TRACKING SDG7

THE ENERGY PROGRESS REPORT 2022

A joint report of the custodian agencies

iea International Energy Agency

IRENA International Renewable Energy Agency

United Nations Statistics Division

THE WORLD BANK IBRD • IDA

World Health Organization

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ACKNOWLEDGMENTS

PARTNERSHIP

The Energy Progress Report is a product of close collaboration among the five SDG 7 custodian agencies in the form of a specially constituted in a Steering Group:

- International Energy Agency (IEA)
- International Renewable Energy Agency (IRENA)
- United Nations Statistics Division (UNSD)
- World Bank
- World Health Organization (WHO)

The Steering Group was supported by the SDG7 Technical Advisory Group composed as follows.

- African Development Bank (AfDB)
- Clean Cooking Alliance
- Denmark (Ministry of Foreign Affairs)
- ENERGIA
- European Commission
- FIA Foundation
- Food and Agricultural Organization (FAO)
- Germany (Federal Ministry for Economic Cooperation and Development)
- Hivos
- International Institute for Applied Systems Analysis
- International Labour Organization (ILO)
- Islamic Development Bank
- Kenya (Ministry of Energy & Petroleum)
- Latin American Energy Organization (OLADE)
- Norway (Ministry of Foreign Affairs)
- Pakistan (Ministry of Foreign Affairs)
- Renewable Energy Policy Network for the 21ST Century (REN 21)
- Sustainable Energy for All (SEforALL)
- TERI School of Advanced Studies
- The Netherlands (Ministry of Foreign Affairs)
- The United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN -OHRLLS)
- UAE (Ministry of Foreign Affairs)
- United Nations Association of China
- United Nations Children's Fund (UNICEF)
- 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)
- United Nations Institute for Training and Research (UNITAR)
- Vienna University of Technology

The financial and technical support of the Energy Sector Management Assistance Program (ESMAP) is gratefully acknowledged. A partnership between the World Bank and 18 entities, ESMAP helps low- and middle-income countries reduce poverty and boost growth through sustainable energy. ESMAP's analytical and advisory services are fully integrated within the World Bank's country financing and policy dialogue in the energy sector.

AUTHORSHIP

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- The chapter on indicators and data was jointly prepared by all custodian agencies under the coordination of the International Energy Agency (Roberta Quadrelli, Pouya Taghavi, Arnau Risquez Martin, Alexandre Bizeul).

DATA SOURCES

The report draws on two metadatabases of global household surveys—the Global Electrification Database managed by the World Bank, and the Global Household Energy Database managed by WHO. Energy balance statistics and indicators for renewable energy and energy efficiency were prepared by IEA (Roberta Quadrelli and Pouya Taghavi with support from Arnau Risquez Martin and Alexandre Bizeul) and UNSD (Leonardo Souza, Agnieszka Koscielniak and Costanza Giovannelli). The indicator on international financial flows to developing countries was prepared by IRENA (Gerardo Escamilla) based on the IRENA Public Investments Database and OECD/DAC Creditor Reporting System. Data on gross domestic product and value-added were mainly drawn from the World Development Indicators of the World Bank. Population data are from the United Nations Population Division.

REVIEW AND CONSULTATION

The public consultation and peer review process was coordinated by the World Bank. Substantive comments were provided by ENERGIA, ESCAP, ESCWA, European Commission, German Federal Ministry for Economic Cooperation and Development BMZ, IIASA, OHRLLS, REN21, SEforALL, and UN-Habitat. The IEA's internal review process was led by Laura Cozzi with contributions from Yannick Monschauer, Daniel Wetzel, Francois Briens, Pouya Taghavi, Roberta Quadrelli, Gianluca Tonolo. The IRENA's internal review process was led by Rabia Ferroukhi with contributions from Ute Collier, Divyam Nagpal, Mirjam Reiner, Gerardo Escamilla. The UNSD's internal review process was led by Leonardo Souza, with contributions from Agnieszka Koscielniak. The World Bank's internal peer review process was led by Demetrios Papathanasiou, with contributions from Gabriela Elizondo Azuela, Chiara Odetta Rogate, Dana Rysankova, Lara Born, Alisha Noella Pinto, Zuzana Dobrotkova, and Henrik Rytter Jensen.

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CONTENTS

EXECUTIVE SUMMARY

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OVERVIEW

This 2022 edition of Tracking SDG 7: The Energy Progress Report assesses achievements in the global quest for universal access to affordable, reliable, sustainable, and modern energy by 2030. At today's rate of progress, the world is still not on track to achieve the SDG 7 goals by 2030. Advances have been impeded, particularly in the most vulnerable countries and those that were already lagging. Figure ES.1 offers an updated snapshot of the primary indicators.

This edition was prepared as the COVID-19 pandemic and its broad social and economic disruptions entered their third year. Some degree of economic recovery has taken place, but the pace of progress on the SDG 7 target is expected to slow down because of new challenges from evolving COVID variants and an energy crisis provoked by the Russian invasion of Ukraine. The report considers the consequences of the evolving pandemic, along with results from global modeling, to determine whether current policy ambitions can meet the SDG 7 targets and to identify the additional actions that may be needed. The report also examines the investments required to achieve the goals. It presents scenarios drawn from the International Energy Agency's (IEA) flagship publication, the World Energy Outlook 2020 (IEA 2021b), and the International Renewable Energy Agency's (IRENA) World Energy Transitions Outlook: 1.5°C Pathway (IRENA 2021c).

From the outset of the pandemic, governments mobilized an unprecedented level of fiscal support to manage the impacts of the pandemic on citizens and the global economy. Appropriations of recovery funds in areas relevant to SDG 7 reached USD 710 billion, but 90 percent of that came in the advanced economies. Emerging markets and developing countries, with their much more limited fiscal leeway, mobilized far less. Increasing clean energy and access investments in these regions requires greater support from international actors.

With oil and gas prices spiking in 2021, aggravated by the war in Ukraine, recovery plans in key economies focused heavily on renewables and efficiency, making the outlook for renewables and energy efficiency stronger than it was a year ago. The rising uncertainty in global oil and gas markets has placed enormous pressure on net importers to reduce their exposure. How the world gets on track toward meeting SDG 7 depends in part on how governments respond to the economic crisis and the role of recovery packages in shaping a more sustainable future.

Although renewable energy demonstrated remarkable resilience during the pandemic, the pace of electrification slowed in recent years. In addition, the pandemic's impact on household incomes made basic energy services unaffordable for around 90 million people in Asia and Africa who had previously enjoyed access. The COVID-19 crisis and another year of extreme weather events and climate change were projected to exacerbate the stark worldwide inequalities in access to reliable energy and health care, especially in rural and peri-urban areas, and highlighted the importance of expanding access to clean, efficient energy to help populations mitigate the effects of both the health and environmental crises.

The September 2021 UN High-Level Dialogue on Energy encouraged governments and the international community to take more action to achieve a sustainable energy future that leaves no one behind. In this context, the SDG 7 custodian agencies—IEA, IRENA, the United Nations Statistics Division (UNSD), the World Bank, and the World Health Organization (WHO)—urge the international community and policy makers to safeguard the gains made toward achieving SDG 7; to remain committed to the need for continued action on affordable, reliable, sustainable, and modern energy for all; and to maintain a strategic focus on the vulnerable countries needing the most support.

The following highlights introduce the key energy indicators.

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

INDICATOR	2010	LATEST YEAR
7.1.1 proportion of population with access to electricity	**1.2 billion** people without access to electricity	**733 million** people without access to electricity (2020)
7.1.2 Proportion of population with primary reliance on clean fuels and technology for cooking	**3 billion** people without access to clean cooking	**2.4 billion** people without access to clean cooking (2020)
7.2.1 Renewable energy share in total final energy consumption	**16.1%** share of total final energy consumption from renewables	**17.7%** share of total final energy consumption from renewables (2019)
7.3.1 Energy intensity measured as a ratio of primary	**5.6 MJ/USD** primary energy intensity	**4.7 MJ/USD** primary energy intensity (2019)
7.a.1 International financial flows to developing countries in support of clean energy research and development and renewable energy	**11.2 USD billion** international financial flows to developing countries in support of clean energy	**10.9 USD billion** international financial flows to developing countries in support of clean energy (2019)

Access to electricity. SDG target 7.1 is universal access to affordable, reliable, sustainable, and modern energy services; indicator 7.1.1 focuses on access to electricity. Recent progress in access to electricity was mixed, as is the outlook for 2030. The global electricity access rate rose markedly between 2010 and 2020, from 83 percent to 91 percent. The number of unserved people fell from 1.2 billion in 2010 to 733 billion in 2020. The pace of annual access growth was faster than in previous years, as access infrastructure projects were finalized, but the annual rate of growth in access slowed from 0.8 percentage points in 2010–18 to 0.5 percentage points in 2018–20, because of the complexity of reaching the remaining unserved populations and the potential impacts of COVID-19. Meeting the 2030 target requires increasing the number of new connections to 100 million a year. At current rates of progress, the world will reach only 92 percent electrification by 2030.

Clean cooking solutions. Universal access to clean cooking is the goal for SDG 7.1.2. On a global scale, the number of people gaining access to clean cooking increased significantly. More than 65 countries have already included household energy or clean cooking related goals in their Nationally Determined Contributions (NDCs) in the lead-up to the 2021 UN Climate Change Summit, COP26 (Clean Cooking Alliance 2021). However, as in previous years, population growth outpaced these improvements, particularly in Sub-Saharan Africa. As a result, the total number of people lacking access to clean cooking—referred to here as the "access deficit" in some regions—has stagnated for decades. In 2000–10, this number was close to 3 billion people. It dropped to 2.4 billion people (2.1–2.7) in 2020.[1] Improvements occurred in Eastern Asia and South-eastern Asia since 2000 and in Central Asia and Southern Asia since 2010. In contrast, the access deficit in Sub-Saharan Africa has nearly doubled since 1990. It rose by more than 50 percent since 2000, reaching a total of 923 million (898–946) people in 2020. A multisectoral, coordinated effort is needed to achieve the SDG 7 target of universal access to clean cooking by 2030. Without increased effort, 2.1 billion people will still lack access to clean cooking in 2030. Learning from the successes and challenges faced by countries that have attempted to design and implement clean household energy policies is critical.

Renewable energy. Ensuring access to affordable, reliable, sustainable, and modern energy for all implies an accelerated deployment of renewable energy sources in electricity, heat, and transport. Although there is no quantitative milestone for SDG 7.2, custodian agencies assess that the current pace of renewable energy uptake needs to rise significantly, to increase the share of renewable energy in total final energy consumption (TFEC), the primary indicator for SDG 7.2. Despite continued disruptions in economic activity and supply chains, renewable energy consumption grew through the pandemic, in contrast with other energy sources. Electricity saw record shares of renewables in new capacity additions in 2021. The positive global and regional trajectories masks the fact that the countries most in need of increased access lag others, however, including in terms of installed capacity to generate renewable electricity. Moreover, rising commodity, energy and shipping prices, as well as restrictive trade measures, have increased the cost of producing and transporting solar photovoltaic (PV) modules, wind turbines, and biofuels worldwide, adding uncertainties for future renewable energy projects. Renewable shares would need to reach well over 30 percent of TFEC by 2030 to be on track for reaching net-zero energy emissions by 2050. Achieving this milestone would require strengthening policy support in all sectors and implementing effective tools to further mobilize private capital, especially in least-developed countries, landlocked developing countries, and small island developing countries.

Energy efficiency. SDG target 7.3 aims to double the annual global rate of improvement in primary energy intensity in 2010–30 versus 1990–2010 to 2.6 percent.[2] In 2010–19, global annual improvements in energy intensity averaged around 1.9 percent, well below the levels needed. To make up for lost ground, the average annual rate of improvement now has to reach 3.2 percent to reach SDG 7.3's target. This rate would need to be even higher—consistently over 4 percent for the rest of this decade—if the world is to reach net-zero emissions from the energy sector by 2050, as envisioned in the IEA's Net Zero Emissions by 2050 Scenario.

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1 Parenthetical figures appearing after estimates throughout the executive summary are 95 percent uncertainty intervals, as defined in the methodology section at the end of the access to clean cooking chapter.

2 Revisions of underlying statistical data and methodological improvements explain the slight changes in historical growth rates from previous editions. The SDG 7.3 target of improving energy intensity by 2.6 percent per year in 2010–30 remains the same, although the latest data for the period 1990–2010 show a rate of improvement in energy intensity of 1.2 percent per year.

Early estimates for 2020 point to a substantial decrease in intensity because of the COVID-19 crisis, partly as a result in the slowdown in real energy efficiency. The outlook for 2021 suggests a return to a 1.9 percent rate of improvement, a return to the average rate during the previous decade, thanks to a sharper focus on energy efficiency policies, particularly in COVID-19 recovery packages. However, to bring the SDG 7.3 target within reach, energy efficiency policies and investment need to be scaled up significantly.

International public financial flows. Although the private sector finances most renewable energy investments, the public sector remains a critical source of finance, particularly for many developing countries. Tracking of SDG 7.a.1 indicator shows that international public financial flows to developing countries in support of clean energy decreased for the second year in a row, falling to USD 10.9 billion in 2019. This level represents a 23 percent decrease from the USD 14.2 billion provided in 2018, a 25 percent decline from the 2010–19 average, and a more than 50 percent drop from the peak of USD 24.7 billion in 2017. Although there is no quantitative target for international public financial flows to developing countries under indicator 7.a.1, the overarching target of SDG 7.a points to the continued importance of enhancing international cooperation. Flows need to be increased to realize SDG 7 as well as enable the achievement of related SDGs including SDG 13 (on climate), especially in light of the reduced fiscal space in many developing countries and the imperatives to ensure a rapid and sustainable recovery from the COVID-19 pandemic.

Indicators and data for tracking progress. Tracking global progress for SDG 7 targets requires high-quality and reliable data for informed and effective policymaking at the global, regional, and country levels. This report introduces a set of global indicators for SDG7 targets to be used along with common frameworks for surveys and standardized methodologies. The quality of data is being improved through national and international cooperation and solid statistical capacity. National data systems are increasing the quality of global tracking, as countries establish legal frameworks and institutional arrangements[3] for comprehensive data collection for energy supply and demand balances; implement end-user surveys (e.g., households, businesses, etc.); and develop quality-assurance frameworks.[4] The global tracking in this report is a collaboration by the several custodian agencies responsible for the SDG 7 targets, considering national data across the regions.[5] The purpose of this joint effort is to disseminate comparable datasets worldwide to improve the quality of global tracking.

The remainder of this summary is devoted to each of the major SDG 7 target areas: access to electricity, access to clean fuels and technologies for cooking, renewable energy, energy efficiency, and international public financial flows to developing countries in support of clean energy. The summary concludes with a word on the indicators and data used to track progress across targets.

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3 Institutional arrangements are set up to optimize data production, exchange, and governance across organizations and government agencies (statistical offices, energy ministries) responsible for implementing energy policies.

4 Quality-assurance frameworks should be consistent with the United Nations' International Recommendations for Energy Statistics. Under IRES (United Nations 2018), data quality is marked by relevance, accuracy, and reliability; timeliness and punctuality; coherence and comparability; and accessibility and clarity. For quality assurance frameworks, see IRES chapter 9.

5 The World Bank and the WHO are responsible for tracking progress toward SDG target 7.1 (universal access); the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), and the UN Statistics Division (UNSD) are responsible for SDG target 7.2 (renewables); IEA and UNSD are responsible for SDG target 7.3 (energy efficiency); IRENA and the Organisation for Economic Co-operation and Development (OECD) jointly tracked target 7.a (international cooperation); and IRENA is responsible for target 7.b (infrastructure and technology).

ACCESS TO ELECTRICITY

Summary of outlook chapter. IEA's Stated Policies Scenario projects that 670 million people would still lack access to electricity in 2030—10 million more than last year's projection. The COVID 19 pandemic is projected to slow the rate of new access, particularly for stand-alone systems. In contrast, grid and mini-grid connections are projected to remain resilient during the pandemic in some regions. The outlook for countries without institutions in place to address access thus appears unpromising. Between 2020 and 2030, the connection rate needs to reach an average of 100 million a year, including 80 million in Africa, where the rate of new connections needs to triple.

* * *

The share of the world's population with access to electricity (SDG 7.1.1) rose from 83 percent in 2010 to 91 percent in 2020, an increase of approximately 1.3 billion people globally.[6] The number of people without access to electricity dropped from 1.2 billion people in 2010 to 733 million in 2020.

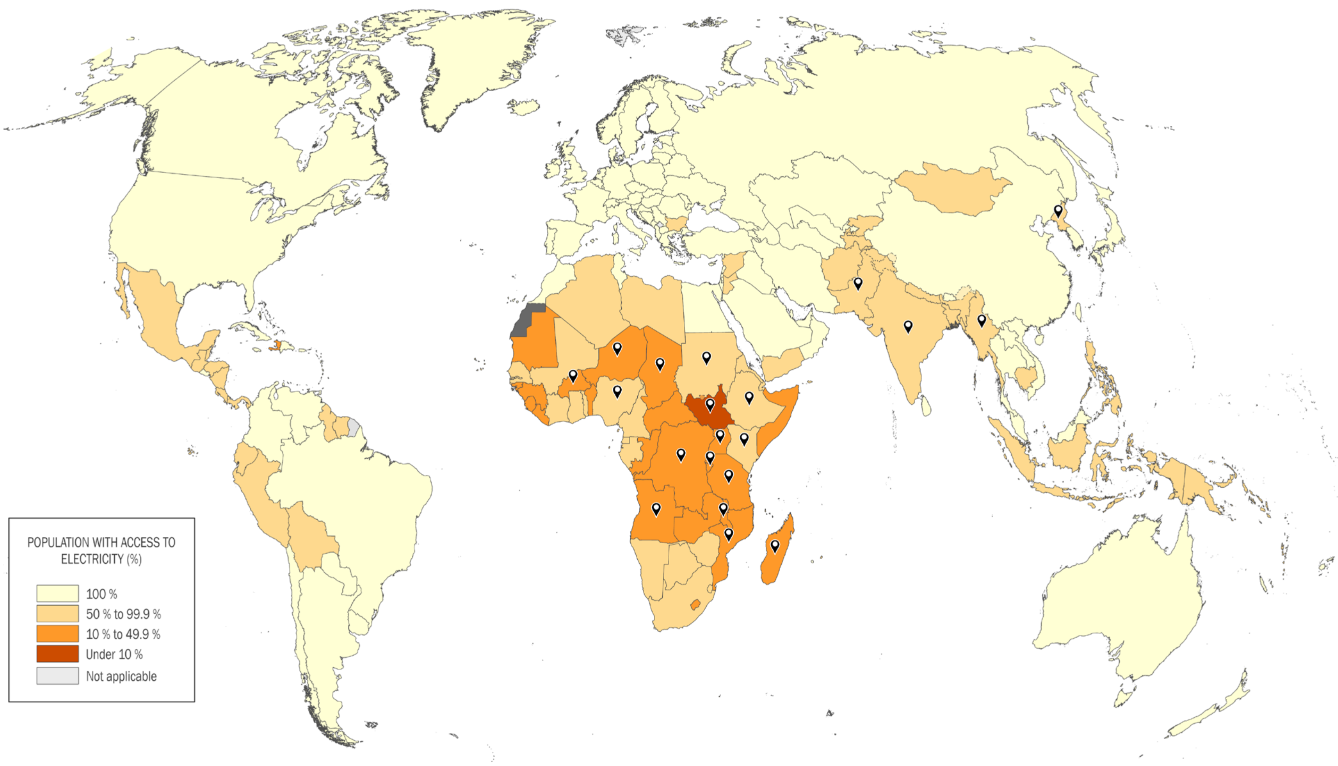
The pace of progress in electrification slowed in recent years, however, because of the increasing complexity of reaching more remote and poorer unserved populations and the expected impact of the COVID-19 pandemic. Between 2010 and 2018, an average of 130 million people gained access to electricity each year. That figure fell to 109 million between 2018 and 2020. The annual rate of increase was 0.8 percentage points between 2010 and 2018. It shrank to just 0.5 percentage points in 2018–20. Even so, the increase in electrification outpaced population growth at a global scale. The COVID-19 crisis has also increased concerns about the affordability of electricity. Under its weight, 90 million connected people in Africa and developing countries in Asia lost the ability to afford an extended bundle of energy services in 2020 (IEA 2021c).

Global access to electricity has increased since 2010, but regional disparities remain wide (figure ES.2). Between 2010 and 2020, every region in the developing world showed consistent progress in electrification.[7] Sub-Saharan Africa remained the least electrified region. Among people without access to electricity, 77 percent—about 568 million people—lived in Sub-Saharan Africa in 2020. Electricity access in that region rose from 46 percent in 2018 to 48 percent in 2020, an annual growth rate of 1 percentage point. However, COVID-19 was anticipated to undermine the pace of progress in the region. Other regions, such as Central and Southern Asia, witnessed declines in their access deficits, despite COVID-19.

6 In this report, access to electricity (also referred to as electrification or the electrification rate) refers to the share of the population with access to electricity over a specified time period or geographic area. It is defined as the ability of the end user to consume electricity for desired services.

7 UN classifications are used for the country groupings in this report (see https://unstats.un.org/unsd/methodology/m49/).

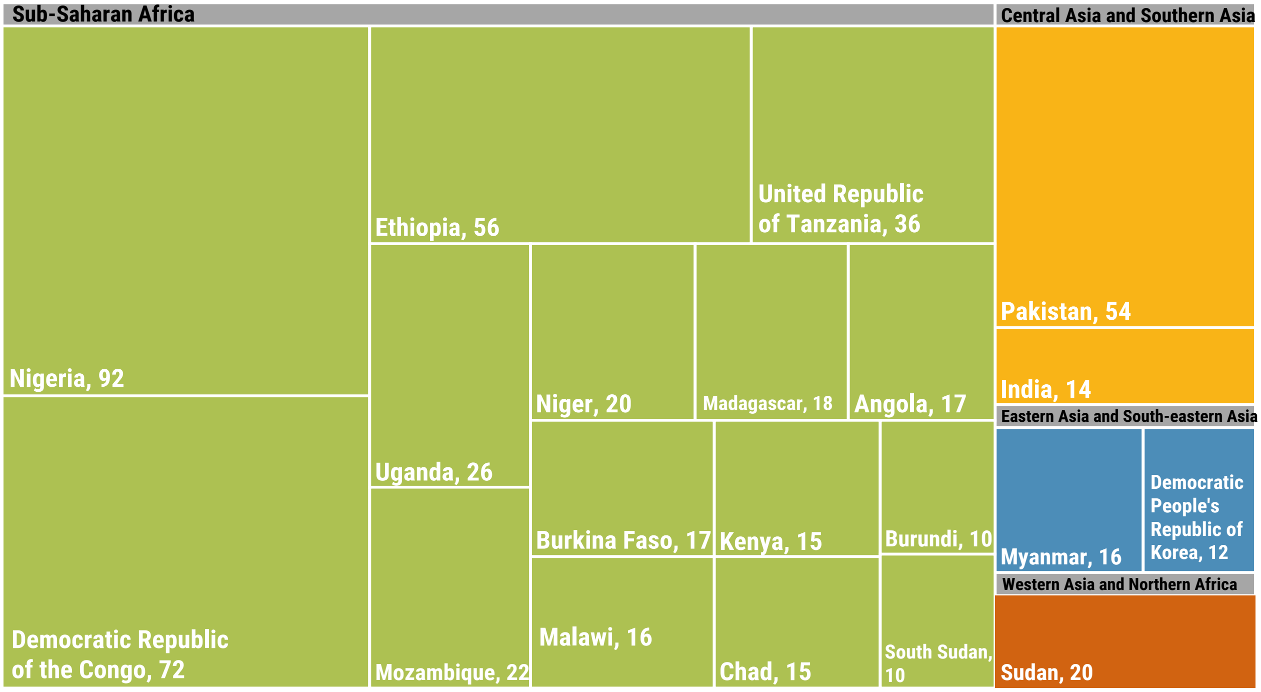
FIGURE ES.2 • Share of population with access to electricity in 2020



Source: World Bank 2022.

The 20 countries with the largest access deficits were home to 76 percent of the entire global population living without access to electricity in 2020 (figure ES.3). Closing the access gap by 2030 hangs on electrification efforts in these 20 countries. Most of the top 20 were in Sub-Saharan Africa. The largest unserved populations are in Nigeria (92 million people), the Democratic Republic of Congo (72 million), and Ethiopia (56 million). Access growth outpaced population growth in Ethiopia between 2010 and 2020; it did not do so in Nigeria and the Democratic Republic of Congo, where electrification failed to keep pace with population growth. In contrast, Kenya and Uganda made the fastest progress in electrification among the top 20, with annualized increases of more than 3.0 percentage points between 2010 and 2020.

FIGURE ES.3 • Number of people without access to electricity in top 20 access-deficit countries, 2020 (millions)



Source: World Bank 2022.
Note: A country's access deficit is the number of people in the country that lack access to electricity.

Differences are also observable in terms of urban versus rural access to electricity. Around 80 percent of the world's people without access to electricity lived in rural areas in 2020, limiting their opportunities to access quality public services (e.g., healthcare), rise out of poverty, and improve their livelihoods. About 75 percent of the world's rural population without access lived in Sub-Saharan Africa. Starting from this low base of access, the pace of electrification was faster in rural areas than in urban areas over the past decade. Access in rural areas increased from 72 percent in 2010 to 83 percent in 2020, outpacing population growth. Globally, the urban access rate has been much higher: 97 percent since 2016. The urban access rate grew faster in Sub-Saharan Africa than in any other region, with annual growth of 1 percentage point between 2010 and 2020, though starting from a significantly lower rate than other regions.

The least-developed countries significantly lag the rest of the world in access to electricity, with an average access rate of 55 percent—a gap of 36 percentage points compared with the global average of 91 percent.[8] More than half of the global population without access (479 million people) lived in least-developed countries in 2020. Only 44 percent of people living in rural areas of least-developed countries had access to electricity. In fragile and conflict-affected countries, where the overall access rate was 55 percent in 2020, gains in electrification kept pace with population growth in 2018–20, leaving 417 million people without access to electricity.[9]

Because of the continuing socioeconomic impact of the COVID-19 pandemic, additional dynamics from climate change and weather events, and the complexities of reaching the "last mile" (that is, rural populations far from the grid), closing the access gap will become increasingly challenging. The global electricity access rate needs to increase by 0.9 percentage points each year to achieve universal access by 2030. If the current growth trend of 0.5 percentage points persists, it will derail progress toward the target of universal

8 The least-developed countries are a subset of low-income countries identified by the United Nations based on per capita gross national income, the Human Asset Index, and economic and Environmental Vulnerability Index.

9 The list of countries affected by violent conflict is based on the World Bank classification published in July 2021 (see https://thedocs.worldbank.org/en/doc/bb52765f38156924d682486726f422d4-0090082021/original/FCSList-FY22.pdf).

electricity access across the world. Robust policies and public financial support are critical to boost growth in electrification fast enough and far enough to leave no one behind, especially the most vulnerable.

Decentralized energy systems are vital to expanding access, especially in rural areas. The use of such solutions grew handily between 2010 and 2019. The number of people with access to decentralized solutions in Tier 1 and above (Tier 1+), including solar home systems and mini-grids, more than tripled, rising from 12 million in 2010 to 39 million in 2019 (IRENA 2021a).[10] In 2019, the main Tier 1+ systems were solar home systems, with mini-grids expanding fast. Off-grid solar markets came under pressure from the COVID-19 pandemic in early 2020. Although the industry has yet to fully recover to pre-COVID-19 levels, it has overall shown resilience since the disruptions, partly because relief funding was made available (GOGLA 2021).

Strong political commitments, better-targeted policies, disruptive technology and business models, and innovative financing tools have helped connect 1.3 billion people to power since 2010. But with only eight years left to achieve SDG target 7.1, governments and the international community face the challenge of drastically increasing the pace of progress in a context of high uncertainty and transition toward net-zero energy systems. Achievement of SDG 7.1 should be an integral part of the just energy transition and embedded in countries' socioeconomic development and climate commitments. The approaches best suited to achieve universal access are also advantageous for reaching net-zero emissions in a just and inclusive way and should be tailored to meet the needs of the least-developed countries. In the context of "building back better," access to electricity is essential not only for more inclusive, sustainable, and resilient growth, but for fully exploiting synergies with other SDGs.

10 According to IRENA, below Tier 1 indicates solar lights (< 11W). Tier 1 access includes solar home systems (11–50W), and small PV mini-grid access. Tier 2 access or higher includes large solar home systems (> 50W), large PV mini-grid access, and non-PV mini-grids.

ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING

Summary of outlook chapter. Unless clean cooking finds a lasting place on the global political agenda, more than 2.1 billion people will continue to rely on traditional uses of biomass, kerosene, or coal for cooking in 2030. This will have dramatic consequences for the environment, economic development, and health, particularly of women and children. As global fuel prices spiked during the recovery period, many governments intervened to maintain affordability of liquefied petroleum gas (LPG), but mounting subsidy burdens from before the pandemic are driving countries to phase out LPG fuel subsidies and contemplate fuel taxes to shore up accounts.

* * *

Increasing access to clean cooking must remain a top priority in the coming years. In 2020, 69 percent (64–73) of the global population had access to clean cooking fuels and technologies. Clean fuels as defined by WHO (2014) are electricity, liquefied petroleum gas, natural gas, biogas, and solar. Clean technologies are those fueled by clean fuels, as well as alcohol-fuel stoves. The remaining 31 percent, some 2.4 billion (2.1–2.7) people, are still cooking primarily with polluting fuels and technologies, such as charcoal, coal, crop waste, dung, kerosene, and wood. (Because of data limitations, this report refers to types of cooking fuel rather than cookstove and fuel combinations).

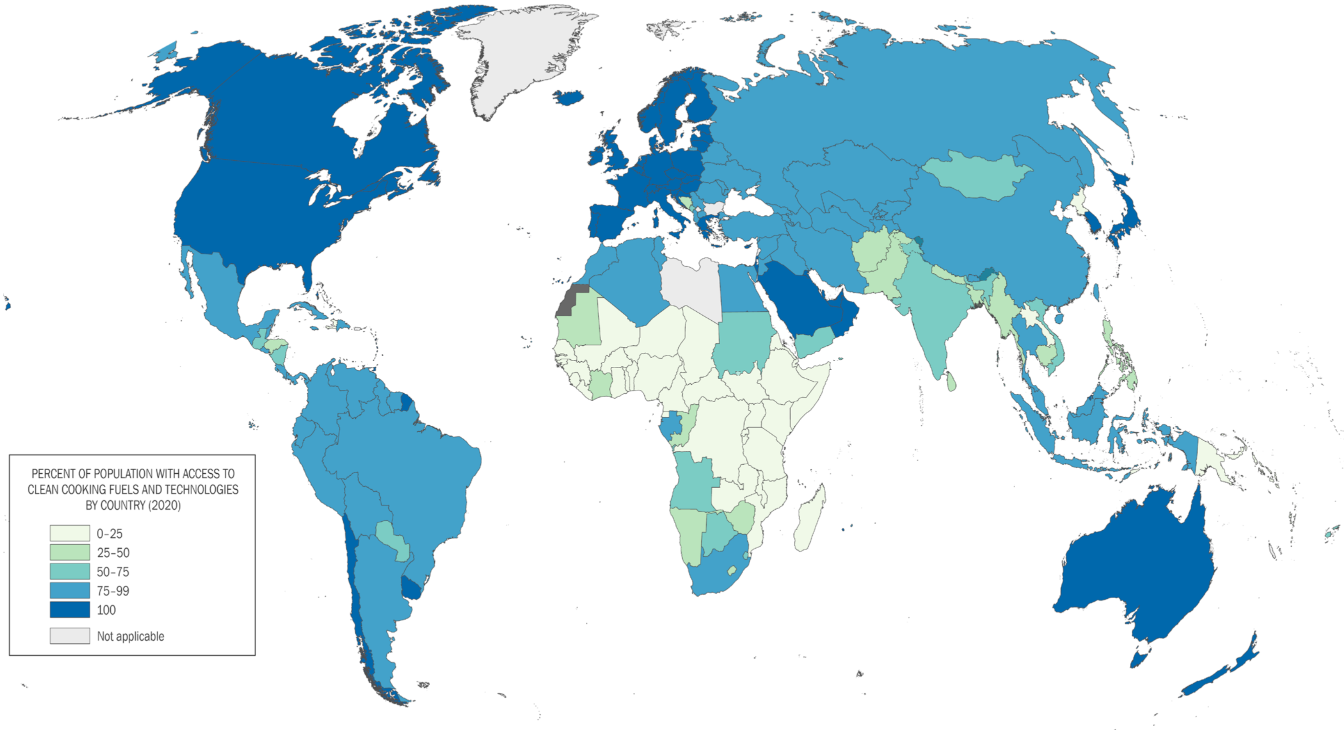
Use of inefficient fuels produces a range of health risks and climate-damaging effects. Greenhouse gas emissions from incomplete combustion of wood fuels for cooking paired with unsustainable harvesting amount to 1 gigaton of carbon dioxide per year, representing about 2 percent of global emissions, on par with emissions from aviation and shipping (Bailis, Broekhoff, and Lee 2016). Use of inefficient stoves and fuels also produces a range of short-lived climate pollutants, such as black carbon, which has a warming effect that is 460–1,500 times stronger than carbon dioxide (Climate and Clean Air Coalition 2020). New estimates of disease burdens indicate that 3.2 million deaths from diseases—including ischemic heart disease, stroke, pneumonia, chronic obstructive pulmonary disease, and cancers—were caused by household air pollution in 2019. Household air pollution accounted for the loss of an estimated 86 million healthy life years, with the largest burden falling on women living in low- and middle-income countries.

Global access to clean cooking is measured by identifying the proportions of the population who rely primarily on clean fuels and technologies. Some progress in the global access rate was made over the last two decades, but current trends indicate that, at present rates of progress, only around 75 percent of the population will have access to clean cooking fuels and technologies by 2030. These estimates are similar to those of the IEA Stated Policies Scenario[11], which suggests that 2.1 billion people will lack access in 2030.

From 2010 to 2020, global access to clean cooking fuels and technologies increased by 1 percentage point (0.5–1.8) a year. The increase was primarily driven by advances in large, populous countries in Asia (figure ES.4). From 2016 to 2020, the top 20 countries with the largest populations lacking access to clean cooking fuels and technologies accounted for more than 80 percent of the global population without access. In 16 of these 20 countries, less than half the population had access to clean cooking.

11 More details about the scenario are available here: https://www.iea.org/reports/sdg7-data-and-projections/access-to-clean-cooking

FIGURE ES.4 • Share of population with access to clean cooking fuels and technologies, by country, 2020



Source: WHO 2022.

Most of these countries have made little progress, with only five—India, China, Indonesia, Myanmar, and Nigeria—showing average access gains of 2 or more percentage points between 2016 and 2020. Central Asia and Southern Asia—along with Eastern Asia and South-eastern Asia—account for most of the gains in 2010–20. The annualized increase in access to clean cooking was 2.5 percentage points (0.5–4.3) in Central Asia and Southern Asia and 2.1 percentage points (0.8–2.1) in Eastern Asia and South-eastern Asia. Progress in Latin America and the Caribbean remained stable, at around 88 percent (85–91), with an average annual increase of 0.3 percentage points (–0.1–0.3) for the period 2010–20. Nineteen of the 20 countries with the lowest share of the population with access to clean cooking fuels and technologies were least-developed countries in Africa (the one country outside of Africa was Haiti). Marginal increases in access were seen in Sub-Saharan Africa, with annualized increases of 0.48 percentage points (0.2–0.5) over the period.

Large urban-rural discrepancies in access to clean cooking fuels and technologies exist worldwide. In 2020, 86 percent of people in urban areas have access to clean fuels and technologies compared with only 48 percent of the rural population.

In low- and middle-income countries, the use of gaseous fuels for cooking increased from 1.8 billion people (36 percent [31–41]) in 2000) to 3.4 billion people (52 percent [46–58]) in 2020, overtaking unprocessed biomass fuels as the dominant cooking fuel. Use of electricity for cooking also rose, from 140 million people (3 percent (2–4]) in 2000 to 690 million people (11 percent [7–15]) in 2020. In Eastern Asia and South-eastern Asia, 530 million people (25 percent of the population [15–37]) relied on electricity for cooking; in Central and Southern Asia, the number was just 24 million (1 percent of the population [0.7–2.5]).

Between 2000 and 2010, increases in the use of clean fuels were accompanied by steep declines in the use of coal, particularly in rural areas, where the use of coal dropped from 11 percent (7–17) in 2000 to 1 percent (0.1–2) in 2020, and kerosene, particularly in urban areas, where its use dropped from 8 percent (7–10) in 2000 to 2 percent (1–3) in 2020. The use of unprocessed biomass fuels (wood, crop waste, and dung) declined, primarily in rural areas, where use of such fuels dropped from 68 percent (63–72) in 2010 to 52 percent (45–59) in 2020.

These improvements notwithstanding, the pace of movement toward universal access to clean fuels and technologies has been slow. Business as usual is no longer possible. Clean cooking fuels must be made a top political priority with targeted policies. The COVID-19 pandemic has exacerbated the vulnerability of people lacking access to clean fuels and technologies. The economic crisis caused by the pandemic will undoubtedly have a further impact on household fuel use; in some countries it threatens to reverse the progress made thus far. However, the same crisis provides opportunities to advance joint efforts to ensure universal access to clean cooking by 2030.

RENEWABLE ENERGY

Summary of outlook chapter. Although the COVID-19 pandemic stalled many energy projects in 2020, the use of renewables continued to grow, accounting for more than 80 percent of all new electricity capacity added in 2020. Intensified policy support and cost reductions could push the share of modern renewables in TFEC to 32–38 percent by 2030, and renewables could account for 60–65 percent of electricity generation. However, much greater efforts will have to be made to increase the use of renewables for transport and heating if internationally agreed goals are to be met.

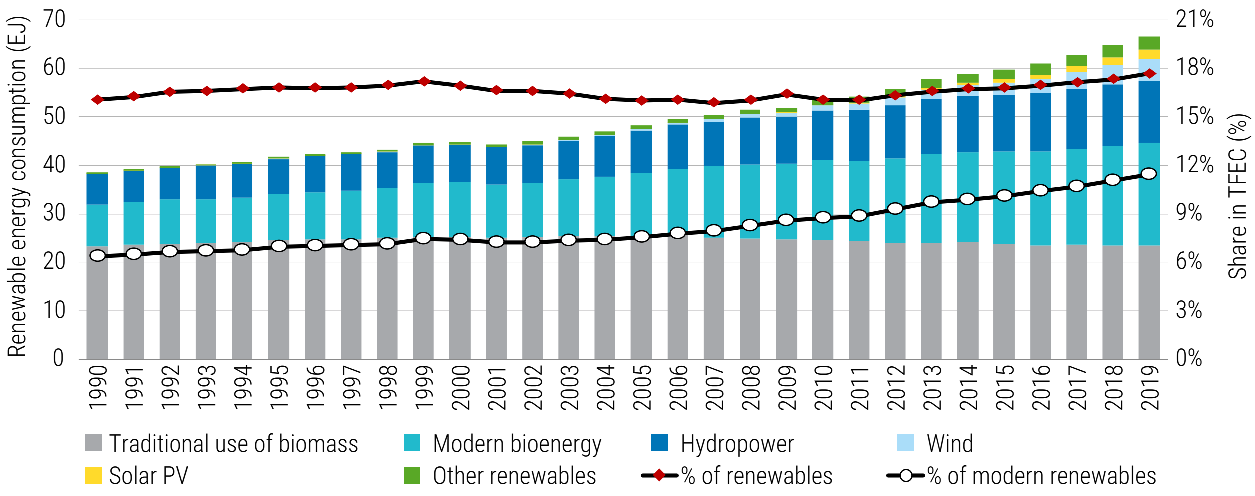
* * *

Ensuring access to affordable, reliable, sustainable, and modern energy for all requires accelerated deployment of renewable energy sources in electricity, heat, and transport. SDG target 7.2 for 2030 calls for "increasing substantially the share of renewable energy in the global energy mix." The main indicator used to assess progress toward SDG 7.2 is the share of renewable energy in TFEC. Current trends in renewable energy uptake need to scale up substantially to be in line with the ambition of SDG 7.

In 2019, the share of renewable energy sources in TFEC amounted to 17.7 percent—only 0.4 percentage points higher than the year before. Renewable energy consumption increased by 2.8 percent from the year before, as TFEC expanded by 0.7 percent. This suboptimal result underlines the importance of reducing energy consumption through energy efficiency and conservation if rapid progress is to be made toward SDG target 7.2. The largest increase in the share of renewables continues to be observed for electricity; the transport and heat sectors saw much slower progress.

Continuing its upward trend since 1990, renewable electricity use grew more than 5 percent year-on-year in 2019 (up from 3 percent in 2018), bringing the share of renewables in global electricity consumption to 26.2 percent (up from 25.3 percent in 2018). To meet the growing global demand for electricity, which rose 1.6 percent in 2019, nonrenewable electricity consumption grew as well, rising 0.4 percent, more slowly than renewables but from a significantly larger base, so that it accounted for 18 percent of the global annual increase in electricity consumption. Hydropower remains by far the largest source of renewable electricity globally, followed by wind, then solar PV, which recorded the fastest growth rate (figure ES.5). Together, wind and solar PV are responsible for 58 percent of the increase in renewable electricity consumption observed over the last 10 years.

FIGURE ES.5 • Renewable energy consumption by technology and share in total energy consumption, 1990–2019



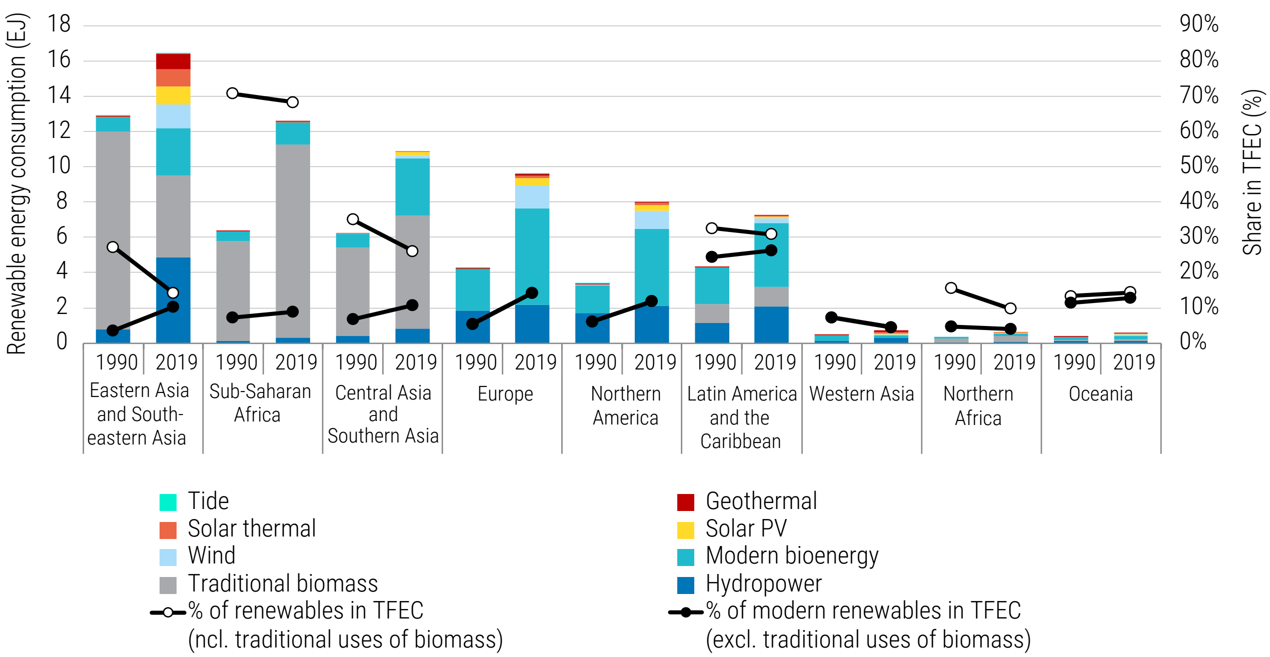
Source: IEA 2021a and UNSD 2021.

Renewable energy used for heating increased by 2.4 percent to 17.8 exajoules (EJ) in 2019, excluding traditional uses of biomass.[12] Traditional uses of biomass in 2019 remained roughly stable globally, accounting for over 13 percent (23.5 EJ) of global heat consumption. Overall, as global heat demand continued to increase (rising 0.3 percent year-on-year), the share of modern renewables in global heat consumption reached just 10.1 percent, an improvement of less than 2 percentage points in 10 years.

As in 2018, renewable energy used in transport grew, rising 7 percent to 4.4 EJ in 2019, the largest increase in absolute terms since 2012. The increase brought the total share of renewable energy to 3.6 percent, up from 3.4 percent in 2018. Biofuels, primarily crop-based ethanol and biodiesel, supplied 91 percent of the renewable energy used in transport. The expansion of renewable electricity and sales of electric vehicles are pushing up the use of renewable electricity in transport, which grew to 0.03 EJ in 2019, the second-largest increase in a single year after 2018.

Significant regional disparities lie behind these global improvements (figure ES.6). Sub-Saharan Africa has the largest share of renewable sources in its energy supply, though traditional uses of biomass represent more than 85 percent of the renewable total. Excluding traditional uses of biomass, Latin America and the Caribbean is the region with the largest share of modern renewables in TFEC, thanks to significant hydropower generation, the consumption of bioenergy in industrial processes, and the use biofuels for transport. In 2019, 44 percent of the global year-on-year increase in modern renewable energy consumption took place in Eastern Asia —essentially in China—where hydropower, solar PV, and wind dominated growth.

FIGURE ES.6 • Renewable energy consumption and share in total final energy consumption, by region, 1990 and 2019



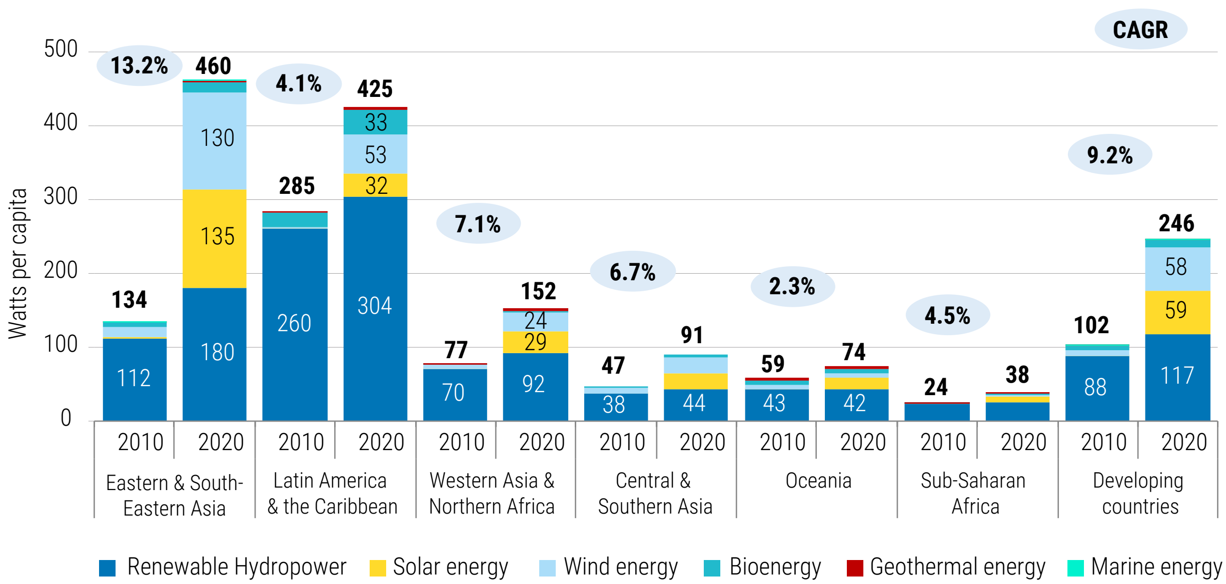
Source: IEA 2021a and UNSD 2021.

12 Owing to limited data availability at the global scale and the difficulty of quantifying the fraction of electricity consumption used to produce heat, this calculation does not account for renewable electricity used for heating and ambient heat harnessed by heat pumps.

Across countries, the share of renewable energy in TFEC varied widely. Between 2000 and 2019, the share of modern renewables in TFEC declined in 4 of the top 20 energy consuming countries—despite growing use of modern renewable energy in all of them—owing to increases in nonrenewable energy use. In 2019, Turkey showed the greatest progress in the share of modern renewables (2.3 percentage points), thanks to its increased hydropower generation, followed by the United Kingdom (1.3 percentage point), where wind power developments and the uptake of biofuels for transport played a leading role.

Indicator 7.B.1 tracks progress in enhancing installed renewables-based generating capacity in developing countries (figure ES.7). In 2020, a record 246 watts per capita of renewable capacity was installed in these countries, an annual growth rate of 11.6 percent. However, positive global and regional trajectories mask the fact that the countries most in need are being left behind. In developing countries as a whole, renewable capacity per capita rose by 9.5 percent a year in the last five years. Growth was much slower in landlocked developing countries (2.4 percent), the least-developed countries (5.2 percent), and small-island developing states (8.3 percent).

Figure ES.7 Capacity per capita, by technology for developing countries, 2000–20, and compound annual growth rate for selected years



Source: IRENA 2021b.

Despite continued disruptions in economic activity and supply chains following responses to the COVID-19 pandemic across the world, renewable energy has shown resilience, especially in the electricity sector. However, in 2021, rising commodity, energy, and shipping prices, in addition to restrictive trade measures, have increased the cost of producing and transporting solar PV modules, wind turbines, and biofuels, increasing uncertainty about renewable energy projects. Getting renewable deployment on track with SDG 7.2 and 7.B.1, as well as with the Paris Agreement, will require stronger policies in all sectors and more effective mobilization of private capital and the strategic use of public financing, particularly in developing countries.

ENERGY EFFICIENCY

Summary of outlook chapter. The rate of improvement in global primary energy intensity[13] has slowed in recent years, as work to replace China's most inefficient industrial facilities reached completion and the pandemic cut household and business spending on energy efficiency. New programs to encourage retrofits and upgrades and to strengthen appliance and building codes may overcome the slump. But to achieve SDG 7 by 2030 the annual rate of improvement in energy intensity will need to exceed 3.2 percent.

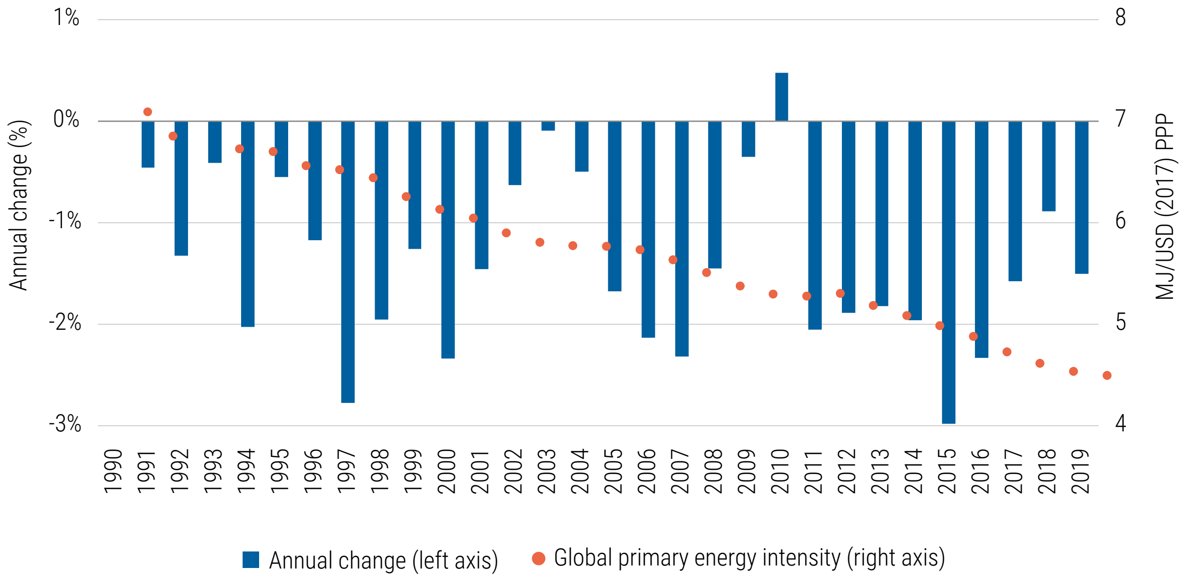
* * *

Achieving SDG target 7.3—doubling the global rate of energy intensity improvement by 2030—would support the other targets of SDG 7. Energy intensity is the ratio of total energy supply to the annual GDP created—in essence, the amount of energy used per unit of wealth created. It drops as energy efficiency improves.

Progress toward SDG target 7.3 is measured by tracking the year-on-year percentage change in energy intensity. Initially, the United Nations recommended an annual improvement rate of 2.6 percent to achieve the target. [14] But as global progress has been slower than it needed to be in all years except 2015, the annual average improvement rate now required to achieve the target of SDG 7.3 by 2030 is now 3.2 percent.

Energy intensity has increased since 1990 (figure ES.8).[15] Globally, it rose 1.5 percent in 2019, to 4.69 megajoules (MJ)/USD (2017 purchasing power parity). This rate of improvement was the second lowest since the global financial crisis, but it was still higher than the rate the previous year. Over 2010–19, annual energy intensity improvements averaged 1.9 percent.

Figure ES.8 • Global primary energy intensity and its annual change, 1990–2019



Source: IEA, UN, and World Bank (see footnote 15).
Note: MJ = megajoule; PPP = purchasing power parity.

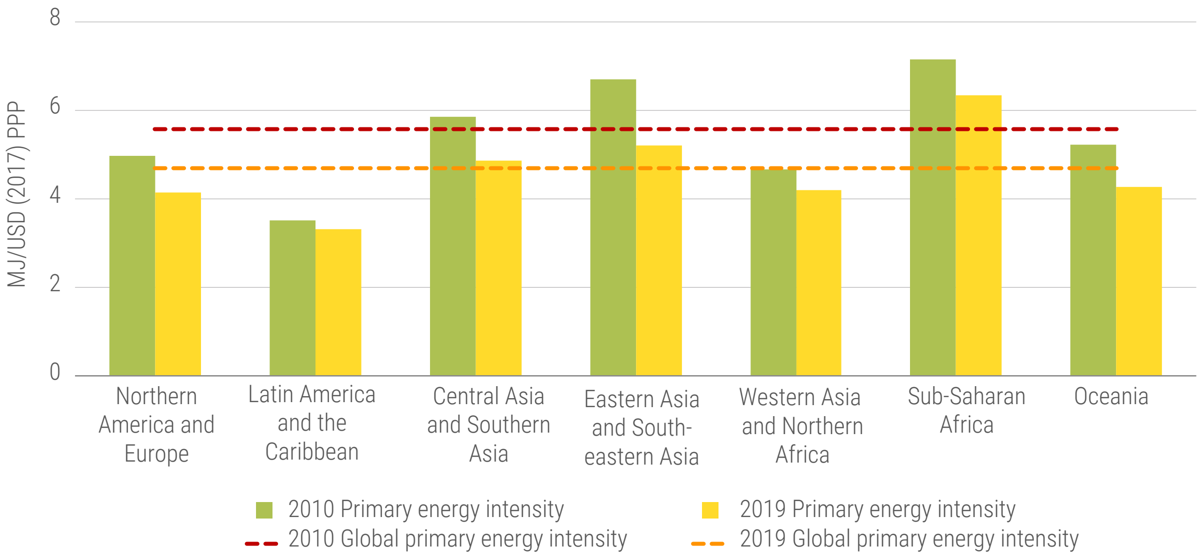
13 Hereafter referred to as "energy intensity". See note to figure ES.10 for the definition of energy intensity by sector.

14 Revisions of underlying statistical data and methodological improvements explain the slight changes in historical growth rates from previous editions. The SDG 7.3 target of improving energy intensity by 2.6 percent per year in 2010–30 remains the same, although the latest data for 1990–2010 show a rate of improvement in energy intensity of 1.2 percent per year.

15 Most of the energy data in this section come from a joint dataset built by the IEA (https://www.iea.org/data-and-statistics/) and the UNSD (https://unstats.un.org/unsd/energystats/). GDP data are sourced from the World Bank's World Development Indicators database (http://datatopics.worldbank.org/world-development-indicators/).

Although energy intensity has improved, stark differences are observable across regions (figure ES.9). The region of Eastern Asia and South-eastern Asia was the only one that overachieved the target of SDG 7.3 between 2010 and 2019, with energy intensity improving by an annual average rate of 2.7 percent, driven by strong economic growth. Average annual improvement rates in Oceania (2.2 percent), Northern America and Europe (2.0 percent), and Central Asia and Southern Asia (2.0 percent) were also above the global average and historical trends. The lowest rates of improvement were in Latin America and the Caribbean (0.6 percent), followed by Western Asia and Northern Africa (1.2 percent) and Sub-Saharan Africa (1.3 percent). Energy intensity in Sub-Saharan Africa is almost double the level in Latin America and the Caribbean, mirroring differences in economic structure, energy supply, and access rather than energy efficiency.

FIGURE ES.9 • Primary energy intensity, by region, 2010 and 2019



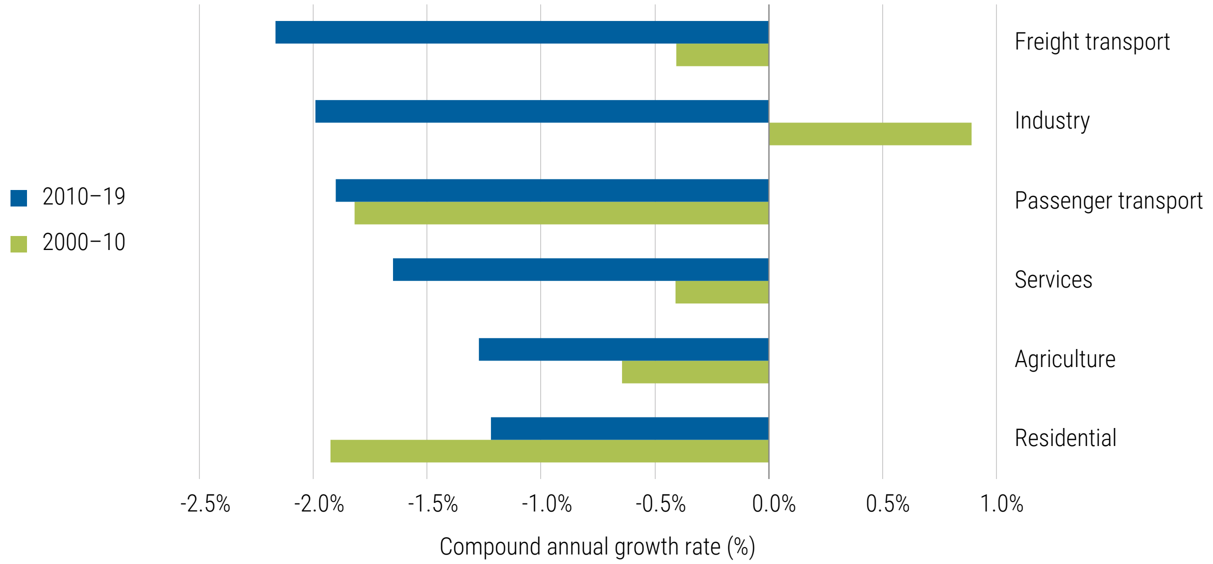
Source: IEA, UN, and World Bank (see footnote 15).
Note: MJ = megajoule; PPP = purchasing power parity.

