9	6.6	117	7.1	7.1
2013	216	7.1	6.8	613	5.3	6.7	129	9.9	7.8
2014	232	7.1	7.0	647	5.5	6.6	141	9.5	8.2
2015	250	7.8	7.3	691	6.8	6.7	155	9.5	8.7
2016	268	7.5	7.3	732	5.9	6.3	169	9.7	9.1
2017	288	7.3	7.4	769	5.1	5.7	186	9.9	9.7
2018	308	6.8	7.3	809	5.2	5.7	202	8.7	9.5
2019	329	6.8	7.2	864	6.9	6.0	217	7.3	9.0
2020	360	9.7	7.6	929	7.5	6.1	243	12.1	9.5
2021	391	8.4	7.8	1,001	7.8	6.5	267	9.5	9.5
2022	424	8.5	8.1	1,073	7.2	6.9	293	10.1	9.5

Source: International Renewable Energy Agency.
CAGR = compound annual growth rate.

Looking beyond the main indicators

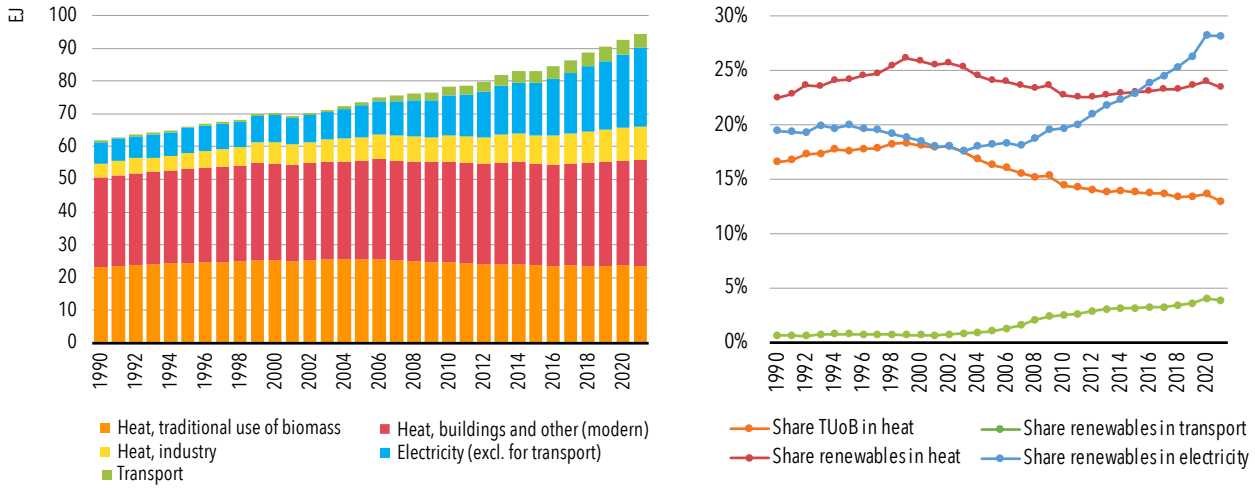
Ensuring access to affordable, reliable, sustainable, and modern energy for all implies a substantial increase in the share of renewable energy in all three main end-use categories. In 2021, heat, transport, and electricity made up 48, 30, and 22 percent, respectively, of TFEC (figure 3.5).

Electricity has had the largest and the most dynamic share of renewables in final consumption; its share grew from 23 percent in 2015 to 28.2 percent in 2021. Renewables-based electricity represented one-third of global renewable energy consumption, and half of modern uses of renewable energy. Hydropower remained the predominant source of renewables-based electricity globally. Continuous new capacity addition—especially of wind and solar PV, which together represented a share 2.3 times larger in 2021 than in 2015—is boosting renewables' share in electricity.

In the **heating** sector, renewable sources accounted for 23.5 percent of energy used; more than half of this corresponded to traditional uses of biomass, which decreased 0.1 percent in 2021. Excluding traditional uses of biomass, modern uses of renewables for heat grew 3.7 percent year-on-year, and the global heat demand grew 3.2 percent year-on-year, due to the recovery of social and economic activities following the disruptions of COVID-19 in 2020. This also caused a 5 percent growth in the use of nonrenewable energy for heat in 2021.

Including the use of renewables-based electricity, the **transport** sector consumes only 9 percent of global modern uses of renewable energy. It is the end-use sector with the lowest renewable energy penetration, at only 4 percent of final energy consumption in 2021. Biofuels (90 percent) dominated renewable energy use in transport. Remarkably, renewable electricity used in vehicles and trains grew 34 percent over 2015, due to a rise in EV sales and a higher share of renewables in electricity for transport.

FIGURE 3.5 • RENEWABLE ENERGY CONSUMPTION AND SHARE BY END USE, 1990–2021

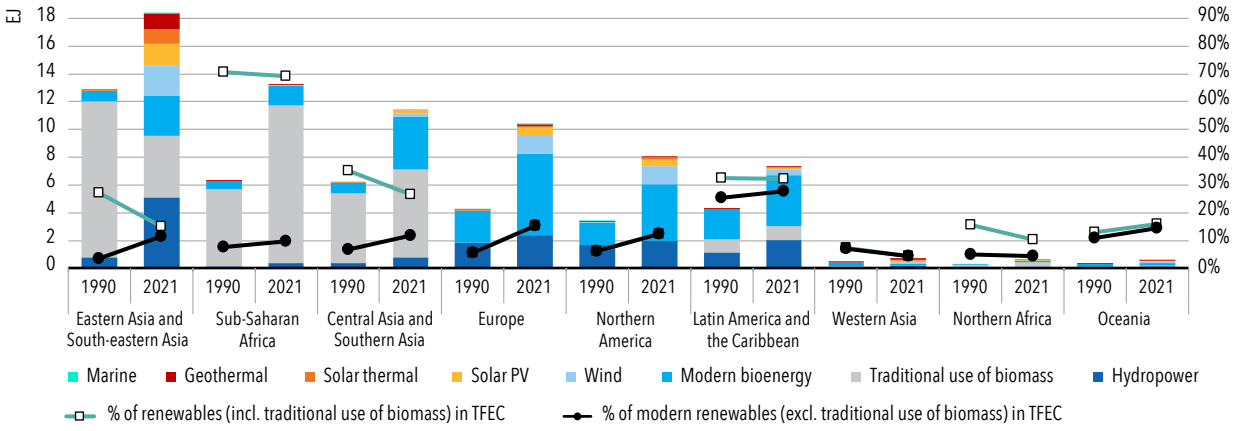


Source: International Energy Agency and United Nations Statistics Division.
Note: Electricity used for transport is included under transport.
EJ = exajoule; TUoB = traditional uses of biomass.

REGIONAL TRENDS

Progress across regions varies widely. For instance, while renewable energy constitutes more than two-thirds of TFEC in Sub-Saharan Africa, excluding traditional uses of biomass, modern uses of renewables represent only 10 percent of TFEC in the region (figure 3.6). The share of modern uses of renewable energy is the largest in Latin America and the Caribbean (28 percent of TFEC in 2021), due mostly to the consumption of bioenergy for industrial processes (especially in the sugar and ethanol industry), biofuels for transport, and sizeable hydropower generation.

FIGURE 3.6 • RENEWABLE ENERGY CONSUMPTION AND SHARE IN TFEC BY REGION, 1990 AND 2021

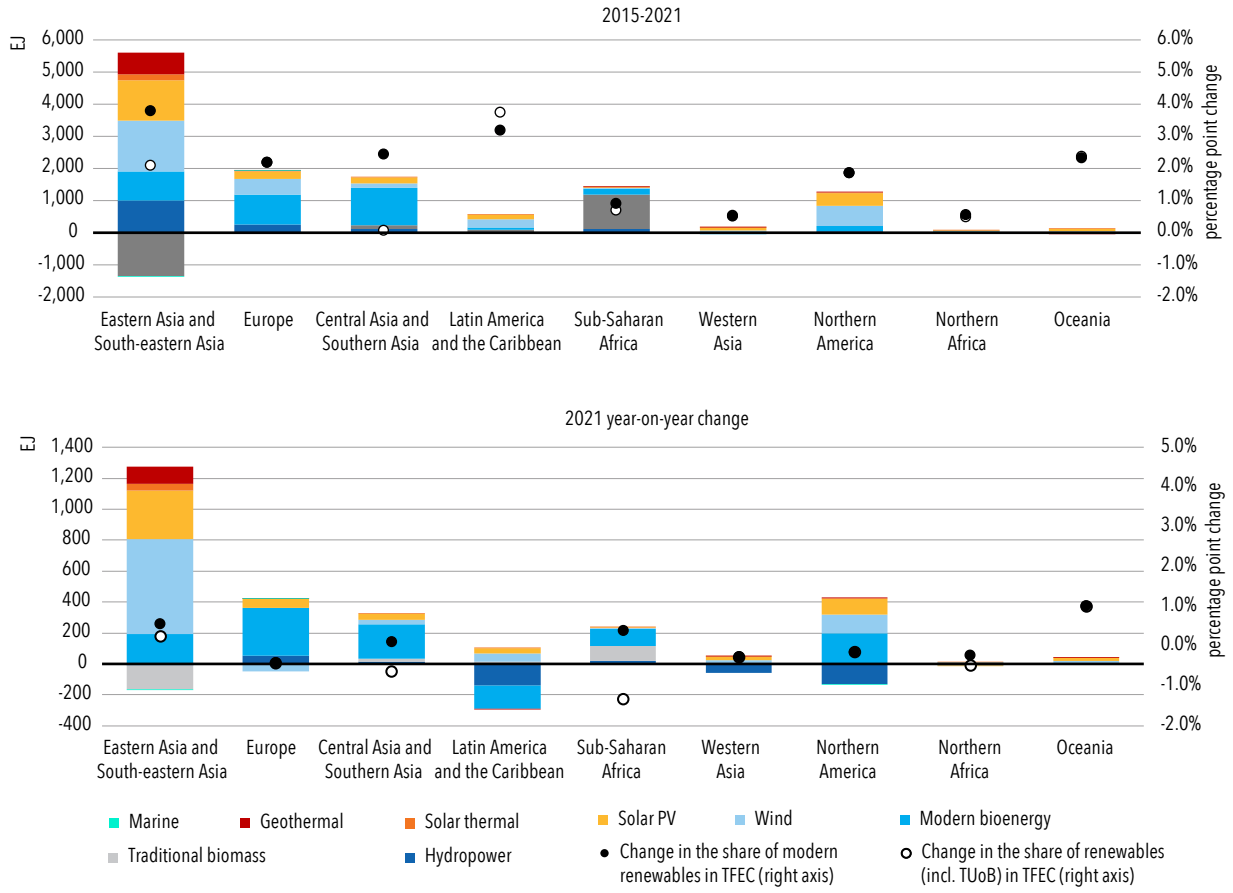


Source: International Energy Agency and United Nations Statistics Division.
EJ = exajoule; PV = photovoltaics; TFEC = total final energy consumption.

