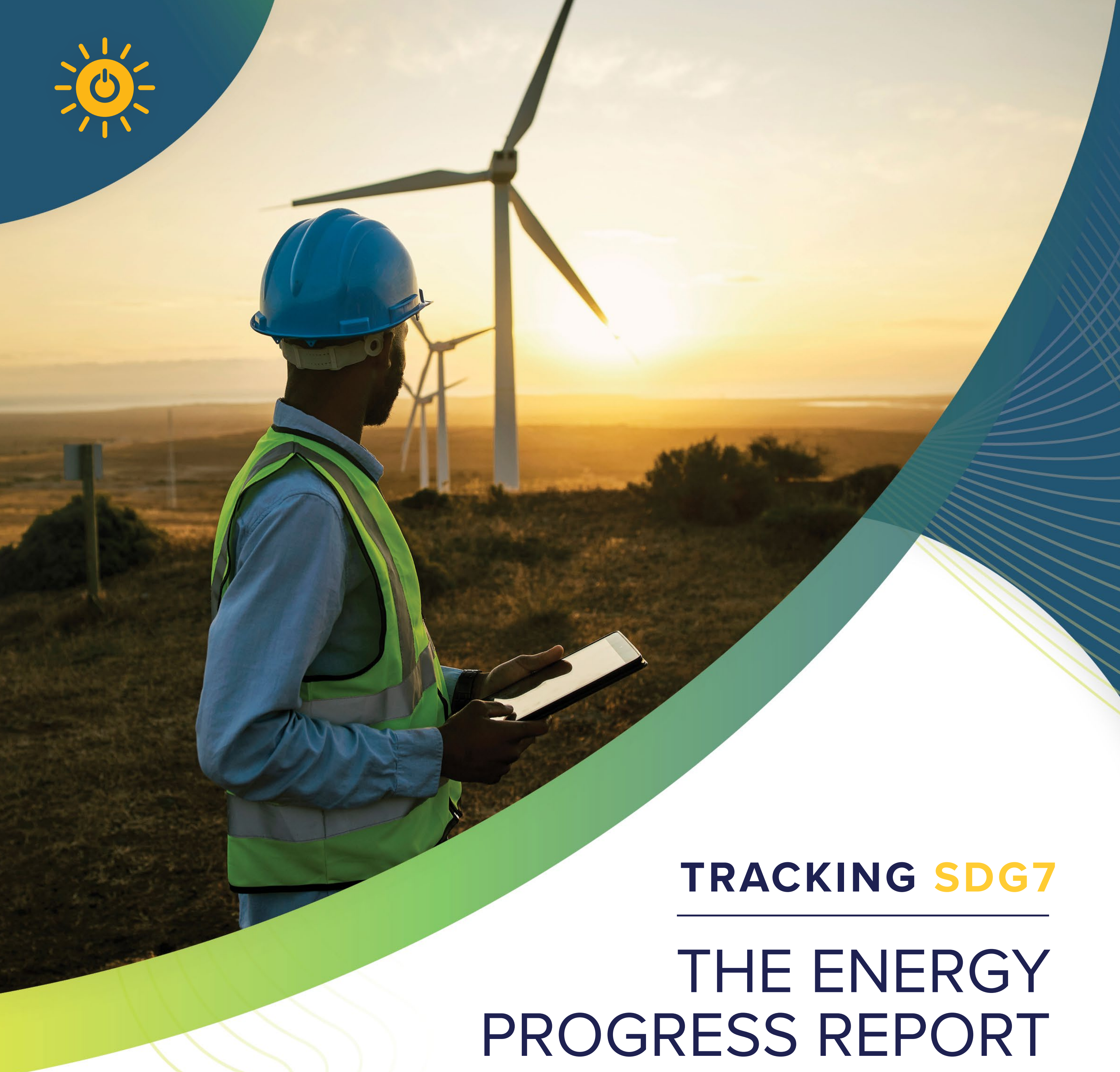

TRACKING SDG7

THE ENERGY PROGRESS REPORT 2026

A joint report of the custodian agencies

International Energy Agency | IRENA International Renewable Energy Agency | United Nations Department of Economic and Social Affairs | World Bank Group | World Health Organization

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Detailed datasets with country data for each SDG 7 indicator can be accessed at no charge at https://trackingsdg7.esmap.org/downloads. The chapters of this report may be downloaded individually from the same site.

Acronyms and abbreviations

ADB	Asian Development Bank
AfDB	African Development Bank
AMDA	Africa Minigrid Developers Association
CAGR	compound annual growth rate
CCA	Clean Cooking Alliance
CO_2	carbon dioxide
COP28	2023 United Nations Climate Change Conference
COP29	2024 United Nations Climate Change Conference
COP30	2025 United Nations Climate Change Conference
CRS	Creditor Reporting System
DAC	Development Assistance Committee (OECD)
DARES	Distributed Access through Renewable Energy Scale-up (Nigeria)
DRC	Democratic Republic of Congo
DRE	decentralized (or distributed) renewable energy
EBRD	European Bank for Reconstruction and Development
EEN	energy efficiency network
EEO	energy efficiency obligation
EJ	exajoule
EnMS	energy management system
EPC	energy performance certificate
ESMAP	Energy Sector Management Assistance Program
EJ	exajoule
EU	European Union
EV	electric vehicle
FCV	fragility, conflict, and violence
FDI	Foreign direct investment
FX	foreign exchange
G20	Group of 20 (governments)
GEC Model	Global Energy and Climate Model
GDP	gross domestic product
GHEM	Global Household Energy Model
GIS	Geographic information system
GOGLA	The global association for the off-grid solar energy industry
$GtCO_2$	gigatons of carbon dioxide
GW	gigawatt
IEA	International Energy Agency

IFC	International Finance Corporation
IMF	International Monetary Fund
IRENA	International Renewable Energy Agency
LDC	least-developed country
LLDC	landlocked developing country
LMIC	low- or middle-income country
LPG	liquefied petroleum gas
LSMS	Living Standards Measurement Study (World Bank)
MEPS	minimum energy performance standards
MJ	megajoule
Mt	tonne (metric ton)
MTF	Multi-Tier Framework
MWh	megawatt-hour
NDC	Nationally Determined Contribution (under UNFCCC)
NTL	Night-time light
ODA	Official Development Assistance
OLACDE	The Latin American and Caribbean Energy Organization
OECD	Organisation for Economic Co-operation and Development
PAHO	Pan American Health Organization
PAYG	pay-as-you-go
PES	Planned Energy Scenario
pp	percentage points
PPP	purchasing power parity
PV	photovoltaic
REmap tool	REnewable Energy roadmap tool
SDG	Sustainable Development Goal
SEforAll	Sustainable Energy for All
SIDS	small island developing state
TES	total energy supply
TFEC	total final energy consumption
TUoB	Traditional uses of biomass
TW	terawatt
UK	United Kingdom
UNDESA	United Nations Department of Economic and Social Affairs
UNFCCC	United Nations Framework Convention on Climate Change
UNSD	United Nations Statistics Division
US	United States
USD	United States dollar
W	watt
WHO	World Health Organization

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Partnership

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- International Energy Agency (IEA)
- International Renewable Energy Agency (IRENA)
- The Statistics Division (UNSD) of the United Nations Department of Economic and Social Affairs (UN DESA)
- World Bank
- World Health Organization (WHO)

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- United Nations Department of Economics and Social Affairs (UN DESA)
- United Nations Development Programme (UNDP)
- United Nations Economic Commission for Africa (UNECA)

- United Nations Economic Commission for Asia and the Pacific (ESCAP)
- United Nations Economic Commission for Latin America and the Caribbean (ECLAC)
- United Nations Economic Commission for Western Asia (ESCWA)
- United Nations Economic Programme for Europe (UNECE)
- United Nations Environment Programme (UNEP)
- United Nations Framework Convention on Climate Change (UNFCCC)
- United Nations Human Settlements Programme (UN-Habitat)
- United Nations Industrial Development Organization (UNIDO)
- World Health Organization (WHO)
- World Bank

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- The chapter on indicators and data was jointly prepared by the custodian agencies under the coordination of UNSD (Leonardo Souza and Jessica Ying Chan).

Data sources

The energy access chapters of the report draws on two meta databases of global household surveys—the Global Electrification Database managed by the World Bank and the Global Household Energy Database (and related estimates) managed by WHO (Heather Adair-Rohani, Wenlu Ye, Alina Cherkas). Energy balance statistics and indicators for renewable energy and energy efficiency were prepared by IEA (Roberta Quadrelli, Agnieszka Koscielniak, and Diego Ruiz Ponsoda) and UNSD (Leonardo Souza, Jessica Ying Chan, and Costanza Giovannelli). The renewable energy–generating capacity per capita indicator, compiled by IRENA (Iman Abdulkadir Ahmed, Nazik Elhassan, Dennis Akande, and Julian Prime), is based on the IRENA electricity capacity database and the United Nations Population Prospects. The indicator on international financial flows to developing countries was prepared by IRENA (Arya Bele and Nazik Elhassan) based on the IRENA Public Investments Database and the OECD/DAC Creditor Reporting System. Data on gross domestic product and value-added were drawn chiefly from the International Monetary Fund database. Population data are from the Population Division of UN DESA.

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The online platform (http://trackingSDG7.esmap.org) was developed by World Bank Group–IT. The report was edited by Steven B. Kennedy. It was designed and typeset by Duina Reyes.

EXECUTIVE SUMMARY

Photo: © Ashley Cooper / The Image Bank / Getty Images

Scaling up access to electricity and clean cooking, boosting the use of renewable energy and infrastructure development, improving energy efficiency and ensuring adequate finance—all are key pillars for the achievement of Sustainable Development Goal 7 (SDG 7) of the UN 2030 Agenda for Sustainable Development. Meeting the environmental and socioeconomic goals of the wider SDG agenda depends closely on SDG 7 and calls for a fundamental shift in energy production, distribution, and consumption, supported by enhanced ambition, long-term planning, greater investment, enabling policies, continued innovation and strong international cooperation. Over the past ten years, the world has made tremendous progress on SDG 7, but action must be accelerated to achieve our common goals. This is especially important in view of global crises that have the potential of slowing or reversing gains made in recent years.

Since its first edition in 2018, Tracking SDG 7: The Energy Progress Report has become the global reference for information on progress toward SDG 7, the aim of which is to "ensure access to affordable, reliable, sustainable, and modern energy for all." This report therefore summarizes global progress on electricity access, clean cooking, renewable energy, energy efficiency, and international financial flows in support of clean energy. It presents updated statistics for each of the indicators and provides policy insights on priority areas and actions needed to spur further progress on SDG 7.

The report is produced annually by the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), the United Nations Statistics Division (UNSD), the World Bank, and the World Health Organization (WHO)—the five custodian agencies responsible for tracking progress toward SDG 7. Figure ES.1 offers a snapshot of the primary indicators.

Despite substantial progress since 2015—including significant increases in the share of renewable energy in the global energy mix and improvements in the global rate of energy efficiency—the achievement of the 2030 target of universal access to affordable, reliable, and modern energy services remains off track and uneven, particularly with respect to the huge remaining energy access gap in Sub-Saharan Africa.

However, much headway can still be made on the road to SDG 7. Technologies are available, the costs of renewables and batteries have fallen dramatically, the policy architecture is expanding, and investment resources are available to be tapped. Accelerating progress will depend on closer collaboration among governments, the private sector, international organizations, and civil society. What is required now is urgency, coordination, and the political will to match commitments with resources, thus ensuring that the benefits of the energy transition reach every person, in every region, including the most vulnerable communities that the current trajectory risks leaving behind.

The global energy transition is unfolding against a backdrop of compounding crises that have repeatedly disrupted progress and whose full implications remain uncertain at the time of this publication. Successive shocks have underscored the fact that progress toward SDG 7 depends not only on ambitious policy, but also on geopolitical stability and the resilience of international cooperation. In this context, accelerating renewable energy deployment and improving energy efficiency in line with SDG 7 provide a critical opportunity for strengthening energy security by diversifying energy sources, reducing dependence on fossil fuel imports, and bolstering macroeconomic resilience. This approach gains importance and urgency as the economic consequences of high energy prices are depleting already constrained fiscal reserves in many countries, leaving developing economies, in particular, vulnerable to subsequent financial shocks.

Summaries of the status of progress toward each of the SDG 7 indicators, namely, (i) access to electricity; (ii) access to clean fuels and technologies for cooking; (iii) renewable energy as a share of energy consumption; (iv) energy efficiency; and (v) international financial flows in support of clean and renewable energy, are provided below.

Figure ES.1 • Primary indicators of global progress toward the SDG 7 targets

INDICATOR	2015	2024
7.1.1 Proportion of population with **access to electricity**	**958 million** people without access to electricity	**655 million** people without access to electricity (2024)
7.1.2 Proportion of population with primary reliance on **clean fuels and technology for cooking**	**2.7 billion** people without access to clean cooking	**2.0 billion** people without access to clean cooking (2024)
7.2.1 **Renewable energy** share in total final energy consumption	**15.6%** share of total final energy consumption from renewables	**18.0%** share of total final energy consumption from renewables (2023)
7.3.1 **Energy intensity** measured as a ratio of primary energy and GDP	**4.22 MJ/USD** primary energy intensity	**3.76 MJ/USD** primary energy intensity (2023)
7.a.1 **International financial flows** to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems	**14.3 USD billion** international financial flows to developing countries in support of clean energy	**24.6 USD billion** international financial flows to developing countries in support of clean energy (2024)
7.b.1 Installed **renewable energy-generating** capacity in developing and developed countries	**248 watts per capita** installed renewables capacity	**544 watts per capita** installed renewables capacity (2024)

SDG 7.1.1 • Access to electricity

Global trend. The global rate of access to electricity has stalled at 92 percent. In 2024, 655 million people were still without electricity. Investment in electricity access remains far below what is needed to achieve universal access by 2030. Achieving the 2030 target will require the pace of progress to more than triple to 1.35 percent per year.

Top 20 access-deficit countries. In 2024, the 20 countries with the largest electricity access deficits accounted for more than three-quarters of people lacking access, even more than in 2022. Eighteen of these countries are in Sub-Saharan Africa, and just three—Nigeria (87 million), the Democratic Republic of Congo (85 million), and Ethiopia (57 million)—account for about one-third of the global deficit. South Sudan (5 percent access), Chad (13 percent), and Malawi (16 percent) show the lowest national electrification rates.

Regional highlights. Central and Southern Asia's share of the global access deficit fell from 36 percent in 2010 to just 3 percent in 2024, reflecting rapid grid expansion, regional power market integration, and rising incomes. Other regions also showed steady improvement, except for Sub-Saharan Africa, which in 2024 was home to 563 million of the 655 million people without electricity.

Differences between urban and rural areas. Urban access rates rose globally from 96 to 98 percent between 2010 and 2024, while rural coverage climbed from 73 to 85 percent. Many of those connected in urban and rural areas alike still face poor-quality, unreliable, or unaffordable service. It is noteworthy that Sub-Saharan Africa stands out as the only region where the rural access deficit widened over the same period, increasing from 376 million to 447 million people.

Determinants of access in countries making good progress from a low baseline. Several factors characterize countries that are successfully addressing the electricity access challenge. Chief among those factors are least-cost electrification planning to alleviate supply-side problems (high costs, weak utilities, scarce finance), dedicated electrification funds, blended finance, and targeted subsidies. Strong geospatial planning, clear institutional mandates, and capable regulators improve efficiency and inclusion. Effective responses to demand-side problems include connection subsidies, pay-as-you-go financing, lifeline tariffs, and awareness campaigns.

Affordability as a binding constraint. The correlation between household income and electricity access is strong. Affordability is the primary barrier. Globally, only 22 percent of households without access earn enough to meet the monthly payment required for basic services. Constraints persist even where least-cost electrification approaches are applied. To succeed, least-cost planning must be complemented by explicit affordability measures, such as lifeline tariffs, cross-subsidies, and targeted social protection supported by regular affordability audits. Affordable electricity is the *sine qua non* of the productive uses of electricity discussed below.

Exploiting distributed renewable energy to boost access and productive uses of electricity. Distributed renewable energy allows governments to meet demand faster and at lower cost, thereby supporting human capital development through the electrification of health facilities, schools, and community infrastructure. It can be used simultaneously to accelerate economic growth by boosting productive uses of electricity. Stimulating productive uses is widely regarded as critical to enhancing the economic and fiscal effect of access initiatives but has yet to be tested at a sufficient scale. Women, in particular, have untapped potential, not only as consumers, but also as entrepreneurs. When coupled with financial incentives, technical assistance, and capacity building, companies can access more woman-headed households and businesses, widening women's participation in the workforce.

SDG 7.1.2 • Access to clean fuels and technologies for cooking and lighting

Global trend. In 2024, an estimated 75 percent of the global population relied primarily on clean cooking fuels and technologies. Although this figure represents notable progress since 2010, roughly a quarter of the world's population—around 2.0 billion people—remains dependent on polluting fuels and technologies. Projections of current trends suggest that 79 percent of the global population will have access by 2030, leaving 1.8 billion people mainly reliant on polluting forms of cooking. Slow progress in some parts of the world, combined with population growth, suggests that the campaign to narrow the global access deficit is slowing and may well falter in the long-term, in the absence of a course correction.

Regional highlights. The percentage of the population with access to clean cooking has almost doubled in most of Asia since 2010. However, the total population without access is growing in Oceania (excluding Australia and New Zealand), in Sub-Saharan Africa, and in Western Asia and Northern Africa. Some 970 million people lack access in Sub-Saharan Africa alone, and that figure may reach 1 billion by 2027. A few large countries account for the most marked decreases in the access deficit since 2010. India alone accounts for about 40 percent of the overall decrease; China for a further 30 percent; and Indonesia for about 10 percent.

Urban-rural divide. Access to clean cooking in rural areas—where an estimated 56 percent of the people covered by this report lived in 2024—lags well behind urban areas, where the access rate is 89 percent. Of the 2.0 billion people without access in 2024, 1.5 billion lived in rural areas. Yet the urban-rural divide is narrowing as rural access rises.

Use of electricity for cooking. Electricity remains a small part of the clean cooking energy mix. It is reported as the primary source of cooking energy primarily in urban areas and in the low- and middle-income countries of Northern America and Europe.

Clean cooking in public institutions. Schools, clinics, hospitals, prisons, and other public institutions still rely on polluting fuels. Yet, the problem suggests an opportunity moving to electricity, biogas, or LPG in such institutions is highly scalable because of the predictability of their energy needs. Electric cooking in schools can cut costs, reduce smoke exposure, and improve efficiency.

Clean cooking and displaced populations. According to the Global Platform for Action, almost 50 million forcibly displaced people may lack access to clean cooking. Yet they remain largely absent from national data gathering and planning. Closing this gap is essential to achieving universal access and ensuring that no one is left behind.

Policy insights. Accelerating access to clean fuels and technologies for cooking demands high-level political leadership paired with cross-ministerial coordination to align policies on energy, health, development, climate, agriculture, and food security. But broad success in ensuring access to clean cooking for those most in need will ultimately hinge on localized solutions—for example, those tailored to rural areas, public institutions, or to the countries with the highest deficits.

Lighting the way to household energy transitions. Progress in household lighting demonstrates what targeted action can achieve: the global population relying on kerosene, oil, gasoline, paraffin or diesel lamps, or solid fuel for lighting dropped from an estimated 1.2 billion people in 2000 to about 200 million in 2024. In other words, a billion fewer people are no longer exposed to the most polluting and hazardous lighting options.

SDG 7.2 • Renewables

Global trend. In 2023, renewables represented 18.0 percent of the world's total final energy consumption (TFEC). Over the past decade, renewables' share of TFEC has increased gradually, while the share of modern renewables grew more strongly, reflecting sustained deployment momentum. The power sector remains the main driver of renewables' use, while heat and transport are emerging as key areas for further acceleration.

Target for 2030. SDG Target 7.2 calls for a substantial increase in the share of renewable energy in the global energy mix by 2030. 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 significantly narrow this gap.

Electricity. Renewables-based electricity consumption grew almost 5 percent in 2023—and by nearly 79 percent from 2013. As of 2023, more than 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 between 2013 to 2023—are rapidly increasing renewables' share. However, hydropower remains the world's predominant source of renewables-based electricity, meeting almost 15 percent of global electricity demand.

Heat. In 2023, renewable sources accounted for more than 21 percent of the world's use of energy for heat. However, nearly half of renewables-based heat still comes from the traditional use of biomass (18 exajoules [EJ]), reflecting ongoing challenges in access to clean cooking. In particular, more than 90 percent of this use was concentrated in Sub-Saharan Africa and Asia. The share of modern renewable energy use in global heat consumption continued to increase, although gradually, reflecting the simultaneous increase in global demand for heat.

Transport. The share of renewable energy in transport TFEC rose to 4.3 percent in 2023, 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, renewables-based electricity use in transport more than doubled from 2013, driven by strong growth in electric vehicle sales and a rising share of renewables in electricity supply for road and rail transport.

Top 20 energy-consuming countries. The share of renewable energy in TFEC varies widely across countries. Among the top 20 energy-consuming countries, China accounted for more than a fifth of global modern uses of renewable energy. In terms of shares of modern renewables in the energy mix, Brazil and Canada continued to top the list in 2023 (47 percent and 24 percent, respectively). These shares are underpinned by their considerable use of hydropower for electricity, biomass for extracting heat (particularly in industry), and, in Brazil's case, biofuels for transport. In the decade ending in 2023, the United Kingdom, Germany, and Brazil achieved the strongest gains in the share of modern renewables.

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. Solar and wind energy remain the primary drivers of overall expansion.

SDG 7.3 • Energy efficiency

Global trend. Primary energy intensity, defined as the ratio of total energy supply to gross domestic product (GDP), is the main global indicator for energy efficiency. Global energy intensity was 3.76 megajoules per US dollar (MJ/USD) in 2023 (based on 2021 purchasing power parity, PPP, rates). The 2023 rate of progress in energy intensity fell to 1.5 percent from 2.4 percent in 2022. This slower progress in global energy intensity masks strong gains in some countries and regions—for example, the European Union, the United States, the Republic of Korea, Türkiye, and the United Kingdom—where strong policy action, increased investment, and changes in consumer behavior led to improvements well above the global average rate.

2030 target. Despite significant global policy activity, improvements in energy intensity continue to fall short of the SDGs, which aim to double the global rate of improvement in energy efficiency between 2010 and 2030 compared with the 1990–2010 baseline. Given that the targeted energy intensity improvement was not achieved in 2023, the required average annual improvement rate for 2024–2030 remains at approximately 4.2 percent per year to reach the SDG 7.3 target.

Regional highlights. In 2023, notable variations were observed in the energy intensity of major economies and may be attributed to differences in economic structure, efficiency levels, and climate. However, no major region achieved the 2.6 percent improvement rate set by SDG Target 7.3 between 2010 and 2023. Northern America and Europe came closest, at 2.3 percent, and Oceania followed at 2.2 percent. Eastern Asia and South-Eastern Asia remained at around 2 percent.

Trends in the 20 countries with the largest total energy supply. From 2010 to 2023, energy intensity dropped notably (relative to 1990–2010) in 15 of the 20 countries with the largest total energy supply. Despite this progress, only six countries succeeded in meeting the 2.6 percent annual reduction required to meet SDG Target 7.3. The United Kingdom recorded the best average annual improvement, with a reduction of 4 percent in energy intensity.

End-use trends. Although reductions in energy intensity across all end-use sectors accelerated in 2010–2023 compared with 2000–2010, the rate of progress fell in the industrial sector in 2023. Between 2010 and 2023, the energy intensity of the building sector steadily improved at an average annual rate of 1.4 percent. The average annual improvement rate for passenger vehicles rose from 0.7 to 1.6 percent, and for heavy-duty trucks from 0.4 to 0.5 percent.

Electricity generation trends. Between 2010 and 2023, the efficiency of fossil-fuel-based generation increased by around 4 percent. Over the same period, the overall efficiency of power generation rose by 11 percent, largely because of the growing share of renewable energy in the electricity mix. Over 2010–2023, average electricity generation efficiency increased to around 47 percent, compared with a more limited improvement from 40 to 42 percent in 1990–2010. Improvements in generation efficiency were linked to lower losses in the transmission and distribution of electricity.

SDG 7.a.1 • International public financial flows to developing countries in support of clean energy

Global trend. International public financial flows in support of clean energy in developing countries increased only slightly in 2024, reaching at least USD 24.6 billion, up from USD 24.4 billion in 2023. Of particular concern are the reduced flows to least developed countries (LDCs), which stood at USD 3.7 billion in 2024, an 11 percent decrease from 2023 levels. The modest overall growth in 2024 must be understood within a challenging broader financing environment, as total official development assistance (ODA) from members of the OECD's Development Assistance Committee fell by 6 percent in 2024, the first decline in five years. Development assistance is expected to continue to tighten in the coming years. Against the backdrop of the unfolding 2026 energy and economic crisis, international public finance for clean energy, particularly in the form of impact-based concessional loans and grants, will play a vital role in upholding the commitment to support energy development in developing countries and ensure they are able to benefit equitably from the global energy transition.

Technology highlights. Among renewable energy technologies, projects attributed solely to solar energy continue to attract the largest share of investment. However, their share has moderated from 43 percent in 2023 to about 30 percent in 2024, broadly in line with its average share over the past five years, representing commitments of roughly USD 7.4 billion.[1] Hydropower's share increased from about 13 percent to 17 percent over the same period, with flows rising to roughly USD 4.1 billion. Wind energy, by contrast, declined from around 13 percent of total commitments in 2023 to about 5 percent in 2024, equivalent to around USD 1.3 billion. Projects involving multiple renewables accounted for most of the growth in 2024, rising 50 percent compared with 2023 to reach USD 11.1 billion and accounting for 45 percent of total flows.

Concentration of commitments. International public financial flows are still primarily concentrated in a few countries, with India, Türkiye, and Argentina at the top. In 2024, 80 percent of commitments were distributed across 32 countries. Flows to LDCs decreased by 11 percent from the 2023 level to USD 3.7 billion, representing only about 15 percent of total flows in 2024. Landlocked developing countries (LLDCs) attracted more financing than LDCs in 2024, reaching USD 4.6 billion, a 16 percent rise from 2023. Meanwhile, flows to small island developing states (SIDS) fell by 5 percent to USD 585 million in 2024. Collectively, these three country groups received less than 30 percent of total public clean energy flows to developing countries in 2024, despite accounting for roughly two-thirds of the global population without electricity access. This fundamental misalignment between where energy poverty is concentrated and where financial flows are directed makes bridging the financing gap for LDCs, LLDCs, and SIDS essential to ensuring that the energy transition is equitable. Sub-Saharan Africa remained a key recipient of funds. However, commitments declined from about USD 7.2 billion in 2023 to around USD 5 billion in 2024, marking a decrease after three years of growth.

Financing instruments. Debt-based instruments accounted for about 80 percent of total flows in both 2023 and 2024. Standard loans were the largest instrument in 2024, at USD 14.4 billion (59 percent of total flows), followed by concessional loans at USD 4.8 billion (19 percent). Grants increased by 39 percent to reach USD 3.3 billion, raising their share of total flows from 10 percent in 2023 to 13 percent in 2024. Equity financing, by contrast, remained marginal, declining to USD 571 million and representing roughly 2 percent of total flows. Of the 65 donors that made commitments in 2024, only 11 provided any equity contributions. Dedicated risk-mitigation instruments, including guarantees and credit lines, grew to USD 1.1 billion (5 percent of total flows). However, their reach remained limited to just six recipient countries, including two LLDCs, down from ten in 2023. Overall, concessional loans, grants and dedicated risk-mitigation support, despite some growth in recent years, remain insufficient relative to the financing needs across developing countries.

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1 The true scale of solar-related investment may be higher than the figure attributed solely to solar would indicate owing to reporting methods.

The outlook for SDG 7

Outlook for progress toward 2030 goals. A series of crises, including current energy crises, are creating headwinds. Even so, policy and technological innovations have delivered meaningful results, especially in boosting renewable energy deployment and improving energy efficiency. The COVID-19 pandemic and the 2022 energy crisis slowed progress in electricity access, notably in Africa, where advances have been reversed. The SDG 7 goal of achieving universal energy access by 2030—as well as related efforts to put the world on a 1.5°C pathway—require investment and policy support for renewables, energy efficiency, and energy access. Unfolding developments connected with ongoing wars and related impacts on energy and economic systems may further impact the outlook to 2030.

Outlook for access to electricity. Progress on electricity access has been significant in the past two decades. Since 2000, the world has reduced the number of people without access by 925 million, and 40 countries have reached at least near-universal access. However, the International Energy Agency (IEA) projects that around 645 million people will lack electricity access in 2030—85 percent of them in Sub-Saharan Africa—underscoring the need to step up efforts. Achieving universal electricity access by 2030 will require significant investment and policy support, as well as accelerated deployment of renewable energy. Debt burdens, cuts in international aid, and population growth outpacing electrification are the main headwinds, making an increase in concessional finance and robust national electrification plans indispensable.

Outlook for access to clean cooking. Universal access to clean cooking by 2030 remains out of reach under current policies and investment. The IEA and the World Health Organization (WHO) estimate that between 1.6 and 1.8 billion people will still lack access to clean cooking by the end of the decade. On the positive side, these estimates project a continued decline in the use of polluting fuels and an increase in the use of gaseous fuels and electricity for cooking. Improvements out to 2030 will continue to be marked by strong regional disparities, as has been the case in past years. While significant progress has been made in Asia, the number of people without access to clean cooking in Sub-Saharan Africa is increasing, largely because the rate of population growth is outpacing gains in access. According to IEA estimates, reaching full clean cooking access by 2030 would require USD 8 billion annually until the gap is closed, half of it for Sub-Saharan Africa alone.

Outlook for renewable energy. Renewable energy is the fastest-growing energy source today, with renewables surpassing coal as the predominant electricity source globally in 2025. To meet the tripling pledge in the COP28 outcomes (as well as climate targets, the IEA's Net Zero Emissions by 2050 Scenario, and IRENA's 1.5°C Scenario) far more ambitious investment and policy support will be required. In other words, modern uses of renewables must reach a 32–35 percent share of TFEC and 68 percent of electricity generation by 2030. At the same time, coal remained the largest source of electricity, providing 34 percent of global generation. Current NDC collective targets amount to only about 5.8 TW—roughly half the tripling goal—meaning ambition must nearly double within less than five years.

Outlook for energy efficiency. Early estimates for 2024 show only a 1 percent annual rate of improvement in energy intensity, against a 2 percent annual improvement average since 2010. Given today's policy trends, that improvement rate is expected to accelerate to around 2.2 percent annually, owing to the increased electrification of end uses. But doubling the average annual rate by 2030 will require strong policy action and a substantial increase in investment. The IEA's Net Zero Emissions scenario estimates the necessary rate of improvement to be just over 4 percent, slightly higher than the SDG 7.3 target of 3.8 percent. IRENA's 1.5°C Scenario estimates more than 5 percent per year will be needed from 2025 to 2030. Energy efficiency is therefore central to meeting sustainability and climate goals.

Investment needs. Achieving the SDG 7 targets will require a substantial increase in clean energy investment. The IEA and IRENA estimate average annual energy-transition related investment in the range of USD 3–5 trillion by 2030, up from the USD 2.2 trillion placed in a comparable set of energy investments today. Though today's rate is twice the amount flowing to fossil fuels, it remains insufficient. IEA's Net Zero Emissions by 2050 Scenario calls for average annual energy investments of USD 3 trillion through 2030; IRENA estimates that the UAE Consensus targets on renewables and efficiency will require around USD 5 trillion per year. Investment in renewable power capacity must rise to USD 1.5 trillion annually. Energy efficiency investment must grow sevenfold to approximately USD 2.6 trillion per year. Investment flows remain heavily concentrated in China, the European Union, and the United States, leaving emerging markets and developing economies critically underfunded. Addressing the investment gap, particularly in developing economies, is essential for advancing the energy transition and ensuring universal access to sustainable energy.

CHAPTER 1

ACCESS TO ELECTRICITY

Photo: © World Bank

Main messages

- **Global trend:** The pace of electrification slowed between 2023 and 2024, as individuals lacking access fell by just 11.5 million; 655 million people worldwide have no electricity, and the global access rate is unchanged at 92 percent. The average annual gain of 0.35 percent from 2020 to 2024 is half the 0.70 percent achieved the previous decade. Reaching universal access by 2030 requires more than tripling this rate to 1.35 percent per year. To accelerate progress, the World Bank Group and African Development Bank have launched Mission 300—an initiative to electrify 300 million Africans by 2030.
- **Regional highlights:** Reflecting rapid grid expansion and rising incomes, Central and Southern Asia shrank its global access deficit from 36 percent in 2010 to just 3 percent in 2024. Sub-Saharan Africa remains the center of the global challenge, as it is home to 563 million of the 655 million people without electricity. Eastern Africa made rapid gains, while the deficit in Central Africa worsened.
- **Top 20 access-deficit countries:** In 2024 the 20 countries with the largest electricity access deficits accounted for 78 percent of people lacking access, up from 75 percent in 2022. Eighteen are in Sub-Saharan Africa, 17 are least-developed countries (LDCs), and 12 are affected by conflict or fragility. The DRC (85 million), Ethiopia (57 million), and Nigeria (87 million) together account for roughly one-third of the global deficit. Chad (13 percent), Malawi (16 percent), and South Sudan (5 percent) have the lowest national electrification rates, having seen only scant improvements since 2010.
- **Access needs across the rural-urban continuum:** Urban access rates rose from 96 percent to 98 percent between 2010 and 2024. Rural coverage improved from 73 percent to 85 percent, though the rural access deficit grew in Sub-Saharan Africa from 376 million to 447 million people, making targeted interventions essential. Urban areas also warrant attention: many connected households have poor service quality or rely on access intermediated through landlords and informal resellers.
- **People served with decentralized renewable energy (DRE):** An estimated 449 million people were served with Tier 1 and Tier 2 off-grid solar solutions in 2024, up from 385 million in 2023—an increase of 64 million. Mini grids provided a Tier 4 or above level of service to nearly 48 million people. Roughly 65 percent of off-grid solar customers are benefiting from first-time access.[2]
- **The remaining populations lacking access:** Those who have not yet accessed electricity tend to have low household incomes and live in remote rural areas in settings marked by fragility or conflict. Income and access are correlated, with large gaps in many countries between the top and bottom quintiles. An uptake gap persists where households remain unconnected despite their proximity to grid infrastructure because of high connection fees and internal wiring costs.

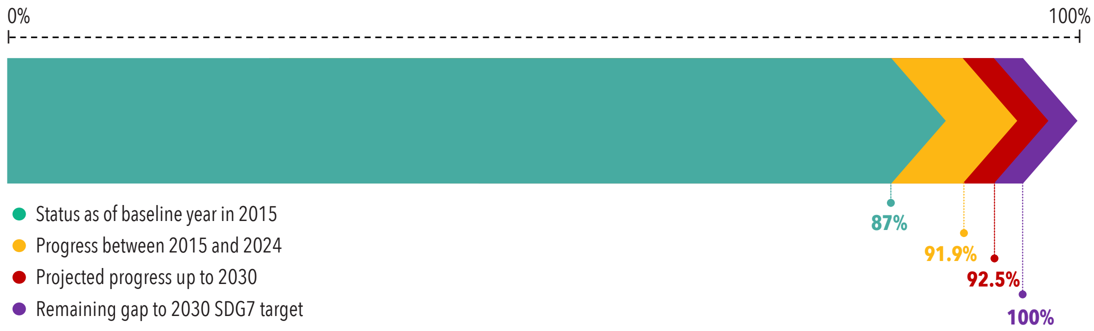
2 The Multi-Tier Framework captures household electricity access across seven attributes—capacity, availability, reliability, quality, affordability, formality, and health and safety—using six tiers. Solar home systems typically provide partial Tier 1, Tier 1, or Tier 2 access, whereas mini grids and grid electricity generally offer Tiers 3, 4, or 5 levels of service. This report series considers Tier 1 the minimum level of service to constitute electricity access, aligned with IEA's basic bundle threshold; it is the standard most governments use in countries with access deficits (IEA 2023). For more information, see annex 1.

- **Policy insights:** For progress to accelerate, several interconnected challenges must be met. Least-cost electrification planning—using geospatial data to optimize the mix of grid, mini grid, and off-grid solutions—is essential to deploy scarce public funding, calibrating subsidies to household affordability and fiscal sustainability. Conditions conducive to private sector delivery and private co-investment are also essential. These require strong institutional capacity, clear regulatory mandates, and blended-finance instruments, including results-based financing and local currency debt. DRE should be fully integrated into national electrification plans that promote productive use of electricity to enhance economic and fiscal impact. Access initiatives must be gender inclusive in ways that specify explicit targets, financial incentives, and disaggregated tracking. Finally, governments should measure access in a harmonized, multidimensional fashion, integrating questions from the Multi-Tier Framework (MTF) into household surveys to inform planning and policy.
- **Accelerating progress through Mission 300:** Mission 300, which is led by the World Bank Group and African Development Bank, and supported by a coordination group of more than 35 partners, aims to connect 300 million people in Sub-Saharan Africa by 2030. The World Bank Group has pledged USD 35 billion in financing whilst the African Development Bank has pledged USD 18 billion. Thirty countries have launched National Energy Compacts - covering least-cost planning, regional integration, DRE scale-up, private investment and utility reform - with more planned for 2026. Partnerships are at the core of Mission 300, with the World Bank Group and the African Development Bank working closely with the Rockefeller Foundation, the Global Energy Alliance for People and Planet, Sustainable Energy for All, the Energy Sector Management Assistance Program donors, and others to align financing, policy support, and expertise.

Are we on track?

Between 2022 and 2023, the number of people with no access to electricity fell by 19 million. The pace of electrification slowed from 2023 to 2024; those lacking access fell by just 11 million. The global access rate stalled at 92 percent. As a result, 655 million people are now living without electricity, this after having risen from 87 percent in 2015 (figure 1.1). If trends continue, the access rate will rise only incrementally to 92.5 percent by 2030 (figure 1.3).

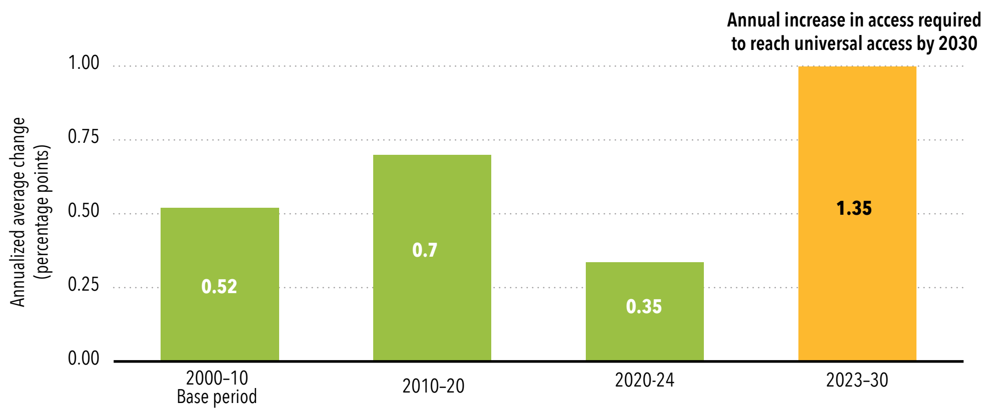
Figure 1.1 • Percentage of population with access to electricity



Source: World Bank and IEA 2026.

The pace of electrification has slowed. Between 2010 and 2020, the average annual increase in people with access was 0.70 percent. Then it dropped to 0.35 percent from 2020 to 2024. The slowdown is attributed in part to COVID and the war in Ukraine, which raised import costs while constraining affordability. The slowing pace was also linked to characteristics of the unconnected population itself: low incomes and living in remote areas affected by conflict, fragility, or displacement. These conditions affect supply costs and risks as well as the required magnitude of subsidies to address affordability. The remaining population lacking access continues to persist in Sub-Saharan Africa, where the rate of new connections must exceed the region's high rates of population growth. To reach universal access by 2030, the pace of electrification would need to be 1.3 percentage points annually—more than triple the latest rate (figure 1.2). To accelerate progress, the World Bank Group and African Development Bank launched Mission 300 in 2024—a new initiative to electrify 300 million Africans by 2030. Results from Mission 300 will be reflected in SDG 7 tracking data in the future.

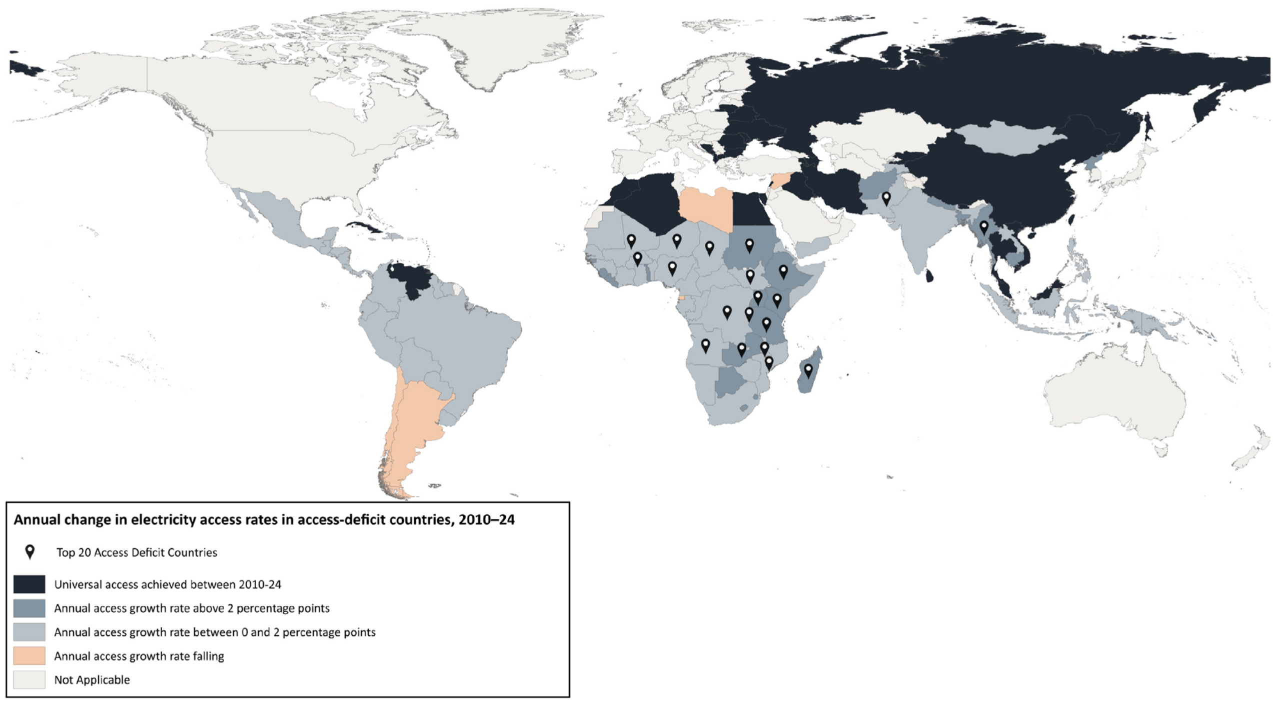
Figure 1.2 • Average annual increase in access to electricity, 2000–24



Source: World Bank and IEA 2025.

Between 2010 and 2024, 46 countries achieved universal access to electricity. Most of these were in North America and Europe (eleven countries) and Latin America and the Caribbean (ten countries). The remaining countries were spread across Western Asia and Northern Africa and Oceania (seven countries each), Central and Southern Asia (five countries), and Eastern and South-eastern Asia (four countries). In Sub-Saharan Africa, only Seychelles and Mauritius reached universal access during this period. Access deficits were found in 94 countries at the end of the period, heavily skewed towards Sub-Saharan Africa. One-quarter of the top-20 access-deficit countries registered annual electrification gains of more than 2 percent and the rest progressed.[3]

Figure 1.3 • Annual change in electricity access rates in access-deficit countries, 2010–24



Source: World Bank 2025.

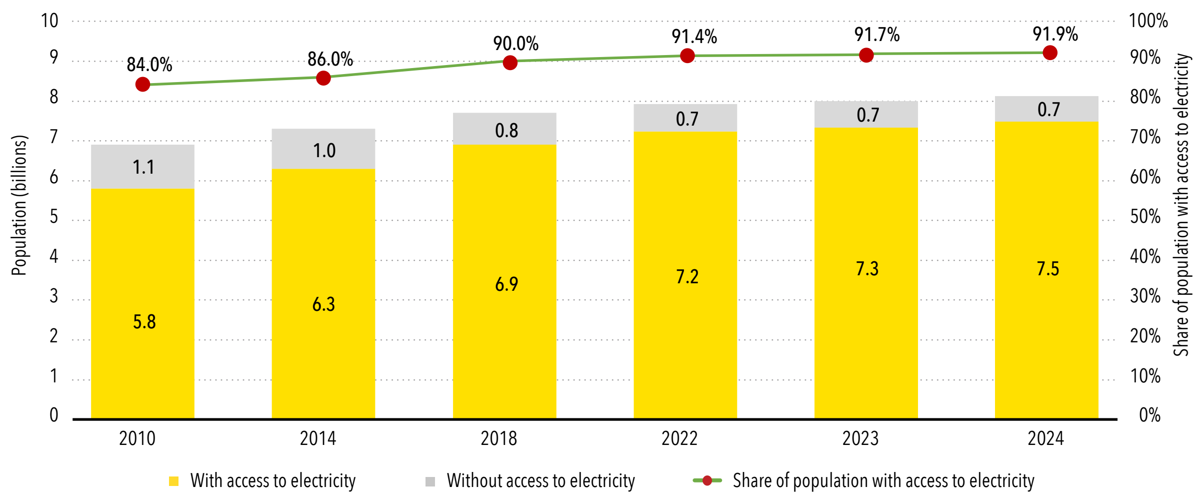
3 Following a detailed reconciliation of national statistics with the latest Organización Latinoamericana y Caribeña de Energía (OLACDE) energy outlook data, five countries in Latin America previously classified as having achieved universal access after applying standard extrapolation methods—have been reclassified as having "near universal access" in the 98–99.8 percent range. This new status reflects the fact of small remnants of unserved populations in remote areas. These countries include Argentina, Chile, Costa Rica, Jamaica, and Mexico. https://www.olade.org/publicaciones/panorama-energetico-de-america-latina-y-el-caribe-2025/. (OLACDE 2025).

Looking beyond the main indicators

Access deficits and population growth

The global electricity access rate rose between 2010 and 2022, from 84 percent to 91.4 percent (figure 1.4), with an average annual increase of 0.70 percent. Over this period, 121 million people received new connections annually. Meanwhile the population grew by 82 million per year, resulting in an average annual decrease in the population lacking access of 39 million. Between 2022 and 2024 the rate tiptoed up, from 91.4 percent to 91.9 percent, or an average annual increase of 0.27 percent. While 110 million people received new connections annually, the population grew by 95 million people per year, resulting in a more modest decrease of 15 million in the population lacking access.[4]

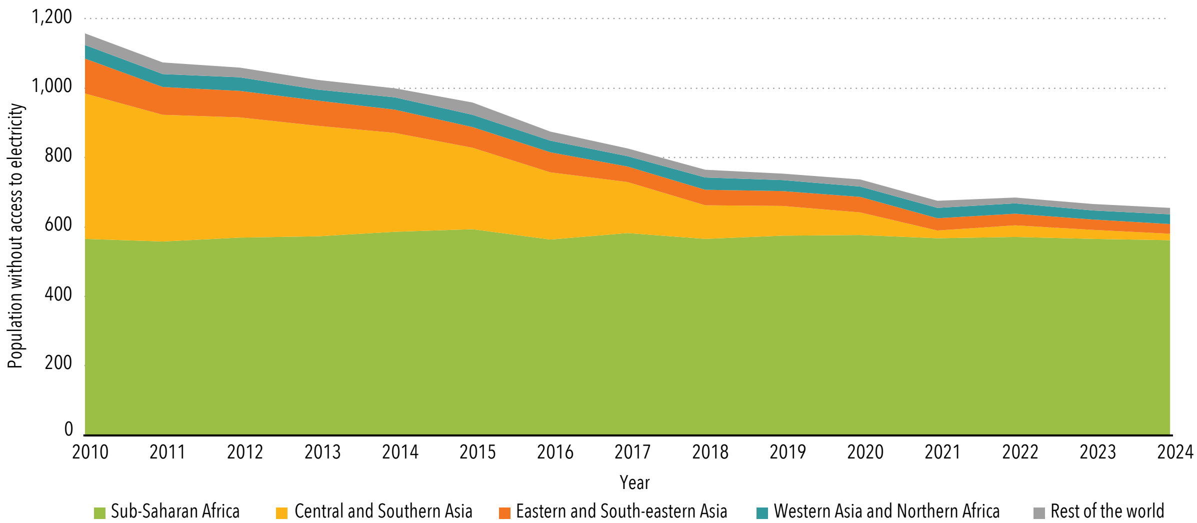
Figure 1.4 • Gains in global electricity access and population growth, 2010–24



While the number of people worldwide lacking access has fallen from 1.1 billion in 2010 to 655 million in 2024, progress has been deeply uneven. Sub-Saharan Africa's share of the global access deficit has grown from 49 percent to 86 percent over this period, as the number of people lacking access in the region dipped from 565 to 563 million. Meanwhile, Central and Southern Asia made dramatic gains, reducing their share of the total population lacking access from 36 percent to 3 percent (figure 1.5).

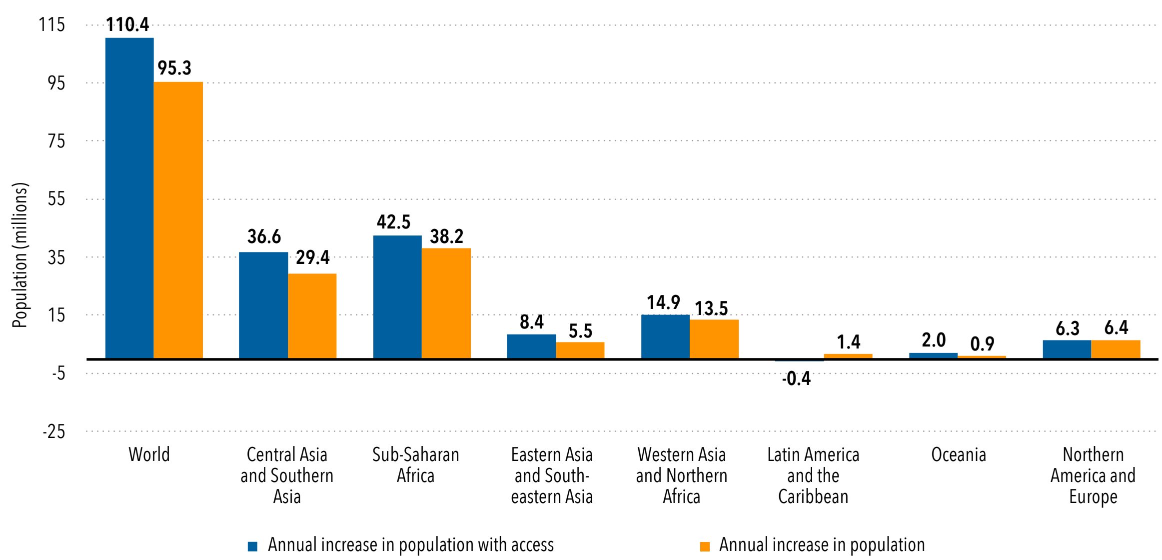
4 Access rates are calculated by subtracting population growth from total new connections. But this cannot not take account of several factors, including the likelihood of higher fertility rates in unconnected areas; higher infant mortality rates in unconnected areas; and rapid urbanization, as people move from unconnected rural to connected urban households. No reliable data are available on which to base assumptions in these areas.

Figure 1.5 • Number of people without access to electricity, by region, 2010–24



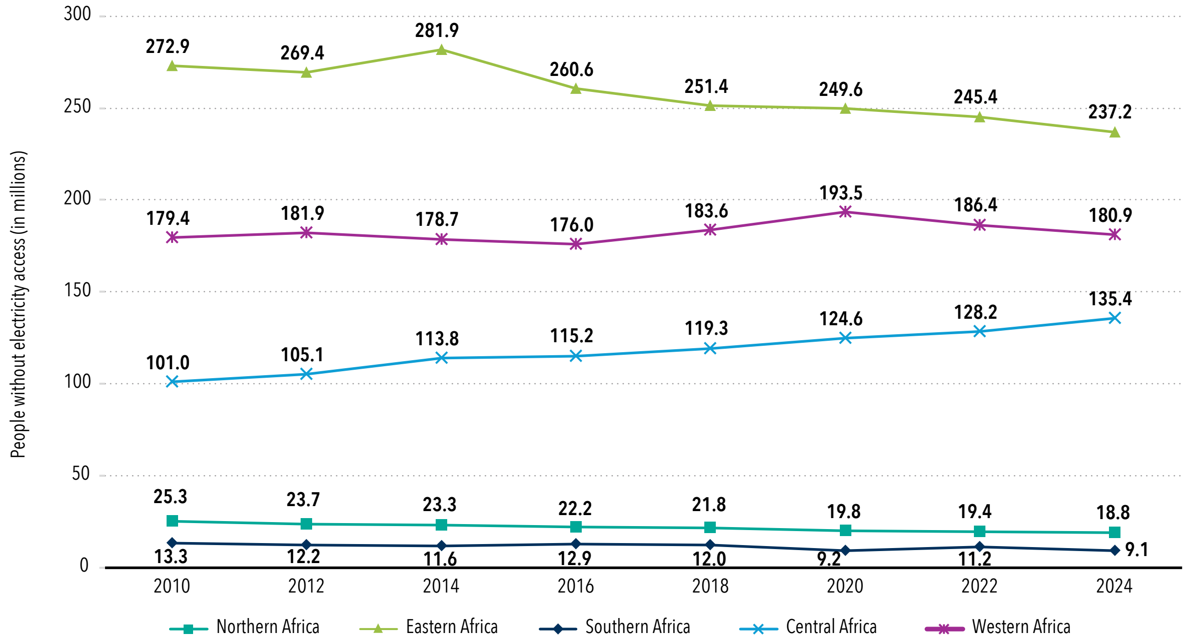
From 2022 to 2024, Eastern Asia, Western Asia, and Latin America established new connections faster than their populations grew. Central and Southern Asia added roughly 37 million new connections per year—8 million more than their annual population growth rate, while Sub-Saharan Africa added 42 million new connections per year—4 million more than their annual population growth rate (figure 1.6).

Figure 1.6 • Annual increases in electrification and population, by region, 2022–24



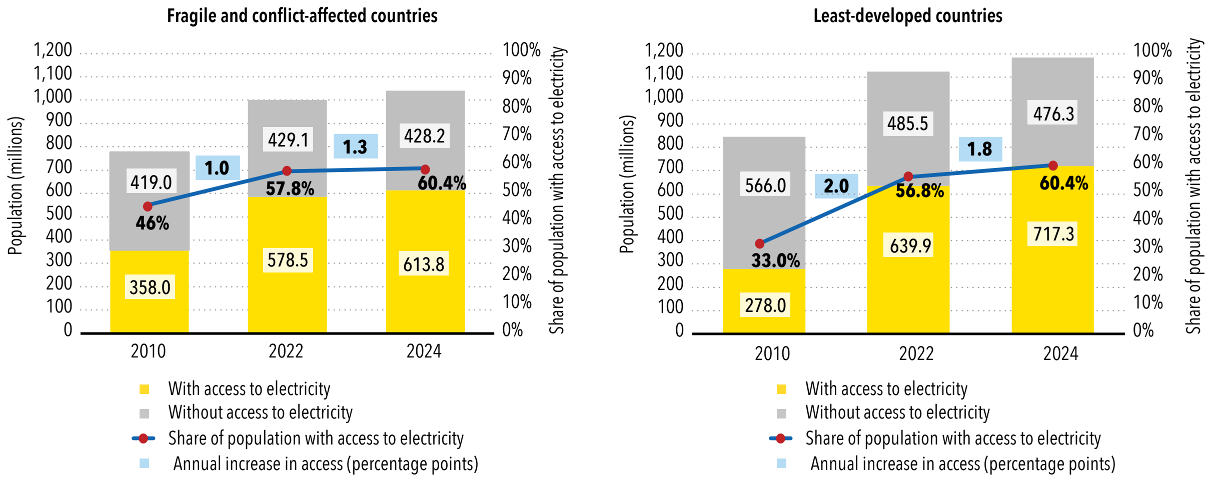
Between 2010 and 2024, progress in closing Africa's electricity access gap was markedly uneven (figure 1.7). In Southern Africa, the access deficit declined by 4 million, largely driven by gains in South Africa and Botswana. Northern Africa recorded consistent advances, reducing its deficit by 6 million, reflecting strong progress in Algeria, Morocco, and Tunisia. Eastern Africa made rapid headway with its larger deficit contracting by 35 million, supported by notable progress in Rwanda, Kenya, Mauritius, and Seychelles. In contrast, Central Africa saw a deterioration, with the deficit widening by 34 million, mainly due to persistent challenges in the Central African Republic, Chad, and the Democratic Republic of Congo. Western Africa displayed a mixed trajectory: the deficit rose from 179 million in 2010 to 186 million in 2022 before edging down slightly to 181 million in 2024, reflecting varied country performance across the region.

Figure 1.7 • Electricity access deficits in Africa by subregion



The access deficit is becoming more concentrated in LDCs and countries affected by fragility, conflict, and violence (FCV). From 2022 to 2024, LDCs saw the numbers of people without electricity dip from 485 million to 471 million, while FCV countries remained almost unchanged, moving from 429 million to 428 million. Burkina Faso, Ethiopia, and Nigeria have made notable progress. LDC households continue to struggle with persistently low incomes, dispersed rural settlement patterns, and limited institutional capacity, while FCV settings continue to constrain electrification. In many FCV contexts, access to electricity has declined in absolute terms in recent years. Communities affected by displacement are typically the hardest hit, consistently exhibiting lower access rates than national averages (United Nations 2025).

Figure 1.8 • Increases in global access to electricity in LDCs and FCV-affected areas, 2010, 2022, 2024

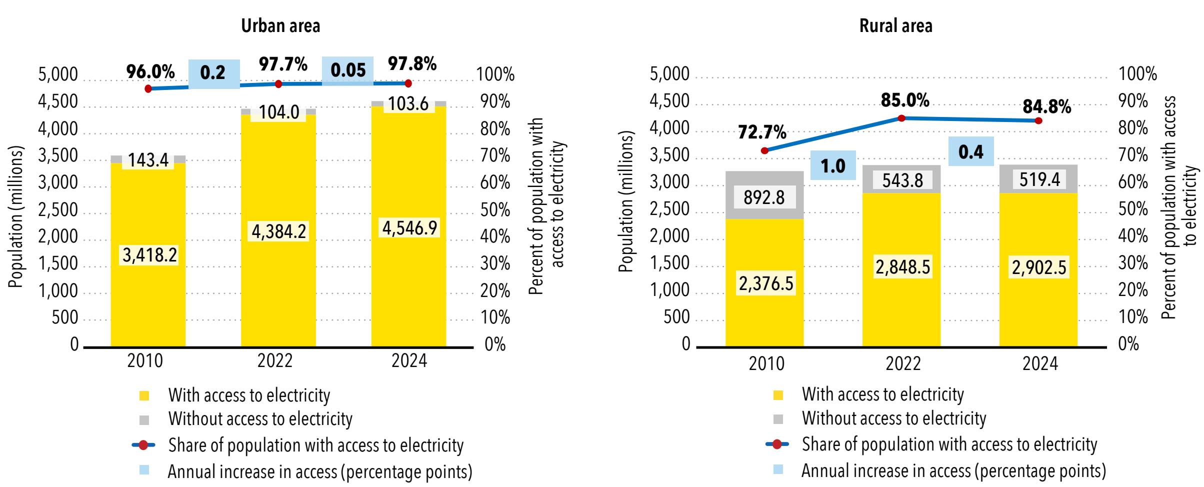


FCV = fragility, conflict, and violence; LDCs = least-developed countries.

Access needs along the rural-urban continuum

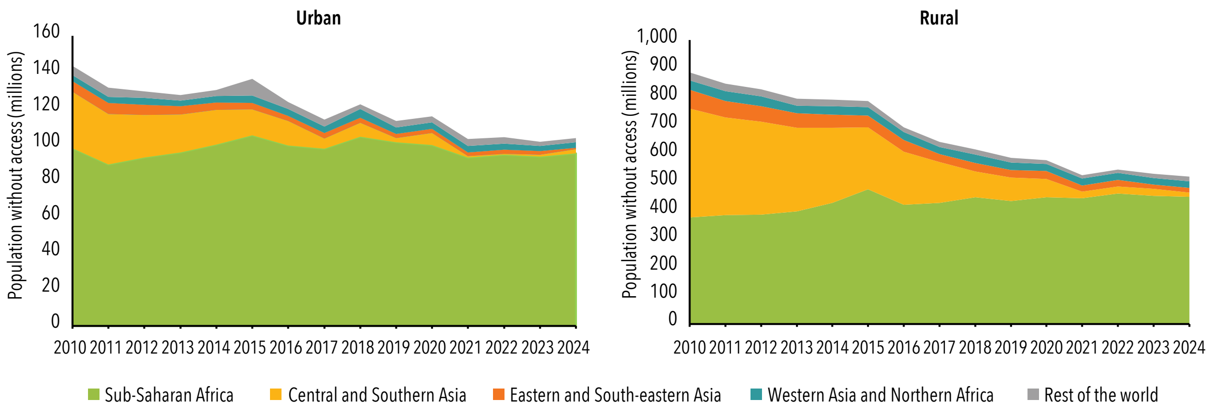
Urban electrification rates are nearing universal access worldwide, rising from 96 percent in 2010 to 98 percent in 2024—or an additional 1.1 billion additional urban connections (figure 1.9). In rural areas, access rose from 73 percent in 2010 to 85 percent in 2024, with 527 million people gaining access. While these numbers highlight the persistent challenge posed by rural access, urban electrification also warrants attention.

Figure 1.9 • Increases in global access to electricity in urban and rural areas, 2010, 2022, and 2024



Progress has been uneven across regions from 2010 to 2024. While Central and Southern Asia slashed its rural unelectrified population from 383 million to just 16 million, the access deficit in rural Sub-Saharan Africa grew from 376 million to 447 million. Targeted interventions to address the rural access change in Sub-Saharan Africa are now essential (figure 1.10). The urban electricity access deficit narrowed worldwide from 145 million people to 104 million in 2024, driven primarily by Central and Southern Asia. Sub-Saharan Africa provided electricity to nearly 250 million people in urban settings. Rapid urbanization, however, caused the deficit in urban access to fall from 98 million in 2010 to only 95 million in 2024.[5]

Figure 1.10 • Access deficits in urban and rural areas, by region



The 519 million rural people worldwide that remain unelectrified are highly diverse. In Latin America and the Caribbean, the 11 million people who are unelectrified live in isolated, remote, and often indigenous communities. The rural access deficit grew in Sub-Saharan Africa by 72 million people between 2010 and 2024. People who live in these remote areas (often marked by conflict or fragility) have low household incomes. Some areas with a rural designation nevertheless have urban-like population densities and economic characteristics and are often functionally a part of nearby cities, but have yet to be reclassified as urban (OECD 2020; Kersey and Koo 2024).

Rapid urbanization is reshaping patterns of electricity access, particularly in Sub-Saharan Africa, where the urban population is projected to double from 600 million today to 1.1 billion by 2050 (OECD and others 2025). Despite high headline connection rates, urban households often face poor service quality, uncertain reliability, and marginal affordability. These shortcomings prevent them from attaining the social and economic benefits associated with a higher level of service. In informal low-income urban communities, many connected end-users rely on intermediated forms of access, such as shared meters with landlords or informal resellers tapping electricity from the grid (Kersey and others 2025). For these households, the availability and affordability of electricity are further constrained by intermediated access arrangements, which suppresses demand.

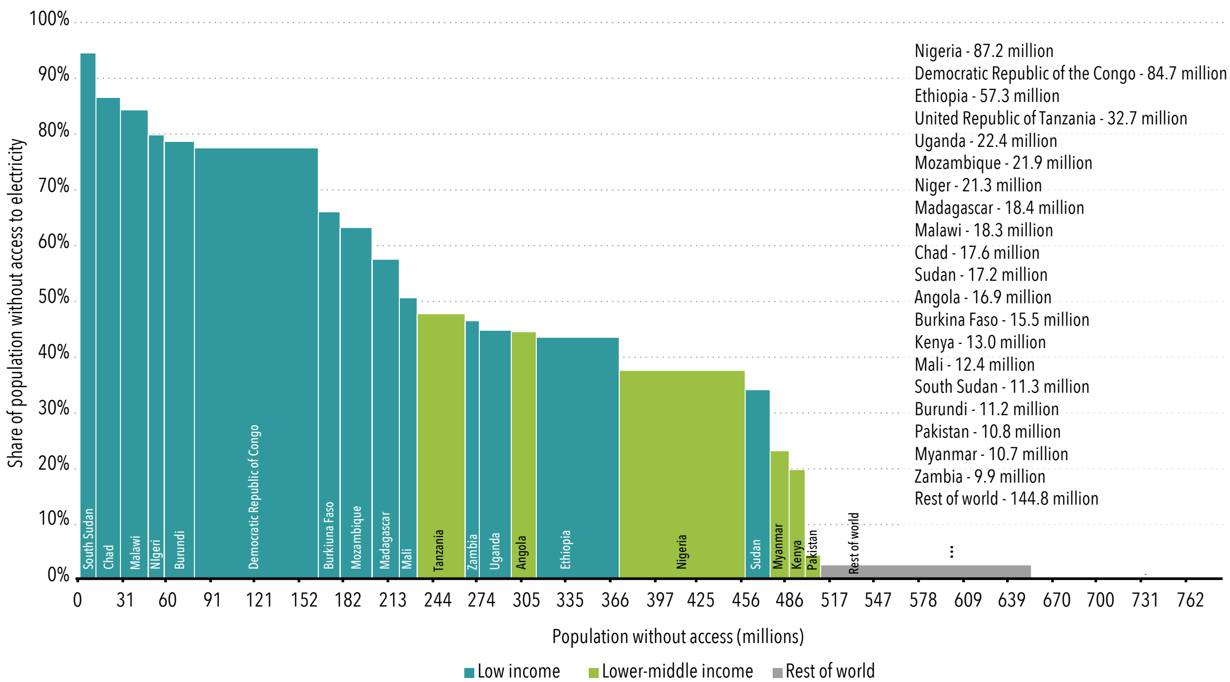
To address these problems, governments should invest in improving the reliability and affordability of grid electricity supply in urban settings, alongside providing new connections. Affordability constraints can be addressed through subsidies, or by passing on savings made on the supply-side through better planning or more competitive procurement of new generation.

5 Sub-Saharan Africa's urban population increased from ~313 million in 2010 to ~542 million in 2023 (73 percent), while the rural population increased from ~562 million to ~718 million (28 percent). For more information, see World Urbanization Prospects 2025, UN DESA, https://population.un.org/wup/. (United Nations, 2025)

Country trends

Progress has been uneven across countries and regions. In 2024, the top-20 access-deficit countries accounted for 78 percent of the global population lacking access, up from 75 percent in 2022. Eighteen are in Sub-Saharan Africa, 17 are LDCs, and 12 are affected by conflict or fragility. Fifteen countries are hosting large numbers of refugees or internally displaced people. Of the global population lacking access, three countries can claim nearly a third of them: the Democratic Republic of Congo, 85 million; Ethiopia, 57 million; and Nigeria, 87 million people (figure 1.11). Outside of Sub-Saharan Africa, Pakistan and Myanmar, each have 11 million people without electricity access.