Between 2000–10 and 2010–19, energy intensity increased in 13 of the 20 countries with the largest total energy supply. However, less than half of the top energy-consuming countries performed better than the global average. China continued to improve its primary energy intensity at the fastest rate (3.8 percent between 2010 and 2019), followed by the United Kingdom (3.7 percent). Japan and Germany also continued to improve their energy intensity at rates beyond the SDG 7.3 target, thanks to decades of work on energy efficiency and a shift in their economies toward producing high-value, low-energy goods and services. Indonesia is the only emerging economy other than China with an average energy intensity rate exceeding the SDG 7.3 target.

Using different intensity metrics,[16] the rate of improvement accelerated across all sectors between 2010 and 2019, except for residential buildings (figure ES.10). The freight transport sector experienced the highest rate of improvement, followed by the industry sector. Mitigating the effects of the growing demand for cooling, heating, and appliances in residential buildings requires better enforcement of building energy codes, especially in emerging economies, where a large share of new housing is being built.

16 See note to figure ES.10 for details.

Figure ES.10 • Compound annual growth rate of energy intensity by sector, 2000–10 and 2010–19



Source: IEA, UN, and World Bank (see footnote 15).
Note: The measures for energy intensity used here differ from those applied to global primary energy intensity. Here, energy intensity for freight transport is defined as final energy use per metric ton-kilometer; for passenger transport, it is final energy use per passenger-kilometer; for residential use, it is final energy use per square meter of floor area; for services, industry, and agriculture, energy intensity is defined as final energy use per unit of gross value added (in 2017 U.S. dollar purchasing power parity). Over time, it would be desirable to develop more refined sectoral and end-use level energy intensity indicators that make it possible to look at energy intensity by industry or end-use. Doing so will not be possible without more disaggregated data and statistical collaboration with the relevant energy-consuming sectors.

The impact of improvements in energy intensity is revealed by trends in its components. Between 1990 and 2019, global GDP increased by a factor of 2.5, while global total energy supply grew by two-thirds.[17] Consistent improvements in global energy intensity, which fell by more than a third between 1990 and 2019, signal trends in the decoupling of energy use from economic growth.

Improving energy efficiency at scale will be a key factor in achieving affordable, sustainable energy access for all. Stronger government policies on energy efficiency are needed to bring the target within reach.

17 "Total primary energy supply" has been renamed "total energy supply," in accordance with the International Recommendations for Energy Statistics (UN 2018).

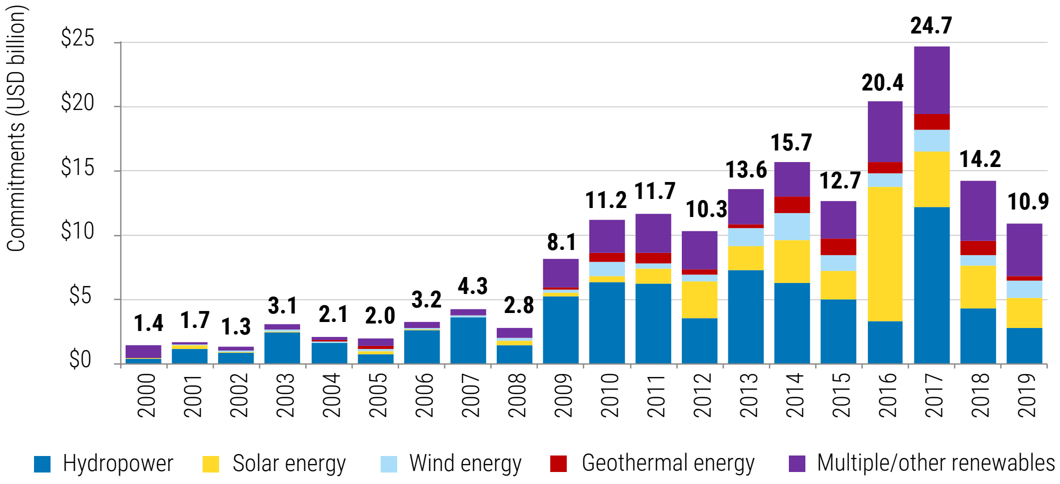
INTERNATIONAL PUBLIC FINANCIAL FLOWS TO DEVELOPING COUNTRIES IN SUPPORT OF CLEAN ENERGY

Summary of outlook chapter. The level of international public financing available for energy projects supporting the realisation of SDG 7 in developing countries is still insufficient to mobilize the larger volumes of investment needed to reach the target. Enhancing international flows, leveraging public funds strategically, using concessional finance to de-risk investments and mobilize more private capital into climate solutions are key area for action. Clean energy investment worldwide will need to ramp up significantly according to IEA's Net Zero Emissions by 2050 Scenario and IRENA's 1.5°C Scenario, with much of the investment being directed to renewables and efficiency.

* * *

Although the private sector finances most renewable energy investments, the public sector remains a critical source of finance, particularly for many developing countries. International public financial flows to developing countries in support of clean energy decreased in 2019 for the second year in a row, falling to USD 10.9 billion. This level of support was 23 percent less than the USD 14.2 billion provided in 2018, 25 percent less than the 2010–19 average, and less than half of the peak of USD 24.7 billion in 2017. Except for large fluctuations in 2016 for solar energy and 2017 for hydropower, the flows remain within the range of USD 10–16 billion per year since 2010 (figure ES.11). A five-year moving average trend shows that average annual commitments decreased for the first time since 2008 by 5.5 percent from USD 17.5 billion in 2014–18 to USD 16.6 billion in 2015–19. The level of financing remains below what is needed to reach SDG 7, in particular for the least-developed countries, landlocked developing countries, and small-island developing states.

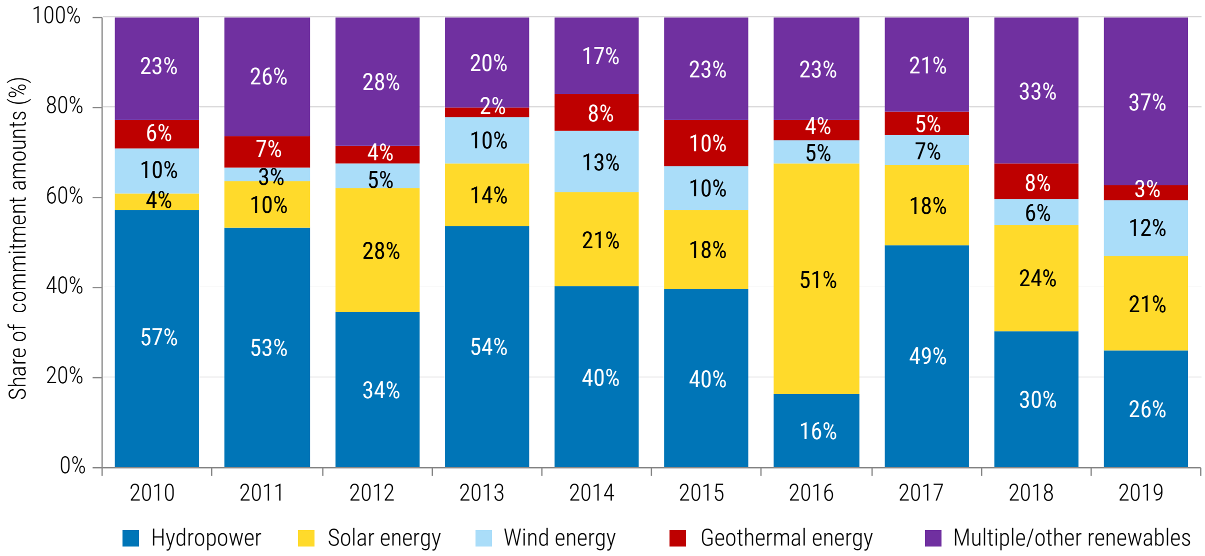
FIGURE ES.11 • Annual international public financial commitments to developing countries in support of clean energy research and development and renewable energy production, by technology, 2000–19



Source: IRENA and OECD 2022.
Note: Multiple/other renewables includes commitments whose descriptions are unclear in the financial databases; commitments that target more than one technology with no details specifying the financial breakdown for each; bioenergy commitments, which are almost negligible; multipurpose financial instruments such as green bonds and investment funds; and commitments targeting a broad range of technologies. Examples of the latter include renewable energy and electrification programs, technical assistance activities, energy efficiency programs, and other infrastructure supporting renewable energy.

The distribution of flows by technology in 2019 is similar to those in 2018 (figure ES.12). Hydropower attracted the bulk of flows (26 percent), followed by solar energy (21 percent) and wind energy (12 percent). Geothermal energy received a little over 3 percent of commitments in 2019. Compared with 2018, the share of wind energy commitments increased by 6 percentage points, while the share of commitments to the other technologies saw a decrease, as commitments increasingly fall into the "multiple/other renewables" category (see note to figure ES.11), reflecting growing interest in energy funds, green bonds, and other government-led programs to support renewables, energy efficiency and electricity access.

FIGURE ES.12 • Shares of annual commitments, by technology,2010–19



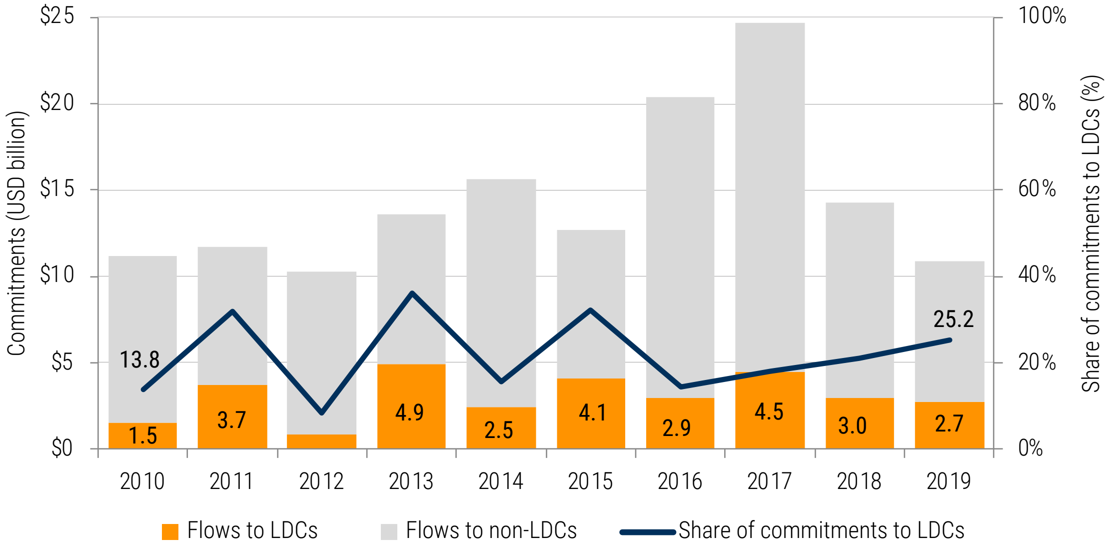
Source: IRENA and OECD 2022.

Geographically, most regions saw a decrease in international public flows in 2019. Flows increased only in Oceania, where they rose by 72 percent (USD 55.1 million). Decreases were less significant in Sub-Saharan Africa, where they fell 1.7 percent to USD 4.0 billion. Flows to Western Asia and Northern Africa decreased by 22 percent to USD 1.8 billion. The bulk of decreases were concentrated in Eastern and South-eastern Asia, where they fell 66.2 percent; Latin America and the Caribbean, where they dropped by 29.8 percent; and Central and Southern Asia, where they declined by 24.5 percent.

In 2019, 24 countries received 80 percent of all commitments. Nigeria, Guinea, and India were the top recipients, attracting a quarter of commitments. Guinea was also a top recipient in 2018, thanks to a USD 1.1 billion commitment to the Souapiti Hydro Project.

Last year's report highlighted the difference in flows directed to emerging markets in developing countries and those farthest behind, as categorized by the United Nations. In 2021, the same countries belonged to the groups of least-developed countries, landlocked developing countries, and small-island developing states, but commitments directed to these countries varied widely by group (figure ES.13). The least-developed countries received 25.2 percent of commitments in 2019, an increase from the 21 percent in 2018, continuing an upward trend since 2016 but masking a 9 percent decrease from USD 3.0 billion to USD 2.7 billion in absolute amounts. Among the 46 least-developed countries, São Tomé and Príncipe, Eritrea, and Kiribati were the only ones that did not receive any flows in 2019. Chad and Timor-Leste did receive funding in 2019, after receiving no commitments in 2018.

FIGURE ES.13 • Annual commitments to least-developed countries and non-LDCs in support of clean energy, 2010–19



Source: IRENA and OECD 2022.
LDCs = least-developed countries.

Models show a significant gap between current investment levels and the levels needed to achieve an energy transition commensurate with the imperatives of sustainable development and abating climate change. Global investments in renewable power generation need to reach USD 1 trillion a year by 2030 (IEA 2021b; IRENA 2021)—about three times the USD 367 billion estimated to have been invested in 2021 (IEA 2021d).[18] Private investors provided more than 85 percent of investments in new renewable energy projects between 2013 and 2018. They will likely continue to provide most of the increased funding.

Governments and international donors will continue to play major roles in encouraging investments in renewable assets, especially in developing countries, where real or perceived risks contribute to the high cost of financing or prevent projects from seeing the light of day. The strategic use of public finance remains key for creating an enabling environment for private investments, developing the needed infrastructure, and addressing perceived risks and barriers to attracting private capital. In addition, funding will be needed to implement policies—capacity-building, education, retraining, and industrial policies—that ensure just and inclusive energy transitions.

18 For more on the investment needed to reach SDG 7, see chapter 6.

TRACKING PROGRESS ACROSS TARGETS: INDICATORS AND DATA

Enhanced energy statistics help countries monitor their progress. The global tracking in this report comes from collaboration among the custodian agencies responsible for the SDG 7 targets. The purpose of this joint effort is to compile and disseminate comparable datasets worldwide.[19] The last section of each chapter of this report includes additional information on the methodologies and approaches used to assess progress on SDG 7.

These statistical tools and methods make it possible to track global progress toward SDG 7 based on collaboration between national statistical offices and relevant international or regional organizations using optimized and standardized data-collection resources. For example, household surveys can be designed to support tracking across SDG 7 targets and even other SDG targets, such as health, air pollution, and quality of life. The World Bank and the WHO have prepared a guidebook to integrate energy access questions into existing national household surveys.[20]

This will be a long-term process. Much more support is needed to develop statistical capacity in countries and regions.

19 The United Nations' metadata repository for SDG 7 indicators is available at https://unstats.un.org/sdgs/metadata/.

20 The Living Standards Measurement Study guidebook for measuring energy access is available at https://documents.worldbank.org/en/publication/documents-reports/documentdetail/557341633679857128/measuring-energy-access-a-guide-to-collecting-data-using-the-core-questions-on-household-energy-use.

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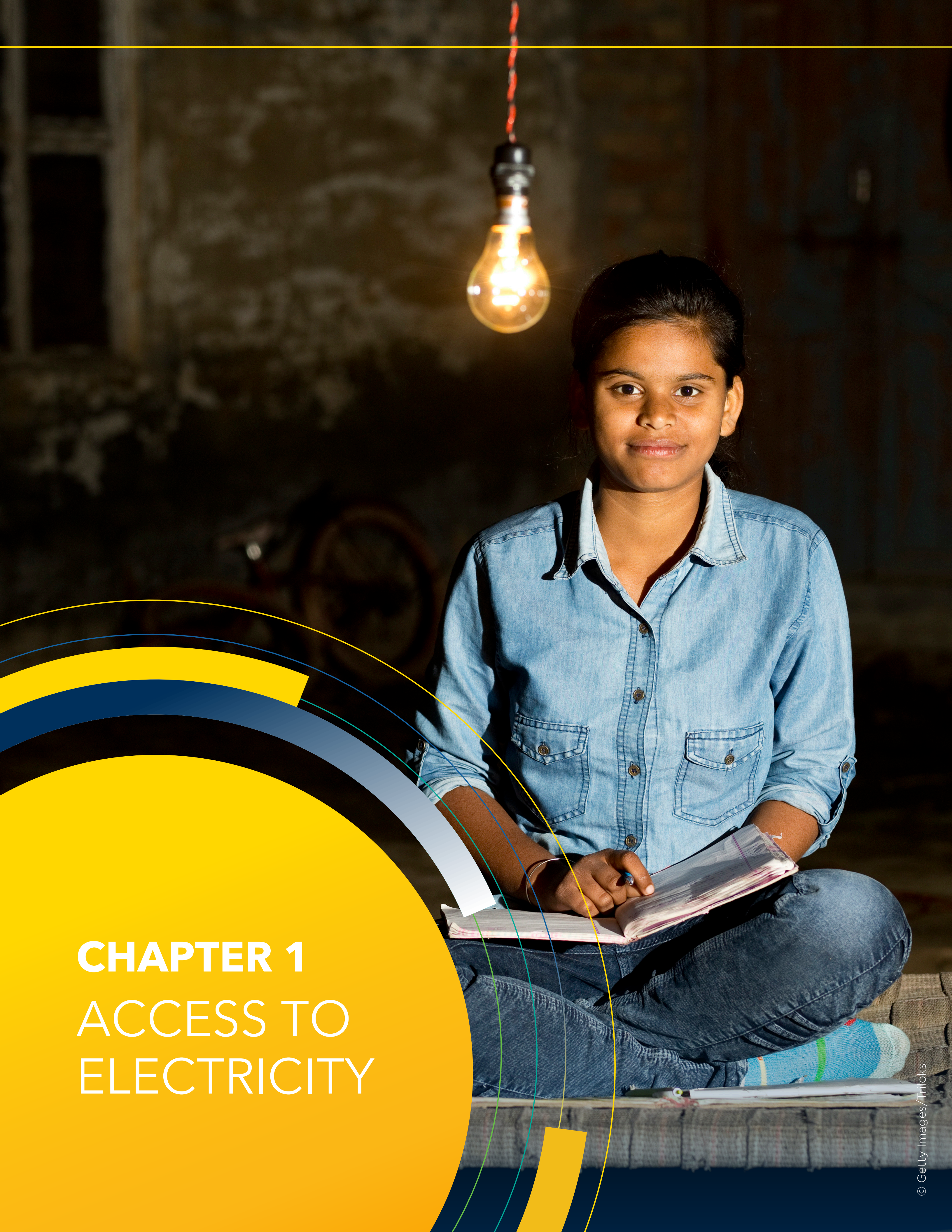

CHAPTER 1
ACCESS TO ELECTRICITY

MAIN MESSAGES

- **Global trend:** The share of the world's population with access to electricity rose from 83 percent in 2010 to 91 percent in 2020,[1] increasing the number of people with access by 1.3 billion globally. The number without access declined from 1.2 billion people in 2010 to 733 million in 2020. However, the pace of progress in electrification has slowed in recent years because of the increasing complexity of reaching more remote and poorer unserved populations and because of the expected impact of the COVID-19 pandemic. From 2010 to 2018, 130 million people gained access to electricity each year, on average; that figure fell to 109 million between 2018 and 2020. The annual rate of growth in access was 0.8 percentage points between 2010 and 2018 but fell to 0.5 percentage points in 2018–20.
- **Target for 2030:** To meet the target of Sustainable Development Goal (SDG) 7.1 to achieve universal electricity access by 2030, the pace of electrification needs to accelerate significantly, especially given the slowdown observed in 2018–20. Without further efforts to reach the poorest and most remote, 670 million people are projected to remain without access in 2030 (IEA 2021).[2] To reach universal access by 2030, the annual growth rate in global electrification will have to increase by 0.9 percentage points. Especially, the number of customers connected each year in the least-developed countries (LDCs) will have to triple from 23 million in 2000–18 to 63 million in 2019–30 (RMI and OHRLLS 2021). The interplay of robust policies and financial support is critical to boosting growth in electrification to leave no one behind, especially the most vulnerable.
- **Regional highlights:** Between 2010 and 2020, every region of the world showed consistent progress in electrification, but with wide disparities.[3] Despite the effects of COVID-19 on the SDG 7 trajectory, electricity access in Sub-Saharan Africa rose from 46 percent in 2018 to 48 percent in 2020, an annual growth rate of 1 percentage point. However, the slowdown of improvements in the period, possibly owing to COVID-19, undermined the pace of progress. Sub-Saharan Africa accounted for more than three-quarters of the people (568 million people) who remained without access in 2020. The region's share of the global access deficit rose from 71 percent in 2018 to 77 percent in 2020, whereas most other regions, including Central and Southern Asia (the second-largest access-deficit region), saw declines in their share of the access deficits.[4]
- **Urban-rural divide in electricity access:** Although rural areas have much larger access deficits than urban areas, the pace of rural electrification was faster than that of urban electrification over the past decade. Access in rural areas increased from 72 percent in 2010 to 83 percent in 2020, outpacing population growth. However, about 80 percent of the world's people without access to electricity lived in rural areas in 2020, three-quarters of them in Sub-Saharan Africa. For them, lack of access limits the ability to improve livelihoods, secure high-quality public services (e.g., healthcare), and rise out of poverty. Globally, the urban access rate has plateaued at 97 percent since 2016. The urban electrification grew faster in

1 In this report, access to electricity (also referred to as "electrification" or "the electrification rate") refers to the share of the population with access to electricity over a specified time period or geographic area. It is defined as the ability of the end user to consume electricity for desired services.

2 Because data through the end of 2020 are included in this edition, in cases where the access trend could be affected by the COVID-19 impact the projection has been revised upward compared with the 2021 the Tracking SDG 7 report.

3 UN classifications are used for the country groupings used in this report (https://unstats.un.org/unsd/methodology/m49/).

4 In this chapter, "access deficit" is defined as the number of people without access to electricity.

Sub-Saharan Africa than in any other region, with annual growth of 1 percentage point between 2010 and 2020, although from a much lower base than in other regions. But the electrification rate in urban areas of the region has been lower than in other regions since 2010, and it stood at 78 percent in 2020. At the current pace, global rural access will fall short of the 2030 target, while urban access will be close to universal.

- **Top 20 access-deficit countries:** The 20 countries with the largest access deficits were home to 76 percent of the global population living without access to electricity (or 560 million people) in 2020. Most of the top 20 deficit countries are in Sub-Saharan Africa. The largest unserved populations are in Nigeria (92 million people), the Democratic Republic of Congo (72 million), and Ethiopia (56 million). The gains in the electrified population outpaced population growth in Ethiopia between 2010 and 2020; the same cannot be said of the Democratic Republic of Congo and Nigeria, where electrification advances failed to keep pace with population growth. Meanwhile, Kenya and Uganda made the fastest progress in electrification, with annualized increases of more than 3 percentage points between 2010 and 2020.[5]
- **Electrification patterns across socioeconomic segments:** Reversing poverty in its multi-dimensional aspects will depend on improving access to electricity. Access deficits are heavily concentrated in vulnerable countries. LDCs faced challenges in accelerating their pace of electrification, with an average access rate of 55 percent in 2020, representing more than half of the global population still without access (or 479 million people).[6] Likewise, countries suffering from fragility, conflict, and violence managed to electrify only 55 percent of their population, leaving 417 million people unserved in 2020.[7]
- **Decentralized renewable energy:** The number of people enjoying access to electricity through decentralized renewable energy increased between 2010 and 2019. Those with access to decentralized solutions in Tier 1 or above (Tier 1+)—including solar home systems and mini-grids—more than tripled, rising from 12 million in 2010 to 39 million in 2019 (IRENA 2021).[8] Off-grid solar markets came under pressure from the COVID-19 pandemic in early 2020. Although the industry has yet to return to pre-COVID-19 levels, it has shown overall resilience since the disruptions (GOGLA 2021a).
- **Affordability of electricity:** The COVID-19 crisis has increased concerns about the affordability of electricity. Before the pandemic, almost half of people without access in Sub-Saharan Africa did not have the ability to pay for an essential bundle of services, and 700 million people with access in Africa and developing countries in Asia could not afford an extended bundle of services (IEA 2021).[9] Under the weight of COVID-19, an additional 90 million connected people in Africa and developing countries in Asia were unable to afford an extended bundle of energy services in 2020. Addressing affordability challenges requires tailored end-user financing to both expand and keep household electricity connections.

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5 In Kenya and Uganda, 15 million and 26 million people lacked access to electricity in 2020.

6 LDCs are a subset of low-income countries identified by the United Nations based on per capita gross national income, the Human Asset Index, and economic and the Environmental Vulnerability Index.

7 The list of countries affected by violent conflict is based on the World Bank classification published in July 2021 (https://thedocs.worldbank.org/en/doc/bb52765f38156924d682486726f422d4-0090082021/original/FCSList-FY22.pdf).

8 According to IRENA (2018), below Tier 1 indicates solar lights (<11W). Tier 1 access for the whole household includes small solar home systems (11–50W), and small PV mini-grid access. Tier 2 access or better includes large solar home systems (>50W), large PV mini-grid access, and non-PV mini-grids.

9 An essential bundle includes four lightbulbs operating for four hours per day, a television for two hours and a fan for three hours. An extended bundle of services includes four light bulbs operating for four hours per day, a fan for six hours per day, a radio or television for four hours per day, and a refrigerator.

ARE WE ON TRACK?

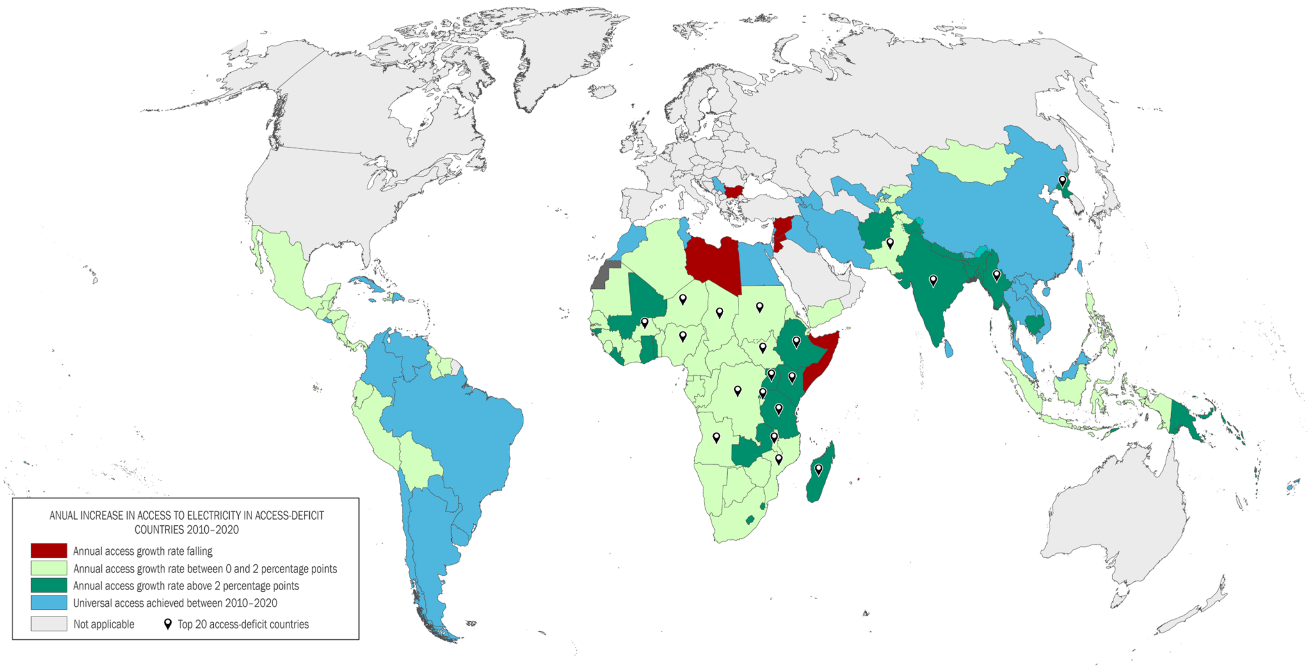
In 2020, 91 percent of the global population had access to electricity, leaving 733 million people still unserved (figure 1.1). Given the sluggish pace of growth in access over the past two years considering the COVID-19 crisis, the share of the population having universal access in 2030 is expected to be just 92 percent, leaving some 670 million people without access (IEA 2021). The shortfall in reaching the SDG target of universal access is driven mainly by the complexities of bringing service to very vulnerable and poor populations. Between 2010 and 2020, 1.3 billion people became connected—an average of 125 million people a year. This progress outpaced annual population growth of 83 million people. Between 2018 and 2020, the access rate rose from 90 percent to 91 percent. During this period, gains in access still outpaced annual population growth of 80 million, but only 109 million people became connected each year, against an annual average of 130 million people in 2010–18.

Figure 1.1 • Percentage of population with access to electricity

Source: World Bank 2022; IEA 2021.

Between 2010 and 2020, 45 countries reached universal access; 19 of them in Latin America and the Caribbean (figure 1.2). As of 2020, 91 countries still had not reached universal access. Sub-Saharan Africa comprised a large proportion of the world's unelectrified population. There, an average of 25 million people gained access to electricity each year between 2010 and 2020, keeping pace with the annual population increase of 26 million. During this period, about a third of access-deficit countries, including 8 of the 20 with the largest numbers of underserved people, had annual access growth rates of more than 2 percentage points. Over this period, 71 percent of access-deficit countries had annual access growth rates of less than 2 percentage points, including 7 countries in which access declined.

Figure 1.2 • Annual change in electricity access rate in access-deficit countries, 2010–20



Source: World Bank 2022.

LOOKING BEYOND THE MAIN INDICATORS

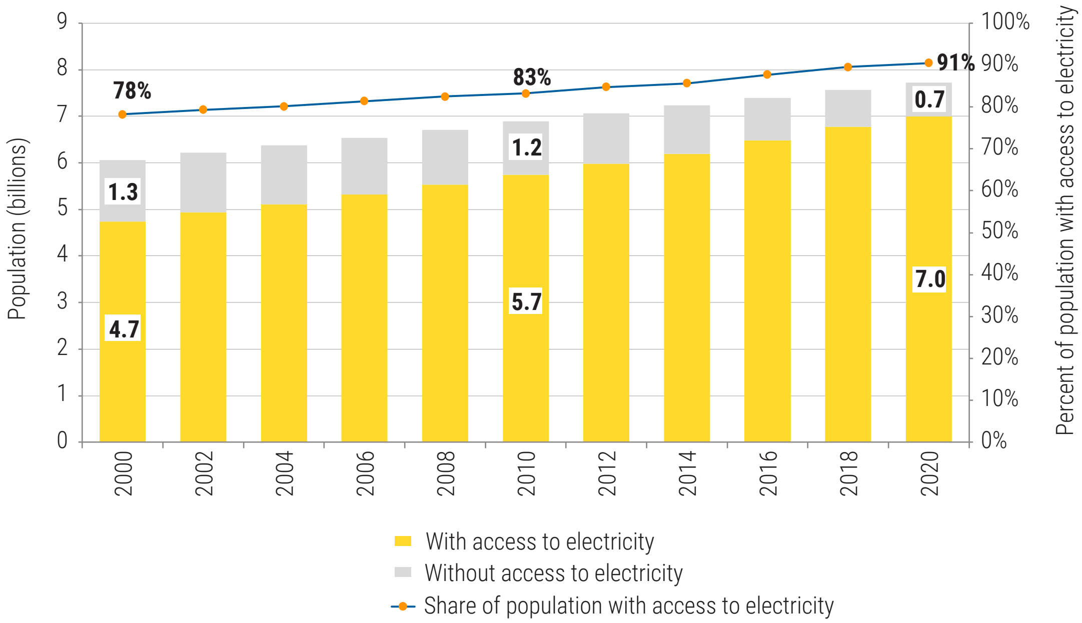
This chapter reviews progress in access to electricity by considering socioeconomic electrification patterns across regions and countries, using data for 2000–20. The purpose of the analysis is to examine global efforts to reach the target of universal access by 2030 and to ensure continuous gains in electrification worldwide. In addition to the analytical findings, the chapter provides policy insights into electrification efforts and their contribution to a sustainable recovery from the COVID-19 pandemic. The methodology used to compile the database is presented at the end of the chapter.

ACCESS AND POPULATION

The global electricity access rate rose continuously between 2010 and 2020, from 83 percent to 91 percent (figure 1.3). During the period, the pace of annual growth in access was faster than in the previous decade (figure 1.4). However, the pace slowed in 2018–20 because of the difficulty of reaching the remaining unserved populations and the potential impacts of COVID-19. Between 2018 and 2020, the access rate rose from 90 percent to 91 percent. Although the pandemic hit the global economy and slowed electrification, some progress was made between 2019 and 2020 as planned infrastructure was finalized. However, the current pace of access growth is still not sufficient to reach the 2030 target. Doing so would require raising the share of people connected to electricity each year by 0.9 percentage points. For example, LDCs would have to triple their pace of electrification, speeding up the annual increase in new customers from 23 million in 2000–18 to 63 million in 2019–30 (RMI and OHRLLS 2021). But at the current growth rate, the share of the world's population with access will reach only 92 percent by 2030. Accelerating progress in electrification from 2020 onwards requires strong policy support, innovative financing instruments, and government action to electrify the poor and most vulnerable and to recover from the pandemic.

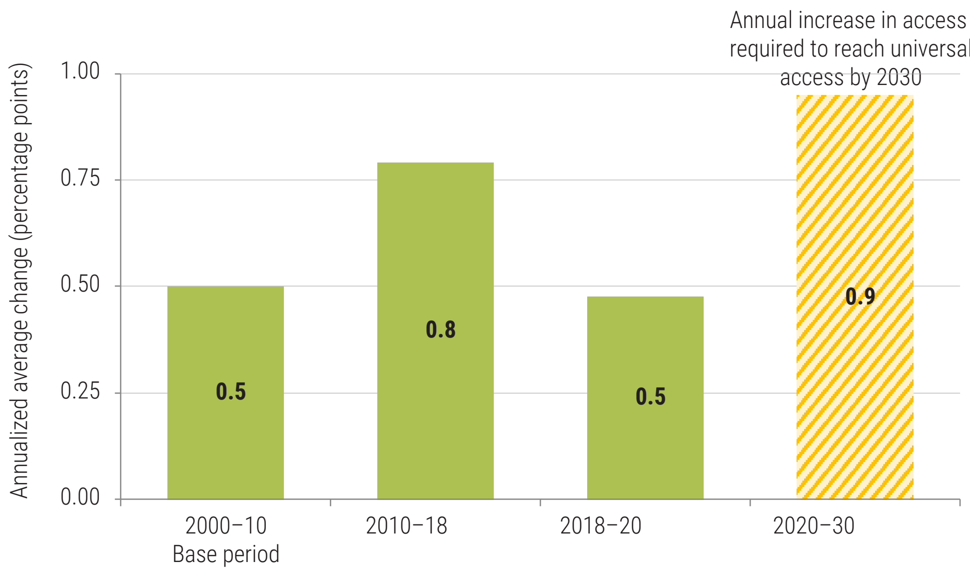
The impact of the COVID-19 crisis on household incomes made electricity less affordable. Before the pandemic, almost half of the unserved population in Sub-Saharan Africa lost its ability to pay for an essential bundle of services, and 700 million people with access in Africa and developing Asia could not afford an extended bundle of services (IEA 2021). Under the pressure of the pandemic, an additional 90 million connected people in Africa and developing Asia could not afford an extended bundle of services in 2020. Under the circumstances, households may opt for cheaper and smaller systems that deliver fewer energy services than they did before the COVID crisis.

Figure 1.3 • Global electricity access and population growth, 2000–20



Source: World Bank 2022.

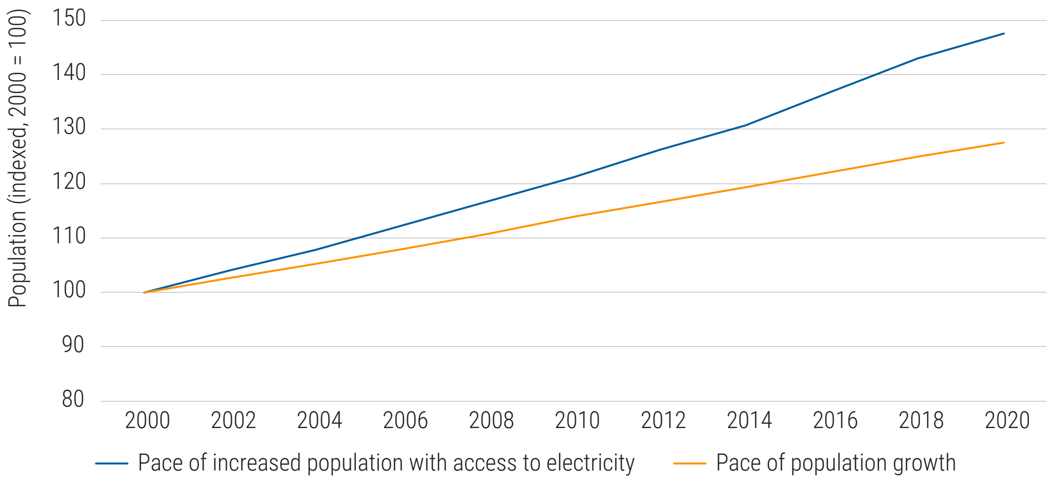
Figure 1.4 • Average annual increase in access to electricity



Source: World Bank 2022.

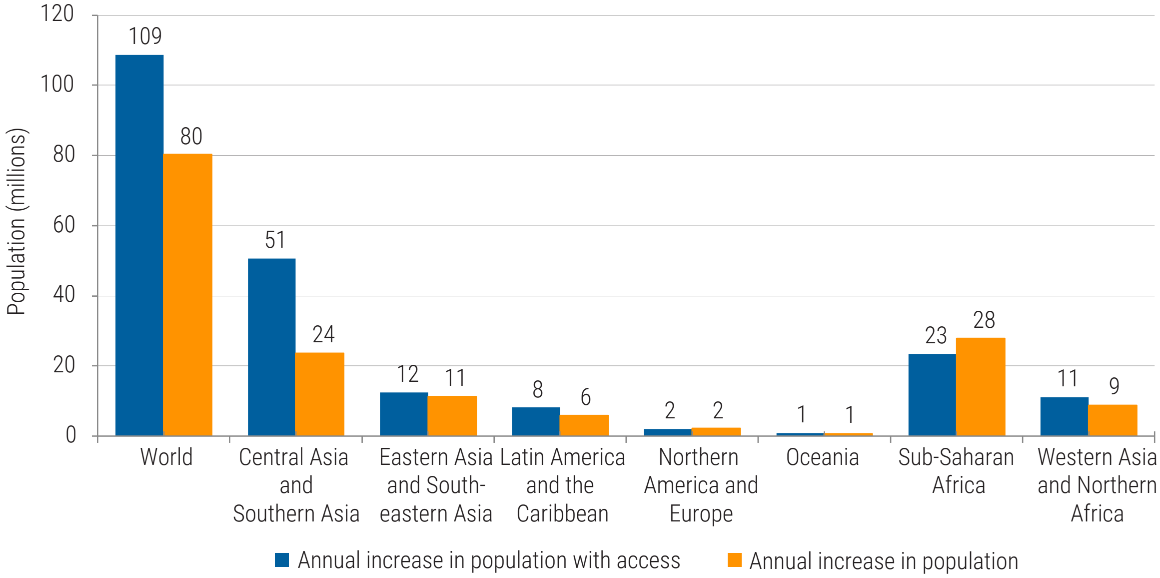
Between 2000 and 2020, the increase in the number of people with access to electricity continuously outpaced population growth (figure 1.5). The difference widened after 2010, as the pace of electrification increased. Even in 2018–20, growth in access outpaced population growth by 29 million people a year. Most of the increase was in Central Asia and Southern Asia, where 51 million were connected annually during the period (figure 1.6). Within this region, the fastest advances in electrification were in Bangladesh and India, each of which saw annual access growth of close to 2 percentage points. By contrast, the pace of electrification slackened over the same period in Sub-Saharan Africa, where annual population growth of 28 million outpaced 23 million people electrified each year. This trend increased the number of unserved people by about 4 million a year in the region.

Figure 1.5 • Pace of global population with electricity access and total population growth, 2000–20



Source: World Bank 2022.

Figure 1.6 • Annual increases in access to electricity and population, by region, 2018–20

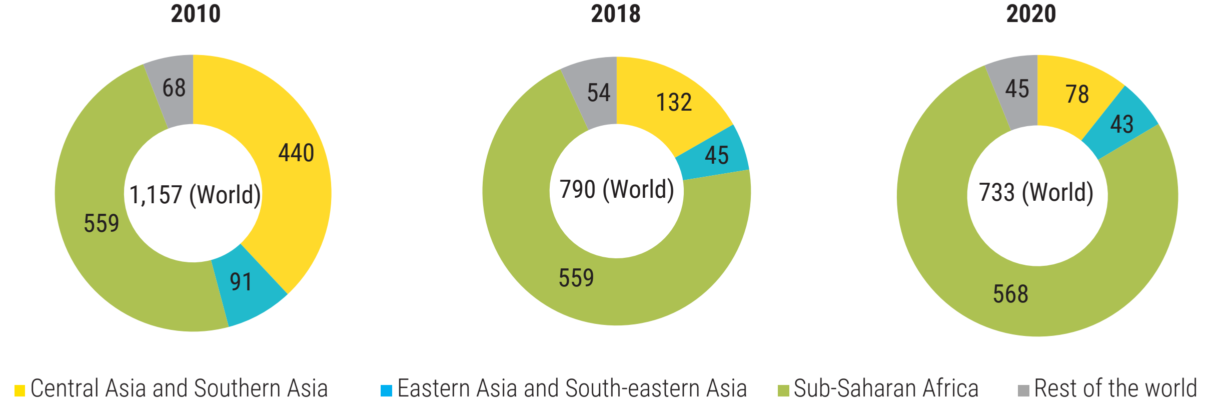


Source: World Bank 2022.

THE ACCESS DEFICIT

In 2020, 733 million of the world's people lived without access to electricity, down from 1.2 billion in 2010. Progress varied across regions (figure 1.7). Although Central Asia and Southern Asia remained the second-largest access-deficit region in 2020, it exhibited a substantial drop in the number of people without access, from 440 million in 2010 to 78 million in 2020, an annual decrease of 36 million. Among the countries in the region, India showed the largest annual drop in the access deficit (28 million). The global access deficit remains concentrated in Sub-Saharan Africa, where it increased from 559 million people in 2010 to 568 million people in 2020, with fluctuations over the decade. As a result, 77 percent of the world's population lacking access to electricity were in Sub-Saharan Africa in 2020. In Sub-Saharan Africa, Eastern Africa accounted for the biggest share of the unserved population due to Ethiopia, the third-largest access deficit country in the world. However, some countries in the region, including Kenya, Rwanda, and Uganda, showed fast advances with more than 3 percentage points of annual access growth in 2010–20. Meanwhile, access deficits declined steadily in the rest of the world.

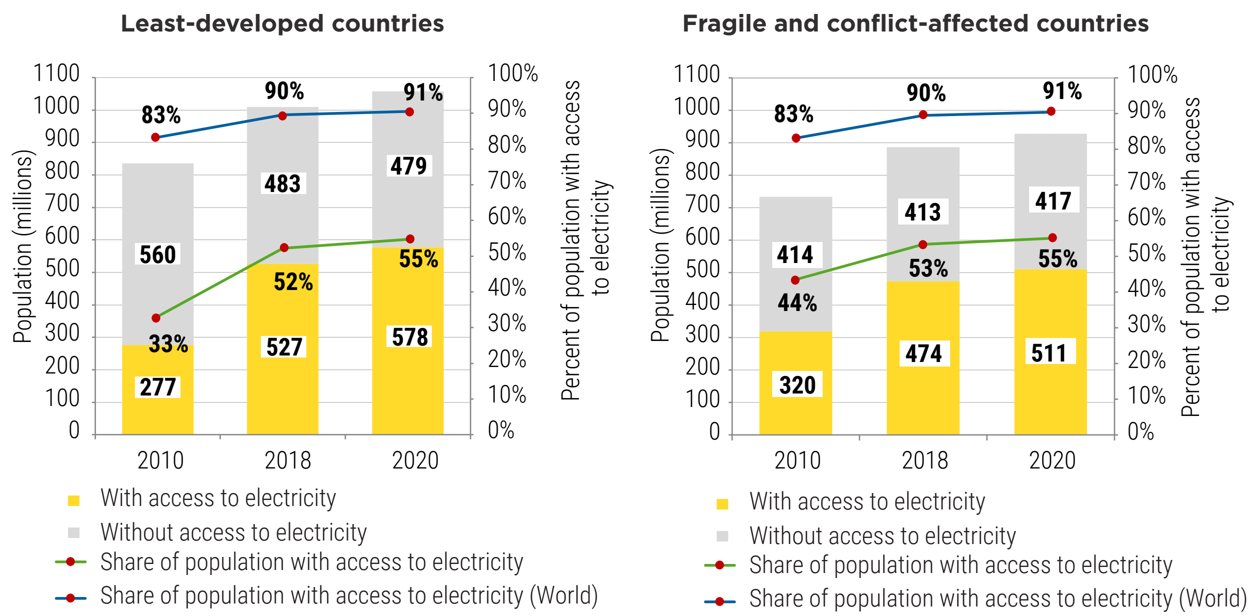
Figure 1.7 • Number of people without access to electricity, in selected regions, 2010, 2018, and 2020 (millions of people)



Source: World Bank 2022.

The access rate in the LDCs soared between 2010 and 2020, from 33 percent to 55 percent, but 479 million people still lacked access at the end of the period (figure 1.8). The 2020 access rate in these countries is almost 36 percentage points below the world average. As access has grown in wealthier countries, the global access deficit has been increasingly concentrated in the LDCs, which accounted for 48 percent of the world's unserved people in 2010 and 65 percent in 2020. The access rate is particularly low in rural areas of these countries, where just 44 percent of the population has access (versus 83 percent in rural areas globally). Between 2018 and 2020, although progress in electrified population outpaced population growth, the annual growth rate in access slowed to 1.3 percentage points, down from 2.4 percentage points in 2010–18. To reach the 2030 target, annual growth in access in the LDCs will have to increase to 4.5 percentage points.

Figure 1.8 • Gains in electricity access in least-developed and fragile and conflict-affected countries, 2010, 2018, and 2020



Source: World Bank 2022.

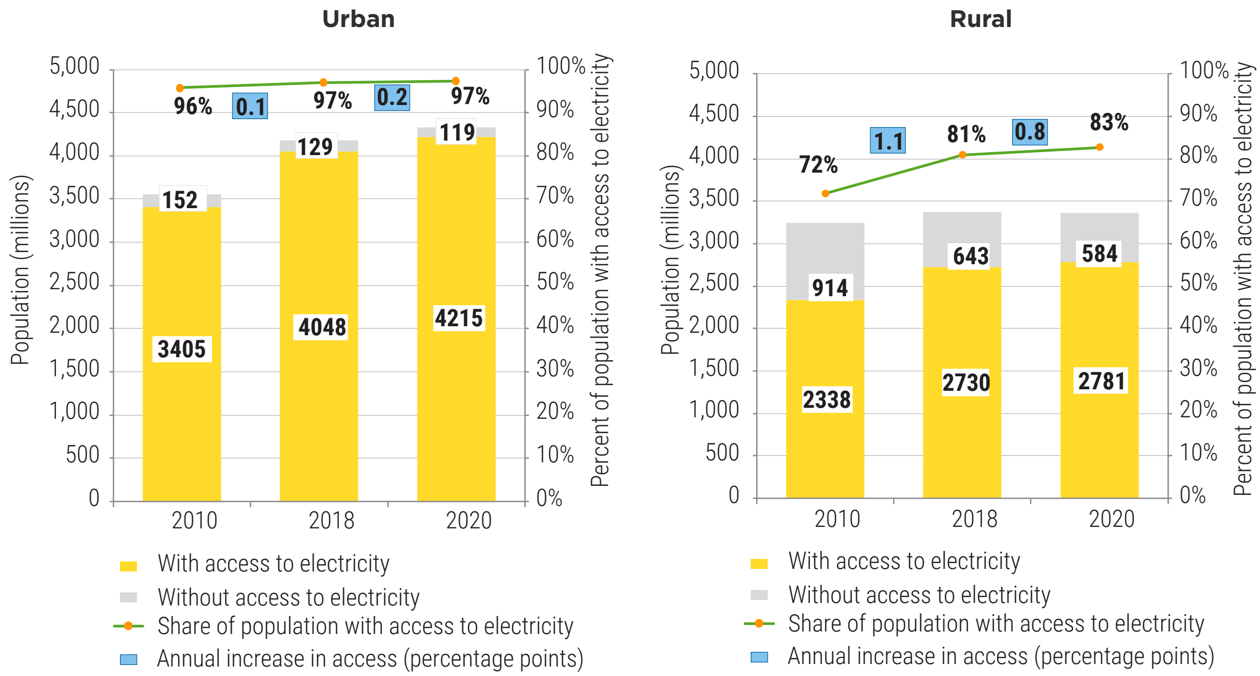
In fragile and conflict-affected settings, the access rate increased from 44 percent in 2010 to 55 percent in 2020 (see figure 1.8). Progress was driven mostly by lower-middle-income countries. During the same period, owing to population growth, the number of underserved people in fragile settings increased marginally from 414 million in 2010 to 417 million in 2020. These countries accounted for 57 percent of the global access deficit in 2020. In their rural areas, the number of people without access rose from 295 million in 2010 to 331 million in 2020. Between 2018 and 2020, the annual access growth of 0.8 percentage points was slower than the 1.2 percentage points recorded in 2010–18. The annual access gains of 19 million people fell behind the population growth of 21 million in 2018–20. Timor-Leste and Yemen made the most progress between 2018 and 2020, with annual growth in access of more than 5 percentage points. At the current speed, the access deficit will be concentrated in fragile and conflict-affected countries in 2030.

THE URBAN-RURAL DIVIDE

As of 2020, global rates of access to electricity were 97 percent in urban areas and 83 percent in rural areas. In 2020, 119 million people in urban areas and 584 million in rural areas still lacked access (figure 1.9). If the current trend continues, the global rural access rate will fall short of the target in 2030, whereas urban access is expected to be nearly universal.

Over the 2010–20 period, the average annual increase in access was 44 million in rural areas and 81 million in urban areas. The annual increase in rural access would have to climb to 1.7 percentage points (from 1.1 on average in 2010–20) to reach universal access in 2030. Although the annual rate of increase in urban areas (0.2 percentage points) was lower than the 1.1 percentage points in rural areas, the net increase in the number of electrified people in urban areas (810 million) was much larger than in rural areas (443 million) because of the rapid increase in urbanization. In Sub-Saharan Africa, the urban access rate rose from 68 percent in 2010 to 78 percent in 2020, the fastest growth of any region. The phenomenon can be ascribed to the very low urban electrification in the region at the start of the period. In rural areas of Sub-Saharan Africa, access rose from 17 percent to 28 percent over 2010–20, but it remains far lower than the global rural rate of 83 percent. In 2020, the number of people in Sub-Saharan Africa without access to electricity was 99 million in urban areas and 440 million in rural areas.

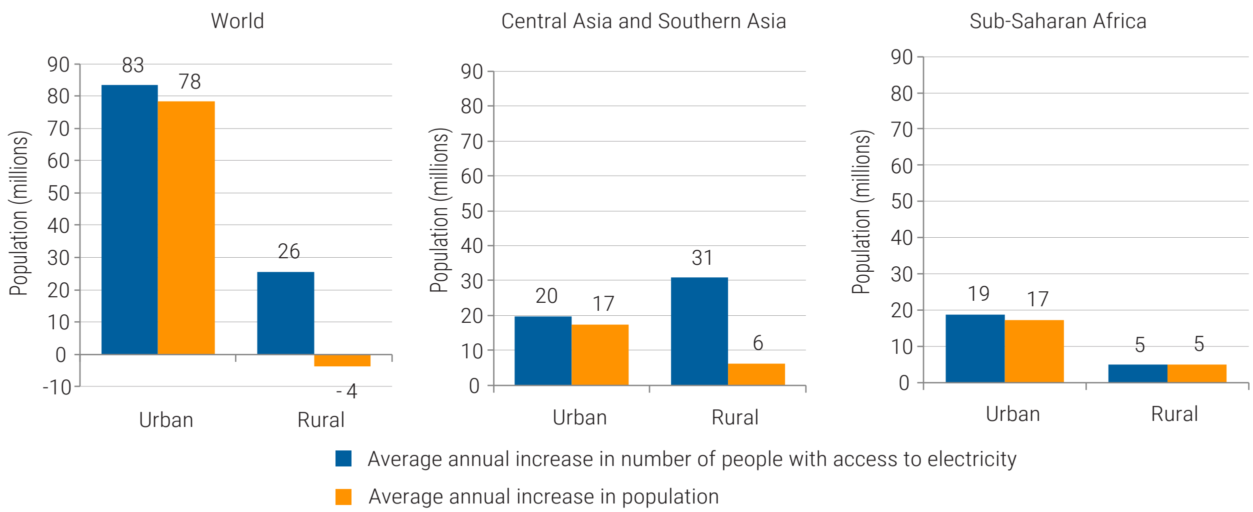
Figure 1.9 • Gains in electricity access in urban and rural areas, 2010, 2018, and 2020



Source: World Bank 2022.

Globally, the pace of annual electrification growth slowed between 2018 and 2020, which can be explained by the complexity of last-mile connectivity, aggravated by the pandemic. Nevertheless, global growth in electrification surpassed population growth in urban and rural areas alike (figure 1.10). The average annual increase in the number of people connected was 83 million in urban areas and 26 million in rural areas. In Central Asia and Southern Asia, the annual increase of 31 million people in rural areas significantly exceeded population growth of 6 million between 2018 and 2020. In Sub-Saharan Africa, rural electrification just kept pace with rural population growth. The modest pace should increase substantially to electrify the 75 percent of the rural population without access in the region.

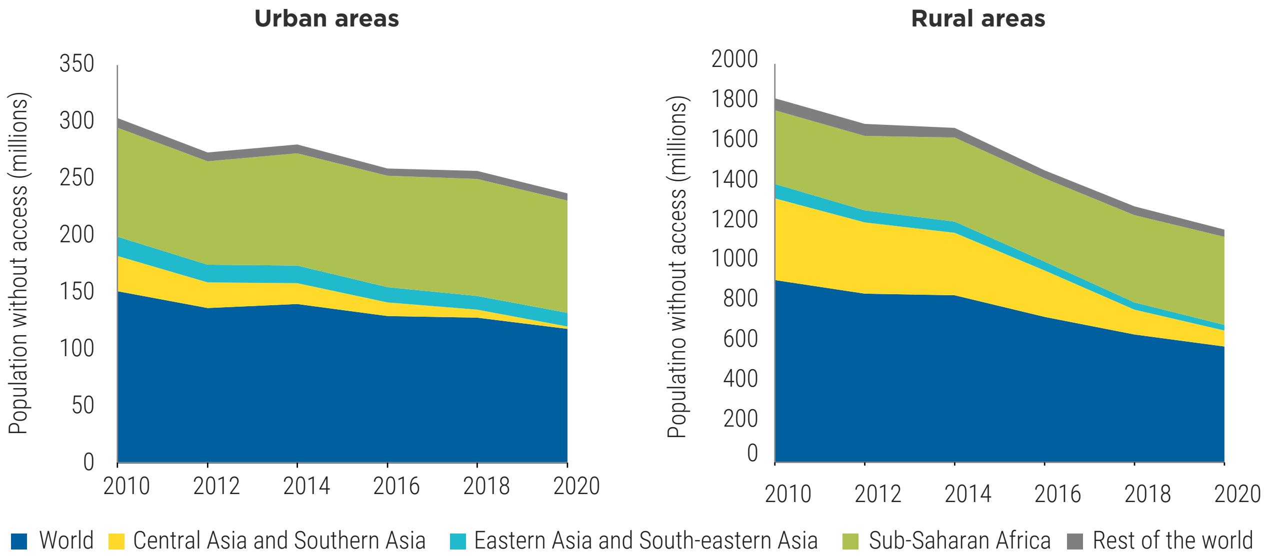
Figure 1.10 • Annual change in number of people with electricity and population in urban and rural areas, globally and in selected regions, 2018–20



Source: World Bank 2022.

Between 2010 and 2020, growth in access was brisk in Central Asia and Southern Asia (figure 1.11). In rural parts of the region, the access deficit plummeted from 409 million people in 2010 to 76 million in 2020, an annual average decline of 33 million people. In urban areas, the number of people without access plunged from 31 million in 2010 to 2 million in 2020, an annual decrease of 3 million. In 2018–20, Central Asia and Southern Asia also showed the world's largest decrease in the access deficit in both urban and rural areas. Meanwhile, as noted, the access deficit grew in Sub-Saharan Africa, where a majority of the world's least-developed and fragile and conflicted-affected countries are located. The increase was slight in urban areas (annually less than 1 million people), but greater in rural areas (7 million annually) in 2010–20. As a result, the region accounted for the world's largest access deficits in both urban and rural areas.

Figure 1.11 • Access deficits in urban and rural areas, globally and in selected regions, 2010–20

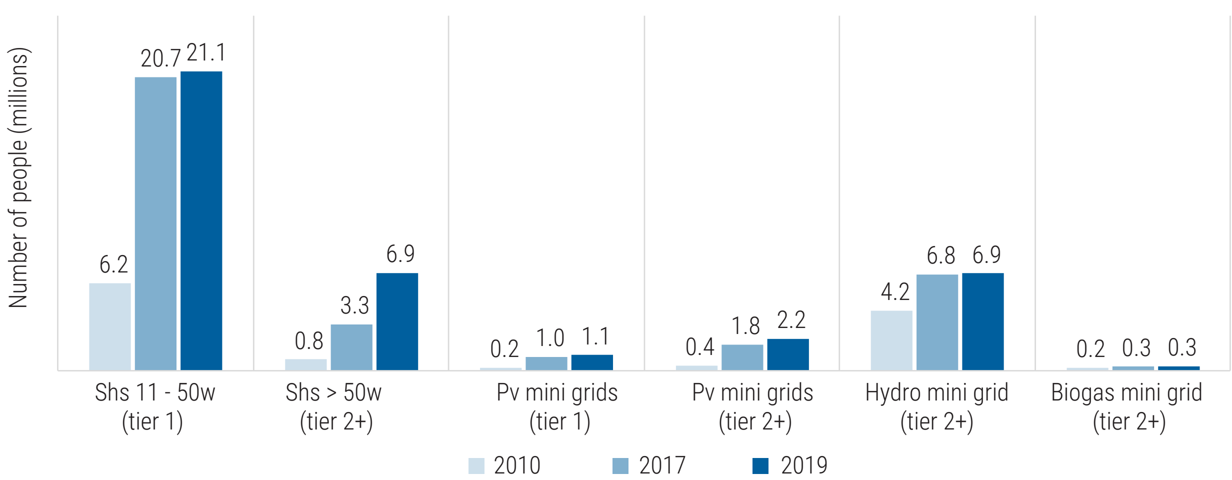


Source: World Bank 2022.