In 2021, significant additions of wind, solar PV, and, to a lesser extent, geothermal capacity in Eastern Asia led the region to account for more than half of the global year-on-year increase in modern uses of renewable energy, while traditional uses of biomass declined significantly (figure 3.7). Europe was the second-largest market (IEA 2022a) in terms of solar PV and wind capacity additions in 2021 and accounted for 17 percent of the global year-on-year growth in modern uses of renewable energy.

The rebound in TFEC after COVID-19's impact in 2020 (+5.1 percent in 2021 year-on-year) made increases in the use of renewable energy less noticeable as a share of TFEC. Eastern and South-eastern Asia and Oceania were the only regions where renewables' share in TFEC grew in 2021 (at +0.26 and +1 percentage point year-on-year, respectively). Modern uses of bioenergy showed the same trend as renewables' share in TFEC in Eastern and South-eastern Asia and Oceania (growing by +0.56 and +1 percentage points in 2021 year-on-year, respectively). In other regions, the share of renewables fell, with the largest decline observed in Latin America and the Caribbean (-2.2 percentage points in 2021 year-on-year). Globally, traditional uses of biomass declined owing to a strong drop in Eastern and South-eastern Asia; this trend was offset by increased consumption in Sub-Saharan Africa.

FIGURE 3.7 • CHANGE IN RENEWABLE ENERGY CONSUMPTION AND IN RENEWABLES' SHARE IN TFEC BY REGION, 2015–21; AND YEAR-ON-YEAR CHANGE, 2021



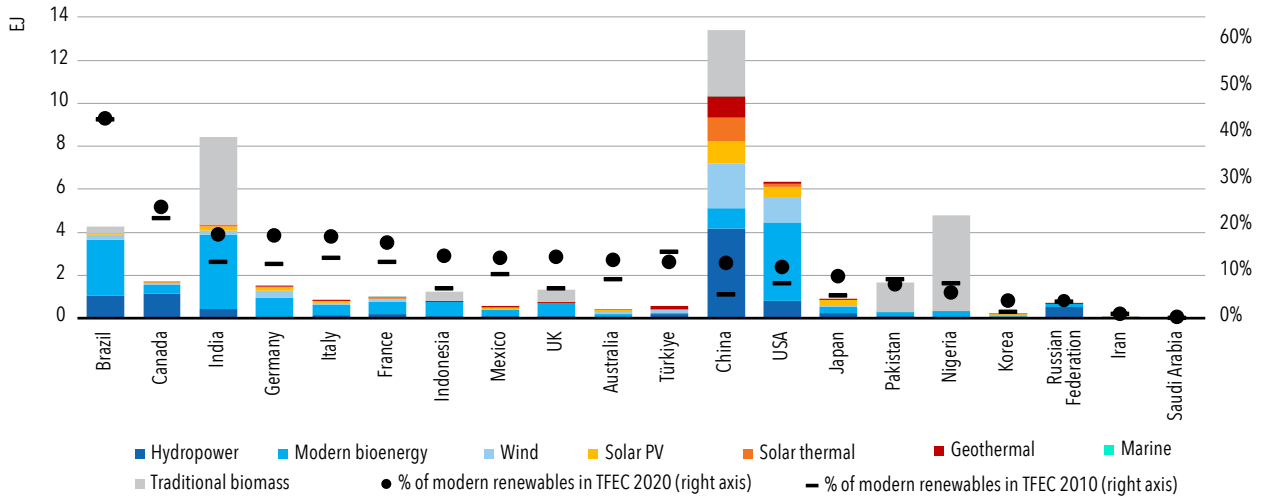
Source: International Energy Agency and United Nations Statistics Division.
EJ = exajoule; PV = photovoltaic; TFEC = total final energy consumption; TUoB = traditional uses of biomass.

At a national level, the share of renewable sources in energy consumption varies widely depending on resource availability, policy support, and the total energy demand resulting from consumption patterns and energy efficiency performance. In 2021, final energy consumption rebounded strongly due to a gradual recovery of social and economic activities following the pandemic-triggered global disruptions in 2020. Nineteen countries among the top 20 energy consumers recorded a higher TFEC in 2021 than 2020, with the exception of Mexico (-3.2 percentage points in TFEC year-on-year).

In 2021, Australia, Mexico, and China recorded the largest year-on-year increase in the share of modern uses of renewables (+1.1, +0.7, and +0.5 percentage points, respectively). Among the top 20 energy-consuming countries, Brazil and Canada continued to lead in the share of modern uses of renewables in 2021 (respectively, 43 and 24 percent of TFEC), due to their considerable reliance on hydro for electricity, biofuels for transport, and biomass for extracting heat, specifically, in industry (figure 3.8). China alone accounted for more than a fifth of global modern uses of renewable energy, even though renewables represented less than 12 percent of its TFEC.

Between 2010 and 2021, the United Kingdom and Indonesia achieved the largest progression in the share of modern uses of renewables in TFEC (+9 and +7 percentage points, respectively); they were followed by China, India, and Germany (with shares ranging between +6 and +7 percentage points). This growth was mostly possible thanks to the development of wind and solar PV, as well as a significant shift from traditional to modern uses of biomass in China, India, and Indonesia.

FIGURE 3.8 • RENEWABLE ENERGY CONSUMPTION, 2021; AND SHARE OF MODERN USES OF RENEWABLES IN TFEC, 2010 AND 2021, FOR THE TOP 20 ENERGY-CONSUMING COUNTRIES

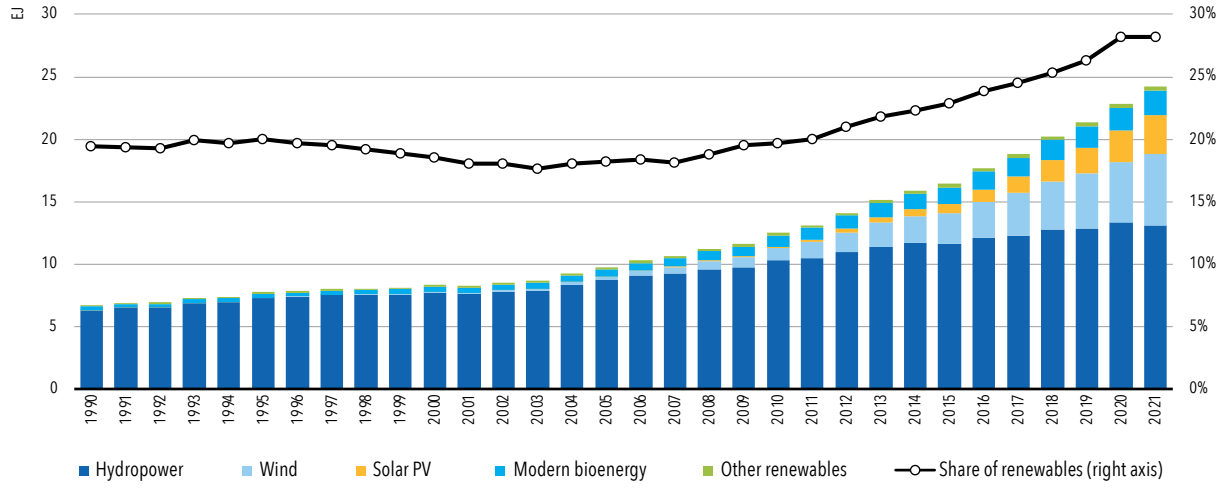


Source: International Energy Agency and United Nations Statistics Division.
EJ = exajoule; PV = photovoltaic; TFEC = total final energy consumption.

ELECTRICITY

Electricity accounted for 22 percent of TFEC globally in 2021. It is the fastest-growing end use: electricity consumption doubled over the past 22 years, and grew 35 percent since 2010.[19] Although global annual electricity consumption remained steady, at 85 EJ in 2021, global renewable electricity consumption increased in 2021 by more than 6 percent (+1.3 EJ) year-on-year. The share of renewables in electricity generation increased to 28.2 percent in 2021—the highest share among all end uses (figure 3.9).

