CHAPTER 3

RENEWABLES

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Main messages

- **Global trend.** In 2023, renewables accounted for 18.0 percent of the world's total final energy consumption (TFEC), including traditional uses of biomass, and 13.4 percent when accounting only for modern renewables. Having doubled their use over the past 15 years, modern renewables continue to expand, growing by 4.8 percent year-on-year. Over the past decade, renewables' share of TFEC has risen 2.5 percentage points (pp), while the share of modern renewables grew 3.6 pp, reflecting sustained momentum. During the same period, the traditional use of biomass fell 8 percent, as access to clean cooking took off in Eastern Asia and South-eastern Asia. The power sector continues to drive renewables use, while heat and transport require stronger policy support. Amid escalating volatility in global energy supply, the accelerated deployment of renewable energy can boost energy diversification and security, lessen dependence on fuel imports, and bolster macroeconomic resilience.
- **Target for 2030.** Ensuring access to affordable, reliable, sustainable, and modern energy for all requires a fast-tracked expansion of renewable energy's use across electricity, heat, and transport. Target 7.2 of Sustainable Development Goal (SDG) 7 calls for a substantial increase in the share of renewables in the global energy mix by 2030, measured through their share in TFEC. Strong and accelerating progress, particularly in renewable electricity, has put renewables on a robust upward trajectory. Building on this momentum will be critical, as current trends remain below what is needed to fully align with SDG 7 and international climate and development objectives, including the pledge to triple global renewable energy capacity. Faster uptake of renewables, especially in heat and transport, can narrow this gap.
- **Electricity.** Renewables-based electricity consumption grew 5 percent year-on-year in 2023, and by 79 percent from 2013, underscoring its important role for SDG 7. As of 2023, 30 percent of all electricity consumption was covered by renewable sources—the largest share among all end uses of renewables. Renewables-based electricity, in turn, accounted for more than 38 percent of global renewable energy consumption and more than half of modern uses of renewable energy. Sustained capacity additions—mainly in solar photovoltaics (PV) and wind, for which the combined consumption increased fivefold in 2023 relative to 2013—are increasing the share of renewables in electricity. Hydropower remains the dominant source of renewables-based electricity in the world, meeting almost 15 percent of global electricity demand.
- **Heat.** In 2023, renewable sources accounted for over 21 percent of energy use for heat, highlighting their significant role in this sector. Nearly half of renewables-based heat comes, however, from the traditional use of biomass (18 exajoules [EJ]), reflecting challenges in access to clean cooking. More than 90 percent of its use was concentrated in Sub-Saharan Africa and Asia. The share of modern renewable energy use in global heat consumption grew, reaching 11.2 percent in 2023, up 1.9 pp from 2013. This is in large part because of the simultaneous increase in global annual heat demand, despite the aftermath of the 2022 global energy crisis.
- **Transport.** In 2023, the share of renewable energy in transport TFEC stood at 4.3 percent, up from 2.9 percent in 2013. Biofuels, mainly crop-based ethanol and biodiesel, continued to dominate renewable energy use in transport, growing 11 percent year-on-year in 2023. At the same time, the use of renewables-based electricity in transport more than doubled over the past decade, driven by strong growth in registrations of electric vehicles (EVs) and a rising share of renewables in electricity supply for road and rail transport.

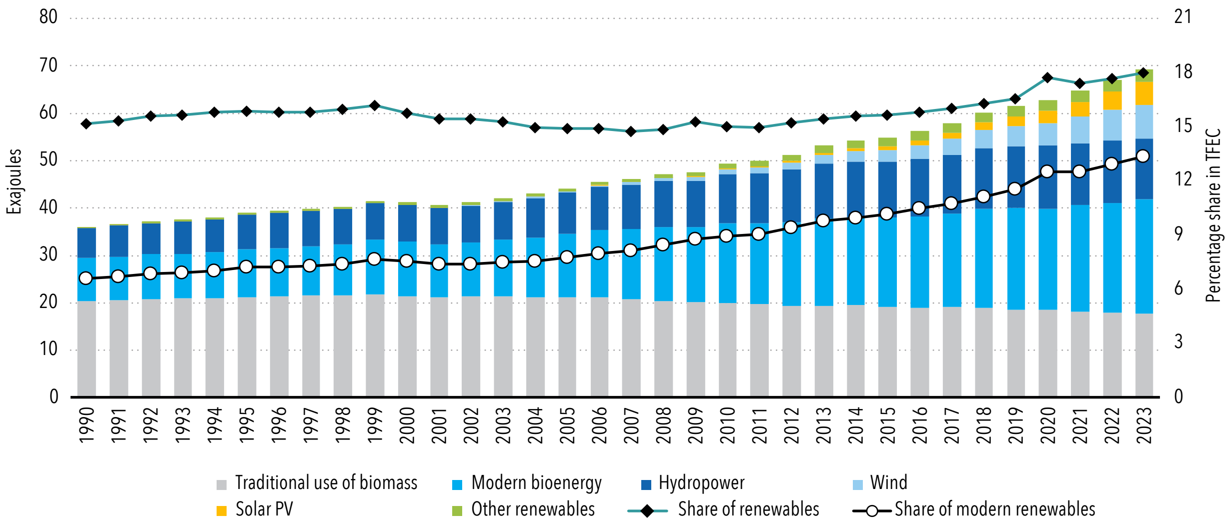
- **Regional highlights.** The widespread use of traditional biomass for heating and cooking in Sub-Saharan Africa places it first among the regions where renewables constitute the largest share of energy supply. When considering only modern uses of renewable energy, the share of renewables in TFEC was the highest in Latin America and the Caribbean, due to hydropower generation and the consumption of modern bioenergy in industrial processes and biofuels for transport. In 2023, more than a third of the global year-on-year increase in modern uses of renewable energy occurred in Eastern Asia and South-eastern Asia, driven by the expansion of wind and solar capacity in China, followed by Europe and Latin America and the Caribbean—each region accounting for almost 20 percent.
- **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 remained leaders in modern renewable energy use, with shares of 47 and 24 percent, respectively, in 2023. These shares are underpinned by their considerable use of hydropower for electricity, biomass for extracting heat, specifically, in industry, and, in Brazil's case, biofuels for transport. Spain and Italy recorded the largest year-on-year gains in the share of modern renewables (4 and 2 pp, respectively). From 2013 to 2023, Brazil, Germany, and the United Kingdom achieved the strongest gains in the share of modern renewables (between 7.5 and 10 pp). This growth was driven by rapid expansion of solar PV and wind expansion and by decreasing TFEC in Germany and the United Kingdom. Worldwide, China alone accounted for more than a fifth of modern uses of renewable energy.
- **Installed renewable energy–generating capacity in developing and developed countries.** Installed renewable energy–generating capacity per capita has continued to grow, reaching a global record of 544 watts per person in 2024. Substantial disparities persist across income groups. High-income and upper-middle-income countries recorded 1,224 watts and 808 watts per person, respectively, whereas lower-middle-income countries averaged 117.4 watts and low-income countries only 33.6 watts per person. Given the energy access deficits, particularly in low-income countries, continued efforts are needed to reach target 7.b, "expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries."

Are we on track?

Renewables have maintained a relatively steady share of TFEC over the past three decades; their share grew slowly in the most recent decade (+2.5 pp), despite their accelerated deployment in electricity generation.[16]

Global final energy consumption grew 1.5 percent year-on-year in 2023, roughly in line with the 1.9 percent growth in 2022. Global renewable energy consumption, including traditional uses of biomass,[17] reached 69.2 EJ in 2023, bringing renewables' share of global TFEC to 18.0 percent. This share was slightly higher than the 17.7 percent[18] the year before, representing the highest share since 1990 (figure 3.1).

Figure 3.1 • Renewable energy consumption and share in TFEC by technology—modern and total renewables, 1990–2023



Source: International Energy Agency and United Nations Statistics Division.

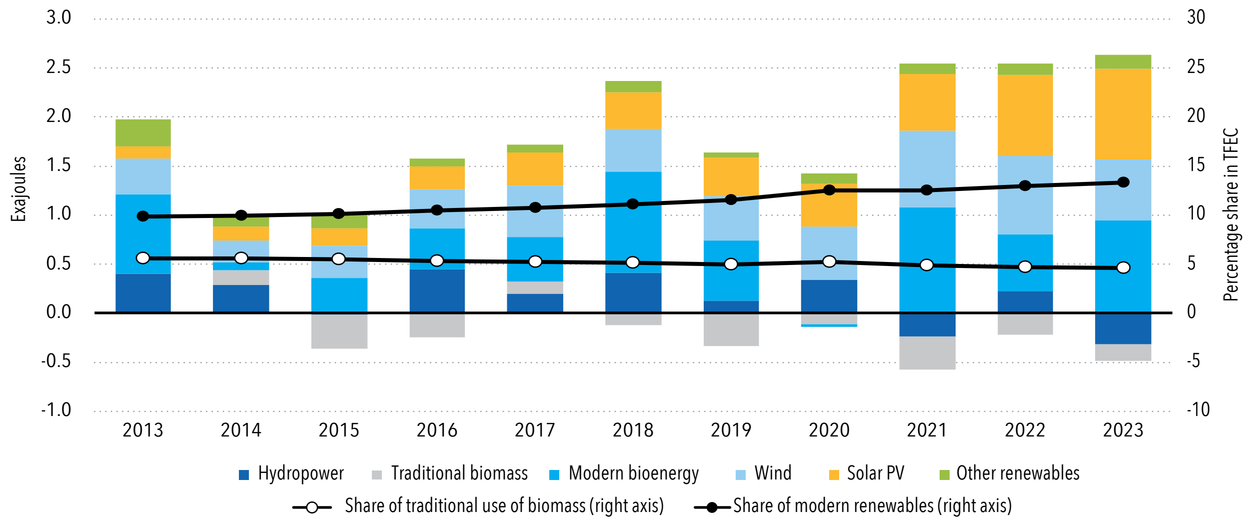
16 Unless otherwise stated, all data in this chapter come from the IEA World Energy Balances database (IEA 2026a), UNSD Energy Balances 2023 (UNSD 2025a), and Energy Statistics Database 2023 (UNSD 2025b).

17 The term "traditional uses of biomass" refers to 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 also used with low efficiency in OECD countries (for example, in fireplaces burning split logs), it is 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 2022 share of renewables in TFEC has been revised downward from 17.9 percent (as stated in last year's report) to 17.7 percent. The main drivers of this change are the downward revision of Chinese residential solid biofuel consumption for 2019 to 2022 and the revision of geothermal supply and demand across the full time series, both resulting from updated IEA estimation methodologies and improved data sources.

From 2022 to 2023, the growth of renewable energy use came from modern uses of bioenergy, solar PV, and wind, followed by geothermal and solar thermal (figure 3.2), with solar PV and wind contributing almost 60 percent. This growth was five times higher than the decline in hydropower and traditional uses of biomass, thus more than offsetting this reduction in renewable energy use.