DECENTRALIZED RENEWABLE ELECTRIFICATION

About 39 million people had access to electricity through a Tier 1+ decentralized renewables-based system in 2019, including solar home systems and mini-grids based on solar, hydropower, and biogas (IRENA 2021), up from 12 million in 2010 (figure 1.12).[10] The number of people with access to Tier 1+ solar home systems rose by a factor of three between 2010 and 2019, to 28 million. The number connected to Tier1+ solar mini-grids also tripled between 2010 and 2019—to 3 million (figure 1.12). During the 2017–19 period, the largest number of people using solar photovoltaic (PV) Tier 1+ mini-grids was in Sub-Saharan Africa, followed by Central Asia and Southern Asia (figure 1.13). Similarly, the number of people using small and large solar home systems was dominant in Central and Southern Asia, and Sub-Saharan Africa in 2017–19.

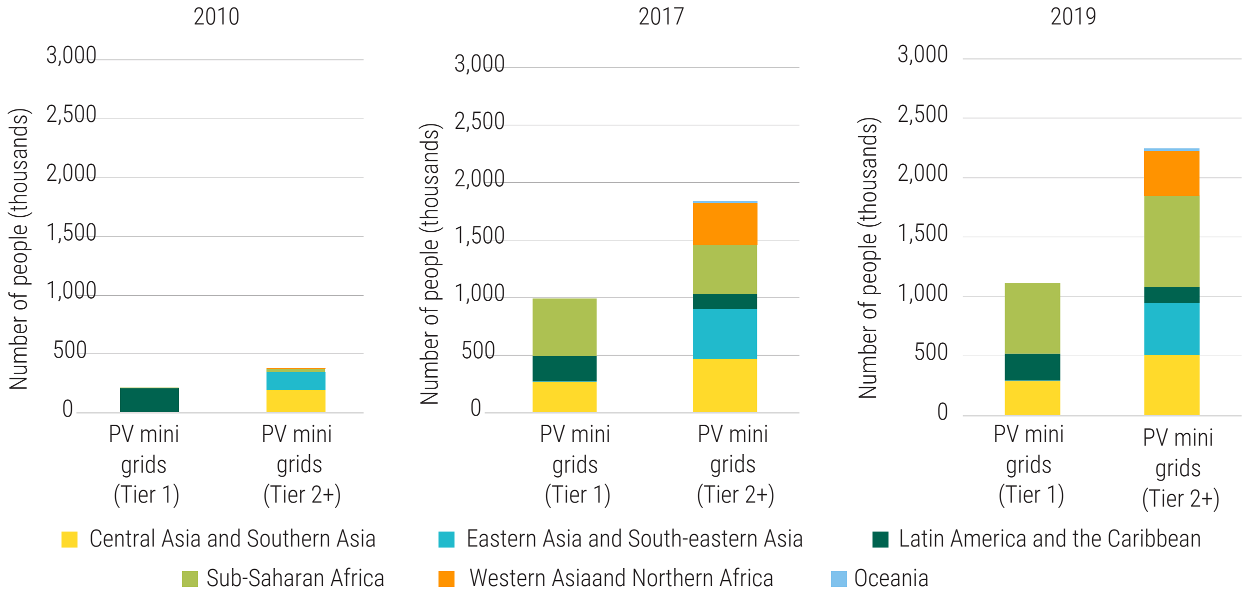
Figure 1.12 • Global number of people with access to Tier 1+ decentralized renewables-based systems, 2010, 2017, and 2019



10 Supply-side data on decentralized energy solutions are provided by the International Renewable Energy Agency (IRENA). Its database of decentralized renewables-based solutions is published with a two-year lag, because of challenges in data availability from several sources. This report reviews and analyzes figures for 2019, which were published in 2021.

Source: IRENA 2021.

Figure 1.13 • Number of PV mini-grid connections, by region, 2010, 2017, and 2019

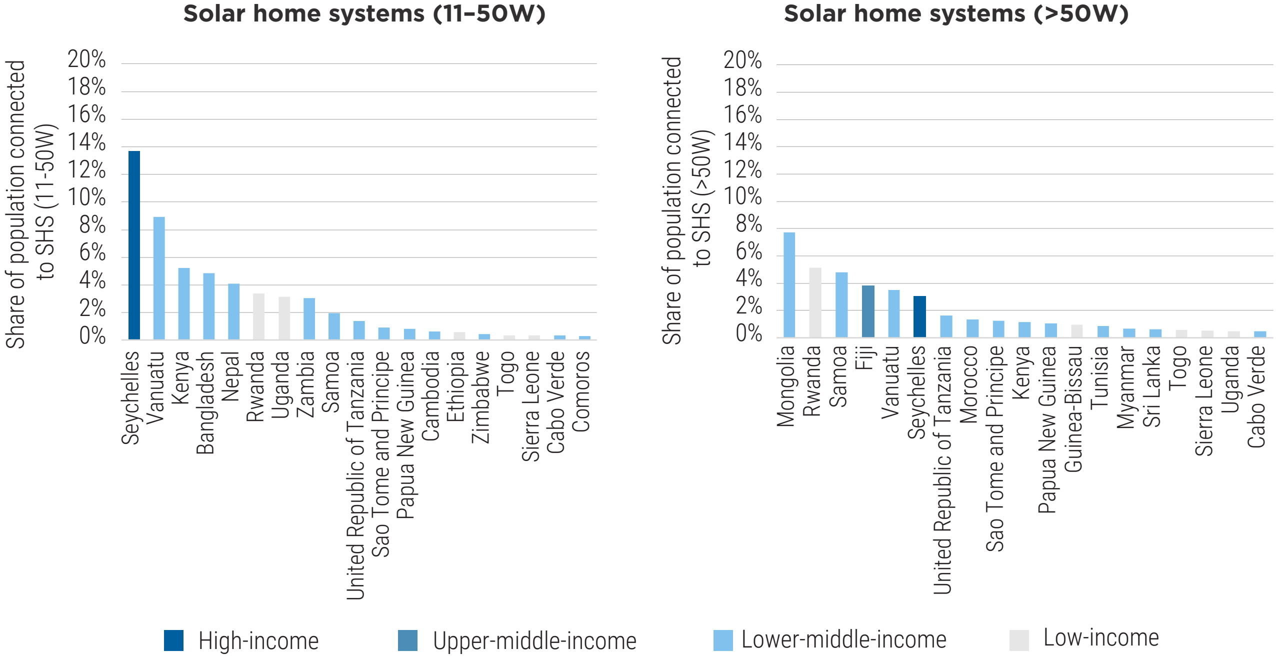


Source: IRENA 2021.

Among the 20 countries with the largest shares of Tier 1+ solar home systems, more than half were in Sub-Saharan Africa in 2019; about 10 million people in the region had access in this form (figure 1.14). Seychelles and Vanuatu had the largest shares of people with access to Tier 1 systems (more than 9 percent). Mongolia, Rwanda, and Samoa showed the largest shares of people using Tier 2+ systems (more than 5 percent). Most of the countries with higher shares of Tier 1+ solar home systems are in lower-middle-income and low-income countries. Tier 1+ solar home systems can engage household members in income-generating activities, such as starting a new business or spending more time working in the home. Tier 1+ solar home systems with monitoring tools can also help them cut their electricity costs.

Meanwhile, Afghanistan, Fiji, Nepal, and Sierra Leone were the countries with the largest shares of the population connected to Tier 1+ mini-grids in 2019. Among regions, Central Asia and Southern Asia accounted for the majority of the world's people (58 percent; 6 million) connected to these systems.

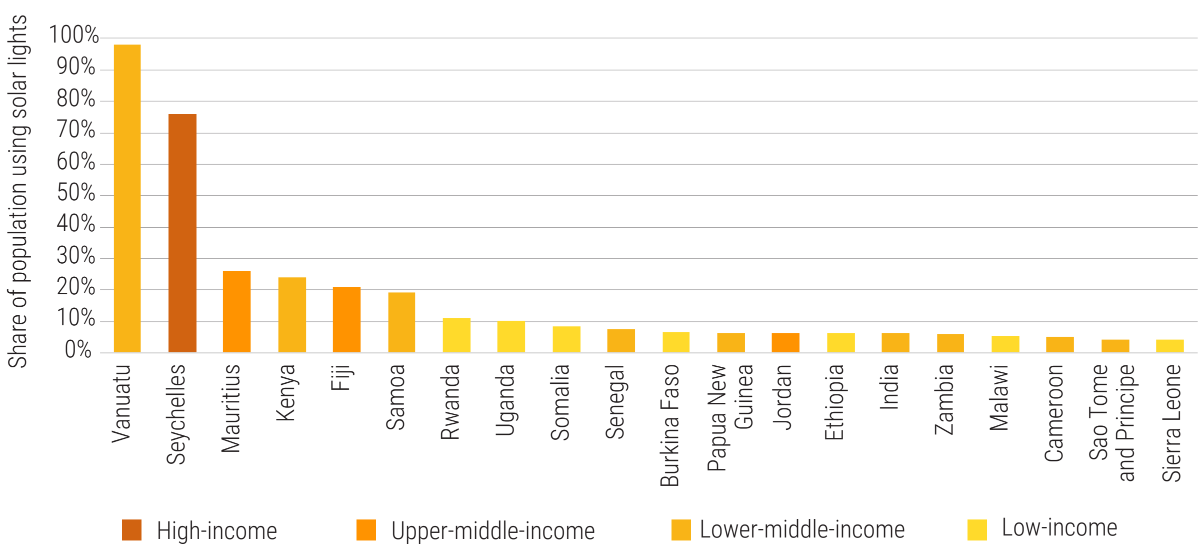
Figure 1.14 • Twenty countries with the largest shares of population enjoying access to solar home systems (Tier 1+), 2019



Source: IRENA 2021.

In 2019, the countries with the largest shares of the population using solar lighting systems below Tier 1[11] were Vanuatu, Seychelles, Mauritius, Kenya, and Fiji (figure 1.15). Between 2017 and 2019, Vanuatu, Fiji, and Mauritius had the fastest growth in the number of people using solar lights, with average annual growth of more than 5 percentage points.

Figure 1.15 • Twenty countries with the largest shares of population enjoying access to solar lights (below Tier 1), 2019



Source: IRENA 2021.

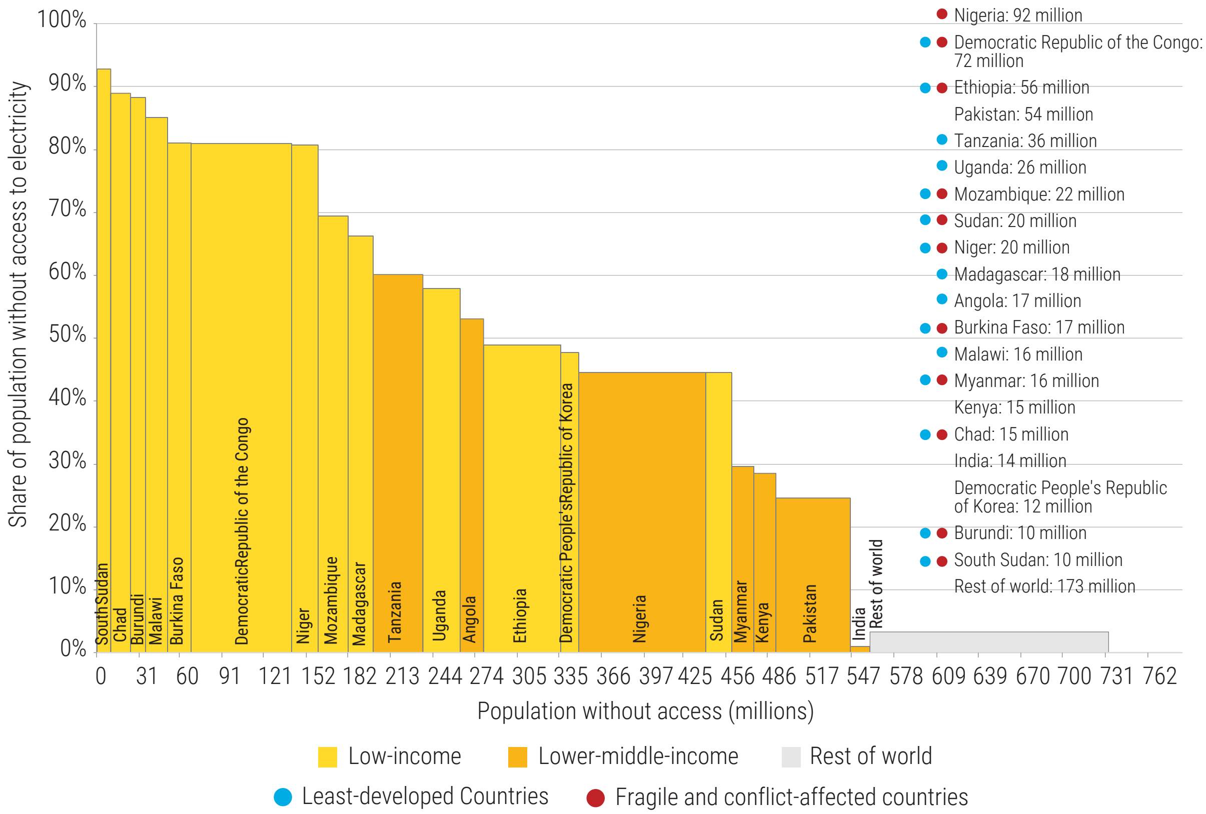
11 Solar lights and lighting kits (<11W) represent access that is below Tier 1, while small and large solar home systems indicate Tier 1+. Although solar lights may not provide Tier 1 access, they can provide that level of access to one or more individuals within the household.

The off-grid solar market faced challenges from the COVID-19 pandemic that began in early 2020. Impacts varied widely across countries, business models, and companies. The industry as a whole is recovering from the disruptions, partly owing to relief funding, although various effects of COVID linger across markets. Between July and December 2020, global sales of off-grid solar lighting products reached 3.6 million, up 19 percent over early 2020. However, global sales of 3.6 million units still showed an 18 percent decline from the second half of 2019 (pre-pandemic) (GOGLA 2021a). In terms of sales volumes, the number of people who gained improved access was expected to rise in the second half of 2020.[12] The upward trend continued in early 2021, and about 101 million people were estimated to have access to off-grid solar products.

COUNTRY TRENDS

The 20 largest access-deficit countries accounted for 76 percent of the global population without access to electricity in 2020, or 560 million people (figure 1.16). Closing the global access gap by 2030 largely depends on electrification efforts in these countries. Fifteen of the top 20 are in Sub-Saharan Africa. In 2020, The top three were Nigeria (92 million), the Democratic Republic of Congo (72 million), and Ethiopia (56 million). Burundi joined the top 20, while Bangladesh[13] exited the list. India's rank fell from third in 2018 to seventeenth in 2020 thanks to a dramatic decrease in the number of people lacking access.

Figure 1.16 • Share and absolute size of population without access to electricity in top 20 access-deficit countries and rest of world, 2020



Source: World Bank 2022.

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12 Tracking entire off-grid connections can be difficult, particularly for non-quality-verified products made by non-GOGLA members. According to the 2020 Off-Grid Solar Market Trends report, GOGLA member sales were only about 28 percent of overall sales. Thus, the tracked sales trend may not reliably represent the number of customers.

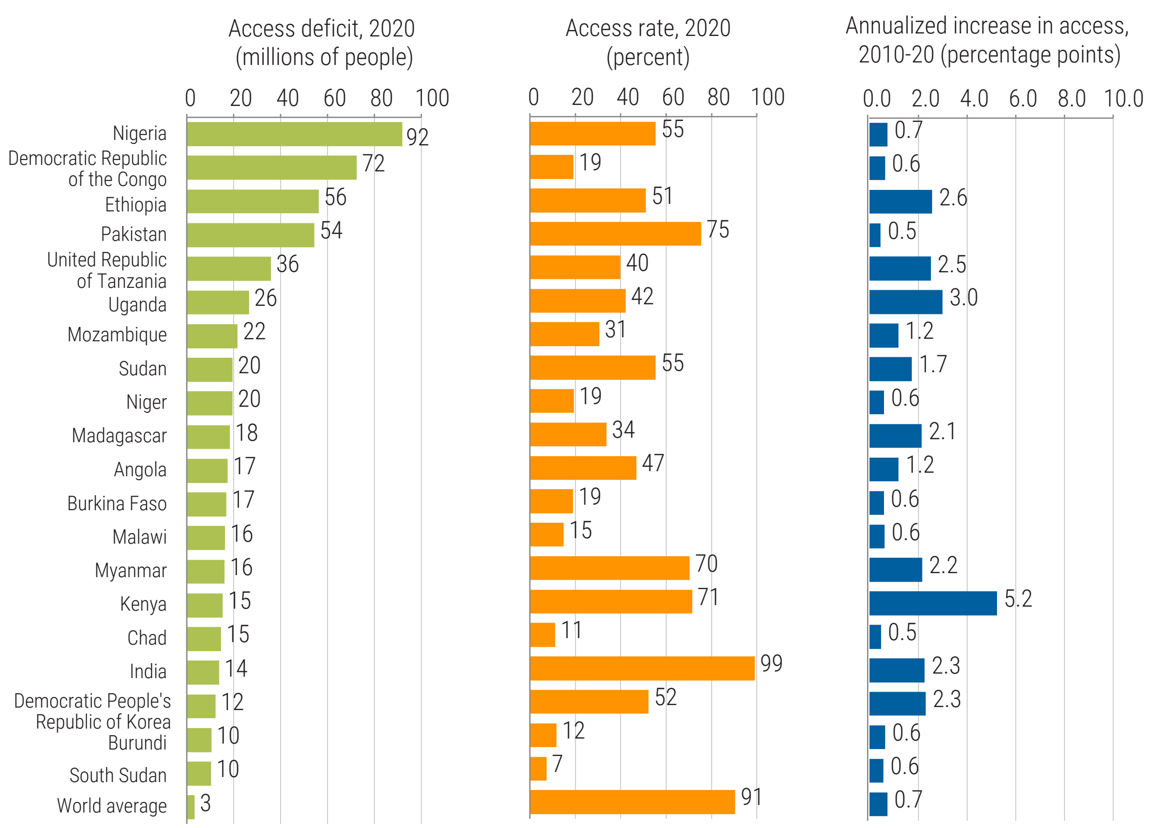
13 In Bangladesh, thanks to the world's largest solar home system program, the number of underserved people was slashed by more than half between 2018 and 2020, falling from 13 million to 6 million. Some 4.13 million solar home systems have been installed under the IDCOL solar home systems program, which benefits 18 million rural people in remote areas (IDCOL 2020). In addition, an enabling environment for designing and implementing effective electricity access policies for both centralized and decentralized solutions contributed to the improvement in access between 2010 and 2019 (ESMAP 2020).

Between 2010 and 2020, access gains in the electrified population outpaced population growth in Ethiopia. During the same period, electrification proceeded slowly in Nigeria and the Democratic Republic of Congo. In Nigeria, the access rate increased by an annual average of just 0.7 percentage points (4 million people) in 2010–20. With population growing at nearly the same pace, the access deficit held steady over the decade. Between 2018 and 2020, as population growth outpaced gains in access in Nigeria, the number of unelectrified people grew by 3 million a year. In the Democratic Republic of Congo, the access deficit widened—from 56 million in 2010 to 72 million in 2020. Between 2018 and 2020, since the pace of electrification slowed to the annual growth rate of 0.3 percentage points, the number of Congolese without access rose by about 2 million people a year. In Ethiopia, the world's third-largest access-deficit country, the deficit narrowed by an average of less than 1 million each year between 2010 and 2020. Recent progress has outstripped population growth, reducing the deficit from 60 million in 2018 to 56 million in 2020.

In Kenya and Uganda, the expansion of the electrified population was faster than population growth between 2010 and 2020. Of the top 20 access-deficit countries, Kenya and Uganda scored the greatest gains between 2010 and 2020, increasing their annual gains in access by 5.2 and 3 percentage points, respectively (figure 1.17). In the period 2018–20, Kenya, along with Ethiopia, showed the fastest growth, with annual gains of more than 3 percentage points. In contrast, progress slowed over the same period in Madagascar, Malawi, Mozambique, and Nigeria.

Fragility and underdevelopment are linked with access deficits. Nearly all of the top 20 access-deficit countries were fragile and conflict-affected or least-developed—or both. Special attention to these countries is essential through prioritized investments and improvements in policy and regulatory frameworks to scale up electricity access toward the SDG 7 targets.

Figure 1.17 • Electricity access in the top 20 access-deficit countries, 2010–20

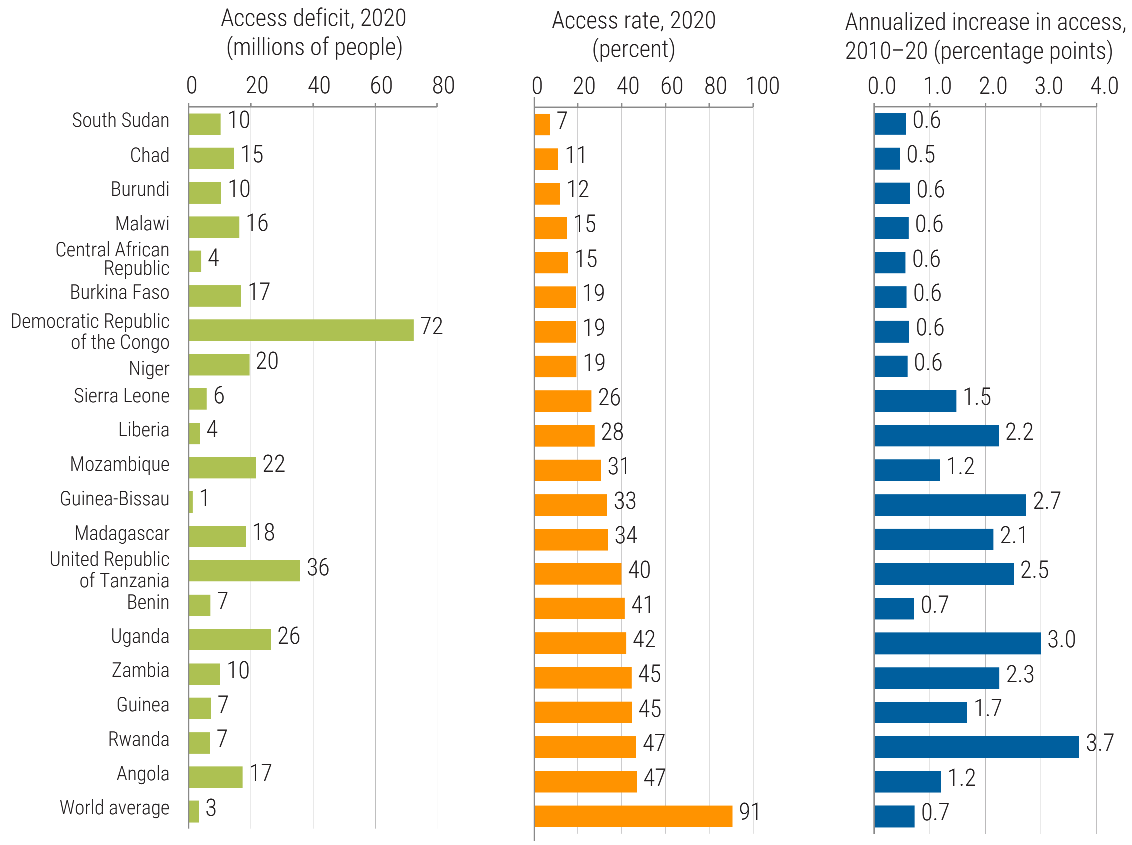


Source: World Bank 2022.

As of 2020, all of the top 20 least-electrified countries, which together account for 45 percent of the global access deficit, were in Sub-Saharan Africa (figure 1.18). In 2020, South Sudan had the lowest access rate (7 percent), followed by Chad (11 percent) and Burundi (12 percent). Between 2010 and 2020, the annual increase in the access rate in 12 of the top 20 was 1 percentage point or less. During the period, Rwanda and Uganda made significant progress, however, increasing electrification by 3.7 and 3 percentage points a year, respectively. Between 2018 and 2020, Rwanda showed the most rapid advance in access, with an annual average gain of 5 percentage points, whereas access in Guinea, Madagascar, Malawi, and Mozambique showed negative growth.

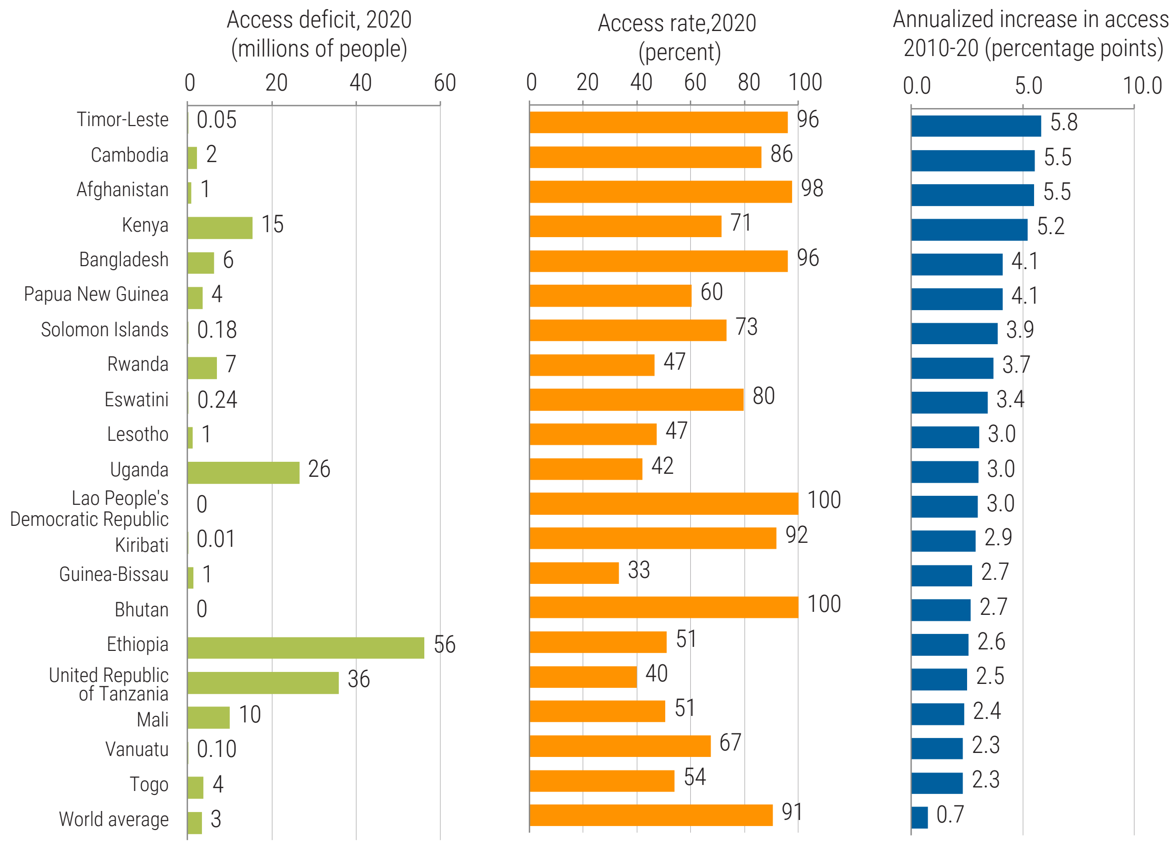
The pace of electrification was highest in Timor-Leste, Cambodia, Afghanistan, and Kenya, where access increased by more than 5 percentage points a year between 2010 and 2020 (figure 1.19). Timor-Leste, Kenya, and Rwanda stood out as the fastest-moving countries in 2018–20, increasing access by more than about 5 percentage points a year on average. In Rwanda, both grid and off-grid efforts have intensified.

Figure 1.18 • Electricity access in the 20 least-electrified countries, 2010–20



Source: World Bank 2022.

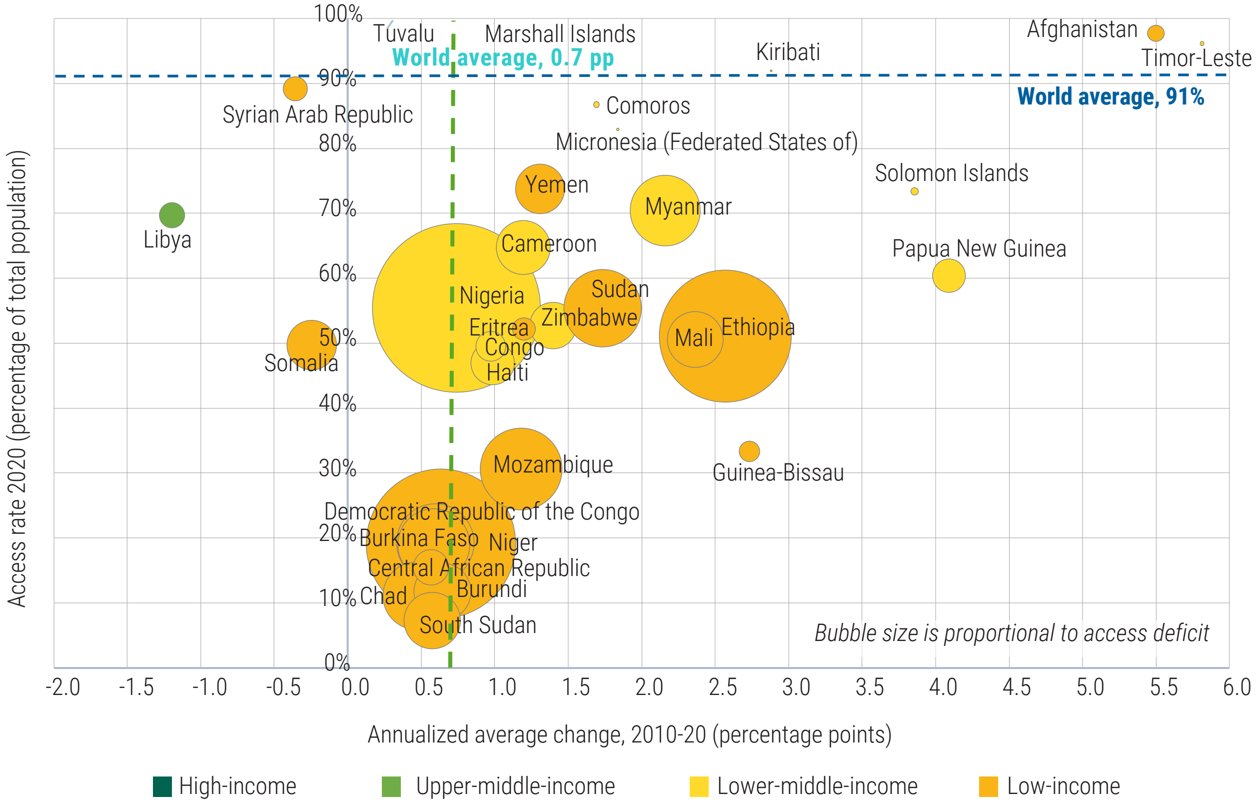
Figure 1.19 • Electricity access in the 20 fastest-electrifying countries, 2010–20



Source: World Bank 2022.

Among countries experiencing fragility, conflict, and violence, Libya, Somalia, and the Syrian Arab Republic saw declines in electrification between 2010 and 2020 (figure 1.20). Meanwhile, the access rate in Timor-Leste and Afghanistan advanced rapidly during the decade, with annual growth of more than 5 percentage points. Through the significant investment in improving the electricity infrastructures, Timor-Leste continues to show fast improvement in electrification, chalking up annual access growth of more than 5 percentage points in 2018–20. Creating an enabling environment adapted to complex situations is critical to improving electricity access in fragile countries.

Figure 1.20 • Share of population with access to electricity in 2020 and average annual growth rate of access in fragile and conflict-affected countries between 2010 and 2020



Source: World Bank 2022.

POLICY INSIGHTS

Strong political commitments, better-targeted policies, disruptive technologies and business models, and innovative financing tools have helped connect 1.3 billion people to power since 2010. But with only eight years left to achieve SDG target 7.1, governments and the international community face the challenge of drastically increasing the pace of progress in a context of high uncertainty and transition towards net-zero energy systems.

A paradigm shift on how policy and investments are directed is needed if the world is to meet the target. The UN High-Level Dialogue on Energy (box 1.1) has issued recommendations to make universal access to electricity a political, economic, and environmental priority, aligned with an inclusive COVID-19 recovery (UN n.d.).

Box 1.1 • Accelerating the transition to universal access to modern energy services through the High-Level Dialogue on Energy

The UN Secretary-General convened the High-Level Dialogue on Energy in September 2021. The goal of the first leader-level meeting on energy held under the auspices of the UN General Assembly in 40 years was to promote accelerated implementation of SDG 7 and the other targets of the 2030 Agenda for Sustainable Development, as well as the climate objectives of the Paris Agreement. The far-reaching preparatory process included stakeholders representing the public and private sectors, civil society, international organizations, and governments.

The Dialogue had five themes: energy access; the energy transition; enabling the SDGs through an inclusive, just energy transition; innovation, technology, and data; and finance and investment. Thematic technical working groups prepared reports and presented recommendations at a ministerial forum. These recommendations were summarized in a "Global Roadmap for Accelerated SDG 7 Action in Support of the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change" (UN n.d.).

The World Bank's Energy Sector Management Assistance Program co-led Technical Working Group 1 on energy access. Its report (UN 2021) included recommendations on how to achieve universal access to electricity and clean cooking by 2030, along with intermediate targets. Implementing these recommendations will require accelerated and sustained progress in four areas:

- Reinforcing enabling policy and regulatory frameworks
- Enhancing the social and economic inclusiveness of energy access
- Aligning the costs, reliability, quality, and affordability of energy services
- Catalyzing, harnessing, and redirecting energy-access financing as needed to deliver universal energy access by 2030.

Another outcome of the Dialogue was the formation of more than 200 energy compacts—voluntary commitments from stakeholders to undertake specific actions, with targets and timelines to further enhance progress on SDG 7. The World Bank developed an energy access compact to assist client countries in achieving SDG 7 targets by 2030 as an integral part of a just energy transition. The compact supports actions to provide 50–60 million people with new or improved access to electricity and 20–100 million people with access to clean cooking by 2025 (IISD 2021).

First, the achievement of the SDG 7.1 target should be an integral part of the just energy transition and therefore embedded in countries' socioeconomic development and climate commitments. Reaching universal access to electricity is essential to achieving net-zero emissions in a just and inclusive way and should be tailored to meet low-income countries' needs. In a context of "building back better," access to electricity must be positioned as an enabler for more inclusive, sustainable and resilient growth, exploiting synergies with other SDGs.

Second, to maximize socioeconomic impacts, political commitments and financing with respect to access to electricity should be coordinated with those on access to clean cooking.

Third, communities—their needs and aspirations for energy for households, farms, enterprises, and public facilities—should be at the center of efforts to deliver universal access. Decision-makers should view communities as co-creators of energy systems that meet their needs and align with their practices, affordability, and cultural contexts.

Fourth, the most remote, vulnerable and poorest unserved populations, often described as the last mile to be connected, should be given special attention to ensure no one is left behind. Those population segments include women and girls; communities experiencing fragility, conflict, and displacement; and people living in LDCs. Agendas for gender equality must include empowering women in the design, production and distribution of modern energy services.

Fifth, the role played by the private sector is critical to provide creative, cost-effective, and scalable solutions. Context-sensitive and innovative business models can help create sustainable approaches to connecting poor and rural communities. Public financing will still have a crucial role to play in bridging the affordability gap, funding an inclusive energy access ecosystem and infrastructure, and, where needed, leveraging private capital into the sector (IRENA and SELCO Foundation 2022). Investing in knowledge exchange, capacity building. and partnership building will drive further innovation to accelerate the pace of access expansion. Lastly, good-quality data are needed to inform more effective access interventions.

As noted in box 1.1, the Technical Working Group on Energy Access produced a report setting forth strategic priorities and recommendations to promote system-level approaches and focused investment to expand access to energy (UN 2021). Those priorities and recommendations are explored in the four subsections that follow.

REINFORCING POLICY AND REGULATORY FRAMEWORKS TO ENSURE UNIVERSAL ACCESS

Achieving universal access to sustainable, reliable, affordable and modern energy must be an integral part of the just energy transition. The goal of universal access should be embedded in countries' climate commitments and their strategies and actions for net-zero energy systems. All access-deficit countries should adopt comprehensive national electrification and clean cooking strategies and integrate energy access priorities within broader economic development and climate strategies, as well as their Nationally Determined Contributions under the 2015 Paris Agreement on climate change. The national strategies and accompanying plans should have specific targets and milestones, be kept up to date, be publicly available, and make good use of best practices. Plans should provide targets for tiers of access, specifically targeting the highest tiers, while ensuring that everyone gains access at least to basic and affordable energy access in the shortest possible time period.

Comprehensive national plans must be backed by dedicated policies and regulations for effective implementation and for ensuring inclusivity and permanence of supply. The policy needs vary depending on local contexts and the chosen electrification solution. Scaling up renewables-powered mini-grids, for instance, requires careful regulatory design to address key aspects of licensing, tariff setting, arrival of the main grid, and delivery of public financing support (IRENA and AfDB 2022). Stable fiscal incentives and robust quality standards have also played a crucial role in improving affordability for decentralized renewables and supporting market development.

More and better data are needed to design and implement sustainable electrification programs. Improving the availability and quality of open-source, verifiable energy data that are pertinent to national, subnational, and local contexts is critical. Policy makers and private companies need end-user and supply-side data to understand market dynamics; analyze the enabling environment for investments; produce effective, tailored projects; and track progress. Policy makers need data on the various dimensions of access (reliability, affordability, usage) to refine electrification strategies in ways that better meet people's needs. These data could be gathered by adding a module on energy to regular household surveys, following the Multi-Tier Framework approach (box 1.2).

Box 1.2 • Modifying household surveys to measure energy access more accurately

More granular household energy data can facilitate energy policy analysis and energy infrastructure planning. Because the data collected from national household surveys do not capture the dimensions needed to understand the role energy services play in poverty reduction, they do not allow for extensive policy analysis. Specialized, stand-alone energy surveys, meanwhile, do not have the breadth of topics and geographical scope of many national household surveys, such as surveys conducted by the World Bank's Living Standards Measurement Study.

Although the geographic coverage of energy access data has increased, most household surveys that collect and report information on energy access provide only very limited data, often reported as a binary metric. The simplistic questions in these surveys do not consider other dimensions of energy access, such as the use of multiple fuels and devices, varying levels of access and use, the quality and safety of the energy source, the affordability of consumer electricity service, and the importance of other household energy services (such as space heating and lighting).

To track these indicators and respond to the recommendations of the UN High-Level Dialogue on Energy for improved availability and quality of energy data, the World Health Organization and the World Bank's Energy Sector Management Assistance Program, in close collaboration with the Living Standards Measurement Study and other contributors, have developed core questions on household energy use and a guidebook for survey practitioners.

The household energy access questionnaire consists of a series of modules that can be incorporated into existing household surveys. The questions include those essential for measuring household access to electricity and clean cooking fuels, monitoring SDG indicators 7.1.1 and 7.1.2, and conducting detailed analysis of the limits of and barriers to access. An additional set of questions for fully assessing household energy use and its health impacts is also provided. As the questionnaire targets people in vulnerable regions, it includes a module on the status of energy access for displaced communities and refugees.

The following modules are included:

- Household electricity: Questions on the main source of electricity, appliances powered, hours of electricity available each day and each evening, and frequency and duration of unscheduled blackouts.
- Household cooking: Questions on the main cookstove used, the brand of the main stove, and the fuels used by the device.
- Household heating: Questions on the number of months the main heating device was used for heating, the main fuel used for heating the home, the brand of the heating device, and the main fuel used.
- Household lighting: Question on the main lighting sources.
- Household energy and gender: Recommended questions on the primary collector of fuel and the primary cook, the time spent collecting fuel, injuries sustained while collecting or transporting fuel, the time spent preparing the stove and fuel, and time spent cooking.

The guidebook provides practitioners with the tools and technical support they need to integrate the new energy access questions into existing national household surveys, including a manual for training enumerators and a photo guide containing visual and descriptive examples of cooking, heating, and lighting energy options. The guidebook and questionnaire can be downloaded using the QR code.

Source: World Bank and the World Health Organization 2021.

The use of geospatial and digital tools has yielded more accurate and real-time data and made the data more accessible in different geographies and at various levels of granularity. Better data on current and projected demand have facilitated the modeling of national electrification systems over time, informing decision-making processes. Technological advances such as system optimization, network design tools, and online platforms have reduced the cost of project preparation and planning, significantly increasing projects' effectiveness. Digital tools have brought innovations to new areas of action, such as community engagement. They have also enabled the creation of state-of-the art integrated energy plans at the national level that span electrification, clean cooking, and productive uses, including demand-side attributes like affordability and propensity to adopt. They have significantly improved the efficiency of mini-grid projects, saving both time and costs. They have been used to facilitate site prospecting, demand analysis, project packaging, solicitation of financing, procurement, and remote monitoring and verification (ESMAP 2022a). The tools are also strengthening cross-sectoral decision-making, fostering integrated planning between clean cooking and electrification and between energy and agriculture. The latter achievement makes it possible to identify opportunities to link electrification efforts with anchor loads such as existing and planned agro-processing infrastructure (IRENA and FAO 2022). Expanding the use and adoption of digital tools should be promoted for the benefit of both private developers and public sector players.

Technology has also allowed decision-makers and practitioners to share knowledge more easily and to build on what has worked and what has not. Accelerating the advancement of knowledge exchange, capacity building, and partnership building is essential to create more robust frameworks for policy and regulation. Investments in human development targeting policy makers, technicians, and local entrepreneurs, with a focus on women and youth, would increase the pace of innovation in technology, business models, financing, and policy, thereby helping to close the access gap.

ENHANCING THE SOCIOECONOMIC INCLUSIVENESS OF ENERGY ACCESS

Providing access to electricity does more than just connect people to power. It facilitates inclusive, sustainable, and resilient economic recovery and growth. Approaches that use targeted demand-side subsidies to support business models focusing on last-mile service and affordability help ensure that poor, remote, and vulnerable households (including displaced people and their host communities) share fully in the benefits of access. In addition to reaching the most vulnerable, inclusive planning for access to electricity also implies factoring in the achievement of other development outcomes under other SDGs through a cross-sectoral approach. Tailoring programs in this way increases their chances of success and improves people's access to public services (e.g., health care, education) and a wider range of possible livelihoods.

Productive uses of energy and rural business development are another area in which synergies with other sectors should be explored. Affordable and efficient appliances; access to finance for small businesses; and skills training, market linkages, and community engagement are all key elements in the design and implementation of robust mechanisms to support productive uses of electricity.[14]

The electrification of public institutions, which has received much attention in the context of the COVID-19 pandemic, illustrates the nexus between access and other sectors and the opportunity to maximize the socioeconomic benefits of access to electricity. Traditional business models for electrifying public institutions have not been made sustainable in most cases, however. To date, most projects for procuring solar PV assets have been grant based, with little attention to what happens after the systems are installed. Fortunately, growing attention is now being paid to service delivery, performance, and long-term operation and maintenance, all parts of a shift to a service-based model that opens new opportunities for the private sector (SEforAll 2021a).

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14 In Indonesia and Peru, for example, partnerships between energy providers (private developers, utilities) and nongovernmental organizations with deep knowledge of local socioeconomic contexts have increased the impact of rural electrification on jobs, income, and productivity (Finucane, Besnard, and Golumbeanu 2021).

Inclusiveness also implies prioritizing support for populations living under conditions of fragility, conflict, and violence. About 594 million people live in such countries and in the world's least-developed countries. Reducing energy poverty in these settings will depend on finding approaches that match the country context while also including the poor explicitly in national access plans, implementing dedicated access programs, improving enabling environments (e.g., for the development of renewables-based mini-grids), and scaling up both public and private financing. Supporting innovation and encouraging exchanges of knowledge derived from successful business models can contribute, as well.

More than 90 percent of refugees living in camps and settlements lack sustainable, reliable, and affordable access to energy, affecting their safety, security, well-being, and health. Poor access also limits opportunities for socialization, learning, and self-reliance (UNHCR 2022). Integrated, inclusive approaches to overcoming the challenges faced by such refugees and their host communities are sorely needed. Such approaches must ensure that energy infrastructure plans, policies, and regulatory frameworks aimed at refugees and host communities are well integrated with overall energy sector development.

Women and girls are disproportionally affected by the lack of access. Thus, there is a pressing need to enhance gender equality in energy-access interventions. Sharing global knowledge on ways to accomplish that goal is critical, because reducing gender gaps reduces poverty. Data that quantify gender inequities in diverse contexts must be collected and shared.[15] Women's groups and groups working to close gender gaps in the sector should be included as key stakeholders in planning and policy making. Similarly, women should be equally represented in decision-making bodies in energy institutions. Policy makers should encourage women's participation as primary agents of change in households and communities. Adequate resources should be allocated to monitoring and evaluating gender-related programs.

ALIGNING THE COSTS, RELIABILITY, QUALITY, AND AFFORDABILITY OF ENERGY SERVICES

Access to electricity does not mean simply getting a connection; it means having a reliable, sufficient ,and affordable source of power. Improving the reliability of grid services implies strengthening generation capacity and transmission and distribution systems; reducing losses; and improving utilities' overall performance.

Under certain circumstances, fostering private sector participation through public-private partnerships and encouraging companies to adopt innovative and scalable business models and technologies can help improve the quality of service, reach last-mile end users, and reduce costs. A prime example is that households remain underserved by electric utilities in most parts of Sub-Saharan Africa, where the largest access deficits are found. Therefore, more comprehensive measures are required to incentivize utilities to improve their technical and financial performance by adopting customer-centric approaches, entering into innovative partnerships, engaging the private sector, and stimulating demand for appliances and productive uses of electricity.

Modern mini-grids are another good example. ESMAP's research on mini-grids—including a detailed analysis of mini-grid costs from more than 400 individual projects in Africa and Asia and a database of more than 40,000 installed and planned mini-grids around the world—has identified five key drivers of better electricity service at lower cost (ESMAP 2022a). These drivers are as follows:

- Private sector companies develop portfolios of mini-grids instead of one-off projects, thus increasing economies of scale and the pace of deployment.
- Mini-grid developers engage with customers and communities to promote income-generating uses of electricity while increasing the up-time of their mini-grids to close to 100 percent.[16]

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15 At a minimum, data on gender gaps in access to electricity by male- and female-headed households and by male- and female-owned businesses should be collected.

16 According to 2022 benchmarking study by the Africa Mini-grid Developers Association, out of 35 mini-grid sites surveyed for the study only two reported service up time of less than 99 percent.

- Countries work to ensure the underlying conditions for private sector mini-grid development at scale, including support for public-private partnerships, light-handed yet well-codified regulations, and initiatives that cut bureaucratic red tape.
- Investors and development partners collaborate to find new ways to assemble financing for private mini-grid developers, consisting of results-based grants, private equity, affordable debt, and de-risking mechanisms.
- Leading mini-grid developers drive down their own costs by leveraging cost reductions in key components such as solar PV and batteries, deploy new strategies such as remote monitoring to reduce operating expenses, and innovate their supply chains to more easily mount projects in hard-to-reach locations.

Building the ecosystem to expand digitally enabled business models such as pay-as-you-go through close coordination with digital players and financiers has also been identified as a way to bring costs, quality, and affordability into closer alignment. In addition, service delivery and sustainability can be improved by incentivizing energy providers—especially utilities. Engaging women as entrepreneurs and employees in the energy access sector (within energy access companies and across value chains) is another way to contribute to reliable last-mile energy access.

Raising the quality of off-grid solutions through the adoption of international standards in local markets will ensure market sustainability. Quality-assurance activities include the adoption and implementation of international quality standards for off-grid products as well as for energy-efficient appliances.

CATALYZING, HARNESSING, AND REDIRECTING FINANCING FOR ENERGY ACCESS

To meet the energy access target, financing must increase to USD 35 billion annually on generation, electricity networks, and decentralized solutions by 2030, with priority given to public and private investments in the LDCs and countries experiencing fragility, conflict, and violence (IEA 2021). Moreover, disbursements must catch up with commitments. The share of public and private financing going to distributed renewable technologies (mini-grid and off-grid solar) is presently less than 1 percent of the total 2019 financing commitments in the electricity sectors of high-impact countries. That share should increase in alignment with the distributed renewable shares identified in national or regional least-cost electrification plans (SEforAll 2021b). The transition to clean energy will also require additional investments in green connections, both existing and future.

Comprehensive and gender-responsive financial packages consist of equity, debt, grants, and de-risking mechanisms. Such packages should first cover the public financing needs of all stakeholders in the energy access ecosystem using a variety of designs. Secondly, they should deploy proven delivery mechanisms such as results-based financing. Lastly, the packages should support more innovative instruments, such as new guarantees and credit-management instruments focused on risk mitigation, to leverage private-sector investments.

Scaling up digitally enabled consumer financing schemes (such as pay-as-you-go or on-bill financing) and mobilizing public funding through social security systems or the impact bond market are critical for reaching the poorest end users and making electricity services affordable. Public funding through results-based financing and tax exemptions is also needed to test innovative business models and support growth in nascent and riskier markets.

Innovative financing solutions can be devised for women, who face special barriers both as consumers and entrepreneurs in the energy sector. Such solutions include integrating gender criteria across funding windows, linking gender quotas to program incentives, teaching business skills, and focusing on technologies that create job opportunities for women or target their productive uses of energy.

End-user subsidies (such as direct cash transfers or results-based financing schemes for very-low-income households) have emerged to complement supply-side support in bridging the affordability gap (GOGLA 2021b and SEforAll 2022). These enable service providers to reduce product costs for the targeted segments (or mandate that they do so). Such subsidies are complex, however, and risk distorting markets. Policy makers should therefore consider them carefully within the broader range of energy access dynamics and financing mechanisms so that they can be adequately designed and implemented.

In summary, the World Bank has identified six principles to maximize the chance of success of public funding schemes[17] (ESMAP 2022b):

- Target resources to the people most in need.
- Support good-quality products.
- Provide support commensurate with need for closing the financing and affordability gaps.
- Provide funding in an efficient and timely manner.
- Effectively verify program results.
- Promote sustainable results.

17 These principles are from the report analyzing funding for off-grid solar, but they can be applied beyond it.

METHODOLOGY

THE WORLD BANK'S GLOBAL ELECTRIFICATION DATABASE

The World Bank's Global Electrification Database compiles nationally representative household survey data and census data for the years between 1990 and 2020. It also 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. At the time of this analysis, the Global Electrification Database contained 1,270 surveys from 140 countries, excluding surveys from developed countries (as classified by the United Nations). Since 2010, 21 percent of countries have published or updated their electricity data at intervals of two to three years in time for global data collection. Greater investment in data collection and capacity building is needed to permit a more comprehensive and accurate understanding of the electricity access picture.

ESTIMATING MISSING VALUES

Surveys are typically published every two to three years, but they can be irregular and infrequent in many regions. A multilevel, nonparametric modeling approach developed by the WHO to estimate clean fuel usage was adapted to project electricity access and then applied to fill in missing data points between 1990 and 2020 (Bonjour et al. 2013).[18] Where data are available, access estimates are weighted by population. Multilevel, nonparametric modeling takes into account the hierarchical structure of data (country and regional levels), using the regional classification of the United Nations.

The model is applied in all countries with at least one data point. In order to use as much real data as possible, results based on survey data are reported in their original form for all years available. The statistical model is used to fill in data only for years in which data are missing and to conduct global and regional analyses. In the absence of survey data for a given year, information from regional trends is used. The difference between real data points and estimated values is clearly identified in the database. Countries considered "developed" by the United Nations and classified as high-income are assumed to have electrification rates of 100 percent from the first year the country joined the category.

For 1990–2010, the statistical model is generally based on insufficient data points or outdated household surveys. To avoid having electrification trends in this period overshadow efforts since 2010, the model was run twice, once with survey data assumptions for 1990–2020 (for model estimates for 1990–2020) and once with survey data and assumptions for 2010–20 (for model estimates for 2010–20). The first run extrapolates electrification trends for 1990–2020 given the available data points. The second considers only real data collected from 2010 and estimates the historical evolution in the most recent years. The outputs from the two model runs are then combined to generate a final value for access to electricity. If survey data are available, the original observation remains in the final database. Otherwise, taking account of a positive linear trend in electrification, the larger of the values generated by the model runs is chosen as the final data point.

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

MEASURING ACCESS TO ELECTRICITY THROUGH OFF-GRID SOURCES

Data coverage

IRENA collects global data on off-grid renewable energy in Africa, Asia, South America, Central America and the Caribbean, and Oceania. Its database covers off-grid renewable power capacity (in megawatts), biogas production (in cubic meters), and energy access (number of inhabitants):

- Off-grid power covers hydropower, solar lights, solar home systems (small and large), solar mini-grids, solar pumps, other solar panels, and biogas and other biomass.
- Biogas production includes cooking, electricity generation, industrial uses, the commercial and public sectors, and agriculture.
- Energy access is estimated for (i) people with access to hydropower, solar lights, solar home systems (small and large), solar mini-grids (Tiers 1 and 2), and biogas; and (ii) people with access to biogas for cooking.

Data sources and dissemination

IRENA collects off-grid capacity and generation data from a variety of sources. These include IRENA 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 PV capacity, based on solar panel import statistics obtained from the United Nations' COMTRADE Database.

IRENA publishes off-grid statistics by the end of December each year. IRENA provides details on the methodology used in this report (IRENA 2018).

CALCULATING THE ANNUAL CHANGE IN ACCESS

The annual change in access is calculated as the difference between the access rate in year 2 and the rate in year 1, divided by the number of years. For the annual change in the number of people with access, UN population data are used to reflect population growth.

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

COMPARING THE ELECTRIFICATION DATA METHODS OF THE WORLD BANK AND THE INTERNATIONAL ENERGY AGENCY

The World Bank and the International Energy Agency (IEA) maintain separate databases of global electricity access rates. The World Bank's Global Electrification Database derives estimates from a suite of standardized household surveys and censuses that are conducted in most countries every two to three years, in conjunction with a multilevel, nonparametric model to extrapolate data for the missing years. The IEA Energy Access Database sources data from government reports of household electrification (usually based on connections reported by utilities). IEA considers a household to have access if it receives enough electricity to power a basic bundle of energy services. The World Bank uses the Multi-Tier Framework, which classifies access along a tiered spectrum, from Tier 0 (no access) to Tier 5 (highest level of access).

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

The 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 distinct 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, data from surveys convey user-centric perspectives on electrification. Survey data capture all forms of electricity access, painting a more complete picture of access than may be possible from data supplied by service providers.

Government data on electrification reported by national ministries of energy are supply-side data on utility connections. Such data 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. 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 that may lead to underestimation of the access deficit.

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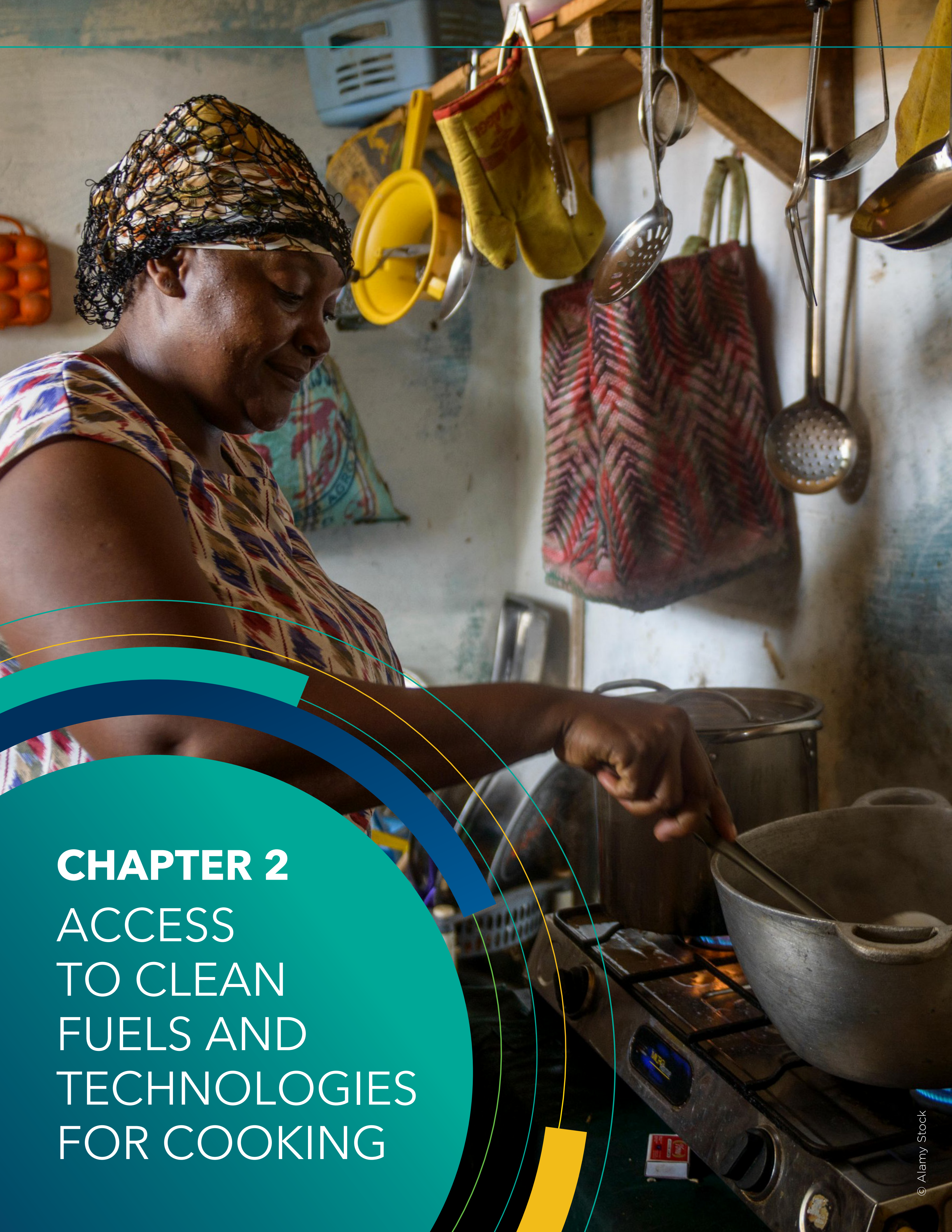

CHAPTER 2
ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING

MAIN MESSAGES

- **Global trend:** In 2020, 69 percent (64–73) percent of the world's people had access to clean cooking fuels and technologies, an increase of almost 70 million people over 2019.[1],[2] Much more needs to be done, as about a third of the global population—some 2.4 (2.1–2.7) billion people—still lacked access in 2020. Over the past decade, access to clean fuels and technologies for cooking rose by only 12 percentage points. If current trends continue, a quarter of the world's people, mostly in low- and middle-income countries, will lack access to clean cooking fuels in 2030.
- **Access and the 2030 target:** Between 2010 and 2020, the global rate of access to clean cooking fuels and technologies increased at an average annual rate of 1 percentage point (0.5–1.8), driven primarily by increases in large, populous countries in Asia. In Sub-Saharan Africa, however, the number of people without access is increasing at an accelerating rate. In a business-as-usual scenario, the number of people without access to clean cooking in Sub-Saharan Africa is set to increase by almost 20 million every year this decade, rising from 923 million in 2020 to over 1.1 billion in 2030, as small gains in the percentage of people with clean cooking fail to keep pace with population growth. Achieving global universal access to clean cooking is impossible without addressing the growing access deficit there.
- **Regional highlights:** Central Asia and Southern Asia—along with Eastern Asia and South-eastern Asia—accounted for most of the access gains between 2010 and 2020; the annualized increase in access to clean cooking was 2.5 percentage points (0.5–4.3) in Central Asia and Southern Asia and 2.1 percentage points (0.8–2.1) in Eastern Asia and South-eastern Asia. Progress in Latin America and the Caribbean remained stagnant, with the access rate remaining around 88 percent (85–91) and the annual increase averaging 0.3 percentage points (–0.1–0.3). Marginal increases in access were seen in Sub-Saharan Africa, with an annualized increase of 0.48 percentage points (0.2–0.5). By 2030, access to clean cooking is projected to reach 80–90 percent in Central Asia, Southern Asia, Eastern Asia, and South-eastern Asia. Meanwhile, only about one in five people in Sub-Saharan Africa (17 percent) has access, and access in Oceania excluding Australia and New Zealand is at just 15 percent, meaning the vast majority of people in these regions will continue to suffer the negative impacts on health, environment, and livelihoods that come with polluting cooking. Sub-Saharan Africa remains the only region in which the number of people without access to clean fuels and technologies is rising. The access deficit there has nearly doubled since 1990, rising more than 50 percent since 2000, to reach 923 million (898–946) people in 2020.
- **Urban-rural divide:** Around the world, urban-rural differences in access to clean cooking fuels and technologies are large. In 2020, 86 percent of people living in urban areas and just 48 percent of the rural population had access to clean fuels and technologies. In Sub-Saharan Africa, more than 93 percent of the rural population lacks access to clean cooking fuels and technologies, compared with 71 percent of the population living in urban areas.