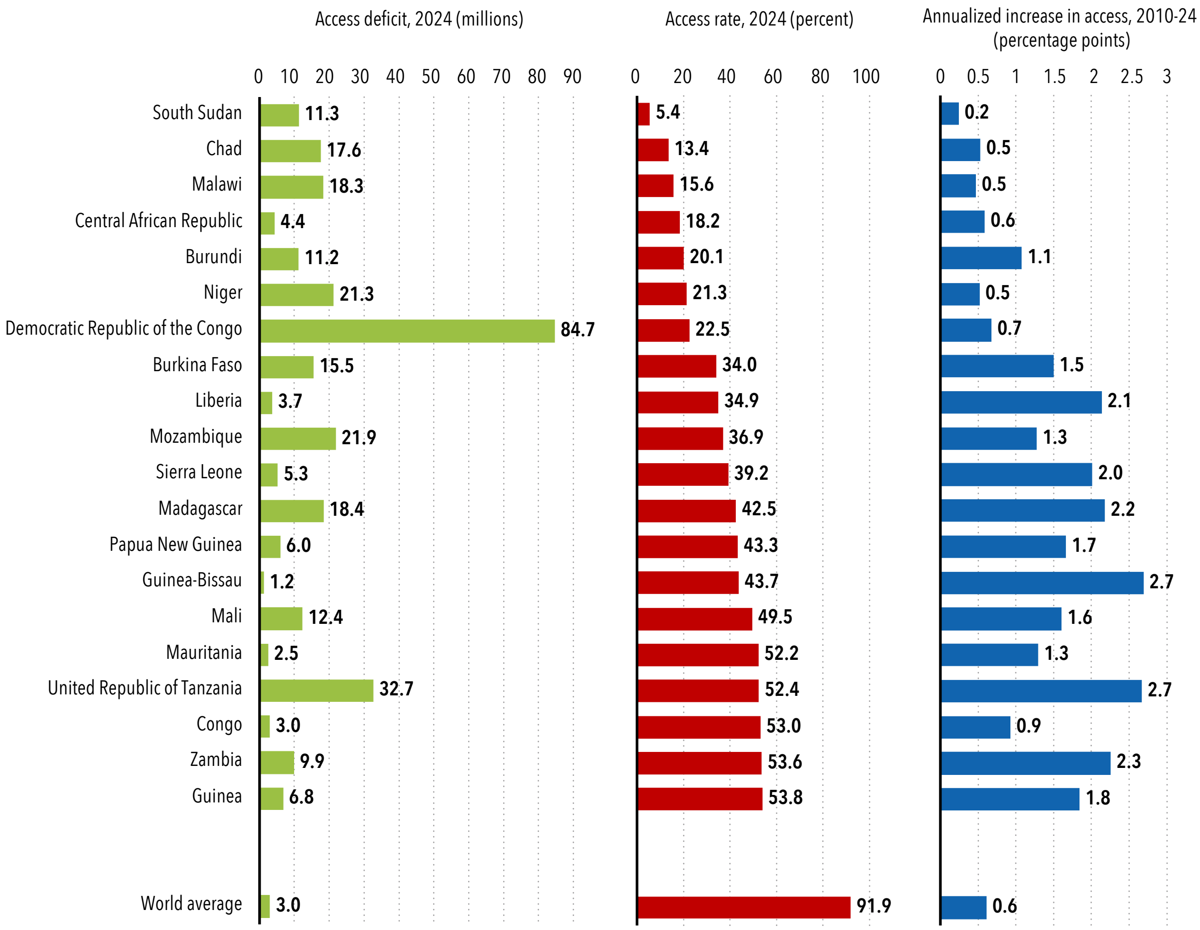
Figure 1.11 • Share and absolute size of population lacking access to electricity in the top-20 access-deficit countries, 2024



Countries with the lowest electricity access rates continue to make slower than average progress. The three countries with the lowest rates of access remain unchanged from the previous SDG 7 tracking report—Chad with 13.4 percent, Malawi at 15.6 percent, and South Sudan with 5.4 percent—have achieved only limited average annual gains of 0.5, 0.5, and 0.2 percent, respectively, since 2010 (figure 1.12).[6]

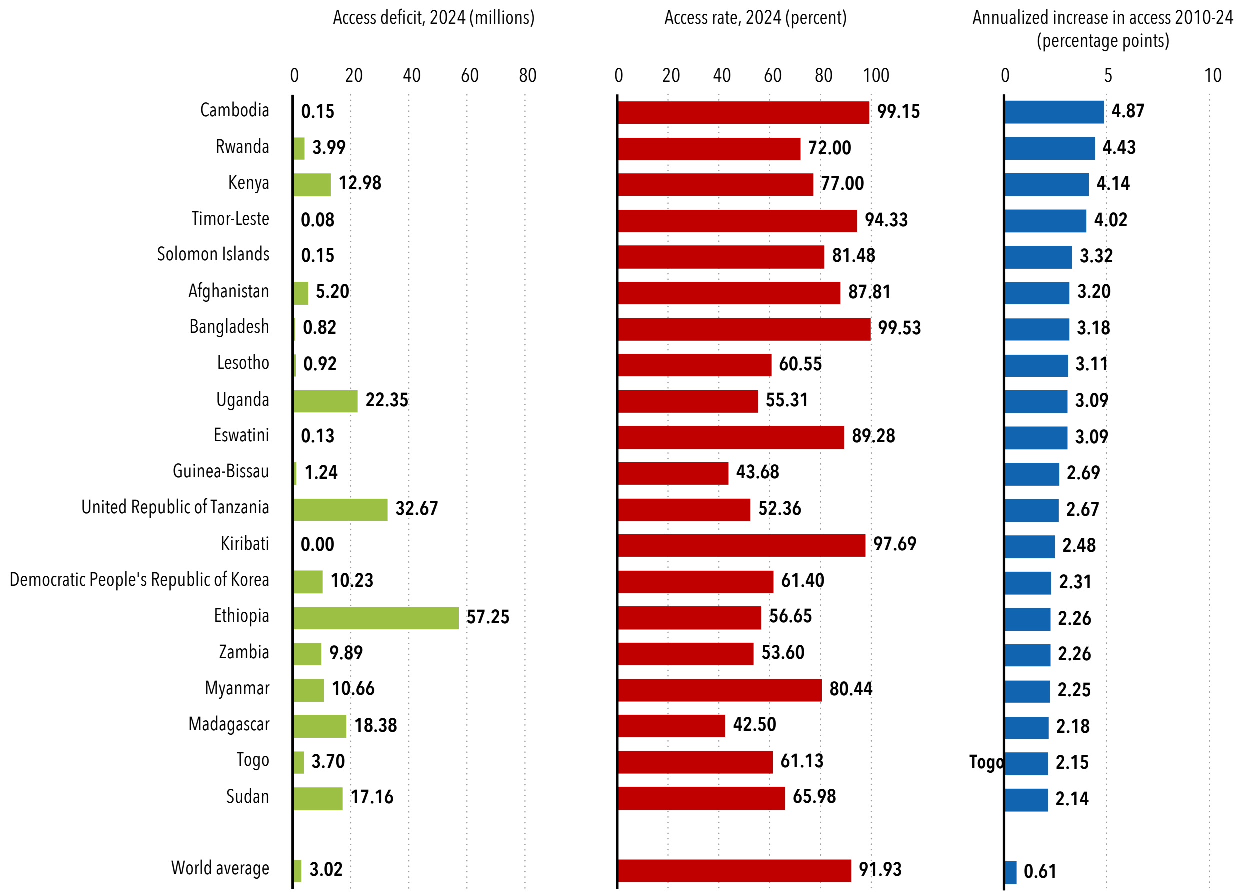
6 South Sudan was established in 2011.

Figure 1.12 • Annualized increase in access in countries with the lowest access rates, 2010–24



From 2010 to 2024, Cambodia, Kenya, and Rwanda recorded the highest annual average percentage gains. Each advanced from a low baseline to more than two-thirds of their population gaining access over the period, with Cambodia standing out at 99 percent access. The progress in these countries reflects sustained government commitment, large-scale investments in grid expansion and off-grid solutions, and effective policy coordination under national electrification programs.

Figure 1.13 • Access to electricity in the 20 fastest-electrifying countries, 2010–24

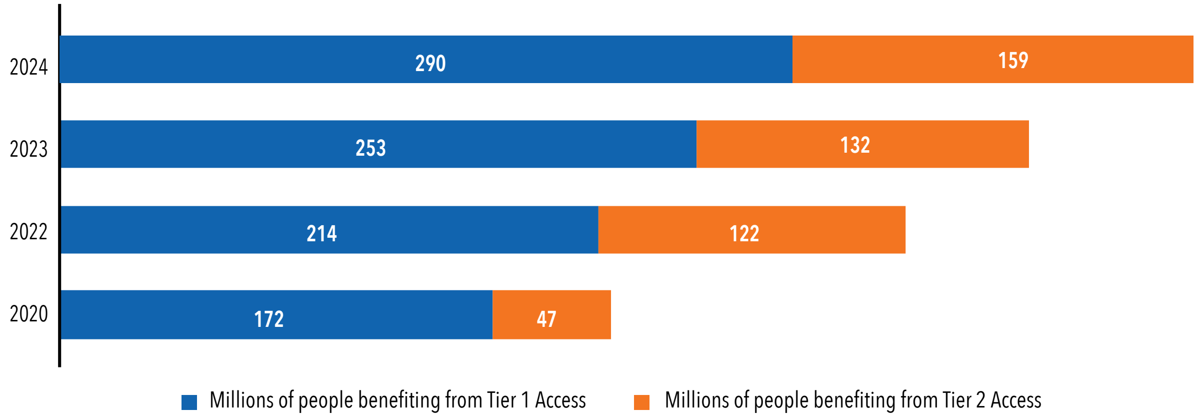


People served with distributed renewable energy

An estimated 449 million people were being served with Tier 1 and Tier 2 off-grid solar solutions in 2024. This is up from 385 million in 2023, an increase of 64 million.[7] The proportion of people benefiting from Tier 1 solutions rose 15 percent, while the proportion with Tier 2 solutions fell 20 percent. After a COVID-related dip in 2020, sales of quality-verified Tier 1+ off-grid solar solutions rebounded to a record high in 2022, followed by a plateau from 2022 to 2024. Year-on-year gains continued in people being served from 2020 onwards, with Kenya, Nigeria and Uganda the largest markets (figure 1.14). In other words, there was a robust, ongoing demand for off-grid solar solutions despite macroeconomic headwinds, high inflation, and climate-linked natural disasters. Roughly 65 percent of people benefiting from off-grid solar have no access to the grid and would otherwise have remained unelectrified, while the other 35 percent use their off-grid solar system as power backup (60 Decibels 2025).

7 This estimate is based on sales data reported by GOGLA affiliates selling quality-verified solar products. GOGLA affiliates are estimated to have a 29 percent market share based on the MTF dataset, the only data source tracking the proportion of quality-verified off-grid solar products across multiple countries. Product lifespans are assumed to be 1.5x warranty periods, calculated at individual product level–typically three years for solar home systems. A 3 percent discount rate for repeat sales is applied to Tier1+ products in the 3–100Wp range. A PAYG discount rate is also applied to PAYG sales, to account for default/repossession. For more information, see GOGLA's Market Insights and Data, https://gogla.org/market-insights-data/.

Figure 1.14 • Estimated number of people served with Tier 1 and Tier 2 standalone off-grid solar solutions



Source: GOGLA 2026.

The most comprehensive recent estimate of people reached with mini grids finds that they are serving nearly 48 million people at a Tier 4 and above level of service (ESMAP 2022a). This translates to more than 21,500 installed systems—half of which rely on solar PV technology. An additional 29,400 mini grids are planned for development and projected to connect over 35 million people. Of these millions, 95 percent of them live in Africa and South Asia and nearly all of them are expected to use solar (99 percent). Reliable, robust data on the global mini grid sector is outdated—with the most comprehensive analysis carried out by the World Bank in 2022. The World Bank, Sustainable Energy for All (SEforALL), and the Africa Minigrid Developers Association (AMDA) are jointly undertaking a market assessment; updated data are expected to be available in early 2027.[8]

These trendlines for people who have both off-grid solar solutions and mini grids are broadly corroborated by IRENA's dataset.[9] IRENA finds that 31 million people living off-grid were served with quality-verified Tier 1+ SHS in 2024, up from 29 million in 2023 (7 percent increase), and people served with mini grids increased from 13.67 to 13.72 million people (0.4 percent increase). The World Bank's estimates are higher than IRENA's because they include off-grid solar products sold by companies that are not GOGLA affiliates (GOGLA is the global association for the off-grid solar energy industry), and mini grid data were drawn from a broader range of sources.[10]

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8 Data for Sub-Saharan Africa—by far the fastest growing market for private sector-led mini grid deployment—is particularly fragmented. The primary sources of project-level data—AMDA's *Benchmarking African Mini Grids* report and the Odyssey software platform—each have significant coverage gaps, which make it difficult to state with confidence the number of operational mini grids or total customer connections. The World Bank and SEforALL are undertaking a joint comprehensive global mini grid market data collection exercise, with the goal of producing an updated dataset to complement the existing World Bank ESMAP *Mini Grids for Half a Billion People Handbook* and the Mini Grid Partnership's *State of the Global Mini Grid Market Report* databases. In addition, AMDA is currently undertaking a comprehensive review of the mini grid sector in Sub-Saharan Africa—covering both private and public deployments—with the aim of producing reliable aggregate figures. Updated data is expected to be available in early 2027. Until that review is complete, figures cited in this report reflect the best available estimates at the time of writing and should be interpreted accordingly. https://www.africamda.org/wp-content/uploads/2025/04/Benchmarking-Africas-Minigrids-Report-2024-Online-version.pdf. (AMDA 2025).

9 IRENA defines off-grid renewable systems as "renewable technologies that serve people in areas that have no physical connection to a main or national power grid." For more information, see Off-grid Renewable Energy Statistics, IRENA, https://www.irena.org/Publications/2025/Dec/Off-grid-Renewable-Energy-Statistics-2025

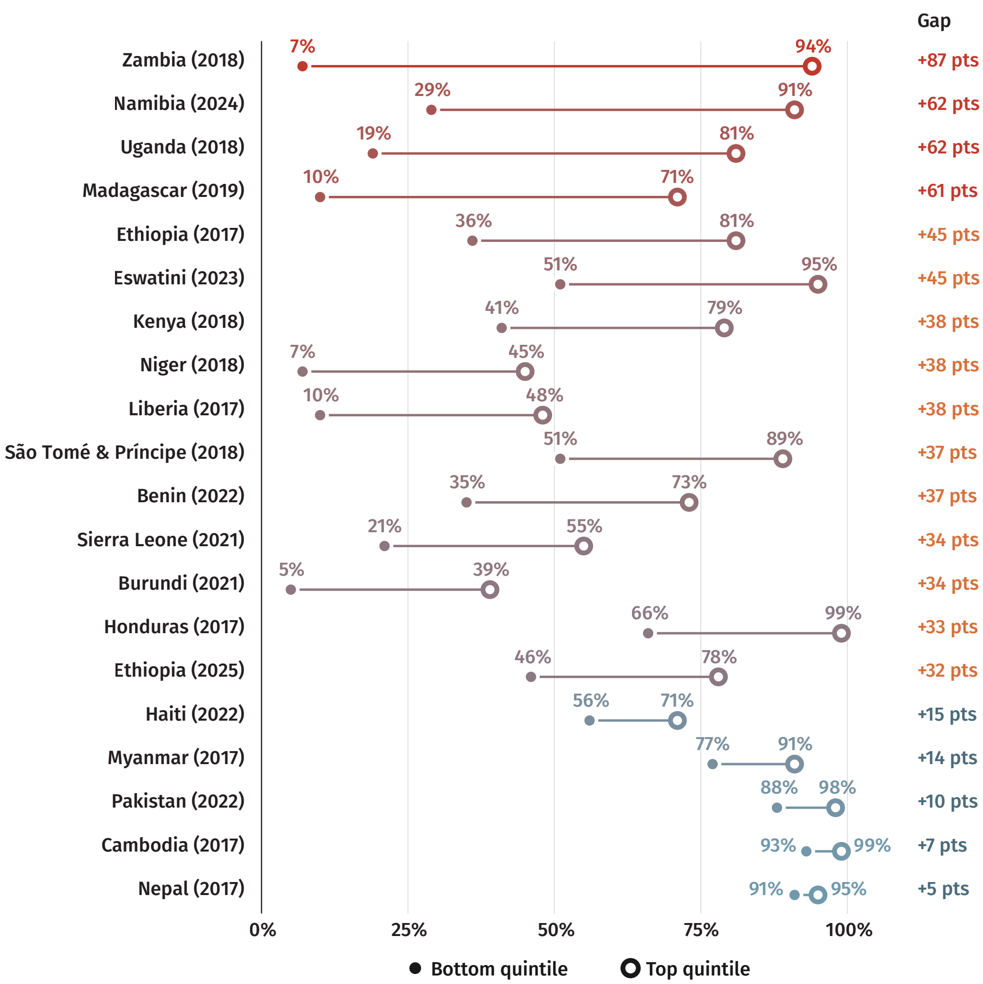
10 The World Bank's methodologies produce a much higher figure for total people served than IRENA's methodology. For off-grid solar, this is a result of including off-grid solar products sold by companies that are not GOGLA affiliates, sales reported in non-access-deficit countries (on the assumption that these products are en route to access-deficit countries), and products sold as power backup in on-grid areas. For mini grids, this stems from relying on a comprehensive market data-gathering exercise undertaken in 2022, which drew upon a wide range of sources.

The remaining population lacking access

Those who remain without access tend to have low household incomes, experience multidimensional poverty, and live in remote rural areas affected by fragility, conflict, or displacement (Alkire and others 2020). Despite national progress, remote populations, women, informal settlements, and indigenous communities are often left behind.

MTF survey data suggest that household income correlates with electricity access. Countries with low electrification rates tend to have sharp disparities in access among income groups, while those with high rates show smaller gaps. In countries with limited access, such as Zambia (2018), income is the main factor determining access (figure 1.15). In contrast, countries with high rates of electrification, like Cambodia (2017), have achieved a more equal distribution of access. Haiti stands out as an exception. Limited grid availability constrains access rates across all quintiles, while all income groups use off-grid solutions.

Figure 1.15 • Access rates for top and bottom income quintiles for selected countries

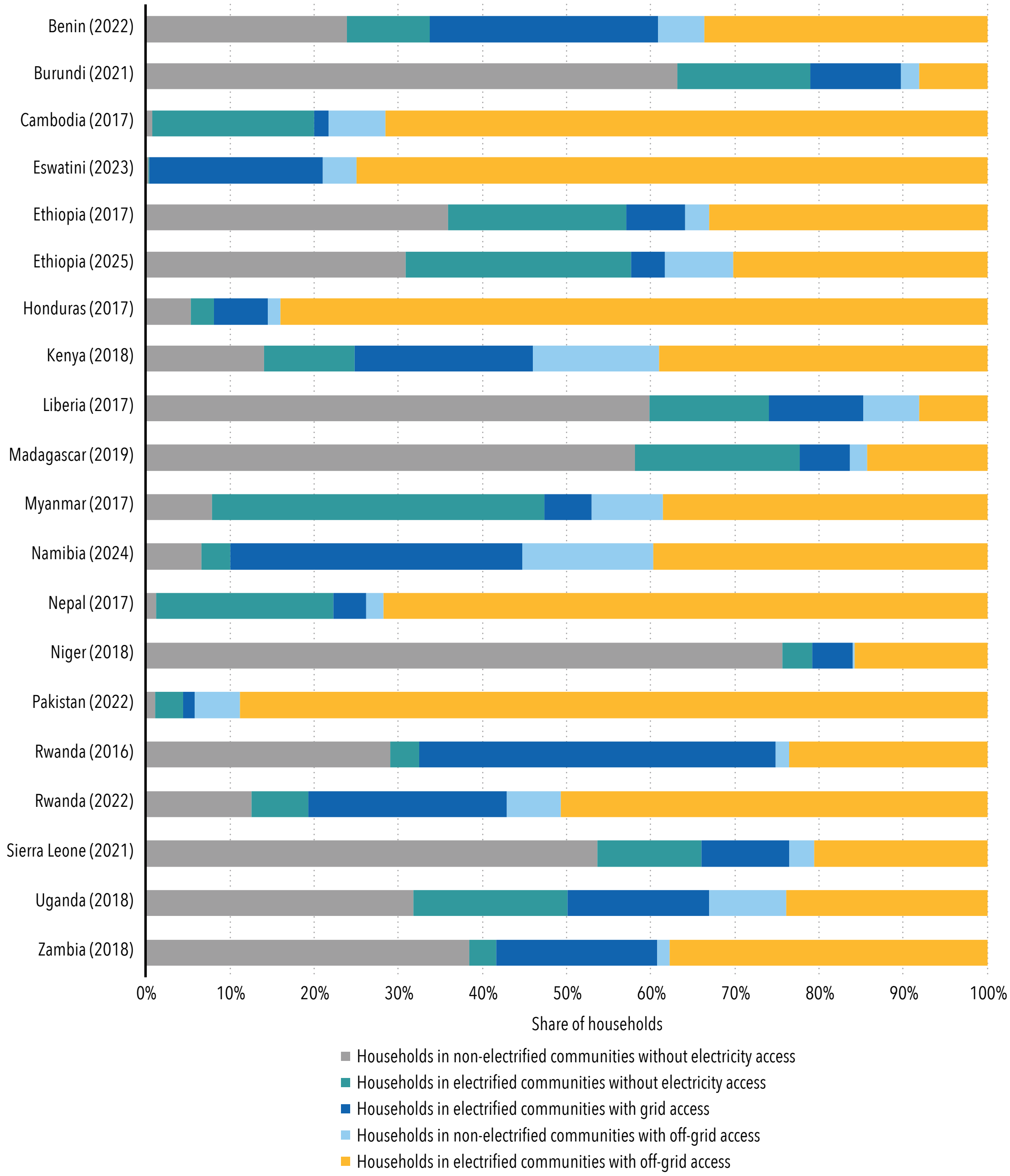


Source: MTF survey data.

Note: Horizontal lines bridge the access gap between the bottom quintiles (left), and top quintiles (right). Longer lines signal wealth-based barriers, while shorter lines indicate more equitable distribution.

An uptake gap exists in countries where households remain unconnected to the grid despite their proximity to grid infrastructure.[11] Low grid uptake rates of 31 percent to 38 percent persist in Burundi, Liberia, and Rwanda, for example, because of high upfront connection fees and the costs of internal wiring (figure 1.16). These countries have therefore introduced dedicated initiatives to help households with such costs. Demand-side challenges to boost uptake in grid-connected areas are often less capital intensive than expanding the grid or offering off-grid solutions in unelectrified areas.

Figure 1.16 • Grid and off-grid uptake rates in electrified and non-electrified communities in selected countries



Source: MTF survey data.

11 A grid-electrified community or settlement is classified as one where at least one household surveyed reported having a grid connection.

Policy insights

Governments seeking to accelerate progress face a daunting task. Public funding must meet affordability constraints; at the same time, fiscally sustainable, least-cost electrification plans require planning and care. Private sector delivery and co-investment involve further leveraging of DRE, while the productive use of energy will need to extend both access and gender-inclusive interventions.

Limited public funding

Current investment falls short of what the DRE sector needs to fulfil its potential, and fiscal space is tightening—both for governments in the Global South and providers of official development assistance. An estimated USD 21 billion is needed through 2030 to provide off-grid solar to the 398 million for whom this solution is least cost. This represents a six-fold increase on the total investment the sector has received to date—equivalent to USD 3.5 billion a year—with public funding providing 40 percent to leverage a further 60 percent in private co-investment (ESMAP and others 2024). The mini grid financing gap is estimated to be much larger. Public funding needs to cover ~60 percent of mini grid connection costs today, while dropping to ~30 percent as markets mature (ESMAP 2022a).

Limited public funding means it is critical to leverage the private sector while attracting private co-investment (ESMAP 2022b). Total investment in off-grid solar fell, however, to USD 300 million in 2024—a 30 percent year-on-year drop from 2023. The decline mirrors the contraction in the mini grid sector and the broader African venture capital ecosystem, which fell 25 percent due to macroeconomic headwinds and currency volatility (GOGLA 2025). The decline was even steeper for early-stage ventures, where start-up capital plunged 70 percent. As with many emerging industries, the DRE sector surged early on. After a reality check, the sector is moving into a phase marked by stronger business models and rising demand. Business fundamentals are improving, successful companies are reaching scale, and the addressable market remains vast and underserved.

More encouragingly, over USD 900 million in results-based financing has been committed to the DRE sector so far—with more than half pledged in 2023–24 (GOGLA 2025). These programs are now moving toward implementation and disbursement. For example, Nigeria's Distributed Access through Renewable Energy Scale-up (DARES) project has allocated USD 300 million for off-grid solar. The Energy Access Scale Up Project in Uganda also demonstrated strong results, financing 200,000 off-grid solar sales in record time. Other schemes have launched in Mozambique, Madagascar, and elsewhere.

Addressing affordability constraints through fiscally sustainable, least-cost electrification plans

Least-cost electrification planning involves using geospatial data and economic modeling to identify the most cost-efficient mix of grid, mini grid, and standalone off-grid solar solutions to meet demand. This approach is essential to the efficient use if scarce public funding. It aligns electricity supply with affordability and demand. Least-cost approaches need to consider the return on electrification investments. In grid settings, high-consumption customers generate enough tariff revenue to cover connection and electricity supply costs, while low-consumption customers do not. This could leading to high, recurring subsidy bills. In mini grid and off-grid settings, investments can create returns through job creation, leading to higher income tax receipts and lower kerosene lighting subsidy bills (Cabraal and others 2021).

Of households worldwide lacking access, only 22 percent can afford the monthly pay-as-you-go (PAYG) fee for a Tier 1 solar home system. Of the 22 percent that can afford grid or mini grid electricity at Tiers 3, 4, or 5, the rest could be electrified with Tier 1 off-grid solar solutions without subsidy (ESMAP and others 2024). The remaining 78 percent need to be electrified through a subsidy. An integrated approach (subsidies combined with credit lines or technical assistance) could address affordability constraints while maintaining the commercial health of DRE companies, which would allow them to attract private co-investment (ESMAP and others 2024).

Least-cost plans need to consider what tier of access to aim for when seeking to connect these households. When setting targets for tiers of access, governments need to consider the cost of supply, affordability, and subsidy needed to make a given level of service affordable, and the fiscal sustainability of subsidies—both for initial connections and supply over time. Further reflections on the MTF framework, what it takes to enable households to move to a higher level of service, are outlined in annex 1.

Although there is no one-size-fits-all solution, governments have recourse to innovative approaches that help them analyze affordability and inform the setting of subsidy levels. For example, Togo combined household survey data, satellite imagery, and mobile phone data to estimate incomes, while Rwanda linked subsidy levels to predefined socioeconomic categories (ESMAP and others 2024). Nigeria's DARES project uses a "vulnerability index" to consider affordability alongside higher distribution costs and risks in remote or insecure areas (Nigeria Rural Electrification Agency 2024).

Creating the conditions for private sector delivery and co-investment

Recent internal World Bank research has revisited the determinants of progress on electricity access worldwide since 1990, in addition to identifying the characteristics of lower-income countries that have high access rates. The resulting study covers 118 countries and offers detailed analysis of 48 low- and lower-middle income countries that have achieved universal access, including rapid improvers such as Bangladesh, Ghana, Nepal, and lower-middle-income countries that have surpassed 95 percent access rates.

Countries that gained universal access before 1990 did so largely as a byproduct of industrialization, urbanization, and economic growth. Their electrification was driven by industrial and commercial demand. Once countries had met nonresidential demand, dedicated programs were put in place to expand access to households, which in most cases took between five to eight years. This grid-focused approach worked well in more densely populated countries enjoying high rates of economic growth, with rising incomes driving electricity demand and facilitating utility cost-recovery. Around 75 percent of countries achieved universal electricity access only after reaching upper-middle or high income status. These patterns underscore the roles of fiscal capacity, institutional maturity, and sustained public investment. This slow-paced approach, however, and tended to focus on economic activity and infrastructure; remote and marginalized communities were the last to benefit.

Countries making progress after 1990 pursued welfare-oriented electrification strategies. They focused on households—leveraging DRE, working through the private sector, and leveraging private co-investment. By depending on geospatial, least-cost planning to reach rural and underserved populations, these countries used grid extension and distributed renewable energy deployed through national access programs; subsidies addressed affordability constraints. Taking advantage of new DRE technologies and business models, countries with low demand and dispersed populations in Sub-Saharan Africa and elsewhere made rapid gains. Between 2015 and 2023, Kenya connected an additional 20 percent of its population using off-grid solar solutions, while Rwanda connected more than 10 percent and Uganda more than 30 percent. https://trackingsdg7.esmap.org/sites/default/files/download-documents/chapter1_accesstoelectricity.pdf. (World Bank and others 2025).

A range of determinants (supply- and demand-side) enabled governments to leverage private sector capacity and co-investment to deliver access quickly and at scale. These determinants, outlined below, are positively correlated with speedy progress toward universal access (Parker and Liddle 2026).

Supply-side determinants

Costs and financing: Rising infrastructure costs pose a challenge as grids expand to remote and sparsely populated areas. Many countries face limited access to concessional finance, financially weak utilities, low private investment, and high upfront capital requirements for rural electrification. Countries that overcome these constraints have generally established electrification funds and used public subsidies to de-risk private investment. Concessional loans, blended finance, and public-private partnerships are common, alongside optimized grid design and least-cost technology mixes that combine grid extension, mini-grids, and solar home systems. Climate finance and results-based financing are also used to support DRE deployment.

Planning and tracking: Weak planning and data systems undermine electrification efforts. Outdated least-cost plans and poor integration of DRE reduce efficiency and discourage private investment. Effective countries rely on national geospatial electrification plans supported by GIS-based tracking systems that benefit from regular updates. They integrate grid and off-grid planning, streamline licensing procedures, and strengthen monitoring and evaluation systems so electrification strategies remain aligned with settlement patterns and demand.

Inclusion: Structural barriers, lack of legal recognition and insufficient consultation, as well as broader power and knowledge gaps, contribute to exclusion. Community-led electrification programs, gender-responsive design, targeted subsidies for poor households, and interventions devoted to displaced people can help to achieve inclusive outcomes. Solar home systems and mini-grids are generally used to reach remote and nomadic groups, while legal frameworks ensure indigenous consultation and protection of rights.

Institutional capacity is a critical determinant of success. Common challenges include the absence of dedicated electrification agencies, limited technical expertise, unclear mandates of government agencies, and weak coordination across ministries, regulators, and utilities. Countries with strong outcomes typically establish national electrification agencies with clear mandates, empower independent regulators, and create inter-ministerial coordination mechanisms. Technical assistance and regional power pool cooperation further strengthen institutional performance.

Demand-side determinants

Affordability and uptake: Once electricity supply is available, high connection fees, internal wiring costs, and household liquidity constraints can prevent uptake. Unreliable supply and unaffordable tariffs lead to affordability outages, particularly in conjunction with prepaid metering systems. Effective demand-side strategies include connection subsidies, output-based aid, PAYG solar financing, and instalment payment plans. Critical measures for improving uptake include lifeline tariffs, targeted social protection, and support for internal wiring (such as standardized kits or ready boards). Some countries have promoted the productive use of electricity to make electrification more economically viable.

Sociocultural factors: Low trust in utilities, inadequate information, unsafe housing, and reluctance to adopt wiring solutions slow adoption in some contexts. Countries address these challenges through awareness campaigns, simplified engineering standards, standardized wiring, and access to microfinance for household wiring, reducing both perceived and actual barriers to connection.

Characteristics of low- and low-middle income countries with high access rates

Low- and lower-middle-income countries with high electricity access rates share several defining features. Above all, there is strong government ownership of the electricity access agenda and commitment to creating an enabling environment for private sector delivery and co-investment. Private sector participation is enabled through clear frameworks for independent power producers, mini-grid operators, and off-grid solar companies that are active in the sector. Streamlined approvals, risk-mitigation tools, and tax or duty exemptions help crowd in investment. Strong planning and tracking underpin these efforts. National electrification plans use GIS-enabled least-cost analysis and fully integrate grid, mini grid, and standalone off-grid solar solutions. Annual public reporting, disaggregated data, and dashboards support evidence-based policy adjustment. Inclusion is prioritized, with programs targeting women, indigenous communities, and informal settlements.

Successful countries maintain stable, multiyear financing frameworks through rural electrification funds, levies, and blended donor finance. Subsidy systems—often backed by output-based aid—are targeted and well designed. They cover connection fees, internal wiring, and access to PAYG solar home systems. Subsidies are often linked to social registries, while institutional arrangements are strengthened through dedicated agencies, defined roles, and coordination mechanisms. Using lifeline blocks, cross-subsidies, and targeted support, tariff structures balance financial sustainability with equity to protect vulnerable consumers while moving toward cost-reflective pricing.

Success depends on effective implementation of national plans. In addition to strong government ownership and commitment, the effort requires capable institutions with clear mandates, staffed by qualified personnel ideally with private sector experience. By tracking the progress of agencies in charge of electricity access initiatives, governments can act when implementation falters. Implementation of national plans can also be bolstered by the application of digital solutions in procurement, monitoring, reporting, verification, and claim processing. Public-private dialogue helps government agencies identify company challenges early, so they can take action before delivery of results is put at risk.

Further leveraging DRE to deliver least-cost access

Alongside investments in grid generation, transmission, and distribution, DRE has enabled governments to meet demand more quickly, and at lower cost, than they could have managed with grid electrification. Proven DRE technologies and business models—such as PAYG off-grid solar—help governments deliver a Tier 1+ level of service to the remaining population, quickly and at scale, which leverages private sector capacity and co-investment. With limited public funding, a least-cost planning approach is best: service in line with demand and cost-efficient payments made with funding mechanisms like results-based financing. As those lacking access become harder to reach, DRE solutions are likely to create first-time access (ESMAP 2024).

The DRE sector is benefiting from powerful tailwinds. As solar PV costs fall, digital enablers (including geospatial planning tools, mobile money, PAYG) are expanding market reach and accelerating mini grid deployment now driven by a growing cohort of developers. Sector consolidation, emerging local supply chains, and innovative public-private financing instruments (such as those used in Nigeria's DARES program) further improve conditions for scale up (ESMAP and others 2024; ESMAP 2022a).

Governments are perfectly positioned to address the structural barriers constraining DRE sector growth. For example, public funding mechanisms can be designed to incentivize credit quality, avoiding over-indebtedness for households and high default rates for companies. Local currency financing can mitigate FX risks, which have been exacerbated by currency devaluations. In addition to subsidizing unprofitable, last-mile, first-time access, public funding mechanisms can support the sector's commercial health, enabling governments to attain private co-investment targets (ESMAP and others 2024; ESMAP 2022a).

DRE can be used to create jobs and accelerate economic growth through productive use of electricity, while supporting human capital development through the electrification of health facilities, schools, and community infrastructure. For example, solar water pumps boost agricultural productivity and food security, off-grid cooling technologies prevent food loss and reduce heat stress, and agricultural processing technologies save time and reduce costs (Efficiency for Access 2024). Provision of financing for income-generating appliances such as pressure cookers, grain mills, bench saws, grinders, and electric motors in mini grid–connected areas could boost average consumption per user by up to 48 percent, improving the financial viability of electricity supply (Crossboundary 2022). Public facilities can be electrified more sustainably through fee-for-service models that incentivize (and ensure sufficient financing for) long-term operations and maintenance through blended financing (WHO and others 2023).

Promoting productive use of electricity to enhance economic and fiscal impacts

Given the urgent need to stimulate economic growth, create jobs, and boost revenues, governments are exploring new ways to enhance the economic and fiscal impact of energy access interventions. Interventions to promote productive use—which accelerates uptake of electric appliances and machinery through financing and other forms of support—are widely regarded as critical to this effort. Potential approaches include scaling up existing productive use assets to leverage established value chains and supporting farmers and businesses to switch from "low capex/high opex" fossil fuel–powered assets to "high capex/low opex" renewable solutions that have lower lifetime costs. The economic and fiscal impact of energy access interventions depends less on connections and more on demand-side realities. Still, productive-use appliances and machinery are available and affordable thanks to financing and subsidies. Whether businesses can access other forms of support—such as business advice, business-to-business matchmaking, capacity building, and access to markets—is also critical. Efforts to promote productive use need to be scaled up across grid, mini grid, and off-grid settings.

Household electrification programs can also have strong economic and fiscal impacts. For example, the IDCOL solar home system program in Bangladesh generated USD 1.5 billion in economic and financial benefits after accounting for the cost of the program; this amount included the USD 654 million in benefits for the government, amassed primarily through SHS taxes and forgone kerosene subsidies (Cabraal and others 2021).

Gender-inclusive interventions in electricity access

Women are disproportionately vulnerable to energy poverty and have untapped potential as end-users, employers, and entrepreneurs. Access initiatives need tailored strategies to reach women as end-users, encourage their entry into the workforce, and support them as business leaders. For example, the Rwanda Renewable Energy Fund Project achieved strong results for women by pairing targeted subsidies with financing from local savings and credit cooperatives. By delivering subsidies and loans through cooperatives rather than commercial banks, the project made access affordable and access to finance for women-headed and low-income households, while also tracking gender outcomes and encouraging inclusive hiring by solar firms. This cooperative approach boosted women's share to 52 percent of beneficiaries. They received over one-third of the loans and held around 45 percent of the jobs in off-grid solar companies. Electricity access can transform gender-based outcomes. In India, the availability of rural electricity produces lower rates of gender-based violence and more reproductive autonomy (Pakrashi and others 2024).

Access initiatives can promote gender-inclusive business practices in the private sector through financial incentives, technical assistance, or eligibility requirements. Gender-inclusive practices include explicit hiring targets, upskilling initiatives, anti-harassment or equal-pay policies, and measures that strengthen business performance overall while strengthening women's safety or mobility and expanding its base of customers (Value for Women 2018). The Nigeria Electrification Project offered companies financial incentives for hiring women, set specific targets for electrifying households and small enterprises run by women, and promoted the use of electricity for income-generating activities traditionally managed by women. A technical internship program enabled hundreds of young women to move into technical roles traditionally dominated by men. The number of women employed in DRE companies more than doubled over the course of the project, which delivered access to 470,000 women-run households and 3,600 women-owned businesses.

Setting targets and monitoring progress are critical. At the project level, these efforts go beyond counting female beneficiaries to tracking workforce trends as well. The unique challenges facing women-led enterprises are described, along with the forms of empowerment derived from greater access (IEA 2025). At a global level, following the launch of the Policy Brief on Gender Indicators in Sustainable Energy in 2025, a coalition of partners is mapping gender across the energy sector (ESMAP and others 2025). The map will provide a base of evidence for a global report aimed at strengthening gender-responsive measurement frameworks in renewable energy.

Defining, measuring, and tracking access

SDG 7.1 aims to "ensure access to affordable, reliable, sustainable, and modern energy for all by 2030," but SDG 7 tracking relies on binary electrification data collected by governments from national utilities and household surveys. Since 2015, the MTF has sought to recognize access as multidimensional and to capture attributes such as availability, capacity, reliability, affordability, quality, safety, and legality (Bhatia and Angelou 2015). Governments now routinely use the MTF's tiers to set household access targets, and MTF surveys cover 28 countries so far. MTF surveys have small sample sizes, take long timelines to develop and implement, and hence are done sporadically, mostly using donor funding. 0These limitations affect their ability to capture spatial variation as well as change over time. The MTF needs to be updated and to continuously evolve. For example, capacity thresholds need to be updated, as Tier 1 SHS can now power appliances previously associated with Tier 2. Ongoing refinement of attributes is also needed to ensure the framework continues to reflect meaningful access and to support sound interpretations of policy.

To measure electricity access, governments are best served by taking a harmonized, multidimensional approach that integrates a subset of MTF survey questions into national household surveys. This ensures the regular collection of gender-disaggregated data, national ownership, and alignment with planning and budgeting processes. Standardization, digital data collection, and automated analysis can shorten survey timelines. Strengthening the capacity of national statistics offices would also be essential to regularly measure electricity access using a multidimensional approach.

Accelerating progress through Mission 300

Mission 300 is a joint initiative led by the World Bank Group and the African Development Bank, supported by a coordination group that includes more than 35 organizations working together to advance progress. The mission is to connect 300 million people in Sub-Saharan Africa to reliable, affordable electricity by 2030. As of March 2025, the World Bank Group and AfDB have helped connect nearly 48 million people by bringing power to homes, businesses, schools, and hospitals across Africa. The WBG is delivering access through around 150 projects that span the entire energy value chain. The WBG has pledged USD 30 billion in financing from the International Development Association and USD 5 billion through the International Finance Corporation and the Multilateral Investment Guarantee Agency to catalyze private sector investment. Another USD 18 billion are pledged by the African Development Bank for the 2024–30 period.

At the center of Mission 300 are National Energy Compacts, developed by African governments with support from the World Bank Group and the African Development Bank. These ambitious, time-bound reform packages set targets to expand access, boost renewable energy use, and attract private capital, while introducing reforms to make power sectors and utilities more sustainable. To date, 30 countries have launched these compacts with the ambition to connect around 470 million people by 2030, with several more scheduled for launch in June 2026. The compacts focus on five priority reform areas: (1) least-cost power generation through competitive tendering and integrated power planning; (2) regional integration to facilitate cross-border power trade; (3) distributed renewable energy and clean cooking solutions; (4) private investment across the energy value chain; and (5) financially viable power utilities.

Partnerships are at the core of Mission 300. The World Bank Group and the African Development Bank work with the Rockefeller Foundation, the Global Energy Alliance for People and Planet, SEforALL, the Energy Sector Management Assistance Program donors, and others to align financing, policy support, and expertise. This coordinated engagement has helped rally nearly USD 9 billion in WBG commitments to date, and approximately USD 1.4 billion in co-financing for World Bank Group projects alone. Key partners include the Asian Infrastructure Investment Bank, the European Commission, the European Investment Bank, the Islamic Development Bank, Italy, the OPEC Fund for International Development, and the Japan International Cooperation Agency.

The slower pace of electrification from 2020 to 2024 means that speedy action is needed both within and beyond Mission 300 to leverage the private sector and mobilize public and private financing. Scarce public funds should be used as efficiently as possible through least-cost solutions that supply electricity in line with demand, affordability, and a fiscally sustainable level of subsidy. Quick private sector delivery at scale with private co-investment is critical, as governments seek to maximize the social, economic, and fiscal impact of access initiatives.

Appendix 1 • Helping households move to a higher level of service

The Multi-Tier Framework (MTF) captures household electricity access across seven tiers—capacity, availability, reliability, quality, affordability, formality, and health and safety—using six tiers (figure A1.1). Solar home systems typically provide partial Tier 1, Tier 1, or Tier 2 access, whereas mini-grids and grid electricity generally offer Tiers 3, 4, or 5 levels of service. The MTF covers households, but not productive uses, or public institutions.

Figure A1.1 • The Multi-Tier Framework for electricity supply

ATTRIBUTES	INDICATOR	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Peak capacity	Power capacity ratings (in W or daily Wh)		Min 3 W	Min 50 W	Min 200 W	Min 800 W	Min 2 kW
			Min 12 Wh	Min 200 Wh	Min 1.0 kWh	Min 3.4 kWh	Min 8.2 kWh
Availability (duration)	OR Services		Lighting of 1,000 lmhr/day	Electrical lighting, air circulation, television, and phone charging are possible			
Availability (duration)	Hours per day		Min 4 hrs	Min 4 hrs	Min 8 hrs	Min 16 hrs	Min 23 hrs
	Hours per evening		Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	Min 4 hrs
Reliability						Max 14 disruptions per week	Max 3 disruptions per week of total duration < 2 hrs
Quality						Voltage problems do not affect the use of desired appliances	
Affordability					Cost of a standard consumption package of 365 kWh/year < 5% of household income		
Legality						Bill is paid to the utility, prepaid card seller, or authorized representative	
Health & safety						Absence of past accidents and perception of high risk in the future	

Source: Bhatia and Angelou 2015.

Consumption levels are typically low among the remaining population lacking access, whether they are connected using grid or DRE solutions, especially in rural Sub-Saharan Africa. When Ethiopia, Kenya, and other countries extended the grid to low-income households, low consumption strained utilities, which could not recover their costs (World Bank 2017). AC mini grids make Tier 5 power available 24/7. In practice, however, most household mini grid connections are Tier 3–4 as consumption is constrained by affordability.

With affordability a major constraint, households at all tiers struggle to access a higher level of service. But household access to a higher tier of service does not automatically translate into higher incomes, broader economic impact, and job creation. Productive uses that raise incomes, creates jobs, and drives economic growth takes place mainly in businesses and on farms, rather than in family homes. Evidence from mini grid and grid-connected settings suggests it can take five to ten years or longer for productive demand to emerge organically.

Productive uses of electricity are essential for boosting incomes in a range of settings: grid, mini grid, and off-grid. Through them, households can afford to consume more electricity. But they require distinct interventions that are tailored to the markets. After appliance financing was introduced, consumption jumped by more than 50 percent in mini grid settings. Finance, not just electricity supply, drives demand. In addition to subsidies and affordable financing, businesses need advice, B2B matchmaking, capacity building, and market access. These kinds of support help them convert the acquisition of assets for productive uses into more productivity, job creation, and economic growth. This support is often best delivered through cross-sector collaboration, for example, between energy and agriculture sector programs.

Technical constraints are also a factor. For example, quality-verified off-grid solar products tend not to be modular or interoperable, which makes it harder for off-grid products to access a larger system, especially during a PAYG repayment period. Least-cost Tier 3+ connections are generally delivered by grids or mini grids, which tend to target areas with higher population density. They are therefore less feasible in remote, rural areas.

CHAPTER 2

ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING

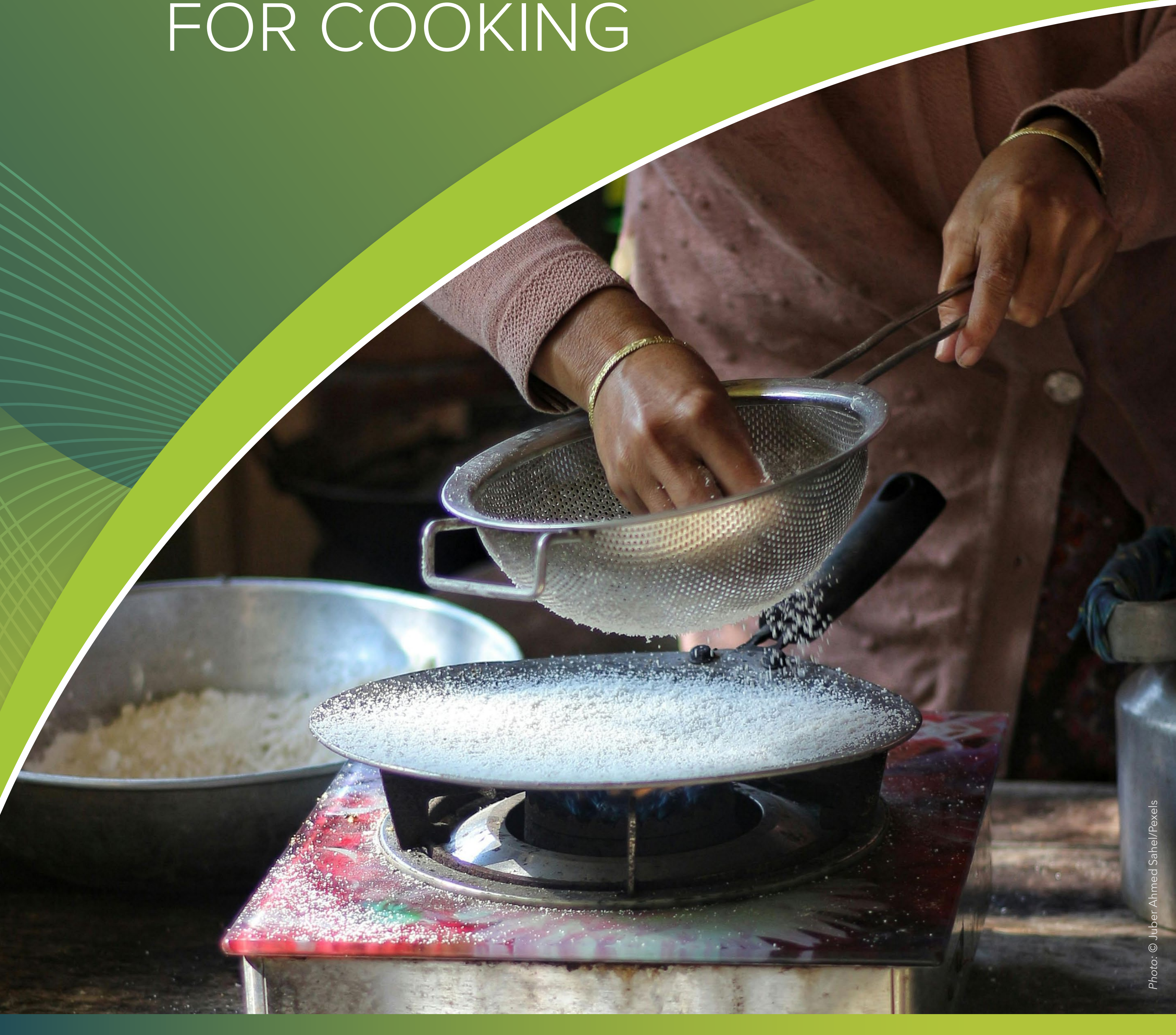


Photo: © Juber Ahmed Sahel/Pexels

Main messages

- **Global trend.** In 2024, an estimated 75 (71–78)[12] percent of the global population relied primarily on clean cooking fuels and technologies. Although this figure represents notable progress since 2010, roughly a quarter of the world's population—around 2.0 (1.8–2.4) billion people—remains dependent on polluting fuels and technologies for cooking.
- **Target for 2030.** Projections of current trends suggest that 79 (74–81) percent of the global population will have access to clean cooking by 2030, leaving 1.8 (1.6–2.2) billion people mainly reliant on polluting cooking. Slow progress in some parts of the world, combined with population growth and challenges to energy security, progress to narrow the global access deficit may slow and ultimately falter in the long-term.
- **Regional highlights.** The percentage of the population with access to clean cooking has almost doubled in most of Asia since 2010. However, the total population without access is growing in Oceania (excluding Australia and New Zealand), in Sub-Saharan Africa, and in Western Asia and Northern Africa. Some 970 (930–1,000) million people lack access in Sub-Saharan Africa alone, and that figure may reach 1 billion by 2027. By 2030, 58 percent of the global access deficit is projected to fall within Sub-Saharan Africa.
- **Urban-rural divide.** Access to clean cooking in rural areas in 2024—where an estimated 56 (51–60) percent of people —lags well behind urban areas, where the access rate is 89 (86–90) percent. Yet the urban-rural divide is narrowing as rural access rises. Of the 2.0 (1.8–2.4) billion people without access, 1.5 (1.4–1.7) billion live in rural areas.
- **The top 20 countries with the largest access deficits.** Three-quarters of the people without access to clean cooking in 2024 can be found in 20 countries. But a few of those countries account for the most marked decreases in the clean cooking access deficit since 2010. India alone accounts for about 40 percent of the decreases in the access deficit; China for a further 30 percent; and Indonesia for about 10 percent.
- **Global and regional fuel trends.** About two-thirds of all people in low- and middle-income countries (LMICs) mainly used gaseous fuels, such as liquefied petroleum gas (LPG), natural gas, or biogas, for cooking in 2024. Use of charcoal is also growing, particularly in Sub-Saharan Africa.
- **Electricity for cooking.** Even though 92 percent of households in LMICs had access to electricity in 2024, electricity remains a small part of the clean cooking energy mix. It is reported as the primary source of cooking energy primarily in urban areas. Its role is greater in LMIC's of Northern America and Europe.
- **Clean cooking in public institutions.** Schools, clinics, hospitals, prisons and other public institutions still rely on polluting fuels, creating health, financial, and environmental burdens. But within the problem lies an opportunity. Moving to electricity, biogas, or LPG in such institutions is highly scalable because of the predictability of their energy needs. Electric cooking in schools can cut costs by 26–85 percent, reduce smoke exposure, and improve efficiency. With expanding programs across Africa and other regions, complemented by global initiatives, schools offer an often overlooked opportunity to advance access to clean cooking while delivering myriad benefits.

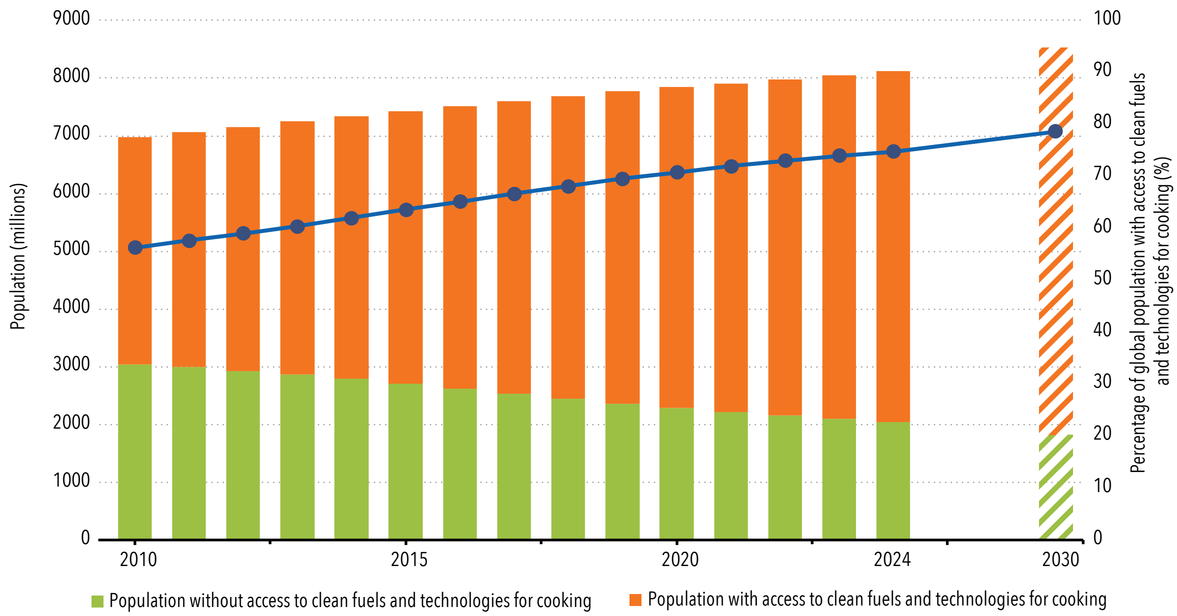
12 Throughout the chapter, figures appearing after estimates inside brackets/parentheses are 95 percent uncertainty intervals, as defined in annex 1. Clean fuels and technologies include stoves powered by electricity, LPG, natural gas, biogas, solar, and alcohol, as defined by the normative technical recommendations of the World Health Organization (WHO 2014). 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 or https://www.who.int/data/gho/data/themes/air-pollution/household-air-pollution.

- **Clean cooking and displaced populations.** Some 48.9 million forcibly displaced people may lack access to clean cooking based on the latest estimates from the Global Platform for Action. Yet these estimates remain largely absent from national data gathering and planning. Closing this data gap is essential to achieving universal access and ensuring that no one is left behind.
- **Policy insights.** Accelerating access to clean fuels and technologies for cooking demands high-level political leadership paired with cross-ministerial coordination to align policies on energy, health, development, climate, agriculture, and food security. Regional cooperation, such as the G20's clean cooking roadmaps, and enhanced climate finance mechanisms can build political commitment and bridge funding gaps, but broad success in ensuring access to clean cooking for those most in need will ultimately hinge on localized solutions—for example, solutions tailored to rural areas, public institutions, or to the 20 highest-deficit countries, which account for around 75 percent of the global access gap can ensure clean cooking access for those most in need.
- **Lighting the way to household energy transitions.** While the global shift to clean cooking remains uneven, progress in household lighting demonstrates what targeted action can achieve: The global population relying primarily on kerosene, oil, gasoline, paraffin or diesel lamps, or solid fuels for lighting dropped from an estimated 1.2 (0.7–2.0) billion people in 2000 to about 200 (90–410) million in 2024. The drop to 2 (1–5) percent of the global population means that a billion fewer people are no longer exposed to the most polluting and hazardous lighting options.

Are we on track?

In 2024, an estimated 75 (71–78) percent of the global population had access to clean cooking fuels and technologies such as electricity, LPG, natural gas, biogas, solar, and alcohol-based stoves. This marks an increase of 18 percentage points over 2010 (figure 2.1). Yet, despite this steady progress, an estimated 2.0 (1.8–2.4) billion people continue to rely mainly on polluting fuels—such as firewood, charcoal, crop waste, kerosene, and coal—for most of their household cooking. The impacts are profound, affecting the health of women and children disproportionately, threatening livelihoods, and complicating efforts to meet international environmental and development targets.

Figure 2.1 • Absolute number of people (left axis, bars) and percentage of the global population (right axis, line) with access to clean cooking, 2010–30

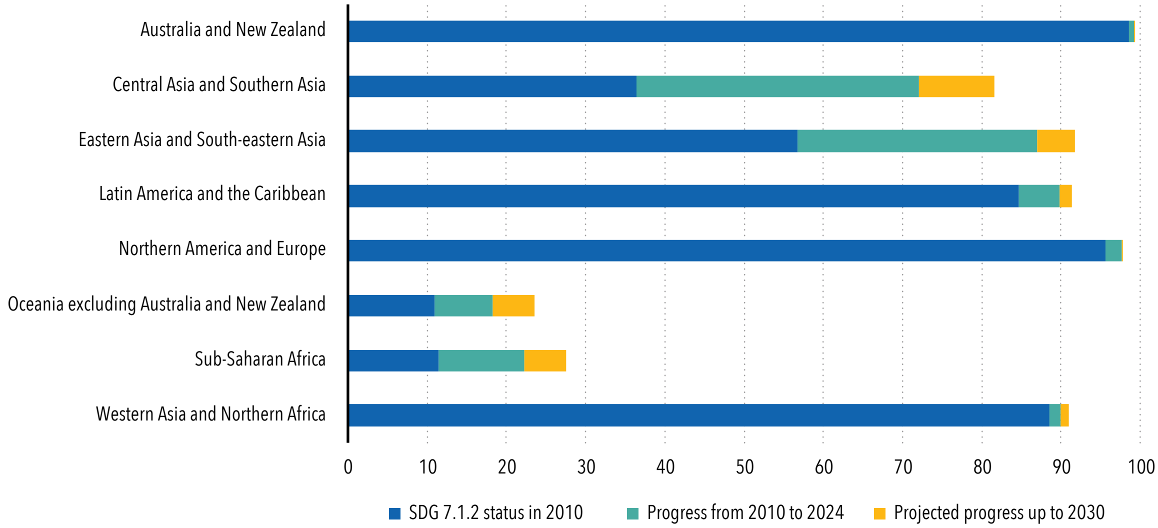


Source: WHO 2026.

Current projections suggest that 79 (74–81) percent of the global population will have access to clean cooking by 2030. If those projections are borne out, roughly 1.8 (1.6–2.2) billion people will be left without access and dependent on polluting fuels, falling starkly short of the universal access target set of Sustainable Development Goal (SDG) 7.

Despite a steady increase in the global percentage with access to clean cooking, much of the world is far from achieving universal access. Figure 2.2 shows, by region, the percentage of the population with access to clean cooking in 2010, progress from 2010 to 2024, and projected progress through 2030. In Central, Eastern, South-eastern, and Southern Asia, the percentage with access to clean cooking approximately doubled from 2010 to 2024.

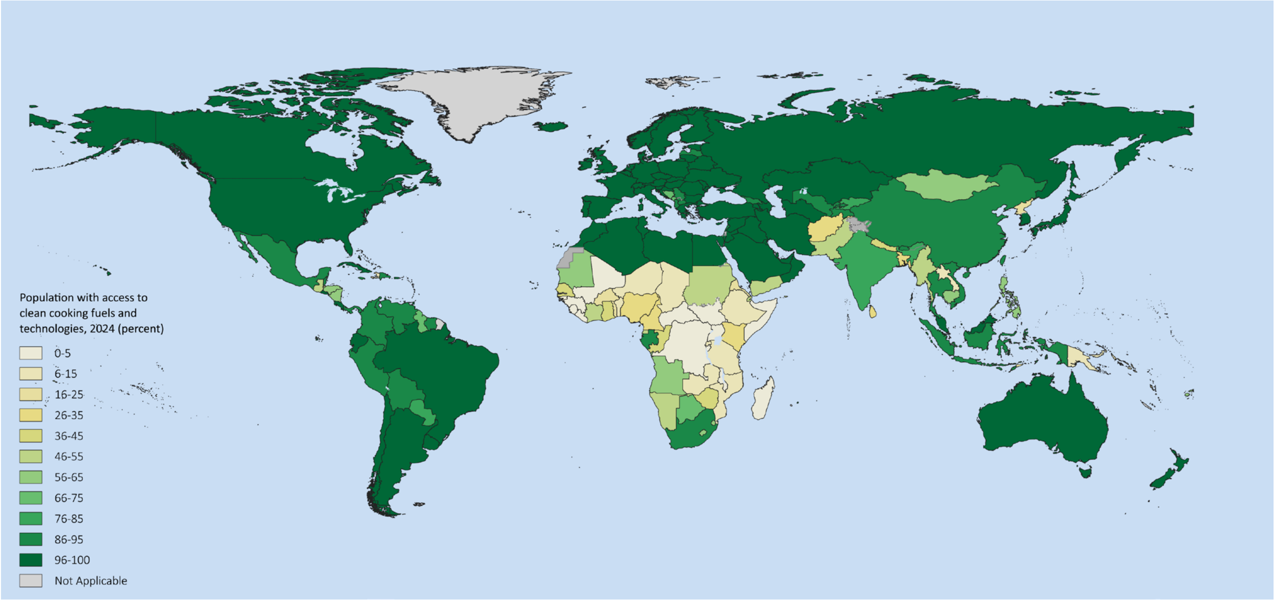
Figure 2.2 • Progress toward universal access to clean cooking, 2010–30



Source: WHO 2026.

To achieve SDG 7, most regions will have to progress faster than they are currently projected to do through 2030. But the scale of the challenge in Sub-Saharan Africa and Oceania (excluding Australia and New Zealand) is unlike that in any of the world's other regions. Here, those who have access to clean cooking are in a small minority—about 1 in 5 people. Especially low rates are found along a belt that begins in Western Africa and cover much of the Sahel and Eastern Africa (figure 2.3).

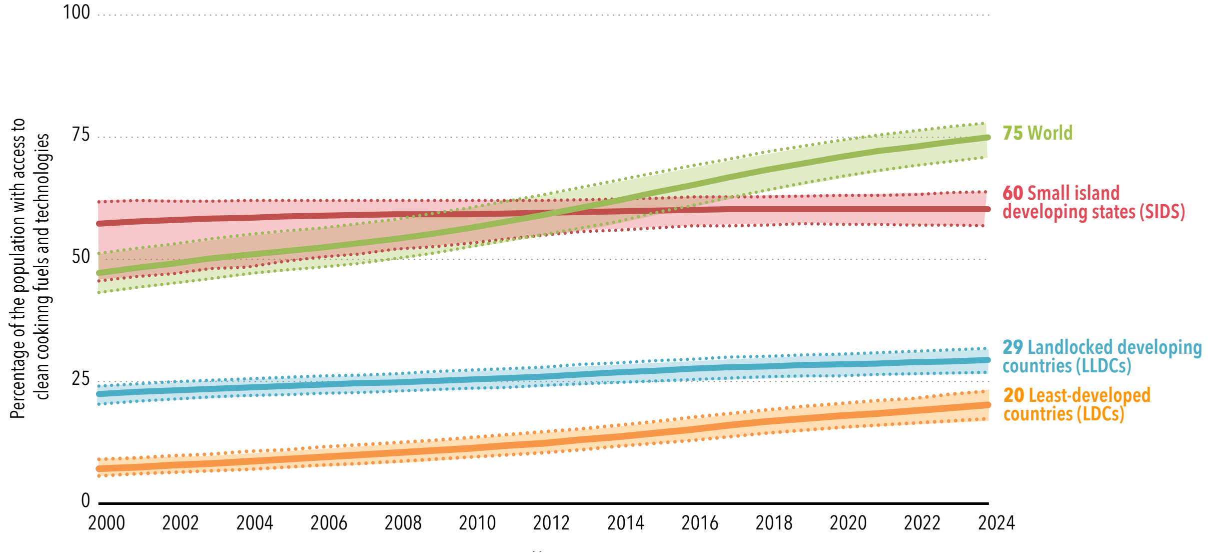
Figure 2.3 • Share of population with access to clean cooking fuels and technologies, 2024 (percent)



Source: WHO 2026.

The challenge of addressing low rates of clean cooking is not geographically bounded; it is faced by many least-developed countries (LDCs), landlocked developing countries (LLDCs), and small island developing states (SIDS) around the world. In 2024, only 20 (17–23) percent of people living in LDCs had access to clean cooking; 29 (27–32) percent had access in LLDCs; and 60 (57–64) percent had access in SIDS—all trailing the global average (figure 2.4). Access to clean cooking in SIDS used to exceed the global average but has fallen behind since the early 2010s owing to slower progress.

Figure 2.4 • Access to clean cooking fuels and technologies in LDCs, LLDCs, SIDs, and worldwide, 2000–24



Source: WHO 2026.

Note: Shaded areas are 95 percent uncertainty intervals.

Substantial barriers still impede progress toward universal access to clean cooking, including rapid population growth in the areas facing the greatest deficits, insufficient financing to scale up clean cooking solutions, and gaps in policies and regulations that could otherwise promote equitable access.

Without stronger commitments and new policies backed by financial support, most LMICs will fall short of universal access by 2030. In high-income countries, meanwhile, the vast majority of the population has transitioned to clean fuels and technologies for cooking, but 2 (1–7) percent still lacked access in 2024—about 30 (10–90) million people.

Over the past decade, global progress in access to clean cooking has averaged just 1.3 percentage points per year, slowing to 1.1 points over the last five years.

Looking beyond the main indicators

The access deficit

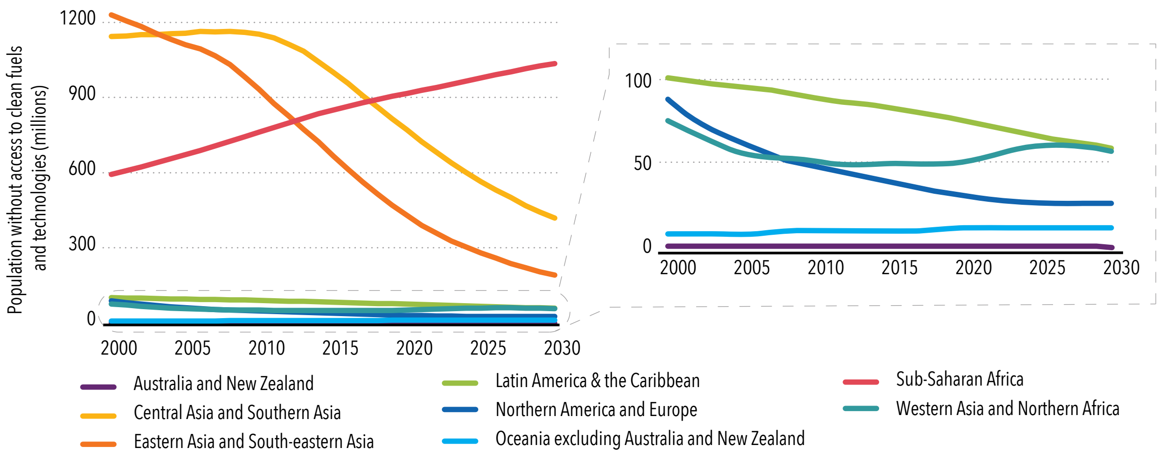
The main SDG 7.1.2 indicator focuses on the percentage of the population with access to clean fuels and technologies, but the absolute number of people without access—also known as the access deficit—often provides a more nuanced picture of progress towards universal access.