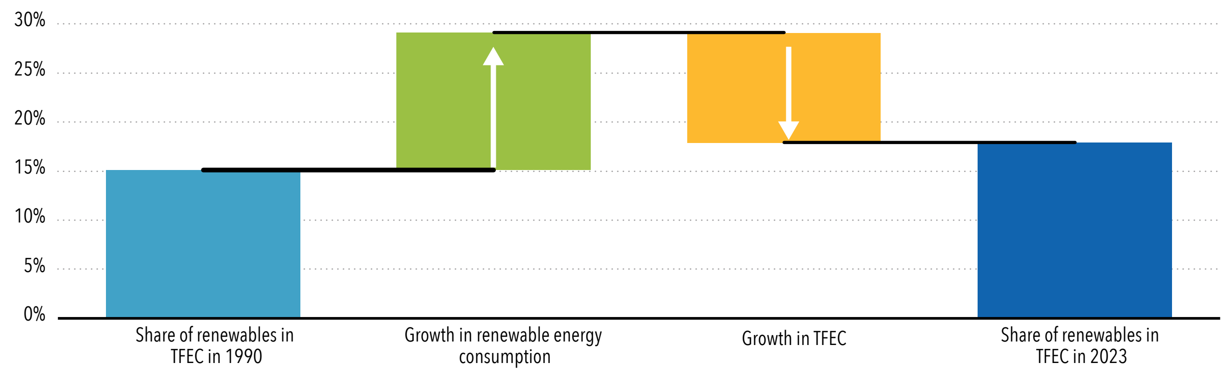
Figure 3.2 • Growth in renewable energy consumption by technology and the shares of modern uses of renewable energy and traditional uses of biomass in TFEC, 2013–23



Source: International Energy Agency and United Nations Statistics Division.

From 1990 to 2023, global renewable energy consumption grew 92 percent while TFEC grew 62 percent. As a result, the share of renewable energy in TFEC remained relatively steady (figure 3.3). Two trends coexisted in that period: the share of modern uses of renewables, excluding traditional uses of biomass, in TFEC progressively increased, from 6.6 percent in 1990 to 13.4 percent in 2023, with the strongest growth in the electricity sector (+20.1 EJ). Meanwhile, the share of traditional uses of biomass declined, from 8.6 percent to around 4.6 percent.

Figure 3.3 • Impact of energy consumption on the growing share of renewables in TFEC globally, 1990–2023



Source: International Energy Agency and United Nations Statistics Division.

From 2013 to 2023, modern uses of bioenergy accounted for almost a third (+5.5 EJ) of the increase in modern uses of renewable energy—the largest absolute increase among renewable sources, although closely followed by wind (+5.1 EJ). Solar PV and wind grew at an annual average of 28 percent and 14 percent, respectively—the fastest growth, despite starting from a smaller base. Overall, bioenergy, including traditional uses of biomass, remained the largest source of renewable energy, representing almost 11 percent of the global final energy consumption and 60 percent of the renewable portion in 2023, followed by hydropower, wind, and solar PV.

Installed renewable energy-generating capacity per capita[19] continued to grow, reaching an all-time high of 544 watts per person globally in 2024. As shown in table 3.1, this is more than double its 2014 value of 230 watts per capita and an increase of 14.1 percent from 477 watts per capita in 2023. The compound annual growth rate (CAGR) over five-year periods also increased to 10.9 percent. Installed capacity per capita remained higher on average in developed countries at 1,249 watts per person, compared to 405 watts per person in developing countries. At the same time, the global year-on-year growth rate was largely driven by higher growth rates in developing countries, with an annual growth of 18.3 percent in 2024, up from 342 watts in 2023, and a five-year CAGR of 13.4 percent. On the country level, the highest capacity additions in 2024 in developing countries were recorded by Niue (480 watts), Qatar (271 watts) and China (260 watts). This contrasts with an annual growth of 8.4 percent from 1,152 watts per person in 2023 and with a five-year CAGR of 8.0 percent in developed countries.

The sustained CAGR observed in renewable energy technologies is not merely as a statistical metric, but relevant to discussions about the progress on the renewable energy component of SDG 7. When deployment begins from a comparatively low baseline, even high growth rates may initially have limited visibility at the aggregate system level. Once deployment reaches a sufficiently large share of the overall energy mix, however, maintaining comparable growth rates can produce increasingly hefty absolute additions, with the ability to accelerate system-wide change through continued technological learning, economies of scale, and declining costs.

Sustaining high compound growth rates becomes progressively more challenging as markets mature and system integration requirements intensify. These requirements include grid expansion, storage deployment, supply-chain capacity, permitting constraints, and the availability of a skilled workforce in areas such as electrical engineering, grid operations, project development, and installation and maintenance. Targeted policy support, infrastructure investment, and enabling regulatory frameworks can, however, help mitigate these constraints and sustain momentum across technologies.

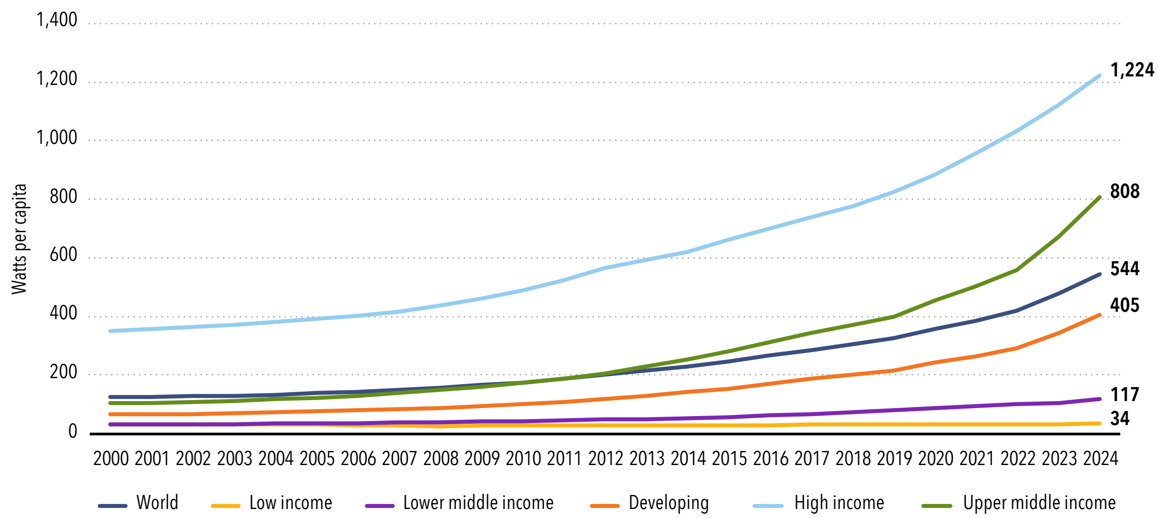
Table 3.1 • Global installed renewable energy generating capacity per capita, annual growth and five-year CAGR, 2014–24

	Global			Developed			Developing		
Year	Renewables per capita	Annual growth (%)	5-year CAGR	Renewables per capita	Annual growth (%)	5-year CAGR	Renewables per capita	Annual growth (%)	5-year CAGR (%)
2014	230	6.7	6.8	639	4.9	6.3	141	9.3	8.2
2015	248	7.7	7.2	682	6.7	6.5	154	9.3	8.7
2016	267	7.8	7.3	722	5.9	6.1	170	10.2	9.3
2017	286	7.0	7.3	758	5.0	5.6	186	9.3	9.7
2018	305	6.6	7.2	797	5.1	5.5	201	8.4	9.3
2019	325	6.7	7.2	851	6.7	5.9	216	7.1	8.9
2020	356	9.6	7.5	914	7.4	6.0	241	11.9	9.4
2021	386	8.5	7.7	984	7.7	6.4	265	9.6	9.3
2022	421	8.9	8.1	1,061	7.9	7.0	292	10.2	9.4
2023	477	13.4	9.4	1,152	8.6	7.6	342	17.4	11.2
2024	544	14.1	10.9	1,249	8.4	8.0	405	18.3	13.4

19 The indicator measuring progress by 2030 toward target 7.b 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 land-locked developing countries, in accordance with their respective programmes of support." In 2022, the IAEG-SDGs officially upgraded the 7.b.1 indicator to include all the countries in the world.

The picture within the developing country group is further nuanced, with significant differences between income groupings (figure 3.4). In 2024, high- and upper-middle-income countries reached 1,224 watts and 808 watts per person, respectively. Lower-middle income countries averaged 117.4 watts, and low-income countries just had 33.6 watts per person. These latter groups also recorded the lowest annual growth rates in installed renewable capacity per capita, at 0.87 percent for low-income and 1.16 percent for lower-middle-income countries, underscoring the need for targeted support to make equitable progress toward target 7.b.1.

Figure 3.4 • Renewable capacity per capita by income group, 2000-24



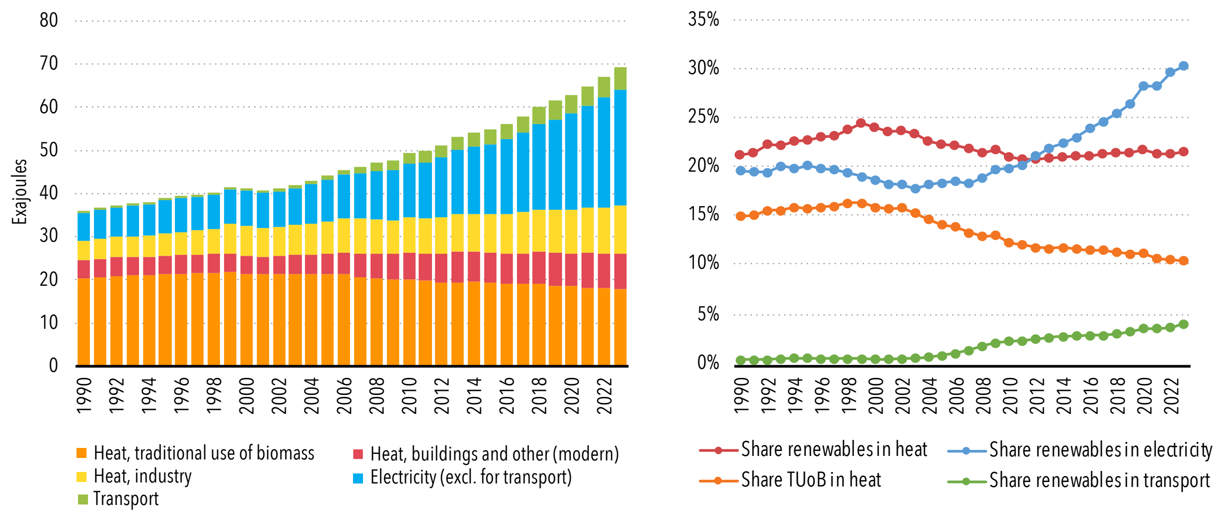
Source: International Renewable Energy Agency.

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, heat, transport, and electricity, which made up 45, 32, and 23 percent, respectively, of TFEC in 2023.

Electricity has seen the largest increase in renewables' share in final consumption. Renewables' share in electricity grew from nearly 22 percent in 2013 to more than 30 percent in 2023 (figure 3.5). In the heating subsector, renewable sources represented 21 percent of energy used; around half of this corresponded to traditional uses of biomass, which fell by almost 1 percent in 2023. Including the use of renewables-based electricity, the transport sector accounts for only 8 percent of global modern uses of renewable energy. It is the end-use sector with the lowest penetration of renewable energy, which represented a little more than 4 percent of the sector's final energy consumption in 2023.