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1 Throughout the chapter, parenthetical figures appearing after estimates are 95 percent uncertainty intervals, as defined in the methodology section at the end of this chapter.

2 Clean fuels and technologies include stoves powered by electricity, liquefied petroleum gas (LPG), natural gas, biogas, solar, and alcohol. Clean fuels and technologies are as defined by the normative technical recommendations in the WHO Guidelines for Indoor Air Quality: Household Fuel Combustion (WHO 2014).

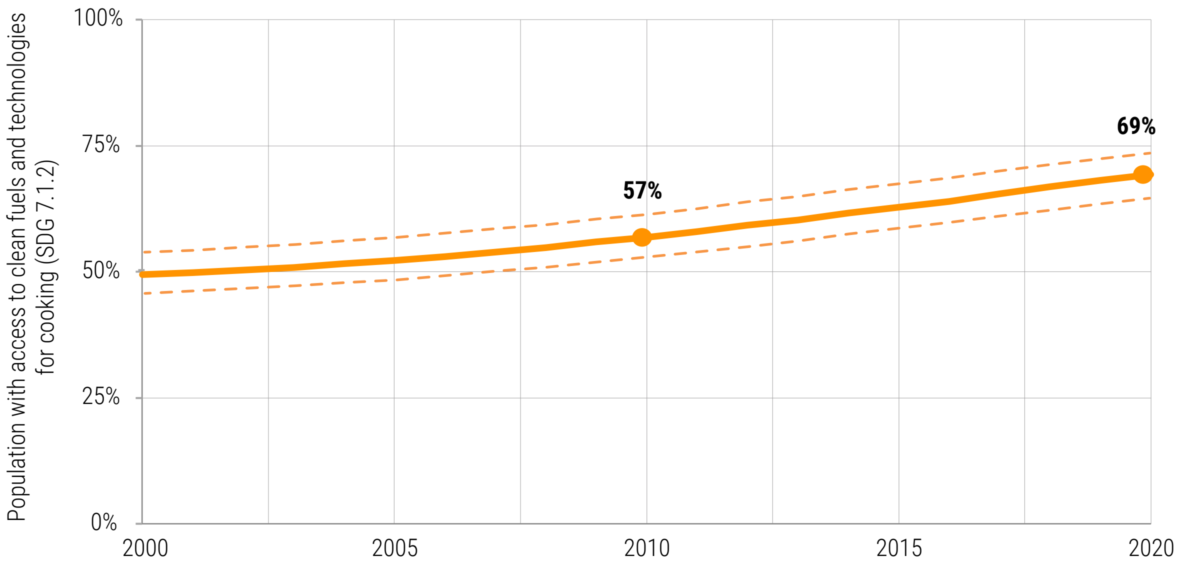
- **The 20 countries with the largest access deficits:** Between 2016 and 2020, the 20 countries with the largest number of people lacking access to clean cooking fuels and technologies accounted for more than 80 percent of the global population without access. In 16 of these countries, less than half the population had access to clean cooking. In most of these countries, little progress had been made, with only five countries—India, China, Indonesia, Myanmar, and Nigeria—showing average gains in access of at least 2 percentage points over 2016–20.
- **The 20 countries with the lowest access rates:** Nineteen of the 20 countries with the lowest percentages of the population with access to clean cooking are least-developed countries in Africa (the one non-African country is Haiti).
- **Global and regional fuel trends:** Globally, primary cooking with gaseous fuels increased consistently between 2010 and 2020, reaching 52 percent (46–58) in low- and middle-income countries in 2020 and overtaking biomass as the dominant cooking fuel in 2010. Use of electricity for cooking increased, reaching 11 percent (7–15) in low- and middle-income countries. Globally, the use of kerosene declined, but its use remains notable in urban areas of low- and middle-income countries in Oceania excluding Australia and New Zealand (10 percent [5–18]) and Sub-Saharan Africa (7 percent [4–9]).
- **Five most populous countries:** Between 2010 and 2020, the access rate for the combined populations of the top five most populous low- and middle-income countries (China, India, Indonesia, Brazil, and Pakistan) increased 26 percentage points. During the same period, the combined access rate for all other low- and middle-income countries increased by just 3 percentage points.
- **Need to increase public and private finance for clean cooking:** Annual investment of USD 4.5 billion is required to achieve clean cooking for all—about USD 1.90 for every person without access in 2020—according to Sustainable Energy for All (SEforAll) and the International Energy Agency. In 2019, total investment was only about USD 134 million (SEforAll 2021)— about USD 0.05 for every person without access, or less than 3 percent what is needed. Scale-up of clean cooking investment flows in Sub-Saharan Africa is urgently needed. If universal access to clean cooking is not achieved, the cost of inaction—driven by negative externalities on health, gender, and climate—is estimated at USD 2.4 trillion a year (ESMAP 2020c).
- **Clean cooking during the COVID-19 pandemic:** Accelerating access to clean cooking is critical to reducing the poorest households' vulnerability to the pandemic and reducing gender inequity. Adoption of clean cooking solutions can reduce health risks from household air pollution, support a green and healthy recovery, and spur economic growth in low- and middle-income countries. National governments—with the support of international organizations and civil society and with strong engagement of the private sector—must harness recovery efforts to develop and implement regulatory and financial policies. The implementation of these policies can enhance affordability and better enable and drive the adoption of clean cooking, especially among the most vulnerable populations, reducing time spent cooking for women and the burden of unpaid work in the care economy (Clean Cooking Alliance 2021b).

ARE WE ON TRACK?

In 2020, 69 percent (64–73) of the global population had access to clean cooking fuels and technologies (stoves powered by electricity, LPG, natural gas, biogas, solar, and alcohol). Some 2.4 billion (2.1–2.7) people cooked primarily with polluting fuels and technologies, such as charcoal, coal, crop waste, dung, kerosene, and wood.[3] Access to clean cooking must become a higher priority on the global agenda if access rates are to improve.

Global access to clean cooking increased over the past two decades (figure 2.1). Despite this progress, only about 76 percent of the population is projected to have access to clean cooking fuels and technologies by 2030. These figures are closely aligned with the projections of the International Energy Agency's Stated Policies Scenario, which maps the energy transition assuming current policies and programs are implemented. Both projections suggest that about 2 billion people will lack access to clean cooking in 2030 unless additional action is taken.

Figure 2.1 • Percentage of global population with access to clean cooking fuels and technologies, 2000–20



Source: WHO 2022.

Globally, the number of people without access to clean cooking continues to shrink. However, the number of people without access in Sub-Saharan Africa is growing, currently at a rate of almost 20 million people a year. This trend reflects the fact that gains in the share of people with access are failing to keep pace with population growth, to the detriment of the almost 1 billion people already suffering the negative health and socioeconomic impacts of polluting cooking in this region. Most countries with low access rates are in Sub-Saharan Africa (figure 2.2). Unless the accelerating access deficit in Sub-Saharan Africa is addressed, global access will stall and begin to decline.

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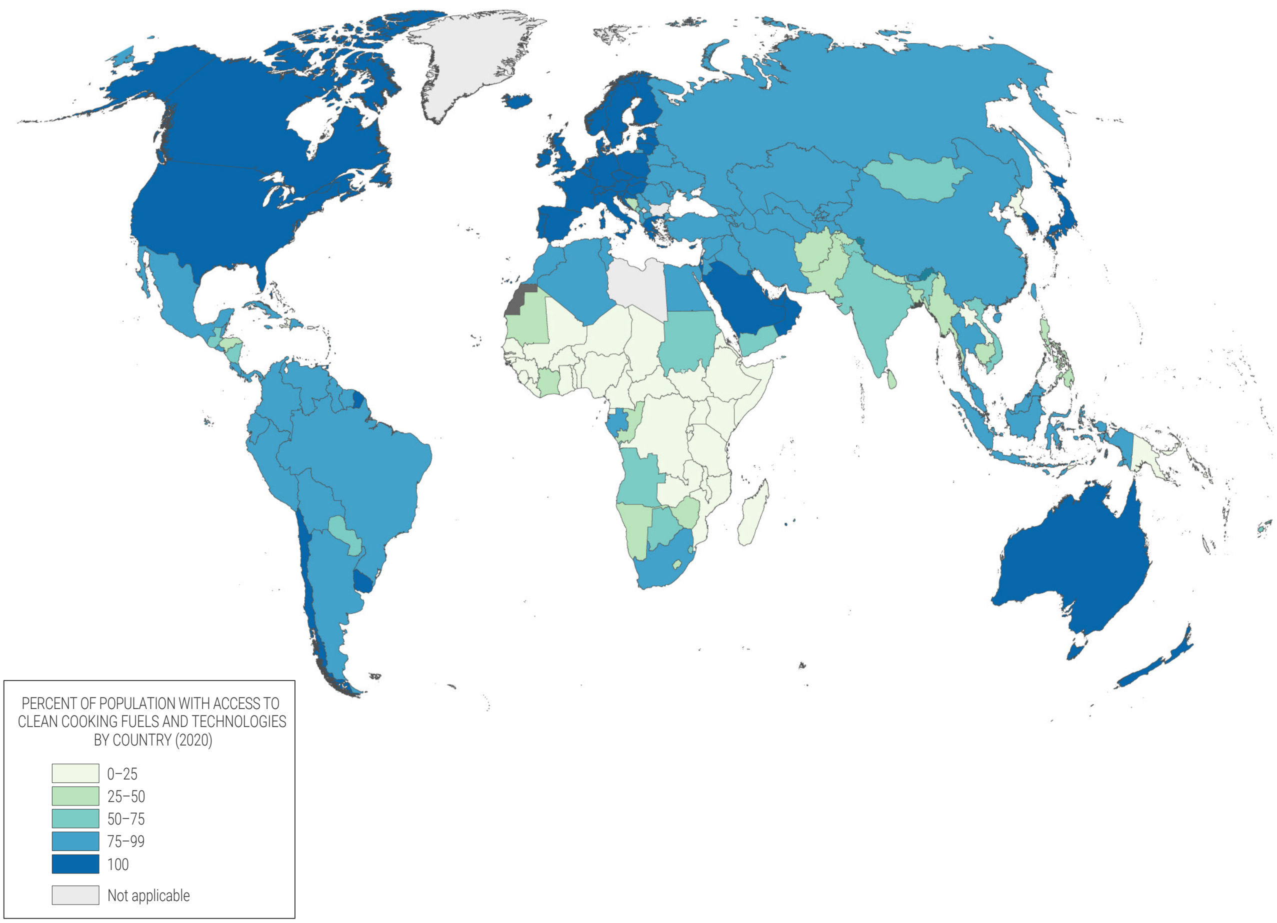
3 Because of the data-driven nature of the analysis and limitations in the data, this chapter examines cooking fuels rather than cookstove and fuel combinations. The methodology section at the end of the chapter provides additional details.

Figure 2.2 • Percentage of population with access to clean cooking fuels and technologies, by country, 2020



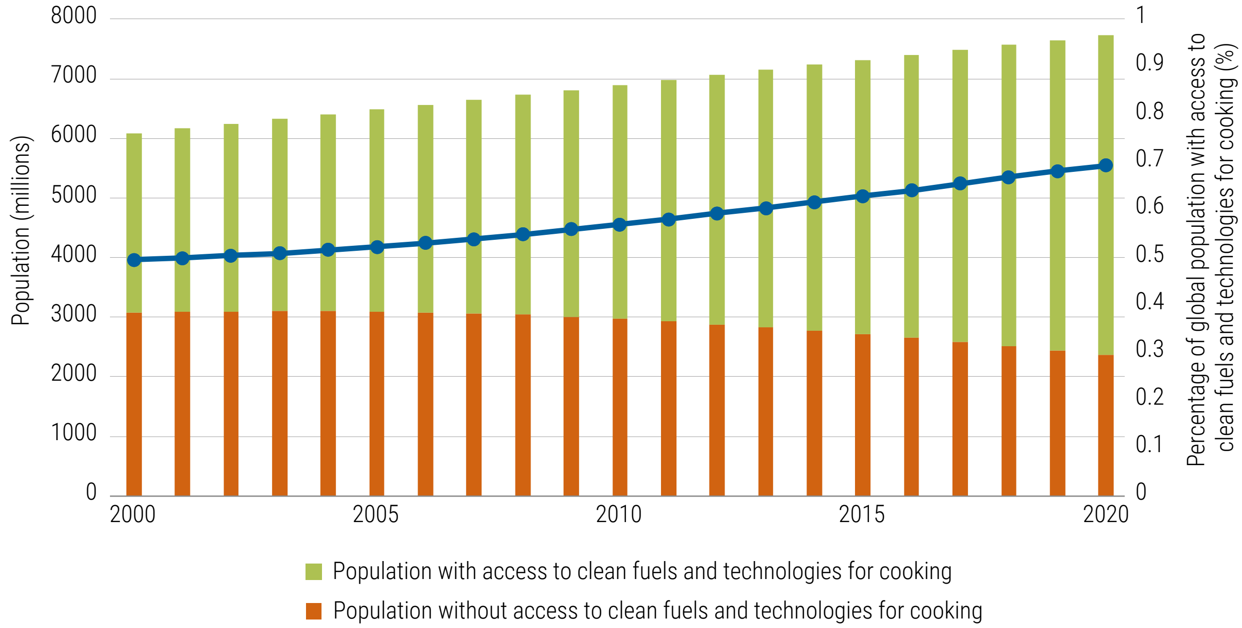
Source: WHO 2022.
Note/disclaimer: This map was produced by the Geospatial Operations Support Team of the World Bank based on the Cartography Unit of the World Bank. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of the custodian agencies concerning the legal status of or sovereignty over any territory or the endorsement or acceptance of such boundaries.

LOOKING BEYOND THE MAIN INDICATORS

ACCESS AND POPULATION

Between 2000 and 2020, the global access rate increased by only about 22 percentage points, to 69 percent (figure 2.3).

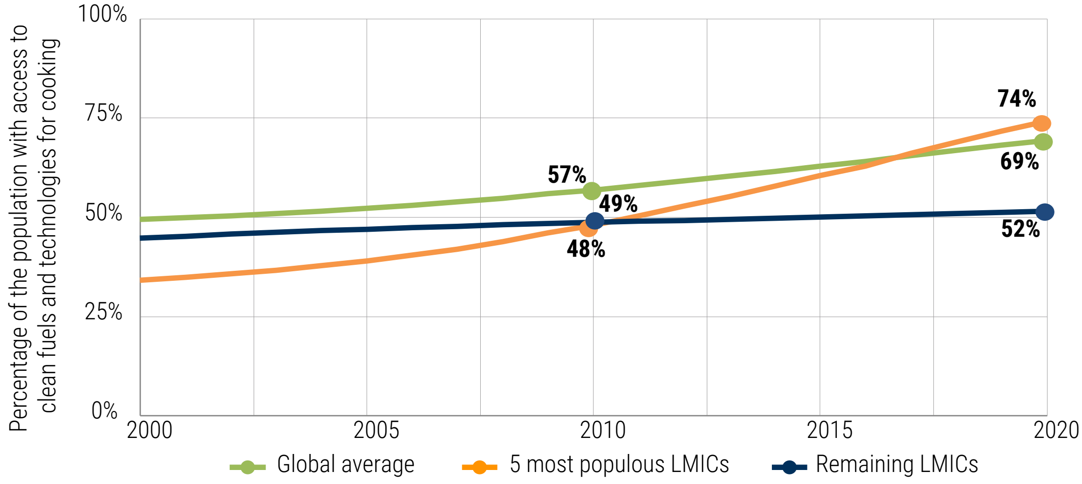
Figure 2.3 • Number of people and percentage of global population with access to clean cooking, 2000–20



Source: WHO 2022.

Improvements in the access rate are driven by the most populous low- and middle-income countries: China, India, Indonesia, Brazil, and Pakistan. Figure 2.4 highlights the effects of these five countries on the observed increase in access to clean cooking from 2010 to 2020 and the low or minimal progress in other low- and middle-income countries. This is a stark reminder that countries already making good progress have diminishing populations that can be converted to clean cooking. The time to address the lack of progress elsewhere is now, or global rates will eventually stall or even decline.

Figure 2.4 • Percentage of population with access to clean cooking globally, in five most populous low- and middle-income countries, and all other low- and middle-income countries, 2000–20



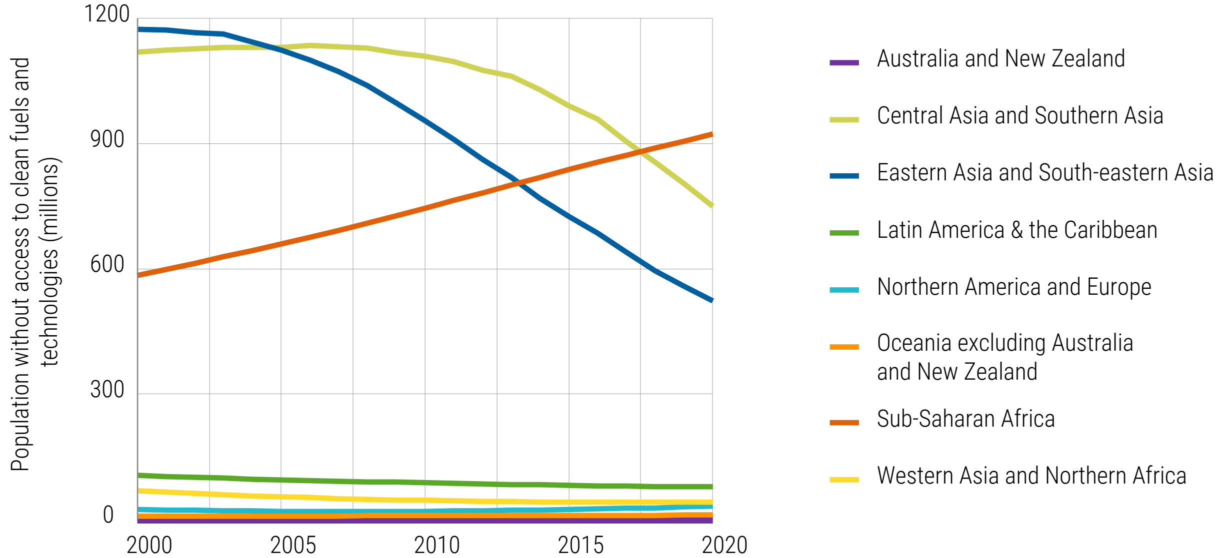
Source: WHO 2022.

LMICs = low- and middle-income countries.

THE ACCESS DEFICIT

Number people with access to clean cooking has risen significantly (figure 2.5). However, population growth has led to an increase in the total number of people lacking access to clean cooking—referred to here as the "access deficit." This number remained close to 3 billion people between 2000 and 2010. It fell to 2.4 billion people (2.1–2.7) in 2020.[4]

Figure 2.5 • Number of people lacking access to clean fuels and technologies, by region, 2000–20



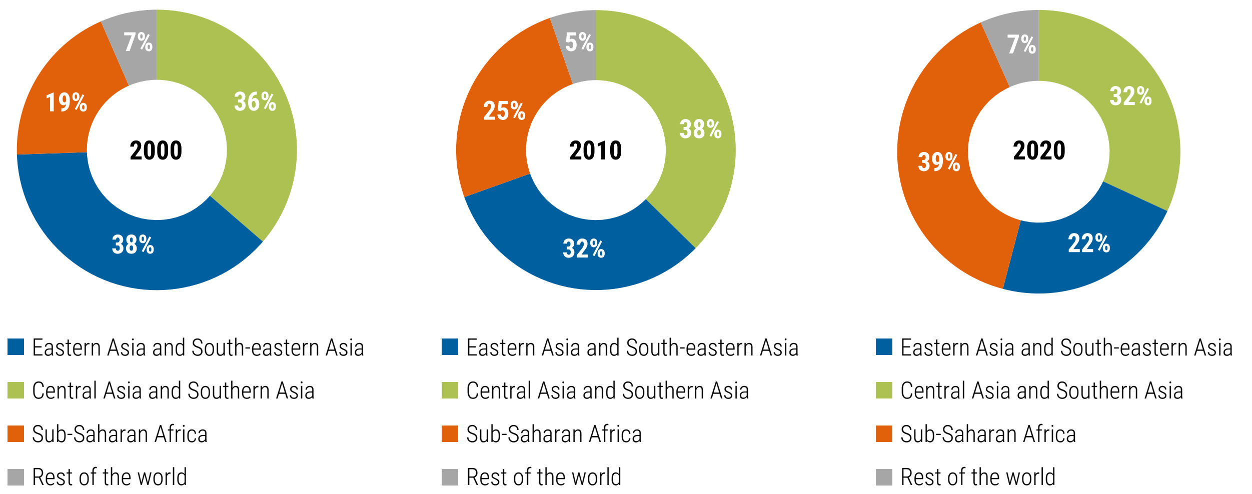
Source: WHO 2022.

4 Many households that primarily rely on clean fuels and technologies continue to use polluting fuels and technologies for some of their cooking energy. For this reason, it is not clear whether exposure to household air pollution is decreasing as rapidly as the access deficit, which only measures the population primarily relying on polluting fuels and technologies.

The access deficit decreased consistently in Eastern Asia and South-eastern Asia since 2000 and in Central Asia and Southern Asia since 2010. Sub-Saharan Africa remains the only region in which the number of people without access is rising. The access deficit in Sub-Saharan Africa nearly doubled between 1990 and 2020; it rose by more than 50 percent since 2000 to 923 million (898–946) in 2020.

In 2000, more than 7 in 10 people without access lived in either Central Asia and Southern Asia or Eastern Asia and South-eastern Asia; only 2 in 10 lived in Sub-Saharan Africa (figure 2.6). In 2020, 4 in 10 people without access lived in Sub-Saharan Africa, as a result of decreases in the access deficit in the two Asian regions and an alarming increase in the access deficit in Sub-Saharan Africa.

Figure 2.6 • Breakdown of global access deficit in the three largest access-deficit regions and rest of world, 2000, 2010, and 2020

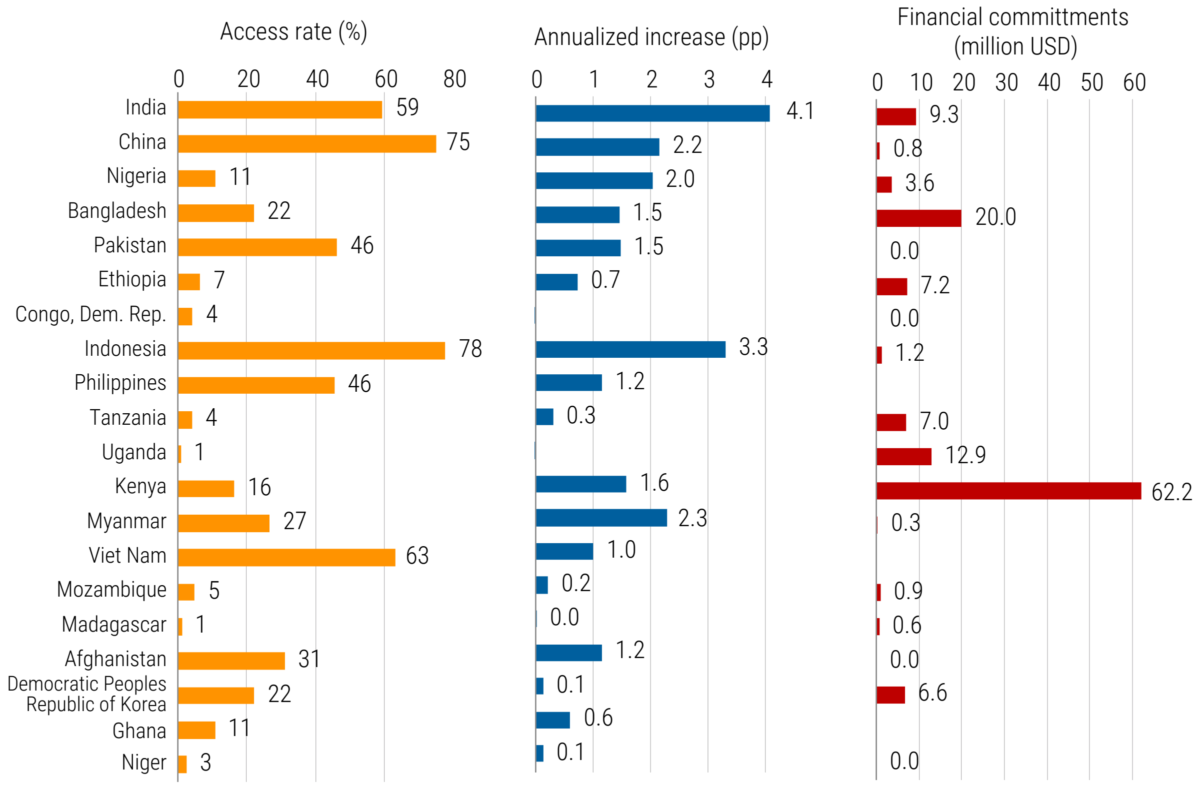


Source: WHO 2022.

ANALYSIS OF TOP 20 ACCESS-DEFICIT COUNTRIES

The top 20 access-deficit countries—the countries with the largest populations lacking access to clean cooking fuels and technologies—accounted for 82 percent of the global population without access to cleaning cooking in 2016–20 (figure 2.7).[5] India accounted for the largest share of the access deficit (548 million people), followed by China (352 million).

Figure 2.7 • Twenty countries with largest number of people lacking access to clean fuels and technologies (average for 2016–20)



Source: WHO 2022.

In 16 of the 20 countries, less than half of the population had access to cleaning cooking; in 6 of them (the Democratic Republic of Congo, Madagascar, Mozambique, Niger, Uganda, and Tanzania), just 5 percent or less of the population had access. India was the largest population without access to clean cooking, but it enjoyed the largest increase in access between 2016 and 2020, with an annual increase of 4.1 percentage points. Other countries that experienced annual gains in access of more than 2 percentage points were Indonesia (3.3 percentage points), Myanmar (2.3 percentage points) and China (2.1 percentage points).

The 20 countries with the lowest access rates showed little to no sign of improvement (figure 2.8). In none of these countries did access increase by more than 0.4 percentage points, and in some countries access decreased. All of these countries except Haiti are in Sub-Saharan Africa. These Sub-Saharan countries also have the least finance dedicated to clean cooking (SEforAll 2021).

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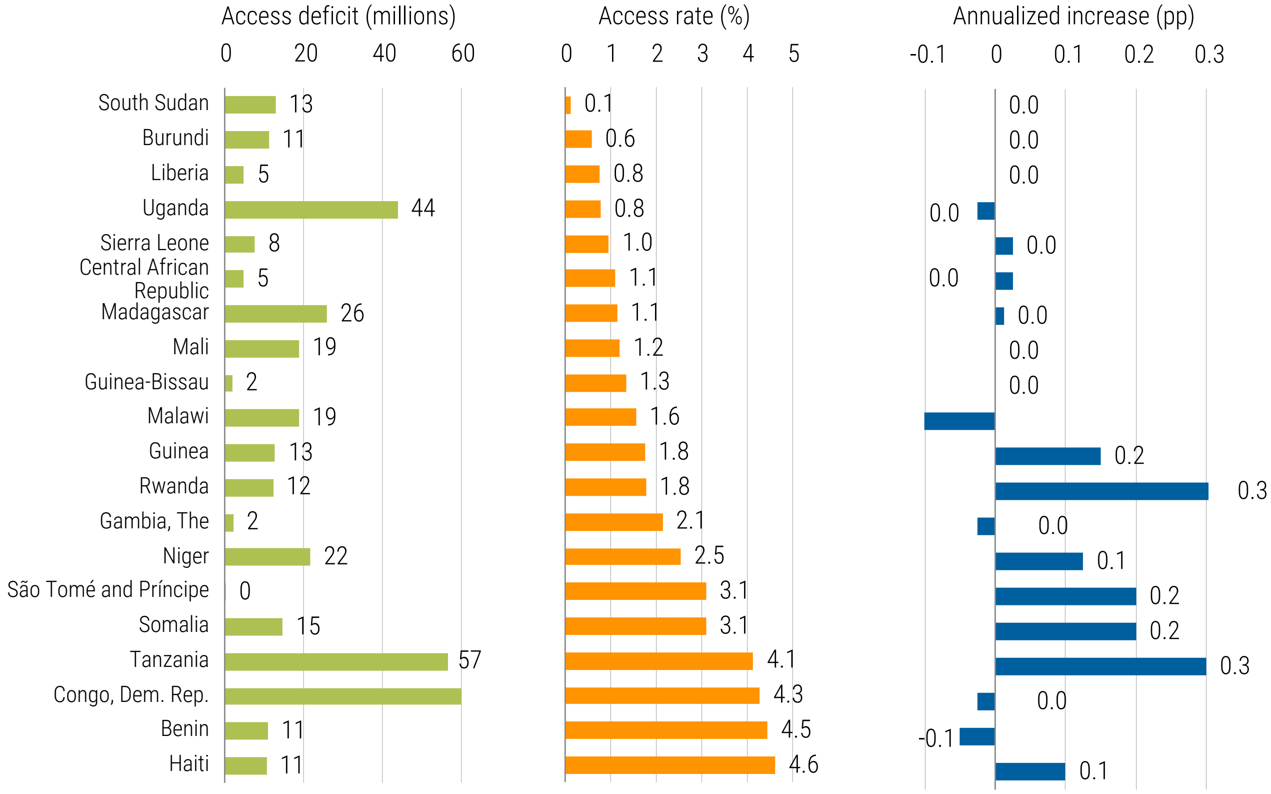
5 The top 20 access-deficit countries are Afghanistan, Bangladesh, China, the Democratic Republic of Congo, Ethiopia, Ghana, India, Indonesia, Kenya, the Democratic People's Republic of Korea, Madagascar, Mozambique, Myanmar, Niger, Nigeria, Pakistan, Philippines, Uganda, Tanzania, and Vietnam.

Figure 2.8 • Twenty countries with lowest rates of access to clean fuels and technologies, average 2016–20

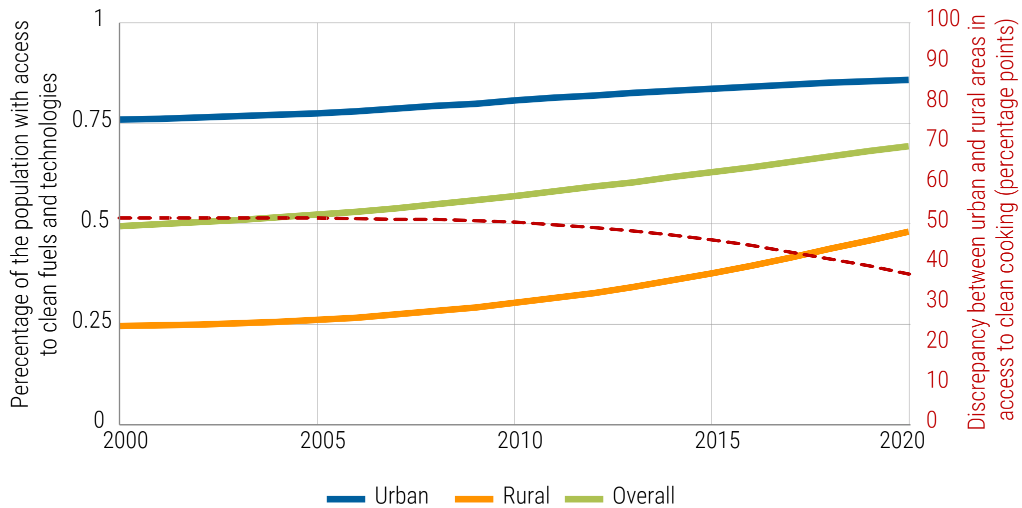


Source: WHO 2022.

URBAN-RURAL DIVIDE

Urban areas have greater access to clean cooking than rural areas, but the gap is narrowing. The percentage of people with access to clean cooking increased by about 22 percentage points over the past 20 years. Between 2000 and 2010, the global difference in access to clean cooking between urban and rural areas was relatively constant, at about 50 percentage points (48–51) in 2010. In the past decade, the gap fell to 38 points (34–40) (figure 2.9).

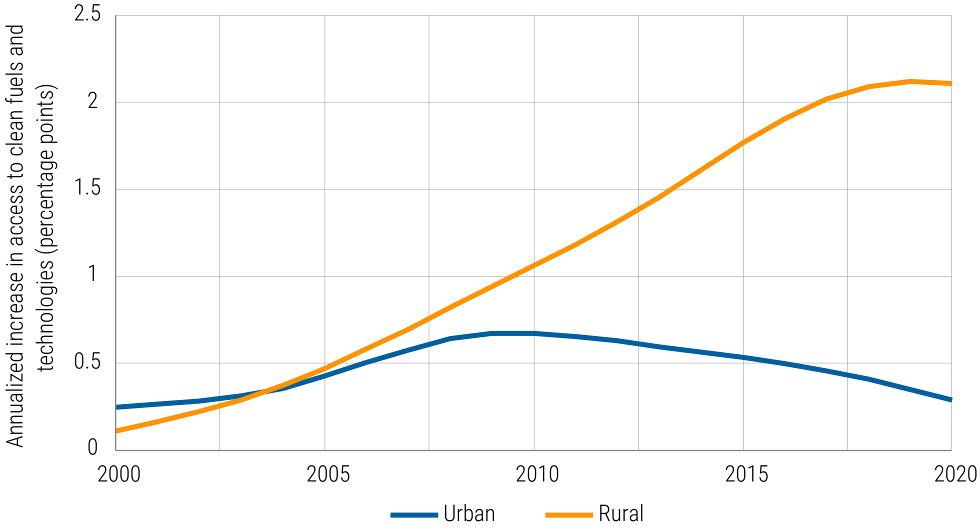
Figure 2.9 • Percentage of people with access to clean cooking in urban and rural areas, 2000–20



Source: WHO 2022.

Access to clean cooking rose at an annual rate of 1.8 (0.1–2.5) percentage points in rural areas and 0.5 percentage points (0.4–0.8) in urban areas. The regions with the greatest progress in rural areas were Central and Southern Asia, with an annual increase of 3 (1–4) percentage points over the past 10 years, followed by Eastern and South-eastern Asia (2.7 [0.5-4.5] percentage points). In Sub-Saharan Africa, the access rate in rural areas was stagnant, with annualized increases of only 0.1 percentage points over this period. Globally, there was a slight decrease in rural areas between 2017 and 2020 (figure 2.10). In contrast, the annual increase in urban areas fell consistently over the past decade. Access thus accelerated in rural areas and decelerated in urban areas. If these trends continue and population growth outpaces gains in access to clean cooking, the proportion of the population with access to clean cooking is projected to stall and possibly decline in urban areas.

Figure 2.10 • Annual increase in access to clean fuels and technologies in urban and rural areas, 2000–20



Source: WHO 2022.

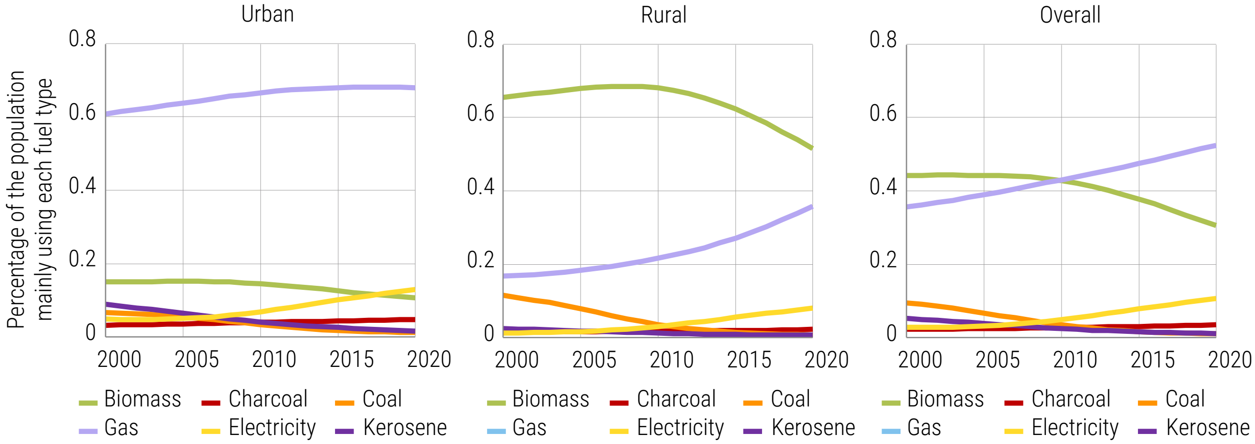
The wider gap in access to clean cooking in rural areas resembles that for access to electricity, although urban access has plateaued at a much higher level (97 percent since 2016).

CHANGES IN THE FUEL MIX

In low- and middle-income countries, the use of gaseous fuels for cooking increased consistently, from 36 percent (31–41) in 2000 (1.8 billion people) to 52 percent (46–58) in 2020 (3.4 billion people), overtaking unprocessed biomass fuels as the dominant cooking fuel over the past decade (figure 2.11). Electricity is emerging as a leading clean fuel of choice after gas. Use of electricity for cooking rose from 3 percent (2–4) in 2000 (140 million people) to 11 percent (7–15) in 2020 (690 million people), with most of the increase occurring in urban areas. In 2020, this value was highest in Eastern Asia and South-eastern Asia, where 25 percent (15–37) of the population (530 million people) relied mainly on electricity for cooking, compared with only 1 percent (0.7–2.5) of the population (24 million) in Central and Southern Asia. This difference highlights the importance of advancing integrated approaches to energy planning that take into account access to both electricity and clean cooking.

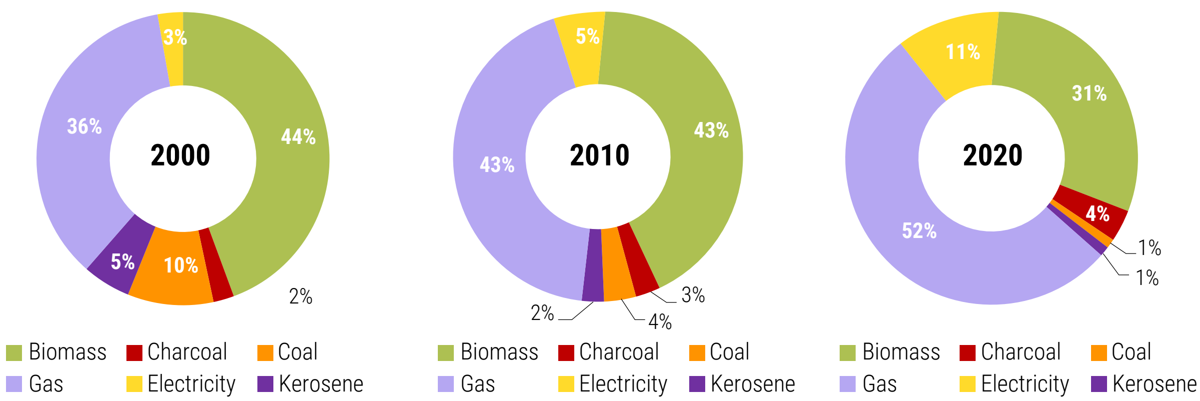
Figure 2.11 • Main cooking fuels used overall and in urban and rural areas of low- and middle- income countries, 2000–20

Panel A



Source: WHO 2022.

Panel B



Source: WHO 2022.

Between 2000 and 2010, increases in the use of clean fuels were accompanied by steep declines in the use of coal, particularly in rural areas, where the use of coal dropped from 11 percent (7–17) in 2000 to 1 percent (0.1–2) in 2020. Use of kerosene decreased, particularly in urban areas, where it dropped from 8 percent (7–10) in 2000 to 2 percent (1–3) in 2020. The use of unprocessed biomass fuels (wood, crop waste, and dung) declined, primarily in rural areas, where use of unprocessed biomass fuels dropped from 68 percent (63–72) in 2010 to 52 percent (45–59) in 2020.

Use of kerosene has dwindled worldwide (figures 2.13 and 2.14), but it remained prominent in urban areas of low- and middle-income countries in both Oceania (10 percent [5–18]) and Sub-Saharan Africa (7 percent [4–9]) in 2020. Globally, the proportion of the population relying on charcoal is low (3 percent [2–4]), but charcoal overtook unprocessed biomass in Sub-Saharan African cities (27 percent [23–32]) in 2020.

Fuel stacking (the simultaneous use of several different fuels, remains extremely common; the statistics presented here address only the main cooking fuel. The number of people relying exclusively on clean fuels is therefore likely to be much smaller than the numbers cited here might imply. Analysis of all cooking fuels used will be possible with the widespread adoption of survey questions that capture all fuels and technologies used for cooking (World Bank and WHO 2021).

POLICY INSIGHTS

The negative impacts associated with the lack of access to modern cooking are estimated to cost USD 2.4 trillion a year, as a result of negative externalities for health (USD 1.4 trillion), gender (USD 0.8 trillion), and climate (USD 0.2 trillion) (ESMAP 2020c). The cost of inaction far exceeds the annual investment needed to achieve the universal access target.

Health is one of the largest costs associated with polluting cooking. Daily exposure to very high levels of household air pollution puts household members, particularly women and children, at greater risk of ischemic heart disease, stroke, chronic obstructive pulmonary disease, pneumonia, and cancers. New estimates from the World Health Organization (WHO) show that 3.2 million deaths are attributed to household air pollution exposure from using polluting fuels and technologies for cooking, with the greatest health losses seen in Eastern and South-eastern Asia and Sub-Saharan Africa.

The health toll is even greater when accounting for the morbidity and disability caused by household air pollution. Most diseases directly linked to household air pollution are chronic in nature. People with these diseases often have symptoms that reduce the quality of their lives and limit day-to-day activities, including employment, socialization, and schooling. As many as 82 million healthy life years are lost each year to exposure to household air pollution, with the greatest disability experienced by women and children.

Researchers have investigated how policies to increase access to clean fuels affect gender roles and inequalities. Some studies show that on average, households headed by women have less access to electricity and are more likely to report the cost of the connection as the main barrier to gaining access than households headed by men (Padam and others 2018; Koo and others 2018; Dave and others 2018; Samad and others 2019; Dubey and others 2020; Koo and others 2019; Luzi and others 2019; Pinto and others 2019; Brutinel and others 2020). Women spend as much as twice as much time as men acquiring fuel for cooking. In Rwanda and Cambodia, far more female-headed households use rudimentary traditional stoves than do male-headed households; however, the opposite trend was found in Ethiopia and Nepal (Padam and others 2018; Koo and others 2018; Dave and others 2018; Pinto and others 2019). In Uganda, women 15 and older spend an average of 3.8 hours a day cooking, and girls spend almost 30 minutes a day doing so. Men and boys are virtually uninvolved in cooking. Female household members in Uganda spend 3.4 hours a week acquiring cooking fuels and preparing foods—7.5 times more than men (ESMAP 2020c). Use of clean cooking technologies thus has a disproportionately large effect on women.

The global temperature rise cannot be limited to 1.5°C without reducing emissions from cooking. Greenhouse gas emissions from unsustainable harvesting and incomplete combustion of wood fuels for cooking amount to a gigaton of carbon dioxide (CO_2) per year—about 2 percent of global emissions, on par with emissions from aviation and shipping (Bailis, Broekhoff, and Lee 2016). Use of inefficient stoves and fuels also produces a range of short-lived climate pollutants, such as black carbon, which has a warming impact on climate that is 460–1,500 times stronger than CO_2. More than 65 countries have already included household energy or clean cooking related goals in their Nationally Determined Contributions in the lead up to the 26th Conference of Parties (COP26) that took place in late 2021 (Clean Cooking Alliance 2021a). The adoption at COP26 of compacts focused on clean cooking are an encouraging step that should help the planet combat the negative impacts of climate change. The compacts on clean cooking were among some two hundred compacts that emerged from the High-Level Dialogue on Energy convened by the UN Secretary-General in 2021. For more on the Dialogue, see box 1.1 in chapter 1.

A coordinated multisectoral effort is needed to achieve the SDG 7 target of universal access to clean cooking by 2030. Learning from the successes and challenges faced by countries that have attempted to design and implement clean household energy policies is critical. The WHO's Household Energy Policy (HEP) Repository, developed in partnership with the Stockholm Environment Institute, serves as an online clearinghouse for policies, regulations, and legislation affecting household energy use at the national, regional, and local levels (WHO 2021). It includes over 100 policies or policy statements that address clean cooking from nearly 30 countries.

This source of data is complemented by the World Bank's Regulatory Indicators for Sustainable Energy (RISE), which evaluate countries' clean cooking policy frameworks based on four indicators: planning, inclusiveness, standards and labelling, and incentives to increase uptake (ESMAP 2020b). The 2019 RISE evaluation found that eight countries with deficits in access to clean cooking (China, Ethiopia, India, Indonesia, Kenya, the Lao People's Democratic Republic, and Nepal) had instituted advanced policy frameworks for clean cooking since 2010; another 22 countries had made moderate progress toward clean cooking policy frameworks; and two (Myanmar and Senegal) had addressed clean cooking in policies included in the WHO HEP Repository.

Lessons from policies assessed for both RISE and the WHO HEP Repository have demonstrated that financial support, such as targeted subsidies, is essential for increasing access to clean household energy but that broader efforts to encourage complete transitions to clean energy are necessary. Cross-sectoral coordination across health, energy, gender, and climate sectors and institutional champions are key to achieving clean cooking transitions.

Dedicated policy and financing interventions must be introduced to (a) strengthen the adoption of clean cooking solutions by addressing affordability and market access challenges and (b) inform the investment and decision in the clean cooking sector. The latter can be achieved by providing reliable data on consumer preferences (demand-side) and the use of different clean cooking solutions, so that resources are allocated to the most viable solutions. Bringing electricity and clean cooking planning closer together—through the development of integrated energy access planning approaches as advanced by SEforAll, the Clean Cooking Alliance, and others, for example—is also important.

Policies and programs also need to raise awareness and build robust supply chains. Lessons from the Africa Renewable Energy Market Analysis launched by IRENA and the African Development Bank suggest that a clean cooking policy framework should include enabling policies to support the uptake of various clean cooking solutions, deployment policies for disseminating solutions, policies to support the integration of the solutions into the energy system, and policies to ensure a just and inclusive transition to clean cooking (IRENA and AfDB 2022).

What is needed to close the access gap in Sub-Saharan Africa in terms of finance? Stated briefly, governments must make clean cooking a national priority; public finance must be better targeted to leverage and de-risk private capital to mobilize more finance; and tracking of finance to energy access projects must be improved to ensure that gender equality is achieved (SE4All 2022) (figure 2.13).

Some governments have plans to promote clean cooking solutions at the national level (box 2.1). The government of Uganda lists promotion of an uptake and sustained use of clean, modern cooking technologies as part of its new energy policy (Ministry of Energy and Mineral Development of Uganda 2019). The data from SEforAll (2021) showed that there has been an increase in clean cooking financing in Uganda from USD 7.2 million in 2018 to 12.9 in 2019.

Furthermore, the potential benefits of using geospatial data platforms in the context of integrated energy plans cannot be overstated. With the use of multiple layers of data and further geospatial modelling, the plan can benefit from low-cost, dynamic and data-driven intelligence. One successful example of geospatial tools that have been developed in sub-Saharan Africa is the Nigeria Integrated Energy Planning Tool, which includes extensive geospatial functionality (Rockefeller Foundation 2022).

Figure 2.13 • Four steps to good clean cooking policy

ADDRESS LACK OF POLICY ATTENTION	TACKLE COST AND FINANCE BARRIERS	BOLSTER SUSTAINABILITY AND SUPPLY CHAINS	CREATE AWARENESS ABOUT IMPACTS AND SOLUTIONS
• Prioritization of clean cooking • Clean cooking strategies (inter-national and national) • Integrated energy planning, including grid, off-grid and clean cooking • Cross-ministerial approaches (including energy, health, agriculture and forestry)	• Financial support (e.g., results-based finance, direct consumer subsidies, low interest loans) • Fiscal measures (e.g., reduced VAT and import duties)	• Regulation and equipment standards • Licensing and certification • Fiscal measures • Training (e.g., business skills, installation and maintenance) • Enable access to early stage/growth capital • Funding for value chain development (e.g., maintenance)	• Data collection on what works • Education, information and awareness programs • Gender- and socially-inclusive policies and programs

Source: IRENA and AfDB 2022.

BOX 2.1 • Allocating financing for clean cooking in Sub-Saharan Africa

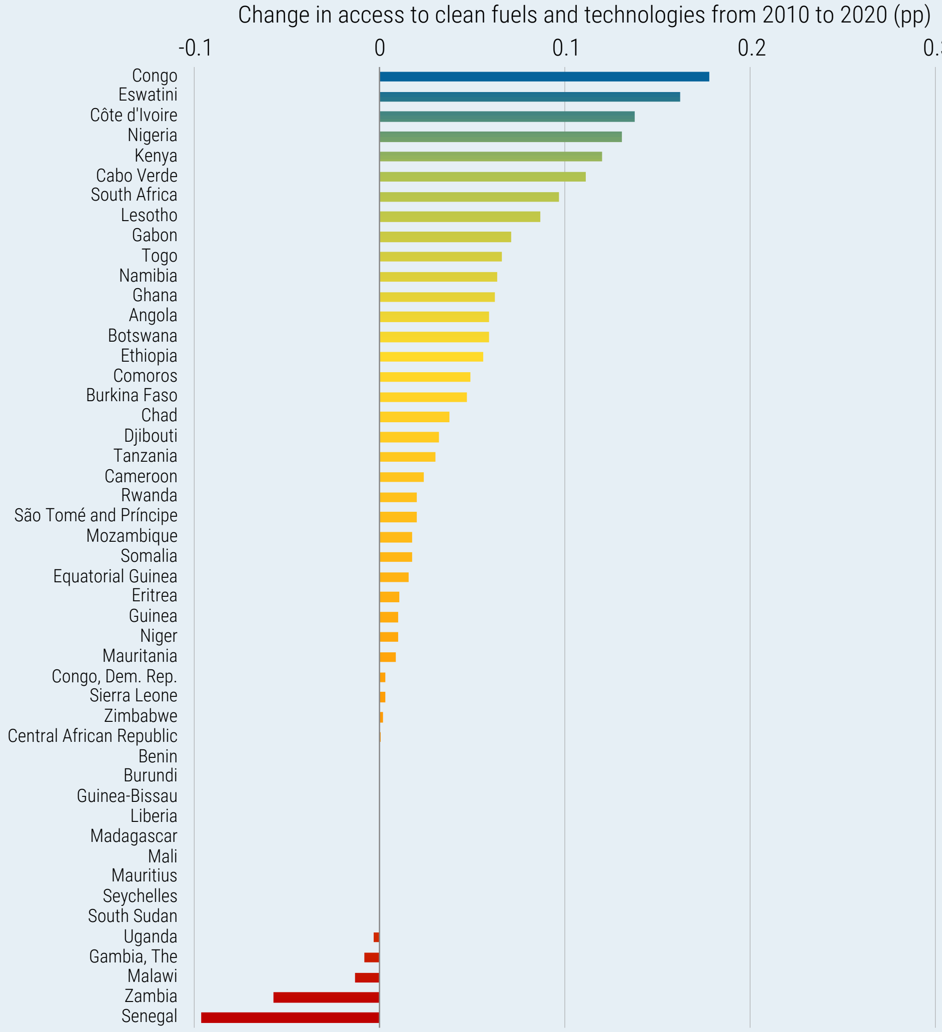
Financing commitments for clean cooking are urgently needed in Sub-Saharan Africa. The Democratic Republic of Congo, Madagascar, and Mozambique (where 96 percent of the population lacks access to clean cooking solutions) each received less than USD 1 million in finance commitments in 2019—less than 1 percent of the annual investment needed in each country. The finance flowing to clean cooking is extremely uneven. Clean cooking finance commitments have stagnated over the last five years, falling critically short of the investment required (SEforAll 2021).

The use of clean cooking fuels and technologies increased in most Sub-Saharan countries between 2010 and 2020 (figure B2.1.1).

Total financing commitments for clean cooking projects in Kenya were 62 percent of all committed finance tracked in high-impact countries in 2019, down from 75 percent in 2018, as it did not receive significant finance commitments from development finance institutions.[a] Kenya received 47 percent of total 2019 high-impact country commitments, with USD 62 million committed by commercial financiers (fund managers, private equity, and institutional investors), directed primarily to LPG and ethanol companies. Ethiopia saw an eight-fold increase in finance commitments compared with 2018, to over USD 7 million. Madagascar and Mozambique saw decreases in committed finance from 2018 levels.

a. High-impact countries—which together are home to more than 80 percent of people without energy access— include Afghanistan, Bangladesh, China, the Democratic Republic of Congo, Ethiopia, Ghana, India, Indonesia, Kenya, the Democratic People's Republic of Korea, Madagascar, Mozambique, Myanmar, Niger, Nigeria, Pakistan, the Philippines, Tanzania, Uganda, and Vietnam.

Figure B2.1.1 • Change in access to clean fuels and technologies for cooking in Sub-Saharan African between 2010 and 2020, by country



Source: IEA (2021d).

OUTLOOK

The pace with which the world is moving toward universal access to clean fuels and technologies must be accelerated. Continuation of a business-as-usual agenda is not possible: Clean cooking fuels must be made a top political priority, with targeted policies. The COVID-19 pandemic has exacerbated the vulnerability of people lacking access to clean fuels and technologies and highlighted the value of women's unpaid work in the care economy (Clean Cooking Alliance 2021b) (box 2.2). COVID-19 also affected the access of other vulnerable groups of people, such as refugees, to clean cooking fuels and technologies (box 2.3) The economic crisis caused by the pandemic will affect household fuel use, in some countries reversing the progress made. However, the crisis provides an opportunity to set new priorities; innovate policies, institutions and businesses; and establish measures that guarantee universal clean cooking by 2030.

BOX 2.2 • How has COVID-19 affected clean cooking and access to clean energy?

The lengthy lockdowns and changes in mobility and goods delivery during the COVID-19 pandemic were often followed by periods of economic stagnation and disruptions in supply chains. In 2021, these problems deepened inequalities in several areas, including the cooking energy sector. Lack of access to modern energy solutions exacerbated by the pandemic is also a barrier to achieving several other SDGs, especially for the poorest and most vulnerable populations.

Empirical evidence on the negative impact of COVID-19 on access to clean cooking is limited. Pachauri and others (2021) conclude that as a result of the pandemic universal access may not be achieved even in 2050, hindering progress on other SDGs, including on health, gender, inequality, and climate.

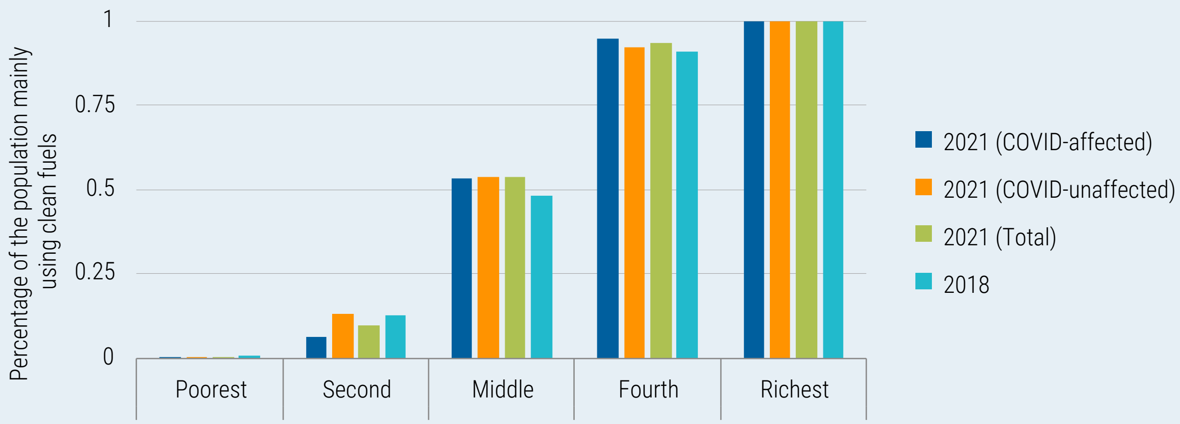
A World Bank study of Kenya (Zhang and Li 2021) illustrates how the onset of the COVID-19 pandemic and the associated lockdown reduced mobility, raised food and fuel price, reduced household income, and increased the number of household members at home during the day. These and other factors have had interacting effects on cooking and fuel use. The types and amount of food cooked, the person doing the cooking, and the fuels used have all changed to varying degrees.

Some population-based data relevant to clean cooking were collected during the pandemic. The newly established Multiple Indicator Cluster Surveys (MICS) Plus surveying framework presented a new opportunity for data collection through a nationally representative sample of respondents to a regular MICS survey using telephone interviews. This methodology has proven effective in emergency settings and crises.

With the growing need to measure the impact of COVID-19, the 2021 MICS survey conducted in Mongolia (National Statistical Office of Mongolia and UNICEF 2021) added questions on the financial impact of the pandemic. Figure B2.2.1 presents a snapshot of differences in clean and polluting fuel usage for cooking in 2018 (before the pandemic) among people in Mongolia who report that their income was affected by COVID-19 and those whose income was either not affected by the pandemic or was affected by external factors. Although the access rate to clean cooking increased from 34.7 percent in 2018 to 37.0 percent in 2020, polluting fuel usage increased among the two poorest quintiles. In the second-highest wealth quantile, use of polluting fuels increased from 87.1 percent to 90.3 percent; among people whose income was affected by COVID, the share rose to 93.6 percent.

Intergovernmental and national policy making should accelerate the timely analysis of short- and long-term impacts of external situations, such as COVID-19, on clean cooking.