FIGURE 3.9 • GLOBAL RENEWABLE ELECTRICITY CONSUMPTION BY TECHNOLOGY, 1990–2021



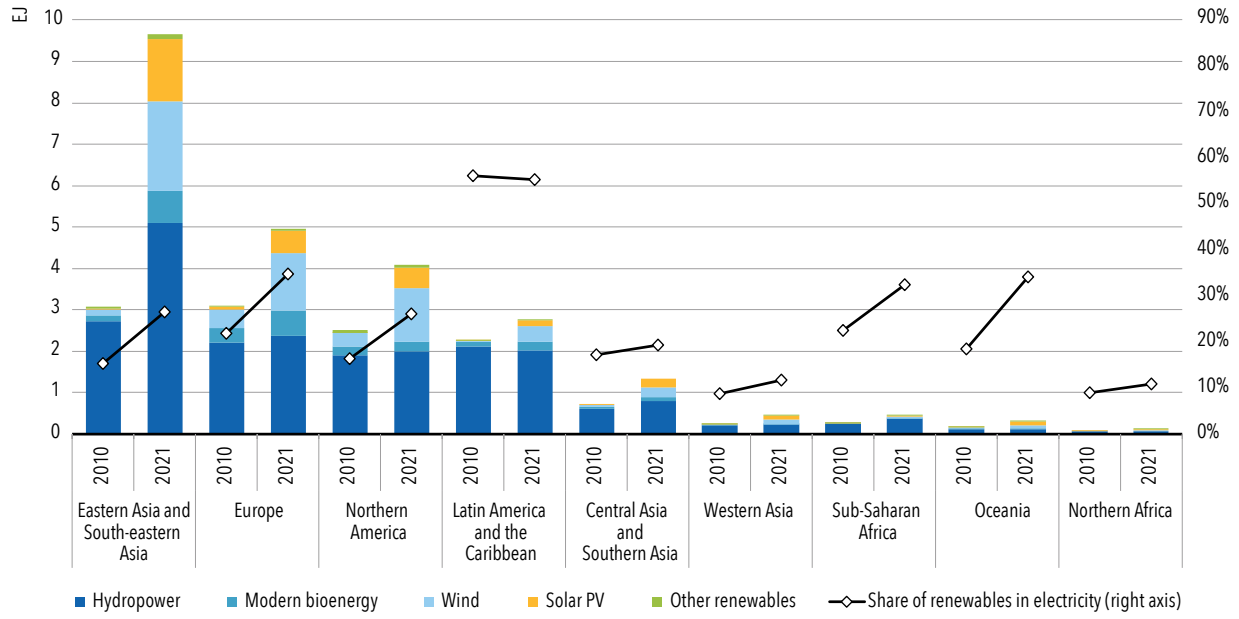
Source: International Energy Agency and United Nations Statistics Division.
EJ = exajoule; PV = photovoltaics.

In 2021, wind and solar PV made the largest contributions to the annual increase in renewable electricity consumption. The remaining growth came from modern uses of bioenergy. Hydropower remained the largest renewable source of electricity globally and for each region, representing more than half of renewable electricity consumption in 2021. However, consumption of hydroelectricity decreased 16 percent annually in 2021 due mostly to extreme drought conditions (IEA 2022c) in Latin America and North America.

Eastern Asia and South-eastern Asia recorded the largest absolute year-on-year increase of renewables in electricity consumption in 2021. More than four-fifths of the growth in global renewable electricity consumption came from this region. This growth was led mainly by rapid developments of wind and solar PV in this region. Latin America and the Caribbean recorded the largest share of renewable sources in electricity consumption; hydropower alone represented two-fifths of the region's electricity consumption in 2021. Europe and Oceania ranked second and third for their shares of renewable sources in electricity consumption. Thanks to rapidly declining costs and policy support, wind and solar PV together represented more than two-thirds of the increase in global renewable electricity consumption from 2010 (figure 3.10).

19 Among the most important factors driving this trend is the rapidly growing use of electricity for space cooling; air conditioners and electric cooling fans accounted for about 10 percent of global electricity consumption in 2018 (IEA 2018).

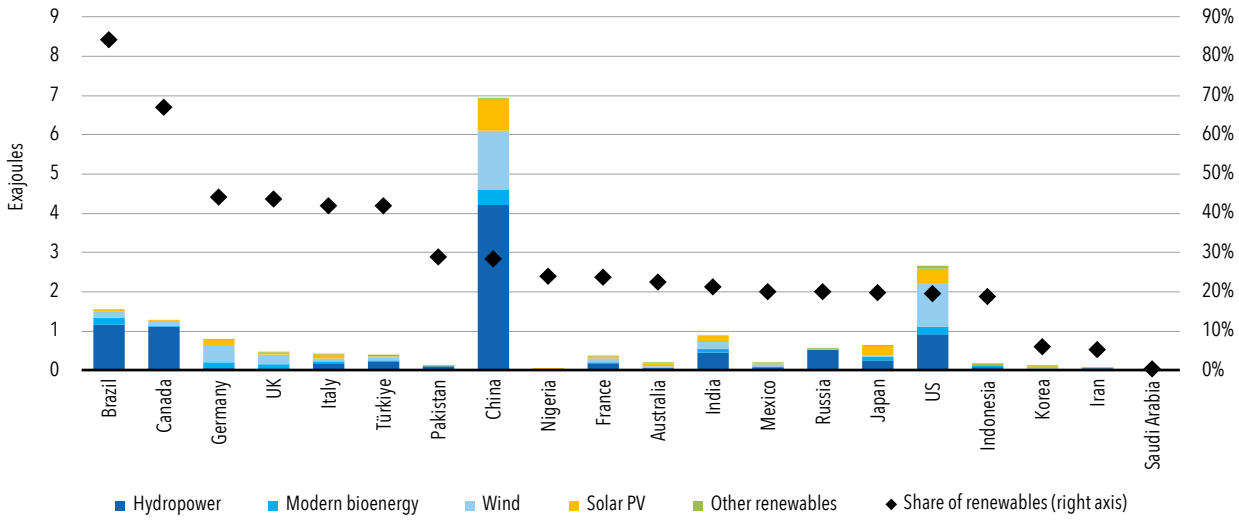
FIGURE 3.10 • RENEWABLE ELECTRICITY CONSUMPTION AND RENEWABLES' SHARE IN ELECTRICITY BY REGION, 2010 AND 2021



Source: International Energy Agency and United Nations Statistics Division.
EJ = exajoule; PV = photovoltaic.

The top 20 energy-consuming countries show strikingly varied trends in renewables' share in electricity consumption, ranging from near 0 percent to over 75 percent. Brazil and Canada are the countries with by far the highest shares, due to large hydropower capacities (figure 3.11). Wind and solar PV together—that is, nondispatchable renewables—are the largest renewable electricity sources in Australia, Germany, the Republic of Korea, the United Kingdom of Great Britain and Northern Ireland, and the United States of America, and they supply more than three-fifths of the total renewable electricity consumed in these countries. Between 2020 and 2021, China contributed 67 percent of the global annual increase in renewable electricity consumption, most of it from wind, solar PV, and modern uses of bioenergy.

FIGURE 3.11 • RENEWABLE-BASED ELECTRICITY CONSUMPTION IN THE TOP 20 FINAL ENERGY USERS, BY SOURCE AND COUNTRY, 2021



Source: International Energy Agency and United Nations Statistics Division.
EJ = exajoule; PV = photovoltaics.

Box 3.1 • COP 28's global renewables tripling agreement

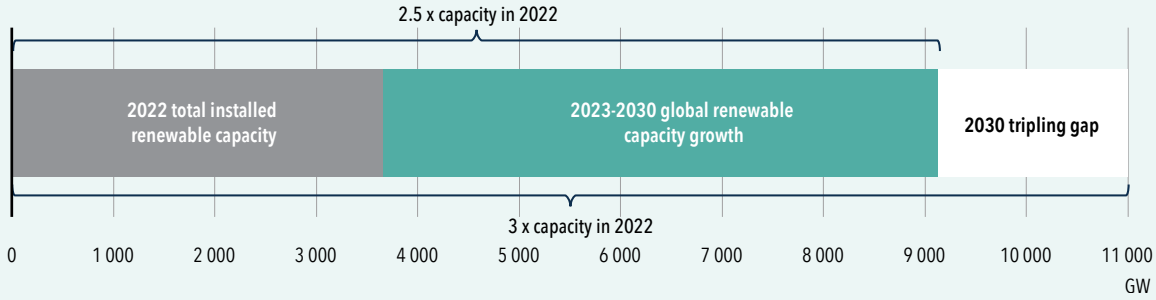
The electricity sector is leading progress toward SDG target 7.2, with renewables accounting for 28.2 percent of total final electricity consumption in 2021. Global annual additions to electricity-generating capacity powered by renewable sources grew by 50 percent in 2023, according to IEA (IEA 2024a). Total annual power additions from renewable sources reached 473 gigawatts (GW) in 2023 (IRENA 2024a). Three-quarters of that capacity is located in China, the United States, and the European Union. Solar photovoltaic accounted for three-quarters of additions worldwide (IEA 2024a; IRENA 2024a).

Yet the current rate of progress is not fast enough to realize the COP 28 agreement on renewable energy, under which over 130 countries committed "to work together to triple the world's installed renewable energy generation capacity to at least 11,000 GW by 2030, taking into consideration different starting points and national circumstances" (UNFCCC 2023).

According to IEA forecasts, under current policies and market conditions, global renewable electric capacity would grow to 7,300 GW by 2028. This would put the world on course to increase renewable capacity two-and-a-half times by 2030—below, but still close to, the objective of a global tripling global (IEA 2024a). The latest IEA Renewable Energy Market Update (IEA 2024a) finds that accelerating policy implementation could drive growth in renewable power capacity 21 percent higher than forecasted and help meet the global tripling agreement.

IRENA similarly finds that tripling renewable power capacity by 2030 is both technically feasible and economically viable, provided sufficient commitment, policy support, and investments are in place. However, commitments based on Nationally Determined Contributions under the Paris Agreement as of October 2023 fall short of what is required to limit global temperature rise to 1.5°C by the end of the century (IRENA 2023a). The Agency estimates that the Group of 20 countries alone would need to increase their collective renewable power capacity from less than 3 terawatts (TW) in 2022 to 9.4 TW by 2030. This would account for more than 80 percent of the global total (IRENA 2024b). For more on the outlook and the progress needed to achieve SDG 7 by 2030, see chapter 6.