Figure 3.5 • Renewable energy consumption and share by end use, 1990–2023



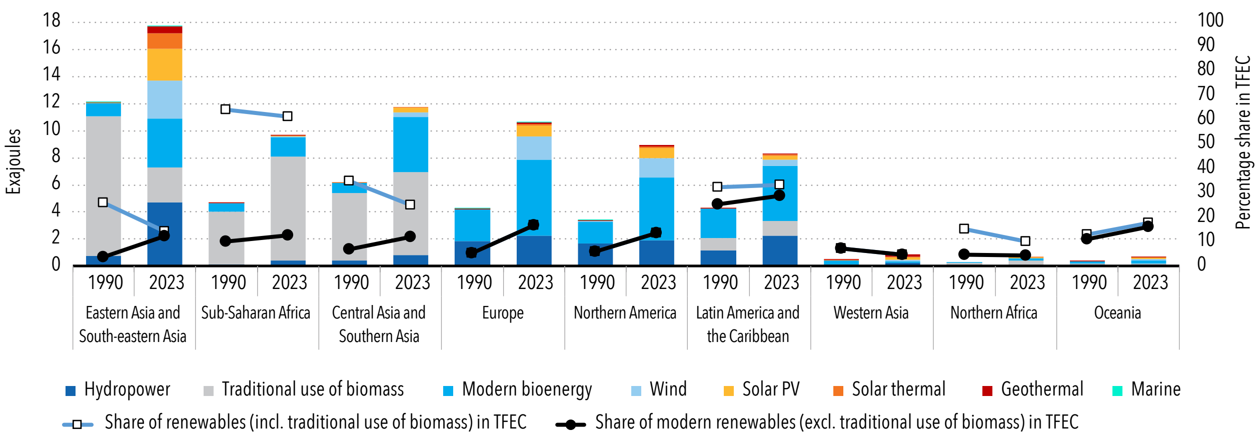
Source: International Energy Agency and United Nations Statistics Division.

Note: Electricity used for transport is included under transport.

Regional trends

Progress across regions is uneven. Renewable energy constitutes almost two-thirds of the TFEC in Sub-Saharan Africa; modern uses of renewables represent only 13 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 (29 percent of TFEC in 2023), due mostly to the consumption of bioenergy for industrial processes, biofuels for transport, and sizeable hydropower generation.

Figure 3.6 • Renewable energy consumption and share in TFEC by region, 1990 and 2023



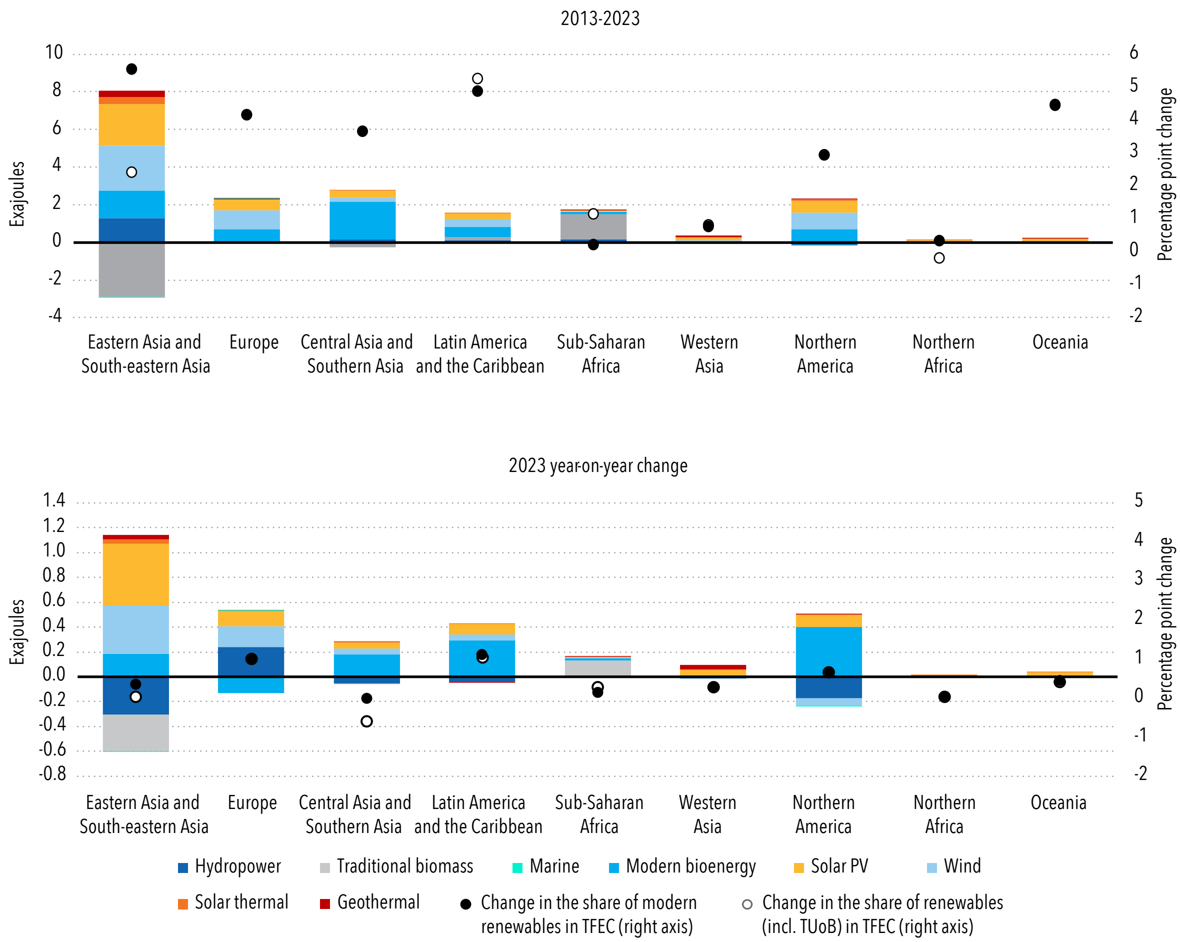
Source: International Energy Agency and United Nations Statistics Division.

Note: "Traditional uses of biomass" refers to the residential consumption of primary solid biofuels and charcoal in countries outside the OECD. Although biomass is used with low efficiency in OECD countries as well, such use is reported here under "modern bioenergy."

In 2023, significant additions of solar PV and wind capacity in Eastern Asia and South-eastern Asia led the region to represent more than a third of the global year-on-year increase in modern uses of renewable energy. Meanwhile, traditional uses of biomass continue to fall (figure 3.7).

TFEC rose in 2023 (+1.5 percent year-on-year). Nonetheless, this made the use of renewable energy more noticeable as a share of TFEC. Renewables' share in TFEC grew in nearly every region, led by Latin America and the Caribbean and Europe (both 1.0 pp in 2023 year-on-year). Growth in modern uses of bioenergy was the highest in Latin America and the Caribbean and Northern America (respectively, +0.9 and 0.7 pp year-on-year). Traditional uses of biomass worldwide dipped, while they rose in Sub-Saharan Africa—growth that was offset by lower consumption in Eastern Asia and South-eastern Asia.

Figure 3.7 • Change in renewable energy consumption and renewables' share in TFEC by region, 2013–23, and year-on-year change, 2023



Source: International Energy Agency and United Nations Statistics Division.

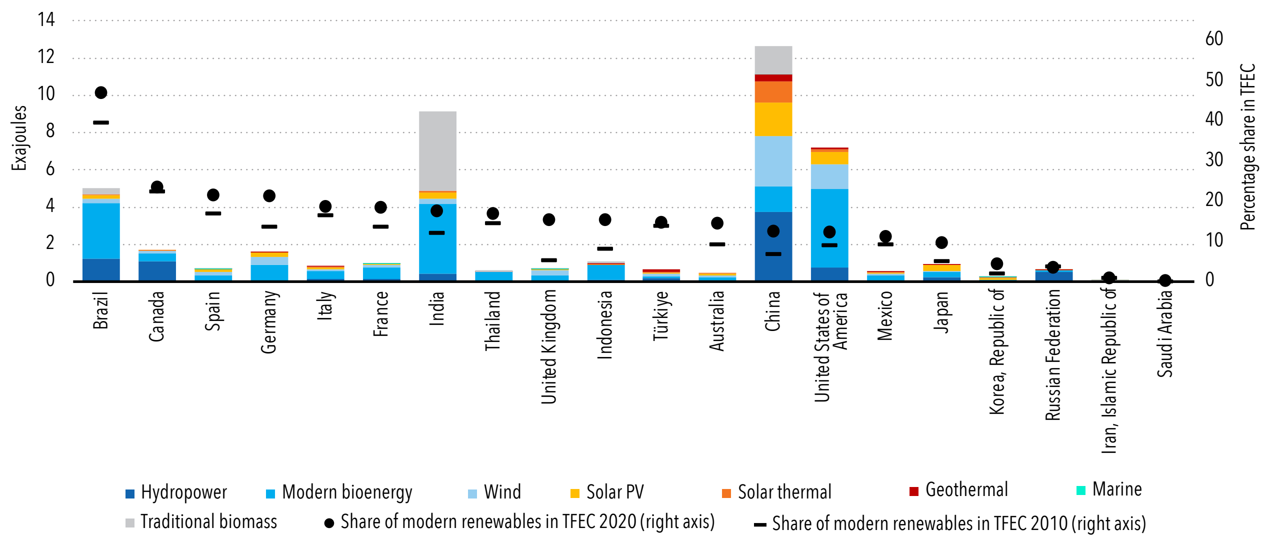
Note: "Traditional uses of biomass" refers to the residential consumption of primary solid biofuels and charcoal in countries outside the OECD. Although biomass is used with low efficiency in OECD countries as well, such use is reported under "modern bioenergy."

At the national level, the share of renewable sources in energy consumption tracks resource availability, policy support, and the total energy demand resulting from consumption patterns and energy efficiency performance. In line with the moderate TFEC growth in 2023, only 8 of the top 20 energy-consuming countries recorded a higher TFEC in 2023 than in 2022.[20] In the remaining 12 countries, TFEC decreased.[21]

In 2023, year-on-year growth in modern uses of renewables was the largest in Spain (+18 percent), followed by Italy (+10 percent). Brazil and Canada continued to lead the top 20 energy-consuming countries in the share of modern uses of renewables in 2023 (47 and 24 percent of TFEC, respectively), due to their reliance on hydropower for electricity, biomass for extracting heat, specifically, in industry, and, in Brazil's case, biofuels for transport. China alone accounted for over a fifth of the global modern uses of renewable energy, despite its TFEC having a less than 13 percent share of modern renewables.

Between 2013 and 2023, the United Kingdom, Germany, and Brazil achieved the largest increases in the share of modern uses of renewables in TFEC (+10.0, +7.6, and +7.5 pp, respectively), followed by Indonesia, China, and India (with shares increasing between +5 and +7 pp points). This growth was possible largely thanks to the development of wind and solar PV, as well as a significant decrease in TFEC in Germany and the United Kingdom between 2013 and 2023. The shift from traditional to modern uses of biomass in China also played a role (figure 3.8).

Figure 3.8 • Renewable energy consumption, 2023, and share of modern uses of renewables in TFEC, 2013 and 2023, for the top 20 energy-consuming countries



Source: International Energy Agency and United Nations Statistics Division.

Note: "Traditional uses of biomass" refers to the residential consumption of primary solid biofuels and charcoal in countries outside the OECD. Although biomass is used with low efficiency in OECD countries as well, such use is reported under "modern bioenergy."