Figure B2.2.1 • Change in access to clean fuels and technologies for cooking in Sub-Saharan African between 2010 and 2020, by country



Source:

Examples of innovation can be seen in some of the solutions that have captured the attention of the investment market. Globally, the number of people using some biogas for cooking reached 125 million in 2019, driven by national and regional bio-digestor programs in Asia and Sub-Saharan Africa (IRENA 2021; IRENA and AfDB 2022). Electricity is increasingly being used for cooking. Cooking with electricity, even in a mini-grid context or via solar energy, is competitive with cooking with other fuels (ESMAP 2020a). Some countries are prioritizing electricity for cooking in place of LPG and other fossil fuels as a means to reduce costs, increase energy security, and mitigate climate impacts. Ecuador—which has subsidized LPG since 1970—is shifting its subsides away from LPG to clean, sustainable, and local sources of renewable electricity. Nepal is seeking reduce reliance on LPG imports from India by promoting the use of electricity, much of which is renewably generated, for cooking.

Achieving universal access to clean cooking would cost approximately USD 1.5 trillion over 10 years (USD 148–USD 156 billion a year). This figure is dwarfed by the benefits to health, gender, and climate, negative externalities to which are estimated to cost USD 2.4 trillion a year (ESMAP 2020c). Overcoming cost challenges is only part of the problem, however; understanding cooking practices, promoting behavior change when possible, and adapting solutions to the way of life of consumers is key for lasting results.

Strategic policies and financial incentives will be key to recovering from setbacks caused by the COVID-19 pandemic. National governments must expand targeted policies and subsidy support to accelerate progress toward universal clean cooking access, especially in Sub-Saharan African, where progress is critically needed. Although some progress has been made in Africa, it is concentrated in countries with larger populations, such as Nigeria and Kenya, and stronger government support. The population relying on polluting cooking in Sub-Saharan Africa is growing by nearly 20 million people a year. Achieving global universal access is impossible without tackling this trend.

Several tools are available to help countries design programs and policies that enhance clean cooking as part of clean household energy transition efforts. The World Bank's Clean Cooking Planning Tool is designed to help energy planners, decision makers, program developers, and researchers visualize potential transition pathways to universal access to clean cooking solutions by 2030. Other tools—such as SEforAll's Integrated Energy Planning Tool and the Clean Cooking Alliance's Clean Cooking Explorer—leverage geospatial data to facilitate energy planning for clean cooking. The World Health Organization's Clean Household Energy Solutions Toolkit includes six modules to help countries design and implement clean household energy policies and programs to achieve the WHO air quality guidelines. It includes the Household Energy Assessment Rapid Tool for evaluating the national household energy context and identifying key energy and health stakeholders; the Benefits of Action to Reduce Household Air Pollution tool for assessing the costs and benefits of different interventions that aim to reduce cooking-related household air pollution; and the Clean Household Energy Policy and Programme Planning Guide, which provides guidance on how to identify and develop an action plan for implementing and monitoring a clean household energy policy or program. These and other resources can help countries determine which clean cooking interventions are the most feasible, affordable, adoptable, and impactful to inform integrated energy planning at the national level.

BOX 2.3 • Transitioning to clean cooking in refugee camps during COVID-19

Globally, there were an estimated 72 million people refugees and internally displaced people worldwide in 2020. Among those living in refugee camps, 88 percent use biomass for cooking (Bisaga and To 2021). Camp residents have limited options for cooking fuels; they typically receive firewood as part of aid from humanitarian partners or collect it from the surrounding areas. Residents who receive fuelwood allocations often must collect supplementary firewood, as the allocations are often insufficient to satisfy all of their cooking needs.

Recognizing these challenges, several efforts have been undertaken to encourage clean fuel transitions. In Rwanda, the Red Cross donated 3,481 cooking gas cylinders to refugees in the Mahama camp in April 2020. These cylinders provided almost half of the 7,000 households previously lacking access with the initial equipment necessary to transition to clean fuel for cooking (UNHCR 2020). In Bangladesh, the United Nations High Commissioner for Refugees (UNHCR) and the World Liquid Petroleum Gas Association continued a program that aimed to transition the Rohingya refugees in Cox's Bazaar to LPG during the COVID-19 pandemic. The program reduced demand for firewood from 462,000 million tons (MT) a year to 37,000 MT.

Environmentally and financially sustainable models for clean cooking in humanitarian settings are urgently needed. Policies on increasing access to clean cooking should be prioritized as part of the humanitarian agenda and more broadly, given the critical role they play in building resilience to shocks, including epidemics and pandemics.

Source: UNHCR 2020, 2021; Bisaga and To 2021.

METHODOLOGY

DATA SOURCES

The WHO Household Energy Database contains regularly updated nationally representative household survey data (WHO 2018) from a number of sources (table 2.1). It serves as the basis for all modelling in this report (currently using the methods of Stoner and others 2020; and previously those of Bonjour and others 2013). The database draws on more than 1,400 surveys conducted in 171 countries (including high-income countries) between 1960 and 2020; 21 percent of the surveys cover the years 2013–18, and around 8 percent of the surveys cover 2016–21. Modelled estimates for low- and middle-income countries are provided only if there are underlying survey data on cooking fuels; there are no estimates for Bulgaria, Lebanon, or Libya. Population data are from United Nations Population Division.

Table 2.1 • Sources of data on clean fuels and technology

Source	Producing entity	Number of countries	Share of data (percent)	Question asked
Census	National statistical agencies	109	18.8	What is the main source of cooking fuel in your household?
Demographic and Health Survey (DHS)	Funded by the US Agency for International Development (USAID; implemented by IDF International	98	16.9	What type of fuel does your household mainly use for cooking?
Living Standard Measurement Survey, income expenditure survey, and other national surveys	National statistical agencies, supported by the World Bank	42	7.2	What is the main source of energy for cooking?
Multi-indicator cluster survey (MICS)	UNICEF	89	15.3	What type of fuel does your household mainly use for cooking?
Survey on Global Aging (SAGE)	World Health Organization	6	0.1	NA
World Health Survey	World Health Organization	50	8.6	NA
National surveys	NA	107	18.4	NA
Other	NA	79	13.6	NA

NA = not applicable.

MODEL

As household surveys are conducted irregularly and reported heterogeneously, this report used the WHO Global Household Energy Model (GHEM) (developed in collaboration with the University of Exeter and maintained in collaboration with the University of Glasgow) to estimate trends in household use of six fuel types: unprocessed biomass (such as wood), charcoal, coal, kerosene, gaseous fuels (such as LPG), and electricity.

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

The GHEM was implemented using the R programming language and the NIMBLE software package for Bayesian modelling with Markov chain Monte Carlo. Summaries can be obtained to provide both point estimates (means) and measures of uncertainty (95 percent credible and 95 percent prediction intervals). The GHEM was applied to the WHO household energy database to produce a comprehensive set of estimates, together with associated measures of uncertainty, of the use of four polluting fuels and two clean fuels for cooking, by country, for each year from 1990 to 2020. (For more details on the modelling methodology and validation, see Stoner and others 2020; for detailed analysis of individual fuel use, se Stoner and others 2021. The complete set of estimates can be downloaded from the WHO Global Health Observatory website.[6])

Only surveys with less than 15 percent of the population reporting "missing," "no cooking," or "other fuels" were included in the analysis. 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." Countries classified by the World Bank as high income (57 countries) in the 2022 fiscal year were assumed to have transitioned to clean household energy. They were therefore reported as having more than 95 percent access to clean fuel and technologies; no fuel-specific estimates are reported for high-income countries. No estimates are reported for low- and middle-income countries without data suitable for modelling (Bulgaria, Lebanon, and Libya). Modelled specific-fuel estimates are reported for 131 low- and middle-income countries and 3 countries with no World Bank income classification (Niue, the Cook Islands, and República Bolivariana de Venezuela). Estimates of overall clean fuel use are reported for 191 countries.

UNCERTAINTY INTERVALS

Many of the point estimates provided 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 estimate may be statistical noise arising from either the modelling process or survey variability and may therefore not reflect real variation. The uncertainty intervals should therefore be considered when assessing changes in access rates or the use of specific fuels.

6 https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/household-air-pollution.

GLOBAL AND REGIONAL AGGREGATIONS

Population data from the 2018 Revision of World Urbanization Prospects were used to derive the population-weighted regional and global aggregates. Low- and middle-income countries without data were excluded from all aggregate calculations; high-income countries were excluded from aggregate calculation for specific fuels.

ANNUALIZED GROWTH RATES AND FUTURE PROJECTIONS

The annualized increase in the access rate is calculated as the difference between the access rate in year 2 and 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 takes population growth into account by working with the final national access rate.

Projected access rates, access deficits, and fuel use can be estimated using the GHEM. Uncertainty increases the farther into the future estimates are calculated.

Projections are hypothetical scenarios in which no new policies or interventions (positive or otherwise) take place, and as such are useful as baseline scenarios for comparing the effect of interventions.

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CHAPTER 3
RENEWABLES

MAIN MESSAGES

- **Global trend:** In 2019, the global share of renewable energy sources in total final energy consumption (TFEC), inclusive of traditional uses of biomass, was 17.7 percent, just 0.4 percentage points higher than the year before. Despite notable growth in renewable energy consumption over the decade between 2010 and 2019, the share of renewable sources in TFEC, excluding traditional uses of biomass, increased by just 2.7 percentage points and represented only 11.5 percent of TFEC in 2019. This modest pace of growth points to the importance of containing energy consumption through energy efficiency and energy conservation. Trends differ across end uses, with the largest increase in the share of renewables continuing to be in the generation of electricity, while the transport and heat sectors have seen much slower progress.
- **Target for 2030:** Ensuring access to affordable, reliable, sustainable, and modern energy for all implies an accelerated deployment of renewable energy sources in all three conventional categories: electricity, heat, and transport. Target 7.2 of the Sustainable Development Goals (SDG) for 2030 is "increasing substantially the share of renewable energy in the global energy mix." The main indicator used to assess progress toward that target is the share of renewable energy in TFEC. While no quantitative milestone has been set for SDG 7.2, custodian agencies assess that the current trend in the indicator is not in line with the ambition of the target, and much faster renewable energy uptake is needed.
- **Electricity:** Renewable electricity use grew more than 5 percent year-on-year in 2019, bringing the share of renewables in global electricity consumption to 26.2 percent, up from 25.3 percent in 2018, the largest share of renewables among the end-use categories. However, electricity represented only a fifth of global TFEC in 2019. In the face of growing global demand for electricity (+1.6 percent in 2019), consumption of nonrenewable electricity continued to grow as well (+0.4 percent in 2019), a slower pace than for renewables but from a significantly larger base. Hydropower remains by far the largest source of renewable electricity globally, followed by wind and solar PV, the last of which recorded the fastest growth rate among these technologies. Together, wind and solar PV are responsible for 58 percent of the increase in renewable electricity consumption observed over the last 10 years, and their deployment has been accelerating.
- **Heat:** Renewable heat consumption increased by 2.4 percent to 17.8 EJ in 2019, excluding traditional uses of biomass.[1] Traditional uses of biomass remained almost stable globally, accounting for more than 13 percent (23.5 EJ) of global heat consumption in that year. Overall, as global heat demand continued to increase (+0.3 percent year-on-year), representing almost half of TFEC, the share of modern renewables in global heat consumption remained just 10.1 percent in 2019, less than a 2-percentage point improvement over the last 10 years.

1 This calculation for the heat sector does not include renewable electricity used for heating or ambient heat harnessed by heat pumps, due to limited data availability at global scale and the difficulty of quantifying the fraction of electricity consumption used specifically for heating.

- **Transport:** In 2019, renewable energy used in transport grew by 7 percent to 4.4 EJ, the fifth-largest increase recorded since 1990 and the largest since 2012. This brought the total share of renewable energy in the sector to 3.6 percent in 2019, up from 3.4 percent in 2018. Biofuels, primarily crop-based ethanol and biodiesel, supplied 91 percent of the total. Nevertheless, sales of electric vehicles are leading to record increases in renewable electricity use in transport. Use grew by 0.03 EJ in 2019, nearly matching the record single-year increase in 2018.
- **Regional highlights:** The region where renewables constitute the largest share of the energy supply is in Sub-Saharan Africa, but that is because traditional uses of biomass for heating and cooking are so widespread. When only modern forms of renewable energy are counted, Latin America and the Caribbean have the highest share of renewables in TFEC, owing to hydropower generation and to the consumption of bioenergy in industrial processes and biofuels for transport. In 2019, 44 percent of the global year-on-year increase in modern renewable energy consumption took place in Eastern Asia—essentially in China—where hydropower, solar photovoltaics (PV), and wind dominated the growth.
- **Top 20 countries:** The share of renewable energy in TFEC varies widely across countries. Between 2000 and 2019, the share of modern renewables declined in four of the top 20 energy consuming countries despite expanding use in all. Simultaneous increases in nonrenewable energy use explain the drop in renewables' share. In 2019, the largest advance in the share of modern renewables was observed in Turkey (+2.3 percentage point), owing to higher hydropower generation, followed by the United Kingdom (+1.3 percentage point), where wind power developments and the uptake of biofuels for transport played a leading role.
- **Installed renewable energy generating capacity in developing countries:** SDG indicator 7.B.1 tracks installed renewable energy generating capacity in developing countries. In 2020 a record 246 watts per capita of renewable capacity was installed, a year-on-year growth rate of 11.6 percent. In 2020, four countries had more than 1,000 watts per capita: Bhutan (3,026), Paraguay (1,238), Uruguay (1,075), and the Lao People's Democratic Republic (1,022). Although growth is positive and accelerating, developing countries are not on track to meet any of the net-zero scenarios or targets by 2030. The positive global and regional trajectory masks the fact that the countries most in need are being left behind even within the group of developing countries. Renewables capacity per capita grew at a compound annual growth rate of 9.5 percent over 2015–20 for the developing world as a whole. Growth lagged in island developing states (8.3 percent), least developed countries (5.2 percent), and landlocked developing countries (2.4 percent).
- **Recent trends:** Despite continued disruptions in economic activity and supply chains following responses to the COVID-19 pandemic, renewable energy developments have shown resilience in 2020. However, in 2021, annual additions of new renewable electricity capacity fell 5 percent to 257 GW. Rising commodity, energy, and shipping prices, in addition to restrictive trade measures, increased the cost of producing and transporting solar PV modules, wind turbines, and biofuels worldwide, heightening uncertainty about future renewable energy projects. Getting renewable deployment back on track to reach SDG 7.2 and 7.B.1, as well as the ambitions of the Paris Agreement, will require stronger policy support for renewables in all sectors and greater mobilization of private capital behind renewable energy projects.

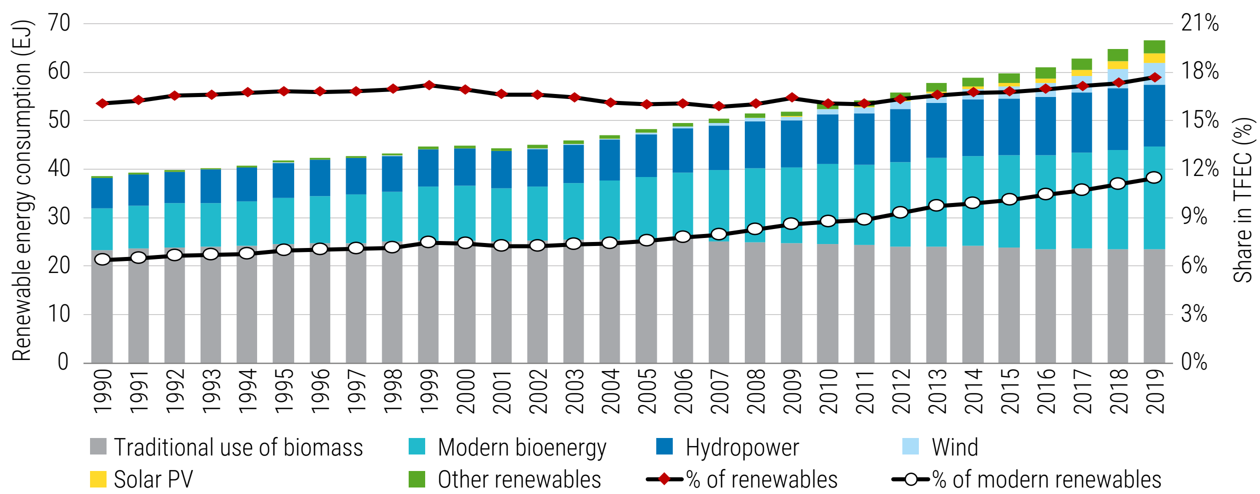
ARE WE MAKING PROGRESS?

In 2019, global consumption of renewable energy, including the traditional uses of biomass, amounted to 66.6 exajoules (EJ), following a 2.7 percent year-on-year increase. During the same period, nonrenewable consumption increased by 0.2 percent. As a result, the share of renewables in total final energy consumption (TFEC) reached 17.7 percent. While being the highest share recorded over the past three decades, it is not even 2 percentage points higher than in 1990. From 2018 to 2019, modern bioenergy, wind and solar PV made the largest contributions to the growth of renewable energy use, followed by hydropower and geothermal energy. [2]

Since 1990, the share of renewable energy in TFEC has held steady despite a 70 percent growth in global consumption of renewable energy. Two simultaneous trends account for this seeming contradiction: traditional uses of biomass have been slowly declining (-5 percent during 2010–19), while the use of modern renewables—that is, excluding the traditional uses of biomass (box 3.1)—has increased almost 50 percent, with its share of TFEC rising from 8.6 percent in 2009 to 11.5 percent in 2019 (figures 3.1 and 3.2). During 2010–19, all renewable energy sources together accounted for less than one-quarter of the global increase in TFEC. To achieve SDG 7 and provide access to affordable, reliable, and sustainable energy for all, a considerable acceleration in the uptake of modern renewables will be required, along with more efficient uses of biomass and substantial progress on energy efficiency and energy conservation.

Over the last decade, modern bioenergy saw the largest absolute increase among renewable sources, accounting for more than a third of the increase in modern renewable energy consumption (figure 3.2). Bioenergy's share was as much as wind and solar PV combined, though the latter two grew the fastest. Overall, bioenergy, including the traditional uses of biomass, remains the largest renewable source of energy, accounting for almost 70 percent of global renewable energy consumption, followed by hydropower, wind and solar PV (figure 3.1).

Figure 3.1 • Renewable energy consumption and share in total final energy consumption, by technology, 1990–2019



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

2 The data in this report reflect revisions from last year's edition. Traditional uses of biomass for heat were revised downward by 0.6 EJ (-2.5 percent) globally for 2018, with most of the change accounted for by India (-0.7 EJ, -15 percent); Nigeria (-0.14 EJ, -3 percent); China (+0.14 EJ, +5 percent); and Liberia (+0.07 EJ, +626 percent). Global modern uses of biomass was revised upward by 0.97 EJ (+5 percent), with India accounting for largest change (+1.1 EJ, +60 percent). Global geothermal heat consumption was also revised upward, by 0.2 EJ (+29 percent), mainly as a result of changes in China. The regional groupings discussed in this section follow the United Nations' M49 regional classification (https://unstats.un.org/unsd/methodology/m49/).

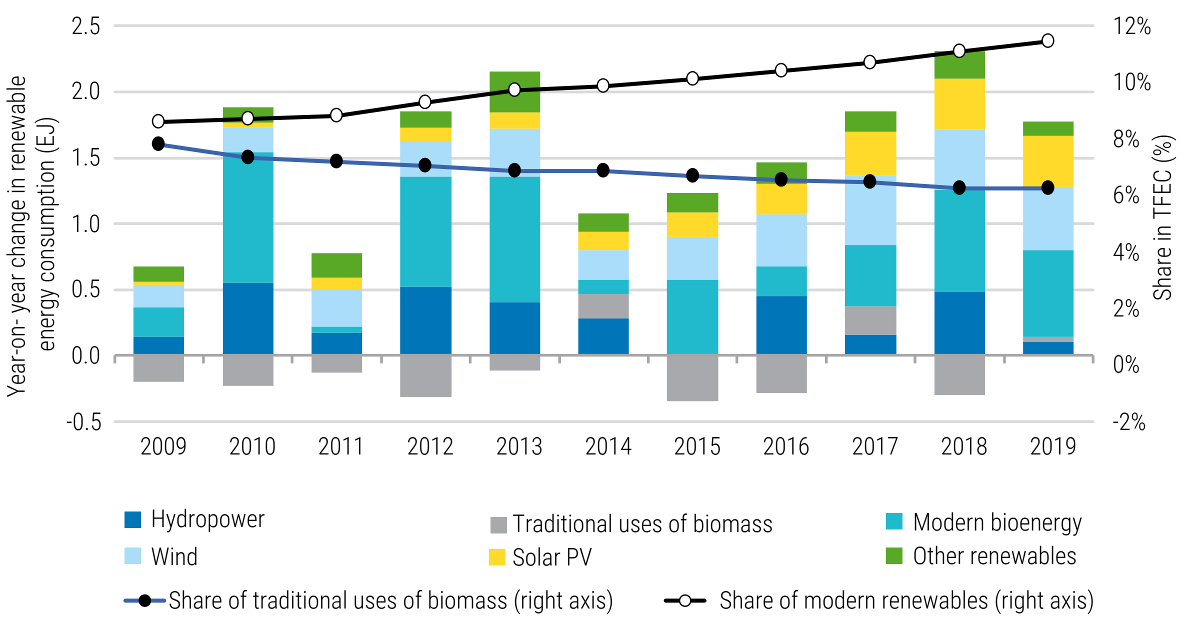
BOX 3.1 • Traditional uses of biomass and modern renewables

The term "traditional uses of biomass" refers to the use of local solid biofuels (wood, charcoal, agricultural residues, and animal dung), burned with basic techniques, such as traditional open cookstoves and fireplaces. Owing to their informal and noncommercial nature, it is difficult to estimate the energy consumed in such practices, which remain widespread in households in parts of the developing world. For purposes of this report, "traditional uses of biomass" refers to the residential consumption of primary solid biofuels and charcoal in non-OECD countries. Although biomass is used with low efficiency in OECD countries, as well—for example, in fireplaces burning split logs—such use is not covered by the traditional uses of biomass cited in this report.

Traditional uses of biomass tend to have very low conversion efficiency (5–15 percent) which can cause local demand to exceed sustainable supply and lead to deforestation and other negative environmental effects. In addition, emissions of particulate matter and other air pollutants are produced. When combined with poor ventilation, the result is indoor air pollution, which is responsible for a range of severe health conditions and is a leading cause of premature death. Even though biomass as it is traditionally used is, in principle, renewable, policy attention should focus on encouraging the adoption of more efficient renewable heating and cooking technologies (see chapter 2 on access to clean fuels and technologies for cooking).

"Modern bioenergy" can be used efficiently for electricity generation, for industrial applications, for cooking in efficient wood and pellet stoves and boilers, and for the production of biofuels for transport. 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.

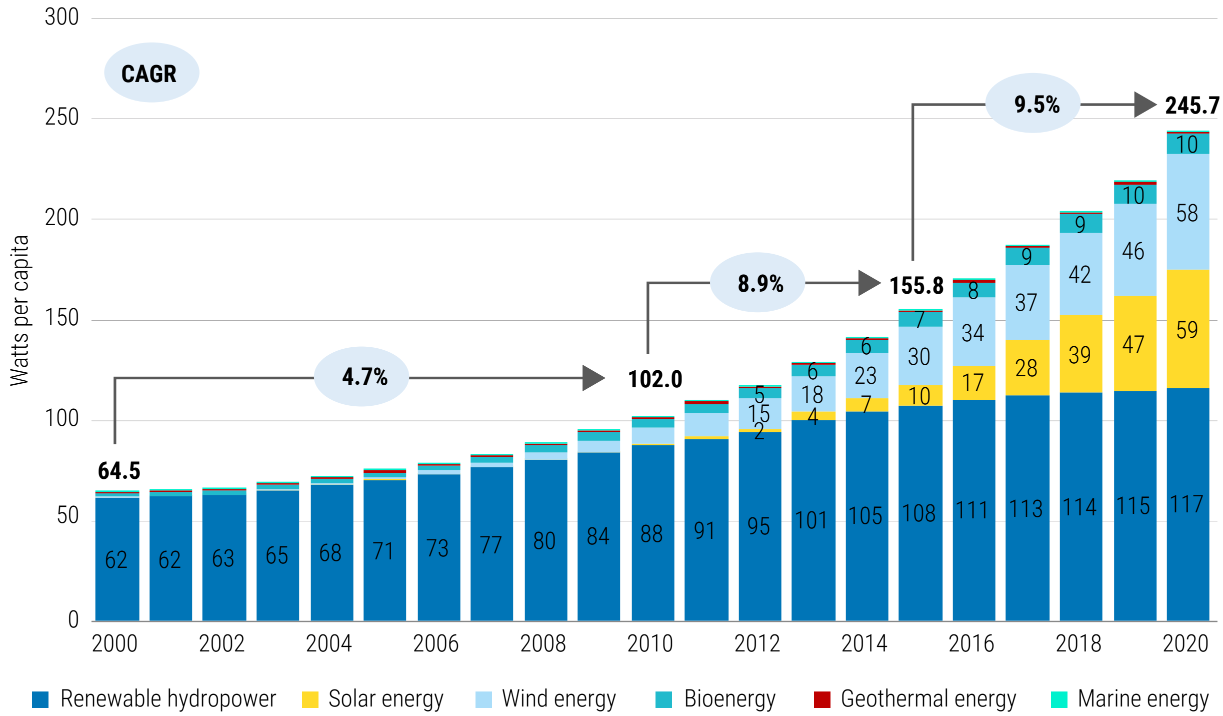
Figure 3.2 • Share of modern renewable energy and traditional uses of biomass in total final energy consumption (left) and increase in renewable energy consumption by technology (right), world, 2009–19



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

Renewable installed capacity per capita has continued to expand over the past ten years in the developing world. The compound annual growth rate (CAGR) of 8.9 percent for the 2010–15 period increased to 9.5 percent between 2015–20, reaching 11.6 percent in 2020 (figure 3.3). Growth in recent years was driven mainly by solar and wind, which increasingly are less expensive than the cheapest new fossil fuel option.

Figure 3.3 • Renewable installed capacity per capita in developing countries (2000–20) and compound annual growth rate for selected periods



Source: International Renewable Energy Agency (IRENA, 2021b)

LOOKING BEYOND THE MAIN INDICATORS

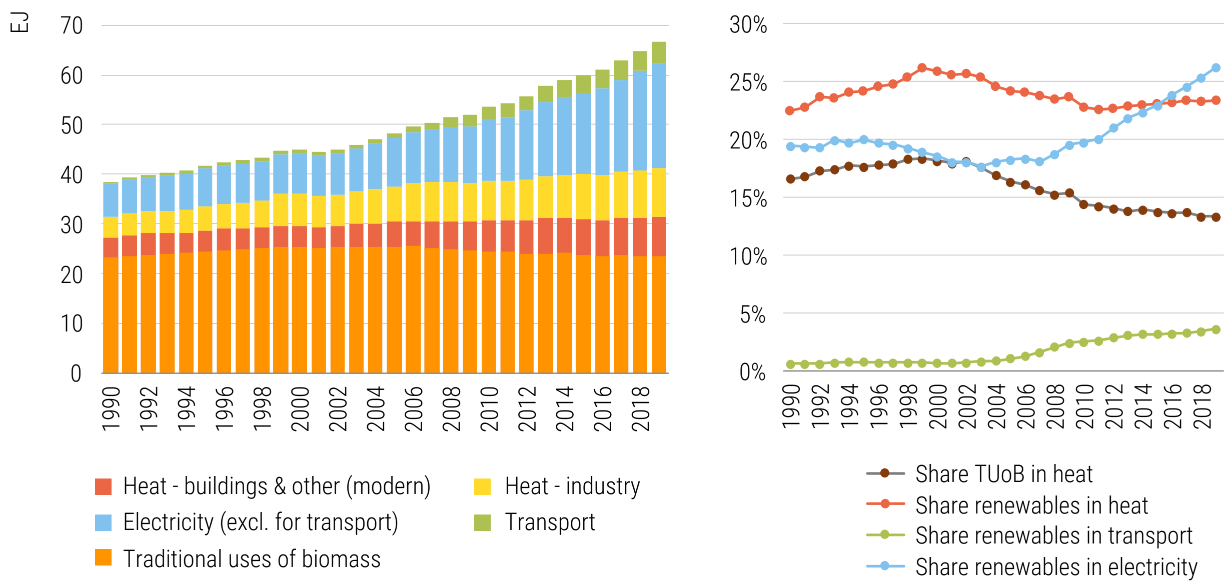
Ensuring access to affordable, reliable, sustainable, and modern energy for all implies a substantial increase in the share of renewable energy in all three main end-use categories: electricity (21 percent of global TFEC in 2019), transport (32 percent), and heat (47 percent).

The share of renewables in TFEC is the greatest for **electricity**, rising from 25.3 percent in 2018 to 26.2 percent in 2019 (figure 3.4). Renewable electricity accounts for almost half of the globe's modern renewable energy consumption and three-fifths of the year-on-year increase. The rapid increase in the penetration of renewables in the electricity sector is driven by the continuous expansion of new capacity additions powered by wind and solar PV.

In the **heat** sector, renewable sources accounted for 23.4 percent of the energy used in 2019, most of which (13.3 percentage points) corresponds to traditional uses of biomass. The consumption of modern renewables for heat (that is, excluding traditional uses of biomass) increased by 2.4 percent year-on-year in 2019, while global heat demand saw a slight increase (+0.3 percent year-on-year). This progress failed to displace nonrenewable energy used for heat, which remained steady in 2019.

The **transport** sector represented only 10 percent of modern renewable energy consumed globally in 2019. It is the end-use sector with the lowest renewable energy penetration, at only 3.6 percent of final energy consumption. Biofuels supply the great majority (91 percent) of renewable consumption in transport, but renewable electricity use is slowly emerging, thanks to the electrification of railways and the uptake of electric vehicles.

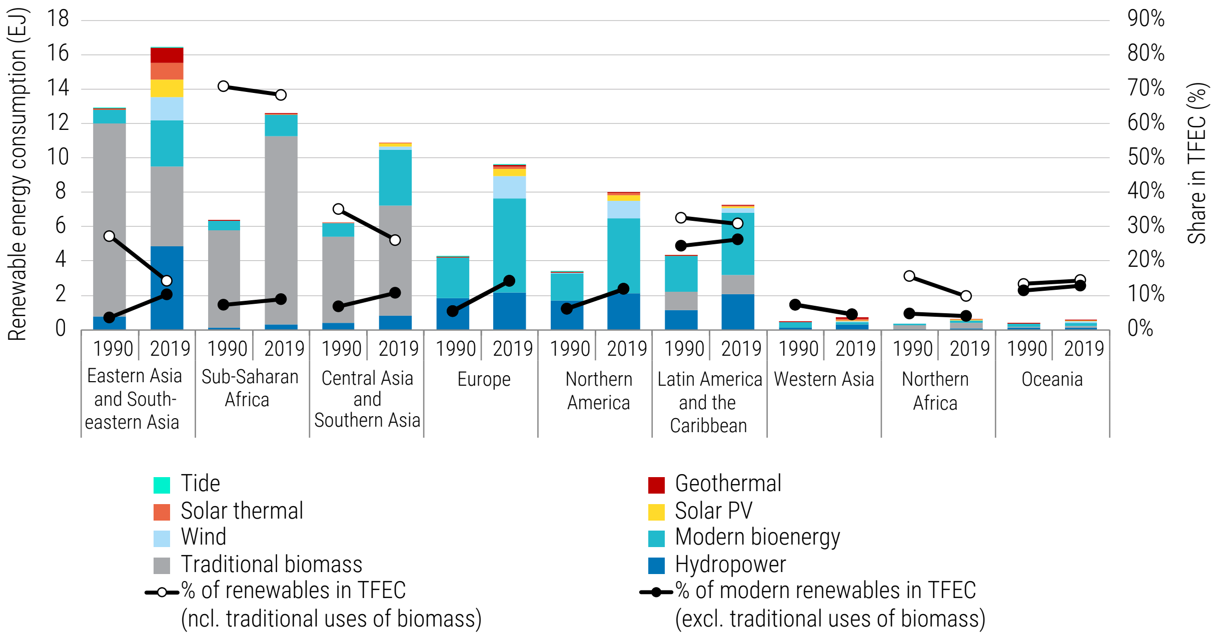
Figure 3.4 • Renewable energy consumption and share by end use, 1990–2019



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).
Note: Electricity used for transport is included under transport; TUoB = traditional uses of biomass.

Behind the global figure lie regional disparities (figure 3.5). Sub-Saharan Africa has the largest share of renewable sources in its energy supply, but traditional uses of biomass represented more than 85 percent of the renewable energy consumed in the region in 2019. Excluding traditional uses of biomass, Latin America and the Caribbean show the highest share of modern renewable energy consumption (26 percent of TFEC in 2019), owing to the significant use of hydropower in electricity generation, and to the consumption of bioenergy for industrial processes (in particular, in the sugar and ethanol industry) and biofuels for transport.

Figure 3.5 • Renewable energy consumption and share in total final energy consumption by region, 1990 and 2019

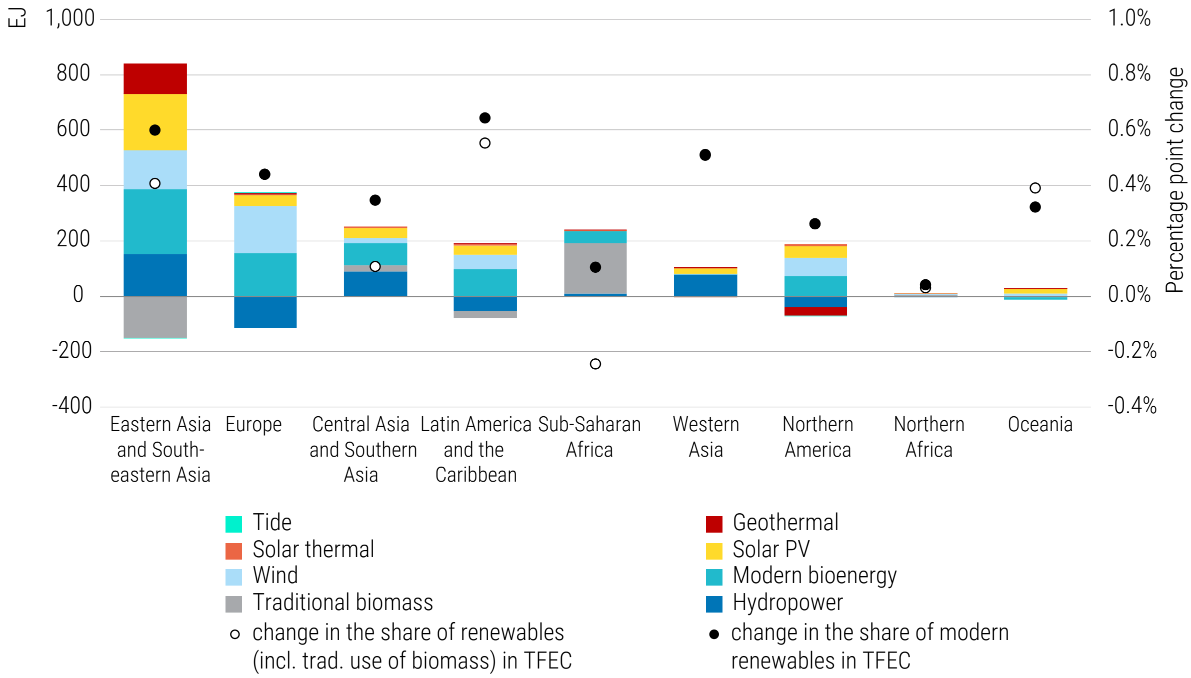


Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

In 2019, 44 percent of the global year-on-year increase in consumption of modern renewable energy occurred in Eastern Asia—essentially China—owing primarily to the deployment of hydropower and solar PV, followed by wind (figure 3.6). With leading contributions from Germany and the United Kingdom, Europe accounted for another 15 percent of the year-on-year growth in modern renewable energy use in 2019, despite less favorable conditions for hydropower, owing to the development of wind power, modern bioenergy for heat and transport, and solar PV.

Latin America and the Caribbean and Eastern Asia saw the most rapid annual advances in the share of renewables in TFEC in 2019: +0.6 and +0.7 percentage points, respectively.

Figure 3.6 • Year-on-year change in renewable energy consumption and in the share of renewables in total final energy consumption, by region, 2019

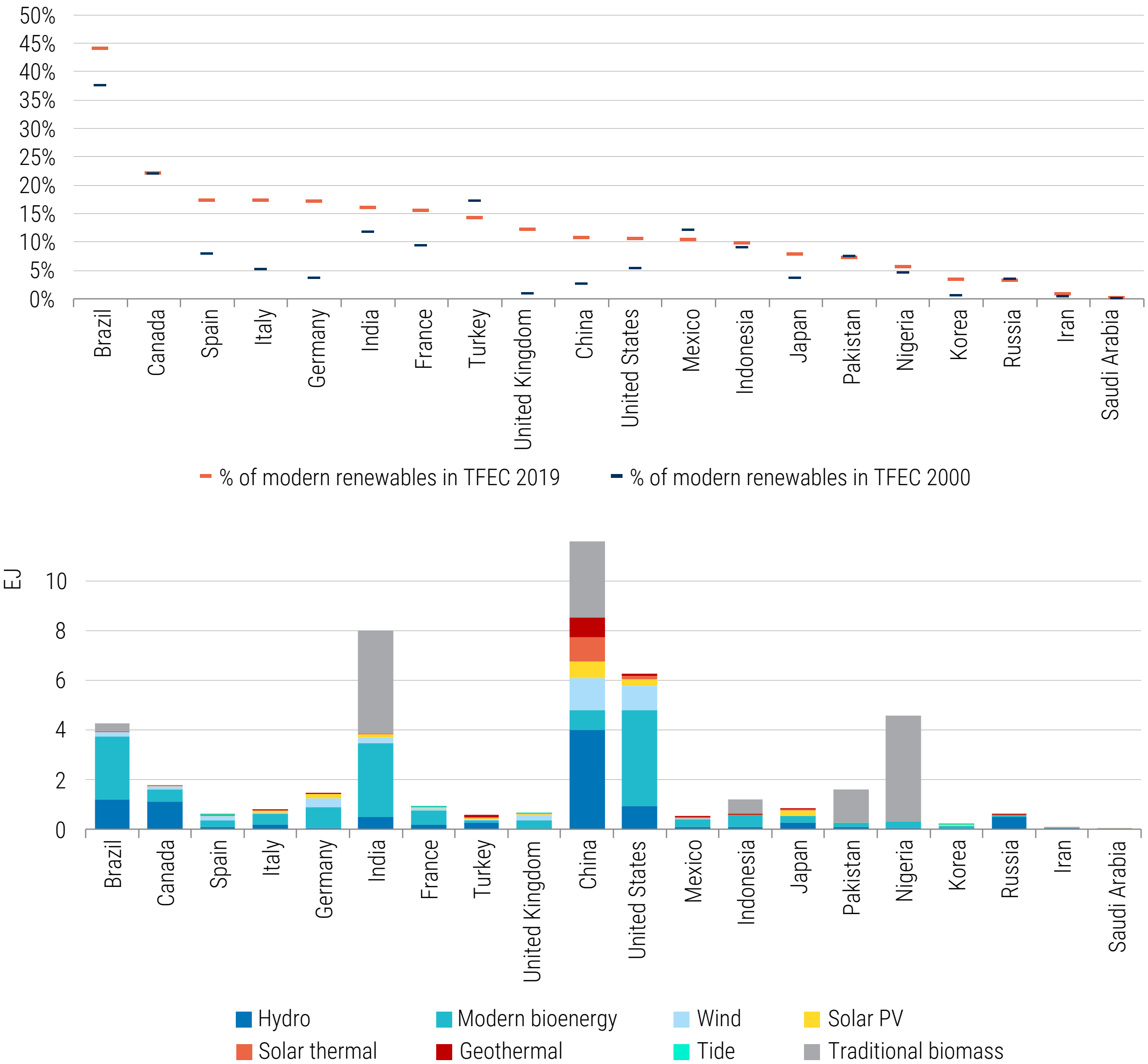


Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

At the national level, the share of renewable sources in energy consumption varies widely depending on resource availability, the consistency and effectiveness of regulatory frameworks, financing mechanisms and policy support, and the impact of energy efficiency and consumption patterns on total energy demand. Among the top 20 energy consuming countries, Brazil and Canada had the highest shares of modern renewables in their energy mix in 2019, owing to heavy reliance on hydro for electricity and bioenergy for heat and transport (figure 3.7). China alone accounted for almost a fifth of global modern renewable energy consumption, yet this represented less than 11 percent of its TFEC. Germany, Italy, and the United Kingdom achieved the largest advances in the share of modern renewables in TFEC between 2000 and 2019, mostly through the deployment of bioenergy (in particular for heat), wind, and solar PV, and thanks to the stabilization or decline of TFEC. In 2019, the largest increase in the share of modern renewables was in Turkey (+2.3 percentage points), owing to higher hydropower generation, followed by the United Kingdom (+1.3 percentage points) and Germany (+1.1 percentage points). Reductions in total energy demand played a key role in the latter two countries, together with the rapid uptake of wind power, bioenergy for heat (Germany), and biofuels (United Kingdom).

Box 3.2 reviews renewable energy deployments in past two years, as the world economy was first disrupted by the COVID-19 pandemic and then began to recover.

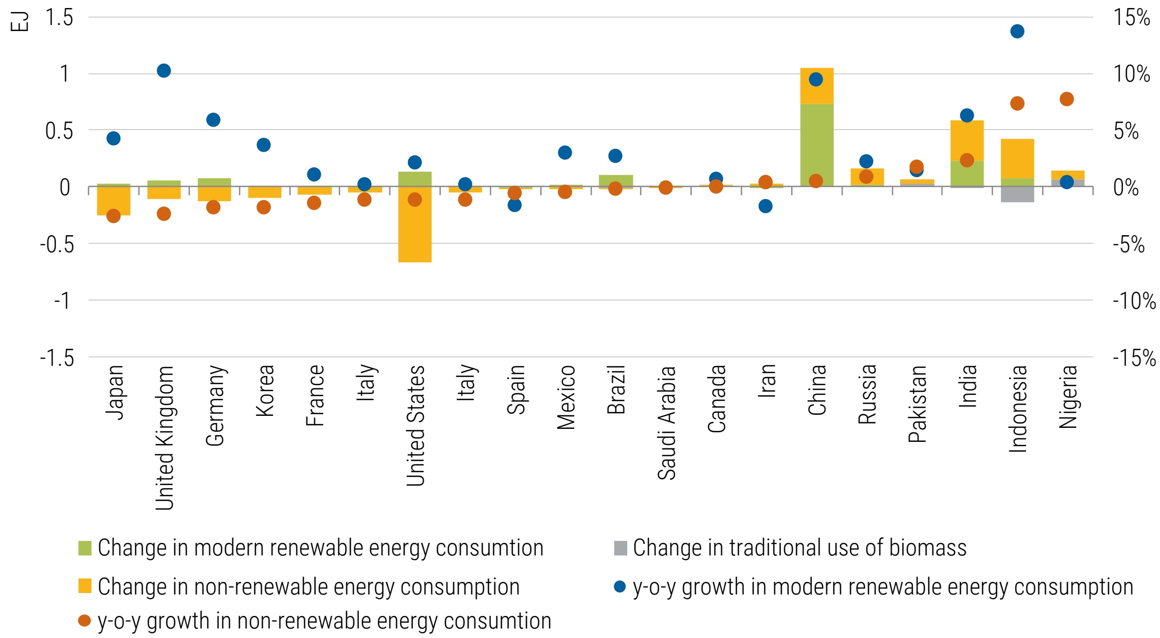
Figure 3.7 • Share of renewables in total final energy consumption, 2000 and 2019, and renewable energy consumption, by source, in the top 20 energy-consuming countries, 2019



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

Between 2000 and 2019, the share of modern renewables in TFEC declined in four out of the 20 largest energy consuming countries, despite growing consumption of modern renewable energy in all of them. In the same period, the consumption of nonrenewable energy increased in 13 of the 20 (figure 3.7). From 2018 to 2019, eight of the 20 largest energy consuming countries experienced an increase in nonrenewable energy consumption, despite growing modern renewable energy use in seven of them (figure 3.8). This highlights the importance of containing overall consumption through energy efficiency and energy conservation, and phasing out the use of fossil fuels to achieve higher shares of renewables in the energy mix.

Figure 3.8 • Annual change in renewable and nonrenewable energy consumption, top 20 countries with the largest total final energy consumption, 2019



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

BOX 3.2 • Accelerating renewable energy deployment in turbulent times: trends in the pandemic recovery context

Despite continued disruptions in economic activity and supply chains following responses to the COVID-19 pandemic across the world, renewable energy developments have shown resilience. However, progress varies across end-use sectors.

Additions of renewable electricity capacity did not set a new record in 2021. Instead, they fell from almost 270 GW in 2020 to 257 GW in 2021. Solar PV accounted for over half of all new additions (IRENA 2022a). Solar PV and onshore wind are becoming the leading choices for renewable power additions. Renewables as a whole have been growing, but their compound annual growth rate of just 8.7 percent since 2016 is significantly below the 12–15 percent increases through 2030 required by the net-zero scenarios and the qualitative SDG targets.

In the transport sector, following a historic decline in 2020 amid a global disruption of transport, demand for biofuels returned to pre-pandemic levels in 2021. Expanding demand for renewable diesel in the United States and biodiesel in Asia offset the lower ethanol demand resulting from high ethanol prices in Brazil and lower gasoline demand in the United States.

Global modern renewable heat consumption saw an estimated 5 percent growth year-on-year in 2021, while traditional uses of biomass increased by 1 percent. As total heat demand expanded by an estimated 3 percent over the same period, the share of modern renewable sources in heat supply rose by only 0.2 percentage points in 2021.

In 2021, rising commodity, energy, and shipping prices raised the cost of producing and transporting solar PV modules, wind turbines, and biofuels, creating uncertainties for future renewable energy projects. Compared with commodity prices in 2019, investment costs for utility-scale solar PV and onshore wind were 25 percent higher by the end of 2021 (IEA 2021b). In addition, restrictive trade measures have caused additional increases in prices of solar PV modules and wind turbines in key markets such as the United States, India, and the European Union. These higher prices pose challenges for small companies with limited finances, as well as for developers who won competitive auctions anticipating continuous reductions in equipment prices. However, higher natural gas and coal prices also contributed to improved competitiveness for wind and solar PV.

In the transport sector, some governments—including Argentina, Colombia, Indonesia, and Brazil—have lowered blending mandates in response to strong increases in biofuel prices, slowing development of biofuels.

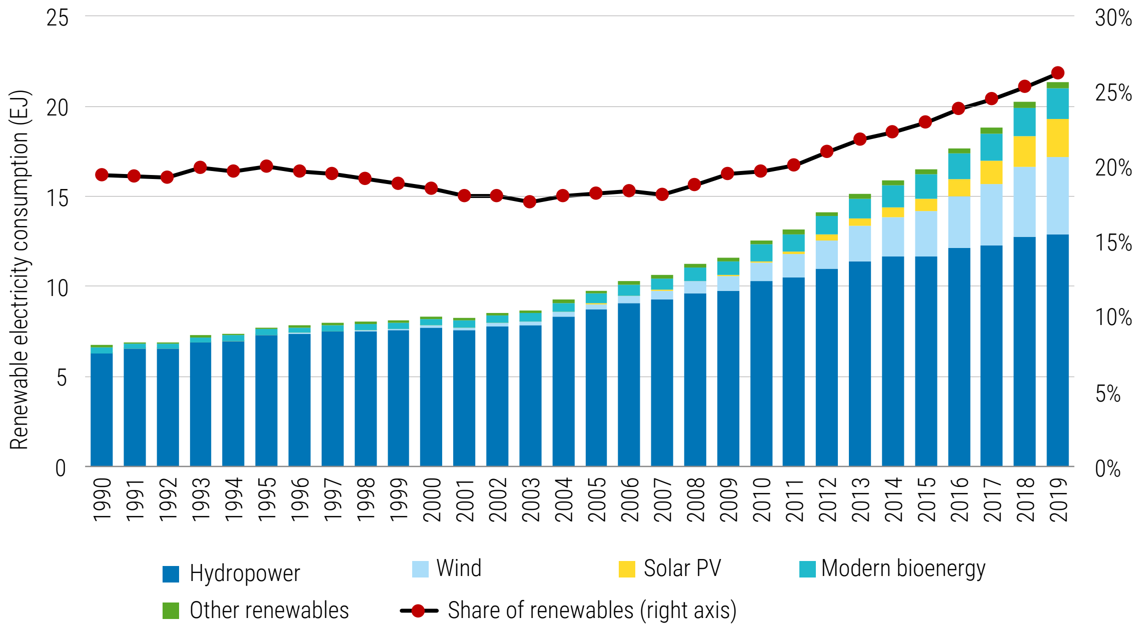
Recent renewable energy deployment trends still fall short of meeting Paris Agreement climate ambitions, as discussed in more detail in chapter 6. Getting renewable deployment on track with SDG 7.2 and 7.B.1, as well as with the ambitions of the Paris Agreement, will require strengthened policy support in all sectors. For instance, as renewables—including electricity, heat, biofuels, and biogas—accounted for just 11 percent of governments' economic recovery spending on clean energy as of October 2021, governments could consider targeting more recovery spending on renewable energy deployment and implementing additional measures to leverage private investments.

ELECTRICITY

Electricity accounted for 21 percent of the globe's TFEC in 2019. It is the fastest-growing energy end use, as electricity consumption has doubled over the last 23 years, with a 37 percent increase in the last decade.[3]

In 2019, global consumption of renewable electricity grew by more than 5 percent (+1.1 EJ) year-on-year, while consumption of nonrenewable electricity grew 0.4 percent (+0.2 EJ). As a result, the share of renewables in electricity generation increased by 0.9 percentage point to 26.2 percent in 2019 (figure 3.9)—currently the highest share of all end-use categories.

Figure 3.9 • Global renewable electricity consumption by technology, 1990-2019



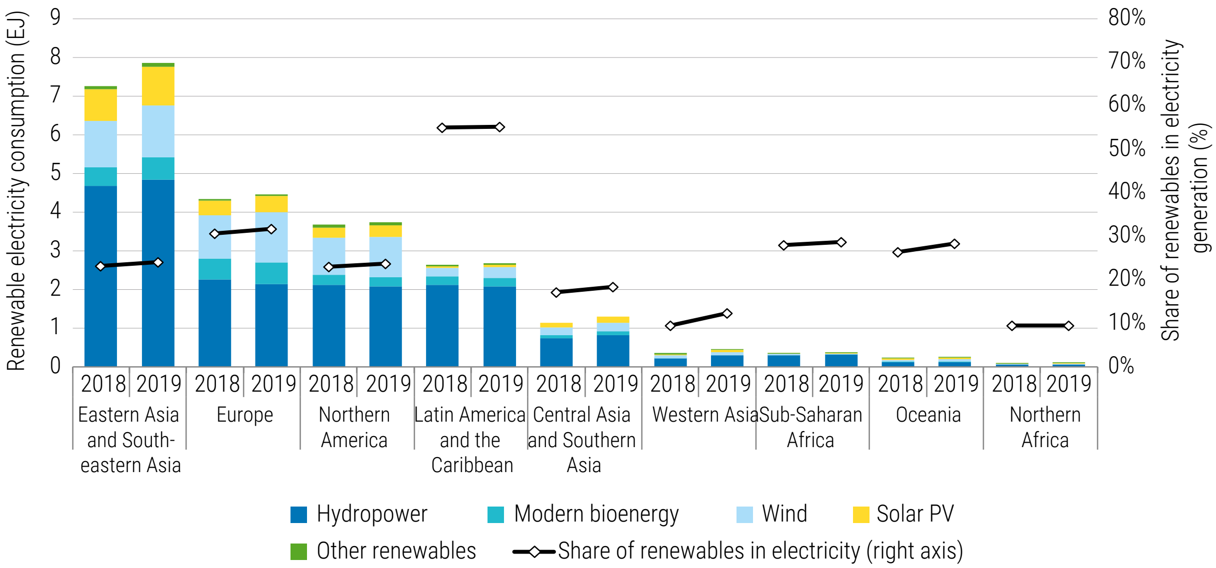
Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

3 Among the largest factors driving this trend is the rapidly growing use of electricity for space cooling, with air conditioners and electric cooling fans accounting for nearly 16 percent of global electricity consumption in buildings in 2020 (IEA 2021b).

In 2019, wind and solar PV contributed almost 45 percent and 35 percent, respectively, of the annual increase in renewable power generation, with most of the remaining growth from bioenergy and hydro. Accounting for 61 percent of renewable power generation and 16 percent of total electricity generation, hydropower remained the largest renewable source of electricity globally and in each region.

Latin America and Caribbean has the largest share of renewable sources in power generation (figure 3.10), with hydropower alone representing 44 percent of regional electricity generation in 2019. That year, the share of renewables in power generation grew fastest in Western Asia, where it rose by almost 3 percentage points year-on-year to 9.5 percent of total generation. The increase was driven chiefly by hydropower development and favorable hydrological conditions, and by the rapid growth of new solar PV capacity and the relative stability of electricity demand. Thanks to rapidly declining costs and policy support, wind and solar PV together accounted for almost 60 percent of the global increase in renewable electricity consumption over the last decade. The share exceeds 80 percent in Europe and Oceania and approaches 90 percent in Northern America.

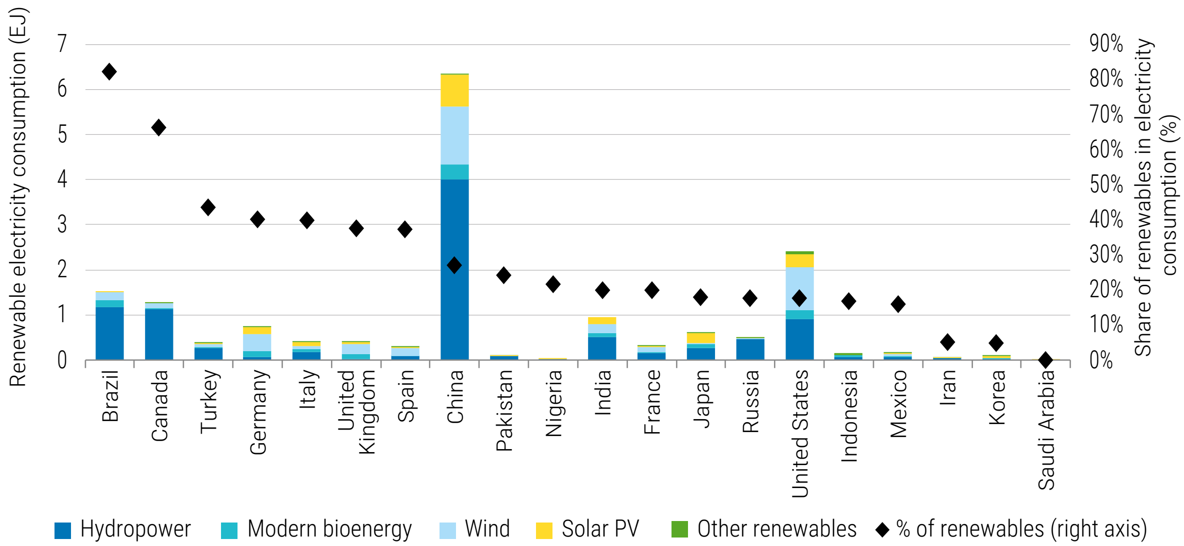
Figure 3.10 • **Renewable electricity consumption and share of renewables in electricity generation by region, 1990 and 2019**



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

The top 20 energy consuming countries show contrasting trends, with the share of renewables in electricity generation varying from near 0 (e.g., Saudi Arabia) to more than 80 percent (Brazil) (figure 3.11). Brazil and Canada have by far the highest shares owing to their large hydropower capacities. Wind and solar PV together—i.e., nondispatchable renewables—are the largest sources of renewable electricity in Germany, the United Kingdom, Spain, the United States, Mexico, and Korea. Their combined share in renewable power generation ranged from 44 to 73 percent in those countries. Among the top 20 energy consuming countries, Turkey, Germany, and the United Kingdom saw the largest growth in the share of renewables in electricity generation, with increases of 11, 5, and 4 percentage points, respectively.

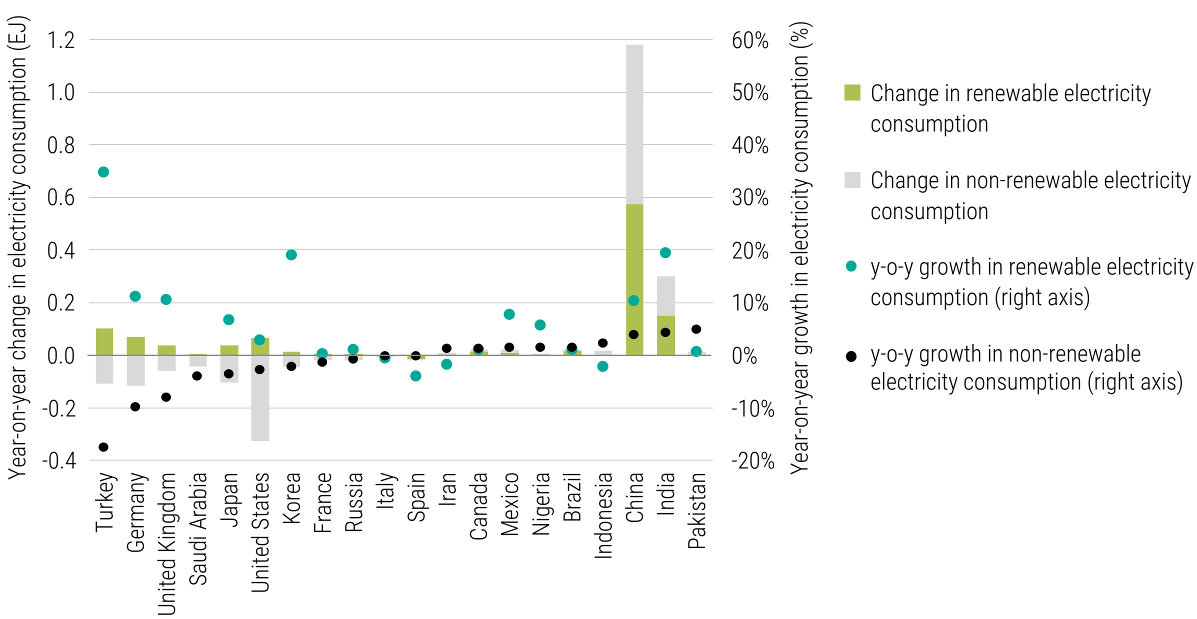
Figure 3.11 • Renewable electricity consumption by source and country, top 20 countries with the largest total final energy consumption, 2019



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

In 2019, China alone contributed more than 54 percent of the global annual increase in renewable electricity generation (figure 3.12). Half of China's growth came from wind and solar PV, while more than 40 percent came from hydropower. India, Turkey, Germany, and the United States were the next largest contributors to this growth, together contributing more than a third of it. During the same period, China was also responsible for the largest increase in nonrenewable electricity consumption, followed by India. Together, these two countries largely offset declines in nonrenewable electricity consumption observed elsewhere in the world.