The global access deficit decreased only gradually between 1990 and 2020—from 3.4 (3.2–3.7) billion to 3.0 (2.8–3.3) billion. Thus, for two decades the deficit dropped by no better than 19 million people on average per year, as gains in the access rate as a percentage were largely offset by population growth.[13] In the years since 2010, the global deficit decreased much more rapidly (see figure 2.1), about 72 million people per year. As of 2024, 1 billion fewer people lived in households that relied mainly on polluting fuels and technologies for cooking than in 2010, a great stride forward on the path to universal modern energy.

However, this progress has not been felt equally across all parts of the globe, and disparate regional trends now threaten long-term global progress. Figure 2.6 shows the access deficit by region, with estimates for 1990–2024 and projections through 2030. Most of the reduction in the global access deficit has taken place in Central Asian and Southern Asian countries and in Eastern Asian and South-eastern Asian countries; the number of people without access has also decreased consistently in Latin America and the Caribbean and in Northern America and Europe. However, the deficit has grown in some of the small island developing states of Oceania and, since the 2010s, in Western Asia and Northern Africa.

The most pressing situation is Sub-Saharan Africa, where the number of people without access to clean cooking fuels and technologies continues to grow. In 2024, only 22 (20–25) percent of people in the region had access to (figure 2.5). This means that 78 (75–80) percent—970 (930–1000) million people—still mainly rely on polluting fuels and technologies to do their cooking. Although a growing number of Sub-Saharan African countries are taking steps to promote cleaner alternatives, population growth continues to outpace gains in access. The overall number without access in Sub-Saharan Africa is currently increasing by around 14 million per year and is expected to surpass 1 billion by around 2027.

Figure 2.5 • Number of people without access to clean fuels and technologies, by region, 2000-2030

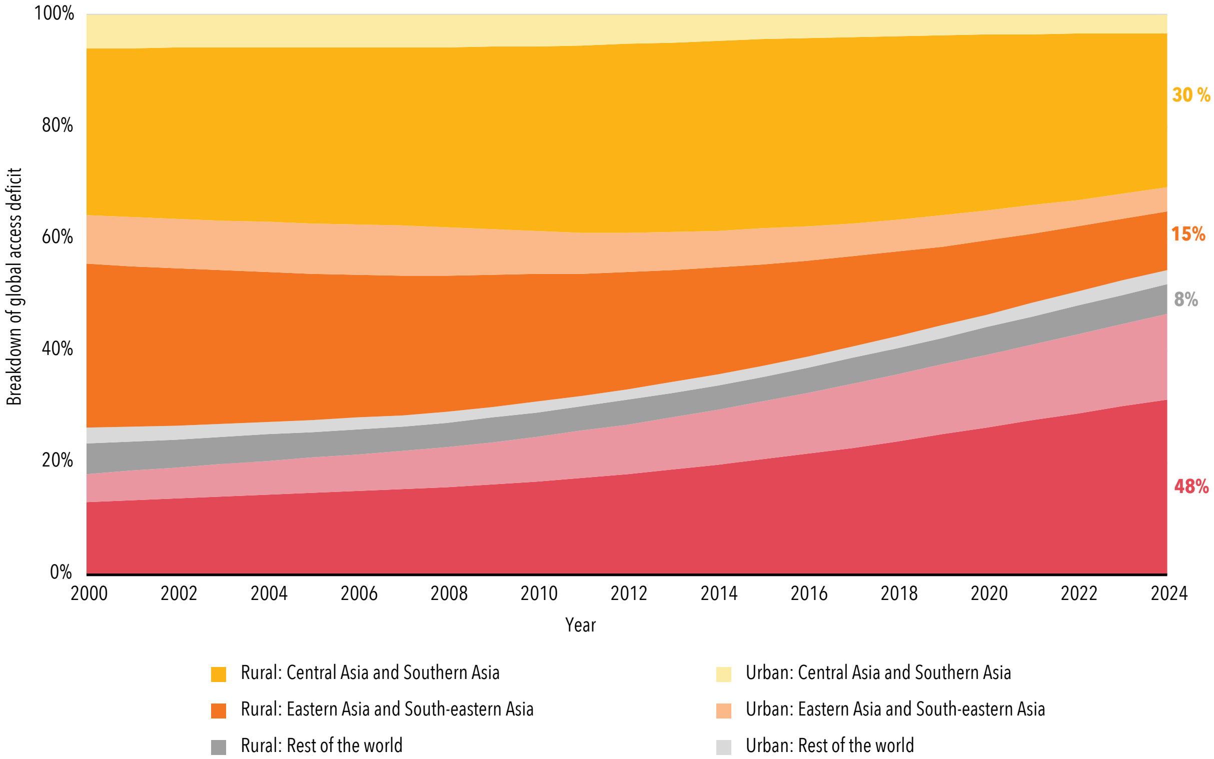


Source: WHO 2026.

13 If the proportion of the population with access to clean cooking remains constant, population growth will increase the absolute number of people both with and without access. Therefore, in a growing population, the access rate must increase at a minimum rate for the number of people without access to remain constant or increase at a higher rate for the number without access to decrease.

As the access deficits in each region change over time, the makeup of the global number of people without access also changes (figure 2.6). In 2000, Central and Southern Asia and Eastern and South-eastern Asia together accounted for 73 percent of the global access deficit, while Sub-Saharan Africa made up 18 percent. By 2024, Sub-Saharan Africa accounted for 48 percent of the global total, reflecting substantial progress in several Asian LMICs regions and the growing deficit in Sub-Saharan Africa. Without new interventions, the access deficit epicenter shifts to Sub-Saharan Africa where it is projected that 58 percent of people living in households without access to clean cooking by 2030.

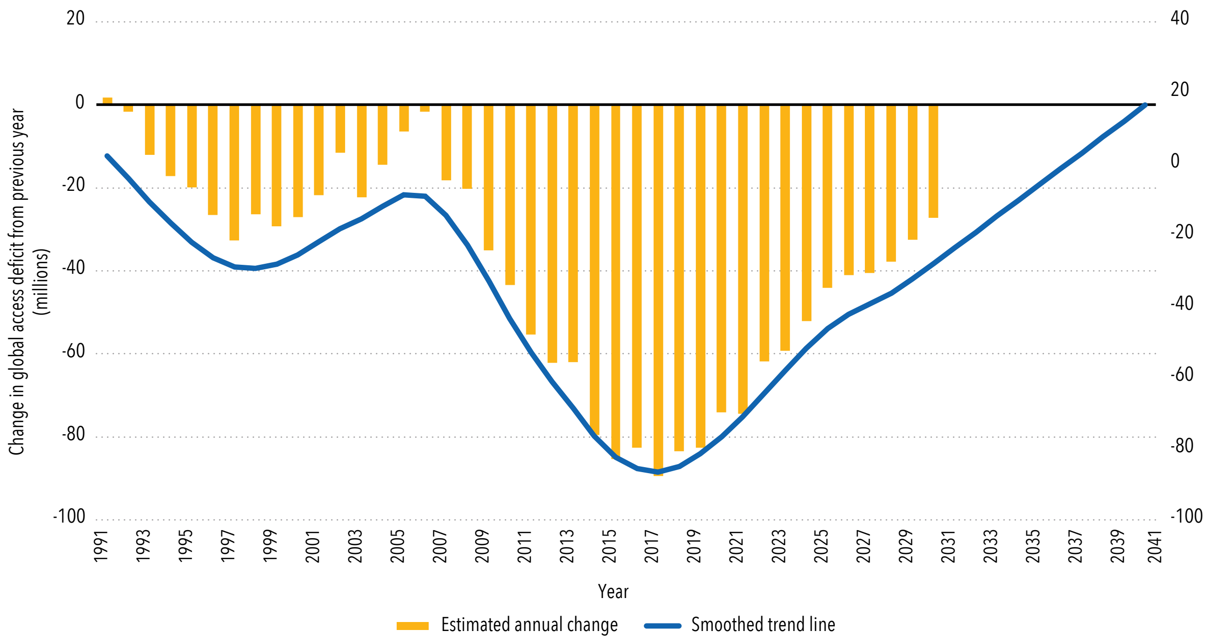
Figure 2.6 • Comparison between the three largest access-deficit regions and the rest of the world, 2000–24



Source: WHO 2026.

The global access deficit is on track to stop decreasing in the 2030s. Figure 2.7 shows the estimated annual change in the global access deficit—that is, the annual drop in the number of people still lacking access to clean cooking. The rate of decrease was fastest in the mid to late 2010s, with the global deficit dropping by about 80 million people each year. Since 2020, estimates and projected trends show a sharp deceleration of progress, with the annual decrease shrinking to about 30 million by 2030. Without new interventions, particularly in Sub-Saharan African and Asian countries with low clean cooking rates, the global access deficit may change directions and begin to widen again.

Figure 2.7 • Annual change in the number of people globally without access to clean fuels and technologies, 2000–30



Source: WHO 2026.

A scenario where the global access deficit begins to grow would be devastating for health and sustainable development. The most recent WHO data found that household air pollution from polluting fuels and technologies caused an estimated 2.9 million premature deaths in 2021, including over 309,000 children under five. Because these impacts grow with the number of people exposed to toxic cooking smoke, a future where the global access deficit stops shrinking is unacceptable.

The scale of the issue is even greater when considering the full extent of polluting fuel use in the home. The parallel use of polluting and clean cooking options, as well as the use of polluting fuels and technologies for heating or lighting can negate or minimize anticipated benefits, a subject discussed in the "Policy Insights" section, and in box 2.1.

Chief among the obstacles to promote clean cooking is the practice of using multiple fuels and technologies simultaneously ("stacking"), a common practice across income levels that can become problematic when economic instability or supply shortages force reliance on more polluting options. Supporting transitions to stacks of cleaner energy—where households rely on multiple clean cooking fuels and technologies (such as electricity and biogas)—is critical for full realization of clean cooking's benefits for health, gender equity, social equality, and climate mitigation.

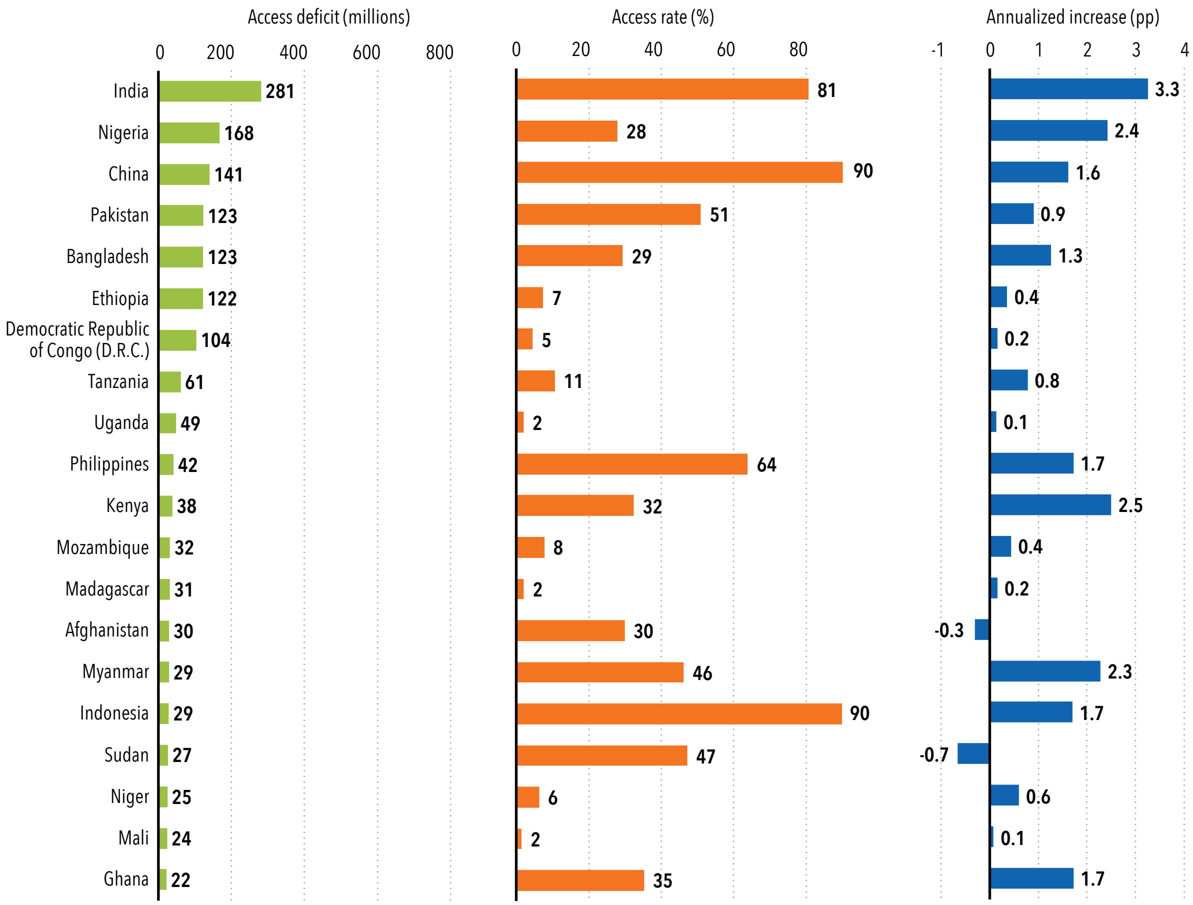
Addressing the stacking challenge demands tailored interventions that account for local economic conditions, local practices in cooking and other domestic energy use, infrastructure limitations, and the availability of sustainable clean energy options.

The top 20 access-deficit countries

The global access deficit is heavily concentrated: Just 20 countries account for about 75 percent of the total, with most located in Sub-Saharan Africa and the remainder in Asia. Eight of these countries—all LDCs with substantial displaced populations—have particularly severe shortfalls. No more than 10 percent of households use clean fuels in the Democratic Republic of Congo, Ethiopia, Madagascar, Mali, Mozambique, Niger, Uganda, and the United Republic of Tanzania (figure 2.8).

Fourteen of the top 20 access-deficit countries have access rates of around 50 percent or less. Because of their large populations, China and Indonesia have the 3rd and 16th highest absolute deficits, despite the fact that 90 percent of their households mainly use clean cooking fuels and technologies (figure 2.9). India has the highest access deficit of all countries but has made notable progress, achieving annualized increases of about 3 percentage points in recent years.

Figure 2.8 • Top 20 countries with the largest access deficit in 2024 (green), their access rate (orange) and annualized increase in access (blue), based on a 2019–24 average

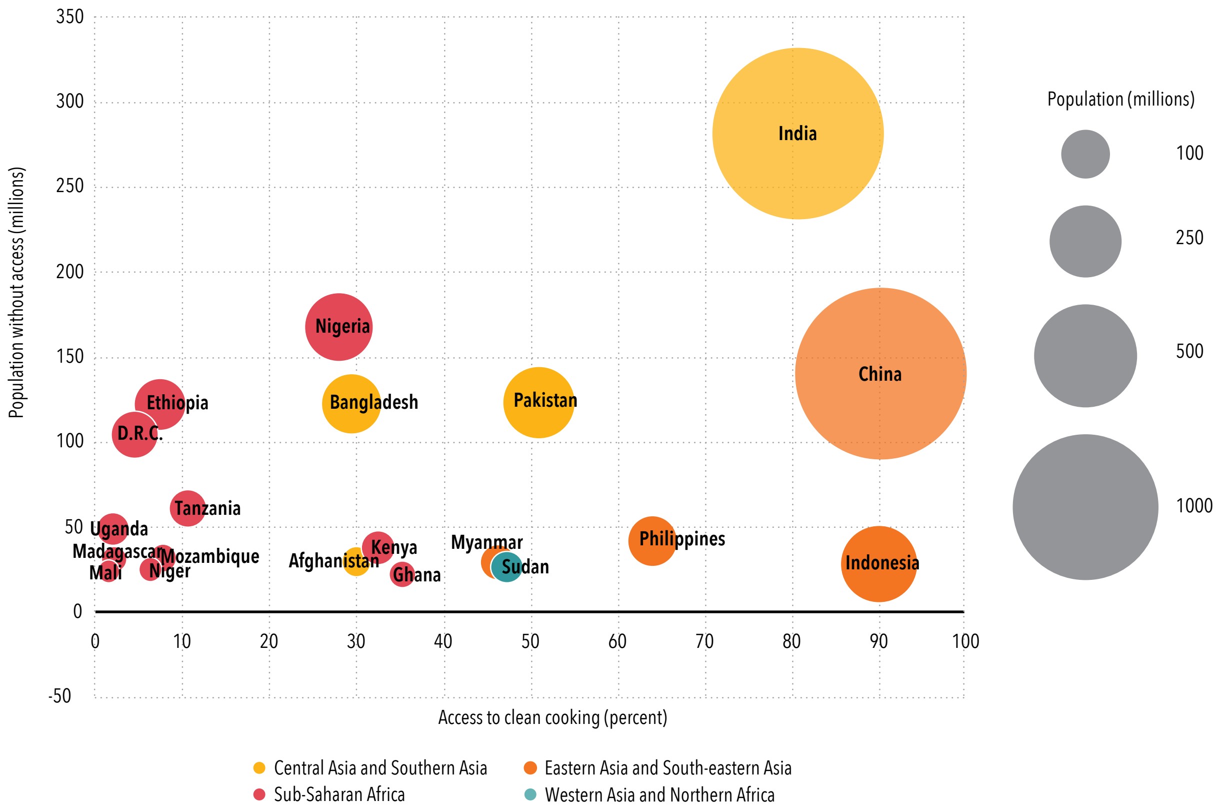


Source: WHO 2026.

pp = percentage point.

While the access deficit remains concentrated in a few countries in 2024, it is also true that transitions in these same countries account for much of the progress made to reduce the global access deficit since 2010. Progress in India alone accounts for about 40 percent of total national decreases in the population without access since 2010[14]; China approximately accounts for a further 30 percent, and Indonesia 10 percent. Once these countries complete or nearly complete their transitions, progress in the global level indicator will slow and likely stall, without stronger interventions elsewhere.

Figure 2.9 • Relationship between access rate, population without access, and population size among the 20 countries with the largest populations without access



Source: WHO 2026.

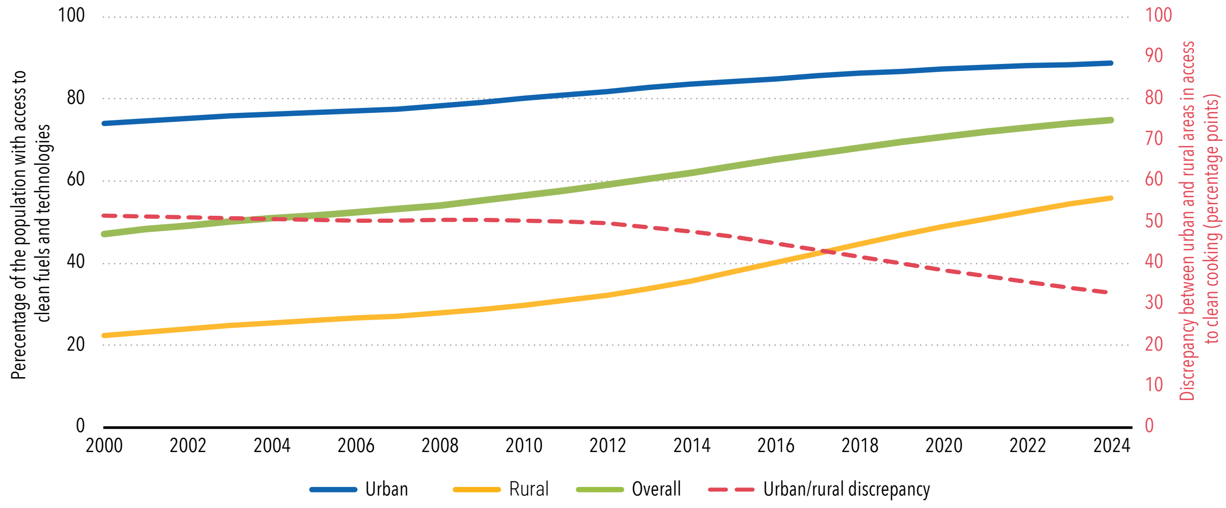
The urban-rural divide

The gap in access to clean cooking between urban and rural households persists, with urban households being more likely to use mainly gas and electric stoves. In 2024, 89 (86–90) percent of people in urban areas have access to clean cooking, compared with 56 (51–60) percent of people in rural areas (figure 2.10).

Of the 2.0 (1.8–2.4) billion people living in households without access worldwide in 2024, 1.5 (1.4–1.7) billion live in rural areas. The global urban-rural divide is narrowing over time, as urban areas in many countries approach 100 percent access and rural access rates rise, especially in some LMICs.

14 "Total national decreases" is calculated as the sum of the drop in the population lacking access in countries where the access deficit fell during the period 2010 to 2024 (that is, excluding countries where the population without access increased).

Figure 2.10 • Percentage of people with access to clean cooking in urban areas, rural areas, and overall (solid lines), and difference in access between urban and rural areas (dashed line), 2000–24

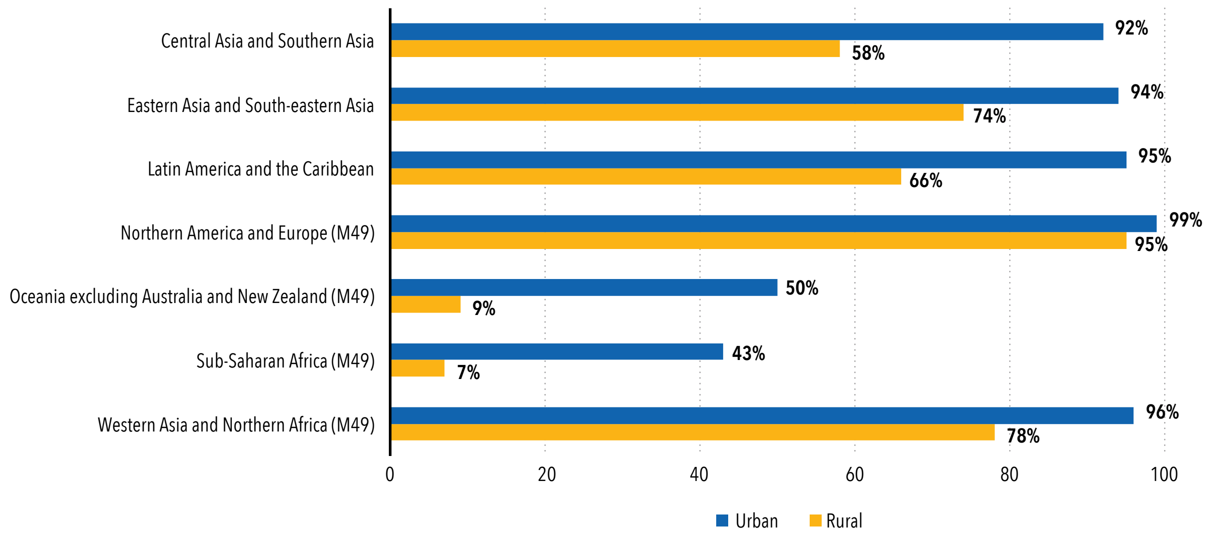


Source: WHO 2026.

Typically, urban areas of LMICs have stronger infrastructure, more reliable energy supplies, and higher incomes. Rural areas, by contrast, lack the infrastructure and market base for large-scale fuel and appliance distribution (ESMAP 2020). Rural access is most dire in Sub-Saharan Africa—where only 7 (6–9) percent of people mainly use clean fuels and technologies—and in Oceania (excluding Australia and New Zealand), where rural access is only 9 (4–26) percent.

Urban access to clean cooking has surpassed 90 percent in Central Asia and Southern Asia, Eastern Asia and South-eastern Asia, Latin America and the Caribbean, and in Western Asia and Northern Africa, but rural access ranges from 58 percent to 78 percent among these regions. In much of the world, therefore, rural areas are proving to be the last bridge to cross in pursuit of universal access (figure 2.11).

Figure 2.11 • Percentage of population with access to clean fuels and technologies for cooking, by residence and region (2024)



Source: WHO 2026.

Changes in the fuel mix

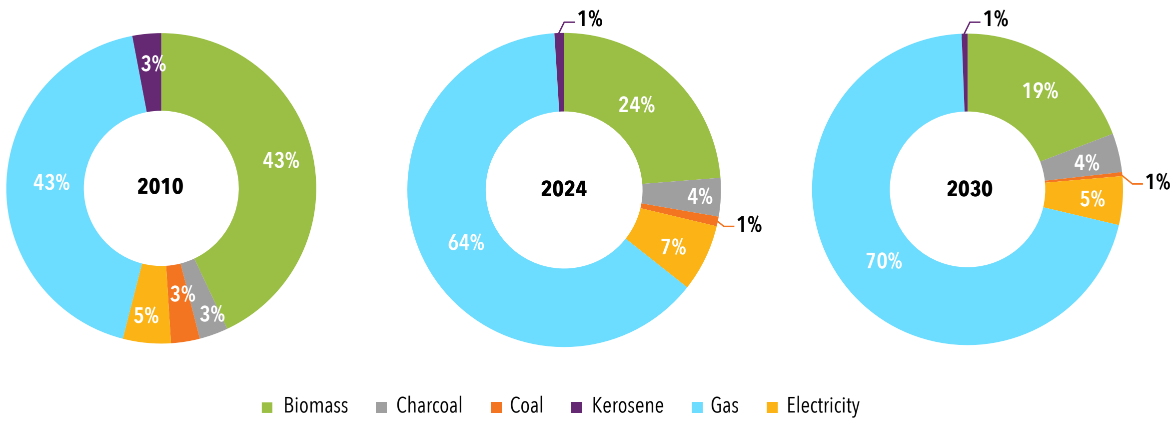
The fuel mix in low- and middle-income countries continues to evolve. As of 2024, gaseous fuels (LPG, natural gas, and biogas) are the dominant energy source, mainly used by 64 (59–68) percent of the population in LMICs. Up to 2020, unprocessed biomass fuels were mainly used by more than half of people in rural areas of LMICs—where they are often gathered at no financial cost—but this dropped to 42 (37–48) percent by 2024, and most rural inhabitants now mainly rely on gaseous fuels or electricity.

Charcoal has a growing number of users as the main cooking fuel, reaching 4 (3–4) percent of people in LMICs in 2024—about 240 million people—compared to 3 (2.5–3.3) percent in 2010. Much of this growth has taken place in Sub-Saharan Africa, due to a slight increase in its use in rural areas: from 6 (5–8) percent in 2010 up to 9 (7–11) percent in 2024. The change came on top of a slight increase in the already high rate of use in urban areas—from 26 (24–29) percent in 2010 to 30 (25–34) percent in 2024—and population growth.

The WHO Guidelines for indoor air quality: household fuel combustion (WHO 2014) advise against using coal and discourage kerosene use to meet household energy needs. The shares of both have since greatly diminished (figure 2.12), though they are still used as the main fuel source by about 80 million people in LMICs worldwide. The percentage mainly using coal for cooking in 2024 was effectively 0 in all regions except Eastern Asia and South-eastern Asia, where 1 (0–4) percent still make primary use of it. Use of kerosene was also very close to 0 percent in most regions, but as of 2024 it is still mainly used by 3 (1–5) percent in Oceania (excluding Australia and New Zealand) and 1 (1–2) percent in Sub-Saharan Africa.

Electricity plays a growing role in LMICs. In 2024, it was used by 6 (4–10) percent of people as their main energy source for cooking. Use of electricity as the main fuel is lowest in rural areas of Central Asia and Southern Asia—1 (0–2) percent of the population—and highest in urban areas of Northern America and Europe—20 (13–44) percent of the population.

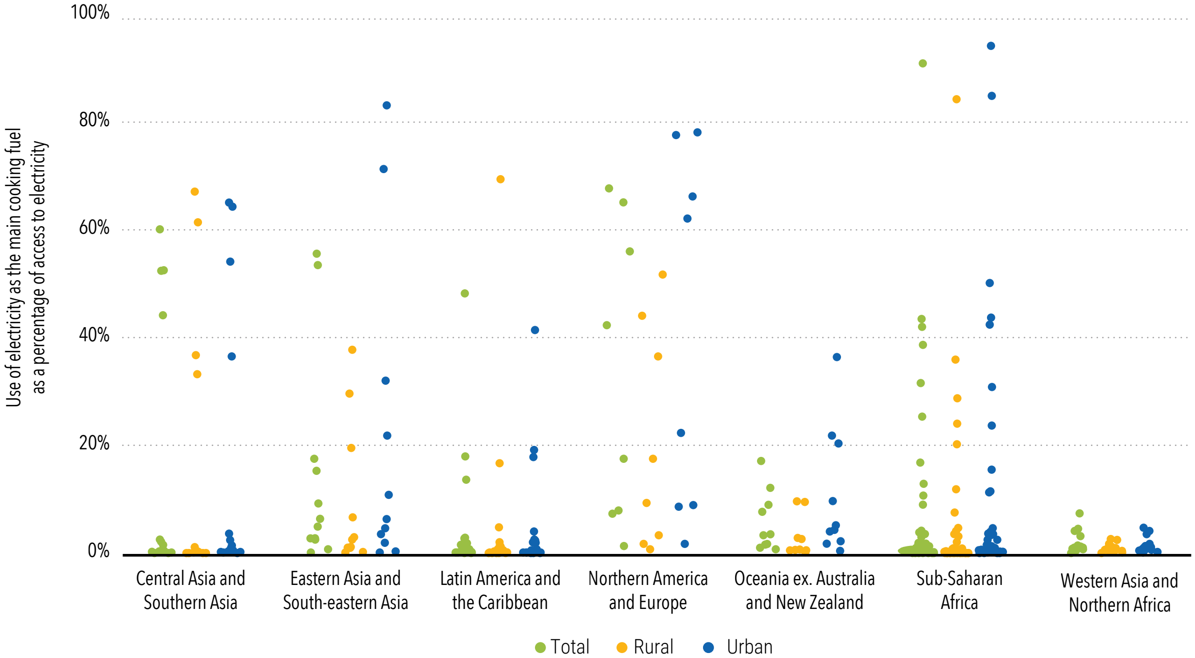
Figure 2.12 • Comparison of the percentages of people in LMICs relying primarily on various fuel types for cooking in 2010, 2024, and projected in 2030



Source: WHO 2026.

Viewed from a different angle, only a small fraction of the population with access to electricity (SDG 7.1.1) reports using electricity as their main source of energy for cooking. Figure 2.13 shows the percentage of the population in individual LMICs using electricity as their primary cooking fuel in 2024 as a fraction of the percentage of the population with access to electricity in the same year. The rates range from 0 percent in many LMICs to more than 90 percent in urban areas of South Africa. Broadly, use of electricity for cooking is higher in urban areas—which also tend to have higher rates of electricity access. This likely aligns with urban residents having greater access to more adequate electricity supplies to meet the power needs of cooking, which is often energy intensive.

Figure 2.13 • Use of electricity as the main fuel for cooking in LMICs in 2024 (percentage share)



Source: WHO 2026.

Use of electricity for cooking also varies by region. The share using electricity as their primary cooking fuel is about 1 percent for a typical (median) LMIC in Central Asia and Southern Asia, Latin America and the Caribbean, Sub-Saharan Africa, and Western Asia and Northern Africa. Use tends to be higher in a typical LMIC in Oceania excluding Australia and New Zealand (about 3 percent) and Eastern Asia and South-eastern Asia (about 6 percent) and tends to be highest in a typical LMIC in Northern America and Europe (about 30 percent). In all regions, some LMICs have a much higher percentage use of electricity access for cooking than others.

The variability in the percentage use across the urban/rural divide, across regions, and across LMICs in the same part of world suggests that use of electricity as the main cooking fuel does not simply increase proportional to overall access to electricity. Instead, it depends on a range of factors, including affordability of electricity and appliances, the reliability of supply, the relative costs of electricity and alternative fuels, cultural practices and preferences, housing characteristics, and the availability of infrastructure and policies that support sustained use.

Policy insights

Progress has been made across all SDG 7 targets since the launch of the 2030 Agenda for Sustainable Development, yet clean cooking lag furthest behind. In 2024, about 75 (71–78) percent of the global population had access to clean cooking fuels and technologies, marking an increase of 18 percent compared with 2010. Yet around 2.0 (1.8—2.4) billion people still rely on polluting fuels and technologies for cooking, and current trends suggest that about 1.8 (1.6–2.2) billion people could still be left behind in 2030.

Looking only at the main indicators, however, can mask much of the important progress that has been made to date in some of the enabling conditions needed to accelerate the transition. Those enabling conditions include greater political demand and commitment, increased investments (see chapter 5), improved technical competence, and overall readiness of national governments to scale up clean cooking. Progress in these areas should therefore be monitored with process indicators alongside clean cooking access rates to better capture a country's readiness and progress in implementation. This also points to the need for a fuller government systemic approach to measuring progress.

The policy case for clean cooking is further reinforced by its health, gender, social, and other implications. WHO estimates that household air pollution resulting from inefficient household energy use was responsible for 2.9 million deaths in 2021, including more than 309,000 deaths among children under five (WHO 2025a). This is likely an underestimate given the increased risk from household air pollution resulting from stove-stacking and inefficient energy use for lighting and other household energy uses (box 2.1). Women and children continue to bear a disproportionate burden linked to gendered patterns of unpaid household work, including cooking, fuel collection, and care responsibilities. Polluting cooking is a major source of outdoor air pollution, as well, adding to the health toll by increasing health and climate risks for all community members. A more multidimensional approach to tracking household energy access and use, including time spent, affordability, safety, convenience, and user needs, could better identify the households and population groups most affected and inform targeted interventions. Clean cooking as part of a broader clean household energy agenda should therefore be treated not only as an energy access issue, but also as a practical intervention for public health, gender equality, and cleaner air, with additional benefits for climate change mitigation.

Box 2.1 • Looking beyond cooking: trends in access to clean lighting

The *WHO Guidelines for indoor air quality: household fuel combustion* (WHO 2014) emphasize the importance of addressing all fuels and technologies used in the home, for lighting as well as for heating and cooking. A renewed push to complete the transition to universal access to modern energy for lighting is low-hanging fruit for SDG 7, since the overall energy requirement for lighting is relatively low compared to that for cooking and heating, and since options like solar systems require comparatively little infrastructure to deploy.

An exploratory statistical analysis of household survey data on fuels and technologies used for lighting has revealed strong global shifts toward cleaner solutions in the past two decades[15].

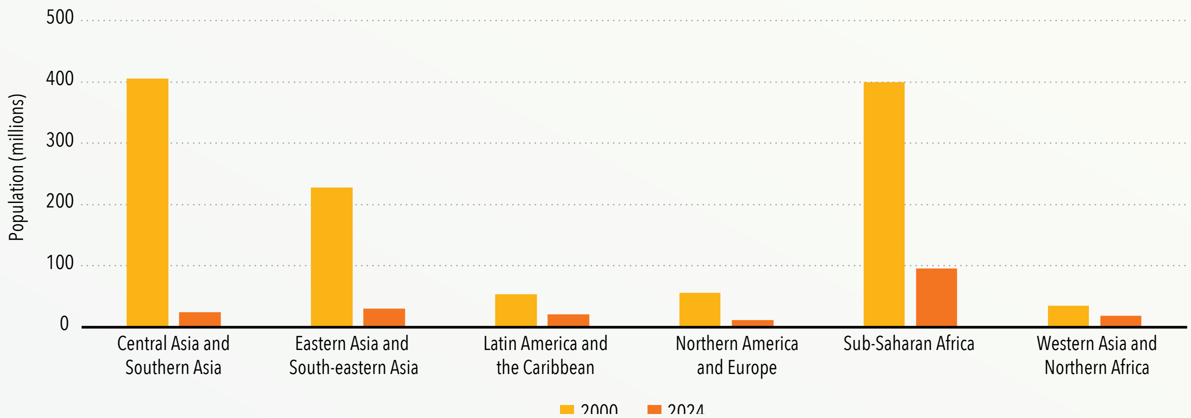
In 2000, an estimated 1.2 (0.7–2.0) billion people—or 19 (12–32) percent of the global population—mainly relied on kerosene, oil, gasoline, paraffin or diesel lamps, or solid fuel to meet their lighting needs, all at the expense of high exposure to pollution at the point of use. By 2024, this number had dropped sharply to 200 (90–410) million, or 2 (1–5) percent, meaning about 1 billion fewer people were exposed.

While the global trend is positive, regional progress is uneven (figure 2.1.1). Notably, in Central Asia and Southern Asia the percentage of people mainly relying on polluting lighting options dropped from 27 (8–54) percent in 2000 to just 1 (0–5) percent in 2024—a decrease of almost 400 million people suggesting a near complete transition. Most of the progress occurred in rural areas, where the percentage relying mainly on polluting fuels and technologies dropped from 35 (11–68) percent to 2 (0–6) percent.

The overall percentage also decreased substantially in Sub-Saharan Africa, from 62 (44–80) percent in 2000 to 8 (2–19) percent in 2024. In Oceania (excluding Australia and New Zealand), the share of people still exposed to polluting fuels and technologies for lighting in 2024 was similar, at 8 (0–37) percent. Because of its large population, Sub-Saharan Africa makes up almost half of the population remaining exposed in 2024.

The gap in access to modern lighting solutions can also be found on the urban–rural dimension, though this gap has been steadily closing since 2000. As of 2024, 1 (0–4) percent of people in urban areas mainly rely on polluting lighting, compared to 4 (2–9) percent in rural areas.

Figure B2.1.1 • Population mainly using polluting fuels and technologies (kerosene, paraffin, oil, diesel, gasoline, and solid fuels) for household lighting



Source: Joint analysis by the University of Glasgow and WHO

Note: Oceania (excluding Australia and New Zealand) is not plotted but amounts to about 1 million people mainly using the polluting options in 2024.

15 Joint analysis by the University of Glasgow and WHO of household survey data on fuels and technologies used for lighting

Securing high-level political support

Since the inception of the Agenda for Sustainable Development, building political support for clean cooking at the global and national levels has been a priority. The lack of high-level support and commitment has been a persistent challenge, one reflected in the historical under-recognition of the problem, limited policy action on the ground and ultimately leading to detrimental impacts like unpaid time, labor, and health and safety costs of the most vulnerable populations, particularly women and children and those displaced populations living in fragile settings. With many competing priorities, securing political commitment early on helps to ensure that clean cooking stays high on the policy agenda and receives adequate funding. Sustained commitment is also needed to enhance coordination and cooperation locally and regionally, and to ensure that the necessary infrastructure, supply chains, and regulatory mechanisms are in place for successful adoption of clean cooking practices in communities.

Political support for clean cooking has grown significantly on the global and national stages over the past decade. The 2024 Clean Cooking Summit in Africa—co-chaired by Tanzania, Norway, the African Development Bank, and the International Energy Agency—marked a major turning point by mobilizing a record USD 2.2 billion in pledges, securing a Clean Cooking Declaration from more than 130 governments and organizations. Funding of USD 470 million has already been disbursed ahead of the pace needed to reach the 2030 targets, and a follow-up summit is planned for the latter half of 2026. In 2025, several key global events promoted clean cooking, gaining commitments from heads of states, ministers, and other decision-makers working in finance, climate, and health, among other sectors. For example, clean cooking was included for the first-time as a standing item under South Africa's G20 presidency (building on the road map developed under Brazil's presidency), with G20 leaders recognizing the benefits for dignity, health, climate, and gender equality that clean cooking affords and calling for investment to accelerate access to clean cooking in Africa. The *G20 Clean Cooking Legacy Programme and the Voluntary Infrastructure Investment Action Plan: Closing the Clean Cooking Gap* were launched together, setting out a pathway for enhanced investment, infrastructure, and finance for clean cooking (G20 2024).

At COP30 (the 30th session of the United Nations Climate Change Conference), held in Brazil in November 2025, clean cooking was included as an outcome under the *United Arab Emirates Just Transition Work Outcome Programme* (UNFCCC 2025). Inclusion recognizes the need for parties to the UNCCC and other stakeholders to scale up access to clean cooking. The World Bank's Global Air Pollution Challenge of halving the number of people exposed to high levels of PM2.5 by 2035, together with the related flagship report, recognized clean cooking as a key pathway to clean air for all, providing some key policy measures complemented by success stories on the ground (World Bank 2025a).

At WHO's 78th World Health Assembly in 2025, health ministers from all WHO Member States adopted an "Updated Roadmap for an enhanced global response to the adverse health effects of air pollution". The road map sets a voluntary target to reduce the health impacts from air pollution by 50 percent and calls on the health sector to promote the adoption of clean cooking as a means to achieve the target (WHO 2025b). Similarly, the UN General Assembly's recent "Political Declaration on Noncommunicable Disease and Mental Health" recognizes access to clean cooking fuels and technologies as a key intervention to address the burden of noncommunicable disease, particularly among women living in LMICs (UN General Assembly 2025). Gaining political commitment at the highest levels and integrating clean cooking goals into other initiatives can help to ensure that action on clean cooking is prioritized as a cross-sector development priority.

Facilitating cooperation at the national and regional levels

High-level political support can lay the groundwork for cooperative integration of clean cooking into the policy frameworks of multiple ministries and other units of national government.

Considering the breadth of the clean cooking ecosystem, a national strategy to ensure coherence among the policies and actions of various ministries and institutions improves efficiency and maximizes the impact of limited resources. Such whole-of-government approaches are attractive to donors and private-sector actors who want to ensure positive returns and impacts from their investments in local infrastructure and clean cooking markets.

For example, Kenya's National Cooking Transition Strategy (2024–2028), supported by the president's office and grounded in the Kenyan constitution's declaration of a "right to a clean and healthy environment," establishes an ambitious target for achieving universal access to clean cooking by 2028 (Ministry of Energy and Petroleum 2024). The strategy has identified three key constraints for clean cooking in their national context and lays out five action areas supply, affordability, local manufacturing and production, awareness-raising, and accountability. It also quantifies the needed investment and expected benefits for the nation's economy, health, climate, and environment. The strategy identifies the Ministry of Energy and Petroleum as the lead agency and sets out the roles of other national and local entities (e.g. county governments, Ministry of Health, National Treasury, Ministry of Environment, Climate Change and Forestry, standards bureau) in implementation. It further elucidates local barriers and opportunities and delineates their interconnected nature, calling for holistic and systematic change, including ensuring clean cooking in public institutions like schools (box 2.2). This kind of framework amplifies coordination capacity, translates national ambition into a clear implementation structure, and supports a systematic approach to tracking progress.

Other countries, too, are translating ambitious targets into implementable plans through national and local coordinated action. The government of India's Pradhan Mantri Ujjawala Yojana (PMUY) and Give It Up Campaign have demonstrated how high-level political support can help spread access rapidly and equitably, in part by strengthening distribution and delivery systems and improving public communication (Government of India, Ministry of Petroleum and Natural Gas N.d.).

New national programs backed by African political leaders in countries like Ethiopia, Tanzania, and Uganda are helping to move the regional needle on access to clean cooking (MoWE 2025; Ministry of Energy 2024; MEMD 2025). Each of these countries is implementing a national strategy that includes key objectives for relevant government institutions and ministries. For example, Tanzania's implementation matrix calls on the Ministry of Community Development and Gender, the Ministry of Education, and the Ministry of Health to raise public and institutional awareness of clean cooking. It calls on the private sector to work with the ministries of Finance and Energy to lower the costs of energy and appliances for clean cooking (Ministry of Energy 2024). Such coordination can also help ensure that policies address both supply-side constraints and household-level factors, such as affordability, decision-making, user preferences, and the appliance needs of women and other primary cooks.

Clean cooking is also a recurring theme in countries' newly updated Nationally Determined Contributions submissions in 2025, reflecting a determination to transition from traditional biomass to modern cooking solutions, including electric cookstoves, biogas systems, and improved cookstoves.

Box 2.2 • Clean cooking in schools

While global tracking of progress on clean cooking has focused largely on households, schools and other public institutions prepare meals for hundreds of millions of people every day, often using firewood or charcoal. This creates a set of environmental, financial, and social challenges. Polluting fuels expose cooks and schoolchildren to harmful smoke; contribute to deforestation, forest degradation, and emissions; and strain school budgets. In many contexts, procuring, transporting, and storing fuel also create a substantial administrative and logistical burden.

Clean cooking solutions address these challenges. The case for action is particularly strong in institutional settings because cooking demand is strong, regular, and predictable, which makes transitions easier to plan, finance, and scale than is the case in dispersed household markets. Emerging global initiatives, including efforts by the School Meals Coalition, are increasingly recognizing school cooking, in particular, as a major, aggregated energy demand that can unlock investment while improving the sustainability of school meal programs.

In cases where electricity is available, "eCooking" presents a particularly compelling opportunity. Electric cooking eliminates smoke exposure in kitchens, improves working conditions, and avoids the supply chain risks associated with biomass and LPG fuels. It also aligns with broader energy system objectives by creating productive and predictable electricity demand, including during off-peak periods. A growing body of evidence shows that these benefits can be achieved alongside significant fuel cost savings. Emerging studies across multiple countries report reductions in cooking costs of 26–85 percent, enabled by the use of efficient eCooking appliances such as electric pressure cookers and eBoilers (Khalifa and others 2025). In parallel, schools often report substantial time savings, reducing the labor burden on kitchen staff.

Recent experiences across East Africa illustrate how this transition is moving from individual school pilots toward more systematic scaling. In Kenya, where most schools are already connected to electricity, national strategies now explicitly identify schools as a priority segment for eCooking, while 36 schools in Tanzania and more than 100 in Uganda are transitioning to eCooking as part of scale-up programs funded by under the UKAid Modern Energy Cooking Services (MECS) programme. This program and a growing number of partners are demonstrating practical delivery models for both grid-connected and solar off-grid electric cooking systems, while generating the evidence needed to shape policy and investment. As these approaches mature, clean cooking in schools offers a clear opportunity to deliver simultaneous gains in health, education, energy access and climate outcomes—making it a vital, and previously overlooked, frontier for achieving SDG 7.

Image 1 • Cooking posho in a 230L ECOCA eBoiler at Buddo Parents' Academy, Kampala, Uganda

Credit: Jacob Fodio Todd, MECS

Image 2 • Cooking maize on a traditional three-stone fire stove at a school in Zambia

Credit: Nancy Serenje, CEEEZ.

Turning national commitments into regional impacts

The advantages of building strong regional ecosystems for clean cooking are many. For one, regional cooperation can strengthen national implementation. Working across national borders to build or share common infrastructure for supply, lowers transaction costs, strengthens local markets, and promotes cooperative regulatory mechanisms for manufacturing and deployment. The recently launched G20 South Africa clean cooking road map, mentioned earlier, takes full advantage of this promise. The road map calls for feasibility studies on the potential for regional clean cooking infrastructure clusters, local value chains for market development, and the possible establishment of regional infrastructure investment funds and risk-sharing instruments to support funding and finance for clean cooking.

In Latin America and the Caribbean, access to clean cooking has improved significantly over the past two decades, but sizeable gaps remain, especially in rural areas (ten countries account for more than 90 percent of the remaining gap in access.) To help accelerate a full regional transition, the ministries of energy in the region have renewed their commitment to advancing clean cooking. In this context, with the support of World Bank and the Inter-American Development Bank, a regional road map was developed with clear targets and mandates to achieve universal access to clean cooking. The road map aims to eliminate the use of open fires for at least 95 percent of the population by 2030 and accelerate the transition to modern energy–based cooking services by 2035 for 97.5 percent of the population, with the remaining 2.5 percent using improved cookstoves. The road map also calls for regional platforms for data and testing standards, aggregated procurement, regional supply chains, pooled-risk sharing, and technical assistance (World Bank 2026).

The Pan American Health Organization (PAHO) and its Member States have also recognized the importance of clean household energy to achieve regional public health goals. As part of PAHO's Disease Elimination Initiative, Member States are aligning action to eliminate the use of polluting fuels for cooking by 2030 to achieve public health goals. The initiative mobilizes the health sector to eliminate the use of polluting fuels in households as part of a comprehensive strategy to achieve reductions in communicable disease targets and improve the health of women and children. Leveraging the supportive voice of health care professionals to promote clean cooking helps drive needed behavior changes in households and ensure that policy decisions on clean cooking are informed by health evidence .

Although the nations of the region are diverse, they share key challenges like affordability, the need for enhanced monitoring, and building household confidence in the use of cleaner cooking options.

Regional cooperation need not focus on clean cooking alone. The point is that clean cooking should be integrated into broader energy, environment, or other development programs, including those focusing on forcibly displaced persons (box 2.3). Integration ensures that clean cooking remains an area of policy relevance and action. For example, the Breath of Change: Solutions for Cleaner Air for the Indo-Gangetic Plains and the Himalayan, presents a regional road map for clean air focusing on reducing air pollution levels to 35 µg/m3 by 2035 through policy actions in five key pollution emitting sectors (household energy use, industry, agriculture, waste management, and transport) common across Bangladesh, Bhutan, India, Nepal, and Pakistan (World Bank 2025b). The strategy recognizes the transboundary nature of the local airshed and the need for countries to cooperate on monitoring systems, governance, and financing to improve air quality in the region. The regional angle helps position clean cooking as part of wider environmental and health strategies, while maintaining its distinct role within the household energy sector.

Box 2.3 • The clean cooking deficit in settings hosting forcibly displaced populations

Despite global progress, a major share of the clean cooking access deficit remains overlooked in settings marked by fragility and displacement. An estimated 48.9 million forcibly displaced people—including refugees and internally displaced persons—lack access to clean cooking.[a] To put this number into perspective, the Global Platform for Action estimates that forcibly displaced people represent 1.4 percent of the global population but could amount to potentially 2.5 percent of those without clean cooking worldwide as per comment below.

These populations are often excluded from national statistics, policy frameworks, and energy planning processes, masking the scale of need and limiting targeted interventions. Yet access to clean cooking is critical in these contexts, underpinning health, protection, environmental sustainability, and livelihoods, while reducing risks such as exposure to harmful smoke and gender-based violence linked to fuel collection.

Most forcibly displaced people without access live in low-income and fragile settings, where structural barriers—including weak infrastructure, financing gaps, and policy fragmentation—impede progress.

Advancing clean cooking access in displacement settings is therefore essential to achieving universal access by 2030. It requires the systematic inclusion of displaced populations in data collection, national energy planning, and investment strategies to ensure that no one is left behind.

a. Philip Sandwell and Paul Quigley (2026) Quantifying the global sustainable energy access gap amongst forcibly displaced people. Geneva. GPA Secretariat, UNOPS. Please see: https://www.humanitarianenergy.org/assets/resources/Quantifying_the_sustainable_energy_deficit_in_displacement_and_fragile_settings.pdf.

Enhanced frameworks for climate finance

Financing remains one of the key constraints to a full transition. The case for greater investment is strengthened by the multiple benefits of clean cooking, including reduced household air pollution exposure, time savings, lower pressure on forest resources in some settings, and reduced emissions of black carbon, a short-lived climate pollutant. These benefits make clean cooking relevant not only to health and development, but also to climate finance. Recent advances in the voluntary carbon markets have facilitated financing for clean cooking while strengthening confidence in credit quality. Enhanced cooperation between the environment and energy sectors could help unlock much-needed climate finance for clean cooking while advancing broader efforts to mitigate climate change.

In 2025, the Integrity Council for the Voluntary Carbon Market approved several cookstove carbon-crediting methodologies (including the CLEAR methodology (Clean Cooking Alliance 2025)), subject to conditions related to fuel-use estimation and monitoring (Integrity Council for the Voluntary Carbon Market 2025). The move is important because stronger methodological requirements can improve confidence in credit quality and help channel finance into clean cooking projects. Other instruments are also emerging. For example, the World Bank launched a Clean Cooking Outcome Bond for Ghana to mobilize results-based finance for expanding clean cooking (World Bank 2025c). These developments suggest that climate finance may become an increasingly important complementary source of support for clean cooking, particularly where public resources are limited.

But climate finance alone will not be sufficient. Strong government leadership, transparent accounting, proper safeguards, and alignment with national priorities are still essential. Where appropriate, funding windows, results-based finance, credit guarantees, and technical assistance can also use gender-sensitive criteria to support women as beneficiaries, workers, entrepreneurs, and leaders in the clean cooking value chain.

Conclusions

The global trajectory toward universal access to clean cooking fuels and technologies reflects both significant advances and enduring disparities. By 2024, approximately 75 (71–78) percent of the global population had gained access to clean cooking solutions, representing an 18 percentage-point increase since 2010. Despite this progress, an estimated 2.0 (1.8–2.4) billion people—primarily in LMICs—remain dependent on polluting fuels such as biomass, charcoal, and kerosene. This reliance exacerbates household air pollution, disproportionately affecting the health of women and children, while also impeding progress toward SDG 7. Regional disparities are particularly pronounced: Sub-Saharan Africa and Oceania (excluding Australia and New Zealand) exhibit access rates of just 22 (20–25) percent and 9 (4–26) percent, respectively, highlighting the urgent need for targeted interventions. Projections indicate that, given current trends, 1.8 (1.6–2.2) billion people will still lack access by 2030, underscoring the inadequacy of incremental progress in meeting global targets.

Addressing this challenge will require a multifaceted approach to integrate policy, finance, and regional collaboration. High-level political commitment, as demonstrated by national strategies in Kenya and India, has proven instrumental in accelerating access. Regional initiatives, such as the G20 South Africa Clean Cooking Roadmap and Latin America's coordinated frameworks, offer scalable models for resource-sharing and infrastructure development. Financing remains a critical constraint, but innovative mechanisms—including climate finance instruments, targeted subsides, and results-based funding models—present opportunities to mobilize resources and ensure that no one is left behind in the clean energy transition. Targeting rural populations, educational institutions, and other key settings where clean cooking initiatives can deliver simultaneous benefits for public health, educational achievement, livelihoods, nutrition, and environmental sustainability must remain a central priority at the national and global levels.

Efforts to achieve universal access to clean cooking are likely to be adversely affected by the current geopolitical crises in different parts of the world. These crises can reduce energy supplies, increase fuel price volatility, and make clean cooking solutions less accessible and affordable for households. Ensuring the widespread availability of affordable clean cooking solutions is therefore a key factor for accelerating the adoption of clean cooking fuels and technologies, which is vital to protect the health and well-being of people and planet. Maximum efforts must be made to ensure that a variety of clean cooking options are available, affordable, and accessible by all, particularly those most vulnerable.

In the absence of targeted and scalable interventions, particularly in light of the current geopolitical circumstances, the number of people lacking access to clean cooking may plateau, halting the progress made in recent years. If progress stalls, the world will fail to meet SDG 7 targets, leaving billions without clean cooking and deepening inequalities in health, gender roles, and climate effects.

CHAPTER 3

RENEWABLES

Photo: © UNDP Cambodia

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.

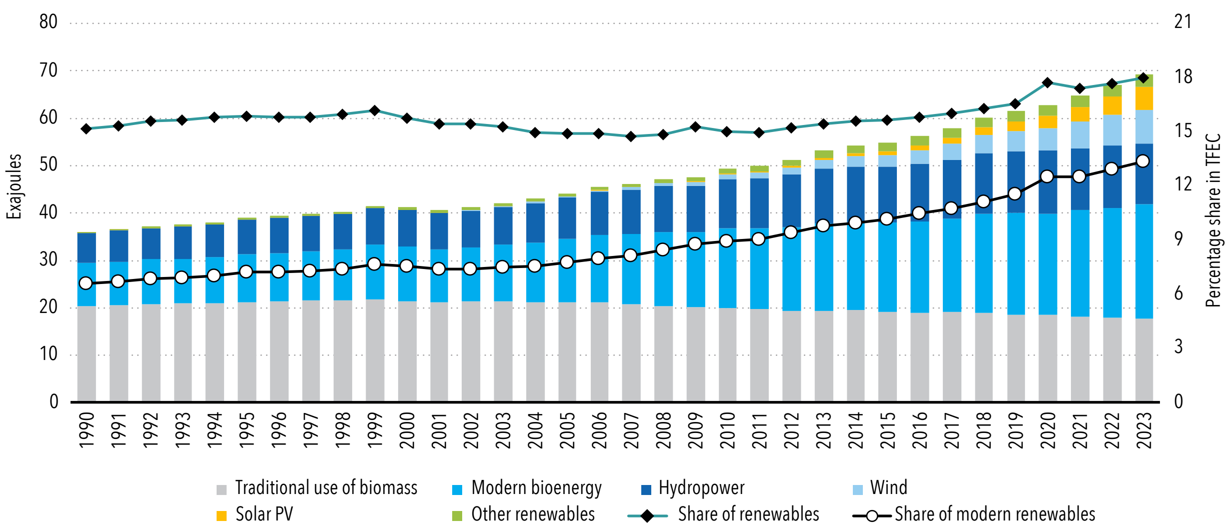
- **Regional highlights.** The widespread use of traditional biomass for heating and cooking in Sub-Saharan Africa places it first among the regions where renewables constitute the largest share of energy supply. When considering only modern uses of renewable energy, the share of renewables in TFEC was 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.

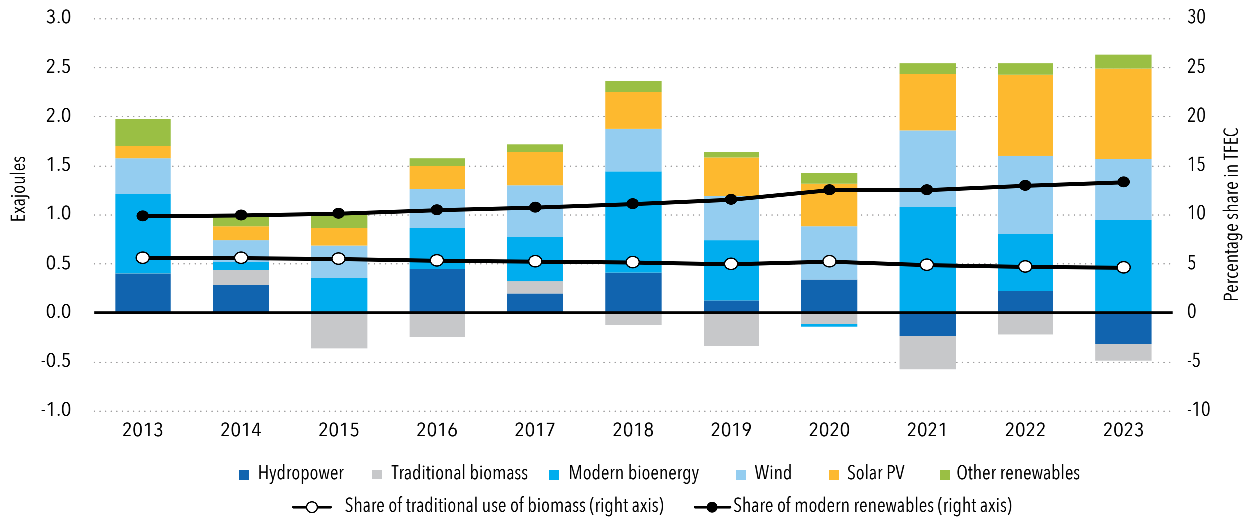
16 Unless otherwise stated, all data in this chapter come from the IEA World Energy Balances database (IEA 2026a), UNSD Energy Balances 2023 (UNSD 2025a), and Energy Statistics Database 2023 (UNSD 2025b).

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.

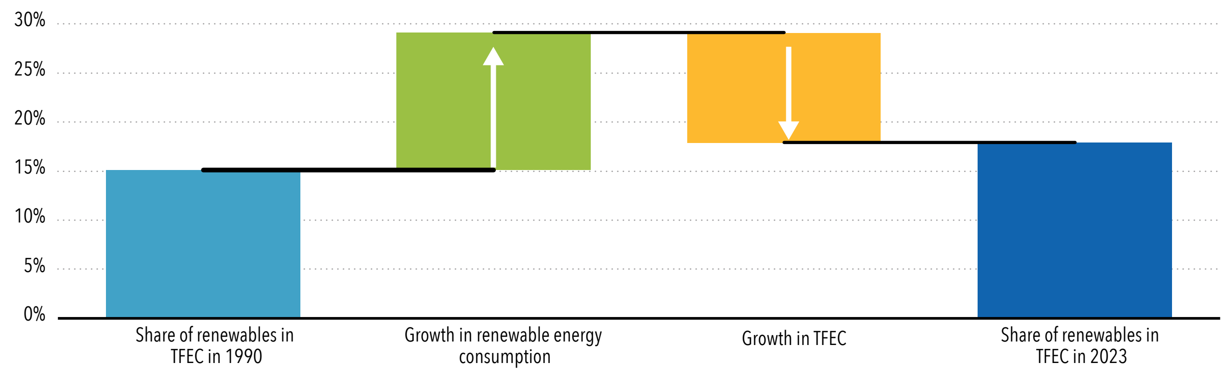
Figure 3.2 • Growth in renewable energy consumption by technology and the shares of modern uses of renewable energy and traditional uses of biomass in TFEC, 2013–23



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.

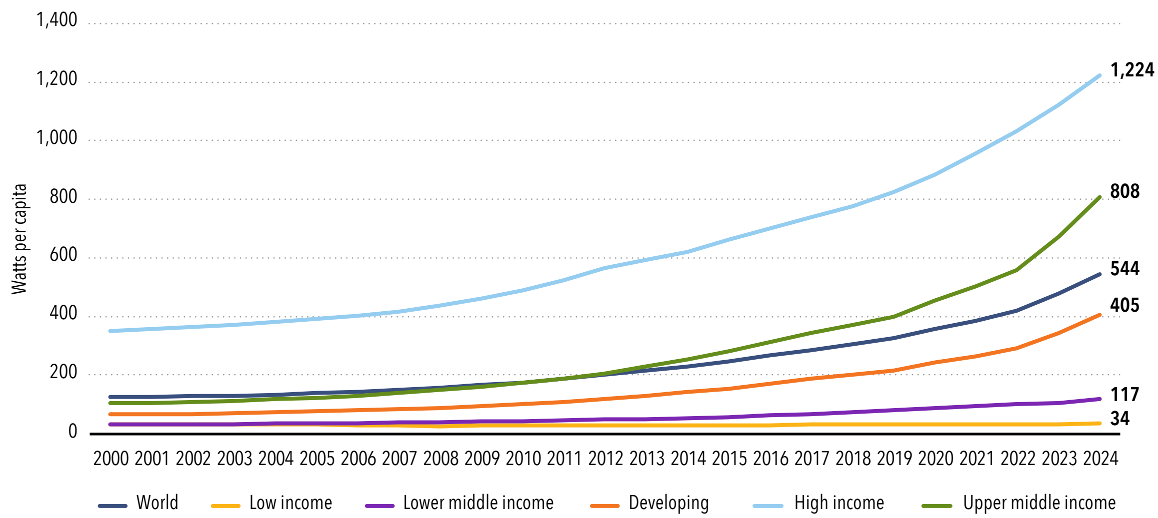
Table 3.1 • Global installed renewable energy generating capacity per capita, annual growth and five-year CAGR, 2014–24

	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



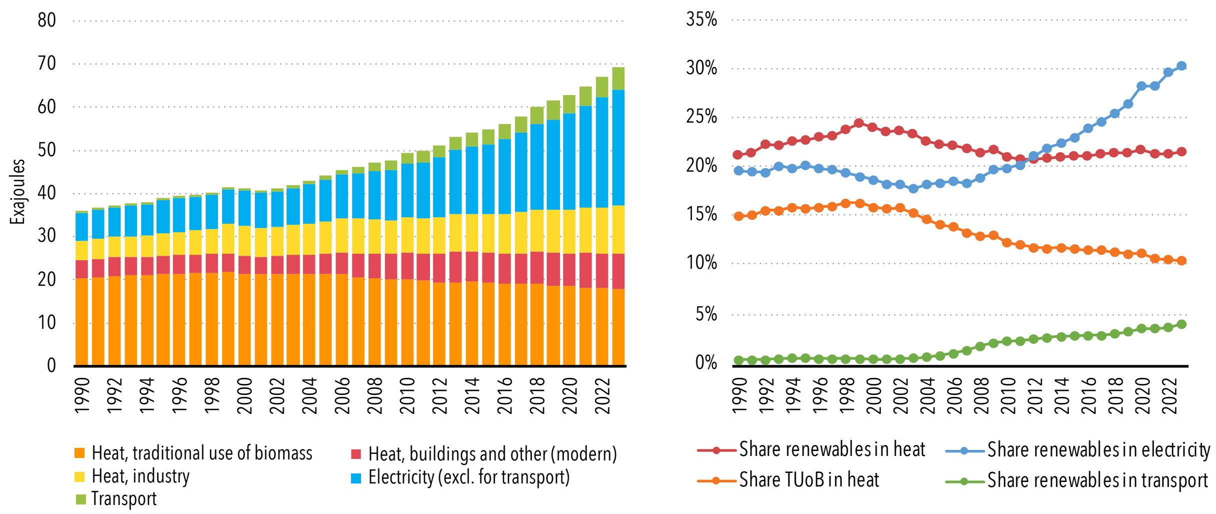
Source: International Renewable Energy Agency.

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



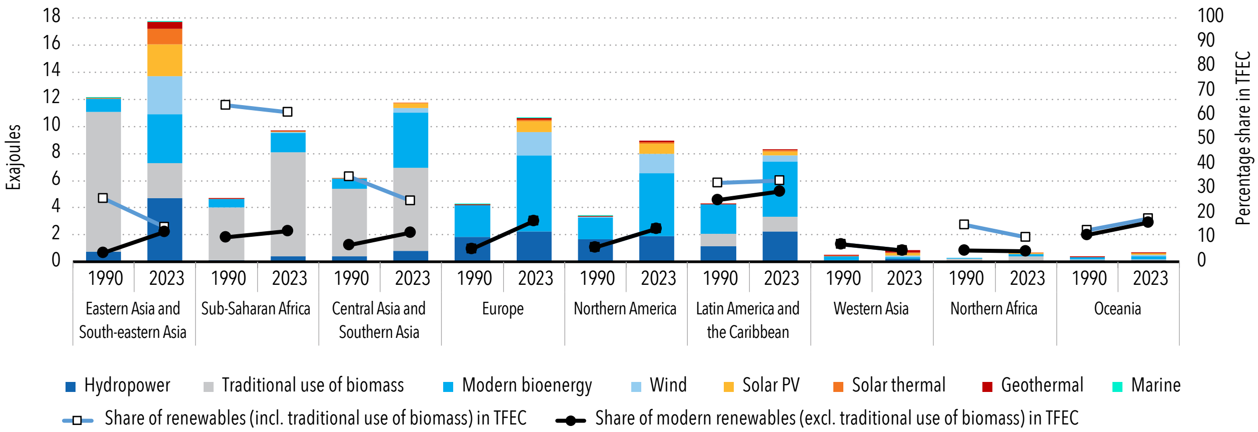
Source: International Energy Agency and United Nations Statistics Division.