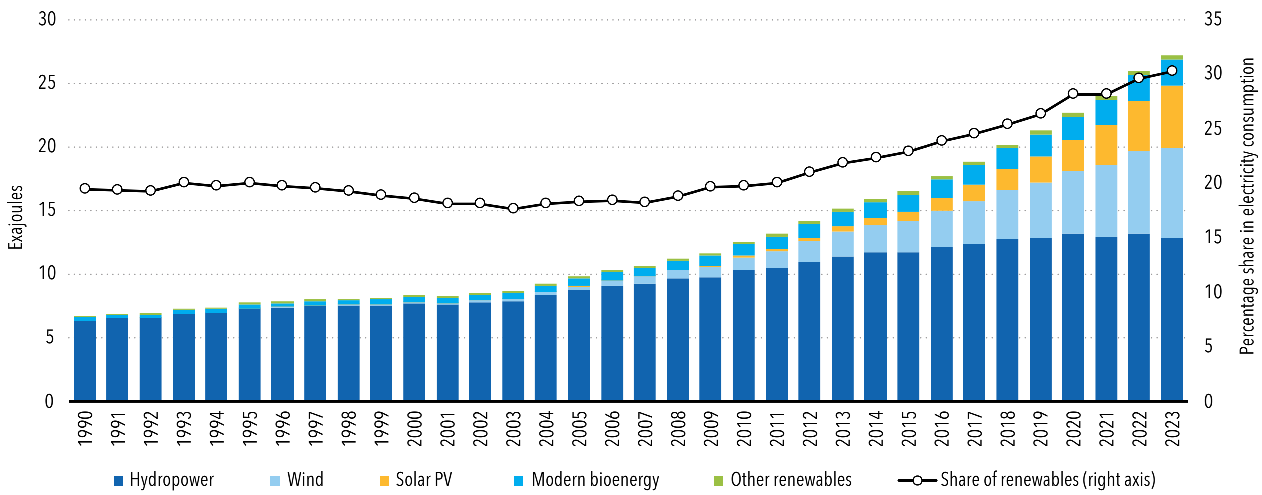
20 Countries that saw an increase in TFEC include Australia, Brazil, China, India, Indonesia, the Islamic Republic of Iran, Saudi Arabia, and Türkiye.

21 Countries that saw a decrease in TFEC include Canada, France, Germany, Italy, Japan, Republic of Korea, Mexico, the Russian Federation, Spain, Thailand, the United Kingdom, and the United States.

Electricity

Electricity accounted for almost 23 percent of TFEC worldwide in 2023. It is the fastest-growing end use: the average pace of electricity demand growth from 2013 to 2023 was 2.6 percent per year, double the annual rate of total energy demand growth over the same period (IEA 2025a). In 2023, global electricity consumption increased slightly, by over 2 percent, to 88 EJ, while renewables-based electricity consumption grew almost 5 percent (+1.2 EJ) year-on-year. The share of renewables in electricity consumption increased to more than 30 percent in 2023—the greatest share among all end uses (figure 3.9).

Figure 3.9 • Global renewables-based electricity consumption by technology, 1990–2023

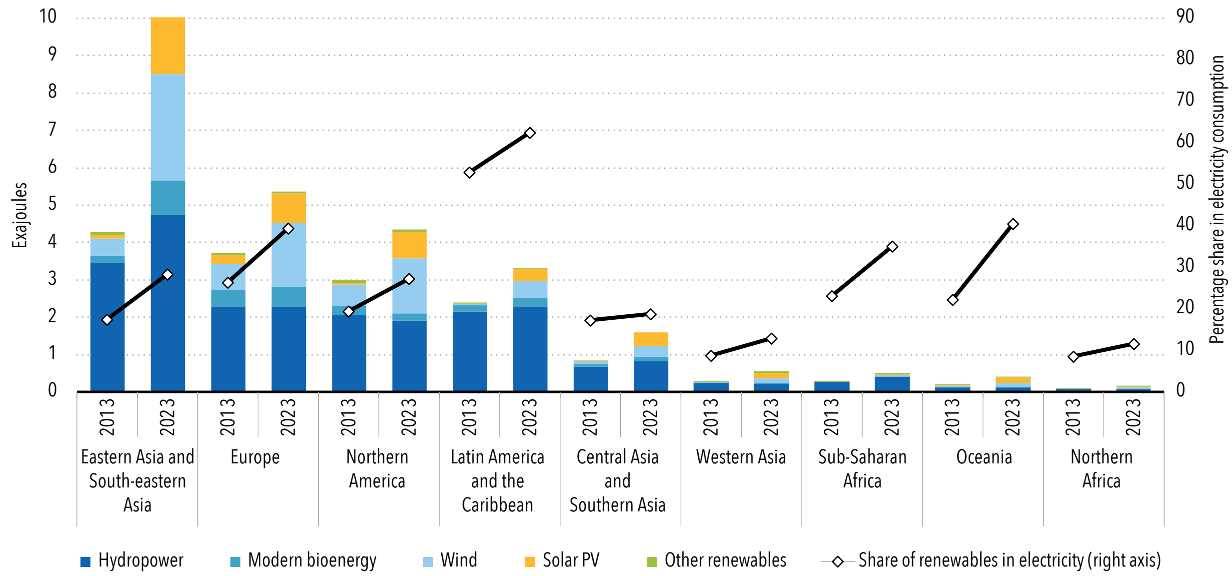


Source: International Energy Agency and United Nations Statistics Division.

In 2023, solar PV and wind made the largest contributions to the annual increase in renewables-based electricity consumption, with other technologies (geothermal and concentrating solar power) contributing marginally. Hydropower, electricity from combustible bioenergy, and marine power decreased year-on-year. Hydropower remained, however, the largest source of renewables-based electricity both worldwide and for each region, representing more than half of renewables-based electricity consumption in four of nine regions in 2023. In the other five regions, variable renewables surpassed electricity consumption from hydropower.

Eastern Asia and South-eastern Asia recorded the largest absolute year-on-year increases of renewables in electricity consumption in 2023. Over half of the global growth in renewables-based electricity consumption came from this region, mainly in China, followed by Japan and Republic of Korea. This growth was led primarily by proliferating wind and solar PV, but modern bioenergy also played a role. The share of renewable sources in electricity consumption was the largest in Latin America and the Caribbean, where hydropower alone accounted for more than 40 percent of the electricity consumption in 2023. Oceania and Europe ranked second and third, respectively, for their shares of renewable sources in electricity consumption (both around 40 percent), followed by Sub-Saharan Africa at 35 percent. Rapidly declining costs and robust policy support helped push wind and solar PV to account for more than 80 percent of the global growth in renewables-based electricity consumption between 2013 and 2023 (figure 3.10).

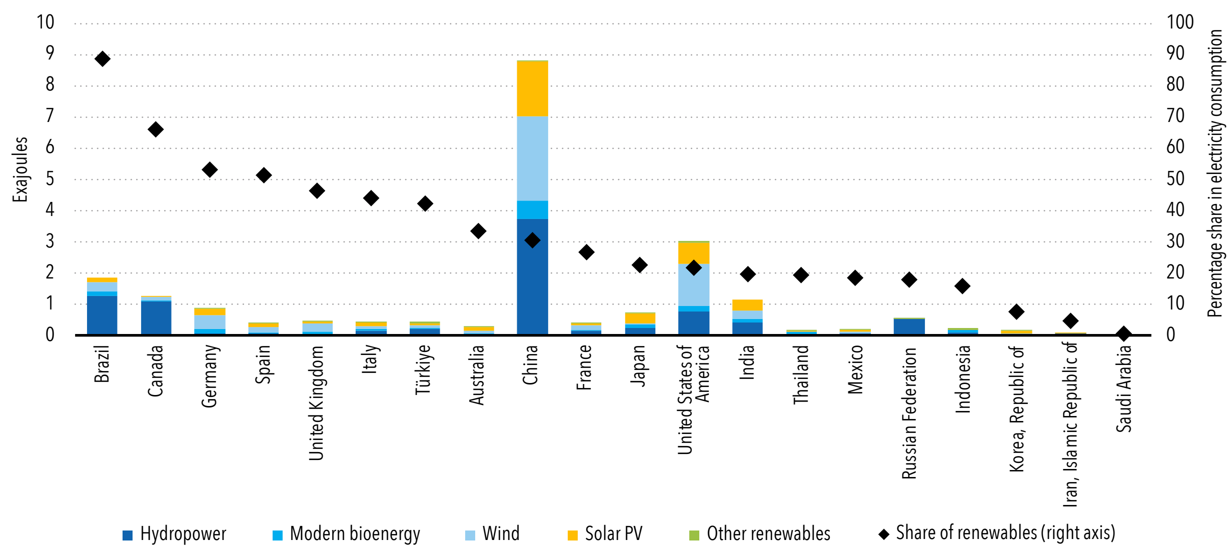
Figure 3.10 • Renewables-based electricity consumption and renewables' share in electricity by region, 2013 and 2023



Source: International Energy Agency and United Nations Statistics Division.

Trends in the share of renewables in electricity consumption vary among the top 20 energy-consuming countries, from about 1 percent to nearly 90 percent. Brazil and Canada lead because of their hydropower consumption (figure 3.11). Wind and solar PV, i.e. non-dispatchable renewables, together are the largest sources of renewables-based electricity in 13 of the top 20 countries, and they supply almost 60 percent of the total renewable electricity consumption in these countries. Between 2022 and 2023, China contributed more than half of the global annual increase in renewables-based electricity consumption, with almost the entire growth stemming from wind and solar PV.

Figure 3.11 • Renewables-based electricity consumption in the top 20 final energy-consuming countries, by source and country, 2023

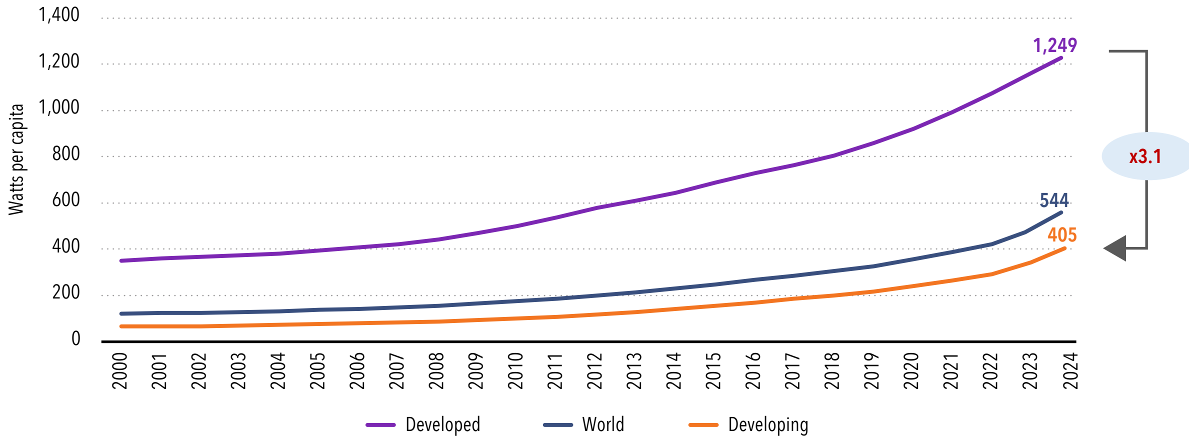


Source: International Energy Agency and United Nations Statistics Division.