Figure 3.12 • Year-on-year change in renewable and nonrenewable electricity consumption by country, top 20 countries with the largest total final energy consumption, 2019



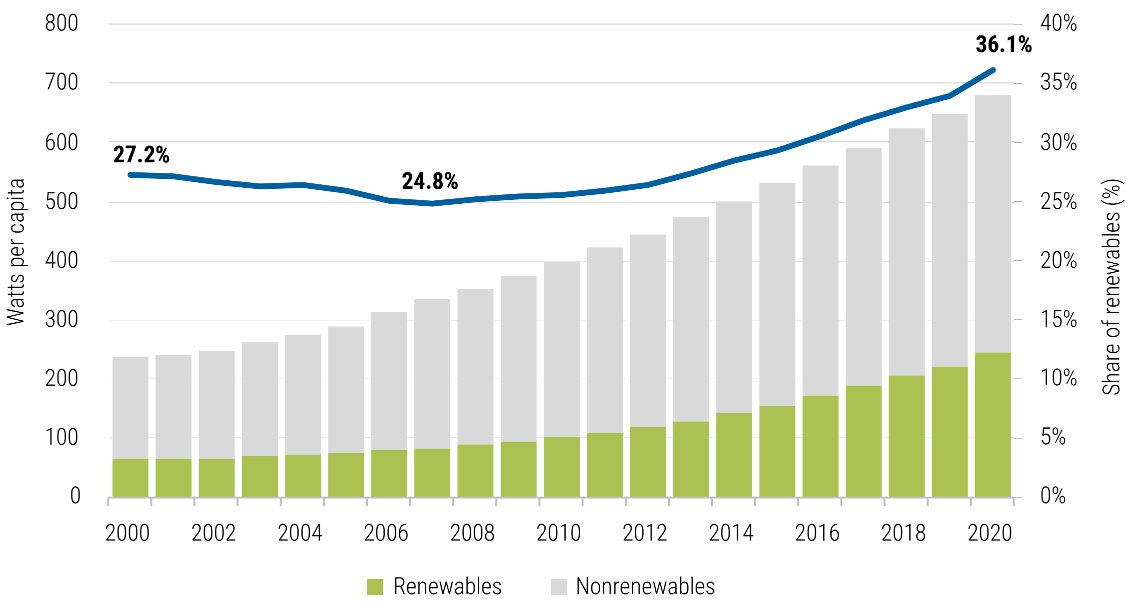
Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

INSTALLED RENEWABLE ELECTRICITY CAPACITY IN DEVELOPING COUNTRIES

As population growth, development patterns, and evolving lifestyles drive up electricity demand in developing countries, the phase-out of fossil fuels will require increases in renewable power generation. For the second year, this chapter tracks progress toward SDG indicator 7.B.1, which focuses on increasing renewables-fueled generating capacity in developing countries (in watts per capita).

Developing countries have seen a rising share of renewables in the power sector since the low point of 24.8 percent in 2007 (figure 3.13). [4] The highest share of renewables to date, 36 percent, was recorded in 2020, with 246 watts per capita of renewable capacity installed. This is close to the world average of 36.5 percent and the 37 percent of developed countries. The 184 GW of renewable power added in developing countries during 2020 is 65 percent larger than the 111 GW additions of 2019 and an all-time record in renewable power additions. These dynamics reflect the economic attractiveness and plummeting costs of renewables, among other factors. Over 60 percent of the total renewable power generation added last year had lower costs than the cheapest new fossil fuel option in 2020 (IRENA 2021a).

Figure 3.13 • Annual installations of power capacity in developing countries, and share of renewables, 2000–20



Source: International Renewable Energy Agency (IRENA, 2021b)

Installation of renewables-powered capacity has been accelerating over the past two decades and outpacing population growth. The first decade of the century saw a CAGR of 4.7 percent, which was surpassed by an 8.9 percent CAGR during 2010–15. Most recently, in the 2015–20 period, the CAGR of renewable capacity per capita stood at 9.5 percent; in 2020, the growth rate jumped to 11.6 percent (figure 3.14). Nonrenewable additions decreased by 23 percent between 2019 and 2020—from 99.4 GW to 76.4 GW. It is not clear whether that decrease represents an emerging trend.

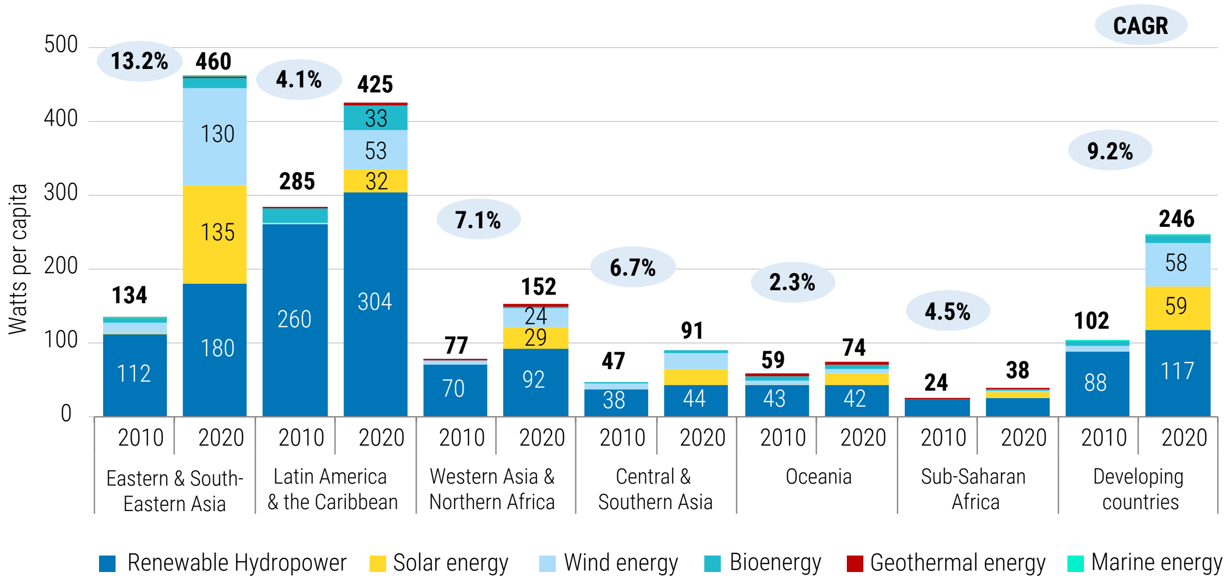
4 The classification of countries included in each group follows the United Nations' M49 regional classification (https://unstats.un.org/unsd/methodology/m49/).

Across regions, growth in renewables-fueled capacity varied over the past ten years. In Eastern and South-Eastern Asia, capacity grew from 134 to 460 watts per capita from 2010 to 2020. Much of this staggering growth was due to additions of wind and solar power. The three countries in the region showing the most growth are Lao PDR, China, and the Republic of Korea.

In Latin America and the Caribbean capacity increased 49 percent, from 285 to 425 watts per capita, the chief components being wind energy (35 percent), hydropower (32 percent), and solar energy (22 percent). Renewables-fueled capacity increased the most in Paraguay, Uruguay, and the Falkland Islands.

Western Asia and North Africa and Central and Southern Asia almost doubled their per capita capacity during 2010–20, mostly because of solar and wind power (at 7.1 percent and 6.7 percent CAGR respectively). Countries in Oceania and Sub-Saharan Africa are lagging, with per capita capacity having grown 25 percent and 56 percent, respectively, over the period.

Figure 3.14 • Growth in renewable electricity capacity per capita by technology across regions, 2010–20



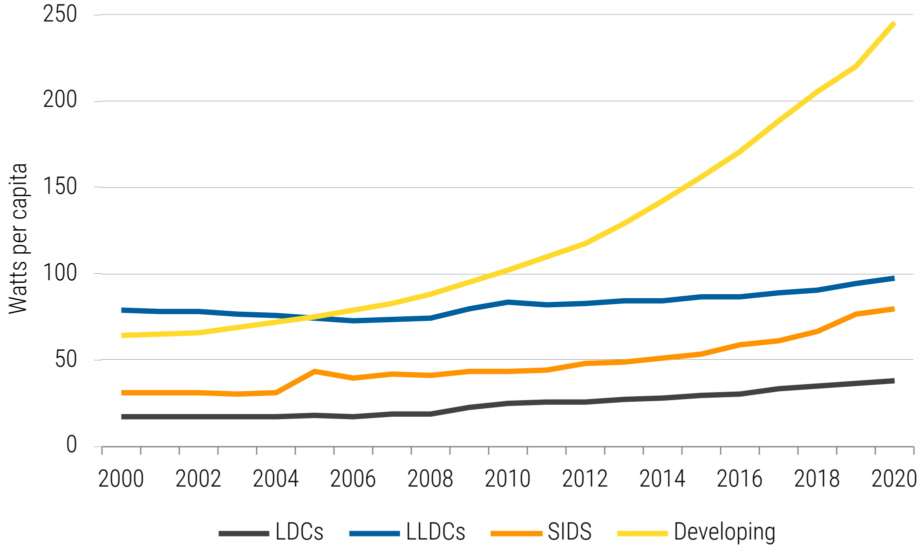
Source: International Renewable Energy Agency (IRENA, 2021b)

Global and regional numbers mask worrying disparities across country groups, with those most in need lagging behind, even in comparison with other developing countries. While developing countries as a whole expanded renewable capacity by 9.5 percent annually in the last five years, Small Island Developing States (SIDS); Least Developed Countries (LDCs); Landlocked developing countries (LLDCs) had lower growth (8.3 percent, 5.2 percent and 2.4 percent, respectively) (figure 3.15). At current annual growth rates, it would take LDCs and LLDCs almost 40 years and SIDS almost 15 years to reach a level of deployment similar to the average 2020 level of developing countries.

Since 2015, SIDS have grown more dynamically than the other country groups, but even their rate of growth is not enough to cover an ever-increasing gap between them and the rest of developing countries, which stood at 168 watts per capita in 2020.

Much attention is needed to raise the ambition of renewable capacity deployment across regions so as not to lock in unsustainable and polluting energy choices and create stranded assets. Closing geographic gaps in the deployment of renewables-based capacity will require tailored policies and investment measures to ensure a fair, just, inclusive, and comprehensive energy transition in the long-term.

Figure 3.15 • Renewable capacity per capita by special groups, 2000–20



Source: International Renewable Energy Agency (IRENA, 2021b)

Following the United Nations' High-Level Dialogue on Energy in 2021, the UN secretary-general advanced a global roadmap of milestones toward achievement of SDG 7, including the decarbonized energy made possible by renewable capacity (box 3.3).

BOX 3.3 • A global roadmap of milestones toward renewables-powered capacity

Following the High-Level Dialogue on Energy in September 2021 (see box 1.1), UN Secretary General António Guterres laid out a global roadmap of milestones to a radical transformation of energy access and transition by 2030, while also contributing to net zero emissions by 2050 (UN 2021a; UN 2021b).

The roadmap emphasizes the importance of rapidly transitioning to decarbonized energy systems, noting that deployment of renewable energy is lagging, particularly in transport, industry, and heating and cooling.

Building on a set of thematic reports, the document sets out two milestones specific to energy capacity powered by modern renewables. The two milestones are to double capacity globally by 2025 and to triple it by 2030.

In addition, a number of compacts were announced in October 2021 on the sidelines of the dialogue. They included private sector investment commitments amounting to 719 GW of renewables-fueled capacity as well as aspirations for another 4,534 GW through catalytic partnerships.

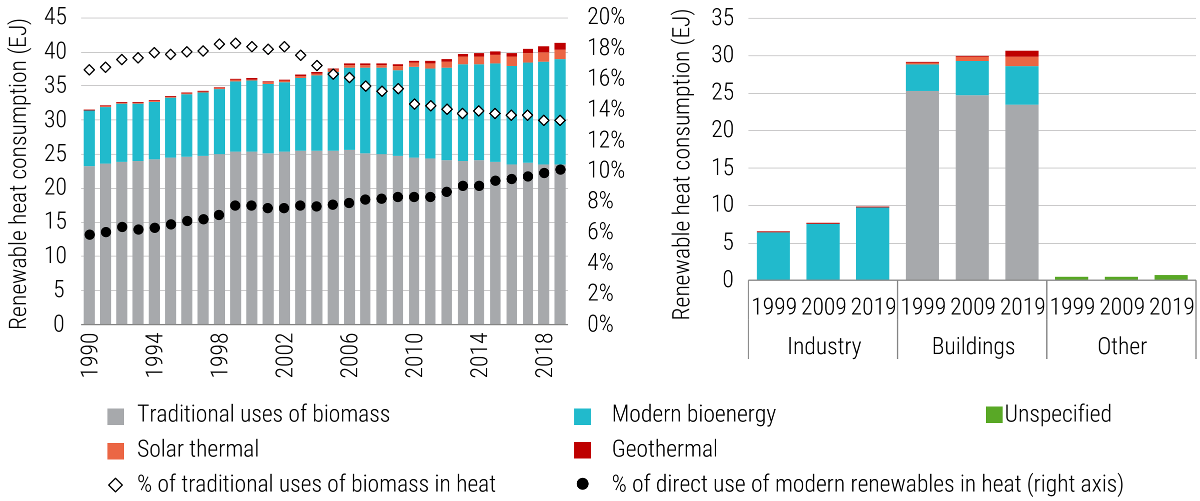
HEAT

Heat is the largest energy end use worldwide, accounting for half of global final energy consumption (176 EJ). Industrial processes are responsible for about half of the total, followed by space and water heating in buildings. Uses in agriculture, mostly for greenhouse heating, round out the total.

With coal, gas, and oil meeting more than three-quarters of global heat demand, the sector remains heavily fossil-fuel dependent. The traditional uses of biomass still account for more than 13 percent (23 EJ) of global heat consumption and even grew by 0.2 percent from 2018 to 2019 (figure 3.16), in line with growth in total heat consumption (+0.3 percent). Excluding these traditional uses of biomass and ambient heat harnessed by heat pumps,[5] on which limited data is available, direct renewables-based heat consumption increased by 2.4 percent from 2018 to 17.8 EJ in 2019. This represented only 10.1 percent of total heat consumption, however, less than two percentage points higher than ten years earlier.

Despite its dominant share in final energy consumption, heating receives limited policy attention and support. Greater ambition and much stronger policy action are needed to progress toward the targets of SDG 7.1 and SDG 7.2. Transitioning away from fossil fuels and inefficient and unsustainable uses of biomass will require combining substantial improvements in energy efficiency, energy conservation, and materials efficiency with rapid deployment of renewable heat technologies.

Figure 3.16 • Renewable heat consumption by source and sector, 1990-2019



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).
Note: Indirect consumption of renewable heat through renewable electricity is not represented on this figure.

Bioenergy accounts for about 87 percent (15.4 EJ) of direct modern uses of renewables for heat,[6] following a 2.1 percent increase between 2018 and 2019, spread equally across industry and the buildings sector. Industry is responsible for a little less than two-thirds of modern bioenergy use, most of which is concentrated in subsectors producing biomass residues on-site such as wood, pulp and paper, and sugar and ethanol.

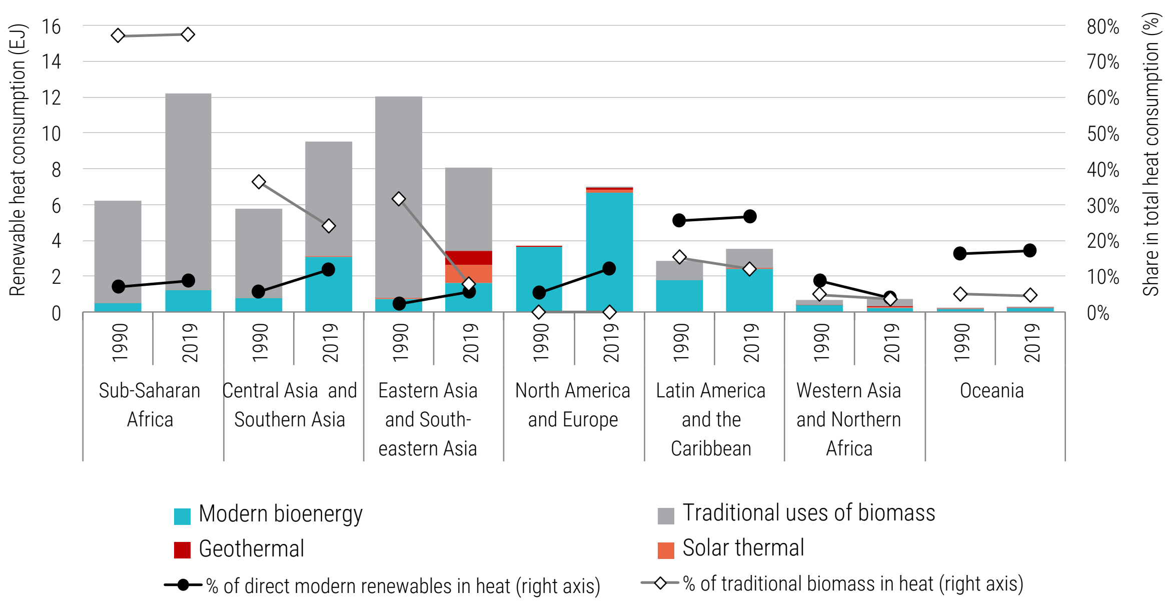
5 The rapid spread of heat pumps over the last decade is making ambient heat an increasingly important heat source, although its importance globally is difficult to estimate because data are unavailable for some markets. For lack of sufficient data, this report does not account for it, although ambient heat can be credited as a renewable source.

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

Global **solar thermal** consumption increased by 1.2 percent in 2019, accounting for 7.8 percent (1.4 EJ) of modern uses of renewables for heat; yet it still met less than 1 percent of total final heat demand. The large majority of solar thermal consumption corresponds to small domestic solar water heaters, although significant untapped potential remains for large-scale systems for district heating and industrial applications, which continue to develop as a niche market. China continued its marked lead in solar thermal development, accounting for 72 percent of global solar thermal capacity in operation and 71 percent of newly installed capacity in 2019 (IEA-SHC, 2020). However, China's market for solar thermal has dropped steadily since 2014 owing to reduced construction activities, phaseouts of incentives, and market competition with other technologies, such as heat pumps and rooftop solar PV. In this context, the emerging hybrid photovoltaic-thermal technologies could play an important role. Solar thermal cooling offers great potential to decarbonize space cooling, especially since the greatest demand coincides with the highest solar irradiance, reducing the load of electric air conditioners at peak times during summer months (IEA 2021c). However, solar thermal cooling remains a niche technology.

Geothermal heat consumption grew by more than 9 percent in 2019, representing 5.4 percent (1 EJ) of modern uses of renewables for heat. About 60 percent of geothermal heat worldwide is harnessed by ground-source heat pumps (Lund and Toth 2020). The large majority of applications are in the building sector, with bathing, swimming, and space heating (primarily via district heating) being the most prevalent end uses. China is responsible for four-fifths of global geothermal heat consumption, followed by Turkey and the United States, which together account for another 10 percent. China's growth in geothermal heat consumption in 2019 represented more than 130 percent of the global increase in geothermal heat use, more than making up for the 7 percent year-on-year decline recorded in the United States.

Figure 3.17 • Renewable heat consumption by region, 1990 and 2019

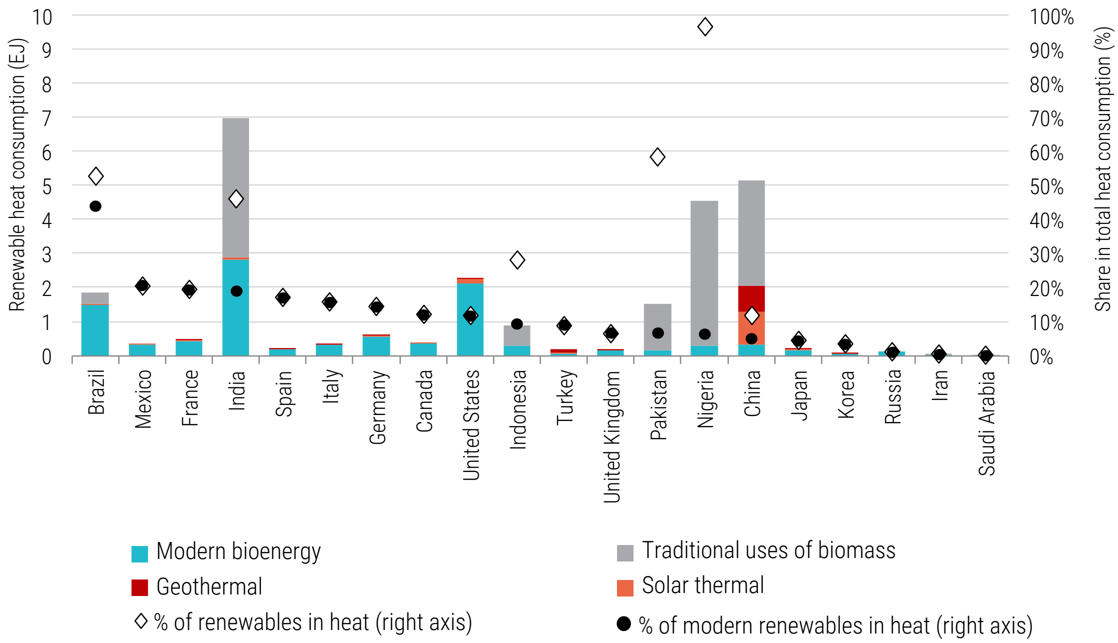


Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).
Note: Indirect consumption of renewable energy through electricity for heat is not included in this figure.

Traditional uses of biomass are primarily concentrated in Sub-Saharan Africa and Asia (figure 3.17), with—in descending order—Nigeria, India, China, Ethiopia, Pakistan, Democratic Republic of Congo and Indonesia together accounting for two-thirds of global consumption (figure 3.18). Despite a slightly declining trend since 2006, traditional uses of biomass in 2019 remain, globally, at a level similar to that of 1990. Trends differed across regions and countries over the last decade, with significant declines in Eastern Asia, especially in China, as well as in Indonesia and Vietnam. That improvement was partly erased on the global scale by population-driven increases in Sub-Saharan Africa—especially in Nigeria, Ethiopia, Uganda and Democratic Republic of the Congo, as well as in Pakistan.

The United States, China, and India together represented more than three-quarters of the global increase in modern renewable heat consumption from 2010 to 2019. Together with Brazil, they were responsible for 46 percent of global heat demand and accounted for almost half of modern renewable heat consumption globally in 2019. This result is shaped by the sizable consumption of bioenergy in the pulp and paper industry and for residential heating in the United States; extensive use of bagasse in the sugar and ethanol industry in Brazil and India; and notable deployment of solar thermal water heaters and geothermal heat in China. Europe is responsible for another quarter of global modern renewable heat consumption, owing to the deployment of residential wood and pellet stoves and boilers (e.g., in France, Germany, Italy) and the use of biomass in district heating (e.g., the Nordic and Baltic countries, Germany, France, Austria). In addition, although not quantified in this report, the growing consumption of renewable electricity through electric heaters and heat pumps in China, the United States, and the European Union contributed indirectly to renewable heat consumption (IEA 2019).

Figure 3.18 • Renewables in heat consumption in top 20 countries with the largest total final energy consumption, 2019



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).
Note: Indirect consumption of renewable energy through electricity for heat is not included in this figure.

TRANSPORT

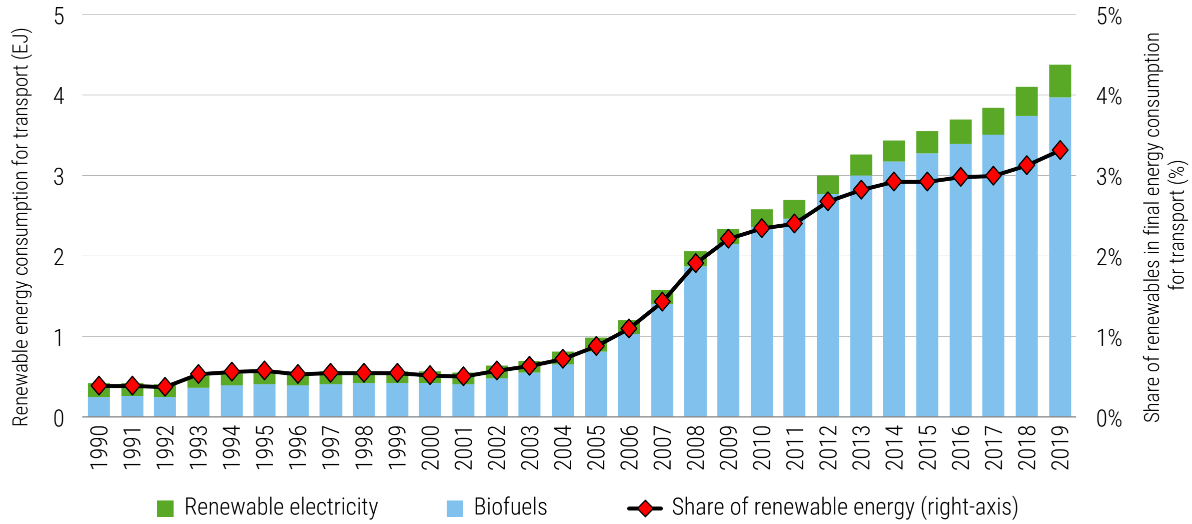
Renewable energy in transport grew by 0.27 EJ in 2019 (+7 percent), the fifth-largest annual growth in absolute terms since 1990 and the largest since 2012 (figure 3.19). Renewable electricity expanded by 0.03 EJ, the second-largest expansion since 1990; biofuels expanded by 0.24 EJ. These advances translated into a slight increase in the share of renewable energy in transport, which reached 3.6 percent in 2019 from 3.4 percent in 2018. However, this increase in share was not enough to contain nonrenewable energy consumption in transport, which grew by 0.35 EJ from 2018 to 2019.

Most of the renewable energy consumed for transport in 2019 came in the form of liquid biofuels (91 percent), mainly crop-based ethanol and biodiesel blended with fossil transport fuels. Most of the remainder was from renewable electricity.

The expansion of biofuels in 2019, driven primarily by country-level policies, was the largest annual increase since 2009. Biodiesel represented about half of the increase, while biogasoline (ethanol) contributed 20 percent. More than half of the growth occurred in Brazil and Europe together—primarily ethanol growth in the former and biodiesel growth in the latter. In Brazil, bioethanol demand grew by 10 percent from 2018 levels to a record 32 billion litres a year. Three main factors contributed to this growth. First, domestic transport fuel demand was 6 percent greater in 2019 than in 2018. Since Brazil's government requires ethanol blending, any increase in gasoline demand also increases ethanol demand. Second, low international sugar prices drove sugar mills to maximize higher-value ethanol production. Third, relatively low ethanol prices compared with gasoline also increased domestic demand for ethanol beyond required blending levels. Because Brazil has a large flex-fuel vehicle fleet, owners can decide whether to fill up with ethanol or a gasoline-ethanol blend, depending on prices. In Europe, country-level policies to meet the Renewable Energy Directive pushed up demand by 6 percent, primarily from biodiesel growth.

Renewable electricity used in vehicles and trains grew 0.03 EJ in 2019 but still accounted for just 9 percent of renewable energy use in transport. A good part of the growth is traceable to an expanding electric vehicle fleet. The number of electric vehicles on the road grew from 5.1 million in 2018 to 7.1 million in 2019 (IEA 2021d). In addition, the electricity powering these vehicles is increasingly coming from renewable sources: the renewable share of total electricity use in transport climbed from 20 percent in 2010 to 26 percent in 2019.

Figure 3.19 • **Biofuels and renewable electricity consumed for transport and share of renewables in total final energy consumption for transport, world, 1990-2019**



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

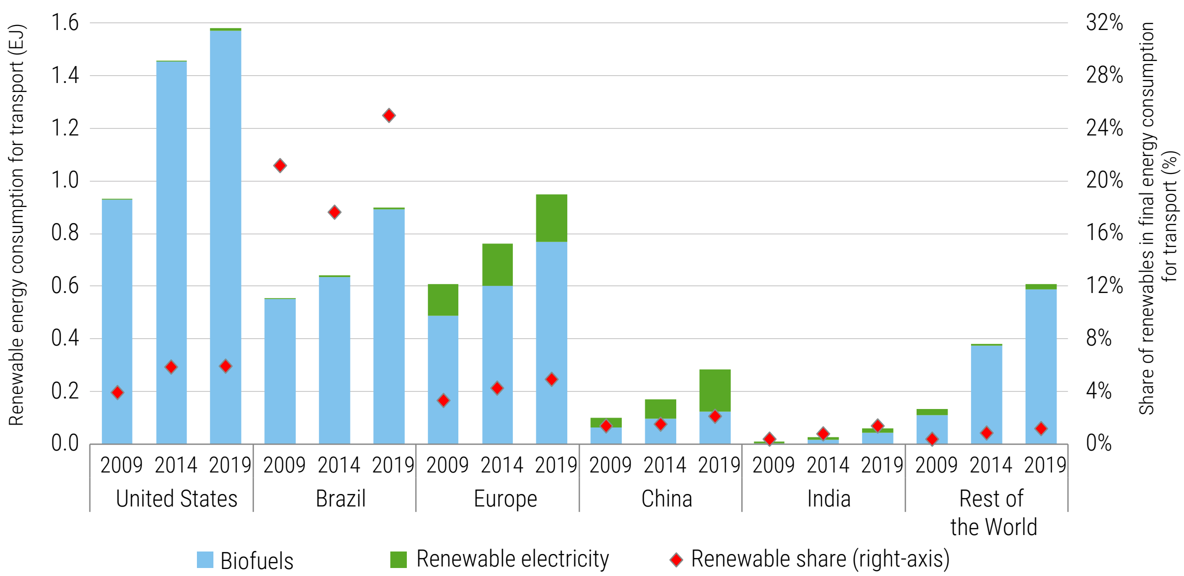
Over the last decade, the amount of renewable energy used in transport has nearly doubled, but its share has increased by only 1.2 percentage points. The growth is thanks to country-level policies to expand biofuels use, electrify transport, and increase the share of renewable sources in electricity generation. Biofuel policies have driven the largest growth in renewable energy, while renewable electricity has played a smaller, but growing, role. Despite many successes at the country level, these policies have just barely kept pace with rising fossil fuel demand, which explains the small share increase. This situation highlights the need for more holistic policy approaches that complement renewable energy uptake in transport with energy efficiency and conservation strategies, in particular through a major modal shift toward more sustainable transport modes, such as public transport systems and active mobility (e.g., biking, walking).

From a regional and country perspective, the United States, Brazil, and Europe account for almost 80 percent of renewable energy used in transport, but shares are growing in other regions as well (figure 3.20). In the United States and Brazil, biofuels—primarily crop-based ethanol and biodiesel—make up 99 percent of the renewable energy used in transport. In Europe, by contrast, renewable electricity represents 19 percent of the renewable energy consumed in transport. Between 2009 and 2019, policies have raised renewable shares in transport from 3.9 percent to 5.9 percent in the United States, and from 3.3 percent to 4.9 percent in Europe.

In China, renewable energy in transport grew by nearly 70 percent between 2014 and 2019 with renewable electricity accounting for three-quarters of the expansion. In that country, renewable electricity represented more than half of all renewable energy used in transport in 2019, owing to electrification of transport efforts in parallel with increasing shares of renewables in power generation, while policy support for biofuels remained modest. In 2019, 47 percent of the global light-duty electric vehicle fleet was in China, as well as more than a half-million electric buses. In India, biofuel support policies have more than doubled renewable energy use in transport since 2014.

Expanding the share of renewable sources in the energy used for transport will require a combination of policies that support biofuels (while ensuring that all feedstock supplies meet the most stringent sustainability criteria), nonbiogenic renewable fuels, transport electrification, and renewable electricity generation, as well as active mobility, transit efficiency (efficiency by design) and phaseouts of fossil fuels. These policies must be steadily but rapidly increased in countries that already have them and rapidly spread to those countries where they are not yet found.

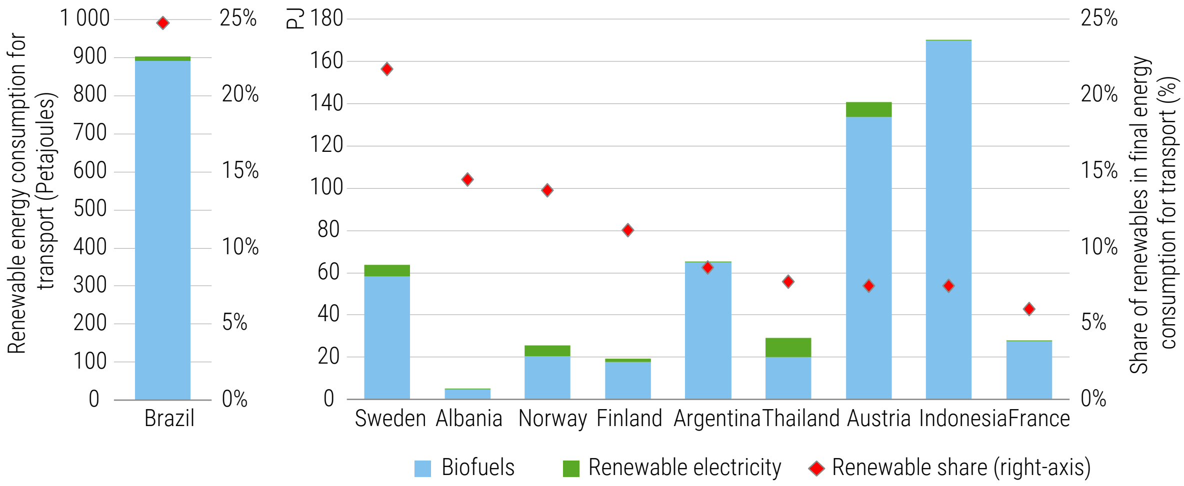
Figure 3.20 • Renewable energy consumption for transport, by source, and renewables' share of total energy consumed for transport, selected countries, 2009, 2014, and 2019



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

In 2019, Brazil, Sweden, Albania, Norway, and Finland, all achieved renewable energy shares above 10 percent (figure 3.21).

Figure 3.21 • Top ten countries by renewable energy share in transportation, 2019



Source: International Energy Agency (IEA, 2021a) and United Nations Statistics Division (UNSD, 2021).

POLICY INSIGHTS: THE ENERGY TRANSITION AND THE HYDROGEN FACTOR

Switching to renewables-based energy systems is one of the key conditions to address climate and energy challenges. Yet not all sectors or industries can easily switch from fossil fuels to direct uses of renewables or renewables-based electricity. Hard-to-electrify and therefore hard-to-abate sectors include steel, cement, chemicals, long-haul road transport, maritime shipping, and aviation. The petrochemical industry is the major consumer of hydrogen, most of which is produced from fossil gas and coal (IRENA 2022b).

Renewables-based hydrogen, so-called "green hydrogen", has been receiving significant attention recently as a solution to decarbonise these sectors. This momentum is also reflected in its increasingly prominent role in energy scenarios (IEA 2021e; IRENA 2022c), as well as in the growing number of over 30 countries that have adopted or are elaborating hydrogen strategies (IRENA 2022d).

Given the potential role of green hydrogen in the energy transition and its relation to SDG 7, ensuring an integrated policy approach is essential to inform its use, avoid unnecessary dispersion in electrifiable sectors, guarantee the "green" nature of the molecules involved, and create an enabling environment. The rest of this section sketches a policy framework for harnessing the potential of green hydrogen.

Green hydrogen policy making can be broken down into four pillars (IRENA 2020a).

PILLAR 1: DEVELOPING A STRATEGY

Recently announced hydrogen strategies are the results of a long process and mark the beginning of new waves of policies. The drafting process clarifies "why hydrogen," "why here," and "why now." It then defines how the strategy will guide research, industry efforts, and early demonstration programmes. An early outcome of the process is an integrated plan setting forth the activities needed to assess the potential for hydrogen, identify the short-term actions needed to advance deployment, articulate the research areas with the highest priority, and identify the applications where demonstration projects are most needed. The government must set targets, present concrete policies, and evaluate their coherence with existing energy policies.

PILLAR 2: SETTING PRIORITIES

Green hydrogen is no silver bullet for all end uses, and policy makers must set clear priorities for its use. Despite its great promise, it is just one of several possible decarbonization alternatives that must be weighed when setting priorities.

The production, transport, and conversion of hydrogen all require energy, resources, and significant investment (ESMAP 2020; IRENA 2020b; IRENA 2021c). As a result, its extensive use may not be in line with the requirements of sustainable development and a decarbonized world, in which energy consumption and capacity deployment will have to be carefully managed. In particular, the production of green hydrogen requires dedicated renewable energy that could be used for other end uses. Indiscriminate use of hydrogen therefore carries the danger of missed opportunities for the energy transition. In many cases, direct electrification using renewable energy, along with energy efficiency, will be a faster and more cost-effective solution to decarbonizing the energy system than green hydrogen.

A central role for green hydrogen is in industrial applications where hydrogen is already used, such the production of ammonia and methanol. The demand from these facilities is large enough to enable economies of scale in production and infrastructure, making the shift to green hydrogen even more cost-effective compared with distributed applications, for which distribution infrastructure can be very costly.

In the transport sector, the rapidly declining cost and technological improvement of batteries have made electric vehicles an attractive solution. However, for international aviation and shipping, two transport subsectors where fewer viable decarbonization alternatives exist, green hydrogen could play an important role.

While it is possible to identify global priority-setting metrics (IRENA 2022b), energy and industrial sector conditions differ greatly between countries and must be taken into account when setting national and regional priorities.

PILLAR 3: BUILDING A TRACKING SYSTEM

Molecules of green and grey hydrogen are identical. For this reason, once hydrogen has been produced, a tracking system is needed to provide consumers and governments with the origin and quality of the hydrogen. Tracking systems are not only necessary to track the origin and attributes of the energy used across the value chain, they are also key for the development of a national, regional, and international green hydrogen market. Setting up these tracking systems will require compliance with technical considerations and regulations to ensure that they provide accurate, reliable, and transparent information about the hydrogen produced and consumed.

From a technical standpoint, green hydrogen tracking systems should provide transparent information on the origin of the electricity used in the production of the hydrogen, as well as on the greenhouse gas content involved in each unit of green hydrogen produced.

From a regulatory perspective, green hydrogen tracking systems should comply with temporal and geographical correlations and additionality requirements to ensure that the hydrogen certified has been produced from renewable energy.

PILLAR 4: PUTTING PLACE A GOVERNANCE SYSTEM AND ENABLING POLICIES

As production of green hydrogen accelerates, the policies that drive the transition must not only cover the deployment, but also its integration into the broader energy system and its wider interactions with economic and social systems. Against this background, concrete actions for policy makers to consider include:

- *Seeking advice from civil society and industry.* Civil society and industry can provide advice to policy makers on proposals, actions, and amendments to the strategy, depending on progress.
- *Implementing measures to maintain industrial competitiveness and create local opportunities.* For example, the Border Carbon Adjustment Mechanism proposed in the European Union and the EU/US agreement on low-carbon steel and aluminium are example of policies to protect industries that are coping with high carbon prices as they transition toward greener solutions (IRENA 2022b).
- *Identifying local economic activity and job-creation opportunities.* Analyses of the employment impact of green hydrogen within an economy have been done in all first-mover countries, where they are used to inform national strategies. This was the case, for example, in the Netherlands (CE Delft 2018; Government of the Netherlands 2020).

- *Introducing hydrogen as a component of energy security.* Not all countries enjoy the presence of large reserves of fossil fuels, meaning that the continuity of supply is governed by ever-changing international political and economic factors. The production of green hydrogen, on the contrary, can occur in any part of the world where renewable energy is available. Hydrogen is also hard to cartelize, lowering the risk to potential importing countries (IRENA 2022d).
- *Ensuring access to financing.* Policy makers can provide direct dedicated funding from state budgets or assist access to private capital by creating guidelines or new facilitating mechanisms. In jurisdictions where the push for the energy transition is strong, there is the possibility that green hydrogen investors may find themselves with multiple possible financing streams and public funds. Applying for them may create a bureaucratic barrier. Creating a one-stop shop for finance can be a solution to reduce the burden, connecting stakeholders with funding sources for green hydrogen projects, while allocating funds more efficiently (WEF and IRENA 2021).
- *Collecting statistics.* Hydrogen currently is not specifically included in national energy balances. Including it as a separate product in national commodity and energy balances, along with specific transformation processes for electricity-powered synthesis plants, would enable greater depth of analysis and insight on renewable energy end uses and efficiency evaluations. In this respect, UNSD is leading a revision of the Standard International Energy Product Classification (UNSD 2018, chapter 3). One goal of that revision is to improve the handling of hydrogen as an energy product.

APPENDIX: METHODOLOGY

Table 3A.1 • Definitions

Renewable energy sources	Total renewable energy from hydropower, 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 plus the amount of electricity and heat consumption estimated from renewable energy sources.
Direct renewables	Bioenergy, solar thermal, and geothermal energy.
Total final energy consumption	The sum of final energy consumption in the transport, industry, and other sectors (equivalent to total final consumption minus nonenergy use).
Traditional uses of biomass	Biomass uses are considered traditional when biomass is consumed in the residential sector in countries outside the Organisation for Economic Co-operation and Development. International Energy Agency statistics divide traditional uses of biomass into primary solid biomass, charcoal and unspecified primary biomass, and waste. Traditional consumption/use of biomass is a "conventional proxy" because it is estimated rather than measured directly.
Modern renewable energy consumption	Total renewable energy consumption minus traditional consumption/use of biomass.

METHODOLOGY FOR MAIN INDICATOR

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

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

The variables are derived from the energy balance flows: TFEC = total final energy consumption as defined in table 3A.1; ELE = gross electricity production; HEAT = gross heat production. Their subscripts correspond to the energy balance products.

The denominator is the TFEC of all energy products (as defined in table 3A.1). The numerator, renewable energy consumption, is a series of calculations defined as the direct consumption of renewable energy sources plus the final consumption of gross electricity and heat estimated to have come from renewable sources. In order to perform the calculation at the final energy level, this estimation allocates the amount of electricity and heat consumption deemed to come from renewable sources based on the share of renewables in gross production.

METHODOLOGY FOR ADDITIONAL METRICS BEYOND THE MAIN INDICATOR

The amount of renewable energy consumption can be divided into three end uses based on the energy service for which the energy is consumed: electricity, heat, and transport. These are calculated from the energy balance and are defined as follows:

Electricity refers to the amounts of electricity consumed in the production of electric and heat services. Electricity used in the transport sector is excluded from this aggregation. Electricity used to produce heat is not included because official data at the final energy service level is unavailable.

Heat refers to the amount of energy consumed for heat-raising purposes in industry and other sectors. Because official data at the final energy service level are unavailable, electricity used for heat is not included in this aggregate. Therefore, the heat category here is not equivalent to the final energy end use service. It is also important to note that in this chapter, in the context of an "end use," heat does not refer to the same quantity as the energy product, "Heat," in the energy balance used in the formula above.

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

METHODOLOGY FOR INDICATOR SDG 7.B.1

Indicator 7.B.1 measures the installed renewable energy-generating capacity in developing countries (in watts per capita) by dividing the maximum installed capacity at year-end of power plants that generate electricity from renewable energy sources by the country's population in mid-year. Data from IRENA are used to calculate the indicator.

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

More detail 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).

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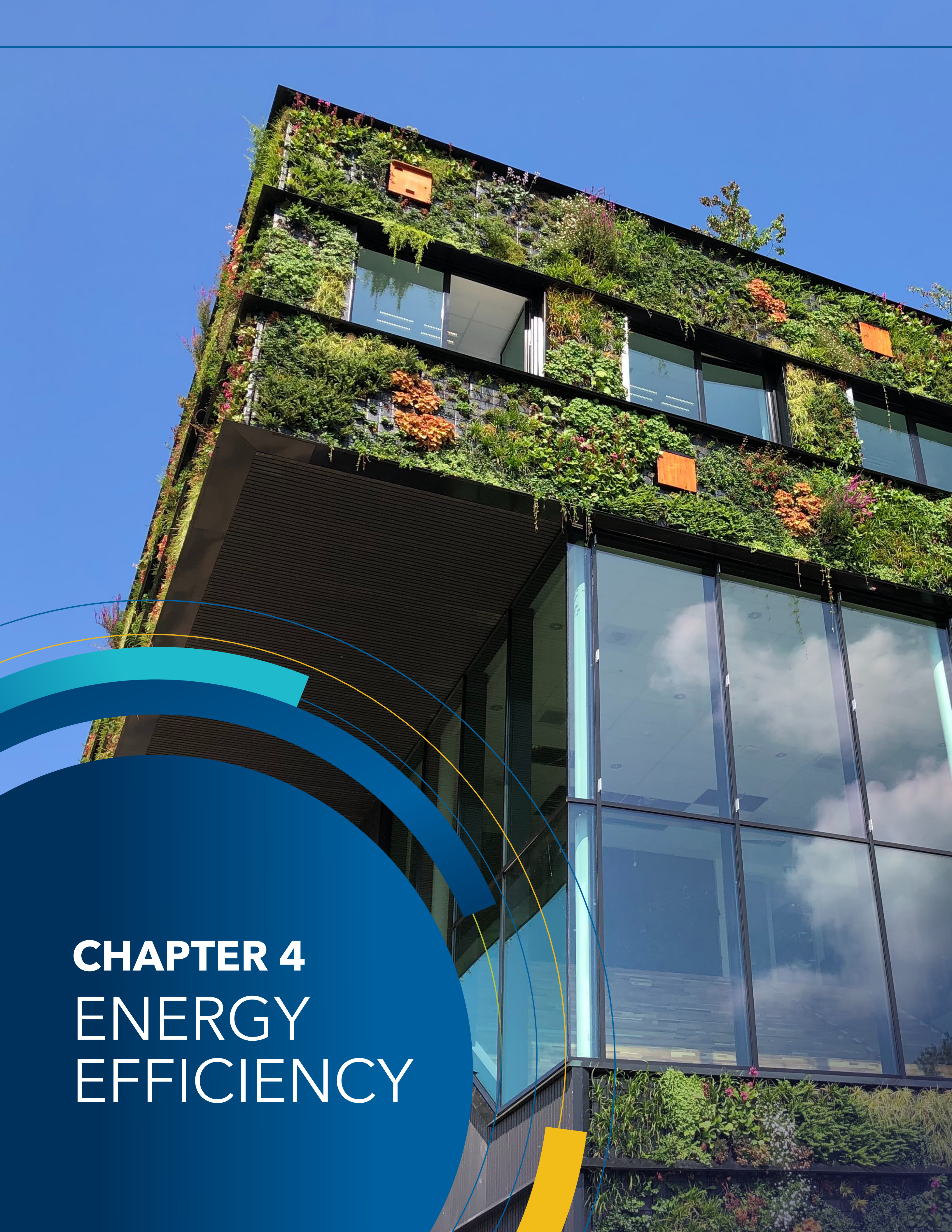

CHAPTER 4
ENERGY EFFICIENCY

MAIN MESSAGES

- **Global trend:** The rate of improvement in primary energy intensity—defined as the percentage decrease in the ratio of total energy supply per unit of gross domestic product (GDP)—has slowed in recent years. Worldwide, primary energy intensity[1] was 4.69 megajoules (MJ) per U.S. dollar in 2019, a 1.5 percent improvement from 2018. This was the second-lowest rate of improvement[2] since the global financial crisis, but still higher than the rate in the previous year.
- **2030 target:** Energy intensity improvements continue to remain below the target set under the United Nations Sustainable Development Goals (SDGs) for 2030. Between 2010 and 2019, the average annual rate of improvement in global energy intensity was 1.9 percent. Although better than the rate of 1.2 percent between 1990 and 2010, it is well below the SDG 7.3 target of 2.6 percent.[3] Annual improvement through 2030 must now average 3.2 percent to meet the target of SDG 7.3. While early estimates for 2020 point to a substantial decrease in intensity improvement as a result of the COVID-19 crisis, the outlook for 2021 suggests a return to the average rate of improvement during the previous decade. Making energy efficiency measures a priority in policy and investment over the coming years can help the world achieve SDG 7.3, promote economic development, improve health and wellbeing, and ensure universal access to clean, efficient energy.
- **Regional highlights:** Eastern Asia and South-eastern Asia was the only region that overachieved the target of SDG 7.3 between 2010 and 2019, with energy intensity improving by an annual average rate of 2.7 percent driven by strong economic growth and significant progress on energy efficiency. Nonetheless, average annual improvement rates in Oceania (2.2 percent), Northern America and Europe and Central Asia and Southern Asia (2.0 percent) were also above the global average and historical trends. The lowest rates of improvement were achieved in Latin America and the Caribbean (0.6 percent), followed by Western Asia and Northern Africa (1.2 percent) and Sub-Saharan Africa (1.3 percent). Data on absolute energy intensity reveal wide regional differences. For example, energy intensity in Sub-Saharan Africa is almost double the level in Latin America and the Caribbean. These variations mirror differences in economic structure, energy supply, and access to energy, rather than in energy efficiency.
- **Trends in the top 20 energy consuming countries:** Comparing the periods 2000–10 and 2010–19, the annual rate of improvement in energy intensity increased in 13 of the 20 countries with the largest total energy supply in the world. However, less than half of the top energy consuming countries performed better than the global average. China continues to improve energy intensity at the fastest rate, at an annual average of 3.8 percent between 2010 and 2019, followed by the United Kingdom at 3.7 percent. Japan and Germany also continue to improve their energy intensity at rates beyond the SDG 7.3 target, thanks to decades of concerted effort toward energy efficiency and a shift in their economies toward producing high-value, low-energy goods and services. Indonesia is the only other emerging economy apart from China with an average energy intensity improvement rate above the SDG 7.3 target.

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1 Hereafter referred to as "energy intensity". See note to figure 4.8 for the definition of energy intensity by sector.

2 Calculated as a compound average annual growth rate.

3 Revisions of underlying statistical data and methodological improvements explain the slight changes in historical growth rates from previous editions. The SDG 7.3 target of improving energy intensity by 2.6 percent per year in 2010–30 remains the same, however.

- **End-use trends:** Compared with the previous decade, the rate of energy intensity improvement accelerated across all sectors over the 2010–19 period, with the exception of the residential buildings sector. The freight transport sector experienced the highest rate of energy intensity improvement, at 2.2 percent a year. Notable progress has also been made in the industry sector (2 percent), which spans a range of energy-intensive economic activities. This is a major enhancement since sectoral energy intensity had deteriorated in the preceding period. Sectoral improvement rates have been the lowest in the residential sector, where the rate of energy intensity improvement slowed from 1.9 percent in the previous period to 1.2 percent annually between 2010 and 2019.
- **Electricity supply trends:** The rising share of renewables in electricity generation improves supply efficiency by eliminating the losses incurred in the conversion of primary (nonrenewable) fuels into electricity. This relationship between efficient primary renewable electricity[4] and a decrease in energy intensity highlights the synergies between SDG targets 7.2 and 7.3. In addition, the average efficiency of fossil fuel electricity generation increased from 36 percent in 2000 to 40 percent in 2019 thanks to growing use of relatively more efficient gas-fired plants and the construction of more efficient coal-fired plants in China and India. Major electricity-producing countries are seeing declines in transmission and distribution losses, indicating higher rates of electrification and a modernized supply infrastructure.

4 Primary renewable electricity, such as hydropower, solar PV, wind, and ocean energy is captured directly from natural resources. Electricity from geothermal, solar thermal, and biomass sources is renewable but it is not treated as 100 percent efficient in energy statistics owing to conversion losses.

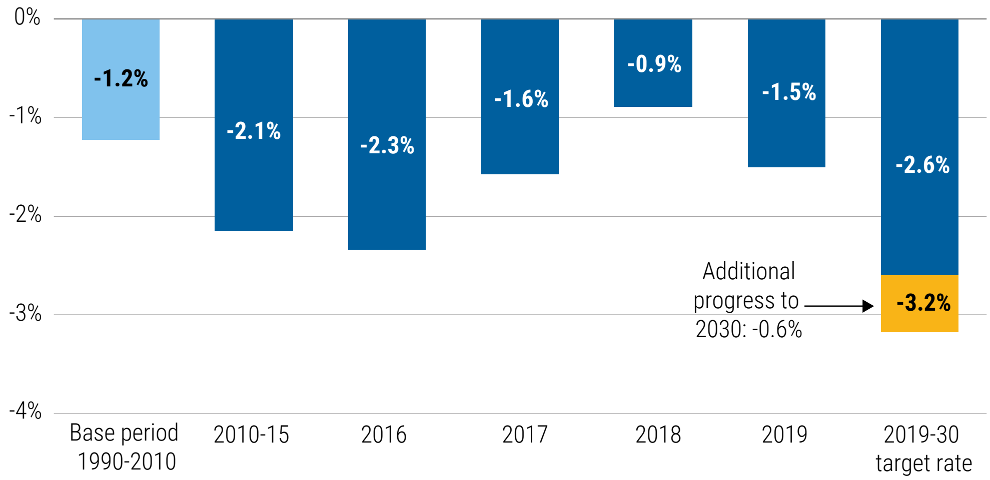
ARE WE ON TRACK?

SDG 7 commits the world to ensure universal access to affordable, reliable, sustainable, and modern energy. Achieving SDG target 7.3—doubling the global rate of improvement in energy intensity relative to the average rate over the period from 1990 to 2010—also contributes to reaching the other targets of SDG 7.[5] Energy intensity is the ratio of total energy supply to the annual GDP created—in essence, the amount of energy used per unit of wealth created. By using this measure of energy intensity to understand efficiency, we can observe how energy use rises or falls while also looking for the (social and economic) development factors that may affect those rates, along with other factors such as weather and behavior change. In general, energy intensity declines as energy efficiency improves.

Progress toward SDG target 7.3 is measured by tracking the year-on-year percentage change in energy intensity. Initially, an annual improvement rate of 2.6 percent between 2010 and 2030 was recommended by the United Nations to achieve the target, but since global progress has been slower than that in all years except 2015, the rate now required is at least 3.2 percent (figure 4.1).

Nevertheless, global energy intensity has shown gradual improvement since 1990[6] (figure 4.2). Recent numbers show that global energy intensity improved by 1.5 percent in 2019 to 4.69 MJ/U.S. dollar (2017 PPP [purchasing power parity]). This was the second lowest rate of improvement since the global financial crisis, but still better than the previous year's rate.

Figure 4.1 • Growth rate of primary energy intensity by period and target rate, 1990–2030

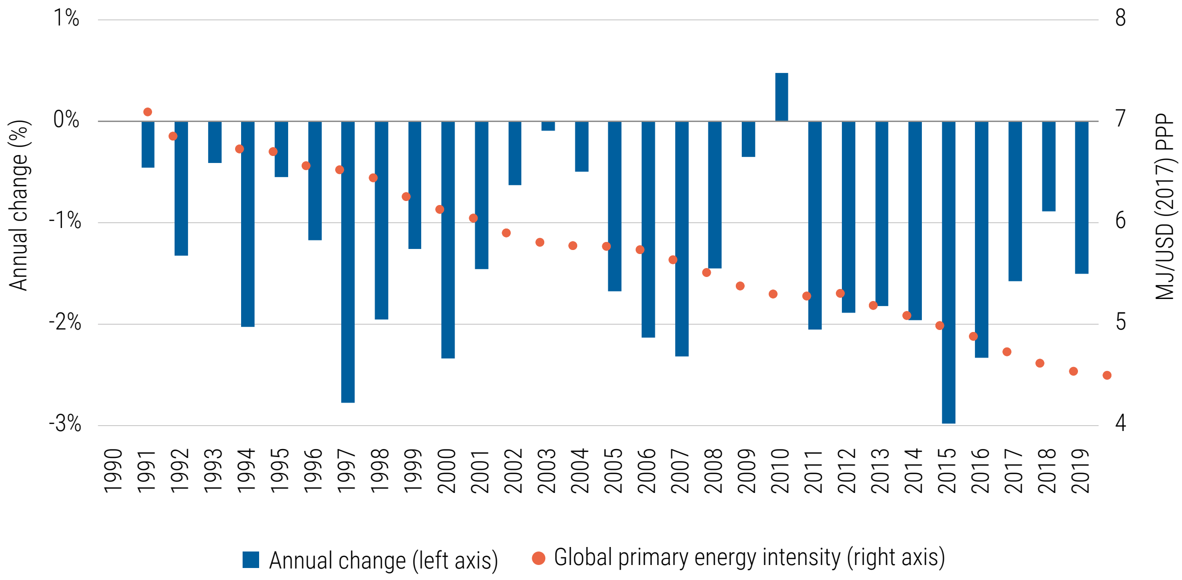


Source: IEA, UN, and World Bank (see footnote 6).

5 Revisions of underlying statistical data and methodological improvements explain the slight changes in growth rates in the base period (1990–2010) from previous editions. The SDG 7.3 target of improving energy intensity by 2.6 percent per year in 2010–30 remains the same, however.

6 Most of the energy data in this chapter comes from a joint dataset built by the International Energy Agency (https://www.iea.org/data-and-statistics/) and the United Nations Statistics Division (https://unstats.un.org/unsd/energystats/). GDP data is sourced from the World Bank's World Development Indicators database (http://datatopics.worldbank.org/world-development-indicators/).

Figure 4.2 • Global primary energy intensity and its annual change, 1990–2019



Source: IEA, UN, and World Bank (see footnote 6).
Note: MJ = megajoule; PPP = purchasing power parity.

LOOKING BEYOND THE MAIN INDICATORS

COMPONENT TRENDS

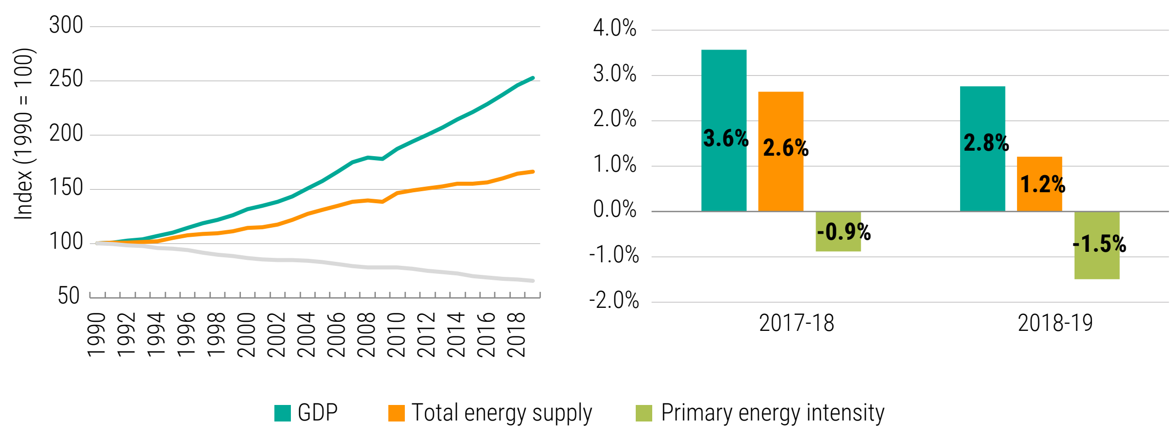
The impact of improvements in energy intensity is revealed by trends in its underlying components (figure 4.3, left). Between 1990 and 2019, global GDP increased by a factor of 2.5, while global total energy supply[7] grew by two-thirds.

The difference in growth rates for GDP and total energy supply is reflected by consistent improvements in global energy intensity, which fell by more than a third between 1990 and 2019, signaling trends in the decoupling of energy use from economic growth. In the period 2010–19, global intensity fell by nearly 16 percent, compared with a 10 percent decrease between 2000 and 2010.

More recently, growth in energy supply shrank by half from 2.6 percent in 2018 to just 1.2 percent in 2019, while GDP growth declined by less than a quarter, from 3.6 percent in 2018 to 2.8 percent in 2019. This resulted in an increase in the improvement rate for energy intensity—from 0.9 percent in 2018 to 1.5 percent in 2019 (figure 4.3, right).

Recent trends in energy efficiency are discussed in box 4.1.