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



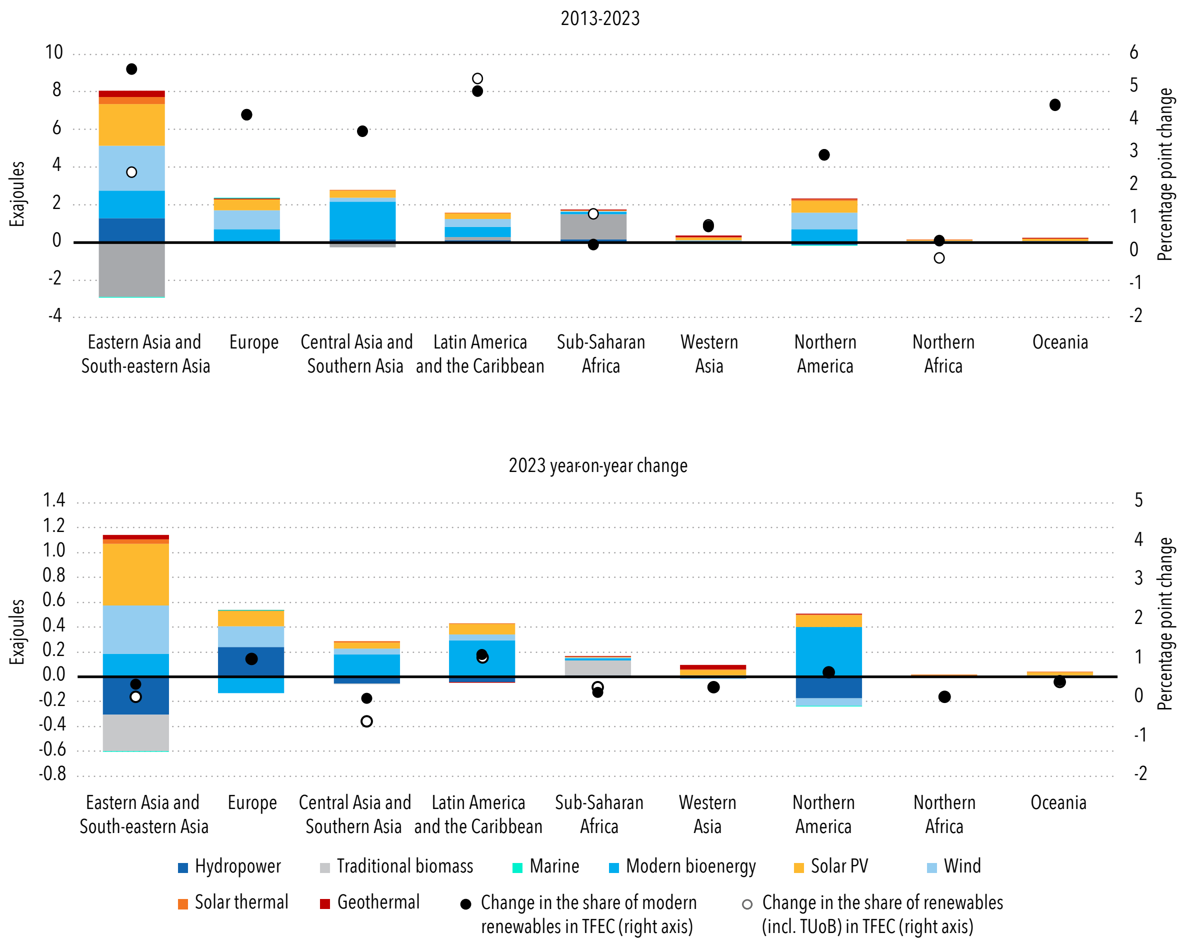
Source: International Energy Agency and United Nations Statistics Division.

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.

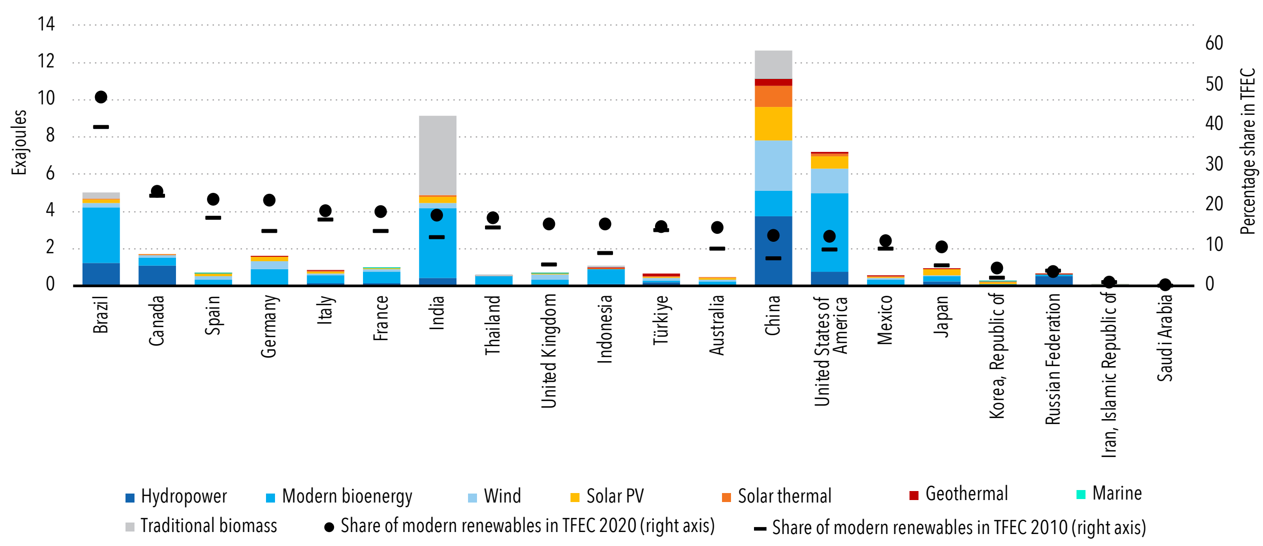
Note: "Traditional uses of biomass" refers to the residential consumption of primary solid biofuels and charcoal in countries outside the OECD. Although biomass is used with low efficiency in OECD countries as well, such use is reported under "modern bioenergy."

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."

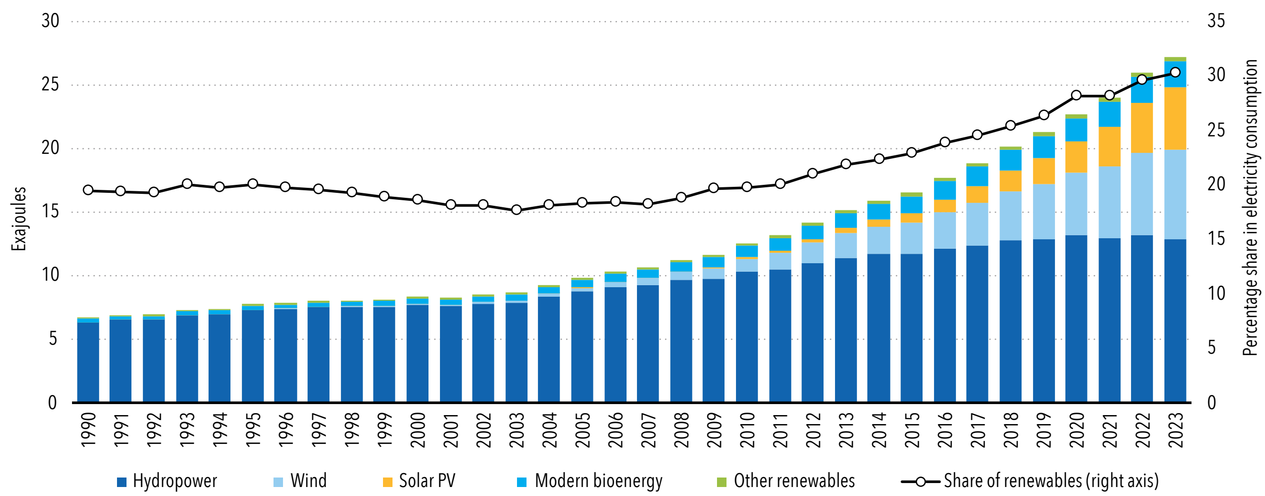
20 Countries that saw an increase in TFEC include Australia, Brazil, China, India, Indonesia, the Islamic Republic of Iran, Saudi Arabia, and Türkiye.

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

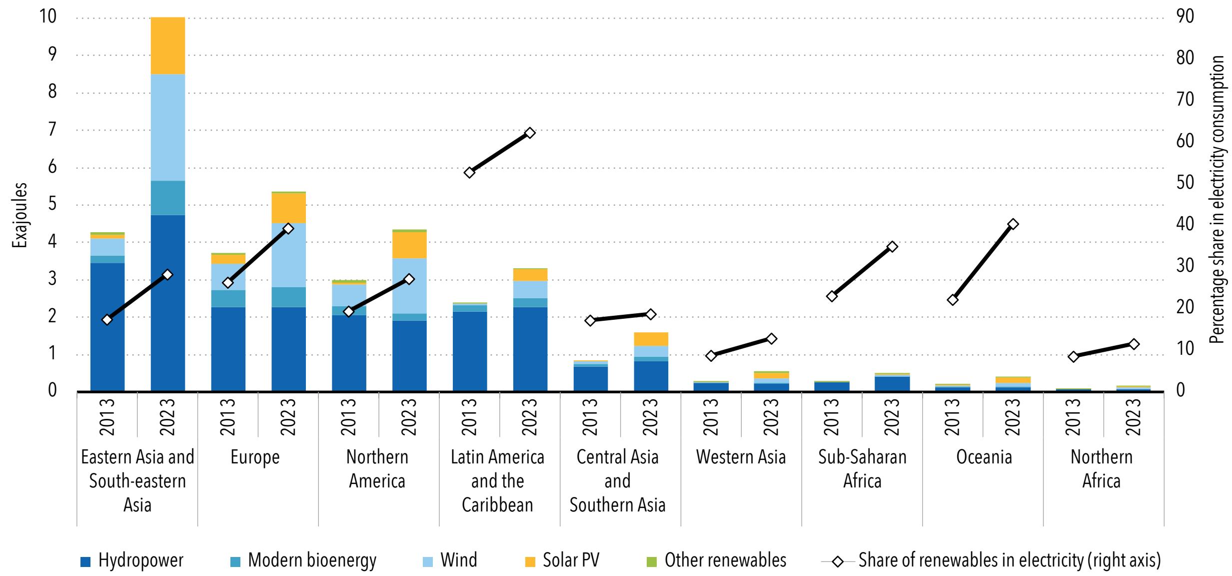


Source: International Energy Agency and United Nations Statistics Division.

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).

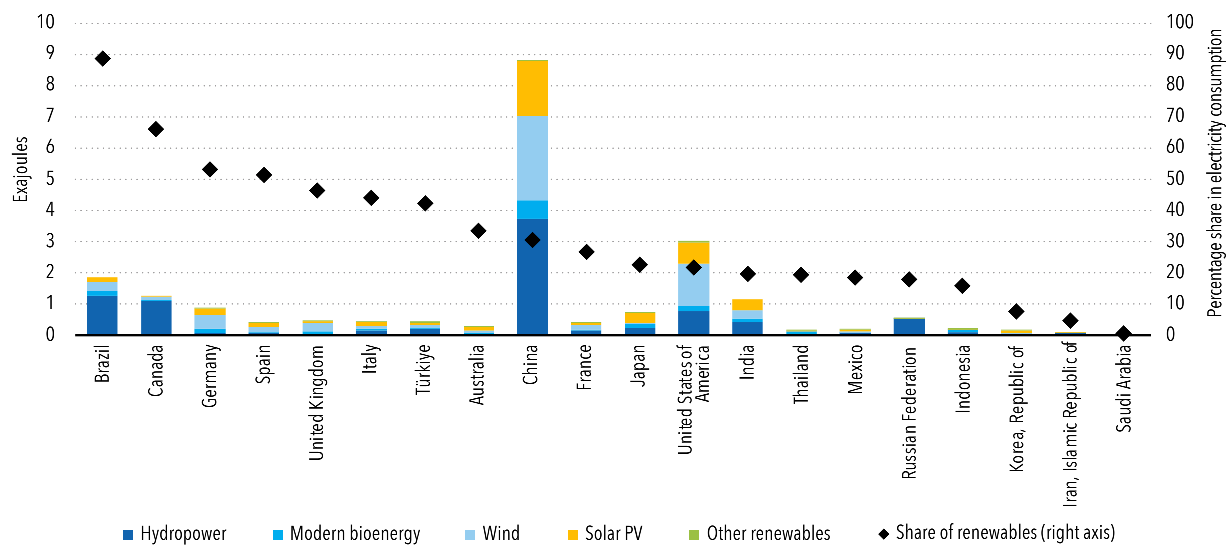
Figure 3.10 • Renewables-based electricity consumption and renewables' share in electricity by region, 2013 and 2023



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

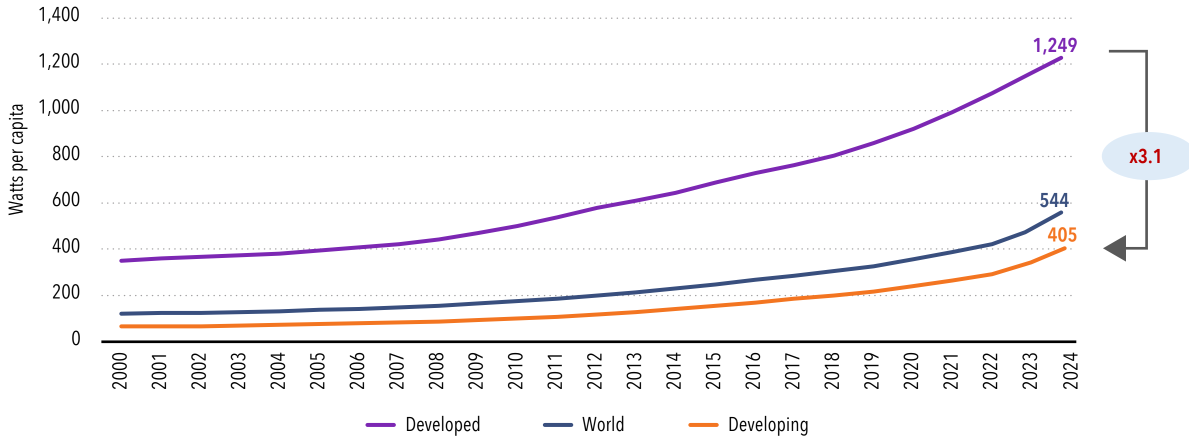


Source: International Energy Agency and United Nations Statistics Division.

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.

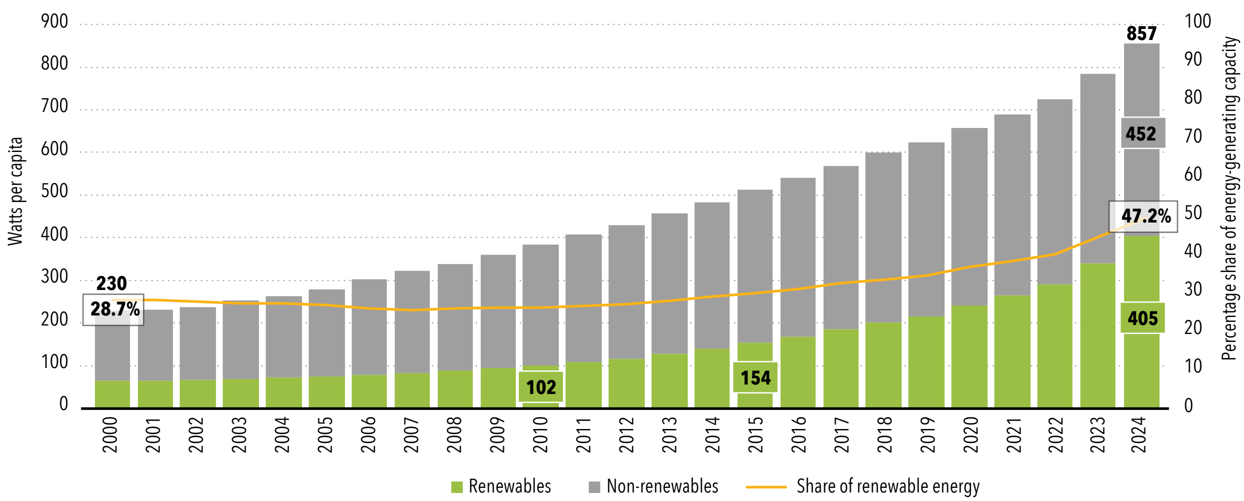
Figure 3.12 • Renewable energy-generating capacity in developing and developed countries, and in the world, 2000–24



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

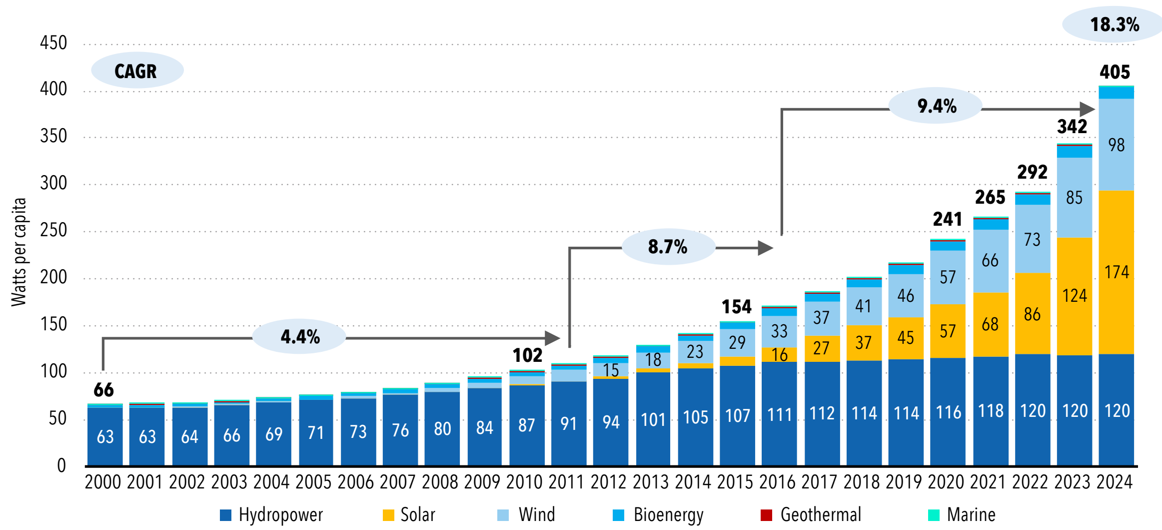


Source: International Renewable Energy Agency.

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



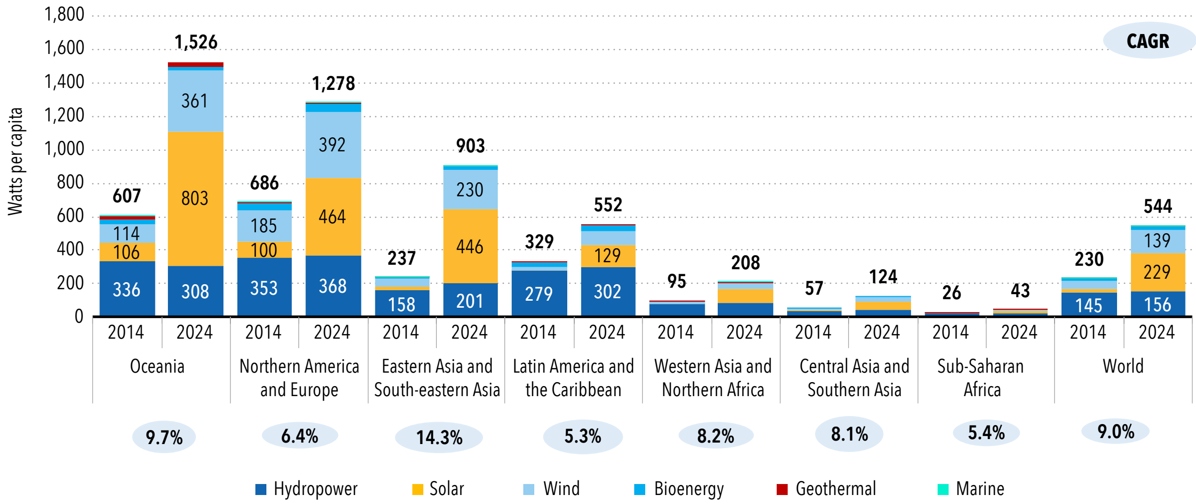
Source: International Renewable Energy Agency.

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

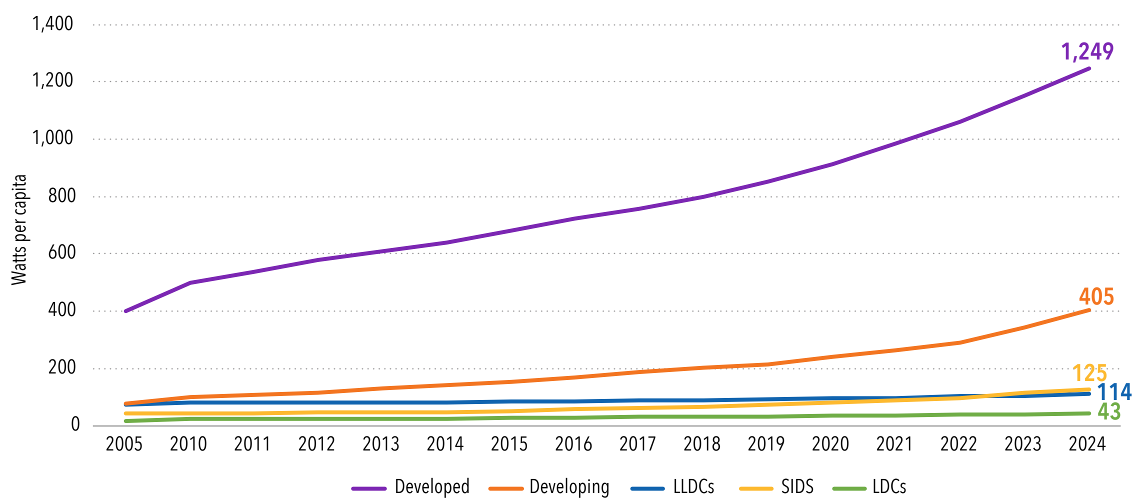


Source: International Renewable Energy Agency.

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.

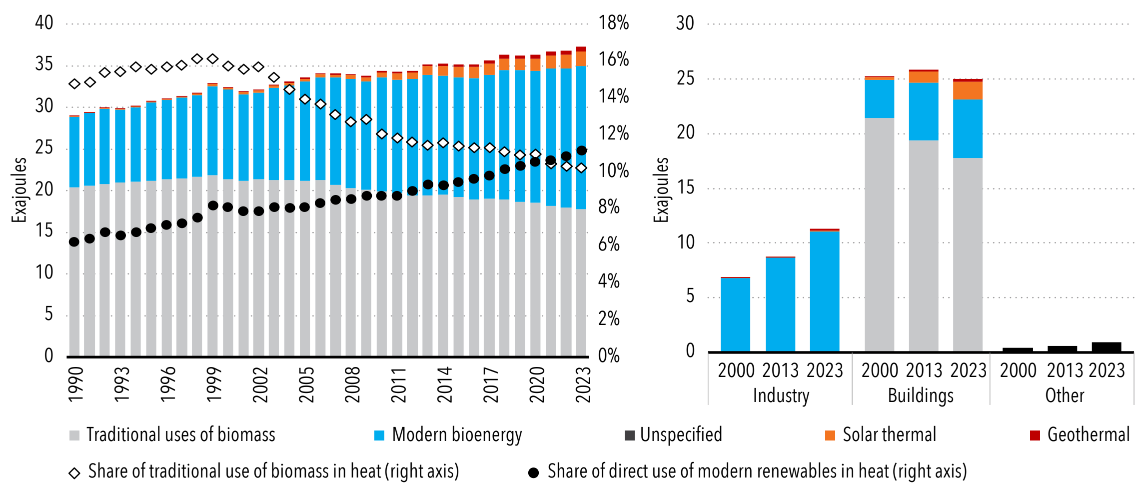
As target 7.b.1 underscores the need to upgrade and develop infrastructure in LDCs, SIDS, and LLDCs, figure 3.16 shows the progress of these groups relative to the wider group of developing countries. In this regard, the latest data shows that disparities persist between developed countries overall and 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.

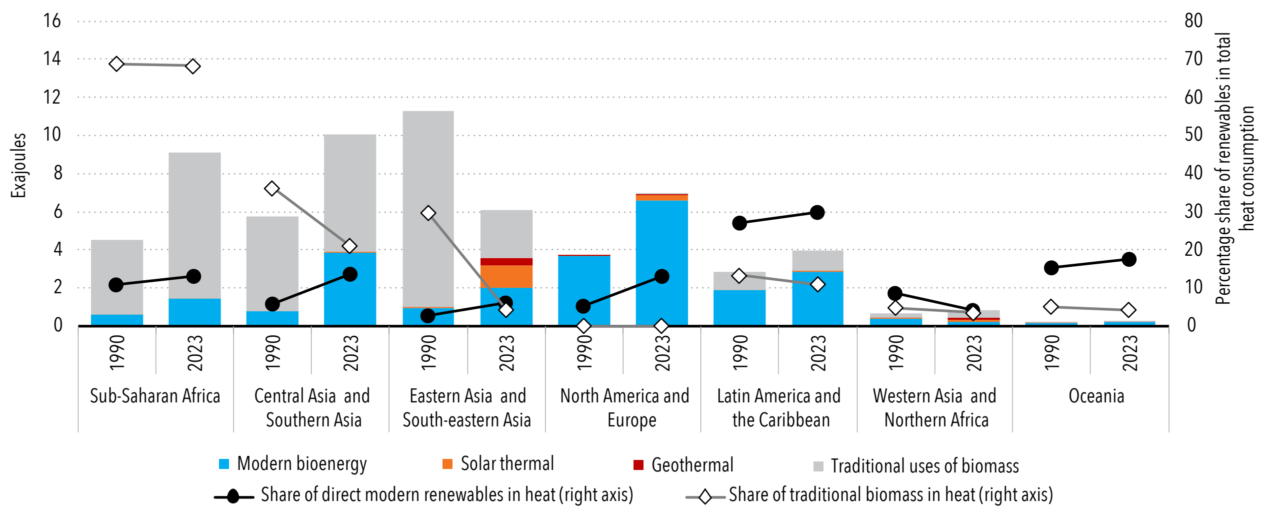
Modern bioenergy accounts for about 88 percent (17.2 EJ) of direct[23] modern use of renewables for heat globally. It accounts for about one-tenth (IEA 2025b) of the energy consumed for industrial heat and one-twentieth of the energy consumed for heat in the buildings sector (IEA 2025b). Industry accounts 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



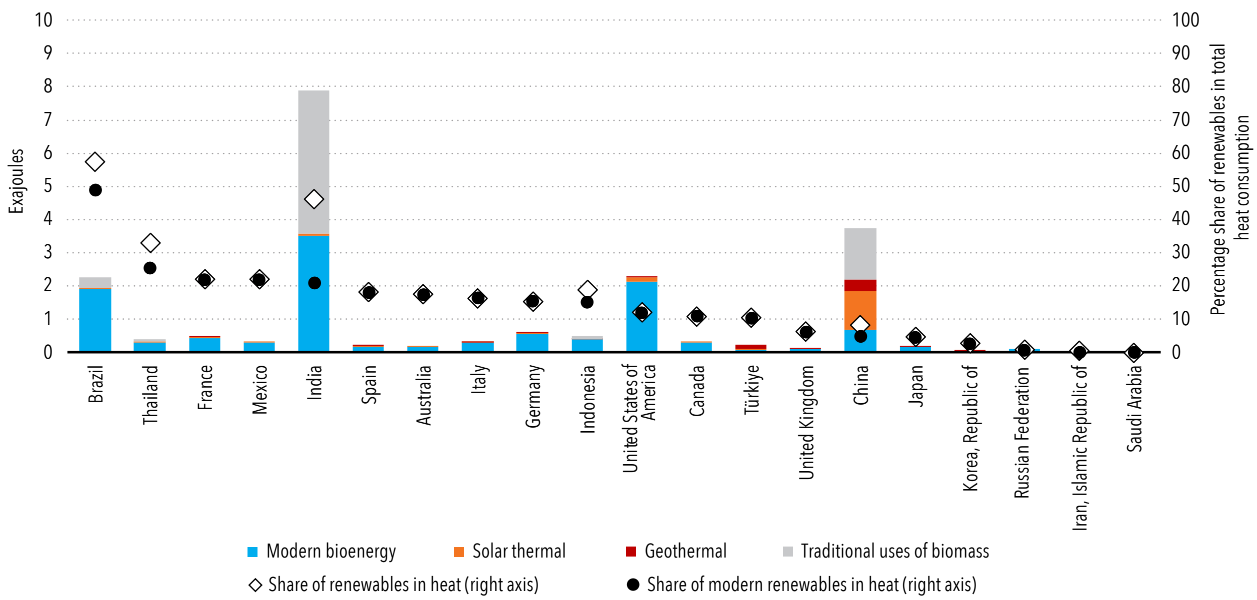
Source: International Energy Agency and United Nations Statistics Division.

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.

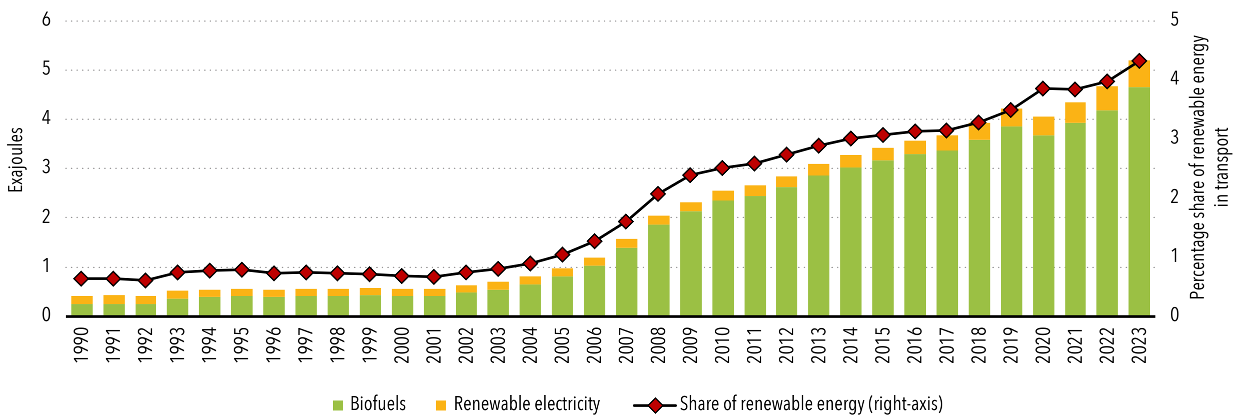
Note: "Traditional uses of biomass" refers to the residential consumption of primary solid biofuels and charcoal in countries outside the OECD. Although biomass is used with low efficiency in OECD countries as well, such use is reported under "modern bioenergy." Indirect consumption of renewable energy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

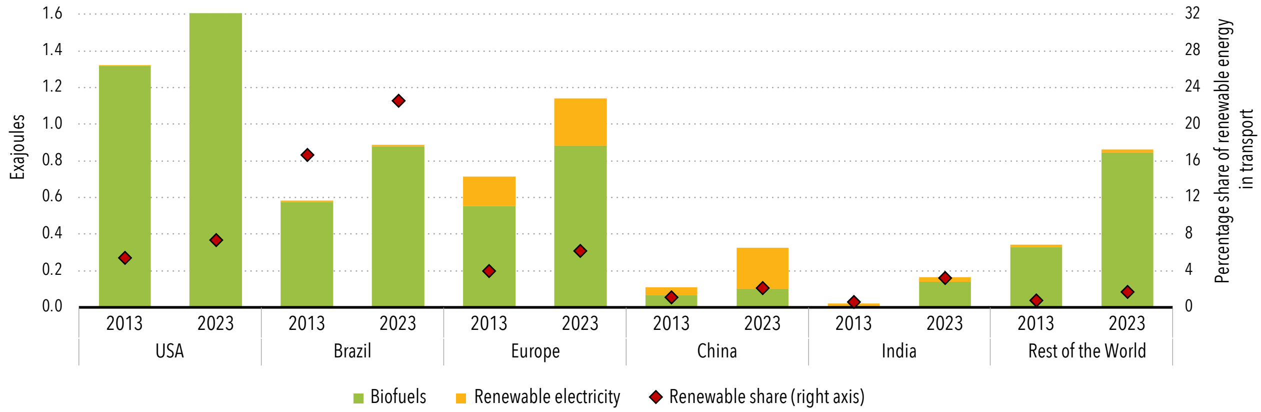


Source: International Energy Agency and United Nations Statistics Division.

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

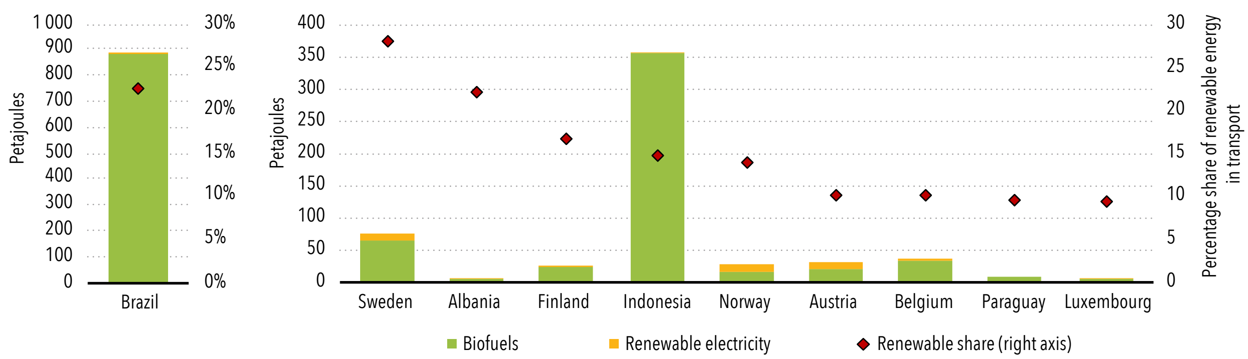


Source: International Energy Agency and United Nations Statistics Division.

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).

CHAPTER 4

ENERGY EFFICIENCY

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Main messages

- **Global trends.** Primary energy intensity, defined as the ratio of total energy supply to gross domestic product (GDP), is the main global indicator for energy efficiency. In 2023, global energy intensity reached 3.76 megajoules per US dollar (MJ/USD[24]), but the annual improvement rate slowed to 1.5 percent—down from a stronger 2.4 percent in 2022. This slower global pace masks strong gains in some countries and regions (e.g., the European Union, the United States, Republic of Korea, Türkiye, and the United Kingdom), where strong policy action, increased investments, and shifts in consumer behavior drove improvements well above the average global rate.
- **2030 target.** Despite significant global policy action, energy intensity improvements continue to fall short of the United Nations' Sustainable Development Goal (SDG) target 7.3, which calls for the global rate of energy intensity improvement to double by 2030 relative to the 1990–2010 average. Given the pace of recent years, energy intensity now needs to improve at about 4.2 percent a year on average between 2024 and 2030 to reach target 7.3.
- **Regional highlights.** Energy intensity varied notably across major economies in 2023, reflecting differences in economic structure, efficiency levels, and climate. Between 2010 and 2023, no major region achieved the 2.6 percent annual improvement rate set by SDG 7.3.[25] Northern America and Europe came closest at 2.3 percent, followed by Oceania at 2.2 percent. Eastern and South-eastern Asia remained around 2 percent, while Central and Southern Asia posted the strongest GDP growth and improved primary energy intensity at roughly the global average in 2023.
- **Trends in the 20 countries with the largest total energy supply.** From 2010 to 2023, energy intensity improved rapidly (relative to 1990–2010) in 15 of these 20 countries. Still, only six met the 2.6 percent annual reduction in energy intensity required by SDG 7.3. The United Kingdom recorded the highest average annual improvement, with a reduction of 4 percent in energy intensity.
- **End-use trends.** Progress in energy intensity across all end-use sectors accelerated in 2010–23 relative to 2000–10, though the industrial sector slipped back in 2023. The buildings sector improved steadily at an average annual rate of 1.4 percent over 2010–23. Passenger vehicles' annual progress rate rose from 0.7 to 1.6 percent, while heavy-duty trucks saw a smaller change, from 0.4 to 0.5 percent.
- **Electricity generation trends.** Between 2010 and 2023, the efficiency of fossil-fuel generation increased by around 4 percent, while overall power generation efficiency rose by 11 percent, driven largely by the growing share of renewables in the electricity mix. Average electricity generation efficiency increased to around 47 percent over the same period, an improvement compared to the more modest increase from 40 to 42 percent observed in 1990–2010.

24 Based on 2021 purchasing power parity (PPP) rates.

25 When target 7.3 and indicator 7.3.1 were defined, the annual average rate of global energy intensity reduction stood at 1.3 percent for the baseline period of 1990–2010. Based on this figure, the target of doubling this average was set at 2.6 percent per year. Due to data revisions, the baseline annual improvement stands at 1.2 percent, but to avoid variations in the numerical target, the custodians of this indicator—IEA and the United Nations Statistics Division—decided to keep the target fixed at 2.6 percent.

Are we on track?

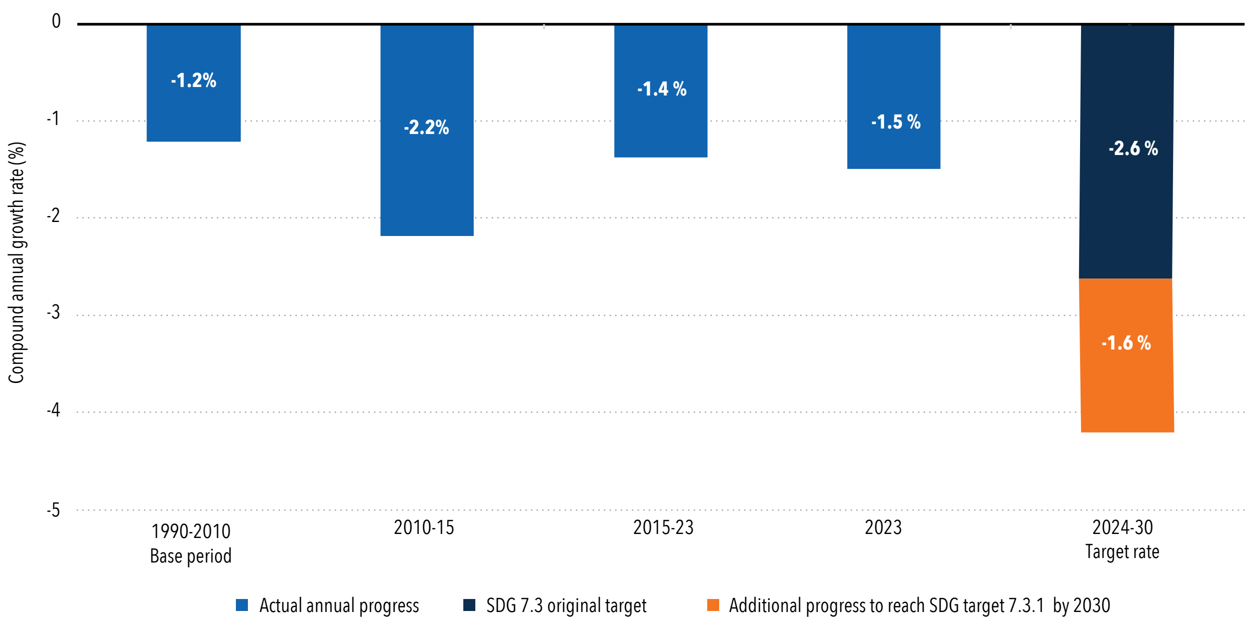
SDG 7 commits to ensuring universal access to affordable, reliable, sustainable, and modern energy. Target 7.3 calls for a doubling of the global rate of energy intensity improvement relative to the 1990–2010 average.

Energy intensity is the ratio of total energy supply to GDP, thus revealing the energy consumed per unit of wealth created. Energy intensity helps track changes in energy consumption and the factors influencing them, for example, changes in economic structure, weather, and behavior. All such factors being equal, as energy efficiency improves, energy intensity decreases.

Progress toward SDG target 7.3 is measured by the year-on-year percentage change in energy intensity. Initially, the United Nations recommended an annual improvement of 2.6 percent between 2010 and 2030 to achieve target 7.3. However, given the slow pace of global progress in all years except 2015, energy intensity now needs to improve at an annual rate of 4.2 percent from 2024 onward to achieve SDG target 7.3.

Global energy intensity improved by 1.5 percent in 2023, to reach 3.76 MJ/USD (2021 PPP)—down from 2.4 percent in 2022. While the effects of the global energy crisis are still being felt, the slowdown in energy intensity improvements is increasingly driven by stronger global economic activity, particularly in China, and record-high temperatures that have boosted cooling demand. With progress again subdued in 2023, the world is not yet on track to meet SDG 7.3 by 2030 (figure 4.1).

Figure 4.1 • Average annual change in global primary energy intensity, by period, 1990–2030



Source: IEA 2026; UNSD 2025.

SDG = Sustainable Development Goal.

Looking beyond the main indicators

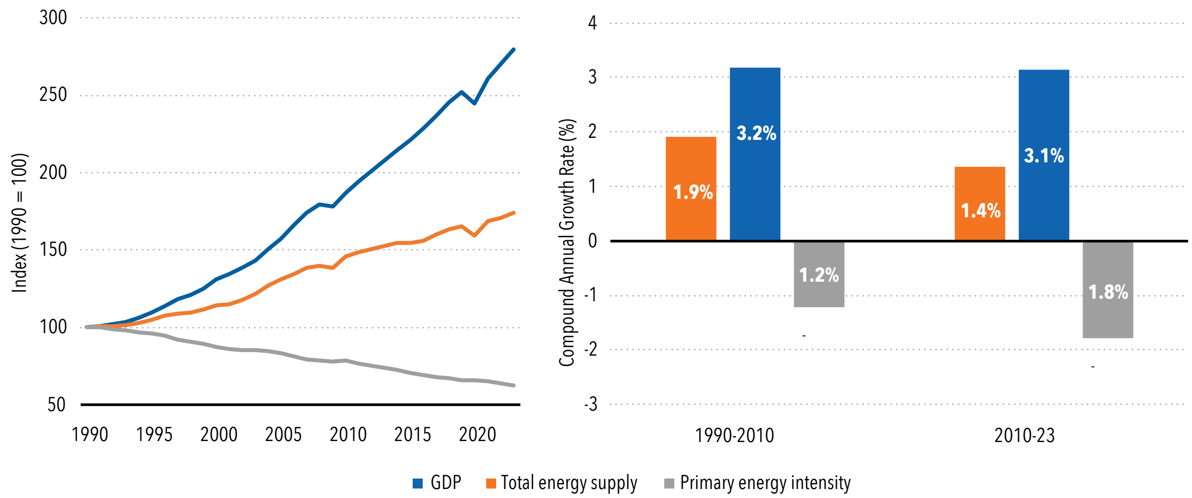
Component trends

Global energy intensity continues to show a gradual decoupling of economic growth from energy demand: GDP grew faster than energy supply, leading to a further decline in overall global energy intensity.

Longer-term data show a sustained structural shift. Annual economic growth averaged 3.1 percent in 2010–23, almost identical to the 3.2 percent over 1990–2010 (figure 4.2). Energy demand, however, grew far more slowly: 1.4 percent per year in 2010–23 versus 1.9 percent in 1990–2010. As a result, global GDP rose 49 percent between 2010 and 2023 while total energy supply rose only 19 percent. Over the full 1990–2023 period, global energy intensity fell by more than a third, allowing the global economy to achieve comparable annual GDP growth rates while utilizing significantly less energy than in the past.

This continued decoupling reflects both structural changes in the global economy and the accelerated deployment of efficient technologies. For example, heat pump sales jumped 75 percent in the first half of 2023 compared with the same period in 2022. This broader uptake of efficient technologies across sectors shaped 2023 results and should drive further gains in the years ahead.

Figure 4.2 • Changes in the components of global primary energy intensity, 1990–2023



Source: IEA 2026; UNSD 2025.

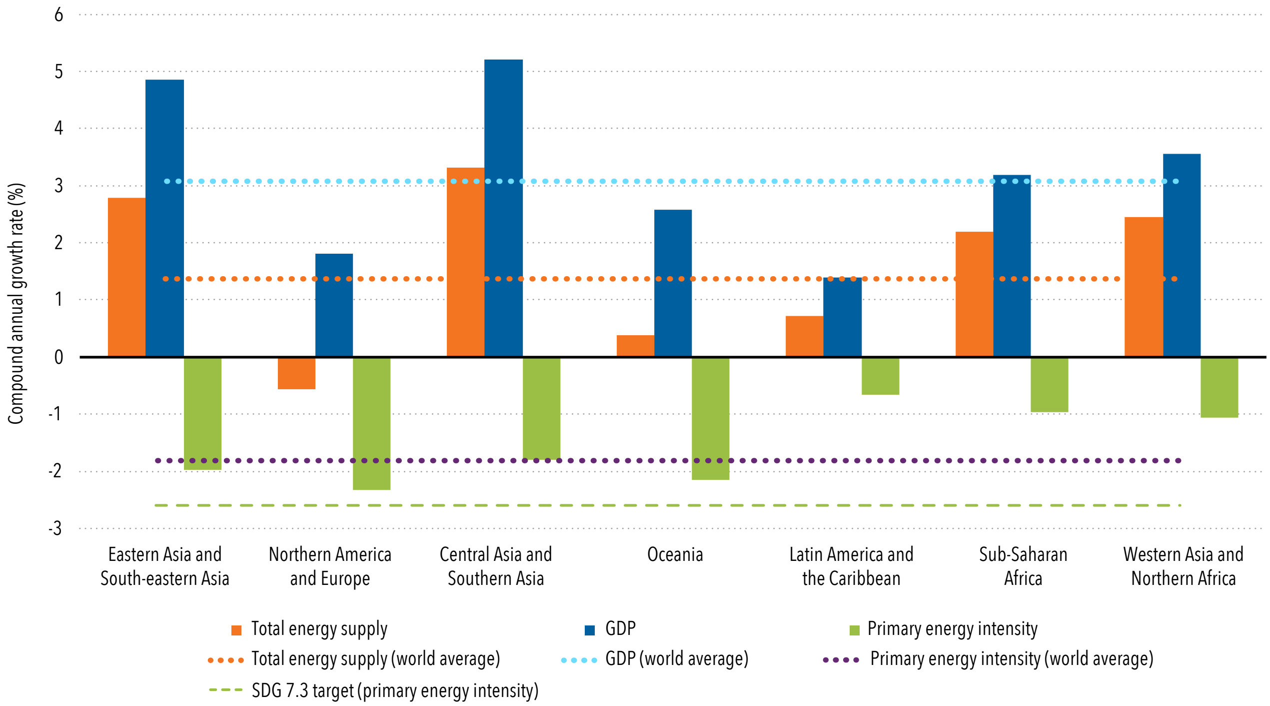
GDP = gross domestic product.

Regional trends

As the global energy crisis eased, GDP expanded in four of the seven major regions and primary energy intensity improved globally. As in 2022, total energy supply grew at a slower rate than GDP in all major regions in 2023. In 2010–23, Latin America and the Caribbean experienced the slowest GDP growth of any major region, at around 1.4 percent. Meanwhile, growth in both energy (3.3 percent) and GDP (5.2 percent) was the fastest in Central and Southern Asia.

Growth reached around 4.9 percent in Eastern and South-eastern Asia and 3.6 percent in Western Asia and Northern Africa, contributing to a global annual average of 3.1 percent over 2010–23 (figure 4.3).

Figure 4.3 • Average annual changes in total energy supply, GDP, and primary energy intensity, by world region, 2010–23



Source: IEA 2026; UNSD 2025.

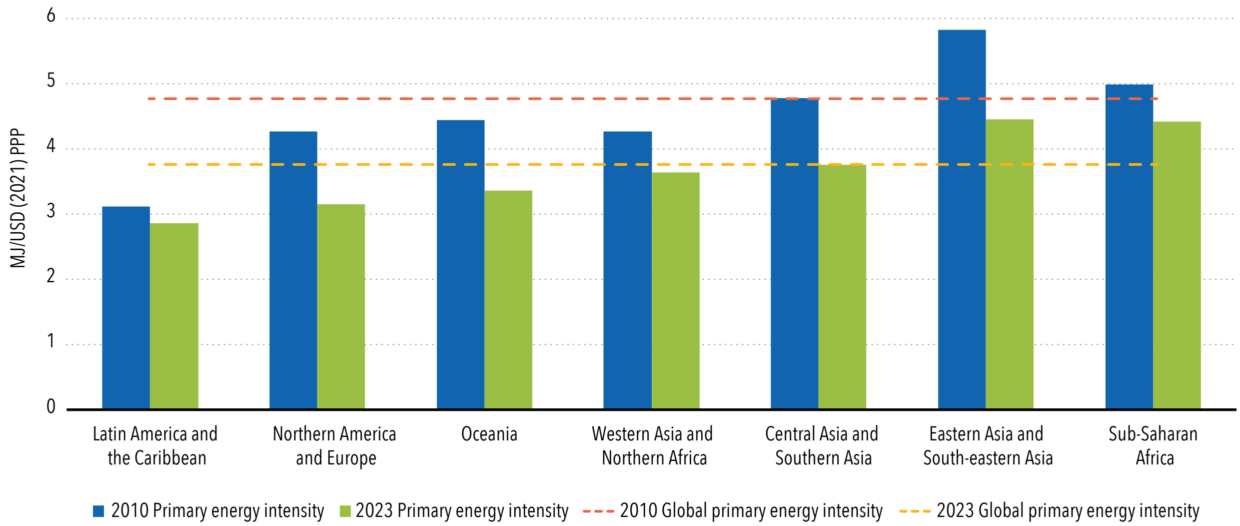
GDP = gross domestic product; SDG = Sustainable Development Goal.

Economic growth outpacing growth in energy demand resulted in energy intensity improving across all major regions, albeit at different speeds. Northern America and Europe came closest to the original improvement target of 2.6 percent, at 2.3 percent over 2010–23, followed by Oceania at 2.2 percent. Eastern and South-eastern Asia remained around 2 percent, while Central and Southern Asia improved more slowly at 1.8 percent, amid strong GDP growth.

Energy intensity was the lowest in Latin America and the Caribbean, which consumed around 2.9 MJ/USD of GDP (2021 PPP) in 2023. Although primary energy intensity in Eastern and South-eastern Asia has declined significantly since 2010, from 5.8 MJ/USD of GDP, it remained unchanged at around 4.5 MJ/USD of GDP in 2023 compared with the previous year.

Primary energy intensity in Northern America and Europe fell from around 4.3 MJ/USD to around 3.1 MJ/USD between 2010 and 2023—a 26 percent improvement. This marks the largest level of progress recorded in any region to date, partly attributed to shifts in consumer behavior and government policies during the global energy crisis. A similar decline was recorded in Oceania, of about 25 percent, from 4.5 MJ/USD to 3.4 MJ/USD. In Western Asia and Northern Africa, primary energy intensity rose 0.8 percent in 2023 after falling nearly 3 percent the previous year, leaving an overall decline of about 13 percent between 2010 and 2023.

Figure 4.4 • Primary energy intensity, by world region, 2010 and 2023



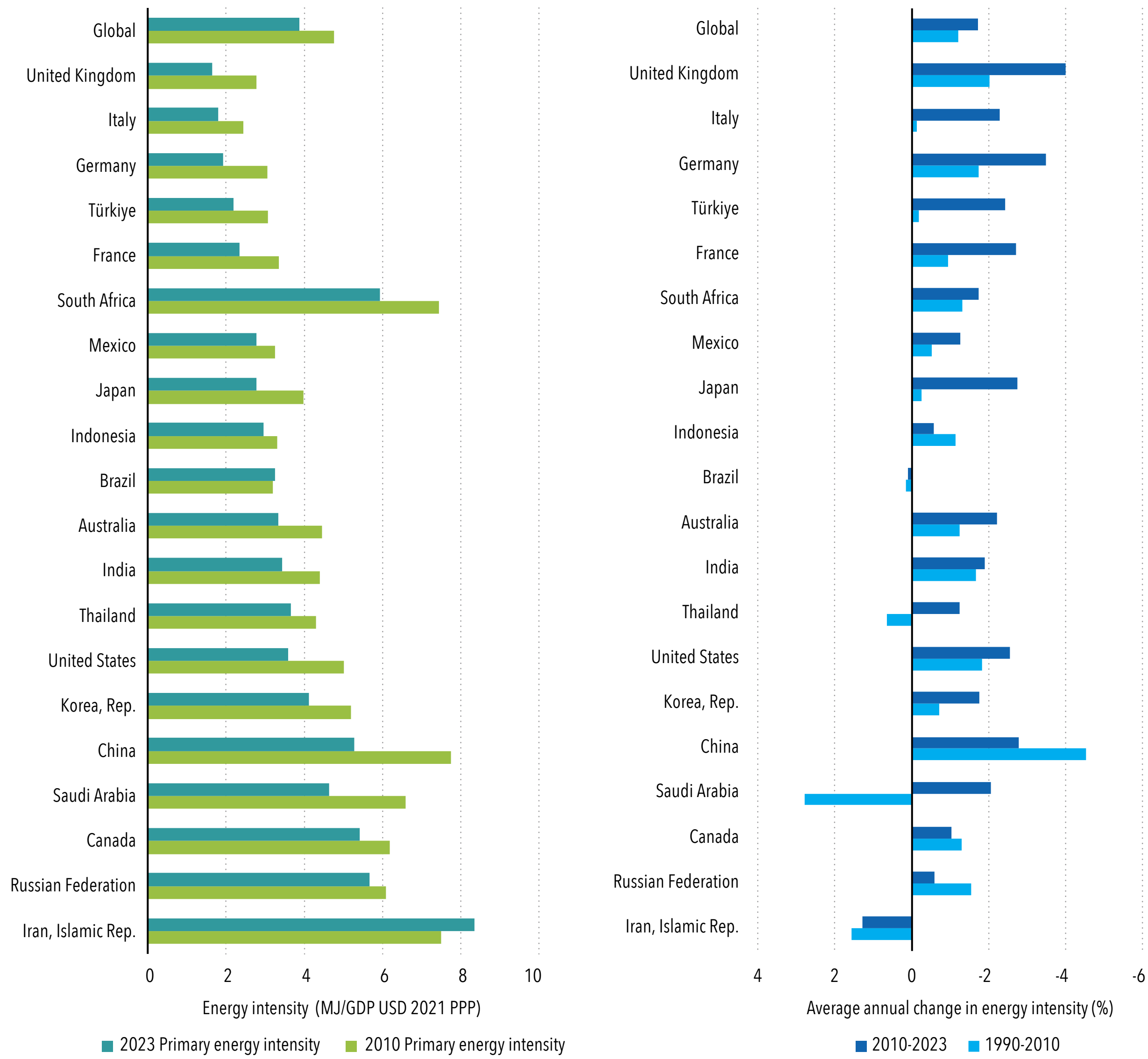
Source: IEA 2026; UNSD 2025.

MJ = megajoule; PPP = purchasing power parity.

Trends in the 20 countries with the largest total energy supply

Improving energy intensity in the top 20 energy-consuming countries is central to realizing SDG target 7.3, given that these countries represent 75 percent of both global energy use and GDP. Between 2010 and 2023, energy intensity rates improved relative to the baseline period of 1990–2010 in 15 of these countries. Six of them—China, France, Germany, Japan, the United Kingdom, and the United States—reached annual improvement rates at or above the SDG target of 2.6 percent. Absolute levels of energy intensity differ widely: European countries such as the United Kingdom, Italy, and Germany posted the lowest levels in 2023, at around 1.9 MJ/USD (2021 PPP) or less. Conversely, five of the top 20 countries exceeded 5 MJ/USD (figure 4.5).

Figure 4.5 • Levels and changes in primary energy intensity in the 20 countries with the largest total energy supply



Source: IEA 2026; UNSD 2025.

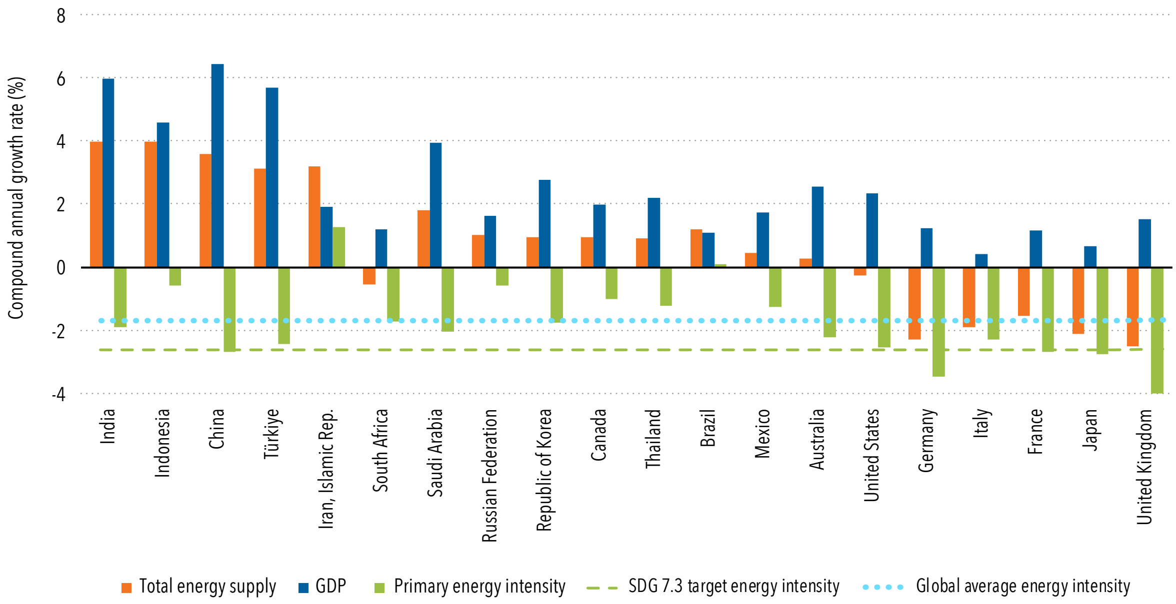
GDP = gross domestic product; MJ = megajoule; PPP = purchasing power parity.

In absolute terms, the energy intensity of 7 of the top 20 energy-consuming countries has remained above the global average over the past decade (figure 4.6). Two of these—the Islamic Republic of Iran and Russia—are also among the world's most energy-intensive economies.

Among the top 20, China, Türkiye, Australia, India, the Republic of Korea, and Saudi Arabia have improved their primary energy intensity at a rate higher than the global average, while recording **an increase in total energy supply**. Their economies grew despite a decrease in energy use, indicating a decoupling of economic growth from energy consumption. These gains reflect advances in industrial efficiency, stricter efficiency standards, and the expansion of renewable energy, among other factors.

By contrast, the United Kingdom, Germany, France, Italy, Japan, and the United States improved primary energy intensity faster than the global average **while also reducing total energy supply**. The United Kingdom led with a 4 percent intensity reduction alongside a 2.5 percent drop in energy supply. Germany, France, Japan, and Italy also showed similar patterns, with reductions in primary energy intensity of 3.5, 2.7, 2.7, and 2.3 percent, respectively.

Figure 4.6 • Average annual changes in total energy supply, GDP, and primary energy intensity in the 20 countries with the largest total energy supply, 2010–23



Source: IEA 2026; UNSD 2025.

GDP = gross domestic product; SDG = Sustainable Development Goal.

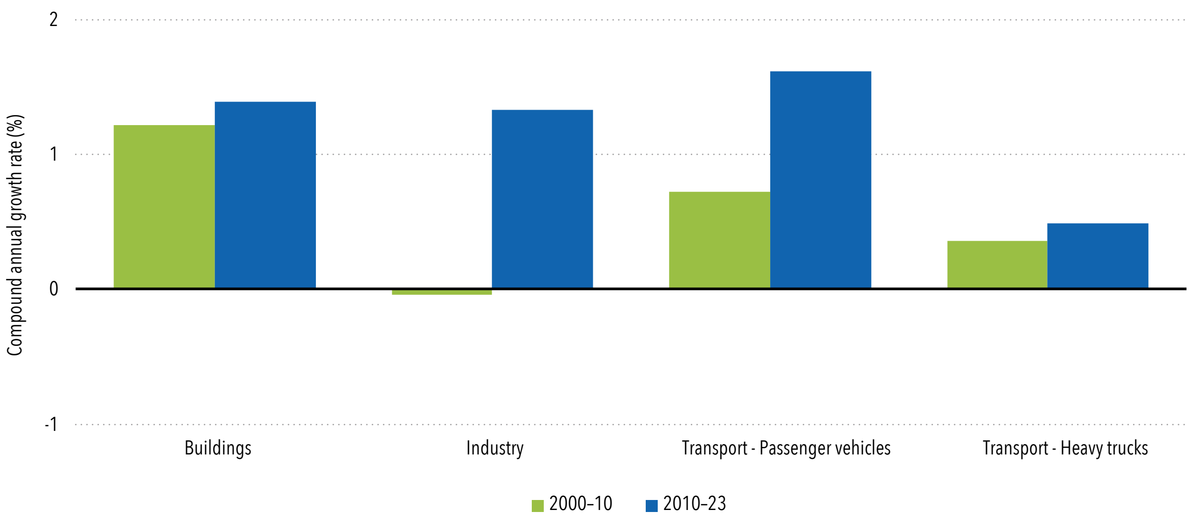
Efficiency trends in end-use sectors

Next to overall energy intensity improvement, it is useful to analyze progress in different end-use sectors. Between 2000 and 2010, the buildings sector experienced the most significant progress in energy intensity, followed by passenger transport and heavy trucks. In contrast, the industrial sector became only slightly more energy intensive. Between 2010 and 2023, energy intensity improved across all end-use sectors relative to the previous decade, though certain sectors achieved more rapid gains than others.

Industrial energy demand has surged in recent years as efficiency improvements have stalled and economic output growth has slowed. Both heavy and light industries have seen energy consumption rise at a faster pace compared to the previous decade. Over 2010–19, growth in average annual energy demand was 1.1 percent in heavy industry and 0.7 percent in light industry. However, this growth roughly doubled in 2019–23, reaching 1.8 percent and 1.9 percent, respectively. Global industrial energy intensity improved by just 0.2 percent per year between 2019 and 2023, down sharply from nearly 2 percent during 2010–19. This decline in efficiency momentum has led to a significant increase in energy demand, which has averaged 1.8 percent per year since 2019—almost twice the historical rate of around 1 percent recorded between 2010 and 2019. This acceleration occurred despite a slowdown in industrial output growth, which has decreased to 2.2 percent per year since 2019, down from 2.8 percent over 2010–19.

Electric vehicle (EV) sales surged in 2023 to about 20 percent of global car sales. However, the continued shift toward larger and heavier vehicles—particularly SUVs, which made up 48 percent of total car sales—offset much of the efficiency gains. Passenger car fleet efficiency improved by 1.6 percent in 2023, despite a significant increase in sales, in line with the average rate observed from 2010 to 2022. Electrification of heavy-duty vehicles lagged, at 3 percent of bus sales and 0.9 percent of truck sales, and energy intensity in that segment was flat in 2023 (figure 4.7).

Figure 4.7 • Average annual change in energy intensity, by sector, 2000–10 and 2010–23



Source: IEA 2026; UNSD 2025.

Note: Energy intensity is estimated as the ratio of total final energy consumption for each end-use sector to a sectoral activity indicator: floor space (buildings), value-added (industry), passenger-kilometers (passenger vehicles), or tonne-kilometers (heavy trucks). These indicators are obtained from IEA's Global Energy and Climate Model. Their positive values denote an improvement (decrease) of energy intensity. For more details, see IEA (2025a).

Trends in the efficiency of electricity generation

In addition to improvements in end-use efficiency, supply-side efficiency gains also count toward energy intensity targets. These include lower transmission and distribution losses from modernized supply infrastructure, more efficient fossil-fuel generation, the phase-out of inefficient power plants, and a larger share of renewables in the electricity generation mix.

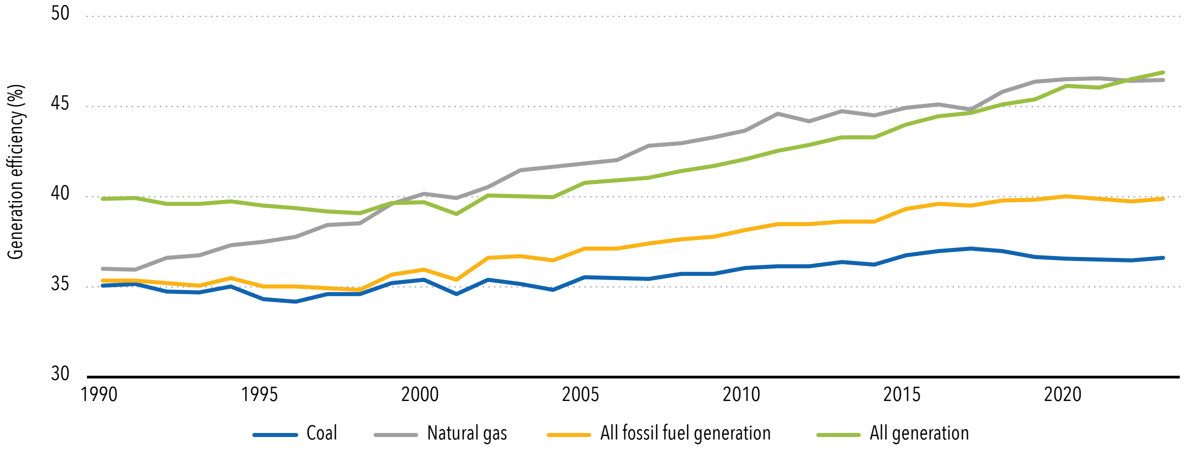
Overall efficiency of the two main fossil fuels used for electricity generation—coal and natural gas—improved steadily between 2000 and 2023, after stagnating in the 1990s. In 2023, fossil-fuel generation efficiency increased by 0.2 percent compared to the previous year, lifting overall generation efficiency across all sources to 46.9 percent (figure 4.8).

Coal-fired generation efficiency fell in 2021 and 2022, but rebounded in 2023 to its 2020 level.

Natural gas-fired generation posted strong efficiency gains in 2019–20, followed by a relatively stable performance over the following three years.

Renewables also play an important role in supply efficiency: a larger renewable share in the electricity mix lifts overall generation efficiency. Therefore, the rapid expansion of renewable energy over the past 15 years has significantly improved the efficiency of the electricity system.

Figure 4.8 • Global electricity generation efficiency, by fuel type and overall efficiency, 1990–2023



Source: IEA 2026; UNSD 2025.