FIGURE B3.1.1 • RENEWABLE CAPACITY GROWTH, 2022–30—AND THE REMAINING DISTANCE TO THE GLOBAL TRIPLING OF RENEWABLES



Source: International Energy Agency.

IEA and IRENA maintain that substantial action is required to triple renewable power capacity by 2030, tailored to the specific contexts of different countries, regions, and technologies. Monitoring and reporting country progress against key commitments, identifying barriers, and providing governments and the global community with recommendations on how to accelerate energy transitions will be essential to progress toward SDG target 7.2. In this regard, both IEA and IRENA are committed to tracking annual progress toward the COP28 tripling agreement and supporting countries in realizing their renewable energy and energy efficiency ambitions. UNFCCC and IEA have joined forces to track COP28 energy outcomes, build consensus on transitions aligned with 1.5 °C, and support the next round of Nationally Determined Contributions (IEA 2024c). IEA's Renewable Energy Progress Tracker (IEA 2024b) allows users to explore historical data and forecasts at the regional and country level, and to track progress toward the tripling goal.

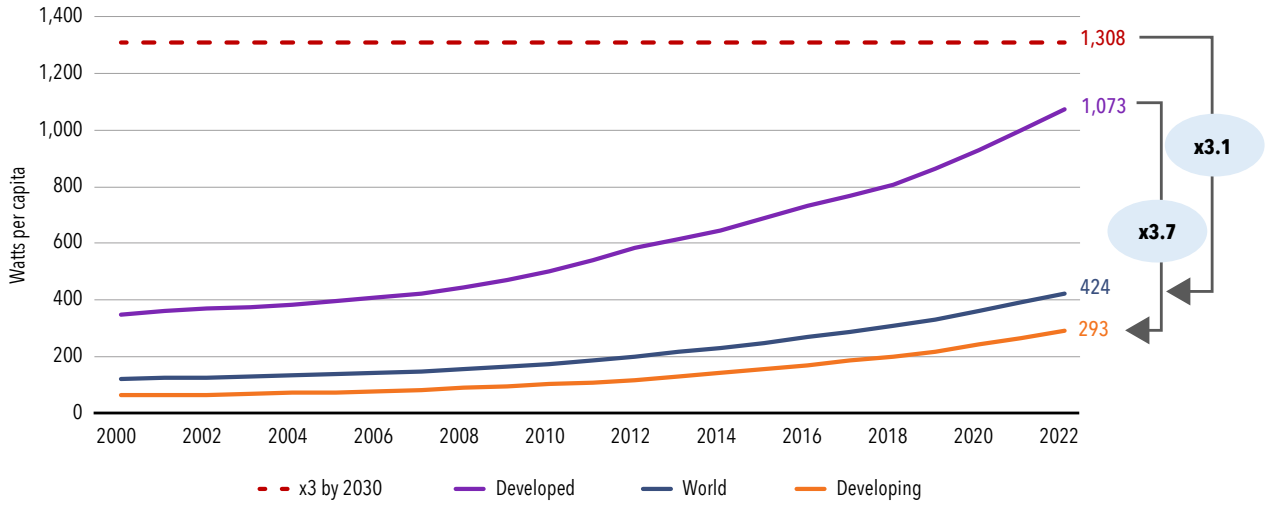
The COP28 presidency has appointed IRENA as the official custodian of a dedicated annual report tracking progress towards the tripling target. IRENA will also continue to monitor global progress towards the tripling target through its annual *World Energy Transitions Outlook*.

INSTALLED RENEWABLE ENERGY GENERATING CAPACITY PER CAPITA

SDG 7 includes a target to "expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least-developed countries, small island developing states and landlocked developing countries, in accordance with their respective programs of support" by 2030. Progress in SDG indicator 7.b.1, which measures the increase in renewable energy generating capacity (in watts per capita), is tracked in this chapter for the fourth consecutive year.

The share of installed renewable energy generating capacity in developing countries and developed countries has been on the rise at least since the beginning of the 2000s, when it stood at 21.4 percent (figure 3.13). In 2022, this share reached its peak, at 40.3 percent, with 424 watts per capita of installed renewable energy generating capacity (see figure 3.12). This value has reached parity across categories of development status, with developed countries reaching 40.1 percent and developing countries, 40.4 percent. While the share of renewables is equal across these groups, the story for renewable wattage per capita is vastly different.

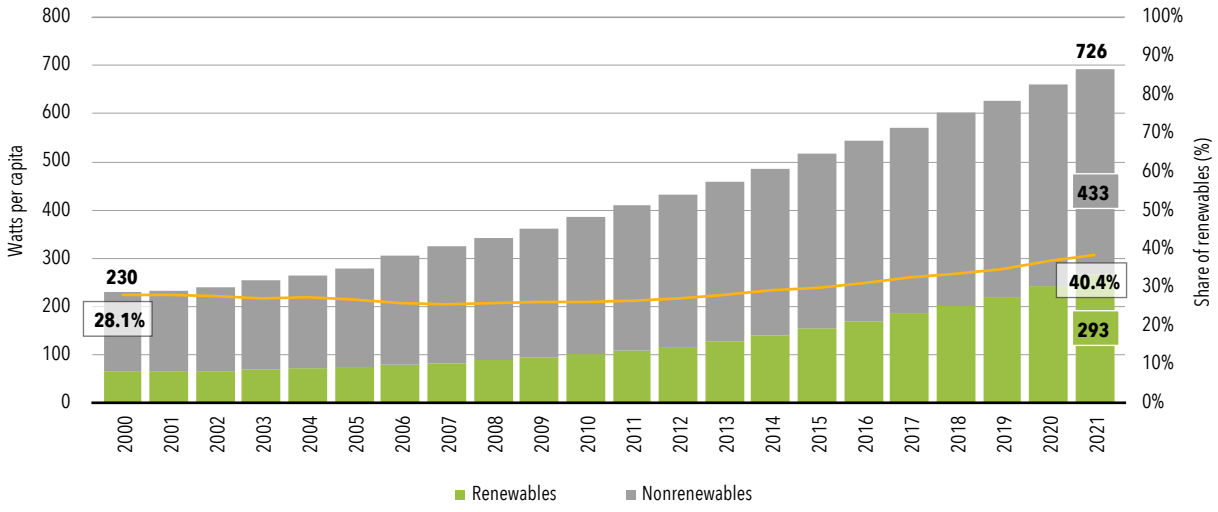
FIGURE 3.12 • ANNUAL GROWTH OF RENEWABLE ENERGY GENERATING CAPACITY PER CAPITA IN DEVELOPING AND DEVELOPED COUNTRIES, AND THE WORLD, 2000–22



Source: International Renewable Energy Agency.

A large gap remains in the deployment of renewable energy per capita between developed and developing countries, as shown in figure 3.12. In 2022, developing countries had 293 renewable watts per capita installed, while developed countries had 1,073 watts per capita, or 3.7 times more. Installation in developing countries accelerated rapidly in recent years, nearly doubling from 155 watts per capita in 2015 to 293 in 2022. Yet lack of financing, market-related and economic challenges, along with technical and capacity limitations, have limited the ability of developing countries to benefit from their renewable energy opportunities.

FIGURE 3.13 • ANNUAL GROWTH OF RENEWABLE ENERGY GENERATING CAPACITY IN DEVELOPING COUNTRIES, AND SHARE OF RENEWABLES, 2000–22

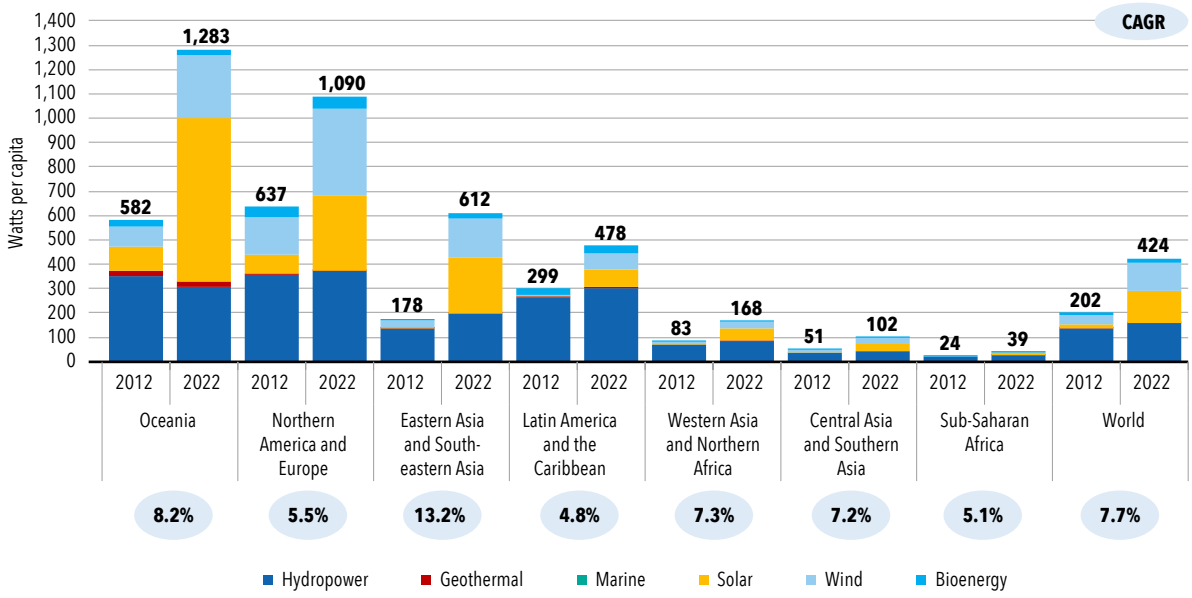


Source: International Renewable Energy Agency.