Figure 4.3 • Trends in underlying components of global primary energy intensity, 1990–2019 (left); and growth rates of GDP, total energy supply, and primary energy intensity, 2017–19 (right)



Source: IEA, UN, and World Bank (see footnote 6).
Note: GDP = gross domestic product.

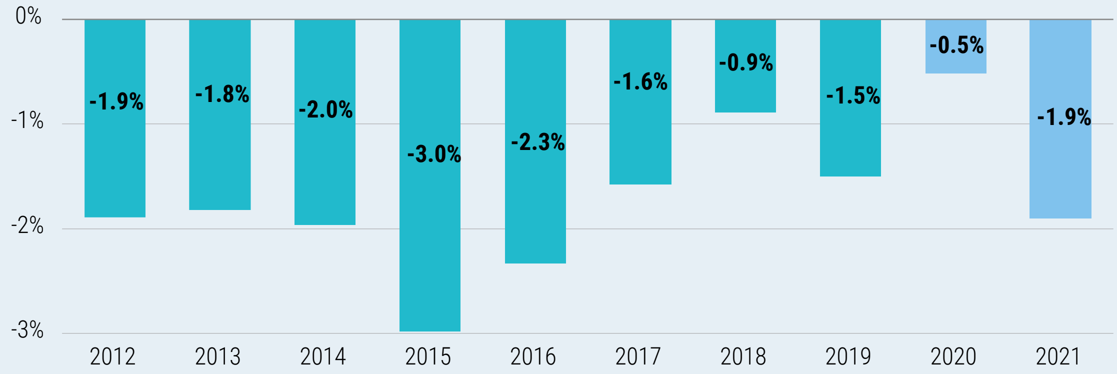
7 "Total primary energy supply" has been renamed "Total energy supply" in accordance with the International Recommendations for Energy Statistics (UN 2018).

BOX 4.1 • Recent energy efficiency trends

The COVID-19 pandemic has disrupted energy and economic trends in recent years. 2020 was one of the worst years ever for progress toward greater energy efficiency, as energy intensity improved by a mere 0.5 percent owing to low energy demand and prices, a slowdown in technical efficiency enhancements, and a shift in economic activity away from less energy-intensive services, such as hospitality and tourism (figure B4.1.1).

In 2021, global energy demand is estimated to have increased by about 4 percent as countries gradually emerged from lockdowns. Combined with a rebound in less-energy-intensive economic activity and rising energy prices and efficiency investments, this is estimated to have resulted in an energy intensity improvement of 1.9 percent, a return to the average rate during the previous ten years.

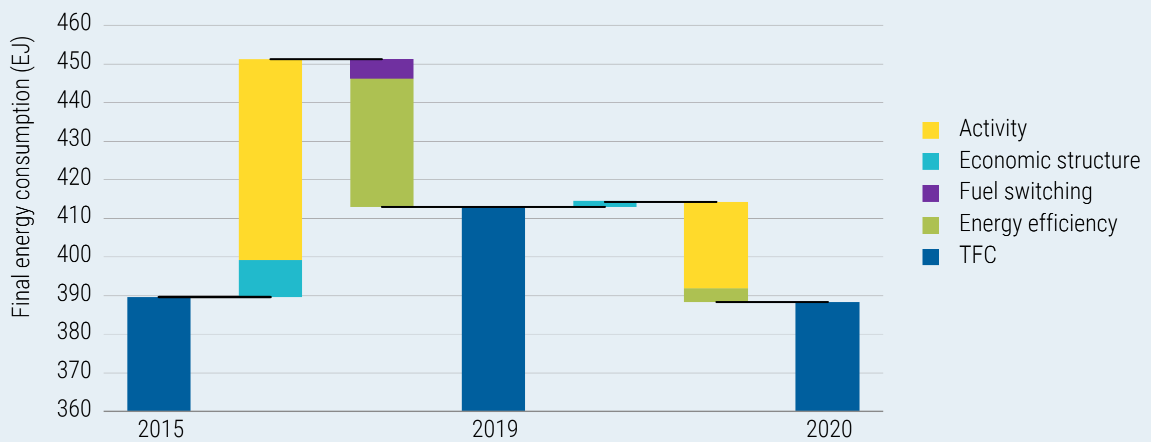
Figure B4.1.1 • Growth rate of global primary energy intensity, 2012–21



Source: IEA (2021d).

However, energy intensity improvements had already slowed before the pandemic, driven by strong demand for energy services and a shift in economic structure towards more energy-intensive industrial production, combined with only modest avoided demand from fuel switching toward electricity and slower rates of improvement in technical efficiency. Nonetheless, energy demand would have been 5 percent higher in 2019 if technical efficiency improvements between 2015 and 2019 had been as low as in 2020 (figure B4.1.2).

Figure B4.1.2 • Decomposition of change in global total final energy consumption, 2015–20



Note: TFEC = total final energy consumption in the industry, buildings and transport sectors.
Source: IEA 2021j.

Energy efficiency helped avoid nearly two-thirds of the potential increase in energy demand that could have occurred between 2015 and 2019 due to economic growth. An important contributor to changes in economic structure that added to global energy demand was strong demand for energy-intensive products in China, while a switch to less-energy-intensive fuels decreased energy demand.

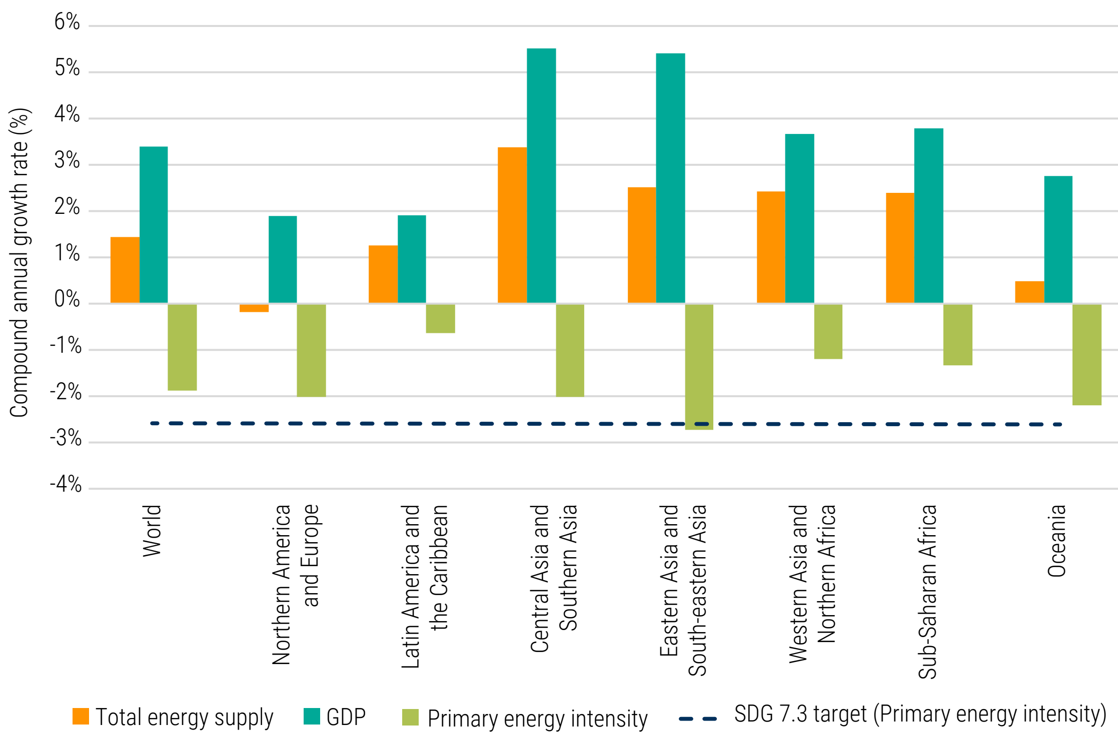
With disruptions caused by COVID-19 shaping recent trends, it is still unclear whether the rebound of energy intensity improvements in 2021 signals the start of a sustained recovery. However, increased investment trends, rising government spending on efficiency (in large part related to recovery plans enacted in response to COVID-19 crisis), and new announcements of higher climate ambition and other policy measures offer some encouraging signals.

REGIONAL TRENDS

Overall, since 2010, energy intensity has improved across the world, but significant differences in trends are observed across regions (figure 4.4). Emerging economies in Central, Southern, and Eastern and South-eastern Asia have seen a rapid increase in economic activity. However, the rise in total energy supply associated with such growth has been mitigated in part by significant improvements in energy efficiency, which have put downward pressure on the global average. Over the same period, mature economies in Northern America and Europe experienced a slight decrease in their total energy consumption, which reflects slower economic growth and a decoupling of the economy from energy usage. This last trend was enabled by a continued shift toward less-energy-intensive industrial activities (such as services) and the greater energy efficiency one typically observes when mature policies are in place, particularly in buildings (Northern America) and industry (Europe). In these economies, energy intensity improved at a rate slightly below global trends, leading to an absolute level of energy intensity slightly below the global average (figure 4.5). Similar trends and absolute levels of energy intensity have been observed for Oceania, where total energy supply increased modestly, while GDP grew faster than in Northern America and Europe.

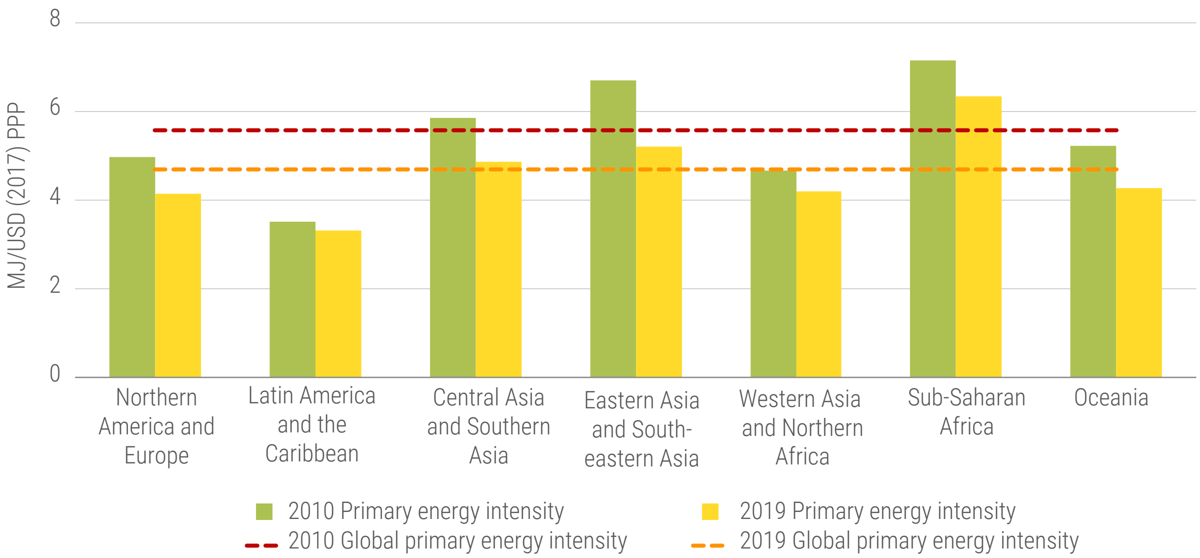
Latin America and the Caribbean, Western Asia and Northern Africa, and Sub-Saharan Africa recorded the smallest average gains in energy intensity improvement over the 2010–19 period (1.3 percent per year or less). However, trends differed across these regions. In Latin America and the Caribbean, both growth in total energy supply and GDP were among the lowest worldwide, but the region is also the least energy intensive region in the world, at 3.3 MJ/U.S. dollar (2017 PPP) (figure 4.5). In Western Asia and Northern Africa, and in Sub-Saharan Africa, on the other hand, growth in total energy supply and GDP were among the highest worldwide. In absolute terms, economic output in Sub-Saharan Africa is highly energy intensive, at 6.3 MJ/U.S. dollar (2017 PPP), reflecting the low value of economic output and the widespread use of inefficient solid biomass for cooking. The figure for Western Asia and Northern Africa was 4.2 MJ/U.S. dollar (2017 PPP) (figure 4.5).

Figure 4.4 • Growth rate of total energy supply, GDP and primary energy intensity at a regional level, 2010–19



Source: IEA, UN, and World Bank (see footnote 6).
Note: GDP = gross domestic product.

Figure 4.5 • Primary energy intensity at a regional level, 2010 and 2019



Source: IEA, UN, and World Bank (see footnote 6).
Note: MJ = megajoule; PPP = purchasing power parity.

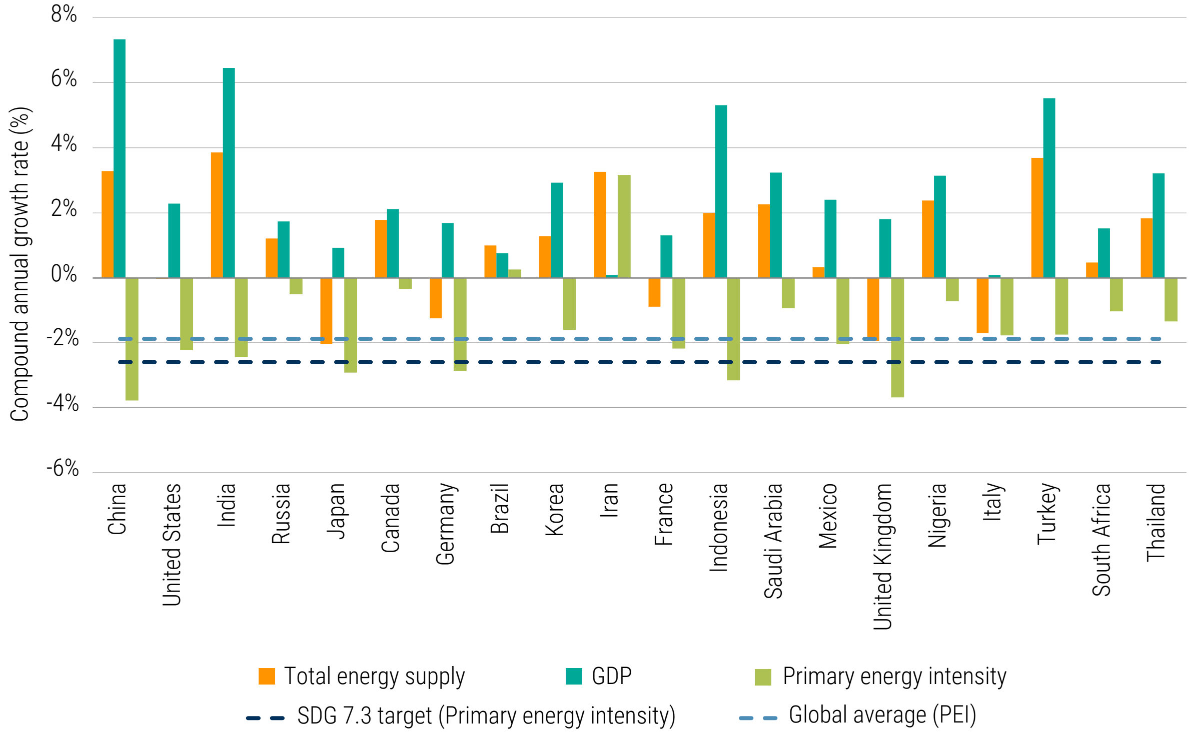
MAJOR COUNTRY TRENDS

Rates of improvement for energy intensity in the 20 countries with the largest total energy supply are central to realizing SDG 7.3, as these countries account for around three-quarters of global GDP and energy consumption. Over the period from 2010 to 2019, 13 of them raised their rate of intensity improvement compared with the previous decade, but less than half performed better than the global average, with only five (China, United Kingdom, Indonesia, Japan, and Germany) exceeding the level required by SDG 7.3 (figure 4.6).

Of these five countries, two—China and Indonesia—are major emerging economies. They have seen rapid structural changes in their economies, changes that have moved them toward higher-value activities that create more GDP for every unit of energy consumed. Particularly in China, concerted efforts to introduce energy efficiency policies over the period have quickened the pace of energy intensity improvements in various sectors.

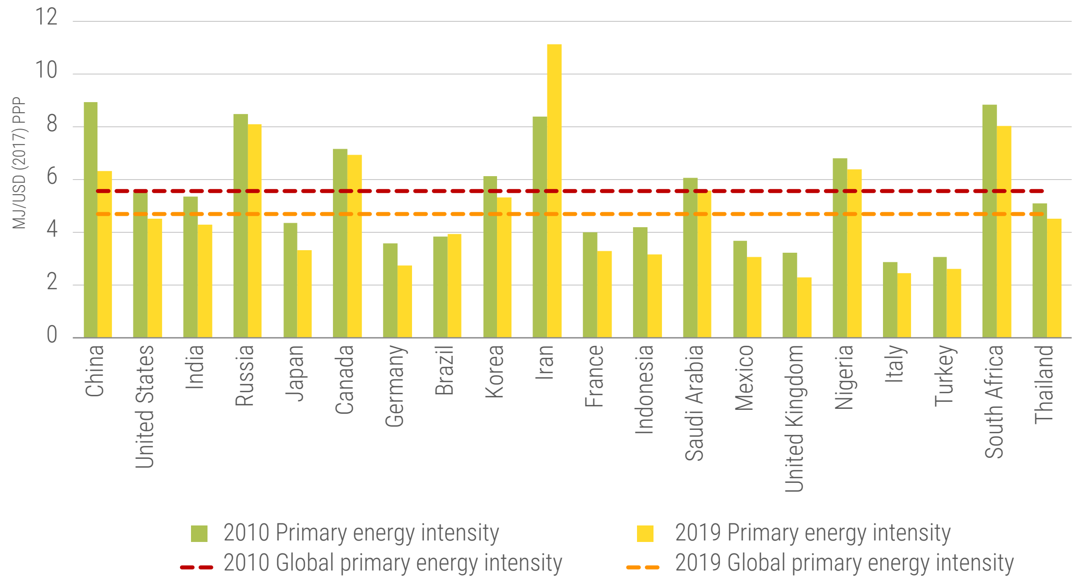
The economies of the United Kingdom, Japan, Germany, and France have expanded as their energy use declined. In Italy, energy intensity improved as total energy supply dropped and GDP remained nearly constant. These trends suggest that economic growth is being decoupled from energy use, as economic activity has largely shifted to high-value, service-related activities that are less energy intensive. In addition, the economies of these countries all have strong, decades-long records of policy action on energy efficiency.

Figure 4.6 • Growth rate of total energy supply, GDP, and primary energy intensity in the 20 countries with the largest total energy supply, 2010–19



Source: IEA, UN, and World Bank (see footnote 6).
Note: Countries along the x-axis are ordered by total energy supply. GDP = gross domestic product; SDG = Sustainable Development Goal; PEI = primary energy intensity.

Figure 4.7 • Primary energy intensity in the 20 countries with the largest total energy supply, 2010 and 2019



Source: IEA, UN, and World Bank (see footnote 6).
Note: Countries along the x-axis are ordered by total energy supply.
MJ = megajoule; PPP = purchasing power parity.

In absolute terms, the energy intensity of eight of the top 20 energy-consuming countries has remained above the global average over the past decade (figure 4.7). Three of the eight (Iran, Russia, and South Africa) are also among the top 25 countries worldwide with the highest energy intensities.

Globally, average energy intensity has fallen by nearly 1 MJ/U.S. dollar (2017 PPP) since 2010. Certain countries have made progress by moving further below the global average, including India, Indonesia, Japan, the United States, and the United Kingdom. Others, such as China and South Africa, despite remaining more energy intensive than the global average, are improving and shifting toward the global average. Countries where progress has been slowest include those where energy-intensive fossil fuel extraction represents a major share of GDP—namely Iran, Brazil, Nigeria, Canada and Russia.

Digitalization has played a prominent role in enabling countries to make progress toward SDG 7.3, as discussed in box 4.2.

BOX 4.2 • Digitalization: The key to accelerating progress toward SDG 7.3 and net-zero emissions by 2050

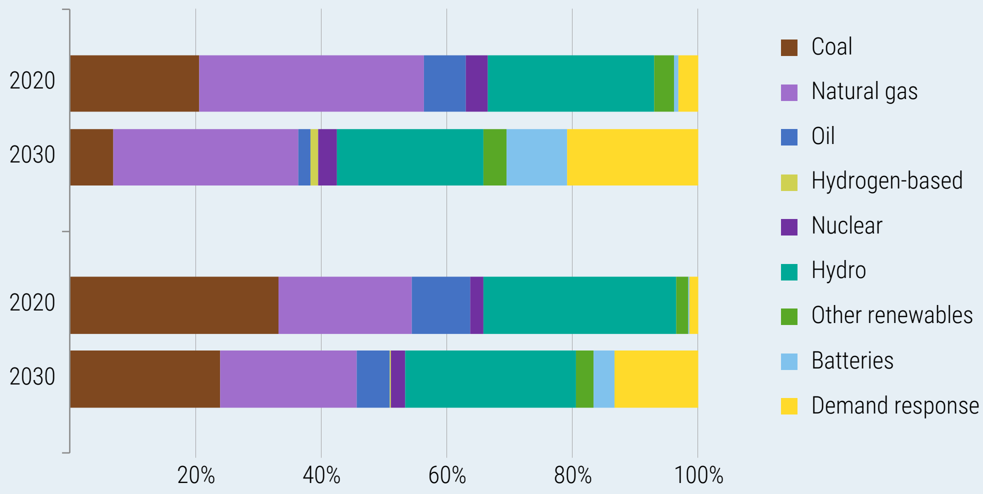
Digitalization is transforming the energy sector and promises to accelerate progress on SDG 7.3. With the proliferation of digital devices and low-cost sensors, a wealth of granular and continuously updated data is now available to optimize energy supply and use. Over the last five years the deployment of connected devices with automated controls—appliances, devices, and sensors—grew by around 33 percent per year to reach 9 billion in 2021, up from 7 billion the year before (4E 2021). This brings challenges in terms of ensuring the energy efficiency of IT infrastructure. Overall energy use by connected devices decreased moderately over the past decade, while increased energy efficiency and operational improvements have enabled a decoupling of data use, internet traffic, and associated electricity use (Malmodin and Lundén 2018; IEA 2021g). Continued efforts in research and development and incentives for energy efficiency are needed to maintain this trend. In particular, the steep growth in devices calls for close attention to enhancing the efficiency of connected devices and IT infrastructure—for example, by reducing the energy consumed during network standby (IEA 2021d).

Digitalization provides insight into how to direct energy efficiency measures so they have the greatest effect and yield the greatest benefit. For example, in the building sector, energy management systems and related technologies can help reduce energy consumption significantly. In the U.S. General Services Administration, building operating costs could be cut by 20 percent by enabling the buildings to interact with the power grid (ACEEE 2019). The IEA 4E Technology Collaboration Programme estimates that smart home technologies can help decrease household energy use by 20–30 percent (4E 2018), and evidence from the United Kingdom has shown that households can use digital technologies to reduce their energy consumption by up to a third (WEC 2018).

Digitalization also offers systemwide benefits, including increased reliability and resilience, operational efficiency, cost reductions, and investment optimization, providing opportunities for a more active participation of customers, including in voluntary peak-reduction schemes. In addition, digitalization can foster economic and social development. For instance, digitally enabled mobile communications technology can play a crucial role in bringing decentralized clean energy solutions to vulnerable urban or marginalized communities via innovative business models. Across Africa, five million people gained access to electricity through pay-as-you-go solar home electricity systems in 2018 alone (IEA 2019a). These models, enabled by smart meters and two-way digital communication, have helped customers in urban, peri-urban, and rural areas to leapfrog traditional providers and install efficient technologies in their dwellings by allowing customers to pay back costs in installments. At the same time, digitalization offers the opportunity to monitor and raise awareness on energy use, which can result in actions to increase energy savings and lower bills.

Digitalization is critical for accommodating growing shares of variable and distributed renewables. According to IEA's Net Zero Emissions by 2050 Scenario, flexibility in electricity networks will quadruple by 2050 to accommodate rising shares of variable renewable resources (wind, solar), with a growing share of the flexibility provided by distributed resources and demand response (IEA 2021c).

Figure B4.2.1 • Electricity system flexibility by source in IEA's Net Zero Scenario, 2020 and 2030



Source: IEA 2021f.

Digital platforms and connected appliances will be essential to full, efficient utilization of a range of flexibility options, including behind-the meter connected devices. Virtual power plants, which aggregate distributed energy resources like batteries and rooftop solar PV panels, as well as demand-side flexibility, could play a crucial role in bringing new sources of flexibility to the system. One recent study suggests that global virtual power plant aggregations are growing faster than traditional demand response, which typically involves utilities contacting large power consumers to reduce demand. While virtual power plant capacity is expected to rise from 4.5 GW in 2020 to 43.7 GW in 2029, the capacity of demand-response programs could double in the same timeframe (Guidehouse 2020).

END-USE TRENDS

Using a variety of metrics (as discussed in the note to figure 4.8), energy intensity can be examined across key sectors such as industry, transport, buildings, and agriculture. Over the 2010-19 period, the rate of improvement accelerated across all sectors, with the exception of the residential buildings sector (figure 4.8).

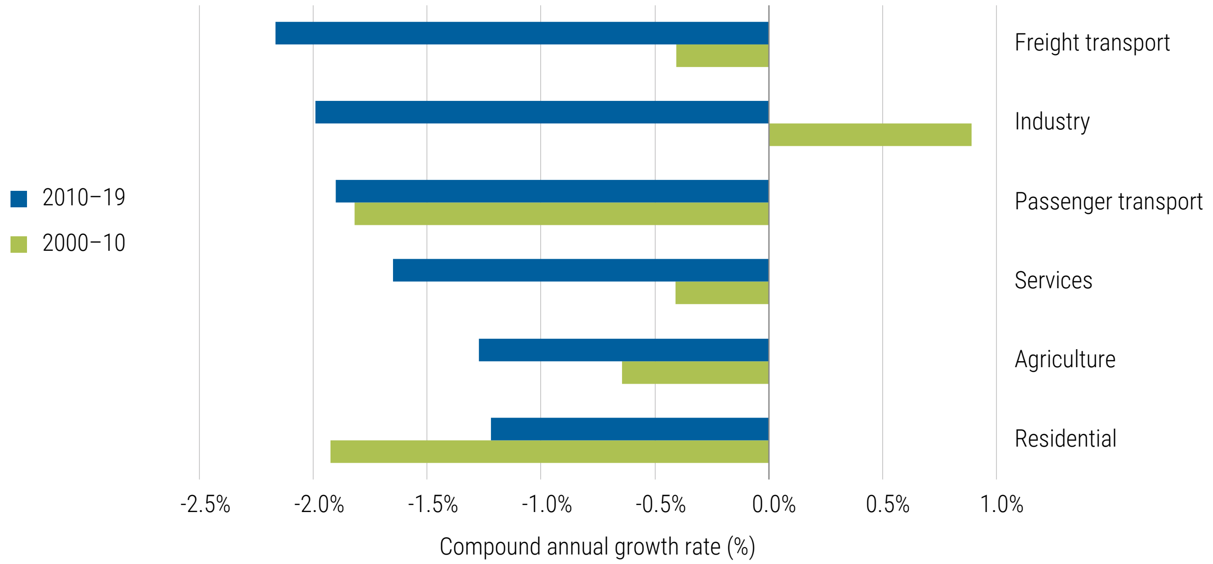
In the industry sector, which comprises highly energy intensive economic activities such as the manufacture of cement, iron, and steel, energy intensity improved by 2 percent per year, on average, during the 2010s. This was a major enhancement, since sectoral energy intensity had deteriorated in the preceding period. The progress was largely driven by emerging Asian economies such as China and India through, for example, more efficient manufacturing processes (IEA 2017). Furthermore, the framework for mandatory energy efficiency policies in the industry sector tends to be more developed than for other sectors around the world (IEA, 2018).

Between 2010 and 2019, the freight transport sector experienced the highest rate of improvement in energy intensity, at 2.2 percent a year. This drop in intensity is steeper than the 0.4 percent annual reduction seen in the 2000–10 period. Energy intensity for passenger transport also improved at a slightly faster rate (1.9 percent a year) in the past decade than in the previous one (1.8 percent). The transport sector is one of the primary sources of global greenhouse gas emissions. As people travel more frequently and over longer distances, and as they consume more imported goods, the sector is growing rapidly. Although stronger fuel economy standards in major markets are improving energy efficiency, these are offset by behavioral changes. For example, consumer demand for larger private road vehicles—comparatively energy intensive forms of transport—remains strong, particularly as living standards rise in emerging economies (IEA, 2019b, 2019c). In 2020, SUV sales constituted around 40 percent of all passenger car sales, up from just 20 percent ten years earlier (IEA, 2021b). As a consequence, fuel consumption of new light-duty vehicles improved at only half the rate observed at the beginning of the last decade (GFEI, 2022).

The residential sector, which is responsible for nearly a third of energy consumption worldwide, has seen a slowdown in the rate of energy intensity improvement, from 1.9 percent in the first decade of the new century to 1.2 percent annually between 2010 and 2019. Mitigating the effects of the growing demand for space cooling, heating, and appliances would require stricter enforcement of building energy codes and more-stringent minimum energy performance standards, especially in emerging economies, where a large share of new dwellings is going up. In the service sector, energy intensity improved by 1.6 percent annually between 2010 and 2019, a major improvement from the 0.4 percent rate in the previous decade.

The improvement rate for agriculture's energy intensity also saw significant progress—from 0.6 percent a year in 2000–10 to 1.3 percent between 2010 and 2019, as economic output of the sector outpaced growth in energy demand.

Figure 4.8 • Compound annual growth rate of energy intensity, by sector, 2000–2010 and 2010–2019



Source: IEA, UN, and World Bank (see footnote 6).
Note: The measures for energy intensity used here differ from those applied to global primary energy intensity. Here, energy intensity for freight transport is defined as final energy use per metric ton-kilometer; for passenger transport, it is final energy use per passenger-kilometer; for residential use, it is final energy use per square meter of floor area; in the services, industry, and agriculture sectors, energy intensity is defined as final energy use per unit of gross value-added (in 2017 U.S. dollars purchasing power parity). It would be desirable, over time, to develop more refined sectoral and end-use-level indicators that make it possible to examine energy intensity by industry (e.g., cement, steel) or end use (e.g., heating, cooling). Doing so will not be possible without more disaggregated data and statistical collaboration with the relevant energy-consuming sectors.

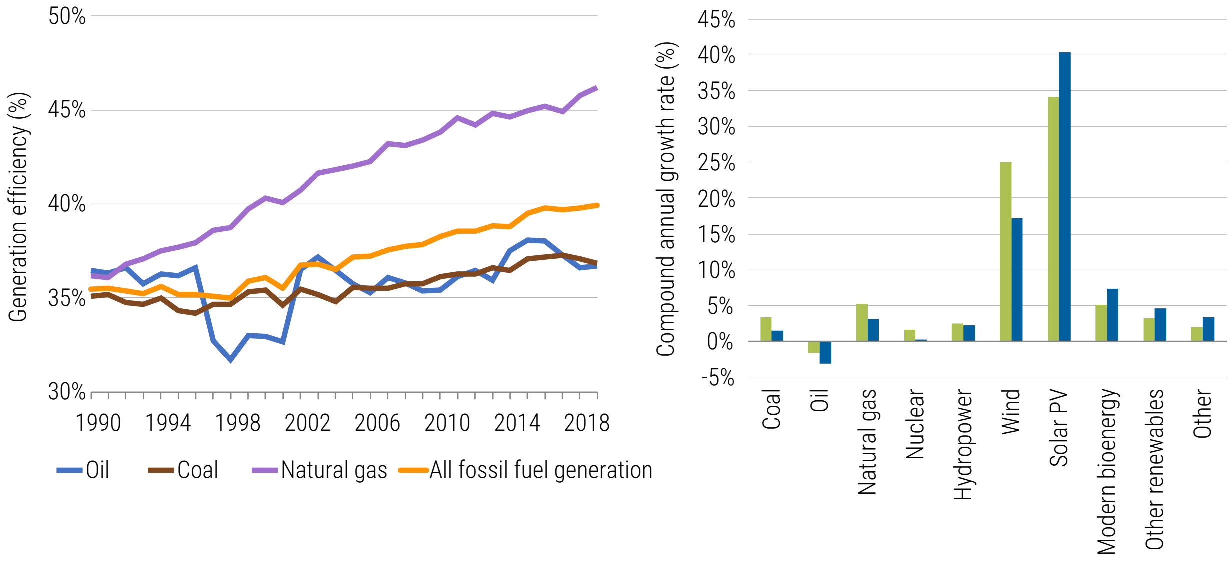
TRENDS IN EFFICIENCY OF ELECTRICITY SUPPLY

In addition to improvements in end-use efficiency, the rate of improvement in global energy intensity is also influenced by changes in the efficiency of electricity supply. These changes include reductions in transmission and distribution losses driven by a modernized supply infrastructure and improvements in the efficiency of fossil fuel generation. After showing flat rates of improvement during the 1990s, the efficiency of fossil fuel generation improved steadily between 2000 and 2015 (figure 4.9). However, efficiency rates for total fossil fuel generation have stalled around 40 percent in recent years, with efficiency improvements of electricity generation from natural gas balancing out a decrease in efficiency of generation from coal and oil.

Another factor affecting supply efficiency for global electricity is the share of renewable energy sources in the mix. Statistically, most renewable energy technologies are treated as being 100 percent efficient, even though minor losses do occur in the conversion of resources such as sunlight and wind into electricity. Even so, both statistically and actually, more renewable energy in the electricity mix boosts the efficiency of electricity supply.

In 2019, renewable energy comprised 26.2 percent of global electricity consumption, up from 19.7 percent in 2010, making a notable contribution to energy efficiency. Growth in electricity generation was particularly strong for solar PV and wind, which grew at an annual average rate of 40.4 percent and 17.2 percent, respectively, between 2010 and 2019 (figure 4.9). As for fossil fuel generation, growth rates were all lower in 2010–19 than in the 1990–2010 period, with electricity generation from oil decreasing even faster than in previous decades. The combined effect of these growth rates has been to improve the overall efficiency of electricity supply by reducing losses experienced when converting energy supply into electricity. These trends therefore highlight the synergistic relationship between the targets of SDG 7.2 and SDG 7.3, as energy intensity improves with rising shares of renewable electricity in the power generation mix, while energy efficiency improvements enable an increase in the share of renewables in the global energy mix (see box 4.3).

Figure 4.9 • Trends in global fossil fuel electricity generation efficiency (left) and growth in electricity generation by fuel type (right), 1990–2019



Source: IEA (2021h); International Energy Agency (IEA), and United Nations Statistics Division (UNSD).

POLICY RECOMMENDATIONS AND CONCLUSIONS

Continued shortfalls in energy intensity improvement imply that strengthened government policies on energy efficiency are needed to meet the SDG 7.3 target by 2030. In addition to helping reach the target, well-designed and well-implemented policies can deliver a range of benefits beyond savings in energy and emissions. These include better health owing to better air quality, reduced energy bills for households and businesses, and new jobs in energy efficiency retrofits.

Strong policy action is also vital as a signal to investors that energy efficiency is a long-term priority, helping to create more certainty for investors and to catalyze the transformative investments needed to return the world to a path to meet the target of SDG 7.3.

ENERGY EFFICIENCY POLICY

Governments have several policy tools for increasing energy efficiency, including regulatory instruments that mandate higher efficiency levels in buildings, appliances, vehicles, and industry; fiscal or financial incentives to encourage installations of energy-efficient equipment and retrofits; and information programs to help energy users make informed decisions. The following section describes some options and policies.[8]

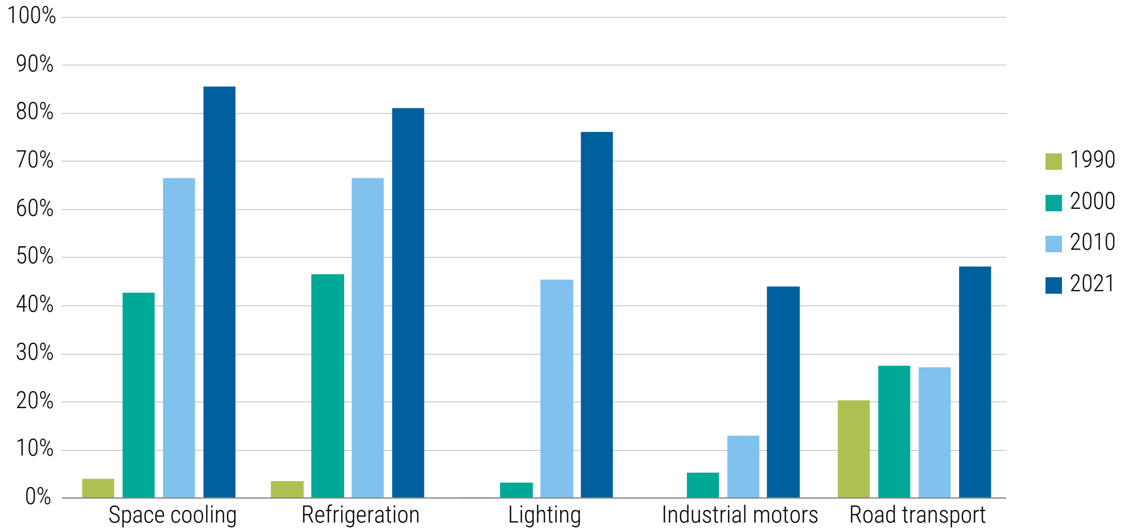
More than a hundred countries now have mandatory performance standards and/or labels related to the energy efficiency of key end uses such as air conditioners, refrigeration, lighting, industrial motors, and passenger cars (IEA 2021d). Additional or expanded standards and labeling schemes are under development in more than 20 countries, mainly in Asia and East and Southern Africa. However, policies are still lacking in many markets undergoing rapid growth in the ownership of appliances, industrial equipment, and vehicles.

More broadly, performance standards and labels apply to more than a hundred types of appliances and equipment in the commercial, industrial, and residential sectors. However, policy coverage is often low. For example, only 40–50 countries have implemented minimum performance standards for washing machines, dishwashers or TVs. As a result, expanding programs in countries where policies presently cover only a limited number of products offers significant scope for further efficiency gains.

Performance standards and labels, adopted early in Europe and North America, now cover a high proportion of key energy-consuming end uses in these regions. Globally, such policies are most commonly used for appliances. For example, more than 80 percent of global energy use for air conditioners and refrigerators is currently covered by minimum energy performance standards, compared with less than half of energy use for industrial motors and road transport (figure 4.10).

8 More information and examples can be found in the IEA's Global Policies Database (IEA 2022b), the World Bank's Regulatory Indicators for Sustainable Energy (RISE) (World Bank 2021), the Global Status Report of Renewable Energy Policy Network for the 21st Century (REN21 2019), or the recommendations of IEA's Global Commission for Urgent Action on Energy Efficiency (IEA 2020).

Figure 4.10 • Global energy use coverage of mandatory energy efficiency standards for key end uses, 1990-2021



Source: IEA analysis for IEA (2021d) based on CLASP (2021) and other sources.
Note: Coverage for space cooling, refrigeration, and lighting is shown for residential sectors.

There is also great variation in the strength of programs across countries. Significant scope exists for enhanced international cooperation in this area to help governments introduce new standards, learn from others' experience, and adopt best practices.

If ambition levels are regularly adjusted to reflect technological progress, performance standards and labels can achieve substantial reductions in energy consumption. For example, long-running appliance efficiency policies have helped to halve the average energy consumption of many common appliances such as refrigerators, air conditioners, lighting devices, televisions, washing machines, and cooking appliances (IEA, 2021a). These huge gains have been achieved even as the price of these appliances has fallen by an average of 2–3 percent per year, suggesting that more-stringent policies could curb emissions further while still benefiting consumers. In the United States, for instance, the energy efficiency standards and labeling program led to net annual fuel savings of around USD 40 billion in 2020, a reduction of USD 320 in the average annual household fuel bill.

Government actions to reduce the cost of energy-efficient equipment or retrofits include economic incentives such as grants, loans, and tax breaks. In New Zealand, a series of energy efficiency programs have combined government and third-party funding with homeowner contributions to replace insulation and heating systems in older houses. Launched in 2018, the program provides subsidies for low-income homeowners. A 2011 cost-benefit analysis of a previous iteration of the insulation grants program found that it delivered health benefits well over NZD 1 billion (USD 610 million) (Grimes et al. 2012). Carbon pricing, the phasing out of fossil fuel subsidies, and cost-reflective energy pricing, coupled with safety net schemes for vulnerable consumers, are also important tools to make energy efficiency investments more attractive.

Bulk procurement is another effective way of easing the cost of such investments, as governments can leverage their considerable purchasing power to procure efficiency services or products. In India, for example, more than 350 million LED lamps have been distributed though the Unnat Jyoti by Affordable LEDs for All (UJALA) program. The economies of scale of the program have helped reduce the price of LED lamps by a factor of ten (EESL 2017).

POLICIES FOR LEVERAGING DIGITAL TECHNOLOGIES TO SCALE UP EFFICIENCY

In order to take advantage of the multiple benefits that energy efficiency and digitalization can offer, national and subnational governments need to:

- Chart the steps needed to make progress on standardization and embedded interoperability. In 2021, the United Kingdom adopted a comprehensive energy system digitalization strategy and action plan (UK BEIS 2021), while the European Union launched a roadmap on digitalization in the energy sector (action plan expected for 2022) (EC 2021).
- Systematically address barriers to data access, sharing, and use, and ensure robust mechanisms for data protection and cyber resilience for the entire energy value chain. This includes overcoming social barriers by building public awareness and acceptance. Costa Rica's smart grid strategy, launched in 2021, includes interoperability, data security, and cybersecurity as guiding principles, as well as capacity building and research support related to smart grids (SEPSE 2021).
- Build capacity to use digital tools for data management and analysis, with specific programs aimed at underprivileged communities. Capacity building is an integral part of India's Revamped Distribution Sector Scheme, approved in 2021, which also includes communication and consumer engagement plans (MOP 2021).
- Take measures to enable investments and encourage the development of innovative business models, including by implementing an innovation-friendly regulatory environment and a clearly defined legal framework. Regulatory sandboxes have been used in countries such as Australia, Italy, the Netherlands, the United Kingdom, and the United States to test innovative technologies and business models (IEA 2019d).
- Leverage digital tools and data to monitor and improve energy efficiency policies. For example, the Hot Maps pilot projects in Europe use an open-source GIS mapping tool that allows city planners to visualize geographical areas with potentially high heating or cooling loads that could be prioritized for efficiency upgrades under heating or cooling action plans (Hotmaps 2022).

Initiatives such as IEA's Digital Demand-Driven Electricity Networks (3DEN) are currently working on recommendations on how to accelerate the uptake of digital technologies for demand-side flexibility and energy efficiency (IEA 2022a).

ENERGY EFFICIENCY INVESTMENT

In 2020, despite the COVID-19 crisis, overall energy efficiency investment held steady at nearly USD 270 billion, but trends differed widely across sectors and regions, with Europe, China, and Northern America accounting for nearly 80 percent of the spending (figure 4.11). Unprecedented growth in the buildings sector, concentrated in Europe, outweighed a heavy decrease in transport efficiency investments, while spending in the industry sector remained largely unchanged. Investment in energy efficiency measures in buildings accounted for two-thirds of the total efficiency spending in 2020 as a result of the scaling up of efficiency policies put in place before the COVID-19 crisis and the early effects of economic recovery measures (IEA 2021d).

Deploying readily available efficiency technologies is one of the most cost-effective means of saving energy while reducing emissions and achieving wider SDG objectives. However, global annual investment in energy efficiency needs to triple by 2030 to reach the target of SDG 7.3 and achieve net-zero emissions by 2050 (UN 2021).

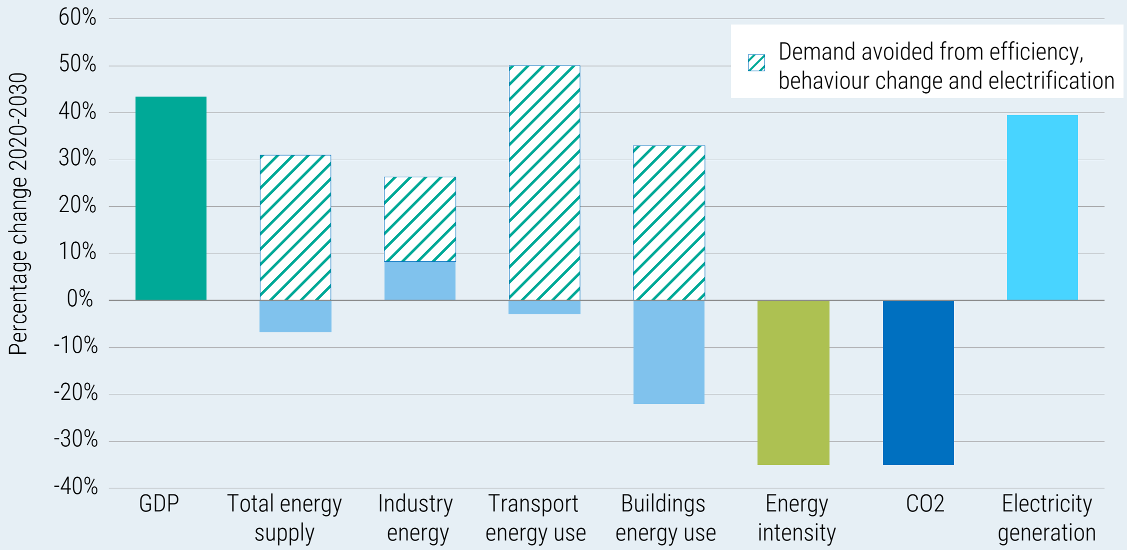
BOX 4.3 • Energy efficiency's role in delivering net-zero ambitions

Building on the momentum of COP26 in Glasgow in November 2021, the pace and ambition of climate goals has accelerated, with more than 50 countries, including the European Union, pledging to reach net-zero emissions by 2050 or soon thereafter. Achieving these goals is essential to give the world an even chance of limiting the rise in the average global temperature to 1.5°C.

In IEA's Net Zero by 2050 Scenario, energy efficiency is frontloaded into the pathway for reducing global emissions of greenhouse gases, with over 40 energy efficiency milestones identified (IEA 2021f). Fast deployment over the next 10 years is feasible, as efficiency depends on cost-effective technologies that are widely available on the market today. Moreover, around 80 percent of the energy efficiency gains in the scenario over the next decade result in overall cost savings to consumers.

Energy efficiency also enables other clean energy measures, such as renewable energy, to outpace growing demand for energy services triggered by rising prosperity and population, especially in emerging economies. In the scenario, the global economy grows more than 40 percent by 2030, yet it uses 7 percent less energy. Without the contribution of energy efficiency, electrification, and behavior change, total energy consumption would be around 30 percent higher in 2030, making it difficult to phase out fossil fuels.

Figure B4.3.1 • Macroeconomic and energy indicators in the IEA's Net Zero by 2050 Scenario

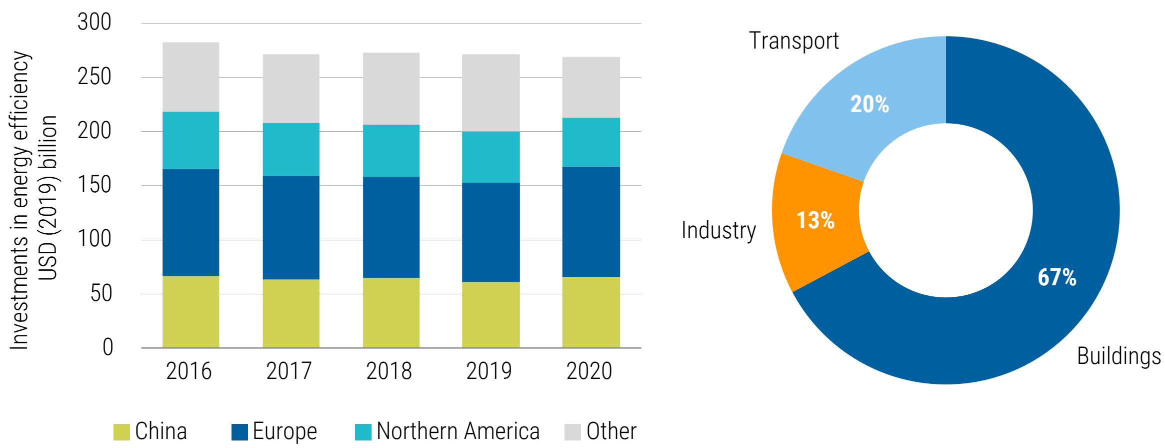


Source: IEA (2021f).

These results are achievable under the scenario through a strong and determined focus on energy efficiency in all sectors, even with the number of households growing by 15 percent by 2030, the floor area of buildings expanding by around a fifth, car traffic increasing by more than 10 percent, and 50 percent more goods moving around the world. Only industrial energy consumption rises over the next ten years in the scenario, though by less than it would without added efficiency, as the world produces 9 percent more steel, 21 percent more petrochemicals, and 5 percent more cement per year by 2030 to meet development needs.

Electrification of transport and heat in buildings and industry is key for decarbonization, with power generation increasing 40 percent in the scenario. Technologies such as electric vehicles and heat pumps are several times more efficient at the device level, but for system decarbonization benefits to be realized they must be powered by renewable sources.

Figure 4.11 • Energy efficiency investment by region, 2016–20 (left), and by sector, 2020 (right)



Source: IEA 2021i.

CONCLUSIONS

The improvement rate for energy intensity continues to remain below the annual 2.6 percent rate initially projected as a prerequisite to reaching the target of SDG 7.3. The rate of energy intensity improvement in 2019 was 1.5 percent, the second lowest since the global financial crisis. However, it was still higher than the rate in 2018. On average, energy intensity improved by 1.9 percent annually since 2010, compared with just 1 percent during the previous decade. In order to meet SDG 7.3's target of doubling the global rate of energy intensity improvement by 2030, the average rate of improvement must now be 3.2 percent per year through 2030 to make up for slow progress in the past. This rate would need to be even higher, consistently over 4 percent for the rest of this decade, to put the world on track to reach net-zero emissions from the energy sector by 2050, as envisioned in the IEA's Net Zero by 2050 Scenario.

Early estimates for 2020 point to a substantial decrease in intensity as a result of the COVID-19 crisis, but the outlook for 2021 suggests a return to the average rate of improvement during the previous decade. To bring the SDG 7.3 target within reach, energy efficiency policies and investment in cost-effective energy efficiency measures need to be scaled up significantly. Given the multiple benefits of energy efficiency, it is an obvious choice for government support, and this has been reflected in a range of recent stimulus packages throughout the world. Energy efficiency–related spending makes up around two-thirds of the total USD 400 billion a year mobilized by governments with their recovery measures between 2021 and 2023[9] (IEA 2021d). This focus on cross-sector energy efficiency also opens an opportunity for continued investment beyond initial recovery efforts.

One of those benefits is that improved efficiency at scale would be a key factor in achieving affordable, sustainable energy access for all. Continued low levels of intensity improvement, the significant potential opportunities for investment and economic recovery, and the pressing need for expanded access all point to the need for urgent action by governments to enact policies that would foster rapid progress toward an annual intensity improvement of at least 3 percent. As underlined by the recommendations of the United Nations' High-Level Dialogue on Energy, efficiency measures and strategies need to address the main barriers to the adoption of such measures and promote structural and behavioral change to support the achievement of the target (UN 2021).

Decoupling the national economy from energy use has been central to the progress that some countries are

9 As monitored by the Fall 2021 update of the IEA Sustainable Recovery Tracker (IEA 2021e).

making toward energy efficiency. In Japan, for example, minimally energy intensive sectors (e.g., services) play a more prominent role in the economy than high-intensity sectors like heavy manufacturing. Still, some developing economies are seeing similar trends as their economies grow and their service and low-intensity manufacturing sectors gather steam.

From the sectoral perspective, the sole exception to the better rate of energy intensity improvement recorded in the past decade was the residential buildings sector. Freight transport experienced the highest rate of improvement, followed by industry and passenger transport. However, as demand for larger passenger cars continued to grow, global average fuel consumption improved more slowly than energy intensity during the decade, despite strengthened fuel efficiency standards in many countries.

Digitalization has also been an emerging trend reshaping the energy landscape and facilitating progress toward improved energy efficiency. Wide-scale data collection, analysis, and application can help direct energy efficiency measures to where they can be most impactful, offering significant opportunities for energy efficiency outcomes across sectors. Some applications for households, for example, could cut total energy use by up to 33 percent (WEC 2018). In addition to the opportunities to optimize efficiency, digitalization can also support deep decarbonization by making it possible to increase and exploit flexibility in the power system, including from behind-the-meter connected devices. Finally, digitalization can also support efforts to widen access to energy thanks to innovative business models such as pay-as-you-go, which benefited five million people in 2018 (IEA 2019a). To take full advantage of the opportunities digitalization offers, governments should consider developing policies to apply digital technologies comprehensively to improve efficiency and produce positive social and economic outcomes.

National and subnational governments already have an array of policies to help them meet their energy efficiency goals. Successful policies of various types are in force around the world, including energy efficiency standards, financial incentives, market-based mechanisms, capacity-building initiatives, and regulatory measures. All encourage investment in energy efficiency and catalyze energy markets in favor of cleaner, more efficient operations.

The world has all of the technology and resources necessary to improve energy efficiency by 50 percent by 2030. The current low rates of improvement and investment point to a major missed opportunity for the global community. Making energy efficiency a priority in policy and investment over the coming years can help the world achieve SDG 7.3, promote economic development, improve health and wellbeing, and ensure universal access to clean, efficient energy.

METHODOLOGY

Total energy supply (TES) in megajoules (MJ)	This 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. (Definition consistent with International Recommendations for Energy Statistics.) *Data sources:* Energy balances from the International Energy Agency (IEA), supplemented by the United Nations Statistics Division (UNSD) for countries not covered by IEA as of 2017.
Gross domestic product (GDP) in 2017 U.S. dollars (USD) at purchasing power parity (PPP)	Sum of gross value-added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. GDP is measured in constant 2017 USD PPP. *Data source:* World Development Indicators database: http://datatopics.worldbank.org/world-development-indicators/).
Primary energy intensity in MJ/2017 USD PPP	$Primary\ energy\ intensity = \frac{TES\ (MJ)}{GDP\ (USD\ 2017\ PPP)}$ Ratio between TES and GDP is measured in MJ per 2017 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 imperfect indicator, as changes are affected by other factors other than energy efficiency, particularly changes in the structure of economic activity.
Average annual rate of improvement in energy intensity (%)	Calculated using 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 *t1* EI_{t1} is energy intensity in year *t2* 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), while 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	Sum of energy consumption by the different end-use sectors, excluding nonenergy uses of fuels. TFEC is broken down into energy demand in the following sectors: industry, transport, residential, services, agriculture, and others. It excludes international marine and aviation bunkers, except at the world level, where it is included in the transport sector. *Data sources:* Energy balances from IEA, supplemented by UNSD for countries not covered by IEA as of 2017.
Value added in 2017 USD PPP	Value-added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value-added is determined by the International Standard Industrial Classification, revision 3. *Data source:* WDI database.

Industrial energy intensity in MJ/2017 USD PPP	$$Industrial\ energy\ intensity = \frac{Industrial\ TFEC\ (MJ)}{Industrial\ value\ added\ (USD\ 2017\ PPP)}$$ Ratio between industry TFEC and industry value-added, measured in MJ per 2017 USD PPP. *Data sources:* Energy balances from IEA and value-added from WDI.
Services energy intensity in MJ/2017 USD PPP	$$Services\ energy\ intensity = \frac{Services\ TFEC\ (MJ)}{Services\ value\ added\ (USD\ 2017\ PPP)}$$ Ratio between services TFEC and services value-added measured in MJ per 2017 USD PPP. *Data sources:* Energy balances from IEA and value-added from WDI.
Agriculture energy intensity in MJ/2017 USD PPP	$$Agriculture\ energy\ intensity = \frac{Agriculture\ TFEC\ (MJ)}{Agriculture\ value\ added\ (USD\ 2017\ PPP)}$$ Ratio between agriculture TFEC and agriculture value-added measured in MJ per 2017 USD PPP. *Data sources:* Energy balances from IEA and value-added from WDI.
Passenger transport energy intensity in MJ/passenger-kilometer	$$Passenger\ transport\ energy\ intensity = \frac{Passenger\ transport\ TFEC\ (MJ)}{Passenger\text{-}kilometers}$$ Ratio between passenger transport final energy consumption and passenger transport activity measured in MJ per passenger-kilometers. *Data source:* IEA Mobility Model.
Freight transport energy intensity in MJ/tonne-km	$$Freight\ transport\ energy\ intensity = \frac{Freight\ transport\ TFEC\ (MJ)}{Ton\text{-}kilometers}$$ Ratio between freight transport final energy consumption and activity measured in MJ per tonne-kilometer. *Data source:* IEA Mobility Model.
Residential energy intensity in MJ/unit of floor area	$$Residential\ energy\ intensity = \frac{Residential\ TFEC\ (MJ)}{Residential\ floor\ area\ (m^2)}$$ Ratio between residential TFEC and square meters of residential building floor area. *Data source:* IEA Mobility Model.
Fossil fuel electricity generation efficiency (%)	$$Generation\ efficiency = \frac{Electricity\ output\ from\ coal, oil, and\ natural\ gas}{Coal, oil, and\ natural\ gas\ input}\ (\%)$$ Ratio of the electricity output from fossil fuel–fired (coal, oil, and gas) power generation and the fossil fuel TES input to power generation. *Data source:* IEA Energy Balances.
Power transmission and distribution losses (%)	$$Power\ transmission\ and\ distribution\ losses = \frac{Electricity\ losses}{(Electricity\ output\ main + Electricity\ output\ CHP + Electricity\ imports)}\ (\%)$$ Where: Electricity losses are electricity transmission and distribution losses; Electricity output main is electricity output from main activity producer electricity plants; and Electricity output CHP is electricity output from combined heat and power plants. *Data source:* IEA Energy Balances.