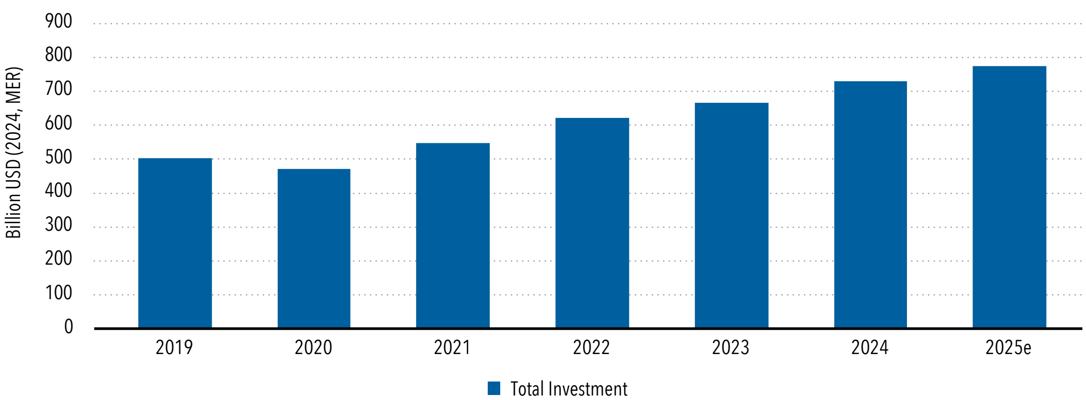
Investment in efficiency, electrification, and end-use renewables

Annual investment in energy efficiency, electrification, and end-use renewables reached about USD 729 billion in 2024, up USD 63 billion from 2023. Total investment expanded by 72 percent over 2015–25, with more than half (54 percent) of that increase coming in the last five years—indicating sustained growth after 2020. Industry grew the fastest in 2024, at around 30 percent, while the transport and buildings sectors experienced more modest increases of 13 percent and 5 percent, respectively. Buildings still account for the largest share in absolute terms, at USD 381 billion (figure 4.9).

Investment in global end-use efficiency remains concentrated in the United States, Europe, and China, which together accounted for around three-quarters of the global total. Although the rapid growth of their building stock represents a significant opportunity, emerging markets and developing economies contributed a smaller share of efficiency-related investments—just 34 percent of global investment in building energy efficiency.

Transport electrification hit new highs—one in five new cars sold globally is now electric—lifting end-use-related investments in transport to USD 312 billion, double the pace of 2023. Nearly two-thirds of total EV sales were in China, followed by North America at 18 percent.

Figure 4.9 • Global investment in energy efficiency, electrification, and renewables for end uses by sector, 2019–25e



Source: IEA 2025b.

Note: An energy efficiency investment is defined as the incremental spending on new energy-efficient equipment or the full cost of refurbishments that reduce energy consumption. The intention is to capture spending that leads to reduced energy consumption.

2025e = estimated values. MER = Market exchange rate. Total investment covers industry, transport and buildings sectors.

Energy efficiency investment within the buildings sector rose steadily, although the pace of growth has slowed. Spending on electric appliances—particularly residential cooling units—held overall investment up, while retrofits and envelopes stagnated or declined. The most substantial shift in 2024 occurred in Europe, where government-backed programs were drastically reduced. In contrast, energy efficiency investment in the United States, especially in retrofits and envelopes, remained stable.

Policy recommendations

Energy intensity improved by just 1.5 percent in 2023, down from a stronger 2.4 percent in 2022. This is well short of SDG target 7.3, which calls for a 2.6 percent annual improvement in energy intensity between 2010 and 2030. To make up this shortfall, the annual improvement rate must increase to 4.2 percent from 2024 onward.

Energy efficiency policies and investments in cost-effective measures need to be scaled up significantly if the global target is to be met. Global investment in energy efficiency and electrification increased rapidly over 2021–23, and this upward trend is projected to continue, reaching roughly USD 800 billion in 2025 (IEA 2025c).

Government support is crucial to enable consumers to invest in energy-efficient technologies, which can significantly lower energy bills. Universal access to electricity and clean cooking, increased electrification, and the incorporation of renewable energies can improve energy intensity by making energy end uses significantly more energy efficient and reducing supply-side inefficiencies. More joint efforts are needed to leverage the synergies between the various SDG 7 targets.

Energy efficiency can deliver many shared benefits to people, such as lowering energy bills, improving health outcomes, and creating new jobs. A strong, early focus on energy efficiency is essential to achieve net zero emissions by 2050. But despite the many benefits of energy efficiency, there are still obstacles preventing people and businesses from investing in energy efficiency improvements. Faster progress in efficiency requires a people-centered approach to ensure fair outcomes, improve skills, create decent jobs, and bring about social and economic development, while engaging people as active participants.

In all sectors, the greatest efficiency gains are achieved by a package of policies that combine three main types of mechanisms: regulation, information, and incentives. Careful policy design and implementation will help leverage energy efficiency's full potential to bolster energy security, create jobs, increase living standards, cut energy bills, and reduce emissions. Successful examples of implementation have the potential to be replicated to boost energy efficiency globally. IEA has published an Energy Efficiency Policy Toolkit summarizing the main tools to be used across sectors (IEA 2024a). Both the technologies and the resources to double energy efficiency improvement by 2030 are available (UN 2021). While countries should work to develop a framework that includes different instruments and covers multiple sectors, in the short term, prioritization can be useful. Some policies can be implemented faster or can have larger effects. This depends on national circumstances, such as the existing policy mix, the structure and size of the economy, available fiscal space, and the country's institutions.

Buildings

Between 2015 and 2024, energy consumption in the buildings sector grew by 1 percent annually, as rising demand for heating, cooling, and appliances outpaced the benefits of efficiency improvements (IEA 2025d). This trend has been driven largely by increased demand for air conditioners and appliances, particularly in emerging markets. Given the affordability stakes, policies targeting energy efficiency within the buildings sector are crucial.

Building energy codes set minimum requirements for a building's energy use and, when comprehensive, can improve efficiency in buildings, lower bills, and ensure optimal comfort. They may establish energy efficiency requirements of an entire building (performance-based codes) or of individual building components such as insulation, lighting, or heating and cooling systems (prescriptive codes). Around 60 codes currently include mandatory requirements for space cooling in residential buildings (IEA 2025c). Beyond energy savings, these codes can enhance overall flexibility of the electricity market by incorporating requirements for on-site renewable energy production, energy management, and integration of smart appliances and equipment that enable a demand response .

Energy performance certificates (EPCs) document a building's energy efficiency level and energy demand. EPCs typically include an A-to-G energy efficiency rating, recommendations for improvements, and estimates of annual energy use based on standard usage patterns (IEA 2025e). They can assess the overall energy performance of the real estate market as well as guide specific policies for different building types, such as targeted retrofit grants for residents of low-performing buildings, or tax benefits and favorable financing terms for high-performing ones.

Retrofit grants can promote efficient technologies by lowering the upfront cost of efficiency upgrades, making them more accessible and affordable. These grants are particularly important for improving the efficiency of existing building stock. Grants can direct investments from stakeholders toward specific energy efficiency measures and motivate them to exceed minimum standards by reducing upfront costs through innovative technologies and best practices. This incentive can target a specific subset of the population that needs the most support.

Appliances

Air conditioners and refrigerators, which account for over 45 percent of electricity demand in buildings, have around 90 percent of their energy use covered by regulation—but significant gaps remain in other areas. In many emerging economies, less than 60 percent of energy use for lighting and cooking falls under regulatory measures (IEA 2025c). Wider coverage and tighter standards are needed to unlock the full potential of energy efficiency gains.

Minimum energy performance standards (MEPS) for appliances establish a minimum efficiency threshold to address efficiency improvement barriers. Products that fall below it cannot be sold, which removes inefficient models from the market. MEPS are one of the longest-standing energy efficiency policy instruments and have proven quite cost-effective in improving the energy efficiency of products.

Labelling programs help consumers make informed decisions while purchasing more energy-efficient products and effectively complement MEPS through additional guidance. Comparative labels, which are often mandatory on similar products, feature a classification scale that enables consumers to compare the energy performance of different items. Endorsement labels, which are voluntary, are found only on best-in-class models or those exceeding a certain efficiency level. These two label types can also complement each other.

Loans and rebates help lower the up-front investment costs of appliances by offering financial support. They encourage consumers to buy more efficient products and motivate suppliers to produce them. These incentives also drive innovation and adoption of new technologies and practices. However, rebates can be expensive for governments, and require careful design. Low-cost loans offer up-front funding for highly efficient models. Often, the eligibility criteria require the scrapping of an old but functioning appliance.

Industry

The industry sector accounted for over 170 exajoules (EJ) of total final energy consumption in 2023 (IEA 2024b). However, there is substantial scope for rapid and large-scale efficiency gains through the following policy actions.

MEPS for industrial electric motors are a regulatory instrument in the industry policy package. They set the minimum level of energy efficiency that electric motors must meet to be sold in a given jurisdiction. Thresholds are calibrated to the motors' size, type, and application. Motors that meet or exceed these thresholds are considered compliant. Noncompliant models cannot be sold in the market.

The stringency of MEPS programs varies widely across countries. Enhanced international cooperation would help governments introduce new standards, draw on others' experience, and adopt best practices. Regional harmonization is also essential as it eases compliance, lowers implementation costs, curbs cross-border dumping of inefficient products, and expands markets for more efficient ones.

As of 2025, one-third of all countries have MEPS for electric motors (2025c). However, the level of stringency among them varies significantly, and overall progress has been relatively slowly. Consequently, new motors on the market are often only about half as efficient as the best ones available.

Other policies to improve energy efficiency include **Industrial Energy Efficiency Networks (EENs) and Energy Management Systems (EnMSs)**. EENs are effective tools for facilitating the exchange of knowledge and information on energy efficiency. These networks vary in structure, but typically consist of energy managers from different industrial sites who meet regularly to share their experiences and strategies for improving energy efficiency. EENs guide industries in becoming more efficient, in line with government policies, and provide governments with valuable industry-specific insights to develop more effective policies. On the other hand, EnMSs enable consumers to manage their energy consumption with greater efficiency and cost savings. A key framework for EnMSs is the international standard ISO 50001, which is based on a continuous cycle of monitoring, targeting, and implementing efficiency measures. Companies adopting ISO 50001 report average savings of 11 percent over the first three years. Light and heavy industries also report consistent energy savings, averaging 4 percent every subsequent year (IEA 2025f).

Transport

Transport accounted for about 122 EJ of total final energy consumption in 2023 (IEA 2026). Private cars and vans were responsible for more than 25 percent of global oil use and around 10 percent of energy-related CO_2 emissions in 2023 (IEA 2025e). Meanwhile, EV sales continue to increase and are expanding beyond passenger cars to include medium and heavy-duty trucks, though this growth is occurring at a slower pace.

Fuel economy standards regulate the efficiency of new vehicles by setting annual corporate average standards, or targets, for fuel economy (miles per gallon or kilometer/liter) or greenhouse gas (GHG/CO_2) emissions (in grams per mile/kilometer). Designs vary, but most apply a uniform standard to all auto manufacturers, for every year that the regulation applies. Some countries offer flexibility mechanisms, such as credits for over-compliant manufacturers, which they can use in the future or trade with underachieving manufacturers. These standards have increasingly incorporated provisions to facilitate the adoption of EVs (including battery electric and plug-in hybrids) and fuel cell vehicles, and can be especially beneficial for heavy-duty trucks. Countries that already have standards in place can tighten them to accelerate progress.

Vehicle efficiency labels help consumers in selecting more energy-efficient vehicles and complement fuel economy standards. These labels come in various formats, including those displayed on vehicles in showrooms and online. Increasingly, EVs now feature labels that include metrics such as a vehicle's driving range. National comparison websites further aid potential buyers by identifying the most fuel-efficient vehicles by category. In addition to information on fuel economy, labels may also include information on CO_2 and air pollutant emissions, along with fuel cost savings, enabling buyers to choose vehicles that cost less to run.

Subsidies for passenger EVs play a key role in accelerating electric car sales, especially among early adopters, by narrowing the price gap between EVs and internal combustion vehicles. Subsidies usually take the form of discounts or rebates, and can also be implemented as tax reductions through income tax credits. Discounts and rebates are the most common incentives used to lower the purchase price of EVs. These can be fixed direct discounts deducted from a vehicle's cost at the point of sale, or rebates/refunds assigned once a vehicle has been purchased. Subsidies have been implemented in most major markets to boost EV adoption, though the incentive levels and eligibility requirements vary. As a result, consumers can select from a range of EV models that are either more efficient or more affordable.

Cross-cutting

With electricity demand rising and renewables taking a larger share of generation, effective demand-side management is increasingly critical, and future energy systems are likely to rely on multiple interconnected flexibility services. Digitalization and artificial intelligence can sharpen energy management by enabling consumers to monitor, optimize, and adjust their electricity use. As peak loads come under greater pressure, demand-side flexibility will be essential for system reliability, efficiency, and cost-effectiveness.

Energy efficiency obligation (EEO) schemes require designated "obligated parties" to achieve energy or emission savings targets across their customer portfolios. Obligated parties include energy utilities, retail energy sales companies, energy distributors, transport fuel distributors, and/or transport fuel retailers. EEO schemes are market-based instruments: obligated parties can choose which measures to deploy to meet their set targets, within set limits. Some EEO schemes include "white certificates" (also called energy savings certificates), which certify that a specified reduction in energy use or emissions has been achieved. White certificates can typically be traded between over- and underperformers, and are usually combined with an obligation to achieve a certain energy or emission savings target.

CHAPTER 5
INTERNATIONAL PUBLIC FINANCIAL FLOWS TO DEVELOPING COUNTRIES IN SUPPORT OF CLEAN ENERGY

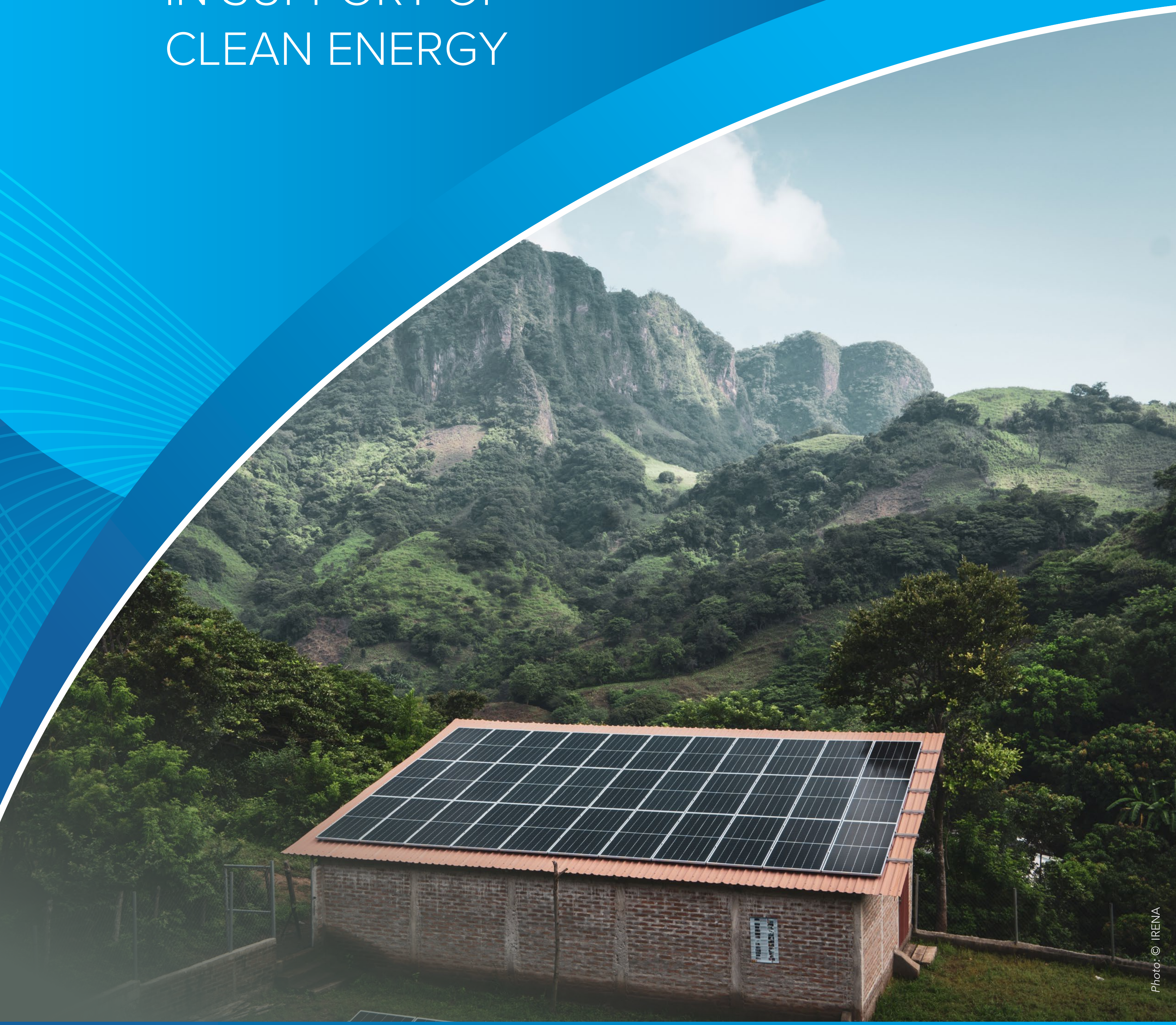


Photo: © IRENA

Main messages

Global trends. SDG 7.a.1 shows that international public financial flows rose in 2024 to USD 24.6 billion, up from USD 24.4 billion in 2023. This modest increase follows three years of growth. With development assistance faltering, however, flows may tighten. Of particular concern are the reduced flows to least-developed countries (LDCs), which stood at USD 3.7 billion in 2024, an 11 percent drop from 2023 levels. Public international flows remain of key importance for LDCs, and other developing countries, as they can help bridge structural financing gaps and underpin adequate financing to achieve SDG 7 and the wider 2030 agenda.

Target for 2030. Under indicator 7.a.1., no quantitative target has been set for international public financial flows. At USD 24.6 billion in 2024,[26] however, just a percentage point above the 2023 level, the trend shows that the world is failing to meet the goal of international cooperation, which funds clean energy research and technologies for countries in need. The modest growth in 2024 must be understood within the broader financing environment, as total official development assistance (ODA) from Development Assistance Committee (DAC) members fell 6 percent in 2024, the first decline in five years. The slide continued in 2025, revealing a 23.1 percent drop compared with 2024, the largest annual contraction on record. Against the backdrop of the 2026 energy and economic crises, international public finance for clean energy (particularly impact-based concessional loans and grants) will be vital in upholding the commitment to energy development in developing countries and in ensuring they can equitably benefit from the energy transition worldwide.

Technology highlights. Among renewable energy technologies, projects attributed solely to solar energy continue to attract the largest share of investments. Their relative proportion has shrunk, however, dropping from 43 percent in 2023 to 30 percent in 2024, or commitments of USD 7.4 billion.[27] Hydropower's share rose from 13 percent to 17 percent over the same period, with flows expanding to USD 4.1 billion. Wind energy, by contrast, declined from 13 percent of total commitments in 2023 to 5 percent in 2024, or USD 1.3 billion. Bioenergy, geothermal, and marine energy together accounted for approximately 3 percent of total flows in 2024. Most growth in 2024 related to multiple/other renewables, rising 50 percent compared to 2023 to reach USD 11.1 billion and accounting for 45 percent of total flows. This category includes projects supporting more than one renewable technology, as well as those lacking sufficient detail for precise technology disaggregation.

Regional highlights. The regional distribution of international public financial flows in 2024 remained concentrated: Latin America and the Caribbean, Central and Southern Asia, and Sub-Saharan Africa together accounted for 66 percent of total commitments. Only three regions showed real progress compared with their historic highs. Northern Africa and Western Asia saw a 23 percent increase in 2024, consistent with the growth observed in 2023. Northern America and Europe reached a new peak in 2024 of USD 1.7 billion, a 5 percent increase from the previous year. Oceania saw a more than sixfold rise in commitments, surpassing peak levels in 2016, mainly due to increased flows into Papua New Guinea and the Marshall Islands. Latin America and the Caribbean recorded the largest share at 24

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26 These figures may be revised upward, as lags in reporting suggest that 2024 commitments are not fully captured in the current data.

27 Where solar components are embedded within multi-technology projects, and financing cannot be attributed to a single technology, commitments are recorded under multiple/other renewables category to ensure accurate reporting under SDG 7.a.1, which indicates that the true scale of solar-related investment may be somewhat higher than the figure attributed solely to solar suggests.

percent, with flows reaching USD 5.9 billion, more than double the 2023 level, but still below the levels seen in 2014, with support focused on Argentina, Brazil, and Ecuador. In 2024, Central and Southern Asia, Eastern and South-eastern Asia, and Sub-Saharan Africa all experienced a decline in climate finance flows compared to 2023, a concerning trend given that these regions are home to some of the world's least developed countries and most climate-vulnerable populations.

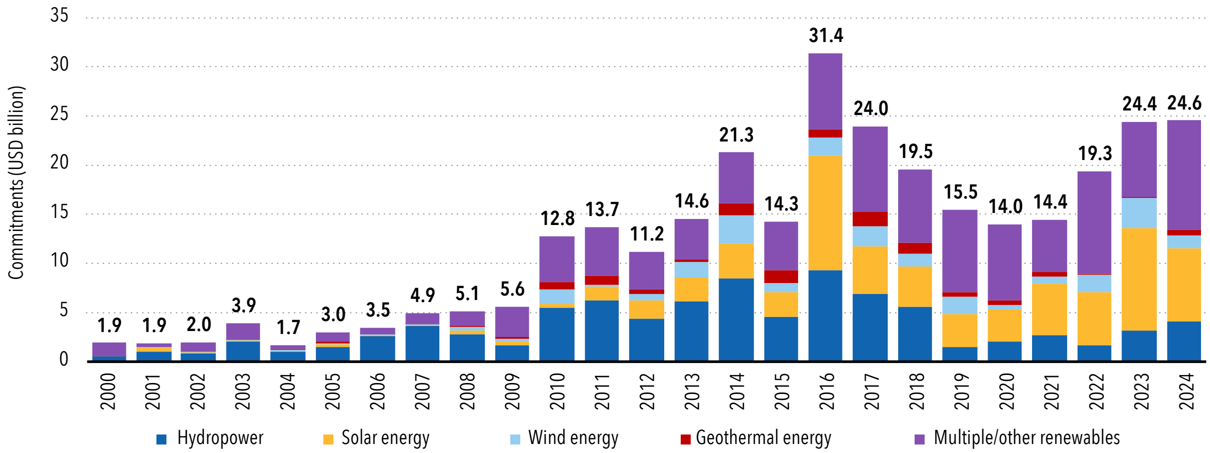
Commitment distribution highlights. International public financial flows are still primarily concentrated in a few countries. In 2024, 80 percent of commitments are distributed across 32 countries, up from 28 in 2023. Flows to LDCs fell 11 percent from the 2023 level to USD 3.7 billion, representing only 15 percent of total flows in 2024. Landlocked Developing Countries (LLDCs) attracted more financing than LDCs in 2024, reaching USD 4.6 billion, a 16 percent bump up from 2023. Meanwhile, flows to small island developing states (SIDS) fell 5 percent to USD 585 million in 2024. These three country groups combined received less than 30 percent of total public clean energy flows to developing countries in 2024, despite accounting for over 60 percent of the global population without access to electricity. This misalignment between where energy poverty is concentrated and where finance flows are directed makes bridging the financing gap for LDCs, LLDCs, and SIDS essential to ensuring an equitable energy transition so no country is left behind.

Financing instruments. Despite the higher cost of debt caused by persistently high interest rates across developing country markets, debt-based instruments remained the main form of public clean energy finance, accounting for 80 percent of total flows in both 2023 and 2024. Standard loans were the largest instrument in 2024 at USD 14.4 billion (59 percent of total flows), followed by concessional loans at USD 4.8 billion (19 percent). Grants leaped 39 percent year-on-year to reach USD 3.3 billion. This rise increased their share of total flows from 10 percent in 2023 to 13 percent in 2024, reflecting a shift toward more favorable financing terms for recipient countries. Equity financing, by contrast, remained marginal, declining to USD 571 million, or roughly 2 percent of total flows. Of the 65 donors who made commitments in 2024, only 11 provided equity contributions. Dedicated risk-mitigation instruments, including guarantees and credit lines, grew to USD 1.1 billion (5 percent of total flows). Their reach remained limited, however, to just six recipient countries (including two LLDCs), down from ten in 2023. This indicates that public financing, particularly impact-based concessional loans, grants, and support for risk mitigation have not yet scaled with the investment needs of developing countries. Scaling public financing is critical, while finding more effective and efficient ways to use these scarce resources to mobilize private capital. This may require public financing to become more risk-bearing—for instance, by moving beyond traditional debt provision toward a higher share of risk-tolerant equity, guarantees, risk-mitigation instruments, and grants that mobilize private investment.

Are we on track?

Achieving the 2030 Agenda on time will require a recalibration of the scale and speed at which the international community mobilizes and channels financing for the energy transitions in developing countries. As shown in figure 5.1, international public financial flows to developing countries in support of clean energy reached USD 24.6 billion in 2024, up slightly from USD 24.4 billion in 2023.[28] But this figure remains well below the peak of USD 31.4 billion recorded in 2016, and the modest progress falls well short of the scale and ambition of SDG 7. The shortfall underscores that the world is not on track to meet the 2030 goal to forge international cooperation and to attain access to clean energy research and technologies for countries in need.

Figure 5.1 • Annual international public financial flows for renewables in developing countries, by technology, 2000–24



Source: IRENA and OECD 2025.

As illustrated in figure 5.2, debt remained the dominant financing instrument in 2024, representing 80 percent of total flows, with grants making up just 13 percent. Geographically, Latin America and the Caribbean received the largest share (24 percent), followed closely by Central Asia and Southern Asia (22 percent) and Sub-Saharan Africa (20 percent). On the technology side, solar energy accounted for 30 percent, hydropower for 17 percent, while multiple and other renewables accounted for 45 percent of flows, reflecting a diversified but still unevenly distributed technology portfolio.

Solar energy continued to account for the largest share of international public financial flows in 2024 (figure 5.2), with projects attributed solely to this technology reaching USD 7.4 billion. But their relative proportion fell from 43 percent in 2023 to 30 percent in 2024. Multiple/other renewables expanded to USD 11.1 billion in 2024 and made up nearly half of total flows. Unlike previous periods when funds categorized as multiple/other renewables temporarily contracted after rapid growth, recent data points indicate widespread expansion across various technologies, mainly driven by the strong rise in financing for projects that combine different renewable energy sources or support enabling energy infrastructure.

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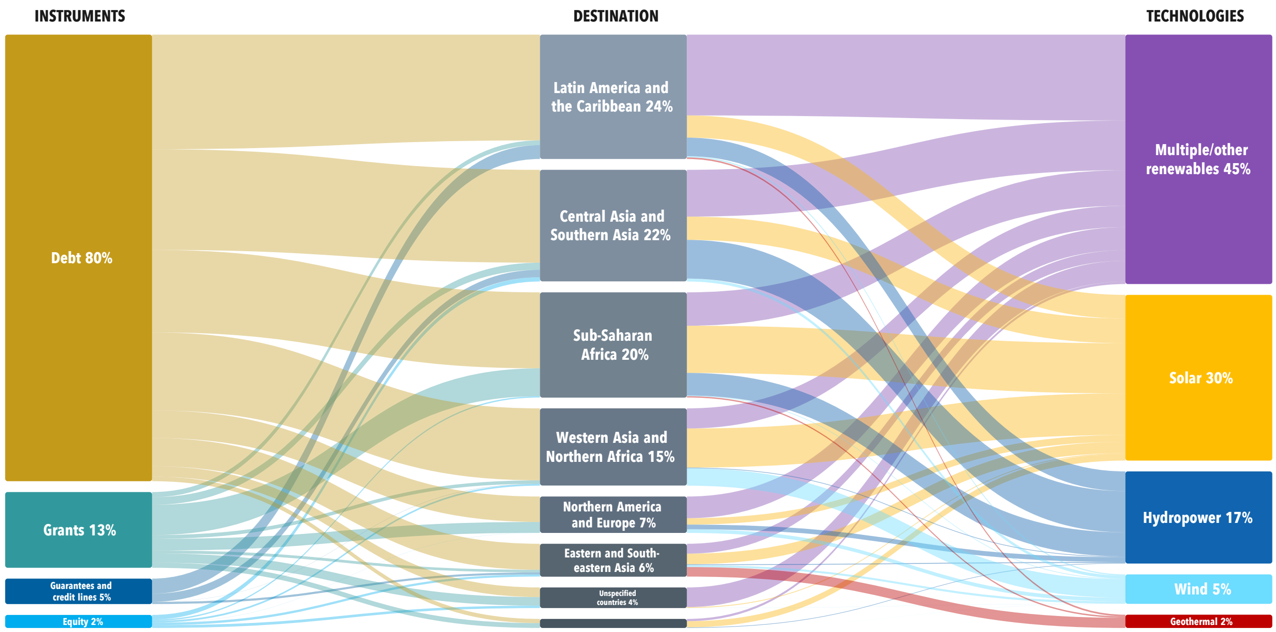
28 Unless stated otherwise, all commitment amounts are expressed in US dollars at 2023 constant prices and exchange rates. Constant amounts are adjusted for inflation rates and changes in exchange rates. Annex 1 provides more information. This edition of the report incorporated additional flows related to new subcategories not considered before, including flows supporting renewable electric power transmission and distribution for centralized grids, as well as technical advisory flows on energy policy and administrative management for renewables. "Changes to the data" section in Annex 1 provides more information on the updated methodology (refer to figure 5.11 and table 5.2).

Commitments to hydropower and geothermal energy also increased over previous years, reaching USD 4.1 billion and USD 0.6 billion, respectively, while wind energy flows fell to USD 1.3 billion. This decline in wind funding coincides with fewer commitments from Japan, which had accounted for 50 percent of the funds in 2023, when flows to wind reached their highest level in over a decade, at over USD 3.1 billion.

Figure 5.2 • Distribution of international public financial flows for renewables in developing countries by instrument, destination, and technology, 2024



Source: IRENA and OECD 2025.

Note: Dimensions within each category are ordered from highest to lowest financial flow volume.

At the donor level, the trend showed progress. The European Union recorded a rise in international public financial flows for renewables (USD 1.4 billion). [29] Bilateral flows from Germany (USD 1.7 billion), France (USD 576 million), Norway (USD 200 million), and Denmark (USD 54.5 million) also rose slightly. These incremental gains highlight a structural issue: funding that is concentrated in just a few donors makes the landscape vulnerable to their strategic and budgetary decisions. An expanded donor base is required, along with mobilizing additional finance from the existing donor base.

Total ODA from DAC members fell 6 percent in 2024, marking the first decline in five years, said to be traceable to reduced bilateral aid and limited donor budgets (OECD 2025). The slump continued in 2025, with a 23.1 percent drop compared to 2024, the largest annual contraction on record. This two-year decline has pushed ODA levels back to the start of the 2030 Agenda because bilateral aid and donor budgets have shrunk (OECD 2026). Clean energy flows to developing countries are unlikely to be shielded from this contraction, placing the SDG 7 agenda under pressure precisely when acceleration is most needed.

With the 2030 target date fast approaching, the international community needs to scale up and strategically leverage international public finance for clean energy, particularly in the form of impact-based financing, such as concessional loans and grants for the countries that are furthest behind and least able to attract private investment on their own terms. At the same time, public funds will need to take on greater risks, rather than replicate the risk aversion of private capital, in order to mobilize the investment at the scale required (IRENA and CPI 2025).

29 This figure covers flows from the European Commission, European Investment Bank, and the European Development Fund.

Looking beyond the main indicators

This section studies trends in international public financial flows from the perspective of technologies, geographic regions, countries,[30] and financing mechanisms.

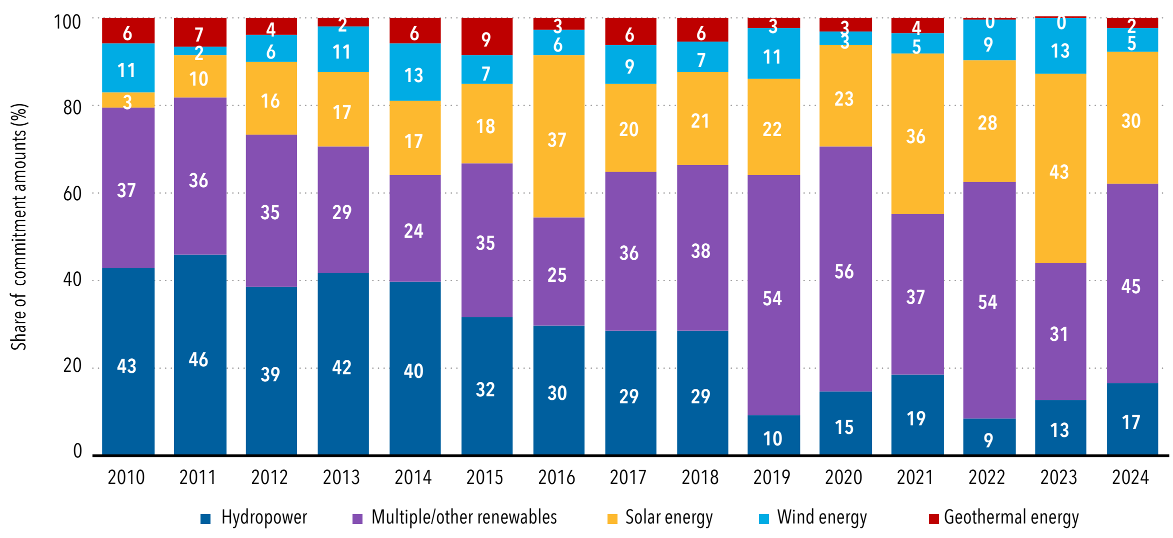
Technology trends

International public investors categorize flows to clean energy by the type of renewable energy involved: hydropower, solar, wind, geothermal, and multiple/other (figure 5.3).[31]

Solar energy remained the leading technology, though its share moderated from about 43 percent in 2023 to roughly 30 percent in 2024, broadly in line with its average share over the past five years. This shift likely reflects the growing integration of solar PV into broader multi-technology projects, rather than a decline in solar investment per se. When solar components are embedded within such projects and financing cannot be exclusively attributed to a single technology, commitments are recorded under the multiple/other renewables category to ensure accurate reporting under SDG 7.a.1. Figures attributed solely to solar components considerably underestimate the true scale of solar-related investment when cross-sectoral contributions are considered.

A total of 436 commitments were made in 2024, amounting to USD 7.4 billion. These commitments ranged from the Europe and Central Asia Renewable Energy Scale-up program at USD 650 million, which is part of Accelerating the Market Transition for Distributed Energy, Türkiye's Multiphase Programmatic Approach. Financed by the World Bank, the program covers more than 230 smaller commitments. With ticket sizes of USD 1 million or less, many of these commitments supported solar-based isolated grids and standalone systems. The financing structures varied: nearly 90 percent of these smaller solar projects were grant-funded, whereas larger commitments relied on debt financing.

Figure 5.3 • Share of international public financial flows to renewables, by type of energy, 2010–24



Source: IRENA and OECD 2025

30 The word country refers to a territory, area, or other unspecified location within the scope of SDG indicator 7.a.1.

31 The multiple/other renewables category comprises unclear commitment descriptions in financial databases and lacks detail on the financial breakdown by technology. It includes bioenergy commitments, which are almost negligible; multipurpose financial instruments like green bonds and investment funds; and commitments targeting a broader range of technologies, such as renewable energy and electrification programs, technical assistance, energy efficiency programs, and other infrastructure supporting renewable energy.

Wind energy's share dipped from 13 percent in 2023 to 5 percent in 2024, or USD 1.3 billion for 48 projects. The surge in wind financing in 2023—its highest level over the past decade—was not sustained into the following year. While the year-on-year drop appears sharp, it should be viewed in the context of the broader trend. Wind financing in the 2020s has generally fluctuated within a relatively narrow band, with 2023 representing an exceptional peak rather than a new baseline. In 2024, flows were driven mainly by a large-scale USD 340 million onshore wind project funded by the International Development Finance Corporation in Türkiye, and another USD 297 million project financed by the Japan Bank for International Co-operation in Saudi Arabia.

Hydropower edged up from 13 percent to 17 percent, equivalent to USD 4.1 billion. Although hydropower projects commanded higher shares prior to 2019, this was driven by multi-billion-dollar commitments in large-scale hydropower projects. Such large commitments have not been recorded in the past five years (2019–24). For instance, during 2013–18, a total of 10 projects with a ticket size of USD 1 billion or more received funding. In the following six years (2019–24), no projects of such magnitude received international public funds. Although hydropower generation is expected to continue growing in absolute terms across developing economies, its share relative to other renewable energy sources is projected to decline as solar and wind scale up (IRENA 2024).

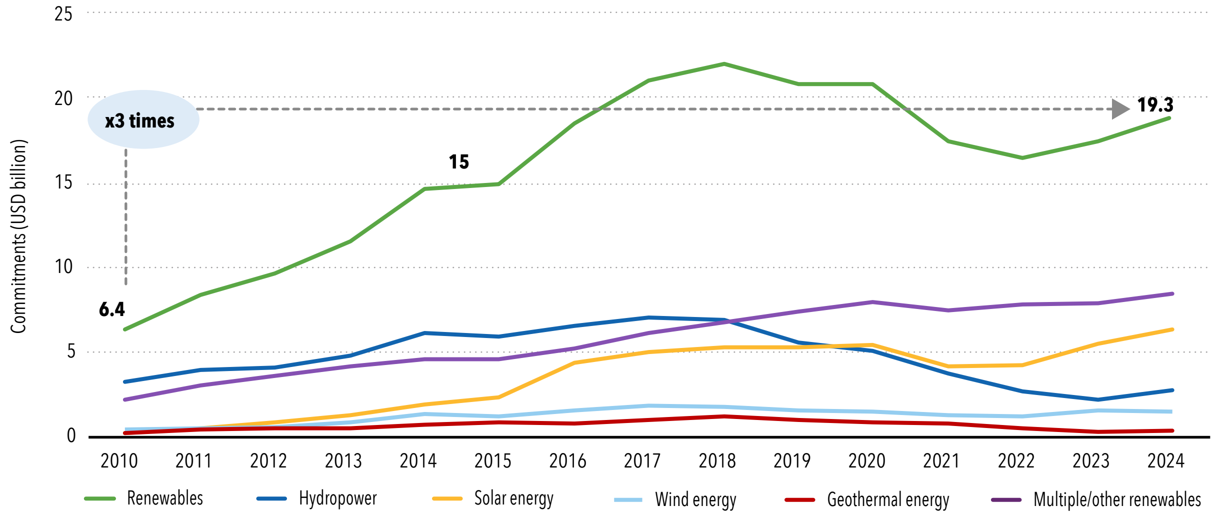
Geothermal energy commitments grew tenfold in 2024, compared to 2023, to USD 594 million, although its share grew only slightly in 2024, still making up a modest 2 percent of the total commitments. While still a fraction of the portfolio, and far below 2010–16 levels, the rise indicates renewed interest in geothermal within the renewable technology mix, driven mainly by projects in China (48 percent of total geothermal commitments) and Indonesia (28 percent).

The most notable change between 2023 and 2024 was in the **multiple/other renewables** category, the share of which leapt from 31 percent to roughly 45 percent of total commitments. This is partly due to more donor funding for projects aimed at multiple technologies, and methodological changes in this year's edition, which includes more such projects. The share of this category has grown over time, as it includes commitments for projects where the technology choice is unclear or nonspecific. Such projects tend to target renewable energy technologies without providing technology-specific financial data. This can comprise larger projects involving a combination of renewable energy technologies such as electrification and/or energy efficiency programs, grid transmission, and distribution development.[32] It may also include smaller projects, such as multi-technology technical assistance programs, and multipurpose financial instruments, such as green bonds and the capitalization of investment funds, the proceeds of which support various technologies. Finally, commitments for bioenergy projects, which are almost negligible, are also included here. This technology has the highest proportion of projects with ticket sizes of USD 1 million or less.

Given the wild annual variations in commitments, a moving average smooths out year-on-year fluctuations and reveals the underlying trend (figure 5.4). In 2024, the five-year moving average for all renewables increased again, reaching USD 19.3 billion—three times the 2010 baseline of USD 6.4 billion and around 20 percent more than the 2015 baseline of USD 15 billion—indicating that the upward shift in the trend has been sustained. In 2024, solar and multiple/other renewables were the main drivers of the rising five-year moving average, with both technologies reaching their highest trend levels in the series. The moving averages of hydropower and geothermal slightly increased in 2024 but remained relatively low. In contrast, the moving average of wind dipped in 2024.

32 Including flows specific to centralized grids and technical advice on energy policy and administration added in this edition of the report.

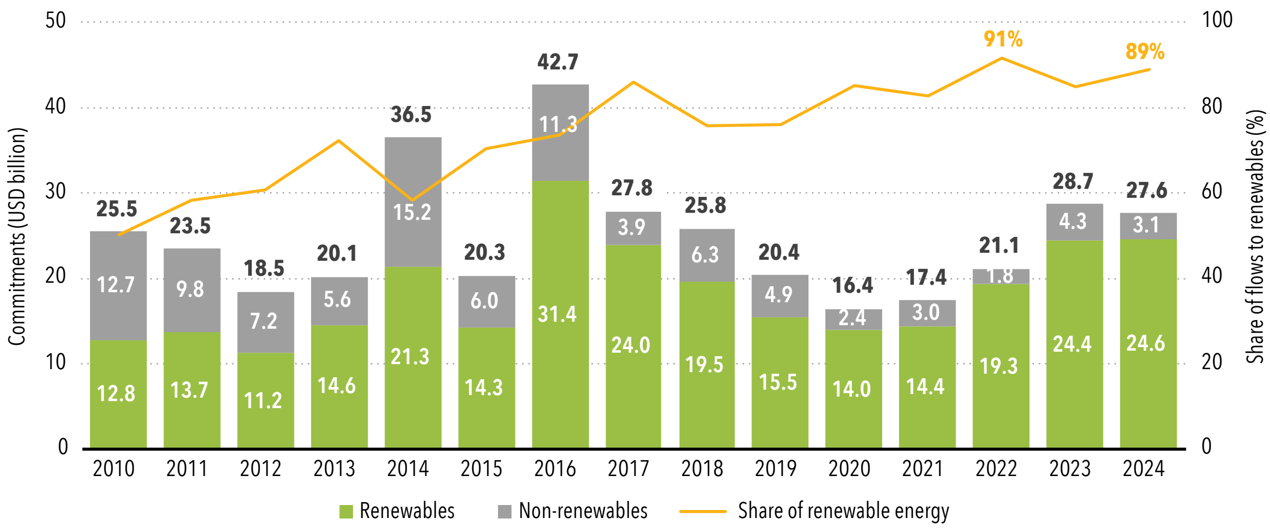
Figure 5.4 • Five-year moving average of international public financial flows to renewables, by technology, 2010–24



Source: IRENA and OECD 2025.

In 2024, international public financial flows toward nonrenewables (mainly fossil fuels and nuclear energy) fell to USD 3.1 billion from USD 4.3 billion in 2023 (figure 5.5). The top three recipients of nonrenewable commitments were Viet Nam (29 percent), Ukraine (11 percent), and Nigeria (10 percent). This included a standard loan of USD 872 million for a natural gas power plant in Viet Nam, more than USD 332 million in funds to support Ukraine's energy infrastructure (primarily supported by European countries), and resilience measures, most of which were grants. Additionally, a Nigerian project worth USD 294 million called Reforms for Economic Stabilization to Enable Transformation. It involved loans for the reform of non-oil revenues and to provide safeguards for oil revenues related to energy generation from nonrenewables. Over the long term, however, the share of renewables in total public financial flows has risen from 50 percent in 2010 to 89 percent in 2024.

Figure 5.5 • Commitments per year by technology group, 2010–24

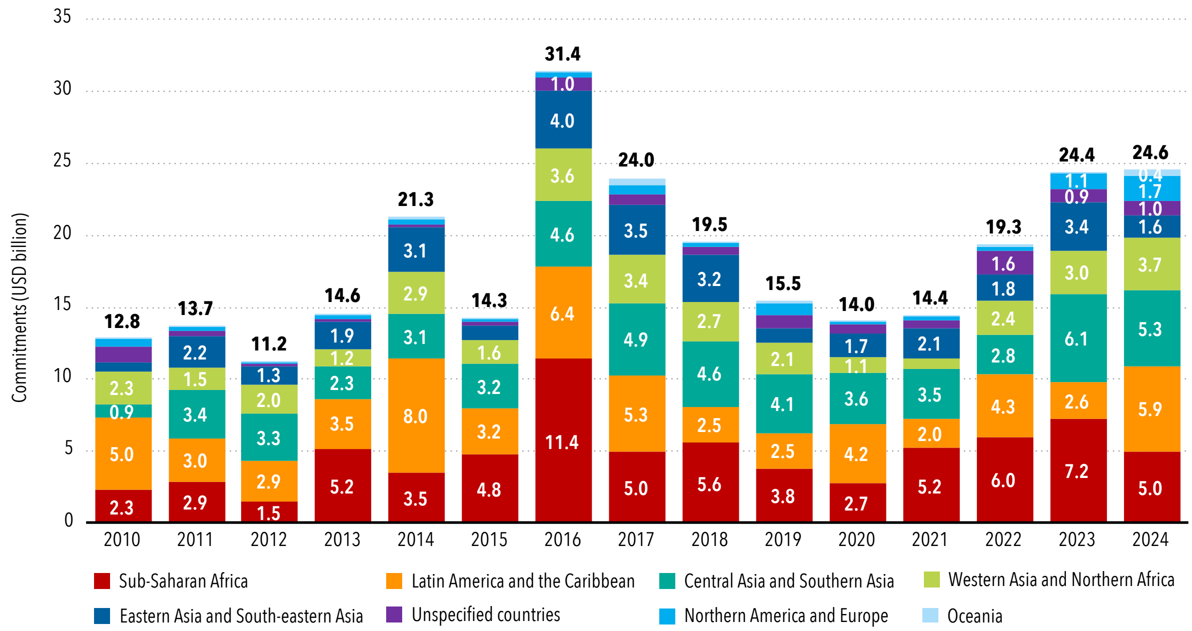


Source: IRENA and OECD 2025.

Regional trends

International public financial flows to all regions changed markedly between 2023 and 2024. The largest increase came from flows to Latin America and the Caribbean (figure 5.6).

Figure 5.6 • Annual international public financial flows of renewables, by region, 2010–2024



Source: IRENA and OECD 2025.

Note: See chapter 7 for the list of countries included in each region.

Compared to their historic peaks, only three regions saw progress in international public financial flows in 2024.

Western Asia and Northern Africa saw flows rise to USD 3.7 billion in 2024, up from USD 3 billion in 2023. This ongoing recovery pushes the region to its highest level, surpassing the peak in 2016. Most commitments went to solar (51 percent) and wind (22 percent) projects, while multiple/other renewable energy initiatives made up 26 percent. About a quarter of the region's flows went to Türkiye (37 percent), with Azerbaijan, Egypt, and Morocco among the top four recipients, collectively accounting for 78 percent of the region's funding. Leading donors included the European Bank for Reconstruction and Development (EBRD) and the World Bank, which made record-high commitments of USD 1,083 million and USD 1,073 million, respectively, to the region.

Northern America and Europe reached a new peak in 2024 of USD 1.7 billion, a 5 percent gain from the previous year, but they accounted for only around 7 percent of total commitments in 2024. This growth was driven by increased flows to Serbia and Ukraine (more than doubling from 2023 levels), mainly through projects in the multiple/other renewables category (over 60 percent of the region's flows). Major donors to this region include the EBRD, Germany, and the European Union. Saudi Arabia made its first financial commitment to the region by providing a loan to Serbia to support development of the transmission system operator (Saudi Fund for Development 2024).

Oceania recorded a sixfold increase in 2024, while remaining a minor recipient, accounting for 1.8 percent of total flows. Despite remaining below USD 0.5 billion, financing levels exceeded the previous peak reported in 2017. Flows were balanced between grants (53 percent) and concessional loans (47 percent). The International Development Association (IDA), the Asian Development Bank, and Australia are major donors in 2024. Around 68 percent of flows went to solar energy, followed by multiple/other renewable energy projects (25 percent) and hydropower (6 percent), mainly supporting Papua New Guinea and the Marshall Islands, the top two recipients in 2024.

One region saw a substantial increase in international public financial flows between 2023 and 2024 but remained well below its peak level.

Latin America and the Caribbean flows more than doubled to USD 5.9 billion in 2024, up from USD 2.6 billion in 2023, and held the largest share of total commitments at 24 percent. This marks the region's highest level since 2016 and indicates a rebound after a few years of moderate flows. Approximately 65 percent of financing was allocated to projects involving multiple or other renewable energy technologies. The Inter-American Development Bank and the World Bank remained the two largest providers, jointly accounting for nearly half of total regional flows in 2024. As with 2023, standard loans continued to be the dominant financing instrument, representing 79 percent inflows to the region. Around 58 percent of financing was concentrated in three countries: Argentina (19.9 percent), Ecuador (19.7 percent), and Brazil (17.9 percent).

Three regions experienced a downward correction after strong growth the year prior.

Sub-Saharan Africa, where most of the LDCs are located, fell to USD 5.0 billion in 2024, from USD 7.2 billion in 2023. Although still exceeding the levels from 2019 to 2021, this decline interrupts the upward trend of the past three years. Almost 45 percent of the flows went to solar power, followed by hydropower at 22 percent, and multiple/other renewables at 32 percent. Increased funding came from institutions such as the International Development Association (32 percent of the region's flows), China (16 percent), and Germany (12 percent). The region remains the largest recipient of grants in absolute terms —USD 1,324 million. Funding in Sub-Saharan Africa is more dispersed than it is elsewhere; over 80 percent of the funds are distributed across 14 countries and territories.

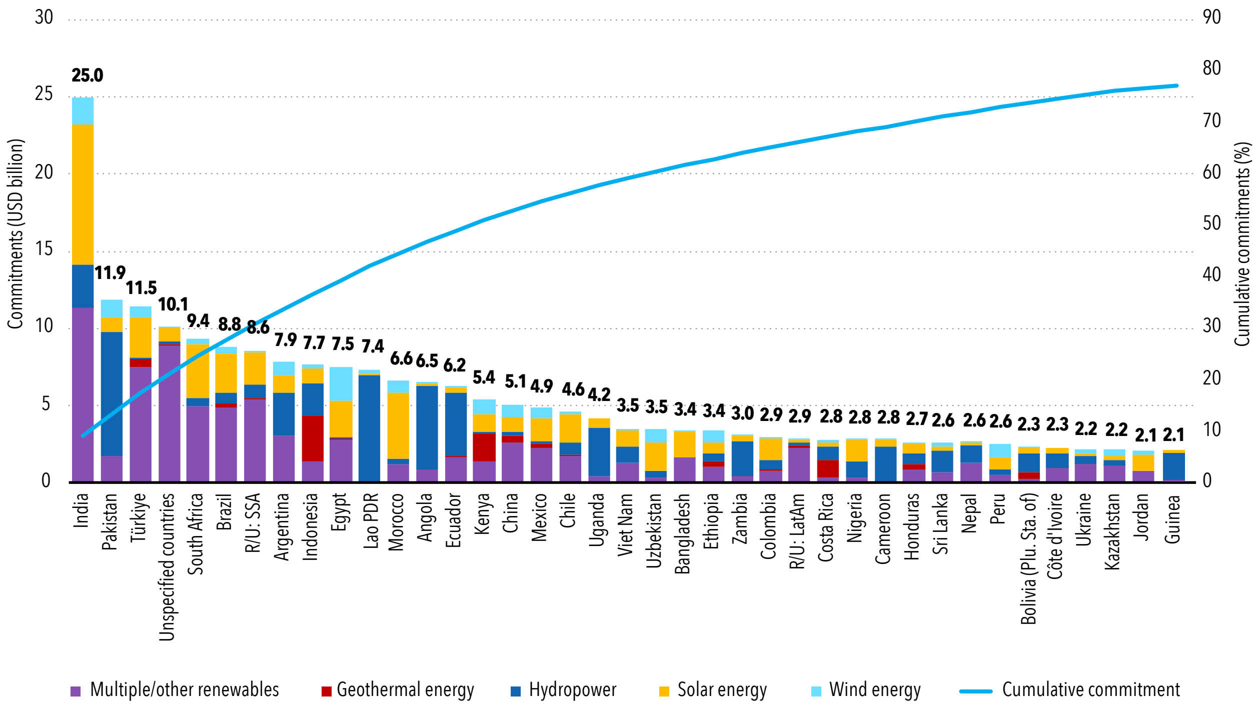
Eastern Asia and South-eastern Asia saw commitments decline from 55 percent in 2024—or USD 1.6 billion—compared to USD 3.4 billion in 2023. This marked year-on-year contraction reverses the growth seen in 2023. Commitments to wind energy halved in 2024, while renewable hydropower fell to less than a tenth of the 2023 commitments. Approximately 27 percent of the flows were directed to Thailand, followed by Indonesia (20 percent) and China (19 percent). Conversely, flows to geothermal energy saw a notable increase in 2024, with around half a billion dollars in commitments, notably for China's Shaanxi Energy Transition and Innovation Demonstration project and Indonesia's PT Medco Cahaya geothermal 35 MW power plant.

Central Asia and Southern Asia accounted for 22 percent of total flows in 2024, amounting to USD 5.3 billion, mainly driven by commitments to hydropower and multiple/other renewable energy projects. This is a decline from 2023, when approximately USD 6.1 billion was committed. About 63 percent of these flows were concentrated in just three countries: India (32 percent), Pakistan (21 percent), and Uzbekistan (10 percent). The Asian Development Bank, IDA, and Germany were the leading contributors, providing 45 percent of the region's total. Overall, over 83 percent of the region's funding was debt-based, comprising standard loans (51 percent) and concessional loans (32 percent).

Country trends

From 2010 to 2023, 41 countries and territories received 80 percent of all commitments. By 2024, this figure rose to 42 countries and territories (figure 5.7).[33]

Figure 5.7 • Top recipients of international public financial flows to renewables, by type of energy, 2010–24



Source: IRENA and OECD 2025.

In 2024, the number of countries and territories receiving 80 percent of flows rose to 33, up from 28 in 2023, with five additional countries. This is the highest number of countries and territories receiving 80 percent of commitments in a single year. Collectively, these 33 countries represent two-thirds of the population among the countries analyzed for SDG 7.a.1.

The top five country recipients of international public financial flows in 2024 were **India** (almost USD 1.67 billion), **Türkiye** (USD 1.36 billion), **Argentina** (USD 1.17 billion), **Ecuador** (USD 1.16 billion), and **Pakistan** (USD 1.12 billion). As in 2023, India and Türkiye remain the top two recipients in 2024. Uzbekistan and South Africa—the third- and fourth-largest recipients in 2023—dropped to 13th and 18th places, respectively, in 2024. Nigeria, which had moved up to fifth place in 2023, was not even in the top 50 in 2024. Such fluctuations are common, reflecting the variable financial flows.

33 Countries and territories drop in and out of the top 80 percent because of the high annual variance in flows.

India's international financial flows declined by nearly 49 percent, from USD 3.3 billion in 2023 to USD 1.67 billion in 2024, yet the country remained the largest recipient. In 2024, India received these funds across 49 projects, mainly allocated to solar energy (29 percent) and multiple/other renewable energy technologies (65 percent). The share of multiple or other renewables increased 2.5 times compared to 2023's 13 percent. The Asian Development Bank was the largest contributor (USD 683 million) in 2024, followed by Germany (USD 476 million). In a notable shift and reversal of the previous year's trend, standard loans fell to 51 percent (USD 0.9 billion) from the peak of 85 percent achieved in 2023 (USD 2.8 billion), offset by concessional loans at 30 percent (USD 506 million). One of the major projects includes USD 236 million from the Asian Development Bank to enhance West Bengal's distribution system. Japan's commitments to India's clean energy sector rose sharply in 2024, with six commitments totaling around USD 216 million. The largest individual project appears to be a loan from the Japan Bank for International Cooperation to NHPC Limited of India.

Türkiye received USD 1.36 billion in 2024 across 19 projects. In 2024, flows were mainly debt-driven, and standard loans accounting for 97 percent and concessional loans for 2 percent of total financing. Only the European Union and Japan provided a standard grant of USD 3 million. As in 2023, the World Bank held the largest share of investments (USD 650 million). Around 60 percent (USD 0.8 billion) went to solar energy —the highest share provided by the World Bank as standard loans for two projects, each worth USD 254 million, for solar energy for isolated grids and standalone systems. Wind energy accounted for 12 percent of total flows, highlighted by a single project supported through a USD 107 million standard loan from the US International Development Finance Corporation to a locally operating independent power producer. Another 15 percent went to multiple/other renewable energy projects, the largest being a USD 66 million EBRD loan to support the development of the country's first hybrid solar-wind plant combined with 10 MWh battery storage technology.

Argentina received USD 1.17 billion in 2024 across six renewable energy projects; the Inter-American Development Bank gave USD 685 million toward the transition to a sustainable electricity sector. The International Bank for Reconstruction and Development contributed USD 489 million to support this transition. A leap from 18th place in 2023 to 3rd in 2024 highlights Argentina's remarkable progress in sustainable energy access and financing. As demand is expected to grow 6 or 7 percent through 2030 and most of the grid infrastructure is 30 to 50 years old, this project is anticipated to help integrate renewable energy into the generation mix.

Ecuador received USD 1.16 billion in 2024, a ninefold increase in flows from 2023 (USD 0.1 billion), across 16 projects. This spike was driven primarily by a single project rather than a sustained shift in financing patterns. The project was financed by the Inter-American Development Bank with USD 933 million, including a USD 489 million standard loan to support the energy transition and promote investment in Ecuador's energy sector. The second-largest contributor was the Republic of Korea, with a USD 100 million concessional loan for multiple/other renewable energy investments. Overall, multiple/other renewable energy projects accounted for 96 percent (USD 1.1 billion) of the flows, while geothermal energy accounted for the remaining 4 percent. Standard loans made up 82 percent (USD 1 billion) of the funding, followed by 17.5 percent (USD 0.2 billion) in concessional loans.

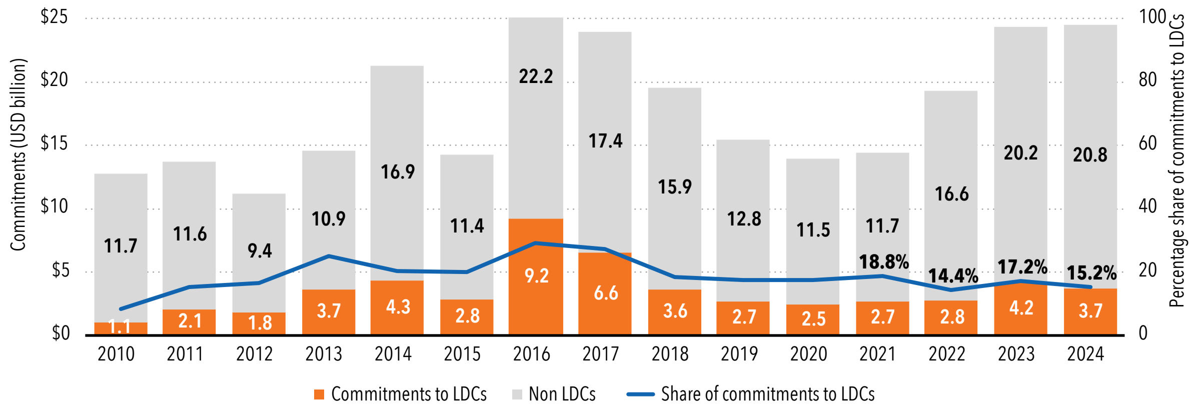
Pakistan received USD 1.12 billion for 32 projects in 2024, with 83 percent (USD 0.9 billion) of the funds allocated to hydropower and the remaining 17 percent (USD 0.2 billion) toward other renewable energy projects. Concessional loans accounted for USD 0.7 billion (66 percent), the largest since 2000, followed by standard loans making up 34 percent (USD 0.4 billion). The most significant commitments included a USD 242 million concessional loan from Saudi Arabia for Pakistan's 48-megawatt Shounter hydropower project and a USD 209 million concessional loan alongside USD 175 million standard loan from the International Development Association, as well as a USD 96 million standard loan from the World Bank for additional financing of the Dasu hydropower project. Pakistan's rise from 11th place in 2023 to 5th in 2024 reflects a substantial increase in international public financial flows, indicating stronger global support for the country's clean energy transition.

Support to least-developed countries, landlocked developing countries, and small island developing states

Analysis of the flow of international public finance to support renewable energy in the 44 LDCs, 32 LLDCs, and 40 SIDS yields insights into flows to the countries with high energy access deficits and often limited fiscal and monetary capacity, which, without much international support, attract little financing.[34]

Flows to LDCs fell by 11 percent from 2023, accounting for only around 15 percent of total flows in 2024 at USD 3.7 billion. Forty-three LDCs received flows during 2024, leaving only Eritrea without any inflows for the year. Ten countries received 80 percent of inflows to LDCs, with Angola (USD 787 million), Ethiopia (USD 491 million), Malawi (USD 245 million), and Nepal (USD 421 million) at the top of the list. The Democratic Republic of Congo (USD 874 million), the top recipient of 2023, dropped to number 32 in 2024.

Figure 5.8 • International public financial flows for renewables in least-developed and non-least-developed countries, 2010–24



Source: IRENA and OECD 2025.

LDCs = least-developed countries.

Financing costs in LDCs remain high, with debt servicing burdens well above pre-pandemic levels and disproportionately higher than those of other developing country groups (UNCTAD 2025). In such contexts, international public finance may need to bear a higher proportion of risks to unlock the required investment. The international community will have to provide more grants, concessional debt, risk-mitigation support, and, crucially, risk-tolerant equity or similar instruments capable of mobilizing private investment. In 2024, more than one-third (36.8 percent) of LDC's flows were in the form of standard loans, 33 percent in grants, 29 percent as concessional loans, while bonds comprised just 1 percent.

Flows to LLDCs rose nearly 16 percent to reach USD 4.6 billion in 2024. As in 2022 and 2023, Uzbekistan received the highest commitment among LLDCs, receiving 11 percent of total flows (USD 529 million), followed by Kazakhstan (USD 526 million) and Tajikistan (USD 525 million).

Flows to small island developing states (SIDS) fell 5 percent to USD 585 million in 2024. Despite this decrease in absolute terms, the number of funded projects rose from 92 in 2023 to 133 in 2024, indicating a wider geographic spread of smaller-scale investments across the region. For example, approximately 33 projects were reported in the 2024 commitment bracket of USD 1 million to USD 100 million, compared with 26 projects in 2023, despite dropping 6 percent in cumulative financing for the same group. Papua New Guinea received the largest single share, attracting USD 212 million, which is 36 percent of the total SIDS flows.

34 The United Nations' M49 regional classification includes 53 SIDS; this report excludes 13 of them from the SDG 7.a.1 classification, as explained in the methodology section at the end of the chapter. The country categories are regularly updated in line with the United Nations' latest M49 classification. Some countries appear in more than one category.

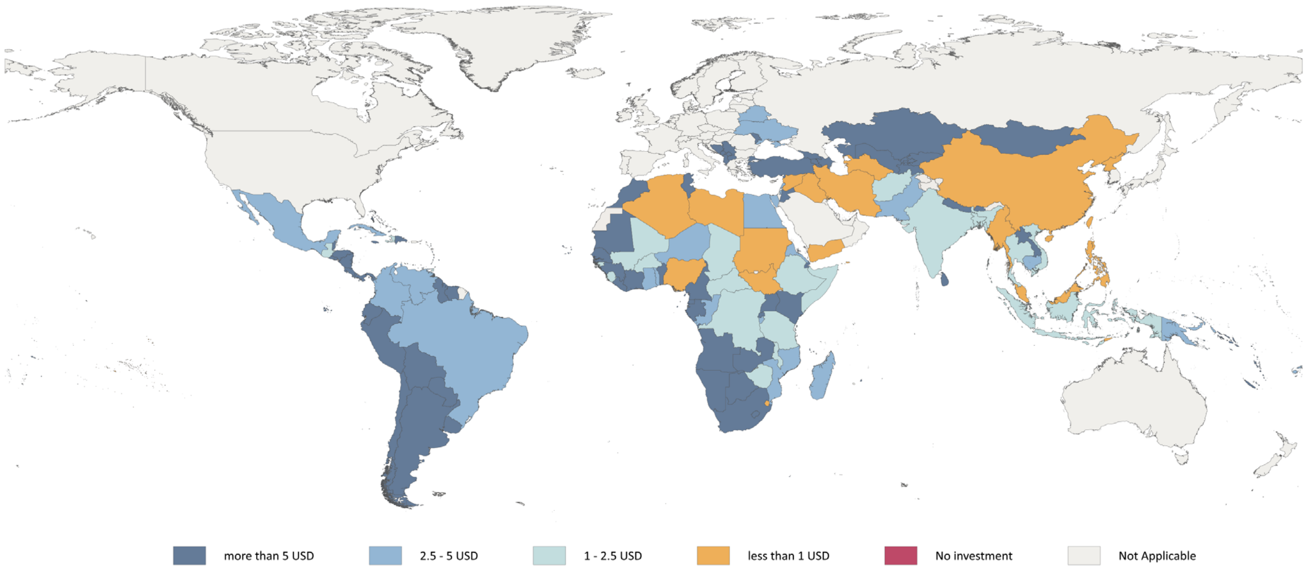
Although SIDS have historically received the least investment in absolute terms, on a per capita basis, SIDS are among the highest recipients, with Niue receiving USD 4,872 per person in 2024. Montserrat, Niue, and Tuvalu have attracted the largest investments since 2010, with a cumulative average of more than USD 300 per person. At the other end of the spectrum, Timor-Leste and Seychelles received less than USD 1 per capita. The highly uneven distribution of funds even within this already underserved group is particularly concerning as SIDS are among the most climate-vulnerable economies worldwide and receive only a pittance of the private mobilization finance flowing to other developing countries (IRENA and CPI 2025).[35] This leaves them both structurally dependent on public financial flows while lacking private capital to bridge the gap.

Distribution of financial flows among countries

In 2024, the number of countries receiving no commitments fell from 27 to 24 (figure 5.8). Most countries and territories (65) received more than USD 5 per capita in 2024 (compared with 53 countries in 2023). Half the LLDCs are in this bracket, including Bhutan (USD 300), Republic of Moldova (USD 56), and Tajikistan (USD 50). In addition, only 39 percent of LDCs and 45 percent of SIDS are among the countries in this category.

Meanwhile, only 29 countries (19 percent of total developing countries) had per capita incomes between USD 1 and USD 5. Finally, a few countries received less than one US cent per person: Afghanistan, Cameroon, Democratic Republic of Congo, Myanmar, Niger, South Sudan, Sudan, and the Syrian Arab Republic, which received the least flows, at less than a tenth of a cent per person. Notably, all these countries appear on the World Bank list of fragile and conflict-affected states,[36] reflecting the broader difficulties that fragile and conflict-affected settings face in accessing and channeling international climate finance (UNDP 2021).

Figure 5.9 • Average per capita international public financial flows for renewables, by country, 2010–24



Source: IRENA and OECD 2025.

Disclaimer: This map was produced by the World Bank's Geospatial Operations Support Team, in the Cartography Unit. The boundaries, colors, denominations, and other information shown do not imply any judgment on the part of the custodian agencies concerning the legal status of or sovereignty over any territory or the endorsement or acceptance of such boundaries.

35 Private finance mobilization involves using public, concessional capital (grants and loans) from development banks to attract private investment for sustainable development in emerging markets (OECD 2025).

36 Based on the World Bank's classification of fragile and conflict-affected (World Bank 2025).

Including all regions and categories within the scope of the indicator, the leading recipients worldwide of flows per capita in 2024 were Marshall Islands (USD 2,079), Niue (USD 4,972), and Tokelau (USD 965), indicating that countries with small populations received more international public financial flows on a per capita basis, despite not receiving vast absolute amounts of commitments. Marshall Islands averaged USD 194 per capita from 2010 to 2024; Montserrat, USD 307 per capita; Niue USD 679 per capita; and Tokelau, USD 435 per capita. High per-capita values do not automatically imply that these countries are better off than more populous nations. Smaller economies frequently incur higher costs when implementing renewable technologies at a similar relative scale, along with added operational and logistical complexities.