In 2022, the total electricity capacity per capita in developing countries was 726 watts, combining both renewables and nonrenewables (figure 3.13). Meanwhile, developed countries had 1,073 watts per capita of only renewables. In other words, people in developed countries had more renewable electricity capacity per capita than the total electricity per capita (from all sources) available to people in developing countries.

Between 2012 and 2022, growth in renewable energy generating capacity per capita varied across regions. The greatest capacity growth was 13.2 percent CAGR (from 178 to 612 watts per capita) in Eastern and South-eastern Asia, primarily due to additions of wind and solar power.

FIGURE 3.14 • GROWTH IN RENEWABLE ENERGY GENERATING CAPACITY PER CAPITA BY TECHNOLOGY ACROSS REGIONS, 2012–22

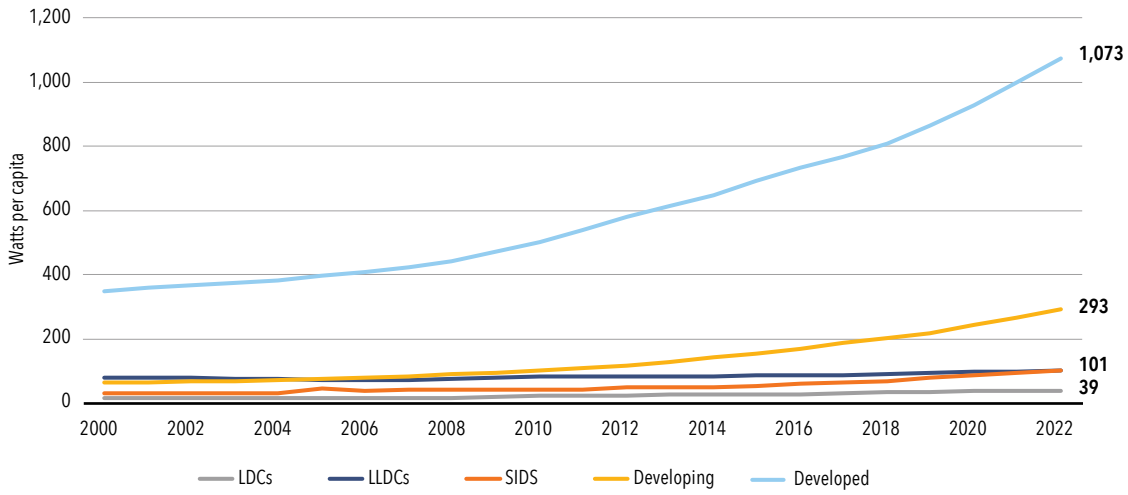


Source: International Renewable Energy Agency.
CAGR = compound annual growth rate.

The second-largest growth rate was Oceania's at 8.2 percent, expanding from 582 to 1,283 watts per capita—values surpassing the developed world average in 2022 and making Oceania the best-performing region. Other regions remained below the global average of 7.7 percent CAGR over the decade. By 2022, Latin America and the Caribbean had the slowest growth rate, at 4.8 percent CAGR, and Sub-Saharan Africa had the lowest average values of 39 watts per capita and the second-lowest CAGR of 5.1 percent (figure 3.14).

Meanwhile, growth rates across country groups reveal concerning disparities, with small island developing states (SIDS), least-developed countries (LDCs), and landlocked developing countries (LLDCs) lagging even developing countries as a group (figure 3.15).

FIGURE 3.15 • RENEWABLE ENERGY GENERATING CAPACITY PER CAPITA BY COUNTRY GROUP, 2000–22



Source: International Renewable Energy Agency.
LDC = least-developed country; LLDC = landlocked developing country; SIDS = small island developing states.

In 2022, LLDCs reached 102 watts per capita and SIDS 101 watts per capita, while LDCs stayed behind at 39 watts per capita of renewable electricity. These country categories represent a widening gap compared with the rest of the world. At CAGRs, LDCs would need almost 41 years, LLDCs would need 38 years, and SIDS would need 11 years to reach a level of deployment similar to the average levels in developing countries in 2022 (293 watts per capita).

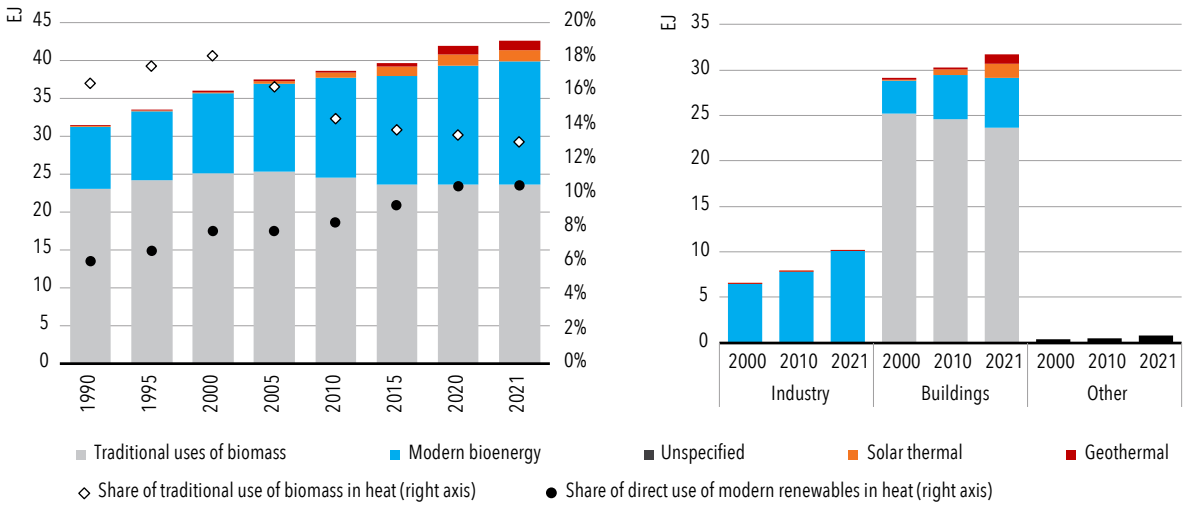
HEAT

Heat is the largest energy end use worldwide, accounting for almost half of global TFEC (182 EJ). Total energy consumption for heat increased by an estimated 3.2 percent in 2021 compared with 2020. With coal, gas, and oil meeting more than three-quarters of global heat demand, the sector remains heavily dependent on fossil fuel. Traditional uses of biomass declined slightly by 0.1 percent in 2021 year-on-year, accounting for nearly 13 percent (24 EJ) of global energy consumption for heat. Excluding traditional uses of biomass, as well as ambient heat harnessed by heat pumps[20] (for which data availability is limited), direct uses of modern renewables for heat increased 1.6 percent year-on-year to reach 19 EJ in 2021. This represented 10.5 percent of total energy consumed for heat, only 2.2 percentage points higher than in 2010 (figure 3.16).

20 The rapid spread of heat pumps over the past decade is making ambient heat an increasingly important heat source, although its prevalence globally is difficult to estimate because data are unavailable for some markets. Because of this lack of data, this report does not account for ambient heat (in excess of any nonrenewable electricity used to run the pumps), although it can be credited as a renewable source, and electric heat pumps are expected to play a key role in the decarbonization of the heating sector.

Despite its dominant share in final energy consumption, the heating sector has received limited policy attention and support until recently. While the last couple of years have seen a number of supporting policy updates for renewable heat based on energy security considerations, greater ambition and stronger policy support are needed to progress toward SDG target 7.1 ("ensure universal access to affordable, reliable and modern energy services"—for instance, for cooking and space and water heating) and SDG target 7.2 ("increase substantially the share of renewable energy in the global energy mix"). Doing so requires combining strong improvements in energy efficiency, conservation, and material efficiency—especially for energy-intensive materials such as cement and steel, which come from hard-to-decarbonize sectors—with fast deployment of renewable heat technologies in order to transition away from fossil fuels and inefficient and unsustainable uses of biomass.

FIGURE 3.16 • RENEWABLE HEAT CONSUMPTION BY SOURCE AND SECTOR, 1990–2021



Source: International Energy Agency and United Nations Statistics Division.
Note: Indirect consumption of renewable heat through renewable electricity and district heating is not represented in this figure.
EJ = exajoule.

Bioenergy accounts for about 82 percent (15.6 EJ) of direct[21] modern use of renewables for heat globally. Bioenergy accounts for about one-tenth (IEA 2021) of energy consumed for heat in the industry and one-twentieth in the buildings sector (IEA 2024b). Industry is responsible for two-thirds of modern use of bioenergy, most of which is concentrated in subsectors producing biomass residues on site such as wood, pulp, and paper industries, as well as the sugar and ethanol industries. In 2021, modern use of bioenergy for heat expanded 1.6 percent year-on-year in industry—mostly due to increasing use in Brazil's and India's sugar and ethanol industries—and increased 6.8 percent in the buildings sector, as heat demand increased.

Global **solar thermal** consumption remained relatively steady in 2021 compared to 2020, accounting for 8 percent (1.54 EJ) of modern use of renewables for heat; yet it still met less than 1 percent of total final heat demand. China continued to dominate solar thermal developments, accounting for around 70 percent of both newly installed capacity and global solar thermal capacity in operation in 2021 (IEA-SHC 2023). However, despite positive development in many European markets, the global market declined by 9.3 percent in 2022 compared to 2021, due to COVID-19 lockdown measures disrupting construction and installation activities in China, but also due to increasing competition

21 Renewables also contribute to heat supply indirectly through renewable electricity used for heating and district heat networks. Accounting for these indirect uses, and excluding ambient heat harnessed by air-source heat pumps, renewable electricity is actually the second-largest modern use of renewable heat source after bioenergy, and the fastest-growing one. It accounted for almost half of the increase in total (direct and indirect) modern use of renewable energy used for heat in 2018, owing to the combination of increasing penetration of renewables in the power sector and heat electrification through the use of electric heat pumps and boilers. The buildings sector is responsible for the majority of electricity consumption for heat.