Installed renewable energy generating capacity per capita

SDG 7 aims to "expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least-developed countries (LDCs), small island developing states (SIDS), and land-locked developing countries (LLDCs)," with progress measured through indicator 7.b.1. The indicator tracks changes in renewable energy–generating capacity per capita across both developing and developed regions.

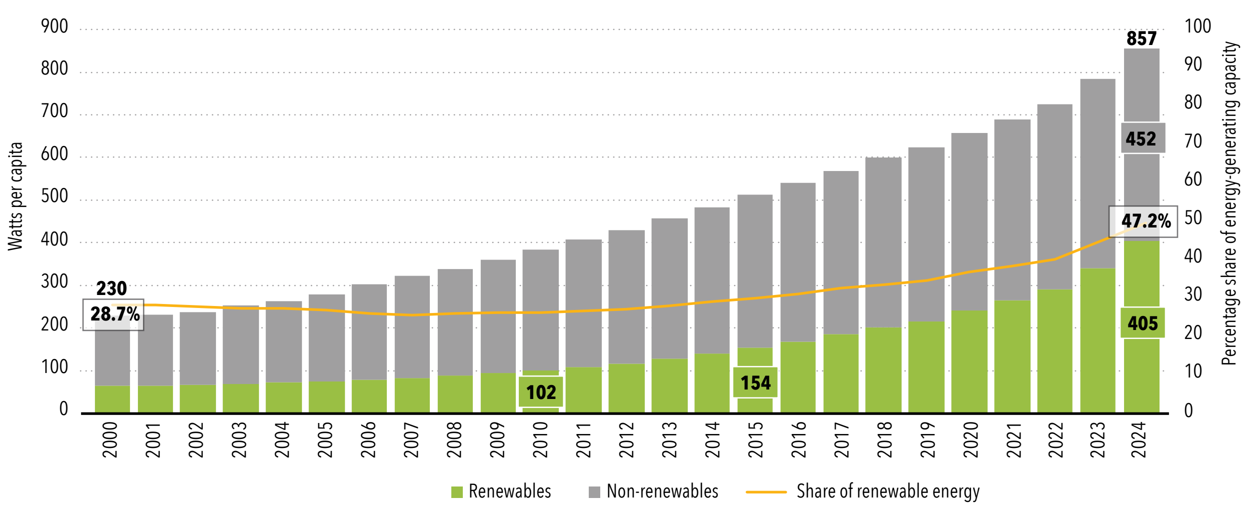
Figure 3.12 • Renewable energy-generating capacity in developing and developed countries, and in the world, 2000–24



Source: International Renewable Energy Agency.

In 2024, developing countries had 405 installed renewable watts per person, a figure close to the global average of 544 installed renewable watts per person, as shown in figure 3.12. But the average person in a developing country would be limited to about a third of installed renewable energy generating capacity, down from 405 to 140 watts per capita, if Brazil, China, and India are excluded from this category, highlighting the variation in renewable energy capacity across developing countries. On the other hand, developed countries reached 1,249 installed renewable watts per person, underscoring substantial disparities in how renewable electricity meets population needs. Although the gap in renewable energy–generating capacity between developing and developed countries has gradually narrowed from 4.4 times in 2015 to just over threefold now, targeted support and investment remain key.

Figure 3.13 • Installed renewable energy-generating capacity in developing countries by technology type and share, 2000–24

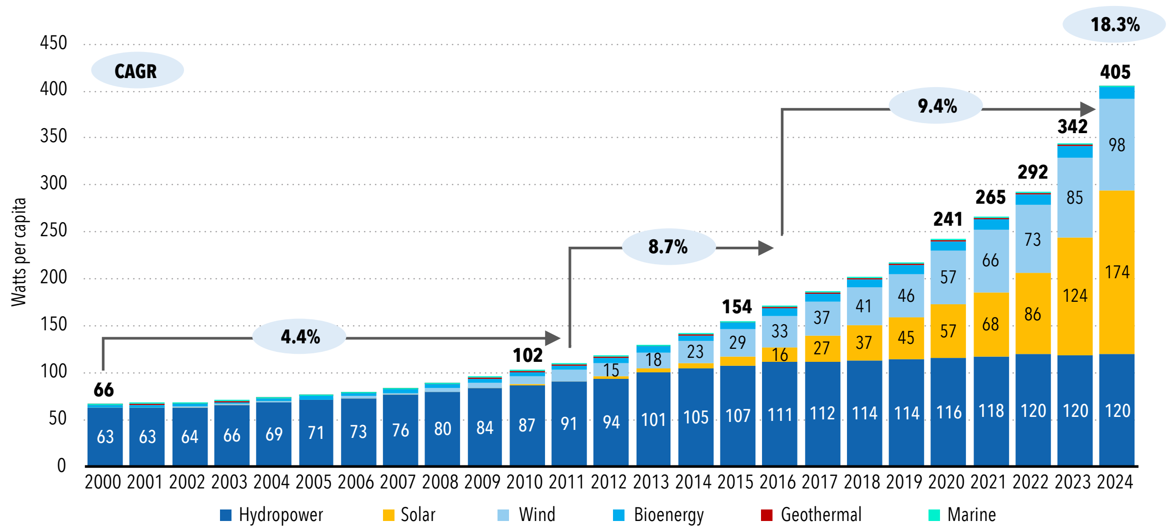


Source: International Renewable Energy Agency.

The latest data shows a sustained rise in the share of installed renewable energy–generating capacity in developing countries. Since the adoption of SDG 7 in 2015, installed renewable capacity per capita in developing countries rose from 29.9 percent to 47.2 percent in 2024 (figure 3.13).

Moreover, renewables now make up a larger share of total installed capacity in low-income countries than in any other income group, accounting for 54.4 percent of capacity per capita. However, this high proportional share reflects a lower overall capacity base: low-income countries continue to have limited renewable energy capacity per capita and weak annual population growth. This disparity is also evident in absolute terms: in 2024, people in developing countries averaged just 857 watts each, which remains well below the renewable-only capacity of 1,249 watts per person in developed countries.

Figure 3.14 • Renewable installed capacity per capita for developing countries (2000–24) and compound annual growth rate of selected years



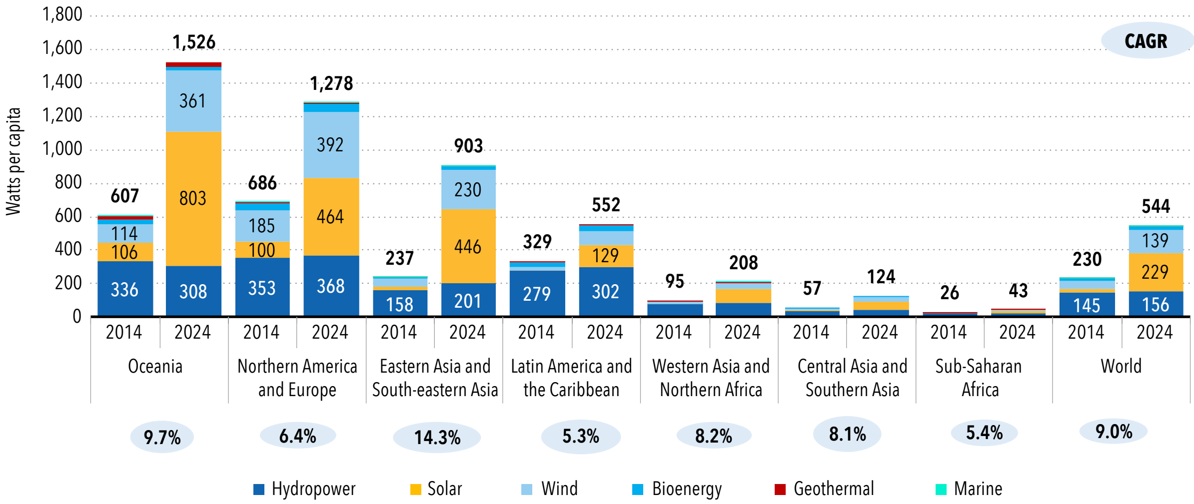
Source: International Renewable Energy Agency.

CAGR = compound annual growth rate.

Solar has driven the largest expansion in renewable energy technologies across developing countries (figure 3.14). The most pronounced acceleration occurred between 2010 and 2015, when solar capacity exhibited a CAGR of 101.1 percent. Although its growth decelerated in subsequent intervals, a trend that is to be expected as the installed base expands and incremental additions constitute a progressively smaller share of the total, it remained strong, with a CAGR of 43.2 percent between 2015 and 2020 and 32.4 percent from 2020 to 2024.

This trend is also reflected in recent year-on-year growth. In 2024, solar recorded the highest increase among all technologies in developing countries, expanding by 39.6 percent from 124 watts per person in 2023 to 174 watts per person. Wind power followed with a 14.8 percent increase (from 85 to 98 watts per person), while bioenergy and hydropower registered comparatively modest growth rates at 4.0 percent and 0.4 percent, respectively. In contrast, geothermal and marine technologies experienced slight declines over the same period. These developments also align with broader cost trends: over the past decade, the costs of most renewable energy technologies, especially solar and wind, have declined sharply, making renewables the most cost-competitive option for new electricity generation in 2024 (IRENA 2025a).

Figure 3.15 • Growth in renewable energy-generating capacity for selected years and installed capacity per capita by technology across regions, 2014 and 2024

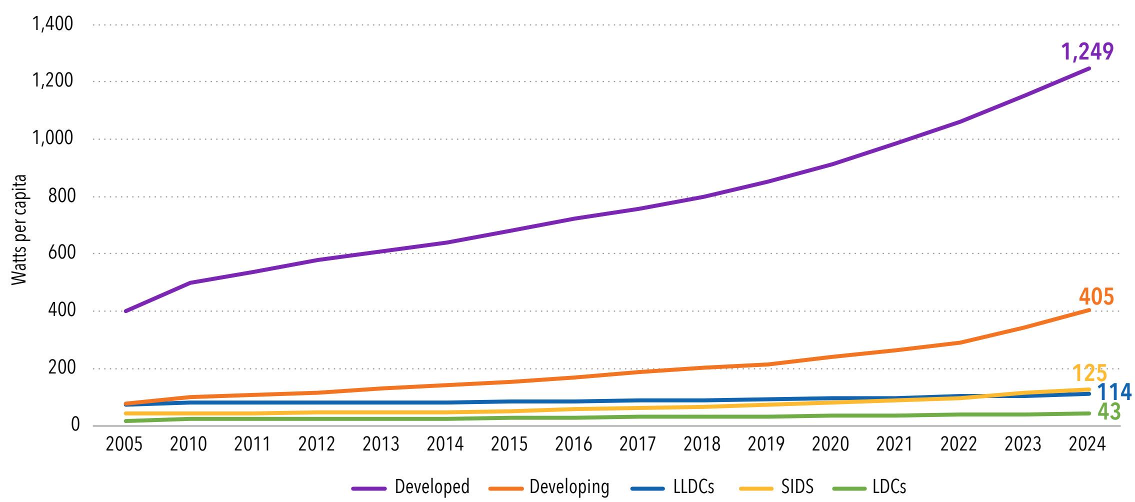


Source: International Renewable Energy Agency.