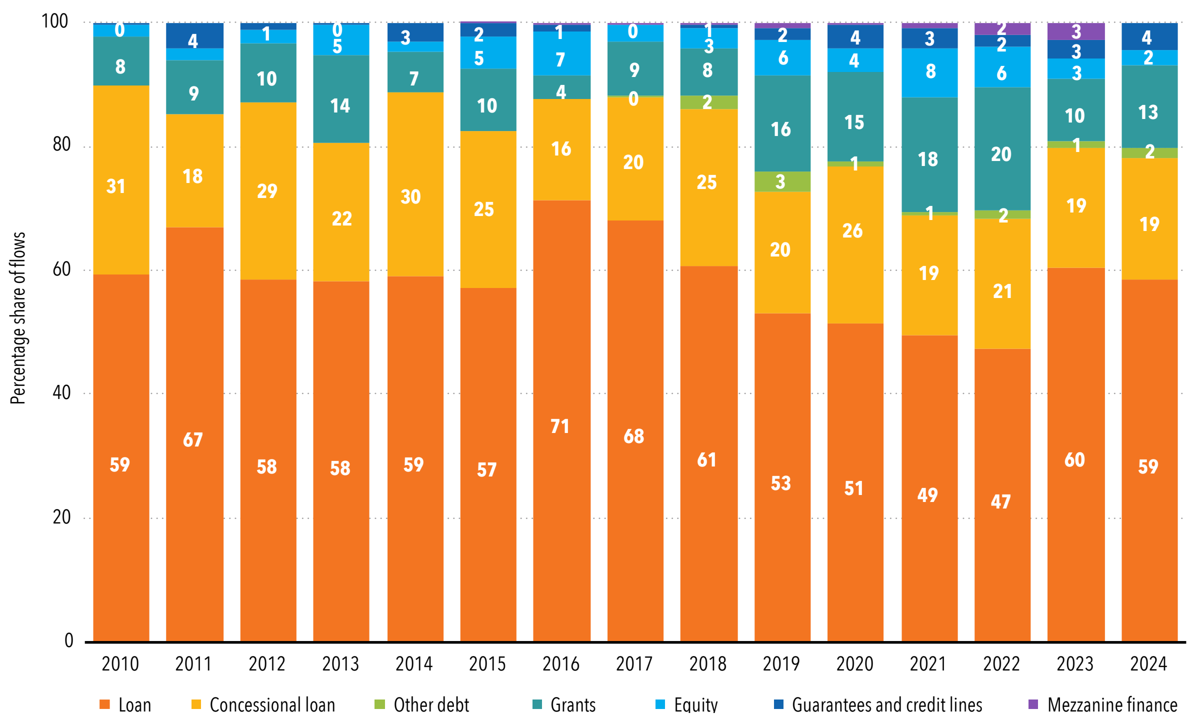
Investments by financing instruments

Since 2010, most international public financial flows for clean energy have been have largely debt-based (standard loans followed by concessional loans). Grants come next, followed by equity financing. Risk-mitigation support, such as guarantees and insurance products, varies from year to year but accounts for a small share overall.

The dominance of debt-based instruments in international public clean energy financial flows is consistent with global energy transition finance trends. Debt financing accounted for nearly half of total global energy transition investment in 2024, with grants representing less than 1 percent of total flows. The high reliance on debt increases financial vulnerability, particularly for developing economies, and targeted concessional finance and grant-based support must expand to ease capital costs and unlock larger project pipelines (OECD 2026).

Following a similar pattern in 2024, the mix remained heavily debt-driven but shifted slightly: debt fell to 80 percent of flows, including 59 percent of standard loans and 19 percent of concessional loans. Grants rose to approximately 13 percent of total flows, compared with 10 percent in 2023. Equity declined to around 2 percent of total flows, while the share of flows funded by guarantees, credit lines, and mezzanine finance together accounted for 5 percent of total financial flows.

Figure 5.10 • International public financial flows for renewables, by instrument, 2010–24



Among debt-based instruments, **standard loans** remained the backbone of international public financial flows yet declined from USD 14.7 billion in 2023 to around USD 14.4 billion in 2024, accounting for almost two-thirds of international public financial flows toward renewables. The largest international public financial flow was a USD 778 million standard loan from the Export-Import Bank of China to Angola for the development of an electricity transmission project.

Similarly, **concessional loans** climbed to USD 4.8 billion in 2024, from USD 4.7 million in 2023. While Germany had overtaken IDA, committing USD 1.3 billion (compared to IDA's USD 1.2 billion) toward a USD 464 million concessional loan in India. Other debt-based instruments included asset-backed securities, green bonds, sustainability-linked bonds, and other debt securities (see methodology section for more details), which accounted for less than 2 percent of overall financing.

Grants accounted for 13 percent of total flows, an increase from the 10 percent reported in 2023. Total volume of flows financed by grants also rose 37 percent to USD 3.3 billion—up from previous year's USD 2.4 billion supporting multiple/other renewables projects. Overall, the largest beneficiaries of grants were Ukraine, where energy infrastructure has suffered extensive damage from the war (Human Rights Monitoring Mission in Ukraine 2024), and Sub-Saharan African countries—primarily Burundi, Ethiopia, Malawi, Mozambique, and Zambia—with electrification rates of 11.6 to 55.4 percent in 2023 (World Bank Group 2023). In 2024, almost half the commitments to Oceania were grants (USD 228 million of total USD 427 million). The International Development Association provided the most flows in the form of grants, equivalent to USD 911 million across 12 countries and territories in 2024.

Equity financing, by contrast, remained marginal, declining to USD 571 million and representing roughly 2 percent of total flows, consistent with a broader pattern where international public finance institutions analyzed in this report are predominantly incentivized to lend rather than take equity positions, partly due to credit rating considerations (Butler 2024).

Since 2000, only 31 out of 80 donors recorded in the database have made an equity contribution. In 2024, this number was limited to just 11 out of 80 donors, with the largest being the International Finance Corporation, the Asian Development Bank, the Asian Infrastructure Investment Bank, and the European Bank for Reconstruction and Development. For instance, the International Finance Corporation acquired a USD 122 million equity stake in India to finance a 602 MWp portfolio for a distributed generation assets project. The next-largest equity provider in 2024 was the Asian Development Bank, which also committed to a project in India related to commercial and industrial decarbonization and another project linked to Actis Asia Climate Transition fund,[37] also funded by (ADB 2024; AIIB 2024). This indicates these institutions' growing role in higher-risk, early-stage project development compared to more traditional loan operations. That said, a lack of equity financing in renewable energy projects has prevented projects from reaching financial closure (Audu and Duclos 2024).

Guarantees and credit lines nearly doubled to USD 1.1 billion in 2024—their highest-ever—accounting for 4.5 percent of the overall flows. Such commitments were made in at least six countries, compared to ten in 2023. The largest was a USD 512 million credit line to Banco do Brasil, aimed at financing renewable energy projects in Brazil.

These trends point to a deeper structural problem: International public finance remains largely risk-averse and is deployed primarily as senior secured debt. Closing investment gaps will require public institutions to take on greater risk through equity, guarantees, blended finance, and other risk-mitigation instruments designed to mobilize private capital at scale (IRENA and CPI, 2025).

37 The Actis Asia Climate Transition Fund invests in companies across Asia and the Pacific—including China, India, Indonesia, Malaysia, Philippines, Thailand, and Viet Nam—to promote decarbonization and climate change mitigation (ADB 2024)

Policy insights

Although international public financial flows to clean energy have continued to register modest growth according to the latest data, progress toward the various SDG 7 targets remains slow, particularly in countries with constrained fiscal space and limited access to affordable capital. While the economic repercussions from the 2026 energy crisis caused by the conflict in the Middle East are still unfolding, countries with limited strategic reserves and constrained market access are expected to bear a disproportionate burden from external shocks to financial stability (IMF 2026). The expected tightening of financial conditions is likely to elevate borrowing costs for many developing economies, thereby exacerbating fiscal challenges and further constraining their capacity to finance the energy transition effectively.

Previous editions of the report have assessed strategic priorities for international public finance in advancing SDG 7. These include reforming multilateral and bilateral lending architectures, strengthening national policy and regulatory frameworks to enable private capital mobilization, and deploying more targeted, impact-oriented public finance to address the electricity access deficit (IEA and others 2022, 2023, 2024). The analysis has further examined differentiated financing strategies across country contexts and the role of country platforms in coordinating stakeholders and scaling investment flows (IEA and others 2025).

The priorities outlined in previous editions remain critical in efforts to achieve SDG 7 given the 2026 energy and economic crises, particularly as development assistance contracts. Considering the slow gains on access to clean cooking,[38] this year's policy analysis focuses on the evolving landscape of clean cooking finance. This analysis adds insights and data on experiences to date, new financing instruments, responsibilities, and opportunities for scaling investments as well as tracking investments in clean cooking.

Regional and geographical disparities and inadequate progress to date underscore the need for investments, available resources, and advances to close the clean cooking gap as significant investment shortfalls remain.

Regional disparities in access to clean cooking reflect disparities in investment and funding levels. Countries showing a great deal of progress have typically seen sustained public investment, particularly in infrastructure and subsidies. For example, China, India, and Indonesia have as of 2024 achieved population access rates of 90.1, 80.6, and 89.9 percent, respectively (WHO 2026). In India, the large-scale liquefied petroleum gas (LPG) subsidy program for the rural poor, called Pradhan Mantri Ujjwala Yojana (now in its tenth year), has shifted 80 million households over to clean cooking (WHO 2021). Indonesia has closed its access gap, having invested up to USD 4.9 billion in 2019 on its LPG program (Hakam and others 2022). In China, rising incomes powered the country's clean cooking transition over the past 20 years, bringing it to 90 percent access (Shen and others 2022). But low-income households in rural China still rely on traditional fuels, proving that rising incomes alone cannot close the access gap. In recent years, an expanding portfolio of technological pathways is closing the deficit, offering advances in electric cooking technologies, renewable energy integration, decentralized energy systems as well as modern bioenergy in solid (for example, pellets), liquid (ethanol), and gaseous (biogas) forms.

The situation in Africa remains particularly challenging. It is the only continent where instead of progress in access to clean cooking, there has been a downward trend since 2015. IRENA's analysis shows that progress in clean cooking is driven by investments, and investments on the continent remain limited (IRENA 2026b). When investments in electricity infrastructure are excluded, government domestic spending on clean cooking by the top-100 access-deficit countries was less than half a billion dollars (USD 385 million). This occurred over a two-year period (2022–24), according to

38 For more on the status of access to clean cooking, see chapter 2.

reporting from the countries (IRENA 2026b), and falls well short of the annual investments of USD 8 billion needed to attain universal access by 2030 (IEA 2024). Despite securing a USD 2.2 billion commitment toward clean cooking in its inaugural Clean Cooking Summit for Africa in 2024, only USD 470 million has been disbursed (IEA 2025). This gap highlights a persistent shortfall not only in the volume of finance but also in its delivery. These disparities underscore the role played by sustained investments that are impact driven and scaled up.

Concentration of investments on a few technologies and companies

Despite the increasing number of viable clean cooking technology options, LPG continues to lead clean cooking investments from both public and private sectors in access-deficit countries. Of the USD 385 million reported through IRENA's government surveys, LPG attracted 65 percent of the investments between 2022 and 2024 (IRENA 2026b), a finding in line with SEforALL (2024) and CCA (2023). The IEA estimates that direct investment in Sub-Saharan Africa, investments in e-cooking and bioethanol, biogas, and other cooking solutions have plunged from USD 192 million in 2020 to USD 83 million in 2023 (IEA 2025). Renewables-based cooking solutions are meanwhile expected to play a significant role in the short and medium term and become more dominant over the long term (IEA 2023). The contours of the clean cooking transition will be determined by investments made today.

Analyses and scenarios on how to close the clean cooking deficit highlight the need for a multi-fuel and multi-technology strategy for achieving universal access. Concentrating investments in a few technologies and companies—with, for example, eight companies receiving 90 percent of capital in 2025 (CCA 2025)—risks unfair competition among the various technologies and undermining the entire transition goal. The 2026 energy crisis has also underscored the vulnerabilities associated with heavy reliance on imported LPG for clean cooking applications. Supply chain disruptions and price volatility could render LPG-based cooking solutions economically infeasible for households. An equitable allocation of investments would allow consumers to choose among cooking technologies that are sustainable, affordable, safe, and aligned with public health objectives while being culturally and contextually appropriate.

Limited range of financing sources and instruments and the need for diversification

Public sector finance is the most dominant and critical source of funds for the clean cooking sector. It can achieve the required scale of transition. But private sector finance plays a complementary role that at times serves as the sector's only form of finance.

Yet private sector finance is clustered around instruments that are not especially responsive to the sector's needs, which include those enabled by public finance, for example, and results-based financing through government and donor programs.

Now in its fifth year, the Clean Cooking Alliance (CCA) tracks clean cooking investments by instruments as part of its Industry Snapshot reports. The latest report (CCA 2025) indicates that debt financing soared to 84 percent in 2025, up from 17 percent in 2024. Debt financing is the main source of capital for clean cooking enterprises. Driven by this surge in debt financing, companies that report their data showed a fivefold increase over capital raised the previous year.

While debt is helping to boost the finance required for the sector, it mainly helps LPG-based businesses. Reports show that 59 percent of the total funding tracked went into LPG enterprises, with individual companies receiving up to USD 50 million debt in a single year (CCA 2023). Given the strong consensus surrounding the clean cooking transition, there should be a fair allocation of financing across different cooking solutions. As it becomes increasingly evident that debt favors businesses promoting LPG, other instruments that could attract businesses promoting a range of cooking solutions should be emphasized.

The data available show, however, a slump in alternative finance instruments. Equity investment, for instance, fell 46 percent from the previous year according to the Clean Cooking Alliance, while grant financing formed just 7 percent of total capital (CCA 2025). The decline in grants toward clean cooking aligns with the overall drop in ODA spending, down 23 percent according to the latest data (OECD 2026). Yet most clean cooking companies are just starting out (Coldrey and others 2023). They are also in need of equity and grants to facilitate their market entry so they can thrive. Such companies include 8 out of 12 Tanzanian companies captured in an in-depth analysis (IRENA 2026a). They said they could not access debt capital and were relying on grants to sustain their operations. At interest rates of up to 17 percent, and stringent collateral requirements, debt capital was out of reach.

Carbon finance has continued to dominate the sector. In 2023, over USD 218 million was invested in clean cooking companies globally, with 96 percent of these funds going to companies that develop or generate carbon credits (CCA 2025). But this level of investment still represents only 2.7 percent of the annual USD 8 billion funding gap. Carbon finance is still unable to unlock the different forms of capital needed, first, to fund the industry's growth path and, second, to build a sustainable and expanding clean cooking market. For example, local financial institutions, despite the potential they represent for capital, play a limited role in clean cooking markets. As a result, although the sector has welcomed carbon finance and attracted private sector investments, carbon finance could also pose risks if it becomes the only or predominant strategy rather than a complementary source of financing.

Overall, these trends highlight the need to diversify financing sources and instruments, as discussed below. Tilting the balance toward more risk-taking and catalytic instruments and structures such as grants, equity, equity-like instruments, risk-sharing, and risk-mitigation instruments such as blended finance can have several benefits. Emphasizing new instruments can also support the diversity and affordability of solutions offered to consumers, as well as their resilience, scalability, and inclusivity. Diversification should apply not only to financing instruments but also to the allocation of investment across clean cooking technologies, including context-specific solutions such as biogas, biomass fuels from residues, e-cooking, and other renewable energy–based cooking options.

The role of international and domestic public finance and other funding sources

Public finance can stimulate demand, tackle affordability constraints, develop supply chains and infrastructure, and incentivize the private sector reach to the last mile (IRENA 2024).

Domestic government spending on clean cooking remains limited in countries with high access deficits, despite the important role it plays in the sector. Many governments in countries that lack universal access see external finance as more important than domestic resource mobilization (IRENA 2026a). But domestic government spending remains vital. Priority should be placed on using domestic government to support last-mile coverage with strategies that side step unintended beneficiaries (for example, as part of social protection programs).

International public funds (especially grants and concessional loans) should be used to boost domestic public spending on clean cooking. Public finance spending is crucial for infrastructure, knowledge and awareness, and affordable stoves and fuels for low-income consumers.

Households themselves represent another source of funds to support clean cooking solutions. Their contribution could grow as traditional fuels become scarce or costly (ESMAP 2020) and as the cost of higher tier alternatives fall through economies of scale. Their potential cannot be realized, however, without targeted support. With no financial assistance, the costs of traditional fuels will deepen energy poverty rather than accelerate adoption. This barrier can be surmounted only through innovation and financial intervention. Scalable business models and financial support (for example, funding for cookstove companies to operate a consumer credit line) alongside broader consumer finance would ease access to those struggling to pay the high upfront costs. On-bill financing of electric cooking appliances is being implemented in Tanzania (MECS 2025).

While private sector investments, including those incentivized by carbon finance, represent a major contribution, government spending is what drives the clean cooking transition, as shown by country examples where success is reported. To take one example, success in mobilizing private sector investments has been seen in countries have that have provided incentives such as removal of import taxes on stoves and components, their production, storage and distribution equipment, and value-added taxes. But such fiscal measures need to be uniformly applied and sustained, as uncertain policy landscapes deter investment. Building a strong pipeline of bankable clean cooking projects can also attract investments into countries, since clean cooking faces a two-prong financing challenge: limited supply of finance and low uptake of funds available for the sector, as in the case of Tanzania (IRENA 2026). Government funds can be used to provide this support, together with grants and concessional finance from donors.

Ultimately, closing the clean cooking gap will require a coordinated approach that combines increased public finance, stronger domestic investment, and targeted financial solutions to unlock household demand.

Strengthening data to track progress and challenges in clean cooking investments

The persistent lack of comprehensive data, combined with the complexities of defining investment boundaries, continues to hinder a clear understanding of progress in clean cooking. The ecosystem of investments in clean-cooking spans diverse upstream infrastructure projects (for example, electricity infrastructure enables e-cooking). Off-grid solar is one example, along with its enabling components, including data and software systems that support carbon finance investments (IRENA 2026).

To identify investment gaps and priorities for clean cooking, a robust and continuous data collection needs to track clean cooking investments. But clean cooking finance does not fall within the scope of SDG 7.a.1 tracking. In addition, efforts to track its financial flows are both sporadic and unharmonized, and various organizations that track flows have their own methodologies. IRENA's analysis identified a major gap in clean cooking finance in government spending in the Global South. IRENA's tracking filled the gap for the period 2022–24 (IRENA 2026b), but for such information to be useful, tracking must be continual, conducted on annual basis, and expanded to cover all funding sources.

Establishing clean cooking strategies linked to investment plans

To mobilize finance for clean cooking, investment strategies and plans are a prerequisite. Although more countries have designed clean cooking strategies, few have adopted investment plans linked to those strategies, making them hard to implement and assess. Depending on the country context, technical assistance might benefit countries as they develop such plans. For instance, IRENA is supporting the government of Uganda on an investment prospectus showcasing clean cooking opportunities in the country. What type of investments would help Uganda to proceed? What investments would raise their visibility to domestic and international investors? The investment prospectus also helps to coordinate donors and other financing entering the country. A prospectus helps to avoid market distortions whereby one donor is financing subsidization of technology while another is focused on market-based approaches.

The investment plans should be linked to financing needs across the entire ecosystem of clean cooking, including technologies, fuels, and the enabling conditions for their adoption (such as planning, modeling, regulation, standards, and capacity building). Some investment may occur outside the clean cooking and energy sector (for instance, investment in information technology systems that enable pay-as-you-go monitoring software). As such, they would generate results for sectors like health, agriculture, and environment. So monitoring frameworks should be developed alongside impact indicators (for example, adoption and sustained use, exposure- and health-related outcomes, catalyzed innovations, and mobilized private sector capital). Such efforts can expand the support base for clean cooking, including tapping into investment opportunities outside the energy sector where the impact of clean cooking extends, like environment, climate, health, education, and agriculture.

CHAPTER 6

THE OUTLOOK FOR SDG 7

Photo: © Kola Sulaimon/AFP via Getty Images

Main messages

- **Outlook for progress toward 2030 goals.** Policy and technological innovations have yielded meaningful results in recent years, particularly in expanding renewable energy deployment and improving energy efficiency. Yet the global energy transition is unfolding against a backdrop of compounding crises that have repeatedly disrupted progress and whose full implications remain uncertain. The war in Ukraine triggered a global energy crisis in 2022, driving up prices, straining public finances in developing economies, and redirecting investment flows. The recent conflicts in the Middle East and other parts of the world are further intensifying risks to energy markets, supply chains, and the fiscal space for interventions designed to promote the energy transition, with the ultimate scale of their impact on the outlook for achievement of Sustainable Development Goal (SDG) 7 by 2030 uncertain. These successive shocks underscore that progress toward SDG 7—achieving universal access to affordable, reliable, sustainable, and modern energy by 2030—is not only a function of policy ambition, but also of geopolitical stability and the resilience of international cooperation.
- **Energy security considerations at the national level have come increasingly to the fore,** with governments prioritizing diversification of energy supply, expanded deployment of domestic renewable energy, and reduced dependence on fossil fuel imports in response to price volatility and geopolitical disruptions. Sustained and scaled-up investment and policy support for renewables, energy efficiency, and energy access remain essential. Yet, crises constrain the fiscal space needed for energy access in many countries—a tension felt acutely in clean cooking, where sudden increases in the price of liquefied petroleum gas have rocked household budgets and subsidy programs across low and middle-income countries.
- **Outlook for access to electricity.** The global deficit in access to electricity is narrowing slowly. The number of people without access declined by 11 million between 2023 and 2024, a pace well below pre-pandemic trends. Under the Stated Policies Scenario of the International Energy Agency (IEA), around 640 million people—85 percent of them in Sub-Saharan Africa—will still lack access by 2030. Achieving universal access would require connecting an average of 110 million people per year through 2030, four out of five of them in Sub-Saharan Africa, at an annual investment cost of USD 45 billion. The main headwinds are debt burdens, cuts in international aid, and rapid population growth. To beat those headwinds, concessional finance and robust national electrification plans will be indispensable.
- **Outlook for access to clean cooking.** Universal access to clean cooking fuels and technologies by 2030 remains out of reach under current policies. IEA and the World Health Organization (WHO) project that between 1.6 and 1.8 billion people—over one-fifth of the world's population—will still lack access by the end of the decade, with Africa accounting for more than half of that deficit. Reaching the universal target will depend on providing access to more than 300 million people each year and, at minimum, an investment of USD 8 billion annually through 2030, half of it for Sub-Saharan Africa. Universal access would deliver a net reduction of 1.5 gigatonnes of CO_2 equivalent per year by 2030—comparable to the annual emissions from all planes and ships combined—alongside significant health and social co-benefits, including the prevention of many deaths from poor indoor air quality and time savings of at least 1.5 hours per day for households, with particular benefits for women. Yet today, less than 20 percent of clean cooking plans are backed by clear financing schemes, underscoring that the gap is not only one of ambition but of resources and implementation.

- **Outlook for renewable energy.** Renewable energy continues to lead global electricity growth. In 2025, renewables surpassed coal as the predominant source of generation, with solar photovoltaic (PV) and wind driving the expansion. Under IEA's Stated Policies Scenario, the share of modern renewables in total final energy consumption (TFEC) is projected to reach 18 percent by 2030. However, meeting the pledge made at COP28 (the 2023 United Nations Climate Change Conference) to triple global renewable power capacity by 2030 requires a more ambitious trajectory. The International Renewable Energy Agency's (IRENA's) 1.5°C Scenario calls for renewables to reach approximately 35 percent of TFEC and 68 percent of electricity generation by 2030. Current targets specified in Nationally Determined Contributions (NDCs) made under the United Nations Framework Convention on Climate Change amount to just 5.8 TW—roughly half the tripling goal—which means that ambition must double in less than five years.
- **Outlook for energy efficiency.** Some 250 new or updated efficiency measures were adopted in 2025 in countries representing more than 85 percent of global energy demand, and more than 50 countries incorporated updated efficiency targets into their NDCs ahead of COP30 (the 2025 United Nations Climate Change Conference). Global energy intensity is estimated to have improved by 1.8 percent in 2025, up from 1 percent in 2024—which remains well short of the 4 percent annual improvement needed under the IEA's Net Zero Emissions by 2050 Scenario and the 5 percent per year required under IRENA's 1.5°C Scenario from 2025 to 2030. Regional progress is uneven, with China and India showing stronger gains, while the United States and European Union are set to fall below 1 percent. Four structural barriers continue to hold back progress. Gains in industrial energy intensity have slowed. Standards have failed to keep pace with best-available technology. Demand for insufficiently efficient cooling equipment has surged. And demand for electricity has outpaced supply generated from renewable sources.
- **Investment needs.** Capital flows to the energy sector are set to rise to USD 3.3 trillion in 2025, with USD 2.2 trillion directed toward clean energy—twice the amount flowing to fossil fuels. Yet this remains insufficient. IEA's Net Zero Emissions by 2050 Scenario calls for average annual energy investments of USD 3 trillion through 2030. IRENA, meanwhile, estimates that the targets of the UAE Consensus on renewables and efficiency will require around USD 5 trillion per year (IRENA, COP30 Presidency, and Global Renewables Alliance 2025). Investment in renewable power capacity reached USD 624 billion in 2024 but must rise to USD 1.5 trillion annually. IEA data shows energy efficiency investment of USD 350 billion in 2024, which must rise sevenfold to approximately USD 2.6 trillion per year. Investment flows remain heavily concentrated in China, the European Union, and the United States, leaving emerging markets and developing economies critically underfunded.

Presentation of scenarios

This chapter describes the results of global modeling exercises undertaken to determine whether current policies are sufficient to meet the SDG 7 targets and to identify what additional actions might be needed. It also examines the investments that would be required. Scenarios for the targets are taken from IEA's *World Energy Outlook* (IEA 2025a), *IRENA's World Energy Transitions Outlook: 1.5°C Pathway* (IRENA 2024), and WHO's Business-as-Usual Scenario (see annex 1). The chapter also draws on insights from two major reports: *COP28 Tripling Renewable Capacity Pledge* (IEA 2024) and *Delivering on the UAE Consensus* (IRENA, COP30 Presidency, and Global Renewables Alliance 2025). It explores scenarios in which energy trends evolve under today's policies, as well as pathways that deliver on all energy-related SDGs, including substantial reduction of air pollution, which causes death and illness (SDG target 3.9), and initiation of effective action to combat climate change (SDG 13). Finally, the chapter considers key investment needs to achieve these goals.

IEA's Stated Policies Scenario (IEA 2025a) explores how energy trends evolve under today's policies, assuming no additional policies are put in place. Under this scenario, bottom-up modeling is conducted that considers how policies, pricing, efficiency standards, electrification programs, and specific infrastructure projects would influence energy trends. The Net Zero Emissions by 2050 Scenario considers the SDG 7 goals of 2030 and net-zero energy sector emissions by 2050 as targets to determine what would be needed to achieve these outcomes. Under the Net Zero Emissions by 2050 Scenario, by 2030, modern renewables reach or exceed a 30 percent share of TFEC, and average annual energy efficiency improvements in global energy intensity reach 4.1 percent over 2025–30. After this critical near-term period, the scenario emphasizes efficiency, renewables, and clean fuels, bringing energy sector emissions to net zero by 2050 and limiting the end-of-century global temperature increase to 1.5°C over preindustrial levels.

IRENA's Planned Energy Scenario (IRENA 2024) presents an outlook for future energy system developments based on current government plans, targets, and policies. In contrast, the agency's 1.5°C Scenario sets out a transformative pathway to align the global energy system with the objective of limiting the earth's temperature rise to 1.5°C above pre-industrial levels by the end of the century. This pathway is underpinned by a set of urgent technological and policy actions, including the rapid scale-up of renewable power generation, increased direct use of renewables, significant improvements in energy efficiency, and the electrification of end-use sectors. It also entails the deployment of clean hydrogen and its derivatives, alongside carbon management solutions such as carbon capture and storage and bioenergy coupled with the latter. Together, these measures would enable deep emissions reductions by 2050, laying the groundwork for a net-zero energy system by mid-century. The scenario also further highlights the broader socioeconomic impacts of the transition, including opportunities for economic growth, job creation, and enhanced social equity (IRENA 2024).

Projected clean cooking access rates, access deficits, and fuel use are estimated using the WHO Global Household Energy Model (see annex 1 for further details). In that model, uncertainty grows the further into the future that estimates are calculated, reflecting how country trends may shift based on how unsettled they were during the data period.

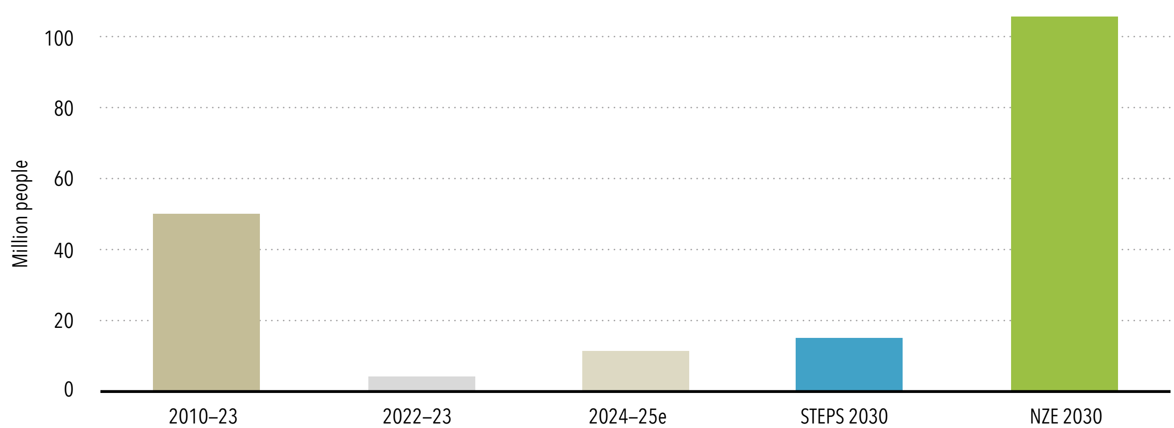
WHO's Business-as-Usual Scenario, used for deriving the clean cooking–related projections, is a hypothetical scenario under which no new policies or interventions (positive or otherwise) are implemented or take place. As such, it is useful as a baseline scenario for comparing the effects of interventions. The Business-as-Usual Scenario is calculated by extrapolating current trends into the future. The year that each country will achieve 100 percent access to clean fuels and technologies is estimated from these projections.

The outlook for access to electricity

The IEA's latest data reveal that the number of the world's people lacking access to electricity declined by just 11 million from 2023 to 2024. That pace is slower than the annual progress achieved before the pandemic and confirms the IEA's earlier estimates. Preliminary 2025 data suggest that the trend will continue, with progress remaining fragile. In many Sub-Saharan African countries, population growth continues to outpace electrification. Debt burdens, which were still elevated after the COVID-19 pandemic and the global energy crisis, along with cuts in international aid, are impeding progress. The end result is that the number of people without access to electricity has remained largely unchanged since 2020.

Electricity access is expected to keep improving through 2030. Trends vary significantly across countries; many will not achieve universal access by 2030 under current policies. In fact, only nine Sub-Saharan African countries achieve universality. Under IEA's Stated Policies Scenario, around 640 million people—roughly 8 percent of the global population—will remain without electricity access by 2030, 85 percent of them in Sub-Saharan Africa. In that region, 40 countries without universal access to electricity have official targets today, yet only about half of them have targets at least as ambitious as SDG target 7.1. This target remains within reach for countries with adequate policies, holistic electrification plans, and well-resourced implementing institutions. Countries without electrification plans and enabling frameworks are not on track to meet the target (figure 6.1).

Figure 6.1 • Population gaining access to electricity annually, historically, and in 2030 under IEA's scenarios



Source: IEA 2025a.

e = estimate; STEPS = IEA Stated Policies Scenario; NZE = IEA Net Zero Emissions by 2050 Scenario.

Most developing nations in Asia are still on course to achieve near-universal electricity access, with fewer than 2 percent of the region's population projected to lack electricity by 2030. According to the Stated Policies Scenario, reaching full universal access by 2030 will require stronger efforts from countries including Afghanistan, Mongolia, and Pakistan. In Central and South America, electricity access is expected to be nearly universal by 2030, with only the most isolated communities remaining without power. Haiti stands as the main exception: despite regional progress, a significant portion of its population is still projected to lack electricity by 2030.

Obtaining financing is often more challenging for countries that have the greatest need to improve access. International support in the form of concessional finance is essential, especially under current economic conditions. More importantly, public finance remains vital for building energy infrastructure, investing in the socioeconomic ecosystem that relies on energy as an input, bridging affordability gaps for consumers, expanding access to last-mile communities, and derisking private investments, including rural economies and food systems that depend on energy for production, processing, and service delivery. Governments must facilitate better access to international finance so that robust electrification plans can be implemented and capital can be allocated to access projects accordingly (IEA 2025a).

Some 110 million people would have to gain access annually to achieve the target of universal access to by 2030. Four out of five of those people live in Sub-Saharan Africa. Efforts must be stepped up there, especially in Nigeria and the least-developed, fragile, and conflict-affected countries of the region, which might benefit from special support measures. The Democratic Republic of Congo, Niger, Sudan, the United Republic of Tanzania, Uganda, and Ethiopia fall into that category; together they are home to half of the region's population projected to be without electricity in 2030. These countries also host tens of millions of forcibly displaced people, who typically have lower levels of access and will require greater inclusion into national policies and plans if universal electrification is to be achieved.

Affordability remains the primary impediment to gaining access and benefiting from it. Central to sustainable improvements will be support for decentralized solutions, tracking and monitoring, the use of geospatial data in electrification planning, and the establishment of capable entities to implement the plans. Low-capacity off-grid energy solutions—for example, small solar systems—will continue to play an important role, especially in remote and hard-to-reach areas. Nevertheless, decentralized solutions must be aligned to support the gradual expansion of energy services via larger systems or grid connections. These alignments will require robust national planning capacity. IRENA supports its member countries in this regard through the Strategic Energy Access Planning Support (SEAPS) program, which provides tools and skills for data-driven, least-cost integrated electrification planning. Good planning, in turn, helps unlock investments to provide underserved communities with the cost-effective solutions. SEAPS has four interconnected pillars: data collection, planning tool development, scenario development, and stakeholder engagement. The four pillars combine to form a participatory, data-driven approach to energy access planning.

In IEA's Net Zero Emissions by 2050 Scenario, nearly 90 percent of new electricity connections will be based on renewables, supported by a decline in the cost of solar PV panels and batteries. The delivery technology is unique to each location. In Sub-Saharan Africa, 43 percent of new connections by 2030 would be directly to the grid, 30 percent through mini-grids, and the remainder through stand-alone systems (mostly solar home systems). In developing countries in Asia, just over half of the new connections would be directly to the grid; almost a third would be through mini-grids.

Many successful electrification plans—such as those in Côte d'Ivoire, the Gambia, Kenya, and Rwanda—take into account the needs of health facilities, schools, agricultural enterprises, and other productive uses, alongside households' needs.

Achieving universal electricity access will require investment amounting to USD 45 billion annually through 2030. These investments include electricity generation, electricity networks, and decentralized solutions. Electricity access must extend beyond a simple connection powering a few household devices; it must support the growing use of energy services that can contribute to socioeconomic prosperity.

The outlook for access to clean cooking fuels and technologies

Current policies are insufficient to achieve universal access to clean cooking by the 2030 target. If current trends continue, IEA and WHO estimate that between 1.6 and 1.8 billion people—over one-fifth of the world's population—will still lack access to clean cooking by 2030 (figure 6.2). Both IEA and WHO have reported significant progress in Asia. In Africa, by contrast, almost the same number of people as today are expected to remain without access at the end of the decade (IEA 2025a; WHO 2026). Many African countries are not expected to achieve universal access even in the 2050s.

IEA estimates that achieving universal access would require adding more than 300 million people each year—about half of them in Sub-Saharan Africa—through 2030. The effort required in Sub-Saharan Africa is equivalent to repeating the best single-year advances in the rest of the world every year from now till 2030. While African countries are implementing clean cooking plans, they lack the resources to support them. Today, less than 20 percent of clean cooking plans are backed by clear financing schemes.

In terms of changes in the fuel mix, if current trends remain unchanged, WHO projects that 70 (64–74) percent of the population of the low- and middle-income countries will rely primarily on gas for cooking if current trends continue through 2030; 6 (3–9) percent will rely primarily on electricity.[39] However, by 2030, 19 (16–24) and 4 (3–5) percent, respectively, will still rely on unprocessed biomass and charcoal, whereas around 1 percent will use kerosene and coal (WHO 2026). The use of gaseous fuels is expected to drive most of the increase in the percentage of the low- and middle-income country population using clean fuels and technologies for cooking.

Under IEA's Net Zero Emissions by 2050 Scenario, the demand for modern uses of energy grows until 2030, while the consumption of charcoal and firewood for cooking is phased out. In some regions, new infrastructure would be needed. For instance, on this pathway in Sub-Saharan Africa, the demand for liquefied petroleum gases grows threefold by 2030, requiring an expansion of distribution services and an increase in cylinders and refilling stations. By 2030, electric cooking alone in Sub-Saharan Africa drives up electricity demand 16 percent from today; that growth could potentially strain distribution systems if not managed well (IEA 2025b). Diversifying clean cooking pathways, including through sustainable options like biogas, can help reduce pressure on electricity systems while expanding access in constrained settings.

Achieving universal access would deliver a net reduction of 1.5 gigatonnes of CO_2 equivalent per year by 2030—a figure comparable to the annual emissions from all planes and ships combined. While transitioning households to electricity and cleaner fuels such as liquefied petroleum gas adds emissions, these are more than offset by reductions in methane and other greenhouse gases from incomplete combustion in traditional stoves (0.9 Gt CO_2-eq), as well as lower deforestation rates (0.7 Gt CO_2-eq). These climate gains come alongside significant health and social co-benefits: many premature deaths from poor indoor air quality could be prevented, and the average household would save at least 1.5 hours a day—time that could be redirected toward education or income-generating work, particularly among women.

Total capital investments in clean cooking technologies and infrastructure through 2030 amount to USD 8 billion annually-half in Sub-Saharan Africa alone (IEA 2023). That amount of investment would require a substantial increase from the current level, which approximates USD 2.5 billion. For these larger investments to materialize, policy guidelines and institutional frameworks must be put in place to incorporate clean cooking into energy planning strategies and attract private funding.

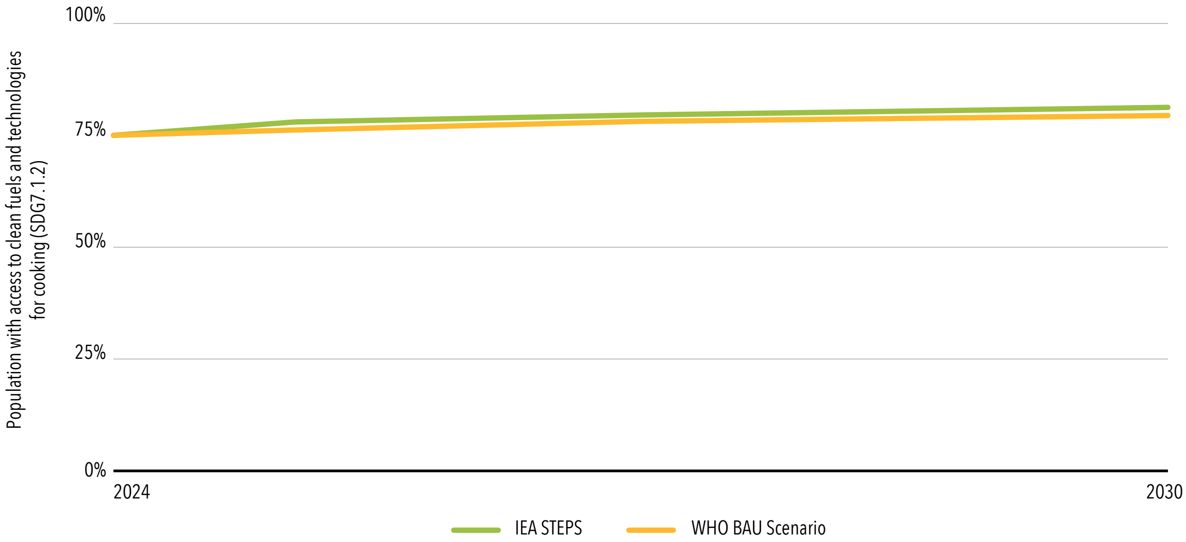
39 Figures appearing after estimates inside brackets/parentheses are 95 percent uncertainty intervals.

Building high-level political support for this often-overlooked part of the energy access agenda is critical to achieving the universal clean cooking target. In 2024, the IEA, in partnership with Tanzania, Norway, and the African Development Bank, co-chaired a Summit on Clean Cooking in Africa. The summit resulted in the adoption of the Clean Cooking Declaration by more than 130 governments and organizations. Around USD 470 million of the USD 2.2 billion committed has already been disbursed, exceeding the annualized commitment needed to meet the 2030 pledges. Investments have reached 22 African countries, with the IEA tracking direct public investments in six countries and private sector disbursements across all 22. This year, the 2026 Summit on Clean Cooking in Africa—co-chaired by Kenya, Norway, the United States, and the IEA, and co-organized with the African Union and the African Development Bank—comes as a response to current pressures on households and governments, with rising costs, supply constraints, and inflation raising the risk of fuel shortages and deepening energy poverty, particularly for the most vulnerable.

To bridge the gap in access to clean cooking, each country must develop its own roadmap, based on its specific circumstances and stage of development. Doing so requires a systematic approach supported by national action as well as international collaboration, with specific attention to the promotion of clean cooking among the most vulnerable and hard-to-reach groups, such as people living in countries and contexts affected by fragility, conflict, and displacement.

A significant increase in public funding will be crucial to attract private investment, make clean cooking more affordable, and foster innovation in clean fuels and technologies. Climate finance, particularly carbon finance, if properly managed, can be pivotal in making clean cooking more accessible, especially for the most underserved communities. Where bioenergy solutions are scaled up for clean cooking, the application of robust assessment frameworks, such as the Global Bioenergy Partnership indicators, will be essential to ensure environmental protection, social inclusion, and economic viability across value chains.

Figure 6.2 • Clean cooking access rate by 2030 in IEA's Stated Policies Scenario and WHO's Business as Usual scenario



Source: IEA 2025a and WHO 2026.

The outlook for renewable energy

SDG target 7.2 calls for a substantial increase in the share of renewable energy in the energy mix. Although it does not specify a quantitative objective, various long-term scenarios for a net-zero energy sector by 2050 require a tripling of installed capacity of renewables-based power by 2030. This is reflected in the COP28 agreement for tripling renewables-based power, which calls for at least 11,000 GW by 2030 (UNFCCC 2023), in line with IEA's Net Zero Emissions by 2050 Scenario and IRENA's 1.5°C Scenario.

The outlook for renewables under the two scenarios remains positive in all regions despite the impact of recent crises on supply chains and prices. The positive outlook is underpinned by targeted policies and falling technology costs. Under IEA's Stated Policies Scenario, the share of all renewables (including traditional uses of biomass) in TFEC is projected to rise from 17 percent in 2024 to 22 percent in 2030, while the share of modern direct uses of renewables, which excludes traditional use of biomass, is projected to increase from 12 percent in 2024 to 18 percent in 2030. In contrast, under IRENA's Planned Energy Scenario, the share of modern use of renewables in TFEC would increase to 18 percent by 2030, driven by the expansion of renewables, particularly in the power and transport sectors. Expanding the use of renewables in productive sectors, such as agriculture, can further support increases in renewable shares in TFEC while delivering development and resilience co-benefits.

Renewables used in the power sector continue to be the fastest-growing energy source worldwide. With governments increasingly prioritizing renewable projects and addressing short-term supply chain concerns, annual capacity additions for renewables in 2025–30 are projected to increase two-and-a-half-fold over 2015–24; solar PV and wind are projected to spearhead the expansion. By 2025, renewables are expected to surpass coal as the predominant source of electricity generation. Solar PV leads as the renewable electricity source, meeting nearly half of the growth in electricity demand over the period, followed by wind, accounting for around 35 percent. Hydropower will continue to be the key low-emission electricity source globally through 2030, providing flexibility through pumped hydro and supporting other essential power system services. Combined with end-use electrification, pumped hydro's flexibility, other forms of storage, and grid expansion will enable the share of renewables-based electricity in TFEC to approach percent by 2030, up from 6 percent in 2024. This trend includes a larger role for transport sector electrification owing to the rapidly growing use of electric vehicles. At the same time, it will add to grid flexibility to the extent that controlled charging is feasible.

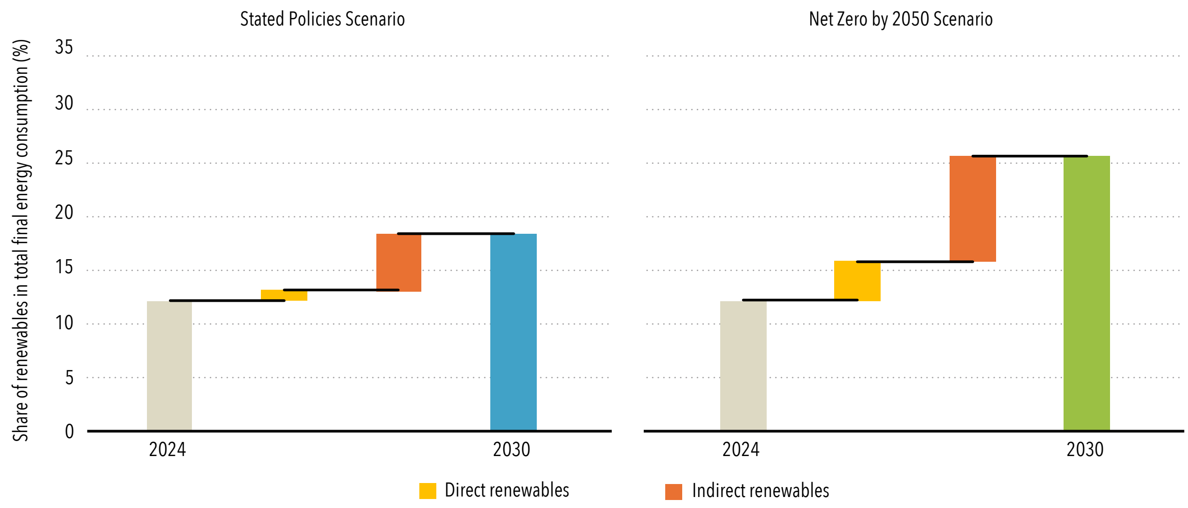
To meet the 2030 target, renewable energy deployment across transport, industry, and buildings would need to accelerate markedly toward 2030 in both scenarios, with the growth rate doubling between 2025 and 2030 compared with the rate from the previous seven-year period. The acceleration would be driven largely by rapid expansion of renewable electricity, which increasingly drives electrification across all end-use sectors. For transport, electric mobility accounts for a major share of the growth, complemented by modern use of sustainable biofuels, with smaller contributions from biogases, clean hydrogen, and e-fuels by 2030. For heating, renewables consumption would need to expand by more than 50 percent, driven by sustainable renewable electricity use in buildings and low-to-medium temperature industrial processes where feasible, alongside continued growth in sustainable bioenergy and pilot applications of green hydrogen (IEA 2025c and IRENA 2024).

Policy action remains key, especially if end-use renewables are to grow at the pace needed to meet climate ambitions. Although cost increases and competing budgetary pressures pose a risk of probable delay in reaching some targets, locally sourced end-use renewables can be part of the toolkit for boosting energy security, reducing risks, and, in turn, cutting costs.

Bridging the gap: Insights from IEA's Net Zero Emissions by 2050 Scenario

The use of renewables increases twice as rapidly under the Net Zero Emissions by 2050 Scenario as under the Stated Policies Scenario (IEA 2025a). Under the more ambitious Net Zero Emissions by 2050 Scenario, modern uses of renewables would represent around a third of TFEC in 2030 (figure 6.3).

Figure 6.3 • Renewables' share in total final energy consumption in 2024 and under IEA scenarios by 2030



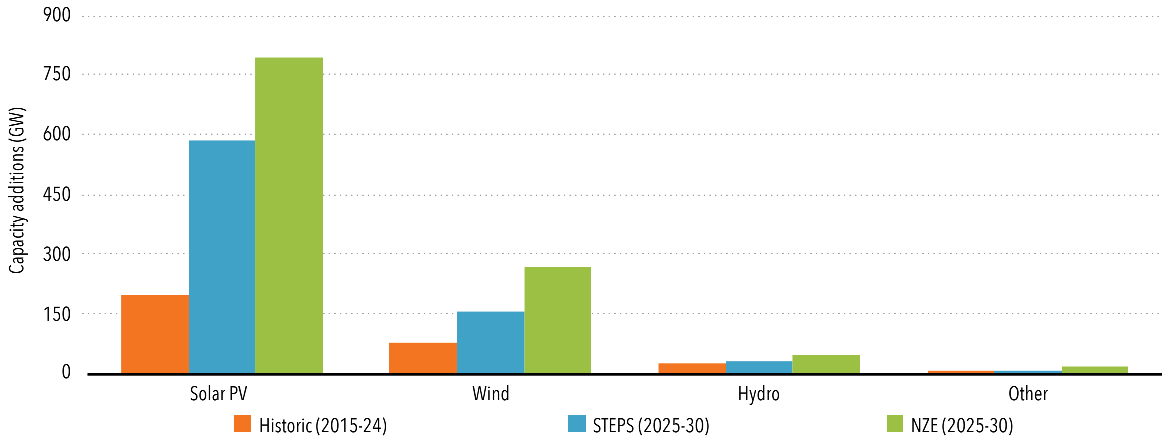
Source: IEA 2025a.

Under the Net Zero Emissions by 2050 Scenario, increased electrification of energy end uses is a primary means to boost renewables' share in TFEC. Under the scenario, electricity's share in final energy demand rises to exceed 30 percent by 2030, compared with about 20 percent under the Stated Policies Scenario. This growth is driven primarily by the electrification of transport and heat. Direct use of renewables, principally biofuels, constitutes 11 percent of fuel for road transport, on average. Combined with growing electrification, renewables' share in transport rises to nearly 17 percent (IEA 2025a).

Renewable energy is used for heating in various applications, including space and water heating, cooking, and industrial processes. The heat can come directly from sources like bioenergy, solar thermal, or geothermal energy, or indirectly through electricity and district heating generated from renewables. Transitioning to direct renewable heat—such as solar thermal water heating, biomass, and low-carbon gases—can help decrease reliance on fossil fuels. In 2024, renewables represented 12 percent of the total energy consumed for heating worldwide. By 2030, that share grows to around 30 percent under the Net Zero Emissions by 2050 Scenario. Under the same scenario, traditional uses of biomass are phased out completely by 2030, being replaced with more modern and efficient fuels and technologies. (Under the Stated Policies Scenario they fall to 3 percent of TFEC by the target year.)

As a share of TFEC in 2030, renewables-based electricity generation increases the most rapidly—to about 60 percent from the current level, a 16 percentage point increase over the level projected in the Stated Policies Scenario. Globally, renewables-based electricity generation grows by 12 percent annually, to approximately 22,520 terawatt-hours by 2030. This is supported by unprecedented solar PV and wind capacity additions, reaching, respectively, 585 GW and 157 GW a year on average over 2025–30 (figure 6.4). Annual investment in renewables-based power triples over the decade, to more than USD 1.2 trillion a year by 2030. That growth is supported by additional spending on expanding and modernizing electricity networks and battery storage and by improving the operational flexibility of existing assets to better integrate renewables.

Figure 6.4 • Average annual capacity additions of renewable power generation, by technology, under IEA scenarios



Source: IEA 2025a.

GW = gigawatt; NZE = Net Zero Emissions by 2050 Scenario; PV = photovoltaics; STEPS = Stated Policies Scenario.

Energy policy, socioeconomic factors, and natural resource availability influence the growth of renewables differently across regions. In developing economies, renewable electricity generation is projected to account for more than 80 percent of growth by 2030 under the Stated Policies Scenario. Under the same scenario, the share of renewables in electricity generation by 2030 varies widely, from 15 percent in the Middle East and 17 percent in Northern Africa to around 80 percent in Central and South America, where hydropower dominates. In the Net Zero Emissions by 2050 Scenario, renewables play an expanding role in all regions, reaching or surpassing 50 percent of total electricity generation in many areas by 2030.

Under the Net Zero Emissions by 2050 Scenario, the supply of low-emission hydrogen increases from 0.3 million metric tons (Mt) today to 90 Mt in 2030. The share of low-emission hydrogen in TFEC reaches 10 percent. Achieving net-zero emissions by 2050 also requires carbon capture technologies. Under the Net Zero Emissions by 2050 Scenario, in 2030, just above 1.2 $GtCO_2$ is absorbed via carbon capture, use, and storage, and by CO_2 removal technologies that do not include nature-based measures.

Accelerating the Energy Transition: Insights from IRENA'S 1.5°C Scenario and from Delivering on the UAE Consensus

Tripling global renewable power capacity by 2030 is a cornerstone of progress toward SDG 7 and of advancing climate action under SDG 13. The period to 2030 represents a critical window for raising ambition and accelerating implementation. While a broad portfolio of technologies will be required to fully decarbonize the energy system by 2050, the limited timeframe to 2030 narrows the range of solutions that can be deployed at scale. In this context, renewable power and energy efficiency stand out as the most readily scalable options to deliver near-term progress. At the same time, sustained innovation and development across a wider set of low-carbon technologies remain essential to ensure long-term transformation for decarbonization and economic growth.

IRENA's 1.5°C Scenario outlines key performance indicators to guide this transition (IRENA 2024). By 2030, renewable energy's share in TFEC would need to rise to around 35 percent to make the pathway a reality, while renewables would account for approximately 68 percent of electricity generation. The share of electricity in TFEC would need to surpass 30 percent, reflecting accelerated electrification across all end-use sectors. Energy intensity improvements would need to average at least 4 percent per year from 2023 until 2030—more than double the rate achieved in the previous decade. In parallel, clean hydrogen production would need to scale up to around 125 million tonnes by 2030. Targeted deployment of carbon removal solutions, particularly in hard-to-abate sectors such as heavy industry, would also be required to complement these efforts.

Figure 6.5 • Key performance indicators for IRENA's 1.5°C Scenario in 2030 compared with the Planned Energy Scenario in 2030 and 2050: Global perspective

GLOBAL PERSPECTIVE	Historical			Planned Energy Scenario (PES)[1]		1.5°C Scenario[1]		Essential milestones
	2021	2022	2023	2030	2050	2030	2050	
KPI.01 RENEWABLES (POWER)[2]								
Renewable energy electricity generation (TWh/yr)	7 873	8 440	N/A	16 504	38 118	27 358	82 148	• Tripling renewable capacity by 2030. • Nine-fold increase in renewables by 2050. • Renewable electricity share in electricity generation to reach c. 70% by 2030 and 90% by 2050.
Renewable energy share in electricity generation (%)	28	29	N/A	46	73	68	91	
Renewable energy installed capacity (GW)	3 083	3 391	3 865	6 773	15 835	11 174	33 216	
Renewable energy share in installed capacity (%)	38	40	43	58	80	77	94	
KPI.02 RENEWABLES (DIRECT USES)								
Renewable energy share in TFEC (%)	17[3]	17[3]	N/A	23	33	35	78	• Doubling the direct use of renewable energy by 2030 and quadrupling it by 2050. • Tripling modern use of bioenergy by 2050.
Modern use of bioenergy (EJ)[4]	23[3]	24[3]	N/A	30	41	46	53	
KPI.03 ENERGY INTENSITY								
Energy intensity improvement rate (%)	0.7[5]	2[5]	N/A	2[6]	2[7]	4[6]	3[7]	• Urgent doubling energy efficiency improvements by 2030.

Figure 6.5 • Key performance indicators for IRENA's 1.5°C Scenario in 2030 compared with the Planned Energy Scenario in 2030 and 2050: Global perspective *(continued)*

GLOBAL PERSPECTIVE	Historical			Planned Energy Scenario (PES)[1]		1.5°C Scenario[1]		Essential milestones
	2021	2022	2023	2030	2050	2030	2050	
KPI.04 ELECTRIFICATION IN END-USE SECTORS (DIRECT)								
Electrification rate in TFEC (%)	22[3]	23[3]	N/A	23	28	30	52	• Direct electrification of end-use sectors would need to increase by 50% by 2030 and more than double by 2050.
KPI.05 CLEAN HYDROGEN AND DERIVATIVES								
Production of clean hydrogen (Mt)	0.6[8]	0.7[8]	0.7[8]	2	21	125	523	• A new set of hydrogen facilities to be scaled up by 2030 and beyond.
KPI.06 CCS, BECCS AND OTHERS								
CO_2 captured from CCS, BECCS and other removal measures (Gt)	0.05[9]	0.05[9]	0.05[9]	0.1	0.5	2.2	7.0	• CO_2 removal, capture and storage measures also needed – to 2.2 Gt and 7 Gt by 2030 and 2050.

Notes: The scenario results presented herein are subject to upward revision in the 2025 edition of the *World Energy Transitions Outlook*, given the current pace of solar and storage growth in certain countries.
BECCS = bioenergy with carbon capture and storage; CCS = carbon capture and storage; CO_2 = carbon dioxide; EJ = exajoule; GW = gigawatt; Gt= gigatonne; KPI = key performance indicator; Mt = megatonne; PES = Planned Energy Scenario; TFEC = total final energy consumption; TWh/yr = terawatt hour per year.

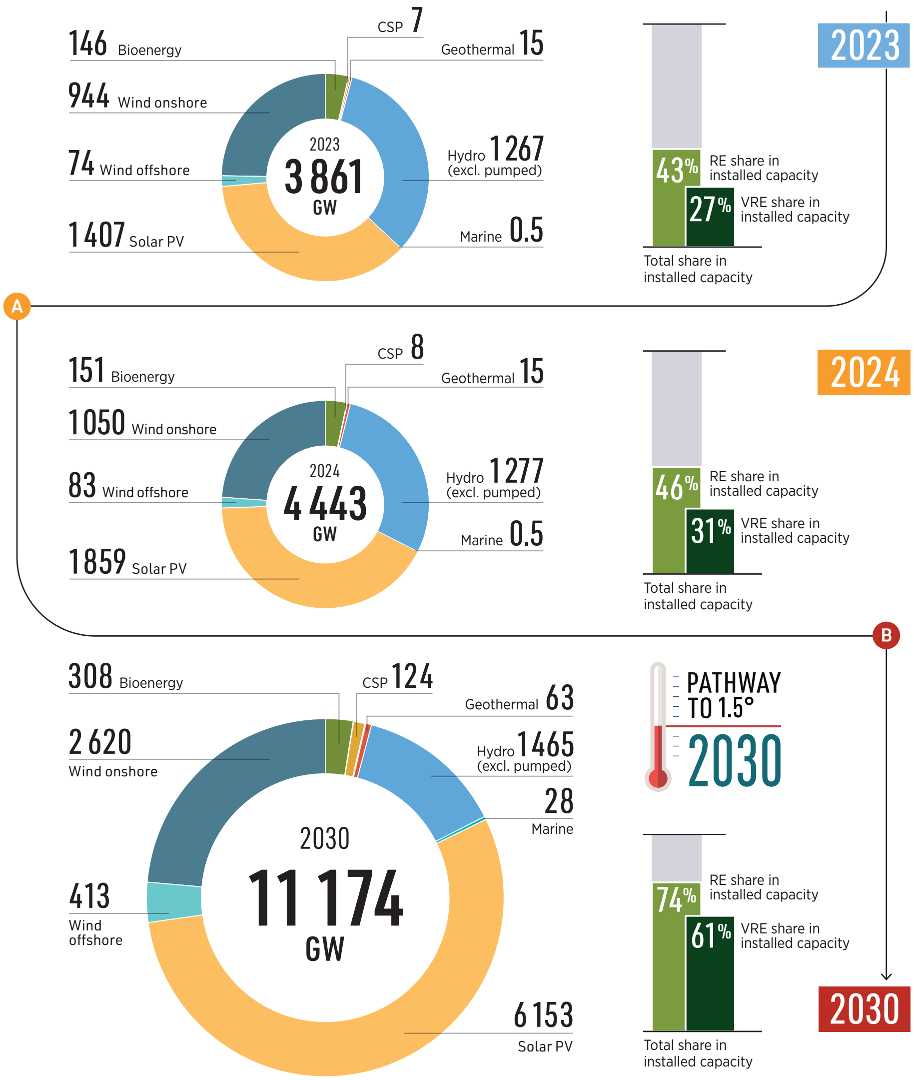
[1] PES and 1.5°C Scenario analyses as of March 2023.
[2] (IRENA, 2024a).
[3] Based on (IEA, 2024b).
[4] Excludes non-energy uses.
[5] Energy intensity improvement achieved estimated using (IEA, 2024b) for primary energy supply and (CE, *n.d.*) for GDP statistics.
[6] Average annual improvement rate from 2023 to 2030 uses (IEA, 2024b) for primary energy supply (historical data), and (CE, *n.d.*) for GDP historical statistics.
[7] Average annual improvement rate from 2023 to 2050 uses (IEA, 2024b) for primary energy supply (historical data), and (CE, *n.d.*) for GDP historical statistics.
[8] (IEA, 2023a).
[9] (IEA, 2024c).

Accelerating the energy transition at the pace and scale required calls for the near-complete decarbonization of the electricity sector by mid-century. In this context, tripling global renewable power capacity by 2030 is both technically feasible and economically viable, but it will depend on strong policy commitments, enabling frameworks, and scaled-up investment across capacity and infrastructure.

Since the adoption of SDG 7 in 2015, annual additions of renewable power capacity have consistently surpassed those of fossil fuel and nuclear generation combined, reaching 692 GW in 2025 (IRENA 2026). However, the expansion of most renewable technologies—including wind, hydropower, geothermal, bioenergy, concentrated solar power, and marine energy—remains below the levels required to align with a 1.5°C pathway and meet the tripling pledge (figure 6.6). Solar PV is a notable exception, with additions of 511 GW in 2025 (IRENA 2026).

Under IRENA's 1.5°C Scenario, accelerating electrification across end-use sectors—particularly heating and transport—together with the expansion of green hydrogen production and new consumption from expanding data centers, is expected to drive a substantial further increase in electricity demand.

Figure 6.6 • Global installed renewables-based power capacity in 2023, 2024, and 2030 under IRENA's 1.5°C Scenario

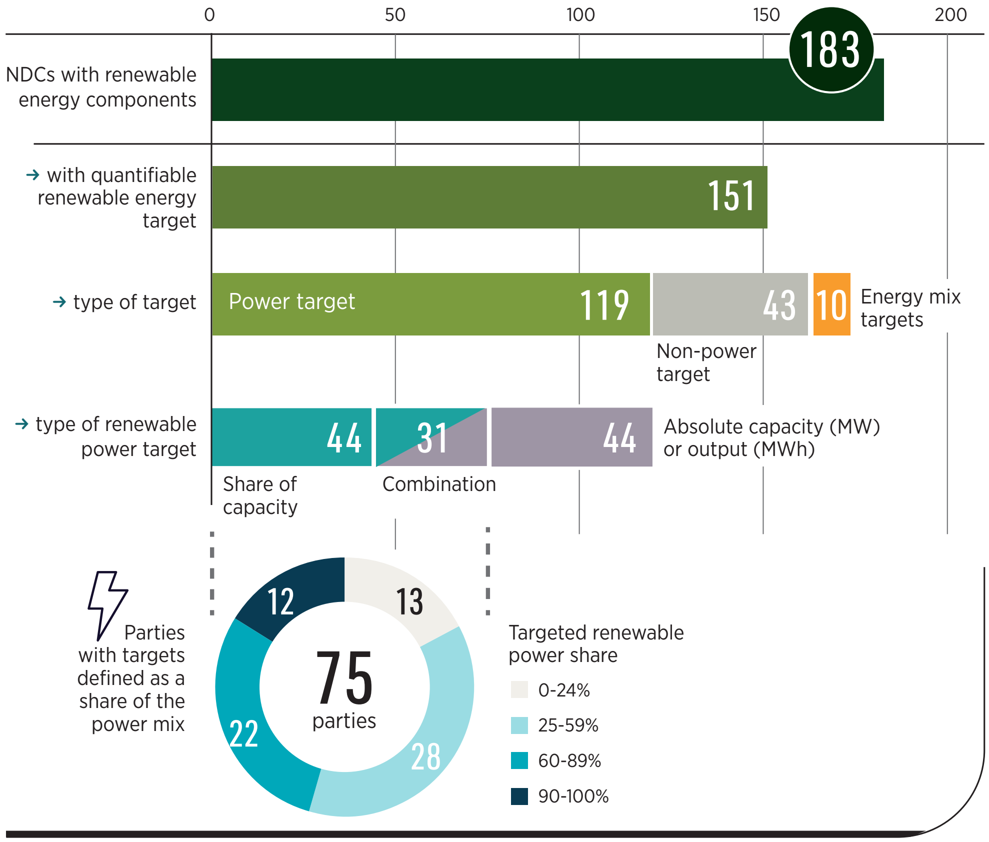


Source: IRENA, COP30 Presidency, and Global Renewables Alliance 2025.

CSP = concentrated solar power; GW = gigawatt; PV = photovoltaic; VRE = variable renewable energy; bioenergy includes biogas, biomass waste and biomass solid; hydropower data excludes pumped hydro; tripling target for the global installed capacity by 2030 is compared to 2022 status.

To achieve the global goal of tripling renewable power capacity by 2030, installed capacity would need to reach around 11.2 TW—highlighting a wide gap relative to current national commitments. IRENA's latest assessment shows that renewable power targets in NDCs submitted as of October 2025 amount to only about 5.8 TW by 2030, or roughly half of what is required. Even when considering broader national plans and targets, projected capacity reaches only around 7.4 TW, still well below the tripling goal (figure 6.7).[40]

Figure 6.7 • Global renewable energy targets in NDCs (as of October 2025) and the gap to the 2030 tripling goal



Source: IRENA, COP30 Presidency, and Global Renewables Alliance 2025.

This shortfall indicates that current ambitions must nearly double within less than five years to remain on track. Although some progress has been made, including updates to NDCs, the overall increase in national targets has been limited. Closing this gap will require significantly stronger policy action, faster implementation, and a major scale-up in investment to accelerate renewable energy deployment.

At the same time, progress across the energy sector remains insufficient to keep the 1.5°C goal within reach. The pace of renewable deployment, energy efficiency improvements, and electrification continues to lag behind what is required, highlighting the need for rapid acceleration before 2030 to scale up renewables, reduce dependence on fossil fuels, and enhance the resilience of the energy system in the face of growing geopolitical uncertainties while avoiding further "lock-in" effects.