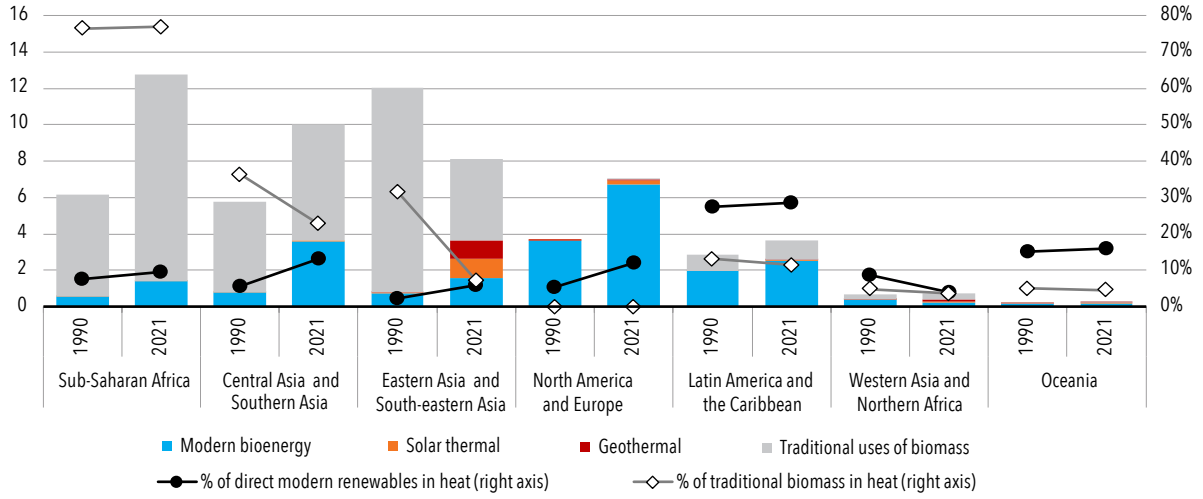
from rooftop PV systems in some important markets like India. From this perspective, hybrid photovoltaic thermal (PVT) systems offer enormous potential.[22] The global installed capacity for these systems reached 0.79 GW of thermal capacity and 0.28 GW of electric capacity in 2022, although new installations slowed down significantly that year due to competition with solar PV systems and changes in funding schemes collapsing the leading PVT market of France (IEA-SHC 2023).

While domestic solar water heaters still represent the large majority of installations—85 percent of newly installed capacity in 2021 (IEA-SHC 2023)—there is also growing interest in large-scale solar thermal systems for industrial applications or connected to district heating networks, which continue to develop as a niche market while significant potential remains untapped. Solar thermal cooling offers great potential to decarbonize space cooling, especially since the greatest demand coincides with the highest solar potential, reducing the load of electric air conditioners at peak times during summer months. However, technology deployment is currently very limited.

Global **geothermal** heat consumption grew 10.4 percent in 2021, driven almost exclusively by China, and represented 6 percent (1.2 EJ) of modern use of renewables for heat. About 60 percent of geothermal heat is harnessed by ground-source heat pumps worldwide (Lund and Toth 2020). The large majority of applications are in the buildings sector, with bathing, swimming, and space heating (primarily via district heating) being the most prevalent end uses globally. China is responsible for more than four-fifths of global geothermal heat consumption, followed by Türkiye and the United States, which together account for almost one-tenth.

Traditional uses of biomass are primarily concentrated in Sub-Saharan Africa and Asia (figure 3.17), with—in descending order—Nigeria, India, China, Ethiopia, Pakistan, the Democratic Republic of the Congo, and the United Republic of Tanzania together accounting for two-thirds of global consumption. Despite a slightly declining trend since 2006, traditional uses of biomass in 2021 were still at a level similar to that of 1990 at a global scale. Contrasting trends were observed across regions and countries in 2012–21, with significant declines in Eastern Asia—especially in China—as well as in Indonesia and Viet Nam, partly compensated by strong population-driven increases in Sub-Saharan Africa (especially in Nigeria, Ethiopia, Uganda, and the Democratic Republic of the Congo).

FIGURE 3.17 • RENEWABLES' CONSUMPTION FOR HEATING, BY REGION, 1990 AND 2021

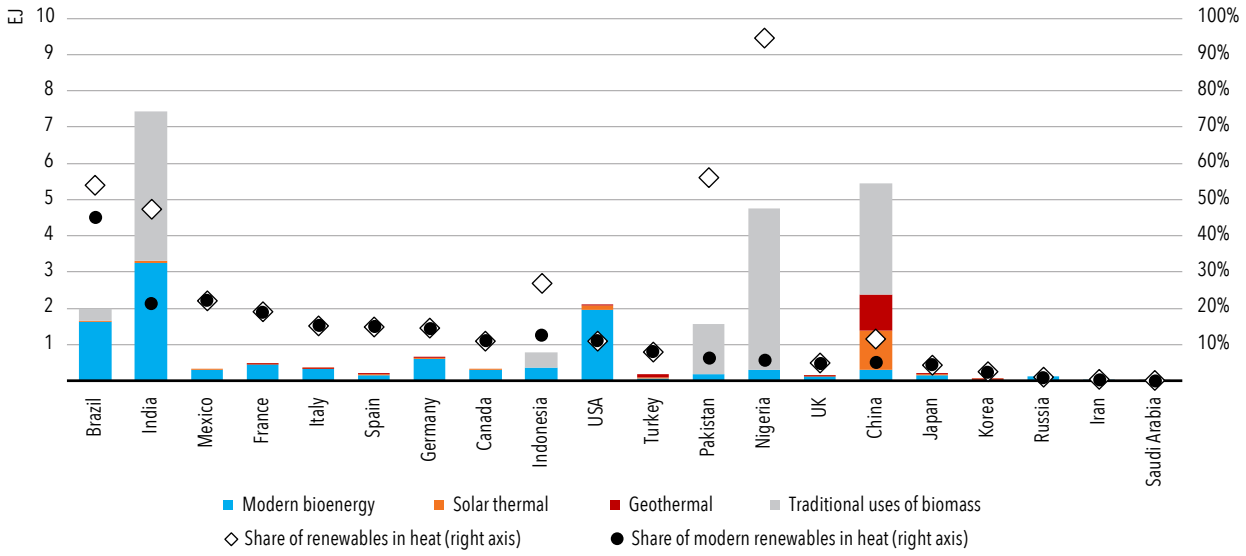


Source: International Energy Agency and United Nations Statistics Division.
Note: Indirect consumption of renewable heat through renewable electricity and district heating is not represented in this figure.
EJ = exajoule.

22 PVT systems combine PV cells with thermal collectors, which allows them to convert solar radiation into both usable thermal and electrical energy.

China and India together represented more than two-thirds of the global increase in modern use of renewable energy for heat from 2010 to 2021. Together with the United States and Brazil, they were responsible for 47 percent of global heat demand and accounted for half of modern use of renewable heat globally in 2021 (figure 3.18). This results from large consumption of bioenergy in the "pulp and paper" industry and for residential heating in the United States; extensive use of bagasse in the sugar and ethanol industry in Brazil and India; and notable deployment of solar thermal water heaters and geothermal heat in China. Europe is responsible for another quarter of global modern use of renewable heat, owing to the use of residential wood and pellet stoves and boilers (e.g., in France, Germany, and Italy) and of biomass in district heating (e.g., Nordic and Baltic countries, Germany, France, and Austria). Although not quantified in this report, the growing consumption of renewable electricity through electric heaters and heat pumps, as well as ambient heat harnessed by heat pumps in China, the United States, and the European Union, contributed indirectly to renewable heat consumption (IEA 2024b).

FIGURE 3.18 • RENEWABLE HEAT CONSUMPTION AND SHARE OF RENEWABLES IN TOTAL HEAT CONSUMPTION, BY COUNTRY, TOP 20 ENERGY-CONSUMING COUNTRIES, 2021



Source: International Energy Agency and United Nations Statistics Division.
Note: Indirect consumption of renewable heat through renewable electricity and district heating is not represented in this figure.
EJ = exajoule.