CAGR = compound annual growth rate.

Among the regions, Eastern Asia and Southeastern Asia led growth over the past decade. With its CAGR of 14.3 percent and a near fourfold increase (from 237 to 903 watts per person), the region has abundant wind and solar power (see figure 3.15). Two other regions—Western Asia and Northern Africa and Central Asia and Southern Asia—more than doubled their per capita renewables. Oceania likewise doubled its installed capacity, with its CAGR among the highest at 9.7 percent. The regional average is skewed, however, by Australia and New Zealand. Excluding these countries, the SIDS and territories in Oceania exhibit a markedly different trend, with a lower growth rate (4.4 percent) and much lower installed renewable energy capacity per capita at 94 watts in 2024. In contrast, Latin America and the Caribbean and Sub-Saharan Africa had the lowest growth rates (5.3 percent and 5.4 percent CAGR, respectively). Given the difficulty in achieving overall energy access in Sub-Saharan Africa, where population growth is outpacing energy demand, accelerated renewable deployment is critical, as discussed in chapter 1.

Figure 3.16 • Renewable energy-generating capacity per capita by country group, 2000–24



Source: International Renewable Energy Agency.

SIDS = small island developing state; LDC = least-developed country; LLDC = landlocked developing country.

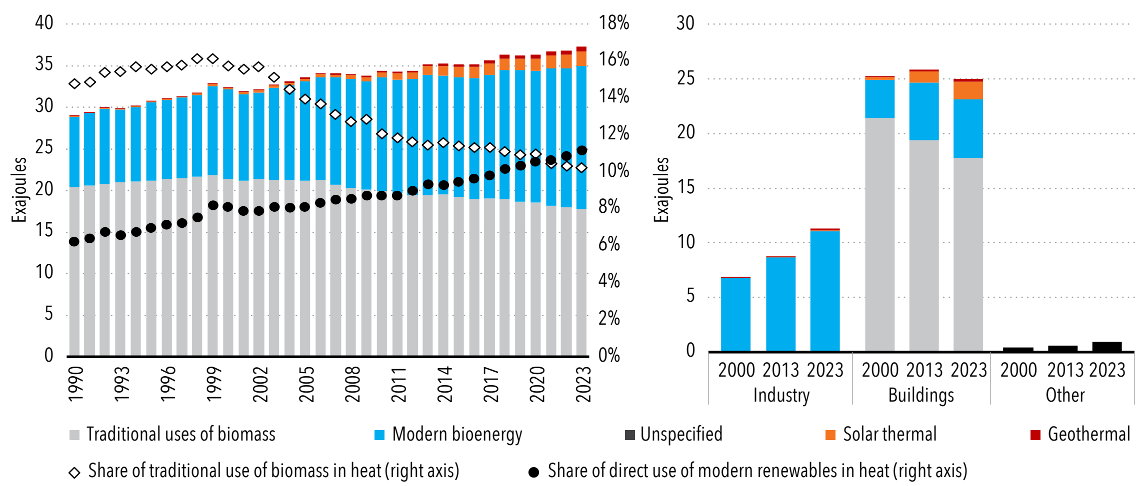
As target 7.b.1 underscores the need to upgrade and develop infrastructure in LDCs, SIDS, and LLDCs, figure 3.16 shows the progress of these groups relative to the wider group of developing countries. In this regard, the latest data shows that disparities persist between developed countries overall and different groups. In 2024, SIDS reached 125 watts per person, LLDCs 114 watts, and LDCs just 43 watts per person, compared with the average 1,249 watts across developed countries. This highlights a widening divide compared to the rest of the world.

Heat

Heat is the largest energy end use worldwide, accounting for almost half of global TFEC (174 EJ). Worldwide, the total energy consumption for heat in 2023 was roughly the same as that in 2022. The global heat sector relies heavily on fossil fuels, meeting more than three-quarters of the heat demand through coal, gas, and oil. Traditional uses of biomass for heat dipped 1 percent in 2023 year-on-year, accounting for over 10 percent (18 EJ) of the global energy consumption for heat. Excluding traditional uses of biomass, as well as ambient heat harnessed by heat pumps[22] (for which limited data are available), direct modern uses of renewables for heat increased 3.3 percent year-on-year to reach 19.5 EJ in 2023. This represented 11 percent of the total energy consumed for heat, only 1.9 pp higher than in 2013 (figure 3.17).

Despite its dominant share in TFEC, the heating sector has attracted scant policy attention and support. Recently, however, policies on developing renewable heat have gained currency (IEA 2025b); these include energy security considerations. But 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"). Strong improvements in energy efficiency, conservation, and material efficiency—particularly for energy-intensive materials such as cement and steel, produced in hard-to-decarbonize sectors—must be combined with rapid deployment of renewable heat technologies and electrification to transition away from fossil fuels, and inefficient and unsustainable uses of biomass.

Figure 3.17 • Renewable heat consumption by source and sector, 1990–2023



Source: International Energy Agency and United Nations Statistics Division.

Note: Indirect consumption of renewable heat through renewables-based electricity is not represented in this figure.

22 The proliferation of heat pumps over the past decade has made ambient heat an important energy source, although its prevalence globally is difficult to estimate because data are unavailable for some markets. Due to the lack of data, the report does not account for ambient heat, 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.

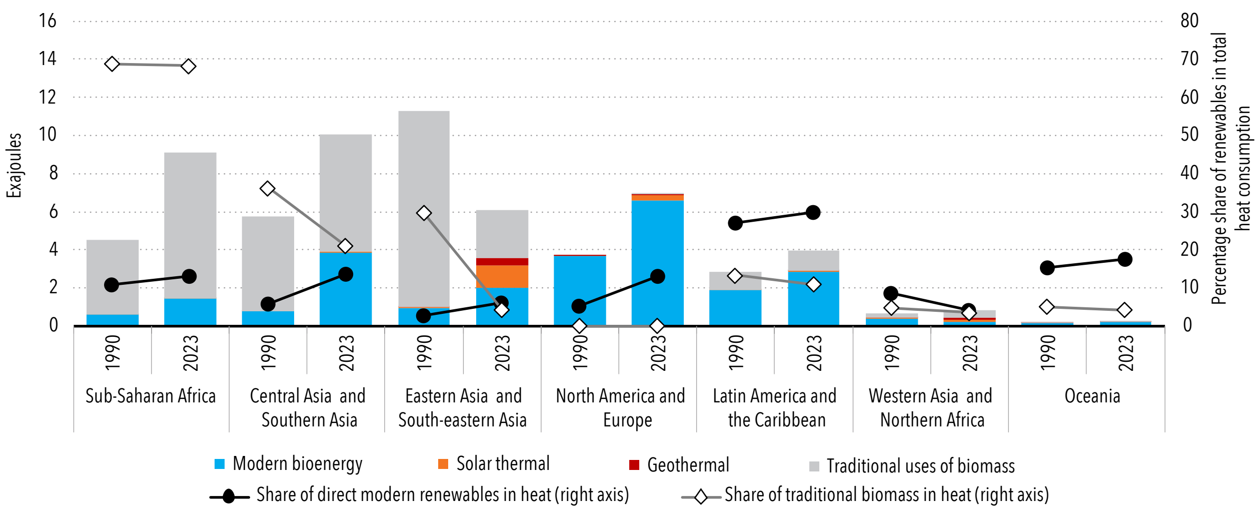
Modern bioenergy accounts for about 88 percent (17.2 EJ) of direct[23] modern use of renewables for heat globally. It accounts for about one-tenth (IEA 2025b) of the energy consumed for industrial heat and one-twentieth of the energy consumed for heat in the buildings sector (IEA 2025b). Industry accounts for around two-thirds of modern uses of bioenergy, mostly in subsectors producing biomass residues on site, such as wood, pulp, and paper industries, as well as the sugar and ethanol industries. In 2023, industrial consumption of modern uses of bioenergy for heat grew by 5 percent year-on-year—mostly due to mounting use in Brazil and India —but fell 1.5 percent in the buildings sector.

Global **solar thermal** heat consumption rose 4 percent between 2022 and 2023; it accounted for 9 percent (1.7 EJ) of modern uses of renewables for heat yet met less than 1 percent of total final heat demand. New solar thermal installations in 2023 fell 7 percent owing to the real estate market in China, where construction slowdowns affected demand. Year-on-year growth occurred, however, in the United Kingdom (+66 percent), India (+27 percent), Greece (+10 percent), Mexico (+5 percent), and Brazil (+3 percent).

Driven almost exclusively by Türkiye and China, global **geothermal** heat consumption grew 14 percent in 2023. This represents around 3 percent (0.6 EJ) of modern uses of renewables for heat. Most of the applications occur in the buildings sector, with bathing, swimming, and space heating (primarily via district heating) the most prevalent end uses. China accounts for 60 percent of the global geothermal heat consumption, followed by Türkiye, which accounts for a fifth.

Traditional uses of biomass predominate in Sub-Saharan Africa and Asia (figure 3.18), with—in descending order—India, China, Ethiopia, Pakistan, the Democratic Republic of the Congo, Nigeria, the United Republic of Tanzania, Myanmar, and Kenya together accounting for two-thirds of global consumption. Despite a slight downward trend since 2006, traditional uses of biomass in 2023 were only around 13 percent lower than they were in 1990 at a global scale. Trends differed across regions and countries in 2013–23, with stark drop-offs in Eastern Asia and South-eastern Asia, especially in China, Indonesia, and Viet Nam. These were partly compensated by population-driven surges in Sub-Saharan Africa (especially in Nigeria, Ethiopia, and the Democratic Republic of Congo).

Figure 3.18 • Renewable heat consumption by region, 1990 and 2023



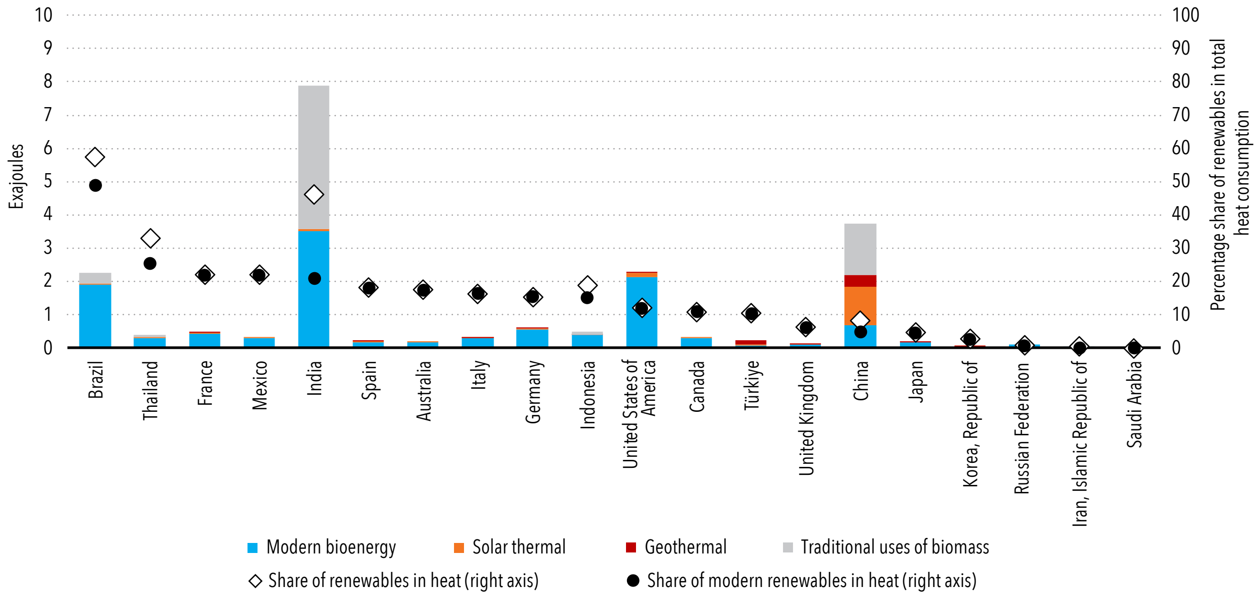
Source: International Energy Agency and United Nations Statistics Division.