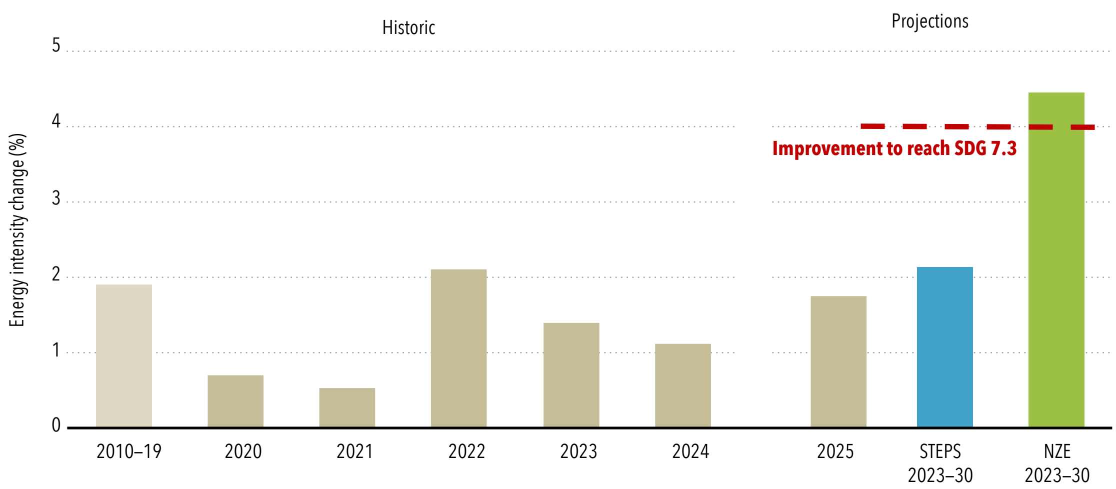
40 The Planned Energy Scenario reflects both explicit and implicit national targets, energy plans, and policies in place. It will be updated in IRENA's forthcoming World Energy Transitions Outlook.

The outlook for energy efficiency

In 2025, governments implemented more than 250 new or updated efficiency-related policies in countries representing 85 percent of global energy demand—an expansion from 2024, when countries accounting for only 70 percent of global energy demand took action. More than 50 countries have also incorporated updated energy efficiency targets into their NDCs ahead of COP30. While this broadening of the policy landscape provides a basis for faster progress, the central challenge remains translating policy coverage into implementation at the pace and stringency required to close the gap between projections and targets.

Global energy intensity is estimated to improve by 1.8 percent in 2025, up from around 1 percent in 2024. While this represents a partial recovery from a particularly weak year, it remains well below the pace required to meet global efficiency targets. Preliminary estimates indicate that several key regions are showing some signs of stronger progress on energy intensity relative to their post-2019 averages. Progress in 2025 is estimated to have been in excess of 3 percent in the People's Republic of China (hereafter "China") and 4 percent in India—both above their averages since 2019. In the United States and the European Union (EU), however, progress in 2025 is set to fall below 1 percent, a marked deceleration following several years of stronger performance in the wake of the energy crisis (figure 6.7). These divergences reflect the extent to which efficiency gains in some advanced economies were partly crisis-driven rather than structurally embedded in policy frameworks.

Figure 6.7 • Historical and projected improvement in global energy intensity by scenario, 2010–30



Source: IEA 2025d.

NZE = Net Zero Emissions by 2050 Scenario; SDG = Sustainable Development Goal; STEPS = Stated Policies Scenario.

Several of the countries that introduced new or updated efficiency policies in 2024 are noted below. Kenya revised its building code to mandate efficiency requirements for new construction. The European Union strengthened regulations to achieve a zero-emission building stock by 2050, including measures to encourage retrofitting. China enhanced appliance standards and set more ambitious national efficiency targets, while the United States tightened fuel economy standards for heavy-duty vehicles.

Over the past year, governments allocated approximately USD 60 billion for building efficiency measures and USD 45 billion for low-emission vehicles, bringing total efficiency-related funding over the last five years to more than USD 1 trillion.

However, policy implementation must accelerate considerably to improve progress on energy efficiency and enter into alignment with global climate ambitions. Around the world, almost half of newly built floor area is not yet covered by efficiency requirements, and the regulations in place vary significantly among countries in their scope and stringency. Similarly, just three out of five industrial electric motors in use globally are covered by minimum energy performance standards—gaps that represent substantial unrealized savings.

Energy efficiency is essential for reducing reliance on fossil fuels. In a highly ambitious scenario aligned with the IEA's pathway to net zero energy sector emissions by 2050, faster efficiency improvements could account for over 70 percent of the projected decline in oil demand and 50 percent of the reduction in gas demand by 2030. The drop in oil demand—comparable to China's total oil consumption in 2025—would largely result from technical efficiency gains (such as more fuel-efficient vehicles) and electrification, including the adoption of EVs. Meanwhile, the reduction in natural gas demand—exceeding Europe's total gas use in 2024—would be driven by measures such as better building insulation and the electrification of heating. Realizing these reductions would require a pace of efficiency improvement far beyond current trends.

Four structural trends continue to hold back faster progress. First, two-thirds of global growth in final energy demand since 2019 has been concentrated in industry, a sector where progress on energy intensity has slowed sharply. Industrial energy demand growth has accelerated since 2019, while the average annual rate of improvement in industrial energy intensity fell below 0.5 percent over that same period, tumbling from almost 2 percent the previous decade. The shift toward more intensive energy use in industry is offsetting gains made in other sectors and weighing down overall progress on energy efficiency.

Second, policies have lagged behind technological advances, leaving significant savings on the table. Many appliances being sold today are only half as efficient as the best available models. As technologies have become more efficient in recent years, efficiency standards have not progressed at the same pace. For example, the efficiency of best-in-class lightbulbs doubled over the past 15 years, while minimum performance standards increased by only 30 percent.

Third, increased access to air conditioners has pushed up electricity demand. Higher living standards have allowed more people to afford much-needed cooling, especially in emerging economies. Energy for space cooling has seen the fastest growth of any end-use in buildings since 2000, rising by more than 4 percent per year. However, the increased demand has largely been met with equipment that falls well short of the most efficient available. If every air conditioner bought since 2019 had been the most efficient available, the world could have avoided demand for electricity equivalent to demand from data centers over the same period.

Fourth, electricity demand growth has outpaced renewable supply, leading to an overall increase in less-efficient fossil fuel generation.

Under IRENA's 1.5°C Scenario, the average annual rate of energy intensity improvement must exceed 3.3 percent over 2020–30. As noted, however, recent progress has fallen short: Energy intensity improved by just 1 percent between 2023 and 2024, well below the level required to meet global targets. As a result, the pace must now accelerate to at least 5 percent annually from 2025 to 2030 given the limited progress made in the past years.

Achieving this scale-up will require the rapid deployment of measures that enhance technical performance—such as high-efficiency boilers, air conditioners, motors, heat pumps, and appliances—alongside greater uptake of technologies enabling the direct use of renewable energy, including solar thermal systems. Delivering these improvements also depends on strong cross-sectoral policies and coordinated action among governments, industry, financial institutions, and other stakeholders, supported by measures such as standards, labeling, and targeted financing. Initiatives such as the Global Energy Efficiency Alliance, launched at COP29 in 2024, play a role in advancing international cooperation, mobilizing finance, and accelerating deployment of technology toward the goal of doubling global improvements in energy efficiency by 2030—a goal that current trajectories have yet to put within reach.

Investments needed to achieve SDG 7

Despite elevated geopolitical tensions and economic uncertainty, capital flows to the energy sector are expected to have risen in 2025 to USD 3.3 trillion, a 2 percent rise in real terms from 2024. Around USD 2.2 trillion is going collectively to renewables, nuclear, grids, storage, low-emissions fuels, efficiency, and electrification, twice as much as the USD 1.1 trillion going to oil, natural gas, and coal. Open questions about the economic and trade outlook means that some investors are adopting a wait-and-see approach to new project approvals, but spending on existing projects has not yet changed significantly. As the 2030 deadline approaches, the central challenge is ensuring that rising investment levels translate into effective delivery of energy access, clean cooking, and reliable services in underserved and rural contexts.

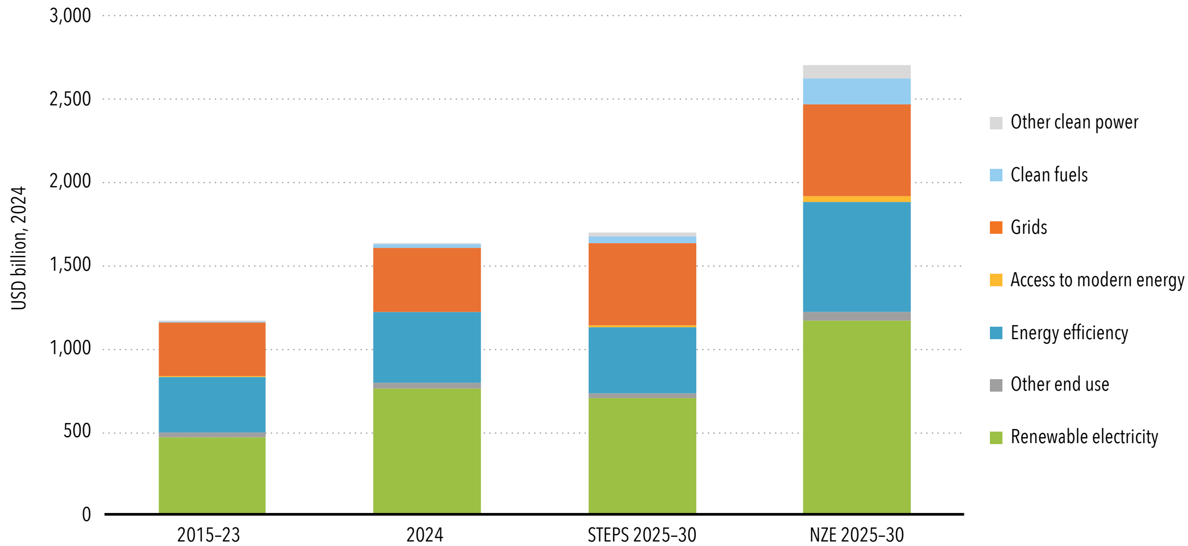
Between 2015 and 2021, annual clean energy investments averaged more than USD 1 trillion (in 2022 dollars). Both IEA and IRENA emphasize the pressing need to escalate investments in the energy transition. According to IEA's Net Zero Emissions by 2050 Scenario, meeting the SDG 7 targets requires an average annual investment of USD 3 trillion in the energy sector over 2022–30, whereas clean energy investments under the Stated Policies Scenario average close to USD 2 trillion in the same period.

The bulk of the investment required to meet the SDG 7 targets under IEA's Net Zero Emissions by 2050 Scenario is allocated to renewables-based electricity generation (including batteries) and end-use efficiency. The investment amounts to USD 1,016 billion and USD 566 billion per year, respectively (again, in 2022 dollars). However, additional average annual spending of USD 2024 496 billion on expanding and modernizing electricity networks is essential to support investments in renewables-based power. Grid investments have not kept pace with generation, especially in emerging markets and developing economies, posing a potential barrier to clean energy transitions without appropriate incentives.

Under the same scenario, achieving universal energy access in developing economies necessitates average annual investments of USD 33 billion by 2030 (figure 6.8). Two-thirds of the investment is required in Sub-Saharan Africa.

Even though these investments represent only 10 percent of annual spending in the upstream oil and gas sector, reaching these levels for access remains challenging owing to the small scale of projects, the affordability challenges faced by end users, and the fragility of many countries with large energy access deficits. International support in the form of aid and from multilateral development banks will be crucial in mobilizing investment levels and mitigating the risks associated with access and other energy investments in emerging markets and developing economies. Aligning access investments with broader sectoral investments in production, transport, processing, storage, and retailing can amplify their effect, helping ensure that they deliver durable socioeconomic benefits and contribute directly to the achievement of SDG 7.

Figure 6.8 • Average annual investment in selected technologies, historically and under IEA scenarios, 2015–30



Source: IEA 2025a.

NZE = Net Zero Emissions by 2050 Scenario; PV = photovoltaic; STEPS = Stated Policies Scenario.

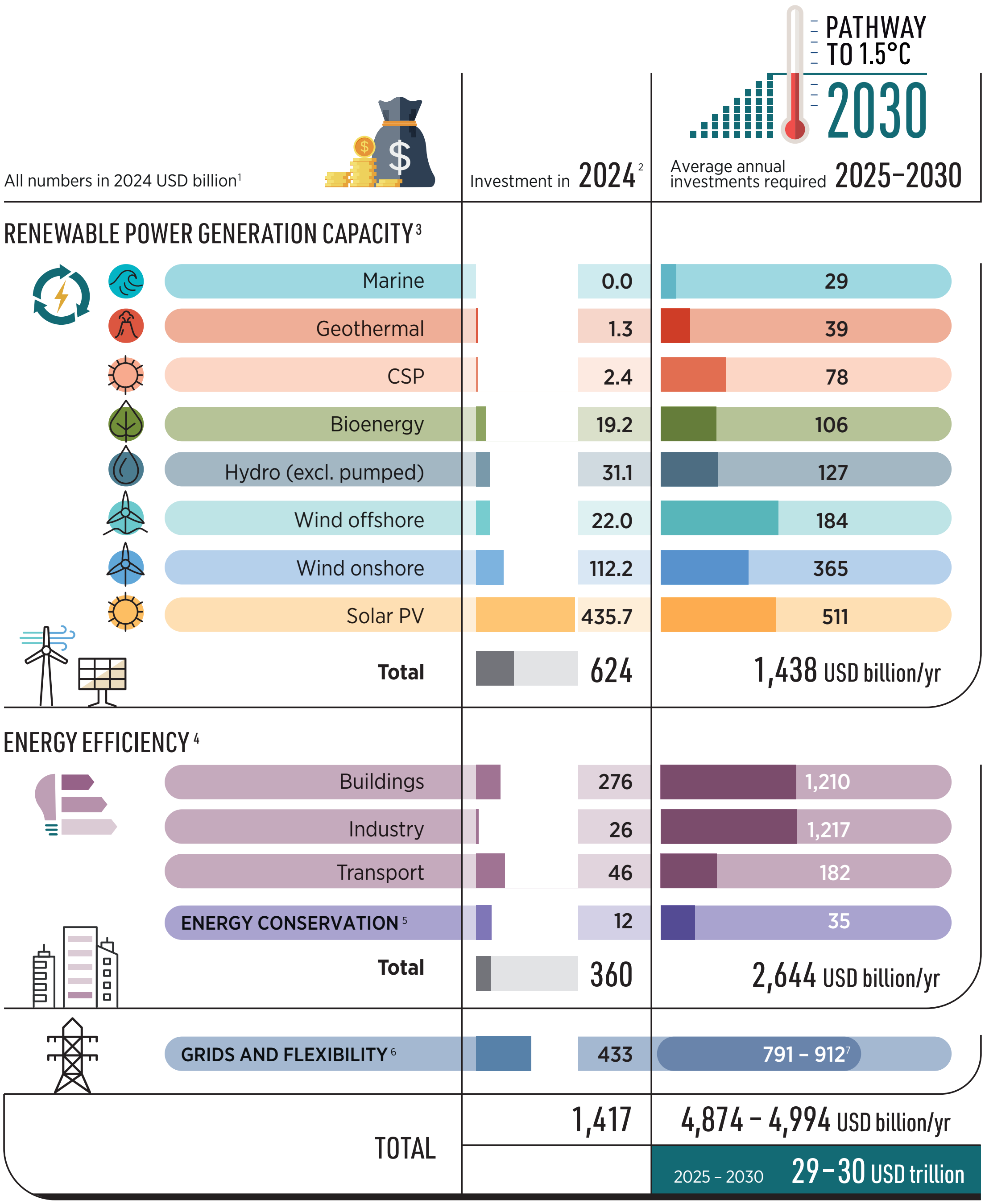
IRENA estimates that achieving the UAE Consensus targets for renewable energy and energy efficiency will require USD 30 trillion in cumulative investment between 2025 and 2030 across renewables, grids, flexibility measures, energy efficiency and conservation measures (figure 6.9).

Closing the investment gap remains a critical challenge, as current capital flows are insufficient to support the scale of transformation envisioned in IRENA's energy transition pathway. Annual investment in renewable power capacity reached about USD 624 billion in 2024, but needs to rise to USD 1.5 trillion per year over 2025 to 2030—more than double current levels. Moreover, investment flows remain highly concentrated, with more than three-quarters directed to China, the European Union, and the United States, leaving emerging markets and developing economies significantly underfunded.

From a technology perspective, solar PV investment is broadly on track to meet the tripling target. However, other technologies—including wind, hydropower, bioenergy, concentrated solar power, geothermal, and ocean energy—remain underfunded and require substantial scaling up. At the same time, investment in enabling infrastructure is lagging: Grids supporting infrastructure and flexibility measures will require approximately USD 790–910 billion annually between 2025 and 2030, nearly double current spending levels, to support renewables integration and system reliability.

On the efficiency side, investment needs are even more pronounced. Current spending—USD 350 billion in 2024—will need to increase more than sevenfold to reach an average of USD 2.6 trillion per year across buildings, transport, and industry over 2025–30. Accelerating both the scale and geographic distribution of investments will be critical to meeting global climate and energy efficiency goals.

Figure 6.9 • Investments required to triple renewable power capacity and double energy efficiency by 2030 compared with 2024 progress



Source: IRENA, COP30 Presidency, and Global Renewables Alliance 2025.

Conclusion

This chapter paints a sobering picture of where the world stands in its pursuit of SDG 7. Progress has been real: since 2000, nearly one billion people have gained access to electricity; renewables now surpass coal as the leading source of global electricity generation; and energy efficiency policies are expanding in scope and stringency. Yet on every dimension of SDG 7—electricity access, clean cooking, renewable energy share, and energy efficiency—the pace of change falls short of what is required to meet the 2030 targets or to keep a 1.5°C pathway within reach.

The access deficit remains concentrated and stubborn. Under current policies, around 640 million people will still lack electricity by 2030 and between 1.6 (IEA 2025a) and 1.8 (WHO 2026) billion will lack clean cooking—with Sub-Saharan Africa accounting for most of both shortfalls. In many countries in the region, population growth is outrunning electrification, and debt burdens compounded by cuts in international aid are undermining the institutional and financial foundations needed to scale up. Addressing these gaps requires not only a major increase in investment—USD 45 billion per year for electricity access and USD 8 billion per year for clean cooking—but also holistic national electrification and clean cooking plans backed by clear financing schemes and empowered implementing institutions.

With respect to renewables' share in TFEC, the trajectory is broadly positive but insufficient. Annual capacity additions are accelerating, and solar PV deployment is outpacing all expectations, yet the portfolio of technologies needed—wind, hydropower, geothermal, bioenergy, and concentrated solar power—is not expanding at the pace required to stay on the 1.5°C pathway. Progress in end-use sectors, especially transport, buildings, and industry has been particularly lagging (see chapter 3). NDC targets submitted by late 2025 make up only half the goal of 11,000 GW by 2030. Closing that gap will demand much stronger policy commitments, faster implementation, and a sustained scale-up in investment, particularly in emerging markets and developing economies, where more than three-quarters of investment currently flows to just three geographic markets. Significant increases in direct uses of renewables as well as electrification across all end uses will be vital, together with economic and technical measures to integrate increasingly high shares of variable renewable energy into the energy system, including grid expansion, flexibility measures, charging refueling infrastructure, energy storage, and market design.

Energy efficiency improvements are picking up but not fast enough. Global energy intensity improved by only around 1 percent in 2024 against a required rate of more than 4 percent annually. Reaching the 2030 efficiency target will now require accelerating to at least 5 percent per year from 2025 onward. Slowing gains in industrial energy intensity, fast growth in demand for air-conditioning, and the spreading gap between technology performance and regulatory standards are the key drags. Initiatives such as the Global Energy Efficiency Alliance, launched at COP29 in 2024, signal growing political will, but they must be translated urgently into binding standards, scaled financing, and cross-sectoral coordination.

Underpinning all is the investment imperative. Current clean energy investment levels—though growing—are roughly half of what IEA's net-zero pathway requires and less than a fifth of the approximately USD 5 trillion annually that IRENA estimates is needed to meet the UAE Consensus targets on renewables and efficiency. Bridging the gap demands both a significant increase in public finance and stronger mechanisms to attract private capital, but also broader improvements in the economic fundamentals that make investments viable in the first place. These include robust project development pipelines, enabling infrastructure, skilled workforces, credible policy incentives, and dynamic market design. Depending on the country context, concessional finance, blended finance mechanisms, de-risking instruments, and multilateral development bank engagement can help mobilize the investment flows the energy transition requires.

The road to SDG 7 is challenging, but much headway can be made in the years to 2030. The technologies are available, the costs of renewables and batteries have fallen dramatically, and the policy architecture is expanding. Ensuring widespread accessibility, affordability, and sustainability requires coordination, a sense of urgency, and the political will to translate commitments into tailored policies and sufficient resources so that the benefits of the energy transition reach every person in every region, including the most vulnerable communities currently at risk of being left behind.

CHAPTER 7
TRACKING PROGRESS TOWARD SDG 7 ACROSS TARGETS: INDICATORS AND DATA

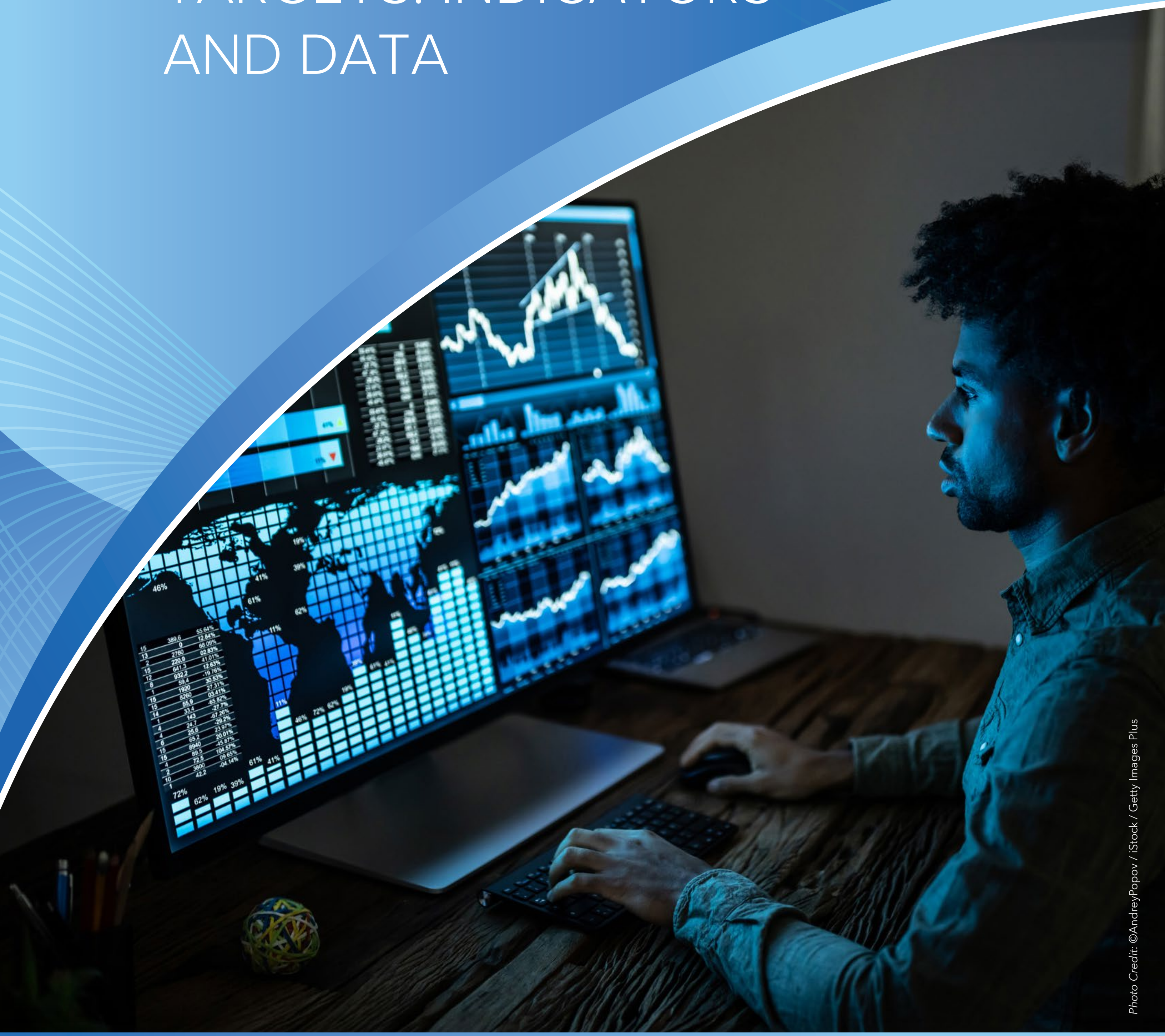


Photo Credit: ©AndreyPopov / iStock / Getty Images Plus

Drawing on national data efforts worldwide, this annual report is a joint effort of the five custodian agencies responsible for monitoring progress toward the targets of Sustainable Development Goal (SDG) 7—universal access to affordable, reliable, sustainable, and modern energy by 2030 (table 7.1). The World Bank and World Health Organization (WHO) are responsible for tracking progress toward SDG target 7.1 (universal access to modern energy services). The International Energy Agency (IEA), International Renewable Energy Agency (IRENA), and United Nations Statistics Division (UNSD) are responsible for tracking SDG target 7.2 (the share of renewable energy in the energy mix). The IEA and UNSD are responsible for tracking SDG target 7.3 (improvements in energy efficiency). IRENA is also responsible for tracking target 7.a (international cooperation)—with the Organisation for Economic Co-operation and Development (OECD)—and target 7.b (promotion of energy infrastructure). The World Bank's Energy Sector Management Assistance Program (ESMAP) produces and publishes the report.

This chapter summarizes the data behind each indicator as well as the methodological challenges of converting the data into indicators. Further details can be found in the United Nations' metadata repository for SDG indicators.[41]

TABLE 7.1 • SDG 7 TARGETS, INDICATORS, AND CUSTODIAN AGENCIES

Target	Indicator	Custodian agency or agencies	Relevant chapter in this report
7.1—By 2030, ensure universal access to affordable, reliable, and modern energy services	7.1.1—Proportion of population with access to electricity	World Bank	Chapter 1
	7.1.2—Proportion of population with primary reliance on clean fuels and technology for cooking	World Health Organization	Chapter 2
7.2—By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1—Renewable energy share in total final energy consumption	International Energy Agency, International Renewable Energy Agency, UN Statistics Division	Chapter 3
7.b—By 2030, 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	7.b.1—Installed [renewables-based] generating capacity in developing and developed countries (in watts per capita)	International Renewable Energy Agency	
7.3—By 2030, double the global rate of improvement in energy efficiency	7.3.1—Energy intensity measured in terms of primary energy and GDP	International Energy Agency, UN Statistics Division	Chapter 4
7.a—By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency, and advanced and cleaner fossil fuel technology, and promote investment in energy infrastructure and clean energy technology	7.a.1—International financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems	International Renewable Energy Agency, Organisation for Economic Co-operation and Development	Chapter 5

Note: GDP = gross domestic product.

41 https://unstats.un.org/sdgs/metadata/.

Access to electricity

Measuring access to electricity (SDG indicator 7.1.1) is not as straightforward as simply counting the number of people with electricity. It is a complex process involving data collection and validation efforts carried out by national and international actors, including governments, energy utilities, private companies, and multilateral development organizations. Understanding the intricacies of electricity access in low-income countries and countries marked by fragility, conflict, or violence requires a comprehensive look at the multiple attributes of access in different settings.

While most microdata from household, enterprise, and agricultural surveys provide useful information to energy practitioners and ministries, they fail to capture the more nuanced aspects of electricity access in households—for example, the economic activities of a household's individual members. Further complexities arise when trying to account for the scale-up of decentralized energy solutions that are not typically distinguished in routine national surveys and energy statistics.

Because the concept of electricity access does not lend itself to easy definition, efforts are underway, using the World Bank's Multi-Tier Framework (MTF), to better capture the spectrum of energy services sought and used by households, enterprises, communities, and institutions. The spectrum spans capacity, availability, reliability, affordability, quality, formality, and safety.[42] The information collected paints a precise and detailed picture of the number of people benefiting from interventions and the nature and magnitude of improvements in electrification. Such information is critical for policy and decision-making.

Capacity-building activities, such as the training of energy statisticians through bilateral and regional programs, will improve the tracking of electricity access by building the skills needed for effective data collection and analysis. High-quality, user-friendly, and comparable data sets will, in turn, help governments and energy practitioners apply new technologies and data analytics to inform policy and its implementation. Resources like the World Bank's online Atlas of Sustainable Development Goals (World Bank 2026), which features interactive storytelling and graphical representations of electricity access trends, demonstrate how accessible data can sharpen insights relevant to key SDG indicators. Similarly, large-scale, open databases that provide real-time information based on satellite data can clarify where and how electricity is being used, while also revealing socioeconomic trends in energy consumption.

Improving data quality and granularity are critical. In 2021, ESMAP collaborated with WHO and the Living Standard Measurement Study (LSMS, the World Bank's flagship household survey program) to publish the Core Questions on Household Energy Use (WHO n.d.), which offered detailed guidelines for fieldwork and data tabulation.[43] These standardized modules are being integrated into national surveys so as to supply timely and actionable insights in support of universal access, rather than merely serving as retrospective assessments. The World Bank has also partnered with national statistical offices to deepen their understanding of energy indicators and improve survey methodologies.

Since its introduction in 2015, ESMAP's MTF survey has been implemented across 27 countries through 29 nationally representative surveys, establishing a globally comparable evidence base on electricity access (Angelou and others 2026). Findings consistently highlight persistent access gaps, where proximity to the grid or decentralized networks does not translate into meaningful service. MTF metrics are now widely used by governments and development partners for target-setting and progress monitoring. Building on this foundation, ESMAP is applying both the MTF and the LSMS to craft new measurement approaches aligned with Mission 300 (Angelou and others) that leverage innovations in remote monitoring, geospatial analysis, and AI-enabled tools. This evolution will make the measurement of electricity access more accurate, less reliant on recall, and better able to capture how service varies across locations and over time.

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42 Information on the MTF can be found at https://mtfenergyaccess.esmap.org/.

43 Living Standard Measurement Study (LSMS), https://www.worldbank.org/en/programs/lsms; Core Questions on Household Energy Use, https://www.who.int/tools/core-questions-for-household-energy-use (World Bank and WHO 2021).

Access to clean cooking fuels and technologies for cooking

SDG indicator 7.1.2 measures the number of people using clean fuels and technologies as their primary energy source for household cooking. Households considered to have access to clean cooking are those that primarily rely on electricity, biogas, solar, alcohol fuels, natural gas, and liquefied petroleum gas for household cooking purposes.[44]

At the moment, most energy-related data collected by national household surveys do not capture everything needed to understand the role of household energy services in mitigating poverty and other impacts; hence, they do not permit extensive energy policy analysis. Including questions on cooking time, fuel collection, and health implications would make clean cooking estimates more granular and aid in the formulation of better national and global policies (World Bank and WHO 2021). Improving the collection of data on the parallel use of multiple cooking solutions (also known as "stove stacking") in low- and middle-income countries would allow a more complete picture of the population exposed to pollution and resultant diseases. Presently, however, such data are too limited in geographic coverage to be used in global tracking efforts.

As with access to electricity, household surveys and censuses are the primary data sources for global estimates. Knowing the extent to which household surveys capture modes and duration of use is vital for designing, implementing, and monitoring the effectiveness and outcomes of clean cooking policies and programs. By refining household surveys and censuses, countries can gain a more complete picture of household energy use; access to clean cooking fuels and technologies; and the effects of cooking practices on air pollution, gender, climate, and other impacts. WHO and the World Bank developed the Measuring Energy Access guidebook and the set of core questions on household energy referenced in the previous section for use as part of the WHO Clean Household Energy Solutions Toolkit.[45] The questions improve upon previous surveys by not only establishing whether a household has electricity access and what its primary cooking fuel is, but also by assessing the type of electricity access; the quality of access; impediments to access; the types of fuels and devices used for cooking, heating, and lighting; and important safety and livelihood impacts of household energy use.

Renewable energy

Progress toward SDG target 7.2—substantially increasing the share of renewable energy in the global energy mix—is tracked using renewable energy's share of total final energy consumption as the key indicator. Here, too, accurate tracking requires comprehensive data across all energy sources (renewable and nonrenewable) and across supply, transformation, and final consumption. The methodology used to derive total final energy consumption, total energy supply, and energy balances is detailed in United Nations (2024). The aggregates are calculated from basic energy statistics compiled by the IEA and UNSD, primarily through questionnaires from national administrations containing thousands of data points per country per year.

To increase the accuracy of tracking renewables, two measurement challenges must be met: (1) monitoring the rapid development of geographically distributed energy sources, such as off-grid and micro-grid solar photovoltaic and wind; and (2) enhancing countries' capacity to measure traditional uses of biomass (solid biofuels) by households. Biomass is the largest source of renewable (if not clean) energy in low- and middle-income countries.

44 Here, "clean" refers to the combinations of fuels and technologies that meet the emissions targets set out in the WHO guidelines for indoor air quality and household fuel combustion (WHO 2014).

45 https://www.who.int/tools/clean-household-energy-solutions-toolkit.

Looking ahead, another measurement challenge looms large with the increasing development of synthetic and hydrogen-based fuels, the renewability of which may be hard to ascertain depending on the mix of energy sources used to produce them. It is also a methodological challenge, since harmonized criteria have not yet been developed to determine the renewable portion of such fuels in individual cases.

National-level household and industry surveys could do more to make renewable energy statistics more reliable. For example, a broader range of questions on biomass use in households and organizations could help determine to what extent it can be considered a sustainable energy source. Traditional fuelwood harvesting is associated with deforestation and habitat loss, yet fuelwood is still assumed to be a renewable energy source for lack of an agreed definition of sustainable harvesting and accurate measures of fuelwood harvests. Survey-based data could help better quantify the "renewable" fraction of biomass use and perhaps prompt significant revisions of earlier estimates. Remote sensing could also help measure fuelwood harvesting, but the resulting data would need to be carefully calibrated against well-run household surveys.

In this context, the IEA's Designing an Energy Statistics Roadmap (IEA 2024) offers a structured framework for national institutions to assess existing energy information systems and plan their development, thus helping to strengthen data collection, integration, and dissemination.

Energy efficiency

Energy intensity, defined as the ratio of total energy supply (TES) to economic output, is used to track progress toward SDG target 7.3—doubling the global rate of improvement in energy efficiency (UN 2018).[46] Measuring the total energy supply requires credible information on, among other things, primary energy production across all sources, as well as trade in all energy products. TES is calculated from basic energy statistics compiled by the IEA and UNSD, primarily through questionnaires from national administrations. This information includes commercially traded energy sources and is of fairly good quality in most countries. [47]

To improve the granularity of energy intensity tracking, it is important to analyze the drivers of demand across sectors, such as industry, transport, and buildings (both residential and commercial/industrial). Collecting demand-side data is much more complex, time consuming, and expensive than collecting supply-side data, because end users are diverse. Consumer surveys can complement data-collection efforts when energy suppliers have limited or no information on how much energy is consumed by different types of users.

Analyzing energy efficiency within sectors requires countries to monitor energy intensities at the end-use level. Efficiency indicators might include energy expended per passenger-kilometer by vehicle type for passenger transport and by tonne-kilometer for freight transport; energy for space heating and cooling by unit of area for buildings; and, for industry, energy used in the physical production of each unit of a particular good. More details on a methodological framework for energy efficiency indicators, as well as country experiences, can be found in IEA's Energy Efficiency Indicators: Fundamentals on Statistics (2014).

Besides finer disaggregation of data, better energy efficiency indicators will depend on greater cross-organizational coordination in activities beyond the energy sector, drawing on building records, vehicle registration, and industrial reports, among other things. Many countries have already begun to collect end-use data and to compile energy efficiency indicators to support their policy making and planning.[48]

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46 In UN 2018, this indicator is called "Overall productivity," as taken from the 2005 publication Energy Indicators for Sustainable Development: Guidelines and Methodologies (IAEA and others 2005). Productivity puts the focus on the economic output, whereas intensity brings the energy aspect into focus.

47 Data collected by various agencies in response to legislation or regulation (not necessarily for statistical purposes) may be used to compile energy statistics after verifying their quality and addressing limitations related to their purpose.

48 An example, besides the IEA energy efficiency indicators themselves (IEA 2014), is the Odyssée database for Europe (https://www.indicators.odyssee-mure.eu/).

International financial flows to developing countries in support of clean and renewable energy

Indicator 7.a.1 measures international public financial flows to developing countries in support of clean energy research and development, as well as renewable energy production (including in hybrid systems). The measurement utilizes data from IRENA and the OECD.

Good measurement of international public investment flows has four components: (1) tracking financial flows; (2) standardizing commitment details; (3) centralizing data collection; and (4) presenting flows in a consistent way.

Tracking public financial flows requires an understanding of how recipients intend to spend aid and other investments for end-use projects and programs. Recipients are defined as end-use organizations and projects run by public investors. The amount of private finance leveraged through public funds, which the OECD already monitors in its data on mobilization of private finance, adds valuable supplementary information to analyses of public flows. International financial flows are typically disbursed in multiple phases and through multiple stakeholders (local governments, ventures, or funds). Some commitments may also be canceled or modified after data have been gathered. Thus, where reporting institutions revise financial investment figures, historical investment information covering multiple years should be considered to reveal changes in amounts.

Commitment details can and should be standardized by sharing best practices among public investors and donors, refining reporting directives, and encouraging public investors and donors. At present, energy-related details are often excluded while collecting investment data. The standardization process can make data more accurate and granular. For example, most data on public investments in clean energy and renewables continue to be collected in a decentralized manner, adversely affecting consistency. For comparability across public donors, data collection must be centralized, using online data-entry portals and questionnaires prefilled to the extent possible with data from other agencies. The Creditor Reporting System database of the OECD's Development Assistance Committee is exemplary in this regard—and also allows self-reporting by donors.

Exchange rates and inflation must be taken into account when comparing international commitments across countries. The OECD methodology is used in this report to deflate international flows by adjusting for inflation from the year the flows occurred to a baseline year (2023) and by converting local currency values to US dollars using exchange rates from the baseline year.

Installed renewable electricity: Generating capacity in developing and developed countries

Indicator 7.b.1 tracks the installed capacity of power plants generating electricity from renewable sources (expressed in watts per capita). The 36 energy types disaggregated by IRENA as renewable fall into six broad categories: hydropower, marine energy (ocean, tidal, and wave), wind energy, solar energy (photovoltaic and thermal), bioenergy, and geothermal energy.

Capacity is defined as the year-end net maximum installed electrical capacity. Assessing a country's electricity production capacity is a valuable way to track progress toward target 7.b because it is an actual reflection of efforts. For many nations, the focus on increasing electricity production, especially from renewable sources, is a crucial step in their journey toward sustainable and modernized services.

Data on renewable energy capacity are collected in the course of IRENA's annual questionnaire cycle. Countries receive questionnaires at the beginning of each year and report renewable energy data for the previous two years. To minimize the reporting burden, the questionnaires for some countries are prefilled with data collected by other agencies (Eurostat, for example). The questionnaires are then sent to relevant national agencies so they can provide any additional details requested by IRENA. Validated data, by country, are published each year in late June in IRENA's Renewable Energy Statistics. Population data are extracted from the UN Population Division's annual World Population Prospects, which represent a country's population at midyear (July 1).

A measure of indicator 7.b.1 in watts per capita is computed by dividing a country's year-end renewable-electricity-generating capacity by its population in that year. Capacity data are drawn from this computation, and they account for the immense variations in needs between countries. Population data are used instead of gross domestic product, since population is the most basic indicator of the demand for modern and sustainable energy services in a country.

Importantly, the indicator's focus on electricity capacity does not capture trends in the modernization of technologies in important, energy-intense sectors such as heat production and transport. Overall, electricity accounts for only about a quarter of the energy used globally, and the share is even smaller in most developing countries. With electricity access continuing to increase, however, the focus on electricity capacity will grow in relevance.

Conclusion

Since the first effort back in 2013, improvements in reporting, advances in countries' statistical capacities, and enhanced models have raised the quality, reliability, and consistency of data on progress toward the SDG 7 targets. This progress should be seen as a reminder of the value of pursuing a common framework using standardized data collection and estimation methodologies. But such a common framework is possible only through cooperation among national statistical offices and other national agencies compiling energy information, and among those offices and relevant international bodies. International cooperation in the compilation of global databases will harmonize estimates across regions and countries and raise awareness of the need for good data.

As the custodian agencies work together to track SDG 7 at a global level, they have found ways to refine their collaboration and strengthen their support to countries. For example, the custodian agencies responsible for this report host webinars for statistical agencies and energy authorities; publish statistical guidance and reports on data collection; and regularly consult with national statistical offices and other national agencies on the estimates they provide. Continuing efforts by the World Bank, WHO, and other custodians to mainstream energy access questions into national household surveys are an important form of support to those offices. For example, the IEA and UNSD have a long history of working together to build national reporting capacity. The two agencies jointly organize workshops with the United Nations Framework Convention on Climate Change to help countries improve institutional coordination and compilation of energy balances.

Improving the accuracy of the SDG 7 indicators ultimately depends on collection of accurate national-level data. Building on recent improvements in data collection for the SDGs, national statistical capacities must continue to grow in strength. National and international institutions interested in policy success should increase resources for this purpose.

In closing, the custodian agencies would like to express their appreciation of the work and dedication of the many colleagues who collect national-level data around the world. Without their efforts, no precise estimates could be produced, and no tracking would be possible. Their work underpins the international efforts culminating in this report and ensures that the SDG 7 targets remain in full view.

Annex 1.
Methodological Notes

Chapter 1 • Access to electricity

The World Bank's Global Electrification Database

The World Bank's Global Electrification Database compiles data from nationally representative household surveys and censuses for the period 1990–2024. It incorporates data from the Socio-Economic Database for Latin America and the Caribbean, the Middle East and North Africa Poverty Database, and the Europe and Central Asia Poverty Database—all of which are based on similar surveys. The database relies on the Bank's Multi-Tier Framework (MTF), which classifies access from Tier 0 (no access) to Tier 5 (the highest level of access). At the time of this analysis, the database contained 1,473 surveys from 149 countries over 1990–2024.

A multilevel, nonparametric model extrapolates data for missing years (described below). The modeling approach, originally developed by the World Health Organization (WHO) to estimate clean fuel usage, was adapted to project electricity access and fill in missing data points.[49] Where data were available, access estimates were weighted by population. The multilevel, nonparametric model considers the hierarchical structure of data (at country and regional levels), using the regional classification of the United Nations.

The model was applied in all countries for which at least one data point was available. To use as much real data as possible, results based on survey data were reported in their original form for all the years for which they were available. The statistical model was used to fill in data for years in which data were otherwise missing and to conduct global and regional analyses. When survey data were not present for a given year, the model drew on regional trends. The difference between real data points and estimated values is clearly identified in the database. High-income countries are assumed to have 100 percent electrification rates for the years they belong to that income category.

For 1990–2010, the statistical model relied on insufficient data points or outdated household surveys. To avoid electrification trends in this period overshadowing efforts made since 2010, the model was run twice: once with survey data and assumptions for 1990–2024 (for model estimates for 1990–2024) and once with survey data and assumptions for 2010–24 (for model estimates for 2010–24). The first run extrapolated electrification trends for 1990–2024, given the available data points. The second run considered only real data collected since 2010 and estimated the historical evolution over the most recent years. Outputs from the two model runs were then combined to generate a final value for access to electricity. If survey data were available, the original observation remained in the final database. Otherwise, the larger value generated by the model runs was chosen as the final data point.

Under the adapted WHO methodology, regional trends affect the estimation of yearly values for countries missing data points for certain years. Depending on the regional trend and the years elapsed since the last year in which data were available for a given country, the model can interpolate unrealistic access rates of 100 percent. To avoid reporting unrealistic rates, the country's latest survey data are extended. In this version of the report, this was done for Brazil, Bolivia, Jamaica, and the Lao People's Democratic Republic.

49 The model draws on the modeling of solid fuel use for household cooking presented in Bonjour and others (2013).

The Multi-Tier Framework (MTF)[50] of the Energy Sector Management Assistance Program (ESMAP) complements the Global Electrification Database's information through household surveys, primarily consumer questionnaires, which provide insights into the quality and reliability of energy services and address affordability issues. To date, the MTF has conducted such surveys in more than 29 countries, assessing electricity access across five tiers of service. ESMAP is looking to focus and expedite the use of such multisectoral surveys in countries where access gaps are widest.

Night-Time Light (NTL) Satellite Imagery for Electrification Estimation further validates and corrects survey data. It fills gaps where surveys were conducted several years ago or were disrupted—for example, during the COVID-19 pandemic or in situations involving fragility, conflict, and violence (FCV). NTL satellite imagery measures artificial light emissions from the Earth's surface. It helps track human activities such as urbanization, economic growth, and electrification. Satellites have recorded NTL emissions since 1992, with increasing spatial resolution and precision. Since 2012, the Visible Infrared Imaging Radiometer Suite (VIIRS) has provided global nightly NTL data. NTL imagery complements survey-based approaches with a remote sensing solution, especially for regions where field data are limited. It provides high-resolution estimates of electrification at the village level, helping to track progress over time and identify access gaps. Repeated rounds of cross-checks and validation further enhance estimates and make data more reliable for policy makers, researchers, and stakeholders through the report series.

Comparison between demand- and supply-side data

While the Global Electrification Database collects data mainly from household surveys and censuses, the International Energy Agency's (IEA's) Energy Access Database draws from government reports on household electrification (usually based on connections reported by utilities). The IEA considers a household to have access if it receives enough electricity to power a basic bundle of energy services.

The two approaches at times yield different estimates. Estimates based on household surveys are moderately higher than estimates based on energy sector data because they capture a wider range of phenomena, including off-grid access, "informal" connections (connections not made by or known to the utility), and self-supply systems.

A comparison of the two datasets in the previous edition of this report (updated in this edition) highlights their respective strengths. Household surveys, typically conducted by national statistical agencies, offer two advantages for measuring electrification. First, thanks to efforts to harmonize questionnaire designs, electrification questions are largely standardized across country surveys. Although not all surveys reveal detailed information on the forms of access, questionnaire designs capture emerging phenomena such as off-grid solar access. Second, survey data convey user-centric perspectives on electrification. They capture all forms of access, painting a more complete picture than is possible using data supplied by service providers. However, a comprehensive and accurate survey-based understanding of electricity access requires greater investment in data collection and capacity building.

Government-reported electrification data, as provided by national ministries of energy, are supply-side data on utility connections. They offer two principal advantages over national surveys. First, administrative data are often available on an annual basis and may therefore be more up to date than surveys, which are conducted every two to three years. (Moreover, since 2010, about 34 percent of countries have published or updated their electricity data at intervals of two to three years, the recommended time frame for global data collection.) Second, administrative data are not subject to the challenges that can arise when conducting field surveys. Household surveys (particularly those implemented in remote and rural areas) may suffer from sampling errors, which can result in the access deficit being underestimated.

50 Information on the Multi-Tier Framework can be found at: https://mtfenergyaccess.esmap.org/.

Measuring access to off-grid solar-based electricity

The rates and levels of access to off-grid solar energy presented in this chapter are based on data shared by affiliates in the biannual data collection undertaken by GOGLA, Lighting Global, and Efficiency for Access.

Off-grid solar lighting products eligible for inclusion include a solar panel, a battery, and at least one light point. Every six months, affiliate companies complete a questionnaire on their product sales by country, system type/size, and business model; they also share product specifications and capacities. Although companies are ultimately responsible for the accuracy of the self-reported data they submit, an independent consultancy (Berenschot), as well as GOGLA, Lighting Global, and the Energy Savings Trust, check the data for quality.

Both off-grid solar product manufacturers and distributors report sales, but public reports cover only manufacturers' sales—which include business-to-business transactions (for example, sales to distributors, governments, and nongovernmental organizations) as well as direct sales to customers—so that sales reported by both manufacturers and distributors are not double counted. The most recent *Market Trends Report* (Lighting Global/ESMAP and others 2022) estimates that the sales of GOGLA affiliate companies represent 28 percent of the total off-grid solar market, although estimates of percentages by country, as well as by system size and business model, vary significantly.

In addition to using standardized impact metrics[51] created by the GOGLA Impact Working Group, additional steps are taken to calculate energy access tiers:

Tier 1. A "SEforALL factor" is applied to sales numbers.[52] This factor estimates the service-level impact of smaller technologies. This tool reviews the system size and capacity of each product and estimates whether it has helped unlock partial or full Tier 1 access. It then calculates the number of people who have achieved either partial or full Tier 1 access.

Tier 2. Products with a capacity of more than 50 watts peak, or more than 20 watts peak and packaged with a television, are deemed to provide Tier 2 energy access. This approach aligns product specifications or the energy service with the requirements for Tier 2 access. Products that have enabled a household to achieve Tier 2 access are not included in the final Tier 1 estimates.

Measuring access to mini-grid–based electricity

The International Renewable Energy Agency (IRENA) collects off-grid capacity and generation data from a variety of sources, including its own questionnaires; national and international databases; and unofficial sources such as project reports, news articles, academic studies, and websites. For some countries, IRENA also estimates off-grid solar photovoltaic capacity based on solar panel import statistics obtained from the United Nations' COMTRADE Database.

IRENA's 2025 decentralised energy database contains global data on off-grid renewable energy for Africa, Asia, South America, Central America and the Caribbean, and Oceania. It covers off-grid renewable power capacity (in megawatts), biogas production (in cubic meters), and energy access (in numbers of inhabitants). This chapter uses energy access data estimated for people with access to hydropower, solar mini-grids (Tiers 1 and 2), and biogas.

IRENA publishes off-grid statistics by the end of December each year. Details on the methodology used in this report are set forth in IRENA (2018).

Data from censuses for more than 200 countries, conducted at varying frequencies and over different periods, are used to track electricity access. Where anomalies are identified through internal validation, analysts conduct internal

51 The Global Impact Metrics are available at https://gogla.org/reports/standardised-impact-metrics-for-the-off-grid-solar-energy-sector-v4/.

52 Where a product provides partial Tier 1 access, a methodology devised by Sustainable Energy for All (SEforALL) can be applied to calculate how several products can be combined to reach Tier 1 equivalency. The methodology was designed to account for "energy stacking" and thus prevent Tier 1 access from being underrepresented in calculations.

reviews, household survey–based validation, and satellite imagery checks. Where this occurs, corrections are made to access levels, using methodologies duly approved by technical experts, who are a key part of the guidance for the Tracking Report. While this is a robust approach, it has its challenges and limitations.

Challenges in measuring and reporting global electricity access fall under three broad topics: (1) data consistency, (2) frequency of data collection, and (3) challenges in data collection. Data inconsistencies in reported figures and difficulties in cross-country comparisons arise from diverse definitions of electricity access across countries, variations in survey questions, and different data collection approaches. Data collection frequency is a challenge: only about 34 percent of countries have been updating their electricity survey data within two to three years—the required time frame—since 2010. This implies that extrapolations are required to update overall estimates.

Data collection challenges include sampling errors, especially for household surveys in remote or rural areas hampered by logistical challenges and capacity constraints. As a result, regional disparities cannot be fully captured, and estimates rather than actual survey data are used for areas with weak statistical systems. As private sector investments are leveraged, particularly in off-grid and mini-grid areas, there is a need for the type of information that helps private investors and consumers decide on investments and installations. The binary categorization of "access" or "no access" is increasingly seen as insufficient. Multisectoral approaches are needed to assess affordability based on income levels, while more information on the geography and composition of underserved areas with a high density of unelectrified households would help decide where and how to focus investments to narrow the access gap.

Frequency and accuracy of data collection are further limitations. More work is needed to make household surveys nimbler, faster, and backed by greater analytical strength. There is also a need for harmonized standards, greater collaboration, and the adoption of new technologies such as satellite imagery and artificial intelligence to make data more accurate and more comparable in measuring global electricity access. However, even state-of-the-art technologies have limitations that need to be carefully considered. Two examples are given below:

Country-specific variations. Light emissions do not translate directly into access rates; for the same electrified population, different countries emit different light levels. Factors such as outdoor activity, energy-saving practices, and infrastructure differences influence results.

Limited multidimensional insight. Electrification is more than just light emissions. Quality household surveys with a multisectoral approach are a must for assessing consumer requirements, affordability thresholds, and the reliability and quality of available options.

Chapter 2 • Access to clean fuels and technologies for cooking

Data sources

The WHO Household Energy Database contains data from nationally representative household surveys (WHO 2026). It is regularly updated, draws on multiple sources (table A1.1), and serves as the basis for all modeling efforts in this report. The database contains around 1,700 surveys conducted in 171 countries (including high-income countries) between 1960 and 2024. A quarter of the surveys cover the years 2013–18; 370 new surveys cover 2016–24.

Population data are from the latest revision of the United Nations (2024) World Urbanization Prospects (2025).

Table A1.1 • Overview of data sources for clean fuels and technology

NAME	ENTITY	NUMBER OF COUNTRIES	QUESTION
Census	National statistical agencies	109	What is the main source of cooking fuel in your household?
Demographic and Health Survey (DHS)	Funded by the United States Agency for International Development (USAID); implemented by ICF International	82	What type of fuel does your household mainly use for cooking?
Living Standards Measurement Survey (LSMS), income expenditure surveys, and other national surveys	National statistical agencies, supported by the World Bank	26	Which is the main source of energy for cooking?
Multiple Indicator Cluster Surveys (MICS)	United Nations Children's Fund (UNICEF)	90	What type of fuel does your household mainly use for cooking?
Study on Global AGEing and Adult Health (SAGE)	World Health Organization (WHO)	6	NA
World Health Survey	WHO	50	NA
National surveys		117	NA
Other		84	NA

Model

Given household surveys are conducted irregularly and reported heterogeneously, the WHO Global Household Energy Model (GHEM), developed in collaboration with the University of Glasgow, is used to estimate trends in household use of six fuel types:

- Unprocessed biomass (for example, wood)
- Charcoal
- Coal
- Kerosene
- Gaseous fuels (for example, liquefied petroleum gas)
- Electricity

Trends in the proportion of the population using each fuel type are estimated using a Bayesian hierarchical model—based on country survey data and with urban and rural disaggregation. Estimates for total polluting fuel use (unprocessed biomass, charcoal, coal, and kerosene) and total clean fuel use (gaseous fuels, electricity, and an aggregation of other clean fuels such as alcohol) are produced by aggregating estimates for relevant fuel types. Estimates produced by the model automatically ensure that total fuel use equals 100 percent.

The model incorporates gross domestic product (GDP) per capita (purchasing power parity [PPP], constant 2021 international dollars), along with the projected use of different fuels over time to improve predictions of fuel consumption by country. The GDP effects offer an informative baseline for estimating fuel use in countries and territories that currently lack survey data meeting the selection criteria, such as Bulgaria, Lebanon, Libya, and many high-income countries. The model also includes country-level effects and smooth time trends to 131 bridge the gap between the GDP-informed baseline and the trends observed in available survey data.

The GHEM is implemented using the R programming language and the NIMBLE software package for Bayesian modeling with Markov chain Monte Carlo (MCMC). Summaries can be obtained to provide both point estimates (for example, means) and measures of uncertainty (for example, 95 percent credible and 95 percent prediction intervals). The GHEM is applied to the WHO Household Energy Database to produce a comprehensive set of country estimates for the use of four polluting cooking fuels and two clean cooking fuels for each year from 1990 to 2024, together with associated measures of uncertainty. Further details on the modeling methodology and validation can be found in Stoner and others (2020), and a more detailed analysis of individual fuel use can be found in Stoner and others (2021).

The analysis included only surveys in which less than 15 percent of the population reported “missing,” “no cooking,” and “other fuels.” Surveys were also discarded if the sum of all mutually exclusive categories reported was not within 98–102 percent. Fuel use values were uniformly scaled (divided) by the sum of all mutually exclusive categories, excluding “missing,” “no cooking,” and “other fuels.”

Estimates of overall clean fuel use were reported for 197 countries. Estimates of clean cooking access are updated annually for the entire time series (for example, 2000–24). Consequently, previous annual estimates may be revised as new data points influence the overall trend for each country.

Uncertainty intervals

Many of the point estimates presented here are accompanied by 95 percent uncertainty intervals, which imply a 95 percent chance that the true value lies within the given range. Small annual changes in the point estimates may reflect statistical noise arising from either the modeling process or survey variability, and may, therefore, not reflect a real variation in the numbers, which vary between years depending on the fuels. The uncertainty intervals should, therefore, be considered when assessing changes in the rate of access to or the use of specific fuels between years.

Moreover, for some countries, the unavailability of recent survey data (for example, for the past 10 years) naturally leads to very wide uncertainty intervals associated with estimates for 2024 and preceding years. For countries with very wide uncertainty intervals, point estimates should be treated with some caution.

Global and regional aggregations

Population data from the World Urbanization Prospects (2025) were used to derive the population-weighted regional and global aggregates (UNDESA 2025).

The aggregation methods ensure that uncertainty in the percentage of people and the absolute number of people using different fuels for cooking in individual countries propagate into the uncertainty intervals accompanying global and regional estimates.

Annualized growth rates

The annualized increase in the access rate is calculated as the difference between the access rate in year 2 and that in year 1, divided by the number of years to annualize the value:

(Access Rate Year 2–Access Rate Year 1) / (Year 2–Year 1)

This approach accounts for population growth by using the final national access rate.

Projections

Projected access rates, access deficits, and fuel use can be estimated using the GHEM. However, uncertainty increases with longer-term estimates, as country trends may shift depending on the level of instability observed during the data period.

Projections in this chapter are hypothetical scenarios in which no new policies or interventions (positive or otherwise) take place. As such, they are useful as baseline scenarios for comparing the effect of interventions. The scenarios are calculated by extrapolating current trends into the future.

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 estimated consumption of renewables-based electricity and renewables-based heat. 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 transport, industry, and other sectors (equivalent to the difference between total final consumption and nonenergy use). Total final energy consumption excludes energy transformed into other forms (for example, natural gas used to generate electricity), as well as energy used by energy industries.

Traditional uses of biomass. Biomass uses are considered traditional when solid biomass is consumed for energy purposes in the residential sector of countries outside the Organisation for Economic Co-operation and Development (OECD). IEA's statistics classify solid 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 of products. Traditional consumption/use of biomass is considered a "conventional proxy" because it is estimated rather than directly measured, due to limited data on the use of solid biomass in traditional and inefficient cookstoves.

Modern uses of renewable energy consumption. This refers to the difference between total renewable energy consumption and traditional consumption/use of biomass.

Methodology for the indicator

The indicator used in this report to track Sustainable Development Goal (SDG) 7.2 is the share of renewable energy in total final energy consumption. Data from the International Energy Agency's World Energy Balances (IEA 2024a) and the United Nations Statistics Division's Energy Balances 2022 (UNSD 2024) are used to calculate the indicator according to this 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, and HEAT = gross heat production; the subscript RES corresponds to the portion coming from renewable energy sources.

The denominator is the total final energy consumption across all energy products (as defined above). The numerator—final renewable 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. For the calculation at the final energy level, the amount of electricity and heat consumption deemed to come from renewable sources is allocated based on the renewables' share in gross production.

Methodology for additional metrics beyond the main indicator

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

Electricity refers to the total electricity consumed by end users, excluding electricity used for transport. Electricity used to produce district heat is also excluded, because it is not part of final consumption. However, electricity used to produce heat in electric boilers and heaters (except where this heat is distributed as district heat) is included, since official data at the final energy service level are unavailable to determine what electricity is used for heat.

Heat refers to the amount of energy consumed for heating in industry and other sectors, as well as other uses not included in electricity and transport, such as fuels for pumping water. Because official data at the final energy service level are unavailable, electricity-based heat in electric boilers and heaters—the final consumers—is not included in this aggregation.

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, heat as an "end use," 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 for transport. The majority is consumed in rail and road transport, followed by pipeline transport. The amount of renewables-based 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 total electricity used nationally in transport.

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 renewable electricity–generating capacity of power plants by the country's midyear population. Data from IRENA are used to calculate this indicator.

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

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).

Chapter 4 • Energy efficiency

Total energy supply (TES) in megajoules (MJ)

Total energy supply represents the amount of energy available in the national territory during the reference period. It is calculated as follows: Total energy supply = Primary energy production + Import of primary and secondary energy – Export of primary and secondary energy – International (aviation and marine) bunkers – Stock changes. This definition is consistent with International Recommendations for Energy Statistics (UN 2024).

Gross domestic product (GDP) in 2021 US dollars (USD) at purchasing power parity (PPP)

This is the sum of the gross value-added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the products' value. It is calculated without making deductions for the depreciation of fabricated assets or for the depletion and degradation of natural resources. GDP is measured in constant 2021 USD PPP. The data source is IMF's World Economic Outlook (https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases/), complemented by World Bank's World Development Indicators (https://databank.worldbank.org/source/world-development-indicators) and CEPII's CHELEM database (http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=17).

Primary energy intensity in MJ/2021 USD PPP

$$Primary\ energy\ intensity = \frac{TES\ (MJ)}{GDP\ (USD\ 2021\ PPP)}$$

The TES–GDP ratio is measured in MJ per 2021 USD PPP. Energy intensity (EI) indicates how much energy is used to produce one unit of economic output. A lower ratio indicates that less energy is used to produce one unit of economic output.

EI is an indicator of an economy's energy efficiency, since an economy can only be meaningfully aggregated in monetary terms, and changes over time can provide insights into progress in efficiency. However, it is an imperfect indicator, since changes are affected by other factors in addition to energy efficiency, especially changes in the structure of economic activity.

Average annual rate of improvement in energy intensity (%)

This is calculated using the compound annual growth rate (CAGR):

$$CAGR = \left(\frac{EI_{t2}}{EI_{t1}}\right)^{\frac{1}{(t2-t1)}} - 1\ (\%)$$

Where:

EI_{t2} is energy intensity in year t2

EI_{t1} is energy intensity in year t1

Negative values represent decreases (or improvements) in energy intensity (less energy is used to produce one unit of economic output or per unit of activity), whereas positive numbers indicate increases in energy intensity (more energy is used to produce one unit of economic output or per unit of activity).

Total final energy consumption (TFEC) in MJ

The sum of the energy consumption of the different end-use sectors, excluding nonenergy uses of fuels, TFEC is broken down into final energy demand in industry, transport, residential, services, agriculture, and other sectors. It excludes international marine and aviation bunkers, except at the global level, where it is included in the transport sector (IEA 2024a; UNSD 2024).

Value-added in 2023 USD PPP

Value-added is the net output of a sector after adding all outputs and subtracting intermediate inputs. It is calculated without making deductions for the depreciation of fabricated assets or the depletion and degradation of natural resources. The industrial origin of value-added is determined by the International Standard Industrial Classification, revision 3 (IEA 2024b).

Industrial energy intensity in MJ/2023 USD PPP

$$Industrial\ energy\ intensity = \frac{Industrial\ TFEC\ (MJ)}{Industrial\ value\ added\ (USD\ 2023\ PPP)}$$

Ratio of industry TFEC and industry value-added, measured in MJ per 2023 USD PPP (IEA 2024a, 2024b.

Road passenger transport energy intensity in MJ/passenger-kilometer (km)

$$Passenger\ transport\ energy\ intensity = \frac{Passenger\ transport\ TFEC\ (MJ)}{Passenger\text{-}kilometers}$$

Ratio of final energy consumption for road passenger transport and road passenger transport activity measured in MJ per passenger-km (IEA 2024c).

Freight transport (heavy trucks) energy intensity in MJ/tonne-km

$$Freight\ transport\ energy\ intensity = \frac{Freight\ transport\ TFEC\ (MJ)}{Tonne\text{-}kilometers}$$

Ratio of freight transport (heavy trucks) final energy consumption and activity measured in MJ per tonne-km (IEA 2024c).

Buildings energy intensity in MJ/unit of floor area

$$Buildings\ energy\ intensity = \frac{Buildings\ TFEC\ (MJ)}{Buildings\ floor\ area\ (m^2)}$$

Ratio of buildings TFEC and square meters of building floor area (IEA 2024c).

Fossil fuel electricity generation efficiency (%)

$$Generation\ efficiency = \frac{Electricity\ output\ from\ coal + oil + natural\ gas}{Electricity\ input\ from\ coal + oil + natural\ gas}\ (\%)$$

Ratio of electricity output from fossil fuel–fired (coal, oil, and natural gas) electricity generation and the fossil fuel–based energy input to electricity generation

Fuel inputs to and electricity output from combined heat and power plants (CHPs) are excluded from this figure (IEA 2024a).

Chapter 5 • International public financial flows to developing countries in support of clean energy

Data sources

For SDG indicator 7.a.1, a combined subset from two databases tracks international public financial flows: the Creditor Reporting System (CRS) of the OECD's Development Assistance Committee (DAC) and IRENA's Renewable Energy Public Finance Database. The CRS is a quarterly updated database containing various financial flows provided by investors to countries for multiple purposes (OECD 2025a). Progress in this indicator is tracked based on only a subset of the commitments in this database. To obtain that subset, we downloaded bulk data from the CRS from 2000 onward; consolidated the files; removed unused columns, noncommitments, and flows from private sector donors (flow code 30); and filtered the data to include clean energy investments (purpose codes 23210–23290, 23410, 23630–23631, and 23110).

IRENA's Renewable Energy Public Finance Database covers commitments beyond those included in the CRS, especially by non-DAC donors that do not report their commitments through the CRS. These flows represent approximately 40 percent of the financial value of the commitments in both databases combined. We categorized each commitment by type of energy, financial instrument, and other metadata that matches the CRS. Reporting precedes data compilation in the CRS by a few months. After the CRS data were released, we reviewed individual commitments across the datasets to remove duplicates from the IRENA data. We compiled both sources and used the combined dataset for SDG 7.a.1.

Deflating nominal US dollar prices to constant prices and exchange rates

Commitments are measured in millions of US dollars at constant prices, using an exchange rate for a base year. The base year is updated annually; it generally reflects a three-year lag in the publication cycle and a one-year lag in the latest reporting data (that is, the 2026 cycle will report commitments up to 2024 at 2023 constant prices).

International financial flows expressed in nominal terms are deflated to remove the effects of inflation and exchange rate changes so that all flows, from all donors and in all years, are expressed as the purchasing power of a US dollar in a recent year (2023 in this report). For this report, a combination of the OECD deflators for DAC donors and deflators calculated by IRENA for other international donors not included in the CRS database is used.[53] The following formula converts the nominal investment amounts in current US dollars to US dollars at constant prices and constant exchange rates:

$$USD_{constant,n,m} = \frac{USD_{current,n}}{DAC\ Deflator_{,n,m}}$$

where *n* is the current year (nominal) and m the constant year (real).

Regional aggregations and classifications

Regional aggregations start with the microdata of commitments. Each commitment is assigned to either a specific country or to an unspecified country, or to a mix of countries. Where commitments could not be categorized under specific countries or territories following the United Nations' M49 classification, they were classified as "residual/ unallocated ODA [official development assistance]," followed by the region name. Where the region was unclear, the commitment was classified under "unspecified countries." Residual flows to specific regions are aggregated under the geographical region aggregates. Residual flows to unspecified countries are aggregated directly under the totals, rather than under any region. International flows for which no information on the region or country is available, are classified as multilateral and excluded from the indicator, since some of this finance may be directed to countries outside the scope of the SDG 7.a.1 indicator.

We continue aggregating financial flows based on the SDG regions and subregions defined by the United Nations and published as the M49 classifications. For other types of classifications, we keep a modified list of countries from "developing regions" to determine which countries are to be included in the aggregation and data dissemination. Chapter 7 discusses these classifications.

Measuring financial flows through commitments

Financial flows are recorded as donor commitments. A commitment is defined as a firm obligation, expressed in writing and backed by the necessary funds. Bilateral commitments are recorded as the full number of expected transfers for the year in which commitments are announced, irrespective of the time required for disbursements, which may occur over weeks, months, or years.