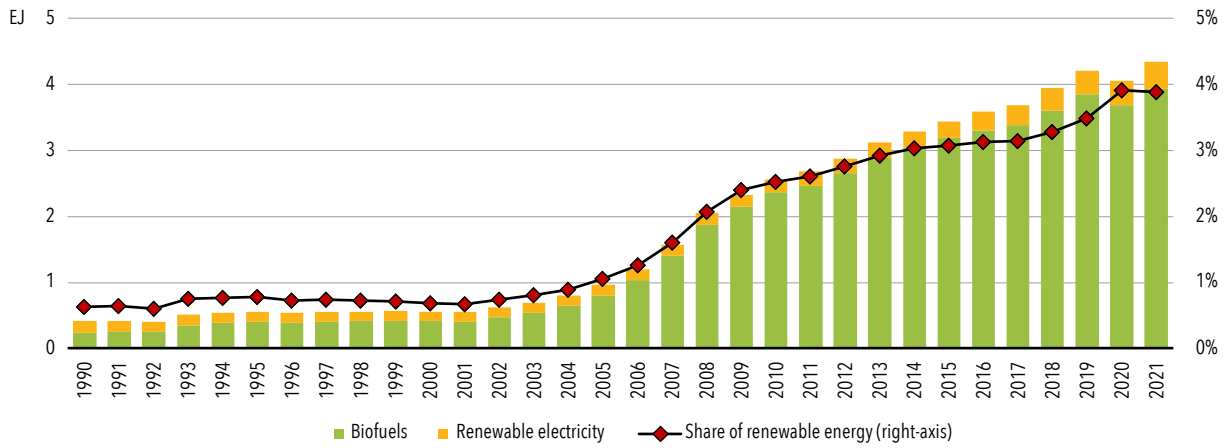
TRANSPORT

The share of renewable energy in transport TFEC rose to 4.4 percent in 2021, up from 3.5 percent in 2015. Global final energy consumption for transport rebounded and increased 8 percent (+8.1 EJ) in 2021, as social and economic activities began to recover from the disruptions caused worldwide by the COVID-19 pandemic in 2020. Accounting for 90 percent of renewable supplies, biofuels continued to dominate renewable energy use in transport, which increased 7 percent year-on-year in 2021 (+0.24 EJ). While overall biofuel demand returned to 2019 levels, the recovery was uneven across countries and fuels, and biofuels' share remained steady at 3.5 percent of final energy consumption in transport in 2021. Bio gasoline and other liquid biofuels (mostly ethanol) demand remained 5 percent below 2019 levels in 2021. This was mainly because high ethanol prices in large markets like Brazil and lower gasoline demand in the United States relative to 2019 levels drove down ethanol volumes in 2021. By comparison, in 2021, biodiesel, renewable diesel, and bio jet kerosene expanded well beyond 2019 levels, albeit from a low base for bio jet kerosene. The combined demand for these fuels in 2021 was 15 percent, or 7 billion liters, more than in 2019.

Liquid biofuels, mainly crop-based ethanol and biodiesel blended with fossil transport fuels, represented 90 percent of renewable energy consumed for transport, with most of the remainder coming from renewable electricity used in vehicles and trains, which grew to 0.42 EJ in 2021, or 2.5 times that of 1990.

Part of this growth is driven by an expanding EV fleet. The number of EVs on the road increased from 7.1 million in 2019 to 11.3 million in 2020 to more than 16.5 million in 2021 (IEA 2022d). The electricity powering these vehicles increasingly came from renewable sources. The renewable share of total electricity use in transport climbed from 20 percent in 2010 to 28 percent in 2021 (figure 3.19).

FIGURE 3.19 • GLOBAL RENEWABLE FUEL SHARE IN TRANSPORT AND TOTALS FOR RENEWABLE ELECTRICITY AND BIOFUELS, 1990–2021



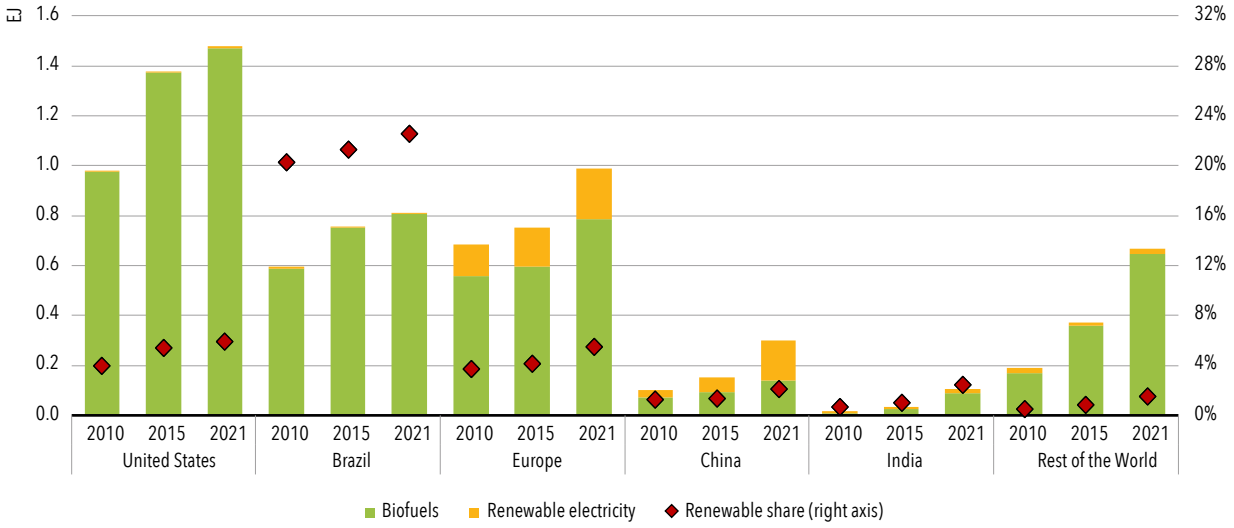
Source: International Energy Agency and United Nations Statistics Division.
EJ = exajoule.

In 1990–2021, renewable energy in transport grew 60 percent, but its share of total consumption increased by only 1.5 percentage points. The growth is thanks to country-level policies to expand biofuels, electrify transport, and increase renewable energy generation. Biofuel policies are the primary driver while renewable electricity played a smaller, but growing, role. Despite many successes at the country level, supportive policies have only marginally kept ahead of growing fossil fuel demand, leading to only a small share increase overall.

While the United States, Brazil, and Europe account for three-quarters of renewable energy used in transport, other countries and regions are also increasing their share (figure 3.20). In the United States and Brazil, 99 percent of renewable energy in transport comes from biofuels (mainly ethanol and biodiesel). In Europe, 20 percent of the renewable energy consumed in transport comes from renewables-based electricity. China's use of renewable energy in transport grew by almost 96 percent between 2015 and 2021, with renewable electricity consumption increasing 2.6 times over the same period. By 2021, renewable electricity represented more than half of all renewable energy used in transport, thanks to increasing shares of renewables in power generation and efforts to electrify transport; biofuel policy support remained limited. Also by 2021, EV sales in China had more than doubled, reaching 3.3 million (IEA 2022d). Together, China and Europe represented more than 85 percent of global electric car sales in 2021. In India, biofuel support policies doubled renewable energy use in transport between 2015 and 2021.

To increase the share of renewable energy in transport will require a combination of policies. Priorities include supporting biofuels (while ensuring that feedstock meets stringent sustainability criteria), transport electrification, renewable electricity generation, as well as active mobility, transit efficiency (by design), and the phaseout of fossil fuels for transport. Such policies must be steadily strengthened where they exist and introduced where they do not.

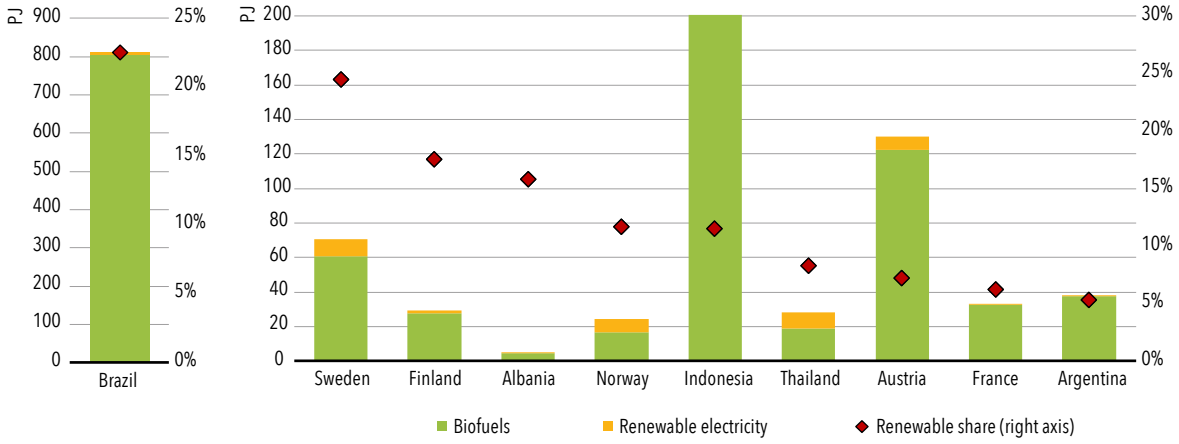
FIGURE 3.20 • RENEWABLE ENERGY SHARE AND TOTAL RENEWABLE ENERGY IN TRANSPORT ACROSS SELECTED COUNTRIES AND REGIONS, 2010, 2015, AND 2021



Source: International Energy Agency and United Nations Statistics Division.
EJ = exajoule.

The United States, Brazil, Europe, China, and India account for 85 percent of renewable energy use in transport, driven by policy support for biofuels and electrification across these countries and regions. In 2021, Brazil, Sweden, Finland, Albania, Norway, and Indonesia recorded the highest shares of renewables in their transport energy consumption, and all achieved renewable energy shares above 10 percent (figure 3.21).

FIGURE 3.21 • TOP 10 COUNTRIES BY RENEWABLE ENERGY SHARE IN TRANSPORT, 2021



Source: International Energy Agency and United Nations Statistics Division.
PJ = petajoule.

Policy insights

Despite significant progress on the renewables targets under SDG 7, achievements in recent years lag far behind ambitions. The agreement by over 130 countries to triple the world's renewable power capacity by 2030 as well as a global consensus on the need to transition away from fossil fuels at COP28 in Dubai in 2023 have significant implications for accelerated renewable energy deployment (UNFCCC 2023). The international, top-level agreement sends an important signal that needs to be incorporated into national renewable energy targeting and planning across countries and regions, including in their nationally determined contributions. Yet the agreement is contingent on far stronger action to reduce policy uncertainty, along with sufficient financing, to help achieve global energy and climate ambitions and reduce inequalities (COP28, IRENA, and GRA 2023).