Note: The statistical framework adopted for this figure does not account for the use of renewables-based electricity for heating. "Traditional uses of biomass" refers to the residential consumption of primary solid biofuels and charcoal in countries outside the OECD. Although biomass is used with low efficiency in OECD countries as well, such use is reported under "modern bioenergy."

23 For the purposes of this report, the heating subsector encompasses all energy not used as electricity or for transport, even those energy uses that are not for heating purposes (for example, diesel oil in a water pump). If heat is treated strictly as an end use, renewables also contribute to heat supply indirectly through renewables-based electricity used for heating and district heat networks. If we account for these indirect uses, and exclude ambient heat harnessed by air source heat pumps, then renewables-based electricity makes the second-largest contribution to modern end use of renewables-based heat after bioenergy, and the fastest-growing one.

China and India together represented over 70 percent of the global increase in modern use of renewable energy for heat from 2013 to 2023. In 2023, along with the United States and Brazil, they represented half of global heat demand and half of modern use of renewable heat (figure 3.19). Brazil, India, and United States were hefty consumers of bioenergy intended for process heat for industry. Residential heating in the United States is an additional major use of bioenergy, along with China's deployment of solar thermal water heaters and geothermal heat. Europe accounts for over 20 percent of the global modern use of renewable heat owing to its use of residential wood and pellet stoves and boilers (for example, in France, Germany, and Italy) and of biomass in district heating (for example, Nordic and Baltic countries, Germany, France, and Austria). Although not detailed in this report, renewable heat consumption was indirectly driven by the growing consumption of renewables-based electricity through electric heaters and heat pumps (accounted for in the electricity sector), as well as the use of heat pumps to harness ambient heat (not quantified in this report) in China, the United States, and the European Union (IEA 2025b).

Figure 3.19 • Renewable heat consumption and the share of renewables in total heat consumption, by country, for the top 20 energy-consuming countries, 2023



Source: International Energy Agency and United Nations Statistics Division.

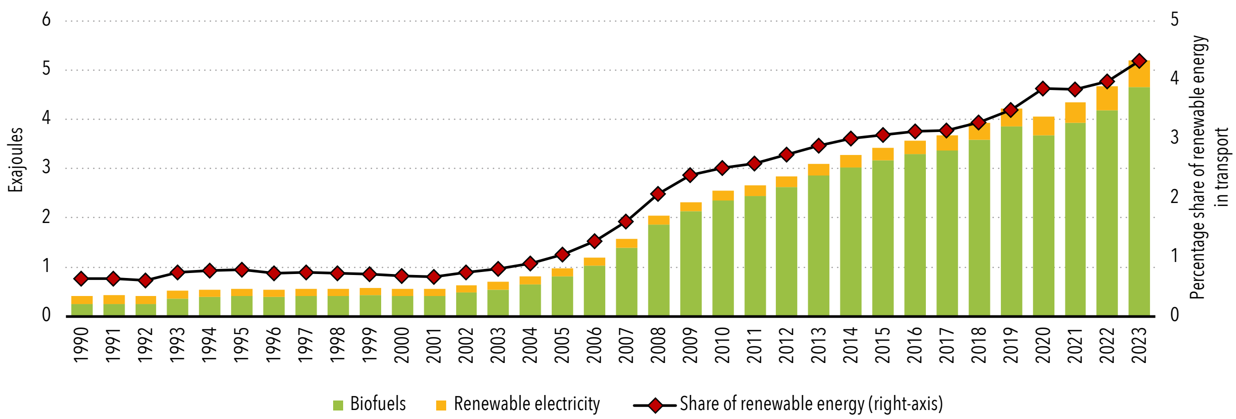
Note: "Traditional uses of biomass" refers to the residential consumption of primary solid biofuels and charcoal in countries outside the OECD. Although biomass is used with low efficiency in OECD countries as well, such use is reported under "modern bioenergy." Indirect consumption of renewable energy through electricity for heat is not included in this figure.

Transport

The share of renewable energy in transport TFEC rose to 4.3 percent in 2023, up from 2.9 percent in 2013. Global TFEC for transport rose almost 3 percent (+3.2 EJ) between 2022 and 2023. Biofuels continued to dominate, mainly as crop-based ethanol and biodiesel blended with fossil fuels, representing nearly 90 percent of the renewable energy consumed for transport. These biofuels grew by 11 percent year-on-year in 2023 (+0.5 EJ), and their overall share in transport TFEC rose to 3.9 percent in 2023, up from 3.6 percent in 2022. In 2023 biodiesel consumption grew 21 percent year-on-year, while bio gasoline climbed 3 percent.

The use of renewables-based electricity in vehicles and trains grew 13 percent from 2022, partly because of an expanding fleet of EVs. The number of EVs on the road rose from 10.2 million in 2020 to more than 40 million in 2023 (IEA 2024). The electricity powering these vehicles comes increasingly from renewable sources, with renewables' share of total electricity used in transport climbing from 22 percent in 2013 to 30 percent in 2023 (figure 3.20).

Figure 3.20 • Global share of renewable fuels in transport and totals for renewables-based electricity and biofuels, 1990–2023

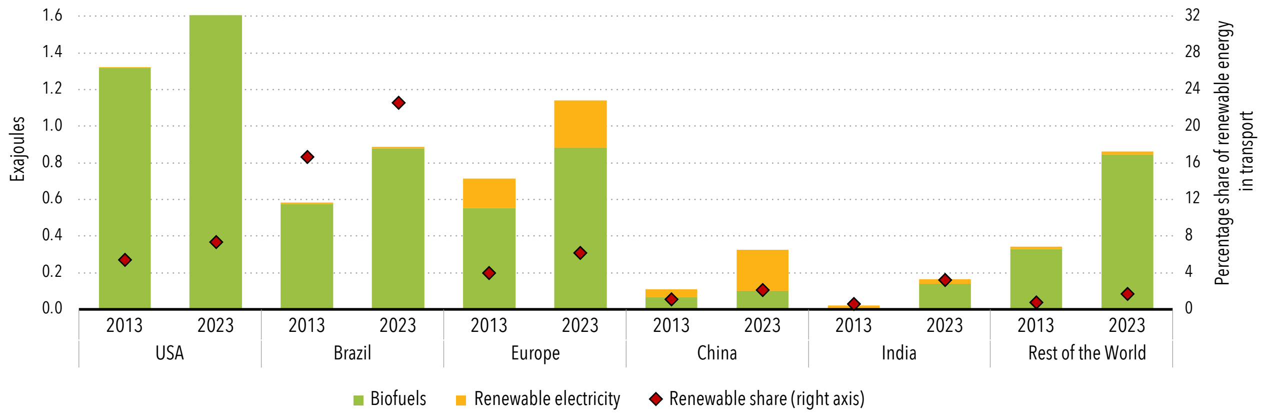


Source: International Energy Agency and United Nations Statistics Division.

From 2013 to 2023, renewable energy in transport almost doubled, but its share of TFEC climbed only 1.4 pp, growth arising mainly through country-level policies that expanded biofuels. Through the electrification of transport and generation of renewable energy, renewable electricity has played a smaller, but growing, role. Despite success at the country level, supportive policies have barely outpaced growing fossil fuel demand, seeing a modest overall increase in share.

While the United States, Brazil, and Europe account for nearly three-quarters of the renewable energy used in transport, other countries and regions are also increasing their shares (figure 3.21). In the United States and Brazil, biofuels (mainly ethanol and biodiesel) represent 99 percent of the renewable energy used in transport. In India, biofuel support policies increased renewable energy use in transport ninefold between 2013 and 2023. In Europe, renewables-based electricity represents almost one-quarter of the renewable energy used in transport. China's use of renewable energy in transport nearly tripled between 2013 and 2023, and renewable electricity consumption for transport grew more than fivefold. By 2023, renewable electricity represented 70 percent of all renewable energy China used in transport owing to rising shares of renewables in power generation and efforts to electrify transportation. Biofuels, however, received limited policy support. In 2023, EV registrations in China surpassed 8 million (IEA 2024); together, China and Europe accounted for more than 80 percent of global sales in 2023.

Figure 3.21 • Renewable energy share and total renewable energy in transport across selected countries and regions, 2013 and 2023

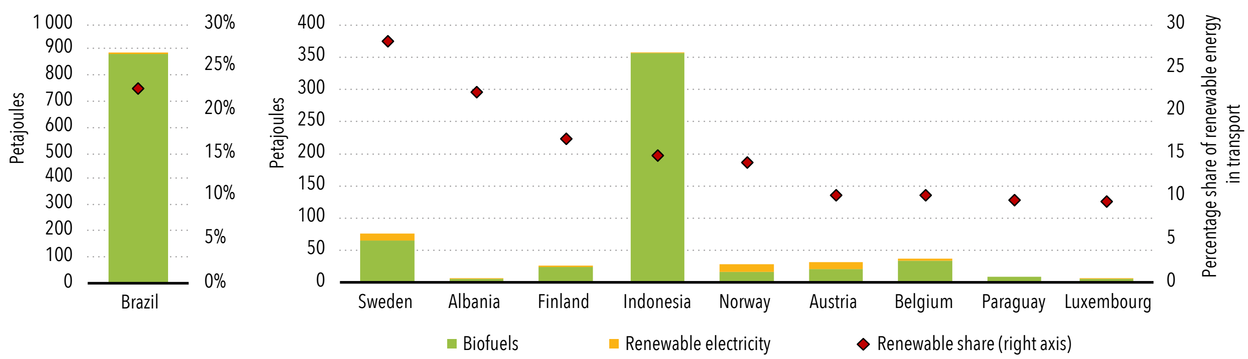


Source: International Energy Agency and United Nations Statistics Division.

Raising the share of renewables in transport will depend on policies that boost biofuels while ensuring that feedstock meets stringent sustainability criteria without affecting food supply. Transport electrification and the generation of renewable electricity should promote active mobility, support transit efficiency (by design), and phase out fossil fuels for transport. Such policies must be strengthened where they exist and introduced where they do not.

In 2023, the share of renewables in transport TFEC was the highest in Brazil, Indonesia, Sweden, Belgium, Finland, and Albania (figure 3.22).

Figure 3.22 • Top 10 countries by share of renewable energy in transport, 2023



Source: International Energy Agency and United Nations Statistics Division.

Policy insights

As the latest data presented in this chapter shows, renewables account for 18.0 percent of the world's TFEC, with progress whipsawing across sectors. While renewable energy accounted for over 21 percent and 30 percent in the heating and electricity sectors, respectively, its share in TFEC in the transport sector stood at 4.3 percent in 2023.