Tracking of financial commitments can yield quite different results than tracking disbursements. Disbursement information would portray the actual yearly renewable energy financial flows more accurately but disbursement data are often limited or not available. On the other hand, a more comprehensive and granular analysis of financial flows is possible through tracking commitments, which also ensures methodological consistency across data sources. It may, however, produce large annual fluctuations in financial flows when large projects are approved. In addition, financial

53 The OECD publishes DAC deflators for each donor. For more information, see https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/informationnoteonthedacdeflators.html. IRENA sometimes tracks flows from donors that are not identified in the DAC list and that do not have an allocated DAC deflator. The agency follows the same methodology as the OECD to calculate country-specific DAC deflators.

commitments may not always translate into disbursements, as contracts may be voided, canceled, or altered. Any changes must be reflected in the annual values.

Financial instruments

The financial instruments used by public financial institutions were categorized based on OECD's list of financial types and IRENA's classifications for concessional loans and credit lines (table A1.2). This taxonomy excludes debt relief mechanisms. Some of these instruments have yet to be used in connection with commitments in the years covered by this chapter.

Table A1.2 • Description of instruments used for international public financial flows

Financial instrument	Description
Debt	
Standard loan	Legal debt obligations assumed by the recipient, including transfers in cash or in kind (creditor acknowledges the nontradability of obligations should any claim arise from nonpayment). As payment obligations on a standard loan are senior obligations (loans entitle creditors to receive payments against their claims before anyone else), they are referred to as senior loans. These loans have better lending terms than those provided by private financial institutions, including longer payment terms, lower interest rates, and grant elements. They are not necessarily market-rate loans. Where no concessional information is available, commitments are categorized as loans, not concessional loans.
Concessional loan	Loans that meet official development assistance criteria of at least a 45 percent grant element for least-developed countries, landlocked developing countries, and small island developing states; 15 percent for lower-middle-income countries; and 10 percent for upper-middle-income countries and multilateral development banks within the Creditor Reporting System database—or when specified as "concessional" by the public donor itself in the International Renewable Energy Agency's Public Investments database. Concessional loans incur external debt from recipients, albeit at a significantly lower interest rate than developed countries could get from commercial banks or private finance institutions.
Bonds	Fixed-interest debt instruments issued by governments, public utilities, banks, or companies that are tradable in financial markets.
Asset-backed securities	Securities whose value and income are backed by a pool of underlying assets.
Reimbursable grants	Contributions provided to a recipient institution for investment purposes with the expectation of long-term reimbursement under the conditions specified in the financing agreement. The provider assumes the risk of total or partial failure of the investment; it can also decide when to reclaim its investment.
Other debt securities	Financial instruments that represent a debt obligation but are neither standard loans, nor concessional loans, bonds, or asset-backed securities. They can be issued by various entities, including governments, corporations, or financial institutions. Examples include promissory notes, commercial paper, and medium-term notes. These securities typically have varying maturities, interest rates, and risk profiles, and may be traded in secondary markets, providing liquidity to investors. They serve as an alternative means of raising capital or financing projects, offering issuers and investors additional options for diversifying their portfolios and managing risk.
Grants	
Standard grant	Transfers in cash or in kind that create no legal debt for the recipient.
Interest subsidy	Payment to soften the terms of private export credits, loans, or credits by the banking sector.
Capital subscription on deposit basis	Payments to multilateral agencies in the form of notes and similar instruments, unconditionally cashable on sight by the recipient institutions. The deposit basis refers to the accounting of the capital once it is deposited in the multilateral agencies' funds.
Capital subscription on encashment basis	Payments to multilateral agencies in the form of notes and similar instruments, unconditionally cashable on sight by the recipient institutions. The encashment basis refers to the accounting of the capital once it is accessed (cashed) by the multilateral agencies from its funds.

Financial instrument	Description
Mezzanine finance	
Subordinated loan	A loan that, in the event of default, will be repaid only after all senior obligations have been satisfied. In return for this increased risk, mezzanine debtholders receive a higher return for their investment.
Preferred equity	Equity that, in the event of default, will be repaid only after all senior obligations and subordinated loans have been satisfied but before common equity holders are paid. It is a more expensive source of finance than senior debt, but less expensive than equity.
Other hybrid instruments	Such instruments include convertible debt or equity.
Equity	
Common equity	Share of ownership in a corporation that gives the owner claims on the residual value of the corporation after the corporation meets creditors' claims.
Shares in collective investment vehicles	Collective undertakings through which investors pool funds for investment in financial or nonfinancial assets. These vehicles issue shares (for corporate structures) or units (for trust structures).
Reinvested earnings	Reinvested earnings are applicable to only foreign direct investment (FDI). Reinvested earnings on FDI consist of the retained earnings of an FDI enterprise, treated as if they were distributed and remitted to foreign direct investors (in proportion to their ownership of the enterprise's equity) and then reinvested in the enterprise.
Guarantees	
Guarantees/ insurance	Promise of indemnification up to a specified amount in the case of default or nonperformance of an asset (such as a failure to meet loan repayments or to redeem bonds, or expropriation of an equity stake). Guarantees typically cover political and commercial risks (credit, regulatory/contractual) that investors are unwilling or unable to bear.
Credit lines	Arrangements between a bank and a borrower establishing a maximum loan balance that the bank will permit the client to maintain. A credit line guarantees that funds will be available, but no financial assets exist until funds are advanced.

Source: IRENA and OECD 2024.

Changes to data

Several revisions were made to the combined public investments database (IRENA and OECD 2025). Some commitments were cancelled, some were reclassified to different years, and some recipient countries were removed from the dataset. This data cycle also incorporates flows from two additional purpose codes/categories in the OECD DAC CRS database, and the methodology has been updated accordingly. These categories are 23630 (electric power transmission and distribution [centralized grids]) and 23110 (energy policy and administrative management), which cover additional clean energy public flows related to technical advisory activities and energy infrastructure commitments (figure A1.1).

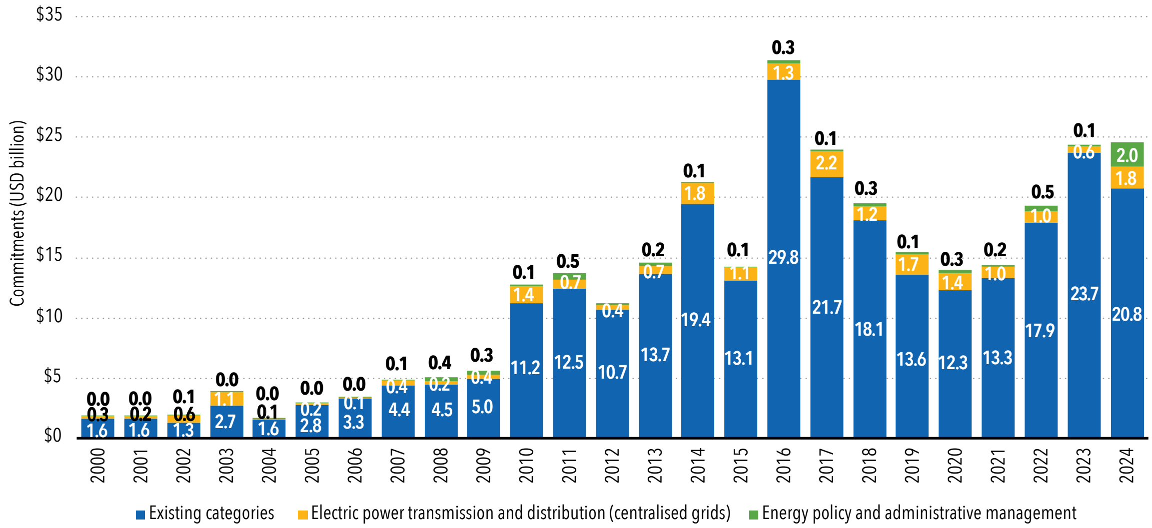
These changes ensure that the data reported under SDG 7.a.1 are as thorough and accurate as possible. Consequently, the historical dataset was revised upward, as outlined in table A1.3, and all figures were updated to reflect 2023 prices and exchange rates (table A1.3). The next paragraph explains how the overall historical trend was affected by this change.

Table A1.3 • Revisions to public flows, 2000–24

Year	Before revision (2022 USD millions)	After revision (2023 USD millions)	Difference (2023 USD millions)
2000	1,447	1,900	453
2001	1,610	1,872	262
2002	1,169	1,958	790
2003	2,787	3,877	1,091
2004	1,573	1,690	117
2005	2,629	2,956	327
2006	3,122	3,474	352
2007	4,336	4,893	557
2008	3,886	5,109	1,223
2009	4,739	5,608	869
2010	10,964	12,781	1,817
2011	12,489	13,693	1,205
2012	10,316	11,208	893
2013	13,190	14,564	1,374
2014	18,956	21,285	2,330
2015	12,143	14,261	2,118
2016	28,427	31,414	2,987
2017	22,320	23,962	1,642
2018	17,483	19,537	2,054
2019	12,353	15,450	3,097
2020	12,053	13,990	1,937
2021	13,159	14,427	1,269
2022	17,014	19,344	2,331
2023	21,570	24,380	2,811
Total	**249,733**	**283,636**	**33,904**

As shown in figure A1.1, adding the extra categories did not significantly change the overall historical trend. The 2016 peak in cumulative public flows along with the trends before and after COVID-19, remain largely unchanged, with a slight upward adjustment of about USD 0.3 million to USD 2.3 million over the respective year ranges. This increase is mainly attributable to flows for electric power transmission and distribution for centralized grid purposes.

Figure A1.1 • International public financial flows for renewables, by purpose categories, 2000–24



The exception is 2024, when the added categories raised the total by around USD 3.8 million, driven primarily by flows related to energy policy and administrative management. Without these categories, total flows that year would have fallen rather than risen modestly. As 2024 is the most recent year for which data have been collected, an upward revision in the next edition is likely, as flows initially missing because of reporting delays may be added later.

For example, the 2023 cumulative figure in this edition, based on the existing purpose categories alone, would have been USD 23.7 billion, up from USD 21.6 billion reported in the 2025 edition. This represents an upward revision of about USD 2.1 billion, partly because this edition uses 2023 deflation and exchange rates rather than the 2022 values used in the 2025 edition.

Chapter 6 • Outlook for SDG 7

Investment figures from IEA scenarios are in constant 2021 USD at the market exchange rate. Investment figures from IRENA scenarios are in constant 2015 USD at the market exchange rate.

IEA methodology

The analysis in this chapter is based on results from the Global Energy and Climate Model (GEC Model) and IEA's analysis in the World Energy Outlook (WEO). Detailed documentation of the World Energy Model (WEM) methodology is available at: https://www.iea.org/reports/global-energy-and-climate-model.

The IEA presents two of its models in this report. The Stated Policies Scenario (STEPS) is designed to provide a sense of the prevailing direction of energy system progression, based on a detailed review of the current policy landscape. It provides a more granular, sector-by-sector evaluation of the policies that have been put in place to reach stated goals and other energy-related objectives, taking account not only of existing policies and measures but also those that are under development. Such policies are implemented under this scenario to the extent that they are supported by specific policies, funding, and measures. The scenario also reflects progress with the implementation of corporate sustainability commitments.

The Net Zero Emissions by 2050 Scenario (NZE Scenario) is a normative scenario that shows a pathway for the global energy sector to achieve net zero CO_2 emissions by 2050, with advanced economies reaching net zero emissions in advance of others. This scenario also meets key energy-related SDGs, in particular universal energy access by 2030 and major improvements in air quality. It is consistent with limiting the global temperature rise to 1.5°C (with at least a 50 percent probability), in line with emissions reductions assessed in the Intergovernmental Panel on Climate Change's (IPCC's) Sixth Assessment Report. This scenario is based on the following assumptions:

- Adoption of all available technologies and emission reduction options is dictated by costs, technology maturity, policy preferences, and market and country conditions.
- All countries cooperate toward achieving net-zero emissions worldwide.
- The entire energy sector undergoes an orderly transition that ensures the security of fuel and electricity supplies at all times, minimizes stranded assets where possible, and avoids volatility in energy markets.

Methodology for tracking access to electricity and to clean cooking

The projections presented in the WEO and in this chapter focus on two elements of energy access—household access to electricity and clean cooking facilities—which are measured separately. The IEA maintains databases on the levels of national, urban, and rural electrification rates. For the proportion of the population without access to clean cooking, the main sources are the WHO's Household Energy Database and IEA's Energy Balances. Both databases are regularly updated and form the baseline for the WEO energy access scenarios to 2040.

The projections under the Stated Policies Scenario consider current and planned policies; recent progress; and population growth, economic growth, the urbanization rate, and the availability and prices of different fuels. The Net Zero Emissions by 2050 Scenario identifies least-cost technologies and fuels for universal access to electricity as well as clean cooking. For electricity access, the analysis incorporates a geographic information systems (GIS) model based on open-access geospatial data; technology, energy prices, electricity access rates, and demand projections are obtained from the GEC Model. This analysis was developed in collaboration with the KTH Royal Institute of Technology, Division of Energy Systems Analysis (KTH-dESA), in Stockholm, Sweden. Further details on the IEA methodology for energy access projections can be found in the Global Energy and Climate Model documentation (https://www.iea.org/reports/global-energy-and-climate-model).

Methodology for renewable energy projections

The annual updates to the WEO projections reflect the broadening and strengthening of policies over time, including for renewables. Projections for renewables-based electricity generation are derived in the renewables submodule of the GEC Model, which projects the future deployment of renewables for electricity generation and the required investment. This future deployment relies on an assessment of the potential of and costs for each renewable energy source (bioenergy, hydropower, photovoltaics, concentrated solar power, geothermal electricity, wind, and marine energy) in each of the 27 GEC Model regions. Under all scenarios, IEA modeling incorporates a process of learning by doing that affects costs. The model calculates deployment as well as the resulting annual investment needs for each renewable source in each region by including the financial incentives for the renewables' use and the nonfinancial barriers in each market; technical and social constraints; and the value added by each technology to the system in terms of energy, capacity, and flexibility.

Methodology for energy efficiency projections

The key energy efficiency indicator refers to GDP and total final energy demand. Economic growth assumptions for the short to medium term are based largely on those prepared by the Organisation for Economic Co-operation and Development, the International Monetary Fund, and the World Bank. Over the long term, growth in each GEC Model region is assumed to converge to an annual long-term rate that depends on demographic and productivity trends, macroeconomic conditions, and the pace of technological change.

Total final energy demand is the sum of energy consumption for each end use in each final demand sector. In each subsector or for each end use, at least six types of energy are shown: coal, oil, gas, electricity, heat, and renewables. The main oil products—liquefied petroleum gas, naphtha, gasoline, kerosene, diesel, heavy fuel oil, and ethane—are modeled separately for each final demand sector.

In most of the equations, energy demand is a function of activity variables driven by the following factors:

- **Socioeconomic variables:** GDP and population are important drivers of sectoral activity variables that determine the energy demand for each end use within each sector.
- **End-user prices:** Historical time series data for coal, oil, gas, electricity, heat, and biomass prices within each sector are compiled based on the IEA's Energy Prices and Taxes database and several external sources. End-user prices are then used as an explanatory variable affecting the demand for energy services.
- **Technological parameters:** Include recycling in industry and material efficiency.

All 27 GEC Model regions for energy demand are modeled in considerable sectoral and end-use detail:

- Industry is separated into six subsectors (with the chemicals sector disaggregated into six subcategories).
- Buildings' energy demand is separated into residential and services buildings, which are then separated into six end uses. Within the residential sector, appliances' energy demand is separated into four appliance types.
- Transport demand is separated into nine modes, with considerable detail for road transport.

IRENA methodology

IRENA scenarios

Since 2014, IRENA has produced a series of roadmaps outlining renewables-driven and energy efficiency pathways for deploying low-carbon technologies for a clean and sustainable energy future globally, regionally, and nationally.

The findings in this report are based on IRENA's (2024) flagship publication *World Energy Transitions Outlook: 1.5°C Pathway*. The Planned Energy Scenario (PES) reflects energy system developments based on governments' existing energy plans, targets, and policies as of early 2024. Meanwhile, the 1.5°C Scenario (1.5-S) presents an energy transition pathway supporting the Paris Agreement's goal of limiting global temperature rise to 1.5°C above preindustrial levels.

IRENA's energy scenarios are developed using its Renewable Energy Roadmap (REmap) energy modeling tool. The first step is an extensive process of collecting data on energy balances, energy statistics, policy and regulatory frameworks (by sector), and key activity indicators relevant to the energy system under analysis.

These data serve as input variables for the REmap tool, which translates them into detailed energy and emission flows, generating full energy and emission balances. These outputs undergo consistency checks against national references, thematic studies, and IRENA's internal work. The results are iteratively refined until they align with a scenario's normative objectives and pass quality control. The REmap tool covers the entire energy system—from *final energy consumption* (fuels, electricity, and heat) to *transformation centers* (power and heat plants, hydrogen production, and biofuels) and primary energy supply (raw energy sources). Final energy consumption is further divided into buildings, transport, and industry, with each sector further subdivided into subsectors, technologies, and energy carriers. The model estimates consumption based on activity levels, efficiency rates, and technology shares, enabling scenario adjustments through:

- Activity reduction, including energy conservation and circular economy measures;
- Efficiency improvements, reducing energy consumption per unit of activity; and
- Technology shifts, increasing renewables and electrification.

Once final energy consumption is determined, the analysis examines transformation centers, which convert primary energy (for example, solar, wind, crude oil, and biomass) into final energy (for example, electricity, gasoline, and biodiesel). The transformation centers are modeled based on energy transformation efficiency, linking energy demand to primary supply.

Scenario development

Each analysis begins with deriving the PES, which reflects current national policies and plans. This scenario serves as the foundation for the 1.5-S, which targets net-zero emissions by midcentury. While the 1.5-S considers existing policies, it prioritizes ambitious mitigation measures, including:

- Demand reduction through conservation and efficiency measures;
- Lower energy and emission intensity through technological improvements; and
- Rapid deployment of clean energy through renewables and electrification.

For more information on the scenarios, methodology, and scope of this work, see https://www.irena.org/remap.

IRENA socioeconomic modeling

Since 2016, IRENA has analyzed the socioeconomic implications of transition roadmaps. This analysis uses a macroeconometric model (E3ME)[54] that integrates the energy system and global economies into a single quantitative framework. IRENA's analysis of key drivers and impacts has yielded insights supporting energy transition planning at different geographical scopes.

The socioeconomic analysis sheds light on the trade-offs between economic prosperity and employment; it also examines welfare aspects, including the distributional implications of policy choices. It discusses the socioeconomic differences between transition pathways at different levels of ambition. Policy makers need to be aware of how policy choices will affect people's well-being and overall welfare, and of the potential gaps and hurdles that could affect progress. Results from the analysis of the socioeconomic footprint include GDP (aggregated economic activity), employment (economywide and with a deep-dive into the energy sector), and the IRENA Welfare Index (which has five dimensions relating to the energy transition—economic, social, environmental, distributional, and access—and two indicators per dimension).

WHO projections

The projected access rates, access deficits, and fuel usage presented in chapter 6 are estimated using the WHO GHEM (detailed further in the methodological notes for chapter 2). The uncertainty of these estimates grows with projections further into the future, reflecting potential shifts in country trends based on their volatility during the data period.

The projections in this chapter are based on a hypothetical business-as-usual scenario derived from current trends that assumes no new policies or interventions (either positive or negative) occur. These scenarios therefore serve as useful baselines for evaluating the impact of potential interventions. They are derived by extrapolating current trends into the future.

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54 The E3ME global macroeconometric model (www.e3me.com) is used for the assessment of socioeconomic impacts. Results for REmap roadmaps (for example, energy mixes and the related investments) are used as exogenous inputs for each scenario, as well as climate- and transition-related policies.

Chapter 7 • Regional classifications of countries/territories

This report classifies countries and territories according to the United Nations' SDG classification for regions; the most recent classification for developing countries; and the special groupings for the least-developed countries, landlocked developing countries, and small island developing states (table A1.4). The SDG regional groupings are not the same as the M49 regional grouping of the United Nations, which focuses more closely on geography. The United Nations discontinued its developing countries classification in late 2022. This report will continue to use the most recent UN classification for developing countries to ensure continuity for indicators 7.a.1 and 7.b.1, as well as 12.a.1.

Table A1.4 • Groupings of regions, countries, and territories as used in this report

Category	Countries/territories within the category
Northern America and Europe	Åland Islands, Albania, Andorra, Austria, Belarus, Belgium, Bermuda, Bosnia and Herzegovina, Bulgaria, Canada, Channel Islands, Croatia, Czechia, Denmark, Estonia, Faroe Islands, Finland, France, Germany, Gibraltar, Greece, Greenland, Guernsey, Holy See (the), Hungary, Iceland, Ireland, Isle of Man, Italy, Jersey, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands (Kingdom of the), North Macedonia, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation (the), Saint Pierre and Miquelon, San Marino, Sark, Serbia, Slovakia, Slovenia, Spain, Svalbard and Jan Mayen Islands, Sweden, Switzerland, Ukraine, United Kingdom of Great Britain and Northern Ireland (the), United States of America (the)
Sub-Saharan Africa	Angola, Benin, Botswana, British Indian Ocean Territory, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic (the), Chad, Comoros (the), Congo (the), Côte d'Ivoire, Democratic Republic of the Congo (the), Djibouti, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, French Southern and Antarctic Territories, Gabon, Gambia (the), Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mayotte, Mozambique, Namibia, Niger (the), Nigeria, Réunion, Rwanda, Saint Helena, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Eswatini, Togo, Uganda, United Republic of Tanzania (the), Zambia, Zimbabwe
Latin America and the Caribbean	Anguilla, Antigua and Barbuda, Argentina, Aruba, Bahamas (the), Barbados, Belize, Bolivia (Plurinational State of), Bonaire, Sint Eustatius and Saba, Bouvet Island, Brazil, British Virgin Islands, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Curaçao, Dominica, Dominican Republic (the), Ecuador, El Salvador, Falkland Islands (Malvinas), French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Saint Barthélemy, Saint Kitts and Nevis, Saint Lucia, Saint Martin (French Part), Saint Vincent and the Grenadines, Sint Maarten (Dutch part), South Georgia and the South Sandwich Islands, Suriname, Trinidad and Tobago, Turks and Caicos Islands, United States Virgin Islands, Uruguay, Venezuela (Bolivarian Republic of)
Western Asia and Northern Africa	Algeria, Armenia, Azerbaijan, Bahrain, Cyprus, Egypt, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, State of Palestine (the), Sudan (the), Syrian Arab Republic (the), Tunisia, Türkiye, United Arab Emirates (the), Western Sahara, Yemen
Oceania	American Samoa, Australia, Christmas Island, Cocos (Keeling Islands), Cook Islands (the), Fiji, French Polynesia, Guam, Heard Island and McDonald Islands, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Caledonia, New Zealand, Niue, Norfolk Island, Northern Mariana Islands, Palau, Papua New Guinea, Pitcairn, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, United States minor outlying islands, Vanuatu, Wallis and Futuna Islands
Eastern Asia and South-eastern Asia	Brunei Darussalam, Cambodia, China, China, Hong Kong Special Administrative Region, China, Macao Special Administrative Region, Democratic People's Republic of Korea (the), Indonesia, Japan, Lao People's Democratic Republic (the), Malaysia, Mongolia, Myanmar, Philippines (the), Republic of Korea (the), Singapore, Thailand, Timor-Leste, Viet Nam
Central Asia and Southern Asia	Afghanistan, Bangladesh, Bhutan, India, Iran (Islamic Republic of), Kazakhstan, Kyrgyzstan, Maldives, Nepal, Pakistan, Sri Lanka, Tajikistan, Turkmenistan, Uzbekistan

Category	Countries/territories within the category
Developed countries	Åland Islands, Albania, Andorra, Australia, Austria, Belarus, Belgium, Bermuda, Bosnia and Herzegovina, Bulgaria, Canada, Channel Islands, Christmas Island, Cocos (Keeling) Islands, Croatia, Cyprus, Czechia, Denmark, Estonia, Faroe Islands, Finland, France, Germany, Gibraltar, Greece, Greenland, Guernsey, Heard Island and McDonald Islands, Holy See (the), Hungary, Iceland, Ireland, Isle of Man, Israel, Italy, Japan, Jersey, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands (Kingdom of the), New Zealand, Norfolk Island, North Macedonia, Norway, Poland, Portugal, Republic of Korea (the), Republic of Moldova (the), Romania, Russian Federation (the), Saint Pierre and Miquelon, San Marino, Sark, Serbia, Slovakia, Slovenia, Spain, Svalbard and Jan Mayen Islands, Sweden, Switzerland, Ukraine, United Kingdom of Great Britain and Northern Ireland (the), United States of America (the)
Developing countries	Afghanistan, Algeria, American Samoa, Angola, Anguilla, Antigua and Barbuda, Argentina, Armenia, Aruba, Azerbaijan, Bahamas (the), Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia (Plurinational State of), Bonaire, Sint Eustatius and Saba, Botswana, Bouvet Island, Brazil, British Indian Ocean Territory, British Virgin Islands, Brunei Darussalam, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Cayman Islands, Central African Republic (the), Chad, Chile, China, China, Hong Kong Special Administrative Region, China, Macao Special Administrative Region, Chinese Taipei, Colombia, Comoros (the), Congo (the), Cook Islands (the), Costa Rica, Côte d'Ivoire, Cuba, Curaçao, Democratic People's Republic of Korea (the), Democratic Republic of the Congo (the), Djibouti, Dominica, Dominican Republic (the), Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Falkland Islands (Malvinas), Fiji, French Guiana, French Polynesia, French Southern and Antarctic Territories, Gabon, Gambia (the), Georgia, Ghana, Grenada, Guadeloupe, Guam, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran (Islamic Republic of), Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Lao People's Democratic Republic (the), Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands (the), Martinique, Mauritania, Mauritius, Mayotte, Mexico, Micronesia (Federated States of), Mongolia, Montserrat, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, New Caledonia, Nicaragua, Niger (the), Nigeria, Niue, Northern Mariana Islands, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines (the), Pitcairn, Puerto Rico, Qatar, Réunion, Rwanda, Saint Barthélemy, Saint Helena, Saint Kitts and Nevis, Saint Lucia, Saint Martin (French Part), Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Sint Maarten (Dutch Part), Solomon Islands, Somalia, South Africa, South Georgia and the South Sandwich Islands, South Sudan, Sri Lanka, State of Palestine (the), Sudan (the), Suriname, Syrian Arab Republic (the), Tajikistan, Thailand, Timor-Leste, Togo, Tokelau, Tonga, Trinidad and Tobago, Tunisia, Türkiye, Turkmenistan, Turks and Caicos Islands, Tuvalu, Uganda, United Arab Emirates (the), United Republic of Tanzania (the), United States minor outlying islands, United States Virgin Islands, Uruguay, Uzbekistan, Vanuatu, Venezuela (Bolivarian Republic of), Viet Nam, Wallis and Futuna Islands, Western Sahara, Yemen, Zambia, Zimbabwe
Least-developed countries	Afghanistan, Angola, Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Central African Republic (the), Chad, Comoros (the), Democratic Republic of the Congo (the), Djibouti, Eritrea, Ethiopia, Gambia (the), Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic (the), Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger (the), Rwanda, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan (the), Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania (the), Yemen, Zambia
Landlocked developing countries	Afghanistan, Armenia, Azerbaijan, Bhutan, Bolivia (Plurinational State of), Botswana, Burkina Faso, Burundi, Central African Republic (the), Chad, Eswatini, Ethiopia, Kazakhstan, Kyrgyzstan, Lao People's Democratic Republic (the), Lesotho, Malawi, Mali, Mongolia, Nepal, Niger (the), North Macedonia, Paraguay, Republic of Moldova, Rwanda, South Sudan, Tajikistan, Turkmenistan, Uganda, Uzbekistan, Zambia, Zimbabwe
Small island developing states	American Samoa, Anguilla, Antigua and Barbuda, Aruba, Bahamas (the), Barbados, Belize, Bonaire, Sint Eustatius and Saba, British Virgin Islands, Cabo Verde, Comoros (the), Cook Islands (the), Cuba, Curaçao, Dominica, Dominican Republic (the), Fiji, French Polynesia, Grenada, Guam, Guinea-Bissau, Guyana, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands (the), Mauritius, Micronesia (Federated States of), Montserrat, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Seychelles, Singapore, Sint Maarten (Dutch Part), Solomon Islands, Suriname, Timor-Leste, Tonga, Trinidad and Tobago, Tuvalu, United States Virgin Islands, Vanuatu

Category	Countries/territories within the category
"Developing countries" under indicator 7.a.1. These are a modified list of countries specific to international public finance flows	Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahamas (the), Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Bolivia (Plurinational State of), Bosnia and Herzegovina, Botswana, Brazil, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Republic (the), Chad, Chile, China, China, Hong Kong Special Administrative Region, China, Macao Special Administrative Region, Chinese Taipei, Colombia, Comoros (the), Congo (the), Cook Islands (the), Costa Rica, Côte d'Ivoire, Cuba, Democratic People's Republic of Korea (the), Democratic Republic of the Congo (the), Djibouti, Dominica, Dominican Republic (the), Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Fiji, French Polynesia, Gabon, Gambia (the), Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran (Islamic Republic of), Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kosovo, Kyrgyzstan, Lao People's Democratic Republic (the), Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands (the), Mauritania, Mauritius, Mexico, Micronesia (Federated States of), Mongolia, Montenegro, Montserrat, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, New Caledonia, Nicaragua, Niger (the), Nigeria, Niue, North Macedonia, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines (the), Republic of Moldova (the), residual/unallocated ODA: Central Asia and Southern Asia, residual/unallocated ODA: Eastern and South-eastern Asia, residual/unallocated ODA: Latin America and the Caribbean, residual/unallocated ODA: Northern America and Europe, residual/unallocated ODA: Oceania excl. Aus. and N. Zealand, residual/unallocated ODA: Sub-Saharan Africa, residual/unallocated ODA: Western Asia and Northern Africa, Rwanda, Saint Helena, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Senegal, Serbia, Seychelles, Sierra Leone, Solomon Islands, Somalia, South Africa, South Sudan, Sri Lanka, State of Palestine (the), Sudan (the), Suriname, Syrian Arab Republic (the), Tajikistan, Thailand, Timor-Leste, Togo, Tokelau, Tonga, Trinidad and Tobago, Tunisia, Türkiye, Turkmenistan, Tuvalu, Uganda, Ukraine, United Republic of Tanzania (the), Unspecified countries, Uruguay, Uzbekistan, Vanuatu, Venezuela (Bolivarian Republic of), Viet Nam, Wallis and Futuna Islands, Yemen, Zambia, Zimbabwe

ODA = official development assistance.

Annex 2.
References

Chapter 1 • Access to electricity

60 Decibels. 2025. "Off-Grid Energy Benchmarks for Solar Home System Customers." https://60decibels.com/insights/off-grid-energy/.

Alkire, Sabina, Usha Kanagaratnam, and Frank Vollmer. 2021. *Interlinkages Between Multidimensional Poverty and Electricity: A Study Using the Global Multidimensional Poverty Index (MPI).* The Rockefeller Foundation and Oxford Poverty and Human Development Initiative (OPHI), University of Oxford. https://ophi.org.uk/sites/default/files/2024-03/Alkire_et_al_2021_Interlinkages.pdf.

AMDA (Africa Minigrid Developers Association). 2025. *Benchmarking Africa's Minigrids Report.* Kenya: AMDA. https://www.africamda.org/wp-content/uploads/2025/04/Benchmarking-Africas-Minigrids-Report-2024-Online-version.pdf.

Bhatia, Mikul, and Niki Angelou. 2015. *Beyond Connections: Energy Access Redefined.* Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/24368.

Cabraal, Anil, William A. Ward, V. Susan Bogach, and Amit Jain. 2021. *Living in the Light: The Bangladesh Solar Home Systems Story.* Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/35311.

Crossboundary. 2022. "Appliance Financing 3.0 Innovation Insight." https://crossboundary.com/mini-grid-innovation-insight-appliance-financing-3-0-crossboundary-innovation-lab/.

Efficiency for Access. 2024. *Leave No One Behind: Bridging the Energy Access Gap with Innovative Off-Grid Solar Solutions.* Washington, DC: Efficiency for Access. https://efficiencyforaccess.org/publications/leave-no-one-behind/.

ESMAP (Energy Sector Management Assistance Program). 2022a. *Mini Grids for Half a Billion People: Market Outlook and Handbook for Decision Makers.* Washington, DC: World Bank. https://www.esmap.org/Mini_Grids_for_Half_a_Billion_People_The_Report.

ESMAP. 2022b. *Designing Public Funding Mechanisms in the Off-Grid Solar Sector.* Washington, DC: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099300005162263450.

ESMAP. 2024. "Global Electrification Platform Explorer." World Bank, Washington, DC. https://electrifynow.energydata.info/.

ESMAP and GOGLA (Global Off-Grid Solar Association). 2024. *Off-Grid Solar Market Trends Report 2024.* Washington, DC: World Bank. https://www.esmap.org/sites/default/files/esmap-files/2024-Off-Grid-Solar-Market-Trends-Report.pdf.

ESMAP, GOGLA, and SEforALL (Sustainable Energy for All). 2024. *Designing Responsible End-User Subsidies for Energy Access: A Toolkit Featuring Case Studies for the Design of Subsidies in Off-Grid Solar and Clean Cooking.* Washington, DC: World Bank. https://openknowledge.worldbank.org/bitstreams/00cc00fc-31f2-45a8-8d06-4925e40e76c7/download.

ESMAP, IEA (International Energy Agency), IRENA (International Renewable Energy Agency), SEforALL, and UN Women. 2025. Gender Indicators for Sustainable Energy: A Call to Action. Washington, DC: World Bank. https://www.esmap.org/sites/default/files/2022/2025/2025-SDG7-Policy-Brief-on-SDG5.pdf.

GOGLA. 2025. *After the Dip: Off-Grid Solar's Defining Moment*. Utrecht: Global Off-Grid Solar Association. https://gogla.org/reports/investment-data-report/after-the-dip-off-grid-solars-defining-moment/.

GOGLA. N.d. "Market Insights and Data." https://gogla.org/market-insights-data/.

IEA (International Energy Agency). 2023. *Guidebook for Improved Electricity Access Statistics*. Paris: IEA. https://www.iea.org/reports/guidebook-for-improved-electricity-access-statistics.

IEA. 2025. *Indicators Handbook for Just and Inclusive Energy Transitions*. Paris: IEA. https://www.iea.org/reports/indicators-handbook-for-just-and-inclusive-energy-transitions.

IEA, IRENA, UNSD (United Nations Statistics Division), World Bank, and WHO (World Health Organization). 2025. T*racking SDG 7: The Energy Progress Report 2025*. Washington, DC: World Bank. https://trackingsdg7.esmap.org/.

IRENA (International Renewable Energy Agency). 2025. *Off-grid Renewable Energy Statistics 2025*. Abu Dhabi: IRENA. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2025/Dec/IRENA_DAT_Off-grid_Renewable_Energy_Statistics_2025.pdf.

Kersey, Jessica, and Bryan Bonsuk Koo. 2024. "Adapting Spatial Frameworks to Guide Energy Access Interventions in Urbanizing Africa." Live Wire 2024/131, World Bank, Washington, DC. https://openknowledge.worldbank.org/bitstreams/10ccbd47-e950-4a6b-b528-1cf234d1fa20/download.

Kersey, Jessica, Civian Kiki Massa, June Lukuyu, Judith Mbabazi, Jay Taneja, Daniel M. Kammen, and Veronica Jacome. 2025. "Grid Connections and Inequitable Access to Electricity in African Cities." Nature Cities 2 (5): 413–21. https://www.researchgate.net/publication/390610080_Grid_connections_and_inequitable_access_to_electricity_in_African_cities.

MGP (Mini-Grids Partnership). 2024. *State of the Global Mini-Grids Market Report 2024*. https://www.minigrids.org/global-market-report-2024/.

Nigeria Rural Electrification Agency. 2024. *DARES Project Implementation Manual*. Abuja: Rural Electrification Agency. https://nep.rea.gov.ng/assets/documents/resource-hub/DARES_PIM_Final.pdf.

OECD (Organisation for Economic Co-operation and Development), Sahel and West Africa Club, and African Development Bank. 2020. *Africa's Urbanisation Dynamics 2020*. Paris: OECD Publishing. https://www.oecd.org/en/publications/africa-s-urbanisation-dynamics-2020_b6bccb81-en.html.

OECD, Sahel and West Africa Club, and African Development Bank. 2025. *Africa's Urbanisation Dynamics 2025*. Paris: OECD Publishing. https://www.oecd.org/en/publications/2025/03/africa-s-urbanisation-dynamics-2025_005a8aa0.html.

Pakrashi, Debayan, Rikhia Bhukta, , Sarani Saha, and Ashish Sedai. 2024. "Community Electrification and Women's Autonomy." *Energy Economics* 137: 107792. https://doi.org/10.1016/j.eneco.2024.107792.

Parker, Steven, and Brantley Liddle. 2026. "Policy's Role in Electricity Access Progress Sub-Saharan Africa." *Energy Policy* 212 (C). https://www.sciencedirect.com/science/article/abs/pii/S0301421526001187?getft_integrator=clarivate&pes=vor&utm_source=clarivate.

United Nations. 2025. *Interlinkages Between SDG 7 and SDG 16*. New York: United Nations. https://sdgs.un.org/publications/sdg7-policy-brief-interlinkages-between-sdg7-and-sdg16-61243.

UNDESA (United Nations, Department of Economic and Social Affairs), Population Division. 2025. *World Urbanization Prospects: The 2025 Revision.* New York: UNDESA. https://population.un.org/wup/.

Value for Women. 2018. *A Business-First Approach to Gender Inclusion: How to Think about Gender Inclusion in Small and Medium Enterprise Operations.* London: Value for Women. https://v4w.org/resources/a-business-first-approach-to-gender-inclusion/.

WHO, World Bank, SEforALL, and IRENA. 2023. *Energizing Health: Accelerating Electricity Access in Healthcare Facilities.* Geneva: WHO. https://www.seforall.org/publications/energizing-health-accelerating-electricity-access-in-health-care-facilities.

World Bank. 2017. *State of Electricity Access Report 2017.* Washington, DC: World Bank. https://www.worldbank.org/en/topic/energy/publication/sear.

World Bank. 2025. "FY26 List of Fragile and Conflict-Affected Situations." World Bank, Washington, DC. https://thedocs.worldbank.org/en/doc/5c7e4e268baaafa6ef38d924be9279be-0090082025/original/FCSListFY26.pdf.

Chapter 2 • Access to clean fuels and technologies for cooking

Clean Cooking Alliance. 2025. "CLEAR Methodology." December. https://cleancooking.org/4c/methodology/.

ESMAP (Energy Sector Management Assistance Program). 2020. The State of Access to Modern Energy Cooking Services. Washington, DC: World Bank Group.

G20 (Group of Twenty). 2024. *G20 Clean Cooking Legacy Programme and the Voluntary Infrastructure Investment Action Plan: Closing the Clean Cooking Gap.* Rio de Janeiro: G20 Brazil. https://g20.org.

Government of India, Ministry of Petroleum and Natural Gas. N.d. "Pradhan Mantri Ujjwala Yojana (PMUY)." Accessed May 11, 2026. https://www.pmuy.gov.in/.

GPA (Global Platform for Action). 2026. [AC1] Forthcoming. "Summary Brief: The Sustainable Energy Access Gap amongst Forcibly Displaced People." Global Platform for Action, Geneva."

Integrity Council for the Voluntary Carbon Market. 2025. "Integrity Council Approves Three Cookstove Methodologies." March 7. https://icvcm.org/integrity-council-approves-three-cookstove-methodologies/.

Khalifa, Y., M. Leach, R. Sieff, J. Nsengiyaremye, B. Onjala, K. Groen, F. F. Nerini, C. Ramirez, and R. Bellanca. 2025. "The Role of Electric Cooking in Providing Sustainable School Meals in Low-Income and Lower-Middle-Income Countries." The Lancet Planetary Health 9: e101204. https://doi.org/10.1016/S2542-5196(25)00004-X.

MEMD (Ministry of Energy and Mineral Development), Uganda. 2025. *National Integrated Clean Cooking Strategy*. Kampala: Government of Uganda. https://ccumemd.ug/wp-content/uploads/2025/10/National-Integrated-Clean-Cooking-Strategy.pdf.

Ministry of Energy, United Republic of Tanzania. 2024. *National Clean Cooking Strategy (2024–2034).* Dar es Salaam: Government of Tanzania. https://www.nishati.go.tz/uploads/documents/en-1717244388-NATIONAL%20CLEAN%20COOKING%20STRATEGY%20(2024-2034).pdf.

Ministry of Energy and Petroleum, Kenya. 2024. *Kenya National Cooking Transition Strategy 2024–2028.* Nairobi: Government of Kenya. https://www.energy.go.ke/sites/default/files/KAWI/Publication/Kenya%20National%20Cooking%20Transition%20Strategy_Signed.pdf.

MoWE (Ministry of Water and Energy). 2025. National Clean Cooking Road Map. January. Addis Ababa: Government of Ethiopia. https://www.mowe.gov.et/sites/default/files/resource/National%20Clean%20Cooking%20Road%20Map.pdf.

UN General Assembly. 2025. *Political Declaration of the 4th High-Level Meeting* (Resolution A/RES/80/117). New York: United Nations. https://digitallibrary.un.org/record/4095600.

UNFCCC (United Nations Framework Convention on Climate Change). 2025. *Report of the Conference of the Parties on Its Thirtieth Session, Held in Belém from 10 to 21 November 2025*. Bonn: UNFCCC.

UNHCR (United Nations High Commissioner for Refugees). 2026. *Global Appeal 2026.* Geneva: UNHCR. https://www.unhcr.org/media/global-appeal-2026.

WHO (World Health Organization). 2014. *WHO Guidelines for Indoor Air Quality: Household Fuel Combustion*. Geneva: WHO. https://iris.who.int/bitstream/handle/10665/141496/9789241548885_eng.pdf?sequence=1.

WHO. 2025a. "Household Air Pollution." Last modified December 16. https://www.who.int/news-room/fact-sheets/detail/household-air-pollution.

WHO. 2025b. *Updated Road Map for an Enhanced Global Response to the Adverse Health Effects of Air Pollution*. Geneva: World Health Organization. https://apps.who.int/gb/ebwha/pdf_files/WHA78/A78_(26)-en.pdf.

WHO. 2026. "Household Energy Database." Global Health Observatory, WHO, Geneva. https://www.who.int/data/gho/data/themes/air-pollution/who-household-energy-db.

World Bank. 2025a. *Accelerating Access to Clean Air for a Livable Planet*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/099032625132535486.

World Bank. 2025b. *A Breath of Change: Solutions for Cleaner Air in the Indo-Gangetic Plains and Himalayan Foothills*. Washington, DC: World Bank. https://www.worldbank.org/en/region/sar/publication/a-breath-of-change-solutions-for-cleaner-air-in-the-indo-gangetic-plains-and-himalayan-foothills.

World Bank. 2025c. "Cooking up Change: How Financial Innovation Can Help Transform Lives." December 5. https://www.worldbank.org/en/news/feature/2025/12/05/cooking-up-change-how-financial-innovation-can-help-transform-lives.

World Bank. 2026. Forthcoming. *Regional Roadmap to Increase Access to Clean Fuels and Technologies for Cooking in LAC*. Washington, DC: World Bank.

Chapter 3 • Renewables

Cheng, Evelyn. 2026. "Why China Can Withstand Oil's Surge Past $100 More Easily Than Other Countries." CNBC, March 9, 2026. Accessed March 16, 2026. https://www.cnbc.com/2026/03/09/china-oil-shock-iran-war-hormuz-energy-transition.html.

COP30 (Thirtieth Conference of the Parties to the United Nations Framework Convention on Climate Change). 2025. "COP30 Presidency Mobilizes Countries and Key Sectors to Implement Commitment to Quadruple Sustainable Fuels." Accessed February 27, 2026. https://cop30.br/en/news-about-cop30/cop30-presidency-mobilizes-countries-and-key-sectors-to-implement-commitment-to-quadruple-sustainable-fuels.

IEA (International Energy Agency). 2024. *Global EV Outlook 2024*. Paris: IEA. https://www.iea.org/reports/global-ev-outlook-2024.

IEA. 2025a. *Global Energy Review 2025.* Paris: IEA. https://www.iea.org/reports/global-energy-review-2025.

IEA. 2025b. World Energy Outlook 2025. Paris: IEA. https://www.iea.org/reports/world-energy-outlook-2025.

IEA. 2025c. *Delivering Sustainable Fuels: Pathways to 2035*. Paris: IEA. Accessed April 14, 2026. https://www.iea.org/reports/delivering-sustainable-fuels.

IEA. 2025d. "Aviation." Paris: IEA. Accessed March 17, 2026. https://www.iea.org/energy-system/transport/aviation.

IEA. 2025e. *Global EV Outlook 2025*. Paris: IEA. https://www.iea.org/reports/global-ev-outlook-2025.

IEA. 2025f. *COP28 Tripling Renewable Capacity Pledge 2025: Update–Analysis*. Paris: IEA. Accessed May 11, 2026. https://www.iea.org/reports/cop28-tripling-renewable-capacity-pledge-2025-update.

IEA. 2026a. "World Energy Balances." Paris: IEA. Accessed May 11, 2026. https://www.iea.org/data-and-statistics/data-product/world-energy-balances.

IEA. 2026b. "The Middle East and Global Energy Markets—Topics." IEA, Paris. Accessed May 11, 2026. https://www.iea.org/topics/the-middle-east-and-global-energy-markets.

IEA, IMF (International Monetary Fund), and World Bank. 2026. "Joint Statement on 13 April by the Heads of the International Energy Agency, International Monetary Fund, and World Bank Group." Accessed April 21, 2026. https://www.iea.org/news/joint-statement-on-13-april-by-the-heads-of-the-international-energy-agency-international-monetary-fund-and-world-bank-group.

IEA, IRENA (International Renewable Energy Agency), UNSD (United Nations Statistics Division), World Bank, and WHO (World Health Organization). 2024. *Tracking SDG7: The Energy Progress Report 2024*. Washington, DC: World Bank. https://www.irena.org/Publications/2023/Jun/Tracking-SDG7-2023.

IEA, IRENA, UNSD, World Bank, and WHO. 2025. *Tracking SDG7: The Energy Progress Report 2025*. Washington, DC: World Bank. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2025/Jun/IRENA_POL_Tracking_SDG7_energy_progress_2025.pdf.

IRENA (International Renewable Energy Agency). 2021. *A Pathway to Decarbonise the Shipping Sector by 2050*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2021/Oct/A-Pathway-to-Decarbonise-the-Shipping-Sector-by-2050.

IRENA. 2022. *Bioenergy for the Energy Transition: Ensuring Sustainability and Overcoming Barriers*. Abu Dhabi: IRENA. https://www.irena.org/publications/2022/Aug/Bioenergy-for-the-Transition.

IRENA. 2024. *Sustainable Aviation Fuels in Southeast Asia: A Regional Perspective on Bio-Based Solutions*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2024/Dec/Sustainable-aviation-fuels-in-Southeast-Asia-A-regional-perspective-on-bio-based-solutions.

IRENA. 2025a. *Renewable Power Generation Costs in 2024*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2025/Jun/Renewable-Power-Generation-Costs-in-2024.

IRENA. 2025b. *Policies for Advancing the Renewables-Based Electrification of Road Transport*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2025/Jun/Policies-for-advancing-the-renewables-based-electrification-of-road-transport.

IRENA. 2026a. *Fostering a Just Energy Transition: A Framework for Policy Design*. Abu Dhabi: IRENA. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2026/Jan/IRENA_POL_Fostering_a_just_energy_transiton_2026.pdf.

IRENA. 2026b. *From Energy Crisis to Energy Security: Actions for Policy Makers*. IRENA Policy Advisory No. 4/26/1. Abu Dhabi: IRENA. https://www.irena.org/Publications/2026/Apr/Renewables-from-energy-crisis-to-energy-security.

IRENA, COP30 Presidency, and Global Renewables Alliance. 2025. *Delivering on the UAE Consensus: Tracking Progress toward Tripling Renewable Energy Capacity and Doubling Energy Efficiency by 2030*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2025/Oct/UAE-Consensus-2030-tripling-renewables-doubling-efficiency.

UN (United Nations). 2021. *Sustainable Transport, Sustainable Development: Interagency Report for Second Global Sustainable Transport Conference.* New York: UN. Accessed February 19, 2026. https://sdgs.un.org/sites/default/files/2021-10/Transportation%20Report%202021_FullReport_Digital.pdf.

UN. 2025. *SDG 7 Policy Briefs in Support of the UN High-Level Political Forum 2025: Maximising the Benefits of Energy Action for Good Health, Gender Equality and Decent Work to Leave No One Behind*. New York: UN. Accessed March 17, 2026. https://www.un.org/sites/un2.un.org/files/2025_policy_briefs_in_support_of_the_high-level_political_forum-071525b.pdf.

UN. 2026. "Middle East Crisis Exposes Global Energy Fault Line as UN Urges Shift to Renewables." UN News, April 2026. Accessed April 21, 2026. https://news.un.org/en/story/2026/04/1167243.

UNSD (United Nations Statistics Division). 2025a. *2023 Energy Balances.* New York: United Nations. https://unstats.un.org/unsd/energystats/pubs/balance/.

UNSD. 2025b. "Energy Statistics Database 2023." https://unstats.un.org/unsd/energystats/data/.

Chapter 4 • Energy efficiency

IEA (International Energy Agency). 2024a. *Energy Efficiency Policy Toolkit 2024*. Paris: IEA. Accessed April 16, 2026. https://www.iea.org/reports/energy-efficiency-policy-toolkit-2024.

IEA. 2024b. *Energy Efficiency 2024.* Paris: IEA. https://www.iea.org/reports/energy-efficiency-2024.

IEA. 2025a. "Energy Efficiency Progress Tracker" Accessed April 1, 2026. https://www.iea.org/data-and-statistics/data-tools/energy-efficiency-progress-tracker

IEA. 2025b. *World Energy Investment 2025.* Paris: IEA. https://www.iea.org/reports/world-energy-investment-2025.

IEA. 2025c. *Energy Efficiency 2025.* Paris: IEA. https://iea.blob.core.windows.net/assets/23a80bb2-6985-4507-ab99-c1d700f6548b/EnergyEfficiency2025.pdf.

IEA. 2025d. *World Energy Outlook 2025.* Paris: IEA. https://www.iea.org/reports/world-energy-outlook-2025.

IEA. 2025e. *Energy Efficiency Policy Toolkit 2025.* Paris: IEA. Accessed March 16, 2026. https://iea.blob.core.windows.net/assets/1c9f0a29-e440-4cbc-839a-9b1916818267/IEAEnergyEfficiencyPolicyToolkit_2025_Online.pdf.

IEA. 2025f. *Gaining an Edge: The Role of Energy Efficiency in Industrial Competitiveness.* Paris: IEA. https://iea.blob.core.windows.net/assets/7e654fb6-4e6f-416c-8d9e-4f424d65eecb/GaininganEdgeTheRoleofEnergyEfficiencyinIndustrialCompetitiveness.pdf.

IEA. 2026. "World Energy Balances." Accessed April 15, 2026. https://www.iea.org/data-and-statistics/data-product/world-energy-balances

UN (United Nations). 2021. *Theme Report on Energy Transition: Towards the Achievement of SDG 7 and Net-Zero Emissions.* New York: UN. https://www.un.org/sites/un2.un.org/files/2021-twg_2-062321.pdf.

United Nations Statistics Division. 2025. 2023 Energy Balances. https://unstats.un.org/unsd/energystats/pubs/balance/.

Chapter 5 • International public financial flows to developing countries in support of clean energy

ADB (Asian Development Bank). 2024. "Regional: Actis Asia Climate Transition SCSp." https://www.adb.org/projects/57210-001/main.

AIIB (Asian Infrastructure Investment Bank). 2024. "Multicountry: Actis Asia Climate Transition Fund." https://www.aiib.org/en/projects/details/2024/approved/Multicountry-Actis-Asia-Climate-Transition-Fund.html.

Audu, Haliru, and Adeline Duclos. 2024. "Five Pillars That Determine Commercial Renewables Projects' Bankability." IRENA Expert Insights, April 2024. https://www.irena.org/News/expertinsights/2024/Apr/Five-Pillars-That-Determine-Commercial-Renewables-Projects-Bankability.

Butler, Courtney. 2024. "Closing the Climate Finance Gap: How to Raise the Money the World Needs to Support Climate Action." Research Paper, Chatham House, November 2024. https://www.chathamhouse.org/2024/11/closing-climate-finance-gap.

CCA (Clean Cooking Alliance). 2023. 2023 *Clean Cooking Industry Snapshot*. Washington, DC: CCA. https://cleancooking.org/reports-and-tools/2023-clean-cooking-industry-snapshot/.

CCA. 2025. *Clean Cooking Industry Snapshot—Top Trends.* Washington, DC: CCA. https://cleancooking.org/reports-and-tools/clean-cooking-industry-snapshot-top-trends/

Coldrey, Olivia, Paul Lant, and Peta Ashworth. 2023. "Elucidating Finance Gaps Through the Clean Cooking Value Chain." *Sustainability* 15 (4): 3577. https://doi.org/10.3390/su15043577.

ESMAP (Energy Sector Management Assistance Program). 2020. *Cooking with Electricity*. Washington, DC: World Bank. https://doi.org/10.1596/34566.

Hakam, D. F., H. Nugraha, A. Wicaksono, R. A. Rahadi, and S. P. Kanugrahan. 2022. "Mega Conversion from LPG to Induction Stove to Achieve Indonesia's Clean Energy Transition." *Energy Strategy Reviews* 41: 100856. https://doi.org/10.1016/j.esr.2022.100856.

Human Rights Monitoring Mission in Ukraine. 2024. *Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population.* https://ukraine.ohchr.org/en/Attacks-on-Ukraines-Energy-Infrastructure-Harm-to-the-Civilian-Population.

IEA (International Energy Agency). 2023. Guidebook for Improved Electricity Access Statistics. Paris: IEA. https://www.iea.org/reports/guidebook-for-improved-electricity-access-statistics.

IEA (International Energy Agency). 2023. A Vision for Clean Cooking Access for All. Paris: IEA. www.iea.org/reports/a-vision-for-clean-cooking-access-for-all.

IEA. 2024. *SDG 7: Data and Projections*. Paris: IEA. https://www.iea.org/reports/sdg7-data-and-projections.

IEA. 2025. *Universal Access to Clean Cooking in Africa*. Paris: IEA. https://www.iea.org/reports/universal-access-to-clean-cooking-in-africa.

IEA, IRENA (International Renewable Energy Agency), UNSD (United Nations Statistics Division), World Bank, and WHO (World Health Organization). 2022. *Tracking SDG7: The Energy Progress Report 2022*. Washington, DC: World Bank. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Jun/SDG7_Tracking_Progress_2022.pdf.

IEA, IRENA, UNSD, World Bank, and WHO. 2023. *Tracking SDG 7: The Energy Progress Report 2023*. Washington, DC: World Bank. https://www.irena.org/Publications/2023/Jun/Tracking-SDG7-2023.

IEA, IRENA, UNSD, World Bank, and WHO. 2024. *Tracking SDG 7: The Energy Progress Report 2024.* Washington, DC: World Bank. https://www.irena.org/Publications/2024/Jun/Tracking-SDG-7-The-Energy-Progress-Report-2024.

IEA, IRENA, UNSD, World Bank, and WHO. 2025. *Tracking SDG 7: The Energy Progress Report 2025*. Washington, DC: World Bank. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2025/Jun/IRENA_POL_Tracking_SDG7_energy_progress_2025.pdf.

IMF (International Monetary Fund). 2026. "How the War in the Middle East Is Affecting Energy, Trade, and Finance." IMF Blog, March 30, 2026. https://www.imf.org/en/blogs/articles/2026/03/30/how-the-war-in-the-middle-east-is-affecting-energy-trade-and-finance.

IRENA (International Renewable Energy Agency). 2024a. *Public Finance for Universal Energy Access*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2024/May/Public-finance-for-universal-energy-access.

IRENA. 2024b. *World Energy Transitions Outlook 2024: 1.5°C Pathway*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2024/Nov/World-Energy-Transitions-Outlook-2024

IRENA. 2026a. *Financing Clean Cooking in Tanzania*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2026/Mar/Financing-clean-cooking-in-Tanzania.

IRENA. 2026b. *Tracking Financial Support Across 100 Clean Cooking Access-Deficit Countries*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2026/Mar/Tracking-financial-support-across-100-clean-cooking-access-deficit-countries.

IRENA and CPI (Climate Policy Initiative). 2025. *Global Landscape of Energy Transition Finance 2025.* Abu Dhabi: IRENA. https://www.irena.org/Publications/2025/Nov/Global-landscape-of-energy-transition-finance-2025.

IRENA and OECD (Organisation for Economic Co-operation and Development). 2025. "Renewable Energy Public Investments Database." (Based on OECD and IRENA data). Data set. https://www.irena.org/data (accessed December 2025).

MECS (Modern Energy Cooking Services). 2025. "Tanzania's Power Utility Scales Up Electric Cooking Through Landmark Partnership." https://mecs.org.uk/tanzanias-power-utility-scales-up-electric-cooking-through-landmark-partnership/.

OECD. 2025a. "CRS: Creditor Reporting System (Flows) [Dataset]." https://data-explorer.oecd.org/vis?tm=creditor%20reporting%20&pg=0&snb=14&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_CRS%40DF_CRS&df[ag]=OECD.DCD.FSD&df[vs]=1.3&dq=DACEU_EC.DPGC.231%2B232%2B233%2B234%2B235%2B236%2B510%2B520%2B530%2B53030.100._T._T.C.Q._T..&pd=2016%2C2023&to[TIME_PERIOD]=false.

OECD. 2025b. "International Aid Falls in 2024 for First Time in Six Years." https://www.oecd.org/en/about/news/press-releases/2025/04/official-development-assistance-2024-figures.html.

OECD. 2026. "A Historic Decline in Foreign Aid: Preliminary 2025 ODA Data." https://www.oecd.org/en/data/insights/data-explainers/2026/04/a-historic-decline-in-foreign-aid-preliminary-2025-oda-data.html

Saudi Fund for Development. 2024. "Saudi Fund for Development Finances 3 Development Projects in Serbia Worth $205 Million." https://www.spa.gov.sa/en/N2190347.

SEforALL (Sustainable Energy for All). 2024. Energizing Finance Report. Vienna: SEforALL. https://www.seforall.org/publications/energizing-finance-report-2024.

Shen, G., R. Xiong, Y. Tian, and many others. 2022. "Substantial Transition to Clean Household Energy Mix in Rural China." National Science Review 9 (7): nwac050. https://doi.org/10.1093/nsr/nwac050.

UNCTAD (United Nations Conference on Trade and Development). 2025. "Costlier Debt Servicing Undermines the Achievement of the SDGs—UNCTAD SDG Pulse 2025." https://sdgpulse.unctad.org/debt-sustainability/index.html.

UNDP (United Nations Development Programme). 2021. Climate Finance for Sustaining Peace: Making Climate Finance Work for Conflict-Affected and Fragile Contexts. New York: UNDP. https://www.undp.org/publications/climate-finance-sustaining-peace-making-climate-finance-work-conflict-affected-and-fragile-contexts.

WHO. 2021. Increasing Access to Clean Cooking through Subsidies. Geneva: WHO. https://doi.org/www.who.int/publications/i/item/WHO-HEP-ECH-AQH-2022.1.

WHO. 2026. "Cooking Fuels: Population with Primary Reliance on Clean Fuels and Technologies for Cooking, Proportion (%)." https://www.who.int/data/gho/data/indicators/indicator-details/GHO/gho-phe-primary-reliance-on-clean-fuels-and-technologies-proportion.

World Bank Group. 2023. "Access to Electricity (% of Population)—Burundi, Ethiopia, Malawi, Mozambique, Zambia [Dataset]." https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=BI-ET-MW-MZ-ZM.

World Bank. 2025. Classification of Fragile and Conflict-Affected Situations—FY26. Washington, DC: World Bank. https://thedocs.worldbank.org/en/doc/5c7e4e268baaafa6ef38d924be9279be-0090082025/original/FCSListFY26.pdf.

Chapter 6 • Outlook for SDG 7

IEA (International Energy Agency). 2023. *A Vision for Clean Cooking Access for All.* Paris: IEA. https://www.iea.org/reports/a-vision-for-clean-cooking-access-for-all.

IEA. 2024. *COP28 Tripling Renewable Capacity Pledge*. Paris: IEA. https://www.iea.org/reports/cop28-tripling-renewable-capacity-pledge.

IEA. 2025a. *World Energy Outlook 2025.* Paris: IEA. https://www.iea.org/reports/world-energy-outlook-2025.

IEA. 2025b. *Universal Access to Clean Cooking in Africa.* Paris: IEA. https://www.iea.org/reports/universal-access-to-clean-cooking-in-africa.

IEA. 2025c. *Renewables 2025.* Paris: IEA. https://www.iea.org/reports/renewables-2025.

IEA. 2025d. *Energy Efficiency 2025*. Paris: IEA. https://www.iea.org/reports/energy-efficiency-2025.

IRENA (International Renewable Energy Agency). 2024. *World Energy Transitions Outlook 2024: 1.5°C Pathway.* Abu Dhabi: IRENA. https://www.irena.org/Publications/2024/Nov/World-Energy-Transitions-Outlook-2024.

IRENA. 2026. *Renewable Capacity Statistics 2026.* Abu Dhabi: IRENA. https://www.irena.org/Publications/2026/Mar/Renewable-capacity-statistics-2026.

IRENA, COP30 Presidency, and Global Renewables Alliance. 2025. *Delivering on the UAE Consensus: Tracking Progress toward Tripling Renewable Energy Capacity and Doubling Energy Efficiency by 2030.* Abu Dhabi: IRENA. https://www.irena.org/Publications/2025/Oct/UAE-Consensus-2030-tripling-renewables-doubling-efficiency.

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.

WHO (World Health Organization). 2026. "Household Energy Database." Global Health Observatory, WHO, Geneva. https://www.who.int/data/gho/data/themes/air-pollution/who-household-energy-db.

Chapter 7 • Data and indicators

Angelou, N., J. Kersey, B. Koo, G. Padam, F. Zaman, J. Park, A. Akuffo, A. Sagesaka, G. Oseni, and A. Palacios-Lopez. 2026. *The Multi-Tier Framework for Energy Access: Insights and Impact from a Decade of Surveys*. Washington, DC: World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099040126145541234.

IAEA (International Atomic Energy Agency), UN (United Nations), IEA (International Energy Agency), Eurostat, and European Environment Agency. 2005. *Energy Indicators for Sustainable Development: Guidelines and Methodologies*. https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1222_web.pdf.

IEA (International Energy Agency). 2014. Energy Efficiency Indicators: Fundamentals on Statistics. Paris: IEA. https://www.iea.org/reports/energy-efficiency-indicators-fundamentals-on-statistics.

IEA. 2024. *Designing an Energy Statistics Roadmap*. Paris: IEA. https://www.iea.org/reports/designing-an-energy-statistics-roadmap.

UN (United Nations). 2018. *International Recommendations for Energy Statistics*. New York: UN. https://unstats.un.org/unsd/energystats/methodology/ires/.

WHO (World Health Organization). 2014. *WHO Guidelines for Indoor Air Quality: Household Fuel Combustion*. Geneva: WHO. https://iris.who.int/bitstream/handle/10665/141496/9789241548885_eng.pdf?sequence=1.

WHO. n.d. "Core Questions on Household Energy Use." https://www.who.int/tools/core-questions-for-household-energy-use.

World Bank. 2026. "Atlas of Global Development 2026." https://datatopics.worldbank.org/sdgatlas?lang=en.

World Bank and WHO. 2021. *Measuring Energy Access: A Guide to Collecting Data Using "The Core Questions on Household Energy Use."* WHO/HEP/ECH/AQH/2021.9. Washington, DC: World Bank. https://www.who.int/publications/i/item/WHO-HEP-ECH-AQH-2021.9.

Annex 1 • Methodological notes

Bonjour, S., H. Adair-Rohani, J. Wolf, N. G. Bruce, S. Mehta, A. Prüss-Ustün, M. Lahiff, E.A. Rehfuess, V. Mishra, and K. R. Smith. 2013. "Solid Fuel Use for Household Cooking: Country and Regional Estimates for 1980–2010." *Environmental Health Perspectives* 121 (7). https://ehp.niehs.nih.gov/doi/10.1289/ehp.1205987.

IEA (International Energy Agency). 2024a. "World Energy Balances." https://www.iea.org/data-and-statistics/data-product/world-energy-balances.

IEA. 2024b. *Tracking Clean Energy Progress 2024*. Paris: IEA.

IEA. 2024c. "World Energy Outlook 2024 Extended Dataset." IEA, Paris. https://www.iea.org/data-and-statistics/data-product/world-energy-outlook-2024-extended-dataset.

IRENA (International Renewable Energy Agency). 2018. *Measurement and Estimation of Off-Grid Solar, Hydro and Biogas Energy*. Abu Dhabi: IRENA. https://www.irena.org/publications/2018/Dec/Measurement-and-estimation-of-off-grid-solar-hydro-and-biogas-energy.

IRENA. 2024. *World Energy Transitions Outlook 2024: 1.5°C Pathway*. Abu Dhabi: IRENA. https://www.irena.org/Publications/2024/Nov/World-Energy-Transitions-Outlook-2024.

IRENA and OECD (Organisation for Economic Co-operation and Development). 2024. "Renewable Energy Public Investments Database." (Based on OECD and IRENA data) Data set. https://www.irena.org/Statistics.

IRENA and OECD. 2025. "Renewable Energy Public Investments Database." Data set. https://www.irena.org/Statistics.

Lighting Global/ESMAP (Energy Sector Management Assistance Program) and GOGLA (Global Off-Grid Solar Association), *Efficiency for Access, and Open Capital Advisors. 2022. Off-Grid Solar Market Trends Report 2022: Outlook.* Washington, DC: World Bank.

OECD (Organisation for Economic Co-operation and Development). 2025. "OECD Data Explorer Creditor Reporting System." https://stats.oecd.org/Index.aspx?DataSetCode=crs1.

Stoner, O., G. Shaddick, T. Economou, S. Gumy, J. Lewis, I. Lucio, G. Ruggeri, and H. Adair-Rohani. 2020. "Global Household Energy Model: A Multivariate Hierarchical Approach to Estimating Trends in the Use of Polluting and Clean Fuels for Cooking." *Journal of the Royal Statistical Society Series C: Applied Statistics* 69 (4): 815–39. https://doi.org/10.1111/rssc.12428.

Stoner, O., J. Lewis, I. L. Martínez, S. Gumy, T. Economou, and H. Adair-Rohani. 2021. "Household Cooking Fuel Estimates at Global and Country Level for 1990 to 2030." Nature Communications 12 (October): 5793. https://doi.org/10.1038/s41467-021-26036-x.

UN (United Nations). 2018. International Recommendations for Energy Statistics. New York: UN. https://unstats.un.org/unsd/energystats/methodology/documents/IRES-web.pdf.

UN (United Nations), Population Division. 2024. "World Population Prospects 2025." Online data. https://population.un.org/wpp/.

UNDESA (United Nations, Department of Economic and Social Affairs). 2025. *World Urbanization Prospects: The 2025 Revision.* New York: UN Department of Economic and Social Affairs. https://population.un.org/wup/.

UNSD (United Nations Statistics Division). 2025. *2023 Energy Balances.* New York: United Nations. https://unstats.un.org/unsd/energystats/pubs/balance/.

WHO (World Health Organization). 2026. "Household Energy Database." Global Health Observatory, WHO, Geneva. https://www.who.int/data/gho/data/themes/air-pollution/who-household-energy-db.

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