Multiple policy tools are required to speed up the necessary transition of energy systems across developed and developing countries in line with the tripling target (IEA 2024a; IRENA 2023b). These tools include setting realistic, yet ambitious targets for deployment that reflect national potential and capacity, and embedding net-zero commitments in legislation. Targets need to be accompanied by effective policy planning and implementation, including through regulatory reform, price-based mechanisms, market incentives, fiscal policy, power market design, and streamlined permitting procedures. Forward-looking planning is also needed to modernize and expand supporting infrastructure, such as storage, electricity transmission, and distribution in the energy sector to accommodate greater shares of renewables, as well as infrastructure facilitating end-user electrification in the agriculture, industry, and transport sectors.

Achieving the tripling target as well as the broader SDGs further hinges on accelerated renewable energy deployment—both in developing and developed countries—integrated with relevant socioeconomic policies. Policy makers need to create economic opportunities for people across the globe through the energy transition. This involves investing in local supply chains, skills, and capacities, as well as creating job opportunities within the renewable energy sector. Dedicated planning, consultation, and policy making are needed to address socioeconomic and environmental impacts of transitioning energy systems. Key areas of focus include the affordability of sustainable energy; job transfers; as well as impacts on land, gender equality, indigenous peoples, and local communities (IRENA 2023b).

While the agreement to triple renewable energy capacity is a global goal, the chapter highlights significant disparities in per capita renewable capacity deployment, with installed capacity in developed countries 3.7 times higher than in developing countries. This underscores the need to support deployment efforts in developing countries through international collaboration. That collaboration must extend to ensuring access to affordable finance, as well as putting in place strong governance mechanisms and robust regulatory frameworks that help reduce real and perceived risks and so attract investment. The facilitation of necessary finance through the mobilization of public and private funds, and collaboration with development financial institutions, are thus fundamental (see also chapter 5).

ANNEX 1.
METHODOLOGICAL NOTES

Chapter 3. Renewables

DEFINITIONS

Renewable energy sources. Total renewable energy from hydropower (excluding pumped hydro), wind, solar photovoltaic, solar thermal, geothermal, tide/wave/ocean, renewable municipal waste, solid biofuels, liquid biofuels, and biogases.

Renewable energy consumption. Final consumption of direct renewables along with the amount of electricity and heat consumption estimated from renewable energy sources. Ambient heat harnessed by heat pumps is not accounted for in this report, due to limited data availability.

Direct renewables. Bioenergy, and direct uses of solar thermal and geothermal energy.

Total final energy consumption. The sum of the final energy consumption in the transport, industry, and other sectors (equivalent to the total final consumption minus nonenergy use). Total final consumption excludes energy transformed into other forms of energy (e.g., natural gas used to generate electricity), as well as energy used by energy industries.

Traditional uses of biomass. Biomass uses are considered traditional when biomass is consumed in the residential sector in countries outside the Organisation for Economic Co-operation and Development. International Energy Agency statistics divide traditional uses of biomass into primary solid biomass, charcoal and unspecified primary biomass, and waste. The United Nations Statistics Division has a similar classification with a more detailed breakdown on products. Traditional consumption/use of biomass is a "conventional proxy" because it is estimated rather than measured directly, due to limited data availability as regards the use of solid biomass in traditional and inefficient cookstoves.

Modern uses of renewable energy consumption. Total renewable energy consumption minus traditional consumption/ use of biomass.

METHODOLOGY FOR MAIN INDICATOR

The indicator used in this report to track SDG 7.2 is the share of renewable energy in total final energy consumption. Data from the International Energy Agency (IEA) and United Nations Statistics Division (UNSD) energy balances are used to calculate the indicator according to the formula:

$$\%TFEC_{RES} = \frac{TFEC_{RES} + \left(TFEC_{ELE} \times \frac{ELE_{RES}}{ELE_{TOTAL}}\right) + \left(TFEC_{HEAT} \times \frac{HEAT_{RES}}{HEAT_{TOTAL}}\right)}{TFEC_{TOTAL}}$$

The variables are derived from the energy balance flows: TFEC = total final energy consumption as defined in the definitions above, ELE = gross electricity production, HEAT = gross heat production, whereas the subscript RES corresponds to the part coming from renewable energy sources.

The denominator is the TFEC of all energy products (as defined above). The numerator, renewable final energy consumption, is a series of calculations defined as the direct consumption of renewable energy sources plus the final consumption of electricity and heat estimated to have come from renewable sources. To perform the calculation at the final energy level, this estimation allocates the amount of electricity and heat consumption deemed to come from renewable sources based on the share of renewables in gross production.

METHODOLOGY FOR ADDITIONAL METRICS BEYOND THE MAIN INDICATOR

The amount of renewable energy consumption can be divided into three sectors to refer to how the energy is consumed: electricity, heat, and transport. They are calculated from the energy balance and are defined as follows:

Electricity refers to the amounts of electricity consumed by end users. Electricity used in the transport sector is excluded from this aggregation. Electricity used to produce district heat is not included because it is not part of the final consumption, whereas electricity used to produce heat in electric boilers and heaters is included here, as official data at the final energy service level is unavailable to determine it was used as heat.

Heat refers to the amount of energy consumed for heat-raising purposes in industry and other sectors, as well as other uses not included in Electricity and Transport, such as fuels used to pump water. Because official data at the final energy service level are unavailable, heat generated from electricity by final consumers in electric boilers and heaters is not included in this aggregate.

Therefore, the heat category here is not equivalent to the final energy end use service. It is also important to note that in this chapter, in the context of an "end use," heat does not refer to the same quantity as the energy product, "Heat," in the energy balance used in the formula above.

Transport refers to the amounts of energy consumed in the transport sectors. Most of the electricity used in the transport sector is consumed in the rail and road sectors, and, in some cases, pipeline transport. The amount of renewable electricity consumed in the transport sector is estimated as the product of the annual shares of renewable sources in gross national electricity production and the amount of electricity used nationally in the transport sector.

METHODOLOGY FOR INDICATOR SDG 7.B.1

Indicator 7.b.1 measures the installed renewable energy–generating capacity in developed and developing countries (in watts per capita). It is computed by dividing the maximum year-end installed capacity of renewable electricity–generating power plants by the country's midyear population. Data from the International Renewable Energy Agency (IRENA) are used to calculate this indicator.

IRENA's electricity capacity database contains information on installed electricity-generating capacity, measured in megawatts. The data set covers all countries and areas from the year 2000, records whether capacity is on-grid or off-grid, and is divided into 36 renewable energy types, which together constitute the six main sources of renewable electricity. For the population part of this indicator, IRENA uses population data from the United Nations World Population Prospects (UN 2021).

More details on the methodology used in this chapter can be found in the SDG indicators metadata repository (https://unstats.un.org/sdgs/metadata/files/Metadata-07-0b-01.pdf).

ANNEX 2.
REFERENCES

CHAPTER 3 • RENEWABLES

COP28, IRENA (International Renewable Energy Agency), and GRA (Global Renewables Alliance). 2023. *Tripling Renewable Power and Doubling Energy Efficiency by 2030: Crucial Steps towards 1.5°C*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2023/Oct/Tripling-renewable-power-and-doubling-energy-efficiency-by-2030.

IEA (International Energy Agency). 2018. *The Future of Cooling: Opportunities for Energy-Efficient Air Conditioning*. Technology report. Paris: IEA. https://www.iea.org/reports/the-future-of-cooling.

IEA. 2021. *World Energy Outlook 2021*. Paris: IEA. https://www.iea.org/reports/world-energy-outlook-2021.

IEA. 2022a. *Renewables 2022*. Paris: IEA. https://www.iea.org/reports/renewables-2022.

IEA. 2022b. *Renewable Energy Market Update: Outlook for 2022 and 2023*. Paris: IEA. https://www.iea.org/reports/renewable-energy-market-update-may-2022.

IEA. 2022c. *Electricity Market Report: January 2022*. Paris: IEA. https://www.iea.org/reports/electricity-market-report-january-2022.

IEA. 2023b. *Renewable Energy Market Update: Outlook for 2023 and 2024*. Paris: IEA. https://www.iea.org/reports/renewable-energy-market-update-june-2023.

IEA. 2024a. *Renewables 2023*. Paris: IEA. https://www.iea.org/reports/renewables-2023.

IEA. 2024b. "Renewable Energy Progress Tracker." IEA, Paris. https://www.iea.org/data-and-statistics/data-tools/renewable-energy-progress-tracker.

IEA-SHC (International Energy Agency–Solar Heating and Cooling Programme). 2023. *Solar Heat Worldwide 2023*. Gleisdorf: IEA-SHC, AEE—Institute for Sustainable Technologies.

IRENA (International Renewable Energy Agency). 2023a. *NDCs and Renewable Energy Targets in 2023: Tripling Renewable Power by 2030*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2023/Dec/NDCs-and-renewable-energy-targets-in-2023-Tripling-renewable-power-by-2030.

IRENA. 2023b. *World Energy Transitions Outlook 2023*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2023/Jun/World-Energy-Transitions-Outlook-2023.

IRENA. 2024a. *Renewable Capacity Statistics 2024*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2024/Mar/Renewable-capacity-statistics-2024

IRENA. 2024b. *Tracking COP28 Outcomes: Tripling Renewable Power Capacity by 2030*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2024/Mar/Tracking-COP28-outcomes-Tripling-renewable-power-capacity-by-2030

Lund, J. W., and A. N. Toth. 2020. *Direct Utilization of Geothermal Energy 2020 Worldwide Review*. Proceedings of the World Geothermal Congress 2020. https://www.geothermal-energy.org/pdf/IGAstandard/WGC/2020/01018.pdf.

UNFCCC (United Nations Framework Convention on Climate Change). 2023. "COP28: Global Renewables and Energy Efficiency Pledge." United Nations Climate Change Conference, Dubai, UAE. https://www.cop28.com/en/global-renewables-and-energy-efficiency-pledge.