The slow transition of the transport sector arises from limited long-term goals and uncertain policy. Consumers worry about battery range and meagre charging stations. High upfront costs for new technologies also act as a barrier, along with scarce financing opportunities in developing markets and limited technological maturity of low-carbon shipping and aviation fuels. Addressing these constraints requires implementing targeted and coordinated policy instruments to boost the uptake of renewables-based technologies and infrastructure in the transport sector. Accordingly, this year's policy insights will highlight technological solutions and strategic interventions to advance the sector's sustainability, in accordance with commitments under the UN 2030 Agenda for Sustainable Development and the Paris Agreement, as well as broader energy security concerns. Key policy considerations include the following:

Establish long-term ambitious strategies and transition roadmaps for a sustainable and resilient transport sector and tailor strategies to national context and transport mode

Feasible pathways for reducing emissions in transport will vary by country and sector. Within road transport, renewables-based electrification is expected to be the central pillar of the transition, driven by advancements in battery technologies and declining costs of EVs (IRENA 2025b). Liquid biofuels play a complementary role in this transition and are expected to support emissions reductions across the transport sector. Their role is going to be particularly salient in hard-to-abate subsectors, including aviation and maritime transport, where energy density requirements and operational constraints limit the viability of electrification in the foreseeable future.

The growing urgency for long-term renewable energy strategies in the transport sectors is underscored by recent geopolitical developments, which highlight the value of strategic planning and sustained implementation in the transport sector. Countries that have pursued multi-decade transition pathways that include greater deployment of EVs and liquid biofuels are comparatively better positioned to withstand disruptions in global oil supply observed in 2026 as they reduce dependence on volatile fossil fuel systems (Cheng 2026; IEA 2025c). Similarly, tailored strategies and deployment roadmaps for sustainable aviation fuels can facilitate their scale-up, supporting decarbonization and fuel diversification within the aviation subsector (IEA 2025c; IRENA 2024).

Ambitious targets and mandates for EVs and renewable fuels for shipping and aviation remain important policy tools in accelerating market adoption. Clear, consistent, and time-bound targets send strong market signals and shape investment and consumer decisions (IEA 2025c; IRENA 2025b). Ambitions differ across countries and subsectors depending on local contexts and capacities. For example, greater ambitions around EV adoption are particularly attainable for cars, two- and three-wheelers, and urban buses, given affordable, advanced, and widely available technologies. For markets still in the early stage of EV deployment, financial and fiscal incentives remain a key policy tool to incentivize market deployment. For LDC markets, the transport sector transition is closely linked with second-hand vehicle importation and international collaboration (IRENA 2025b). Constraints related to critical minerals, supply chains, and EV-charging infrastructure are all likely to influence the pace and extent of electrification, especially in the near term. Similarly, the availability of biomass feedstocks to produce liquid biofuels, sustainability considerations, and the cost of importing liquid biofuels, will determine the role of biofuels within national transport decarbonization strategies.

Across sectors, sector-specific measures tailored to each transport mode are critical. But these need to be combined with cross-cutting instruments like fuel standards, carbon pricing, and energy-efficiency measures and renewable energy targets. Financial and fiscal measures are also vital: exempted or reduced vehicle purchase tax, value-added taxes on EVs, charging infrastructure, and charging electricity (IRENA 2021, 2025b). In addition, policies in support of modal shifting—both in freight transport and in urban mobility systems—will be important in lowering overall energy demand and associated emissions.

Align transport electrification with power planning, infrastructure, and markets, including leveraging flexible charging for renewables integration

Despite the momentum around EVs, limited charging availability remains one of the most significant barriers to greater deployment. Countries must further incentivize the deployment of charging infrastructure through targets, integrated planning, building mandates, and fiscal and financial incentives. Policy support to expanding convenient home and public charging infrastructure, supported by pre-cabled buildings, integrated grid planning, and policies that streamline installation and ensure sufficient charger coverage, can further facilitate transport electrification in the coming years (IRENA 2025b).

Smart charging can minimize EV impact on grid peak demand and unlock system flexibility to accommodate higher shares of solar and wind generation. But substantial investment needs and coordination challenges are daunting. Electricity/grid utilities, EV service providers, and insufficient incentives around tariff, and market and business models demand flexibility. To address these challenges, a comprehensive national framework aligned with broader energy and transport strategies is needed to support investment, facilitate stakeholder coordination, and realize system-wide benefits (IRENA 2025b).

Leverage urban transport policies to support the transport transition

Urban transport policies are key levers for the energy transition in the transport sector. These encompass measures such as integrated urban planning, infrastructure development, air quality standards, and vehicle fuel-efficiency mandates. Well-designed city-level low- and zero-emission zones can accelerate this shift by discouraging the purchase of fossil fuel vehicles and encouraging active mobility and the use of public transport, including buses, trams, light rail, and subways. Depending on the context, municipalities can also advance zero-emission mobility through the public procurement of electric or low emission fueled buses and trains for transit operators and municipal fleets as well as tolls, congestion pricing, or vehicle quotas (IRENA 2025b). Such instruments can shift modal demand toward more sustainable transport options while generating dedicated revenue streams to finance the deployment of electric buses and the expansion of tram networks.

Targeted solutions and policy support are required for sustainable fuels in transport sub-sectors considered hard to electrify, including maritime transport and aviation

Sustainable liquid and gaseous fuels (including sustainable biofuels, biogases, low-emission hydrogen, ammonia and derived e-fuels) offer especially viable transition pathways for the aviation and maritime sector (IEA 2025c; IRENA 2021). Supply is limited, however, and for the foreseeable future they will be costlier than their fossil fuel counterparts. For instance, sustainable aviation fuels account for less than 0.1 percent of all aviation fuels consumed today (IEA 2025d). Further policy and regulatory support will be needed to accelerate deployment both at the international and domestic levels. This includes using mandates and targets to create demand and market signals for investors; using regulatory measures such as carbon taxes, fuels standards, or other performance-based measures to boost the cost-competitiveness of sustainable fuels and incentivize their uptake by end-users; developing standardized and transparent carbon accounting and sustainability criteria to ensure interoperability of fuels for decision makers and trade; developing supply chains and infrastructure to support scale-up and distribution of fuels, and supporting innovation for emerging technologies research, development, and scale up assistance for emerging fuels. Investments will also be needed in developing new vessels and planes and retrofitting existing vessels to enable infrastructure and the production of sustainable fuels (IRENA 2021).

Embed socioeconomic and environmental considerations in support policies to EV and sustainable fuels to manage trade-offs and maximize co-benefits

The transport energy transition has the potential to support economic development and job creation. This includes jobs from manufacturing EVs and producing sustainable liquid and gaseous fuels to opportunities across value chains and supply infrastructure. These are especially important in rural and underserved communities where resources, such as biomass and critical minerals, may need to be sourced for manufacturing EVs or sustainable fuels. They can also provide new opportunities to support labor market transitions. Examples from Southeast Asia and Africa show how countries are already taking advantage of these opportunities (IRENA 2025b; IEA 2025e). Transport policy also needs to consider the distinct needs of groups that may be potentially disadvantaged by the transport transition, including women, lower income earners, or old people, and ensure opportunities are equitably extended to them (UN 2021). Although EVs typically have lower operating and fuel costs over their lifetime, their higher upfront purchase price remains a major barrier, particularly for lower-income households. Targeted fiscal, financial, and business models can improve affordability, accelerate adoption, and strengthen the social and political acceptability of the transport energy transition and support just energy transition efforts (IRENA 2025b, 2026a).

Policy design should systematically integrate approaches to prevent and mitigate potential adverse environmental impacts across the full lifecycle of technologies and fuels. For example, in the case of EVs, policy makers should adopt circular economy frameworks to ensure the sustainable collection and treatment of degraded EV batteries, thereby preventing environmental impacts linked to mining virgin materials, reducing resource extraction pressures and waste risks (IRENA 2025b). Similarly, sustainable fuels should be subject to carbon accounting and sustainability criteria that consider appropriate land, biodiversity, and socioeconomic issues (IEA 2025c; IRENA 2022). Frameworks that account for the broader circular (bio)economy will reduce redundancies, maximize resources, and leverage existing value chains. Internationally recognized tools such as the Global Bioenergy Partnership indicators for bioenergy sustainability can support governments in assessing biomass availability, landuse impacts, food security implications and lifecycle emissions, while ensuring coherence with broader bioenergy uses in heat and clean cooking within agrifood systems.

Strengthen international cooperation to support adequate and sustainable transport sector development in developing countries that leaves no one behind

Ensuring that populations in emerging and developing markets, especially least-developed markets, can equitably access the socioeconomic benefits associated with sustainable transport development necessitates robust international cooperation. Such cooperation should encompass targeted technical assistance, capacity-building initiatives, and concessional financial mechanisms that seek to foster localized EV value chains and the circular economy, where economically and institutionally feasible. Moreover, national policy frameworks, and international cooperation efforts in their support, must also prioritize the provision of a diverse range of affordable EV and sustainable fuel options tailored to local market conditions. This is critical to mitigating structural dependencies on imported second-hand vehicles, which may otherwise entrench technological obsolescence, limit environmental gains, and constrain the long-term sustainability of domestic transport systems (IRENA 2025b).

International ambition and partnerships can support action across relevant sectors. For example, the net-zero ambitions set by both the International Maritime Organization and the International Civil Aviation Organization signal global intent for a more sustainable transport sector. Translating these ambitions into effective outcomes will, however, require stronger implementation frameworks, including clearer interim targets and more robust regulatory measures to drive emissions reductions across both sectors. The recent adoption of the Belém 4x pledge is expected to add momentum to sustainable fuel uptake in the transport sector and beyond. The pledge was endorsed by 23 countries at COP30 and aims to quadruple sustainable fuel production and use by 2035 (COP30 2025).

Beyond the policy measures to enhance renewable energy penetration in the transport sector outlined above, concerted efforts are required to accelerate the deployment of renewable energy technologies to boost their share in the energy mix.

The pledge to triple global renewable energy capacity remains a priority (IRENA and others 2025; IEA 2025f). As discussed in previous editions of the report, enabling frameworks include target setting, long-term planning, and calibrating market structures and infrastructure to the renewables era. Also key: harnessing digitalization and adequate financing mechanisms (IEA and others 2024, 2025). The latest data presented in this chapter also underscore the persistent gap in installed renewable capacity between developed and developing countries; tailored support is required for LDCs and SIDS (UN 2025).

Against the backdrop of "the greatest threat to global energy security in history" (IEA 2026b), countries are likely to turn to faster renewable energy deployment to bolster energy security. According to the latest assessment, the impacts of the conflict in the Middle East are substantial, global, and highly asymmetric. They disproportionately affect energy importers, in particular low-income countries (IEA, IMF, and World Bank 2026). Priorities, measures, and the specific contribution that renewable deployment can make depend on country context, but a suite of measures can help, ranging from short-term relief through distributed renewables in weak-grid remote areas to long-term actions such as strengthening domestic supply chains (IRENA 2026b). Support for alternative power sources in an increasingly unstable world is a key pillar of greater global resilience and peace. Furthermore, to respond to the energy crisis without deepening the climate crisis, mobilizing clean energy finance, particularly for developing countries, will ensure a faster, fairer and more secure energy transition (UN 2026).