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

MAIN MESSAGES

- **Global trends:** Tracking of Sustainable Development Goal (SDG) indicator 7.a.1 shows that international public financial flows[1] in support of clean energy in developing countries were declining even before the COVID-19 pandemic. In 2019, they amounted to USD 10.9 billion—a 23 percent drop from 2018. This was 25 percent less than the 2010–19 decade-long average, and less than half the 2017 peak of USD 24.7 billion. Except for large fluctuations in 2016 for solar energy and in 2017 for hydropower, flows remained within the range of USD 10–16 billion every year between 2010 and 2019. Looking at a five-year moving average trend, annual commitments decreased for the first time since 2008 by 5.5 percent—from USD 17.5 billion in 2014–18 to USD 16.6 billion in 2015–19. The level of financing remains far below what is needed to reach SDG 7, in particular for the least-developed countries, landlocked developing countries, and small island developing states.
- **The target for 2030:** Although there is no quantitative target for international public financial flows under indicator 7.a.1, the fact that the world is not on track to meet the larger target of SDG 7.a points to the continued importance of international cooperation. This is evident when comparing current flows with those needed for an energy transition that would limit the global temperature increase to 1.5°C, with parameters set out in the United Nation's *Global Roadmap for Accelerated SDG7 Action in Support of the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change* (UN 2021a). Directing international public flows toward clean energy solutions has become even more difficult since 2020, as public resources are increasingly reallocated toward recovery from the COVID-19 pandemic. The amount of funding for non-renewables, and the overwhelming concentration of flows for clean energy on a few countries, underscores the need for greater action toward SDG target 7.a, ensuring no one is left behind. The challenges are not to be underestimated: amid reduced fiscal space in many developing countries, it is critical that the recovery from the COVID-19 pandemic be both rapid and sustainable.
- **Technology highlights:** International public financial flows decreased across all renewable energy technologies between 2018 and 2019 for the second year in a row. In 2019, hydropower attracted 26 percent of commitments, followed by solar energy at 21 percent and wind energy at 12 percent. Geothermal energy reached a little over 3 percent of commitments. The remaining portion (37 percent) went to other renewables. Compared to 2018, the share of wind energy commitments increased by 6 percentage points while the shares of other technologies decreased. Those decreases reflect the fact that commitments increasingly fall into a "multiple/other renewables" category populated by energy funds, green bonds, and other government-led programs to support renewables, energy efficiency, and electricity access. In other words, growing numbers of new commitments are not specific to any one technology.
- **Regional highlights:** All regions saw a decrease in international public flows in 2019 except Oceania, where they increased by 72 percent (USD 55.1 million). Comparatively, decreases were less significant in Sub-Saharan Africa, which saw a drop of only 1.7 percent to USD 4.0 billion, sustaining the interest of public donors. Similarly, in Western Asia and Northern Africa flows decreased by 22.3 percent to USD 1.8

1 International public financial flows include official development assistance (ODA) and other official flows that are transferred internationally to developing countries. Almost 65 institutions or donors, which included over 215 agencies, produced the commitments during the 2000–19 period. More information can be found in the "Methodology" section of this chapter.

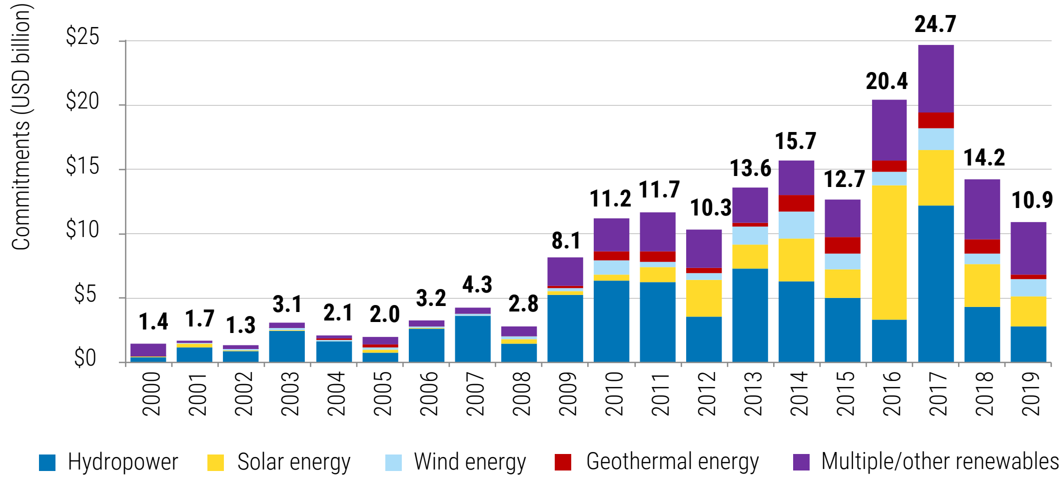
billion. The bulk of the reductions was concentrated in Eastern and South-eastern Asia, with a drop of 66.2 percent; in Latin America and the Caribbean the drop was 29.8 percent; and in Central and Southern Asia, 24.5 percent. Public financial flows continue to be concentrated in a few countries. Excluding those commitments that could not be easily categorized, 80 percent of the 2019 flows were directed to 22 countries, the region of Sub-Saharan Africa, and "unspecified developing countries."

- **Country highlights and distribution:** Public financial flows continue to be concentrated in a few countries, with 30 countries receiving 80 percent of all commitments. **Nigeria**, **Guinea**, and **India** were the top receiving countries in 2019, attracting one-quarter of commitments. Least-developed countries received 25.2 percent of commitments in 2019—but this increase from 21 percent in 2018 hides a 9 percent decrease in amount from USD 3.0 billion to USD 2.7 billion. The share of flows to landlocked developing countries increased marginally, from 14.1 percent of total flows in 2018 to 14.7 percent in 2019, while decreasing in amount by 20 percent from USD 2.0 billion to USD 1.6 billion. Commitments to small island developing states went up from 1.5 percent in 2018 to 2.9 percent in 2019, which amounted to a 45 percent increase from USD 214 million to USD 312 million.
- **Financing instruments highlights:** The mix of financial instruments that support clean energy is changing. The share of debt instruments (standard loans, concessional loans, and other debts) from public financing sources consistently decreased to 75 percent between 2016 and 2019. The shift was compensated by an increase in grants, followed by equity and guarantees on a percentage basis.

ARE WE ON TRACK?

Public international financial flows to developing countries in support of clean energy research and development and renewable energy production (together referred to as “renewables” throughout this chapter) decreased for the second year in a row. In 2019 they amounted to USD 10.9 billion—a 23 percent decrease compared to 2018 (figure 5.1). This was 25 percent less than the 2010–19 decade-long average, and less than half of the 2017 peak of USD 24.7 billion. This contraction occurred before COVID-19, indicating that the world was not on track to enhance these flows even before the pandemic.

FIGURE 5.1 • **Annual international public financial flows toward renewables in developing countries, by technology, 2000–19**



Source: IRENA and OECD 2022.
Note: Multiple/other renewables includes commitments whose descriptions are unclear in the financial databases; commitments that target more than one technology with no details specifying the financial breakdown for each; bioenergy commitments, which are almost negligible; multipurpose financial instruments such as green bonds and investment funds; and commitments targeting a broad range of technologies. Examples of the latter include renewable energy and electrification programs, technical assistance activities, energy efficiency programs, and other infrastructure supporting renewable energy.

The public international flows in 2019 (USD 10.9 billion) were as low as those in 2012, and down by USD 3.4 billion compared to 2018. Except for large fluctuations in 2016 for solar energy and in 2017 for hydropower, flows remained in the range of USD 10–16 billion per year after 2010.

The **solar energy** boom of 2016 is explained by larger investment projects and a spike in the volume of commitments. Investments per commitment reached USD 24.7 million in 2016, almost twice as much as the 2010–19 average of USD 13.6 million. At the time, 421 commitments for solar energy had been made (1.8 times more than the 2010–19 average), led almost entirely by solar photovoltaic projects financed by the International Finance Corporation.

Historically, **hydropower** investments per commitment are notably larger—by almost three times—than for any other technology. In 2017, hydropower commitments were 5.8 times greater than those directed toward other technologies, driven by the Ex-Im Bank of China’s investments of USD 5.0 billion for the Mambilla Hydroelectric plant in Nigeria, USD 1.7 billion for the Pak Lay Dam in the Lao People’s Democratic Republic, and USD 1.4 billion for the Suki Kinari Hydroelectric Plant in Pakistan.

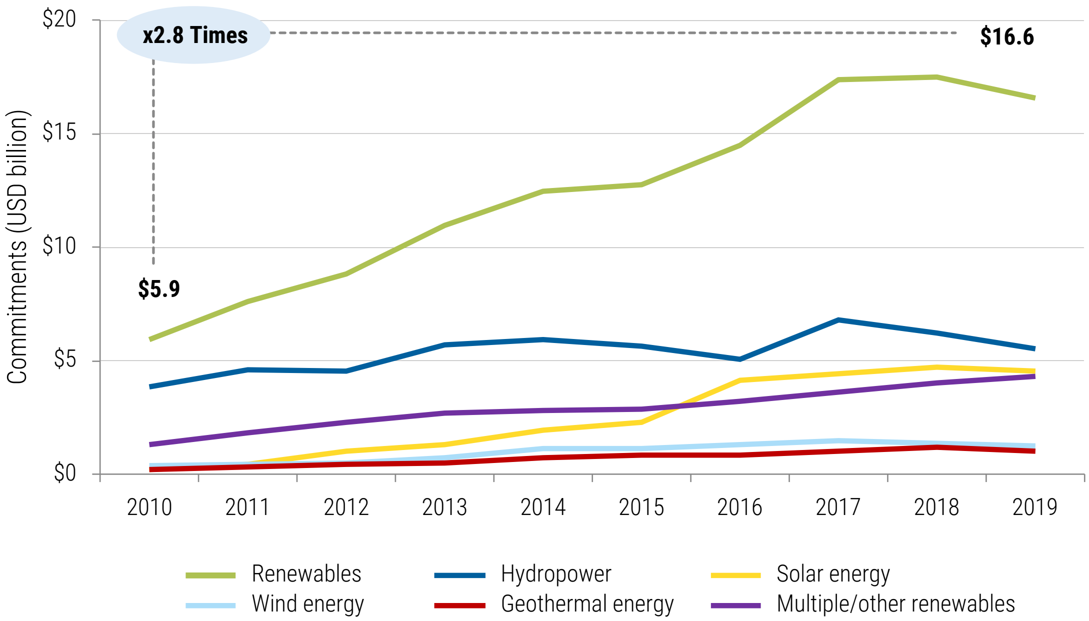
Although **wind energy** and **geothermal energy** did not experience similar trends, there were some notable investments in recent years. In 2015 and 2017, the China Development Bank committed USD 252 million to the

Thatta (Jhimpir) UEP 100 MW wind farm, followed by a commitment of USD 230 million to the Three Gorges second and third wind farms, both in Pakistan. Similarly, in 2016–17, the Japanese International Co-operation Agency committed USD 566 million and USD 420 million to the Laguna Colorada geothermal power plant in Bolivia and the Olkaria V geothermal power development project in Kenya, respectively.

The rest of the commitments were directed to projects involving **multiple or other renewables**. These included investments directed to renewable energy programs; combined renewables and energy efficiency projects or support platforms, green bonds, climate change frameworks, or facilities; and other refinancing schemes that indirectly supported renewables, such as those reducing environmental pollution. However, a focus on financial data over technology-specific details may end up misclassifying commitments in this category. For instance, solar rooftop programs that would otherwise be classified as solar energy commitments appear in this category in the Organisation for Economic Co-operation and Development's (OECD's) Creditor Reporting System (CRS), one of the two main sources of information behind the SDG 7.a.1 indicator. This highlights the importance of exercises to ensure that investments are classified under the right technologies.

Because of the year-on-year fluctuation of international public flows, we analyze temporal trends using a five-year moving average (referred to as MA5) of commitment amounts. Figure 5.2 illustrates technological trends in addition to the total flows.

FIGURE 5.2 • Commitments based on the five-year moving average against the 2010 baseline, by technology, 2010–19



Source: IRENA and OECD 2022.

Over the 2010–19 decade, commitments increased from USD 5.9 billion in 2010 to USD 16.6 billion in 2019, almost tripling in value. In real terms, even with the 2019 slowdown, this decade-long growth indicates enhanced collaboration to support clean energy in developing countries.

In 2019, the five-year moving average of international public financial flows committed to clean energy decreased for the first time since 2008, by 5.5 percent—from a peak of USD 17.5 billion in 2018 to USD 16.6 billion. The decrease occurred across all technologies, indicating a slowdown in international public flows, also confirmed by the year-on-year comparison of these moving averages.

As of 2020, the impacts of COVID-19 were likely to depress international public flows. That, combined with the lack of large investments in 2018 and 2019, would bring down the MA5 for 2020 and potentially for 2021. It may take a few years of increased investments to make up for these lower commitments.

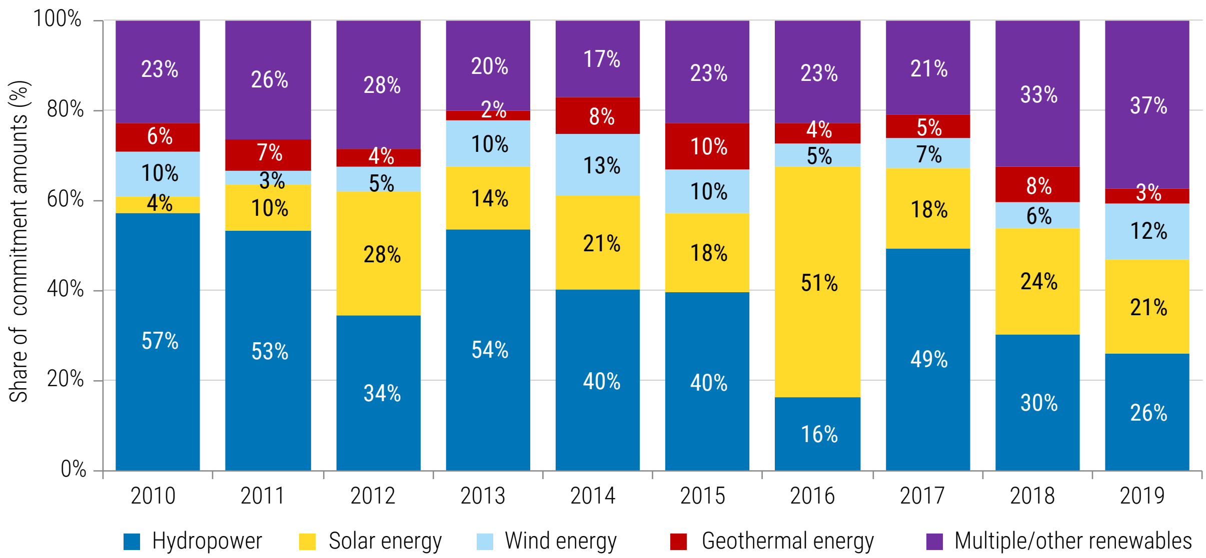
LOOKING BEYOND THE MAIN INDICATORS

Having multiple ways to look at the 7.a.1 indicator helps us identify the directions of international public flows in terms of technologies, geographical regions, countries, and financial mechanisms, as summarized below.

TECHNOLOGICAL TRENDS

International public flows toward clean energy are often categorized by the type of renewable energy involved: hydropower, solar, wind, or geothermal.[2]

FIGURE 5.3 • Share of annual commitments by technology, 2010–19



Source: IRENA and OECD 2022.

The distribution of flows by technology in 2019 was similar to that of the previous year. Hydropower attracted 26 percent of flows, followed by solar energy at 21 percent and wind energy with 12 percent. Geothermal energy received a little over 3 percent of commitments. Compared to 2018, the share of wind energy commitments increased by 6 percentage points. The remaining portion (37 percent) of commitments went to the multiple/other renewables category, with increased interest in energy funds, green bonds, and other government-led programs that supported multiple renewable technologies, energy efficiency, and electricity access.

There were remarkable differences in the distribution of flows by technology between 2016 and 2017 due to several commitments that were substantially greater than the rest, and large shares of investments that shifted to solar in 2016 and hydropower in 2017 (box 5.1). During 2018 and 2019, however, there were no significantly large single-project commitments to shift the technology mix and skew the flows. The trends observed in 2018 and 2019 therefore provide clearer insights into the annual investments across technologies. In the decade-long trend, as shown in figure 5.3, we see a constant decrease of hydropower in the mix and an increase of solar energy.

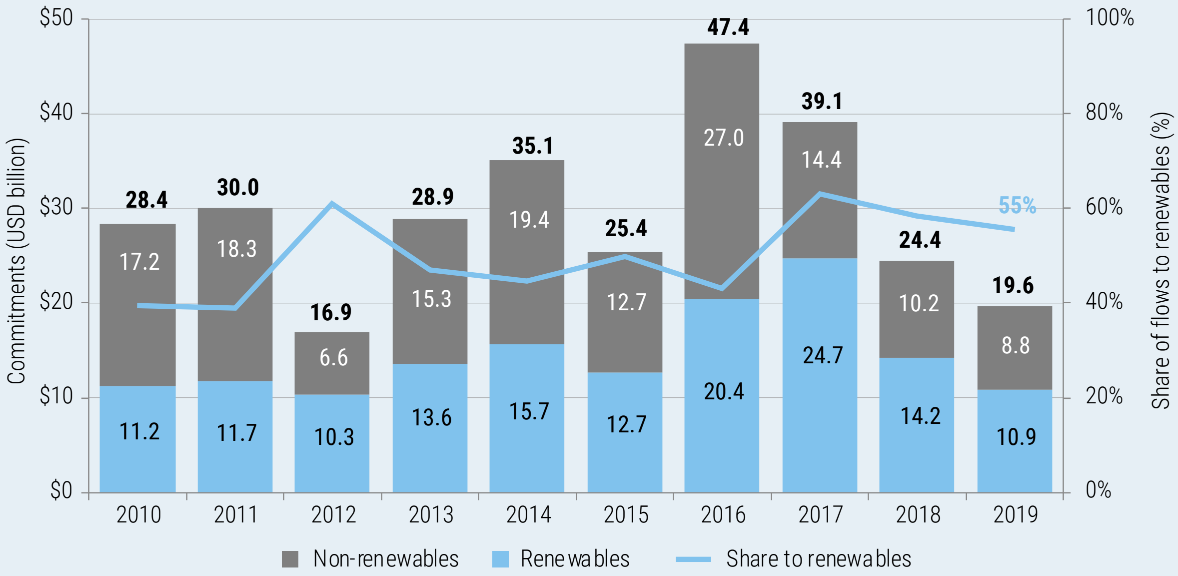
2 The "multiple/other renewables" category includes commitments targeting more than one technology (with no breakdown of the financial details for each technology) or targeting an alternate source of renewable energy that receives negligible commitments.

BOX 5.1 • The big picture: international public flows to both renewables and nonrenewables

Several public institutions have recently announced that they would be ending direct public support for unabated fossil fuels—particularly coal power plants. Since 2020, many multilateral development banks as well as donor countries have pledged to stop funding such projects. A look at the past decade shows that these efforts are long overdue given the climate and broader sustainability imperatives.

Figure B5.1.1 shows that international public flows from the same donors tracked for the 7.a.1 indicator[a] supported nonrenewable energy in slightly larger amounts than renewable energy in 2010–19.

FIGURE B5.1.1 • Annual commitments by energy type: renewables and nonrenewables, 2000–19



Source: IRENA and OECD 2022.

Cumulatively, nonrenewables attracted USD 149.8 billion (or 2.9 percent more than renewables at USD 145.5 billion) between 2010 and 2019. On average, nonrenewables received USD 14.9 billion per year, slightly more than the USD 14.5 billion for renewables. Figure B5.1.1 shows that renewables attracted more public financial flows each year after 2017, but significant public flows still went toward nonrenewable energy technologies. This stresses the importance of international public donors considering immediate changes to their investment strategies by redirecting public flows from nonrenewables to renewables, especially considering the scarcity of public resources and their importance in mobilizing private finance.

Because of the large overlap of donors participating in both renewables and nonrenewables, it is within their scope to adjust their portfolios to a greener strategy. For example, alternative renewable investments that gained popularity in the 2015–19 period, such as green bonds, can become a staple financial mechanism. A World Bank study shows that investment portfolios with green bonds are less volatile than those that consist exclusively of conventional and fossil-fuel-based bonds (Semmler and others 2021). They also attract private investors—a much-needed leverage for public funds—and lower financial market barriers to green investments (IRENA 2020a).

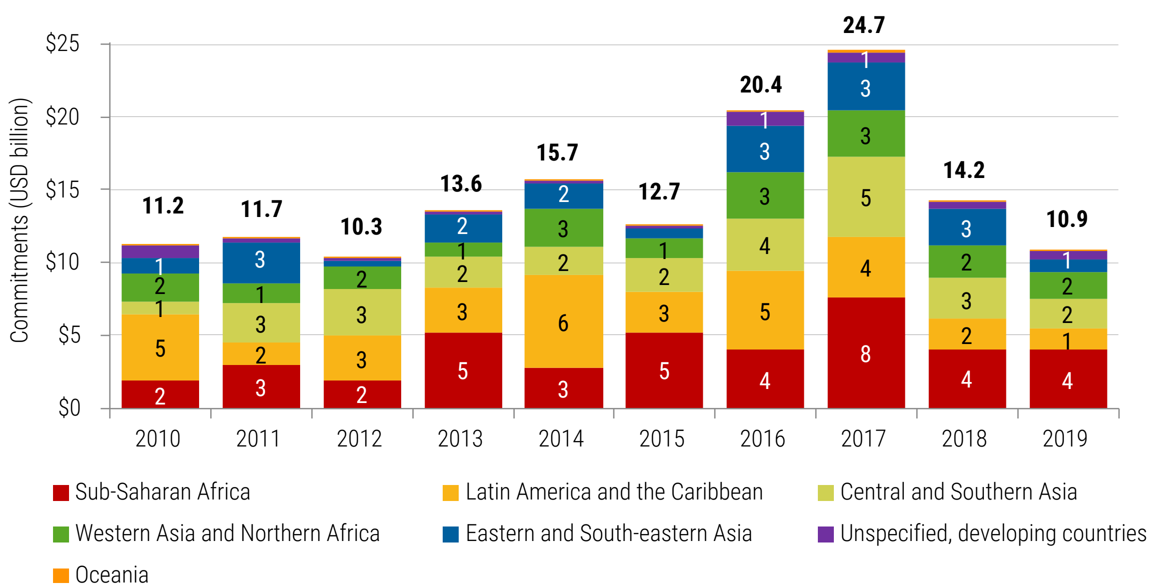
Yet, even if all international public flows to nonrenewables are converted to renewables, the overall investment amounts would still be be substantially lower than what is required to overcome the funding gaps in developing countries. This is especially the case for least-developed countries, landlocked developing countries, and small island developing states, which have been traditionally skipped in the international public finance space and often have larger deficits in the ratio of their current account balance to gross domestic product (World Bank 2021b), potentially making international debt an ever-increasing challenge to their development. In 2012, overall international public flows to energy were USD 16.9 billion, less than those directed to renewables in 2016 and 2017. In the peak year of investment, overall international public flows to renewables amounted to USD 47.4 billion. This amount is dwarfed by many other financing targets. One, for instance, is the USD 117.6 billion of public funds directed to support fossil fuels in countries of the Organisation for Economic Co-operation and Development in 2019 (OECD 2021).

a Not all the donors tracked by SDG 7.a.1 had investments in both renewables and nonrenewables. Kazakhstan and Qatar directed their flows solely to nonrenewables, whereas 17 donors directed them exclusively to renewables; 48 donors invested across all energy types.

REGIONAL TRENDS

Geographically, all regions saw a decrease in international public flows in 2019—a 23.6 percent drop from 2018 (figure 5.4). Only Oceania and "unspecified developing countries"[3] saw an increase in flows, of 72 percent (USD 55.1 million) and 27 percent (USD 123.9 million), respectively.

FIGURE 5.4 • Annual commitments by region, 2010–19



Source: IRENA and OECD 2022.

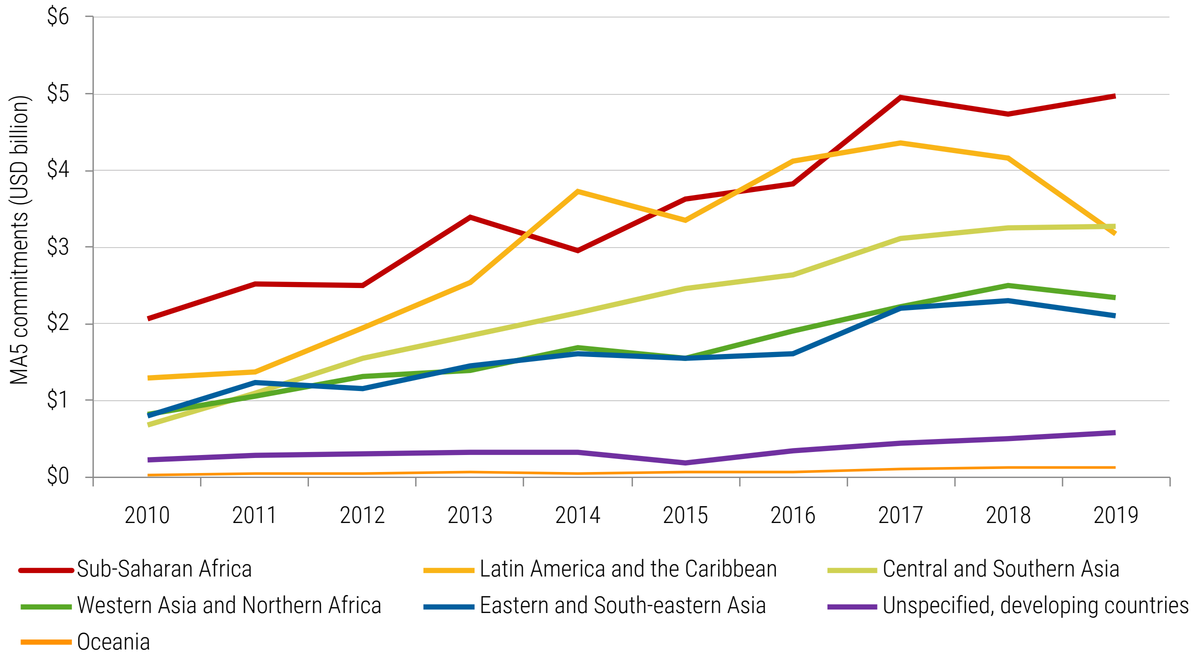
In 2019, Sub-Saharan Africa saw a minor decrease of 1.7 percent to USD 4 billion compared to 2018, indicating that the region had continued to sustain the interest of public donors. Other researchers, such as the Africa-EU Energy Partnership, also observed a strong inflow of commitments to the region, especially grid transmission and distribution investments from Europe (AEEP 2021). Compared to 2018, flows dropped by more than 22 percent in Western Asia and Northern Africa, by 25 percent in Central and Southern Asia, and by 30 percent

3 "Unspecified developing countries" is a new category added this year for commitments directed to multiple developing countries, not directed at a specific geographical region, and not including any developed countries.

in Latin America and the Caribbean in 2019, whereas Eastern and South-eastern Asia saw the most significant drop at 66.2 percent.

Overall, the MA5 for all regions (figure 5.5) shows that while growth has slowed, the regions attracted more investments in recent years than they did in 2010 and some remained on an upward trend. However, Latin America and the Caribbean saw a sharp drop in 2019, followed by Western Asia and Northern Africa, and Central and Southern Asia. Across developing countries average annual commitments decreased by 5.5 percent in 2019, from USD 17.5 billion in 2018 to 16.6 billion in 2019.

FIGURE 5.5 • Annual commitments by region based on a five-year moving average, 2010–19



Source: IRENA and OECD 2022.
MA5 = 5-year moving average

Sub-Saharan Africa attracted the largest flows across regions in 2019—amounting to USD 4 billion, slightly lower than in 2018.[4] The region alone received 37 percent of all developing countries' commitments. Considering the entire decade of 2010–19, it received a total of USD 39.6 billion, also the largest total among other regions. According to the MA5, average annual commitments increased by 5.3 percent in 2019, indicating the region's resilience amid a global downward trend. These commitments more than doubled between 2010 and 2019, due to the region's hydropower projects (which attracted big investors, especially China) and notable commitments to solar energy (which averaged USD 612 million in 2010–19 but are no longer on the rise).

Commitments received by **Central and Southern Asia** decreased by 24.5 percent (from USD 2.8 billion in 2018 to USD 2.1 billion in 2019), mostly due to a halving of commitments toward solar energy (from USD 1.0 billion to USD 511 million). Average annual commitments remained consistent in 2019 considering the MA5 but increased almost fivefold between 2010 and 2019 (more than other regions during the decade) due to steady increases in solar and wind energy flows. However, hydropower held the largest share of commitments across the decade, at USD 11.3 billion, owing largely to the USD 6.5 billion directed to projects in Pakistan.

4 The Africa-EU Energy Partnership reports that European institutions and Member States sent USD 2.3 billion in public flows to Africa in 2019.

Western Asia and Northern Africa received USD 1.8 billion in flows during 2019, down 22.3 percent from the USD 2.3 billion in 2018, largely due to reduced commitments toward solar energy (from USD 1.0 billion to USD 460 million). Considering the MA5, average annual commitments tripled between 2010 and 2019 (in line with an average increase of 2.8-fold across developing countries) but decreased by 6.3 percent in 2019. The region attracted USD 8.1 billion for investments in solar energy— concentrated mainly in **Morocco** (USD 3.3 billion), the **Arab Republic of Egypt** (USD 1.8 billion), and **Turkey** (USD 1.1 billion).

Latin America and the Caribbean received commitments of USD 1.5 billion in 2019, 29.8 percent less than the USD 2.1 billion in 2018 and as low as 2011 levels. The region's average annual commitments decreased the most in 2019, by 23.6 percent, considering the MA5. While they more than doubled between 2010 and 2019, the region had the second-lowest growth over the decade. Hydropower commitments proliferated in Latin America and the Caribbean, amounting to USD 12.7 billion over the 2010–19 decade, followed by USD 8.2 billion for solar energy and USD 7.4 billion for multiple/other renewables. In 2019, most flows went toward wind (USD 449 million) and solar energy (USD 363 million), while multiple/other renewables attracted a majority of the balance. **Argentina** received the most at USD 475 million, primarily due to large wind and solar projects awarded through renewable energy auctions. **Mexico** was next at USD 339 million, with a focus on solar energy and to a lesser degree wind energy. **Colombia** was third at USD 152 million, almost all of which was directed to the National Program to Ensure Sustainable and Efficient Energy Supply, Phase II.

Commitments in **Eastern and South-eastern Asia** were slashed by two-thirds to USD 845 million in 2019, a steep drop from the USD 2.5 billion received in 2018. Average annual commitments decreased by 8.4 percent in 2019 considering the MA5, having tripled between 2010 and 2019. Half of all international public flows during 2010–19 went to hydropower projects in the region. The **Lao People's Democratic Republic** alone received USD 6.1 billion for hydropower projects during this period, but only USD 0.1 million in 2019. Across the region, hydropower projects received only USD 0.8 million in 2019, signifying a large decrease in commitments and the vulnerability of these countries to attract investments outside of large-scale hydropower.

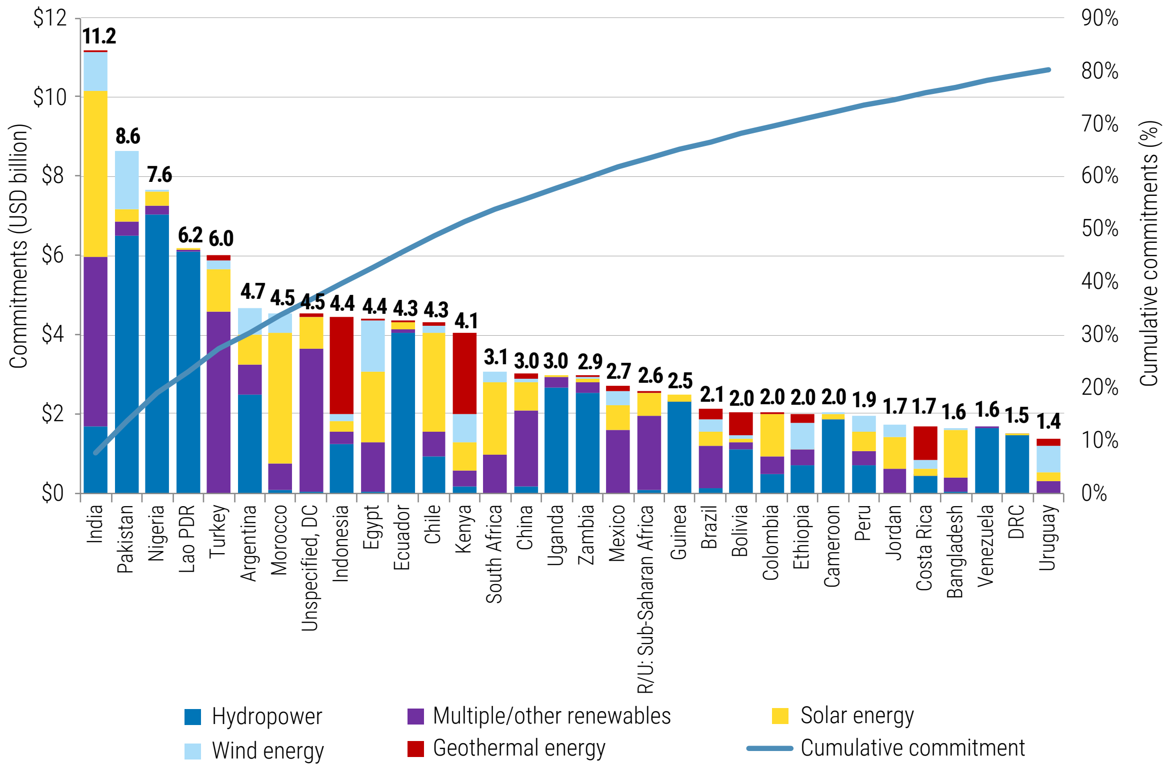
A total of USD 587 million went to **unspecified, developing countries** in 2019, 26.7 percent more than the USD 464 million in 2018. Some of these commitments were directed to multiple regions or countries simply because their underlying financial mechanisms are by design allocated to multiple recipients (e.g., green bonds, regional funds, and international grants). Other commitments in this category were directed to a single country that remained unidentified in the financial data. Across the period 2010–19, 36 percent of these flows were grants, followed by 27 percent concessional loans, 18 percent common equity and shares in collective investment vehicles, and 18 percent loans; the rest were guarantees and other instruments. This is contrary to the global trend of public donors preferring loans for a majority of their commitments, both during the 2010–19 decade and in 2019.

In 2019, **Oceania** attracted the smallest overall investment of all regions, a position it had held for at least the previous two decades. Still, the USD 132 million it received in 2019 indicates a substantial increase of 71.8 percent from the USD 77 million received in 2018. Average annual commitments to the region increased slightly by 4.8 percent in 2019 considering the MA5 (amid a drop in commitments across other regions) and almost quadrupled between 2010 and 2019. These were mostly directed toward solar energy. In 2019 the region received USD 49 million exclusively in grants for electrification, solar power development projects, and renewable energy expansion in the islands.

COUNTRY TRENDS

It bears reiterating that cumulative international public flows during the 2010–19 decade were concentrated in 30 countries (figure 5.6),[5] signaling a slight improvement from the 29 countries receiving commitments in 2010–18.

FIGURE 5.6 • Total commitments by top recipients, 2010–19



Source: IRENA and OECD 2022.
DRC = Democratic Republic of Congo; DC = developing countries; R/U = residual/unallocated official development assistance.

TOP RECEIVING COUNTRIES

In 2019 alone, 24 countries received 80 percent of all commitments. These included Sub-Saharan African countries and unspecified, developing countries. **Nigeria**, **Guinea**, and **India** were the top recipients, attracting one-quarter of all commitments. While India and Nigeria were consistently at the top across the years 2010–19, Guinea stood out only at the end of the period, due to the USD 1.1 billion commitment to the Souapiti Hydro Project received in 2018 and 2019.

As in 2018, many developing countries did not receive any international public financial flows in 2019, or in the entire decade of 2010–19. Many of these are small territories or high-income economies[6] such as **Bahrain**, **Singapore**, and the **United Arab Emirates**. Seven countries did not attract any flows in 2019 but received commitments in 2018 (albeit small ones that did not exceed USD 1 million, with the exception of the Iran (Islamic Republic of), the **Venezuela (Bolivarian Republic of), Eritrea, Gabon, Botswana, Kiribati, the Syrian Arab Republic**, and **Iran (Islamic Republic of).** On the other hand, 13 countries did not receive any commitments in 2018 but received a total of USD 130.8 million in 2019: **Uruguay, Tajikistan, Azerbaijan, Mauritius, Cabo Verde, Chad, Nauru, Eswatini, Tokelau, Timor-Leste, Palau, Grenada,** and **Niue.**

5 "Country," as used in this chapter, also refers, as appropriate, to a territory, area, or other unspecified location.

6 Countries with a per capita gross national income of USD 12,536 or more are classified as high-income economies: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

Nigeria attracted USD 1.2 billion in 2019, almost 11 percent of all commitments across developing countries. At USD 1 billion, the Gurara II hydropower project financed by the Exim Bank of China was a crucial project attracting international flows. Most other projects were directed toward solar energy and multiple renewables. The Green Climate Fund committed USD 100 million to the Nigeria Solar Independent Power Producer Support Program, and the French Development Agency (AFD) USD 33 million to support various renewable energy and energy efficiency projects. Multiple grants (amounting to USD 50,000 each) were provided by the African Development Foundation in the United States, and the governments of the United Kingdom, the Republic of Korea, Hungary, and the Netherlands to support off-grid renewables.

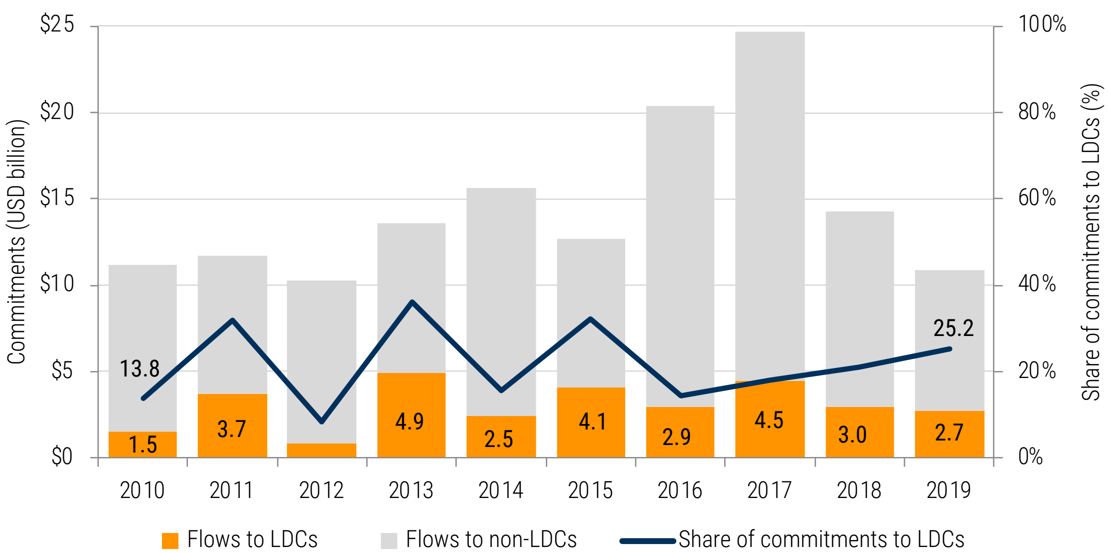
Guinea received USD 820 million in commitments during 2019, the largest share of which went to the 294 MW Koukoutamba hydropower plant. The project received USD 812 million from the Exim Bank of China, showing for a second year in a row that even a least-developed country (LDC) can attract significant funding. This increased support helped the country expand its 368 MW of installed hydropower capacity, which had remained the same since 2015.

India was the third-largest recipient of international public financial flows in 2019 (with flows reaching USD 786 million) as well as the largest recipient of flows during the decade (at USD 11.2 billion). The commitments of 2019, however, were directed toward a more varied portfolio of projects and programs than those of the previous decade. The largest commitment was a USD 224 million concessional loan to the Renewable Energy Financing Facility II, funded by Germany's KfW. Other notable ones included a USD 100 million loan to the L&T Green Infrastructure On-Lending Facility and a USD 65 million loan to the Rajasthan 250 MW solar project Hero Future Energies, both by the Asian Infrastructure Investment Bank, and two USD 75 million loans to wind and solar energy innovation technologies by the International Bank of Reconstruction and Development.

REACHING THOSE FURTHEST BEHIND

Last year we highlighted the difference in flows directed to emerging markets in developing countries and those furthest behind as categorized by the United Nations, namely the LDCs, landlocked developing countries (LLDCs), and small island developing states (SIDS).[7] During 2021, there were no changes in these lists of countries, but commitments to them varied considerably (figure 5.7).

FIGURE 5.7 • Annual commitments to LDCs and non-LDCs in support of clean energy, 2010–19



Source: IRENA and OECD 2022.
LDCs = least-developed countries.

7 The classification of countries included in each group follows the United Nations M49 regional classification: https://unstats.un.org/unsd/methodology/m49/.

Least-developed countries received 25.2 percent of commitments in 2019, an increase from 21 percent in 2018. They continued their upward trend from 2016, which hides a 9 percent decrease from USD 3.0 billion to USD 2.7 billion in absolute amounts. Of the 46 LDCs, **Eritrea, Sao Tome and Principe,** and **Kiribati** were the only ones that did not receive any flows in 2019; **Chad** and **Timor-Leste** received flows after not attracting any in 2018.

The group of 30 **landlocked developing countries** considered face trade and development challenges related to their lack of sea access and their geographical remoteness.[8] The share of flows to them increased marginally from 14.1 percent in 2018 to 14.7 percent in 2019, while the absolute amounts decreased by 20 percent from USD 2.0 billion to USD 1.6 billion. Amid the decrease, all LLDCs except **Botswana** received some sort of commitment in 2019.

The 53 **small island developing states** considered are especially vulnerable to the adverse effects of climate change, have remote geographies, and depend highly on external markets for goods to compensate for their narrow resource base. SIDS attracted 2.9 percent of commitments in 2019, up from 1.5 percent in 2018, with a 45 percent increase from USD 214 million to USD 312 million. Over the period 2010–19, however, 12 SIDS did not receive any commitments at all, whereas 6 countries attracted half of the total.

Reaching those furthest behind will entail providing universal access to affordable, reliable, and modern energy for all, under the SDG 7.a target. A separate analysis of international public financial flows to 20 high-impact countries for electricity access,[9] showed that commitments increased by 34 percent (USD 12.6 billion) in 2019 compared to the previous year. Investments for clean cooking totaled USD 133.5 million, of which international public financial flows made up half. However, this still falls significantly short of the USD 4.5 billion required in annual investment to achieve universal access to clean cooking (SEforAll, 2021).[10]

DISTRIBUTION OF FINANCIAL FLOWS TO DEVELOPING COUNTRIES

Figure 5.8 outlines the distribution of international public financial flows to developing countries over the 2010–19 decade. To account for population size, the map shows the decade-long average of commitment amounts per capita. This is visualized in a range of colors depending on financing commitments per capita on average. Dividing the flows by population for each country helps to compare the real impact of international public financial flows on developing countries. Since larger countries would likely attract larger investments, many disparities are hidden when only observing flows received by an individual country. While the map shows 186 developing countries, commitments directed to regions or to unspecified countries are excluded.

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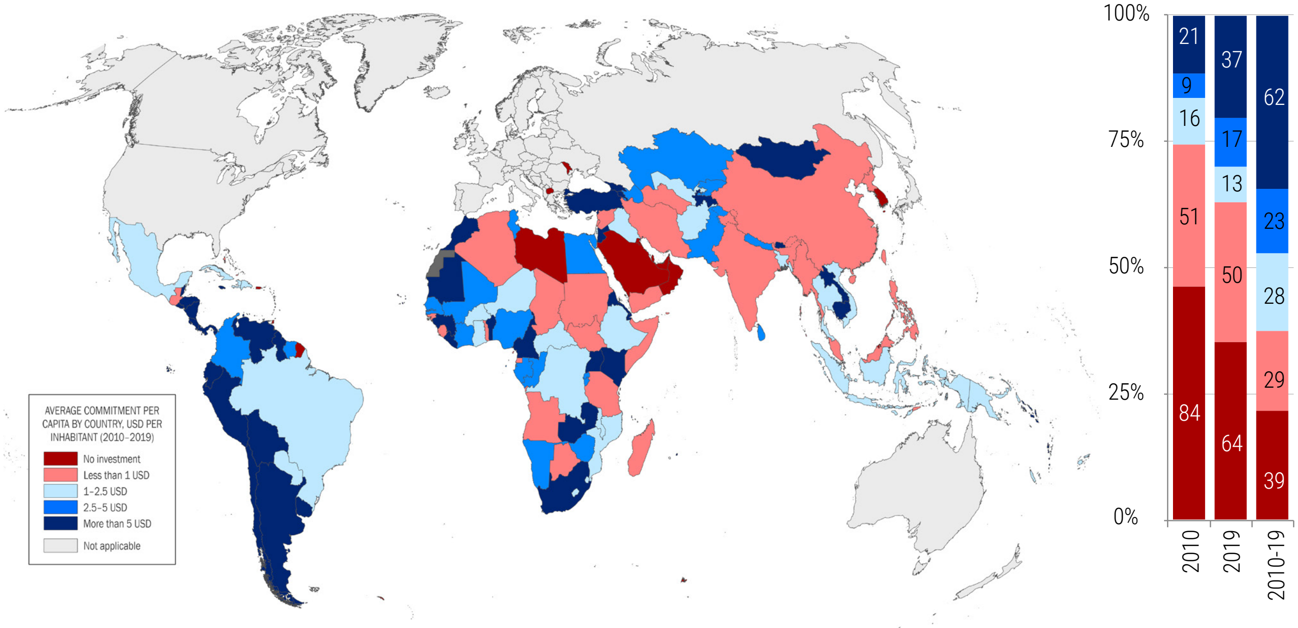
8 While categorized as LLDCs, the Republic of North Macedonia and the Republic of Moldova are not considered “developing” by the United Nations and are therefore excluded from the scope of the indicator and this analysis.

9 These countries are home to 76 percent of the global population without electricity access.

10 These figures include commitments to both renewables and nonrenewables. In 2019, overall finance to grid-connected renewables made up 36 percent of the total USD 32 billion.

FIGURE 5.8 • Average commitment per capita by developing country [left] and number of countries by range of commitment per capita [right], 2010–19



Source: The data on international public financial flows to developing countries in support of clean energy underlying this map were drawn from IRENA and OECD (2022).
Note: All USD amounts are adjusted to constant prices and 2019 exchange rates.
Disclaimer: This map was produced by the Geospatial Operations Support Team of the World Bank based on the Cartography Unit of the World Bank. The boundaries, colors, denominations, and other information shown on any map in this work 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.

With 2019 commitments included in the decade averages of 2010–19, not much has changed from the map published in last year's report based on the 2010–18 averages. During the decade, developing countries received an average of USD 2.24 per capita, a slight decrease (of 3.8 percent) from the 2010–18 average of USD 2.33 per capita.

The right side of figure 5.8 shows this distribution by number of countries for the years 2010, 2019, and the entire decade of 2010–19. In 2010, 84 countries did not receive commitments at all, while in 2019 this number decreased to 64 countries—a welcome trend toward zero although still representing over one-third of developing countries. Even so, across the decade, 39 countries did not receive commitments. While the map shows many countries receiving less than USD 1 per capita, these are just 29 countries out of the 181. Most developing countries received more than USD 5 per capita on average during the decade but are not shown due to their small geographical size.

These distributions reveal the fluctuating nature of international public financial flows. One year may bring millions to a specific country, and the next year none at all. Only when reviewing multiple years can we assess the distributions of these flows. Table 5.1 summarizes the decade-long flow distribution across developing countries, LDCs, LLDCs, and SIDS.

TABLE 5.1 • Distribution of international public financial flows by population trend and special country groups

	Flow distribution (USD per capita)			Population trend (% change)	
Country group	2010–19	2018	2019	2010–19 to 2019 (%)	2018–19 (%)
Developing countries	2.24	2.10	1.47	-34.5	-30
Least-developed countries	3.30	2.97	2.65	-19.7	-10.8
Landlocked developing countries	5.24	3.98	3.11	-40.6	-21.9
Small island developing states	3.62	3.12	4.49	+43.9	+24

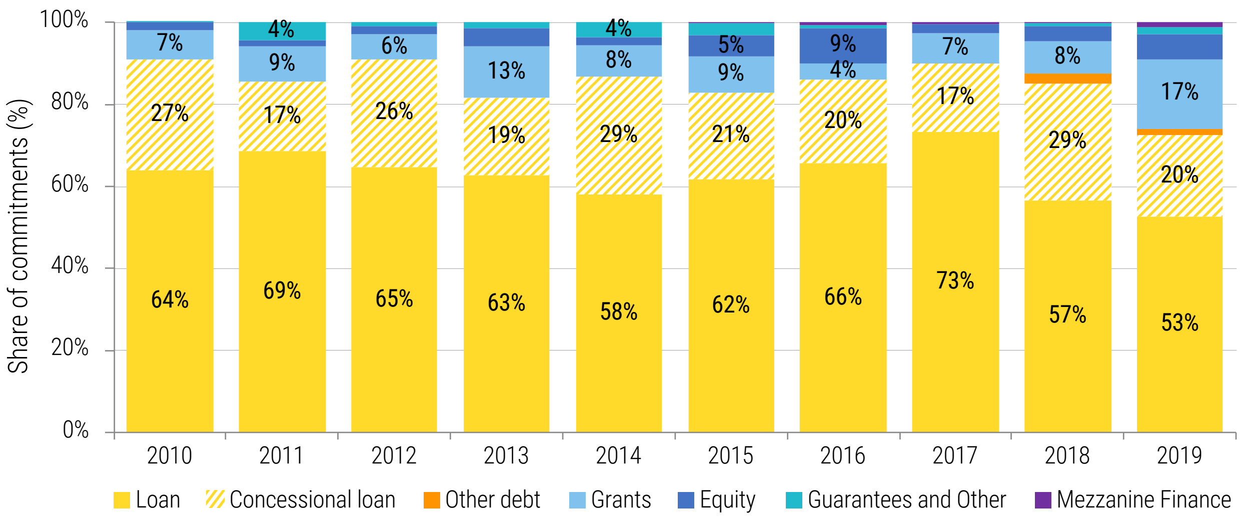
Source: Source: IRENA and OECD 2022..

According to the year-on-year change and at the country level, countries received larger commitments in 2019 than in 2010. However, 2019 marked a clear decline in distribution of flows with developing countries receiving USD 1.47 per capita, 30 percent less than in 2018 and more than one-third less than the decade's average. Fortunately, this decline was not prevalent in countries most in need of public flows. LLDCs were the worst hit, with a 21.9 percent decrease from USD 3.98 per capita in 2018 to USD 3.11 per capita in 2019. LDCs had 10.8 percent less distribution, from USD 2.97 per capita in 2018 to USD 2.65 per capita in 2019. SIDS, on the other hand, had a positive change and the largest distribution of flows across population, reaching USD 4.49 per capita in 2019, more than triple the developing countries' average. The trend is supported by a combination of the largest flows being directed to the largest SIDS (**Cuba, Haiti, the Dominican Republic,** and **Papua New Guinea**) and a large number of SIDS with small populations. Yet, all these groups received a fairer than average distribution of flows across populations.

INVESTMENTS BY FINANCING INSTRUMENTS

This year, we present a more detailed distribution of flows by financial instrument and a refined categorization for commitments, based on the OECD's types of finance, flow types, and the concessional loans and credit line classifications of the International Renewable Energy Agency (IRENA). Figure 5.9 shows the main instruments used for financing international public flows to developing countries.

FIGURE 5.9 • Shares of annual commitments by financial instrument, 2010–19



Source: IRENA and OECD 2022.

The financial instrument mix that supports clean energy has been changing in recent years. The share of debt instruments from public financing sources (standard loans, concessional loans, and other debts) consistently decreased, to about 75 percent in 2019 from 90 percent in 2017. The shift was compensated by the increasing share of grants followed by equity and guarantees.

Standard loans reached USD 5.7 billion in 2019, despite a 29 percent decrease from 2018. While they made up more than half of all commitments, these loans declined to the smallest share in the 2010–19 decade—almost as low as 46 percent of the mix they represented in 2008 during the global financial crisis. Eighty percent of loans in 2019 were directed to hydropower (39 percent), solar energy (22 percent), wind energy (16 percent), and geothermal energy (5 percent), while multiple/other renewables received the balance (18 percent). Capitalize loans are legal debt obligations assumed by the recipient, composed of transfers in cash or in kind (the creditor also acknowledges the nontradability of obligations should any claim arise from nonpayment). Because these flows come from public financial institutions, they have better lending terms than loans provided by private financial institutions (e.g., commercial banks), including longer payment terms, lower interest rates, and low or negligible grant elements. As such, these loans are not necessarily "market-rate" loans.[11] Engaging in these loans should be carefully evaluated during the postpandemic recovery, especially by LDCs, LLDCs, and SIDS, to avoid stressing fiscal policies as this could lead countries into an unsustainable external debt situation. Standard loans financed various solar projects, many of which almost halved in size—from USD 11 million per commitment in 2018 to USD 6 million per commitment in 2019. This decrease is partly attributed to lower capital expenses needed per megawatt of installed capacity, which means loans do not need to be as large as before. Other reasons include a larger volume of smaller projects being funded by international public donors, an uptake in co-financing of projects with the private sector as technologies mature, and the uptake of other instruments and risk mitigation over project financing.

Concessional loans,[12] the second-most-used financial instrument in 2019, accounted for 20 percent of commitments and amounted to USD 2.2 billion, down by almost half from the 2018 figure of USD 4.1 billion and almost as low as concessional loans committed in 2011. In 2019, USD 937 million or 43 percent of total concessional loans were directed toward rural electrification programs, renewable energy/energy efficiency, direct investing in private companies, financing facilities, and risk mitigation programs—all of which are classified as multiple/other renewables. Technology wise, solar energy, at USD 563 million, attracted most of the concessional loans across 17 countries, followed by USD 393 million to hydropower and a highly concentrated USD 242 million for wind energy (as USD 224 million of this went to Morocco alone). Geographically, Morocco, India, and Sudan attracted most of these loans at USD 308 million, USD 227 million, and USD 197 million, respectively. Ideally, the value and share of these loans in the financial instrument mix should increase in the future so developing countries can avoid large external debt and developed countries can meet the official development assistance (ODA) requirements of public donors.

Grants reached a record of USD 1.8 billion in 2019, making up 17 percent of the financial instrument mix and signaling an increase of debt-free instruments that support developing countries without increasing their external debt burdens. Since 2013, at least USD 1 billion in grants were committed annually, averaging USD 1.4 billion every year of the 2013–19 period. This uptake of grants was recently allocated to regional programs. Of the grants worth USD 1.8 billion in 2019, USD 330 million were distributed through regional programs. Three notable recipients were Colombia with USD 153 million, Mozambique with USD 106 million, and Panama with USD 90 million.

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11 In cases where no concessional information was found for commitments, we categorize them as standard loans, not concessional loans.

12 Concessional loans are those that meet the ODA criteria of at least a 45 percent grant element for LDCs, LLDCs, and SIDS; 15 percent for lower-middle-income countries; and 10 percent for upper-middle-income countries and multilateral development banks within the OECD CRS database; or those loans that are specified as "concessional" by the public donor itself within the IRENA Public Investments database. Recipients could also incur external debt from concessional loans after receiving transfers in cash or in kind, although at a significantly lower interest rate than what developed countries could get from commercial banks or private financial institutions.

Equity is the third set of instruments: it amounted to USD 678 million in 2019, up 22 percent from the USD 556 million received in 2018. Common equity attracted USD 762 million each year during the period 2015–19. Shares in collective investing vehicles (e.g., investment funds) grew significantly from USD 5.5 million in 2015 to USD 191.3 million in 2019. More growth is expected as these instruments are more widely used by public finance institutions.

Guarantees, the fourth group of financial instruments, amounted to USD 184 million in 2019, less than 2 percent of the total flows. Guarantees/insurance and credit lines have the potential to leverage off commercial lending (ratio above 1 for private/public, debt/equity indicators), creating a new pull for untapped capital pools to mobilize additional funds for renewable projects. Guarantees have not seen their share of the financial mechanism mix increase, as the process of obtaining them is slow (since they are multilateral by nature) and they require a better enabling environment (regulations, fiscal policies, etc.).

POLICY INSIGHTS

International public flows need to increase substantially to meet SDG 7 and SDG 13[13] as well as to support the postpandemic recovery in developing countries.

Existing models show a significant gap between current investment levels and those needed to achieve the energy transition in line with climate and sustainable development imperatives. For instance, global investments in renewable power generation need to reach between USD 1 trillion (IEA 2021b) and USD 1.7 trillion (IRENA 2021b) annually by 2030.[14] To put this into perspective, only USD 366 billion was committed to renewable energy projects in 2021 (BNEF 2022).

The increased funding is expected to come from the private sector, continuing a global trend: 85 percent of investments in new renewable energy projects were provided by private investors between 2013 and 2018. Investors are increasingly limiting their exposure to assets not aligned with global climate actions and are channeling their funds to green assets.

Nevertheless, public finance institutions and international donors still have a major role to play, beyond direct investments in renewable assets. This is especially so in developing countries, where real or perceived risks contribute to the high costs of financing, resulting in increased electricity prices for end consumers or projects not seeing the light of day. In this context, aligning policies and the funds of public finance providers is key to creating an enabling environment for private investments, developing the needed infrastructure, and addressing perceived risks and barriers to attract private capital to bring new markets to maturity. In addition, funding will be needed to implement policies that ensure a just and inclusive energy transition (e.g., capacity building, education and retraining, and industrial policies).

While advanced economies are best positioned to mobilize public financing to reinforce the energy transition, stronger international collaboration is necessary to channel such funding to the rest of the world. Emerging economies benefit from international cooperation supporting renewable energy deployment. Commitments to support renewable energy financing in developing countries were made during COP26[15] (box 5.2), and several development finance institutions (DFIs) are funding renewable energy deployment, but more needs to be done.

13 SDG target 13.a is to implement the commitment undertaken by developed countries that are parties to the United Nations Framework Convention on Climate Change to jointly mobilize USD 100 billion annually by 2020 to address the needs of developing countries in the context of meaningful mitigation actions and transparency of implementation and to fully operationalize the Green Climate Fund through its capitalization as soon as possible.

14 For more on investments needed to reach SDG 7, see chapter 6.

15 The 26th session of the Conference of the Parties.

BOX 5.2 • Announcements on public climate finance at COP26

The 26th session of the Conference of the Parties (COP26) was underpinned by several landmark commitments to meet the climate objectives of the Paris Agreement and to realize SDG 7.

With multiple countries pledging additional climate financing to developing countries, it is estimated that the USD 100 billion per year target could be met by 2023. Driven by the imperative to achieve a better balance between mitigation and adaptation financing, countries also committed to double global adaptation finance by 2025. This will be operationalized through a two-year work program (UNFCCC n.d.).

Yet, current commitments stand in stark contrast to the USD 3.5 trillion required annually to limit warming to 1.5°C (S&P Global 2021). The annual adaptation costs of developing countries are expected to be in the range of USD 140 billion to USD 300 billion by 2030 (Independent Expert Group on Climate Finance 2020). This exceeds the overall climate financing target, which comprises both mitigation and adaptation support. This target may not only be met in 2023 but even exceeded according to the Climate Finance Delivery Plan led by Germany and Canada and launched ahead of COP26. Although this is a welcome sign, an unprecedented scaling up of climate finance is needed, with greater transparency, accountability, and equity in fund disbursements.

Additionally, 39 signatories (including countries and multilateral development banks) committed to prioritize support for the clean energy transition and to largely cease public finance for unabated fossil fuel energy (defined as fossil fuel energy without pollution control measures such as carbon capture and storage) by the end of 2022 (COP26 Presidency 2021). This follows earlier pledges made by key funders of overseas development (e.g., China, France, Germany, Japan, the Republic of Korea, and the United Kingdom) to halt the financing of coal power plants. Just China's pullout from financing coal power abroad could free up USD 130 billion worth of investments for clean energy, impacting 44 countries across Asia and Africa (Global Energy Monitor 2021).

Several initiatives to enhance strategic public financing were announced during COP26, including the Energy Transition Accelerator Financing Platform, a new USD 1 billion global climate finance facility to accelerate the transition to renewable energy in developing countries, managed by the International Renewable Energy Agency.

COP26 also saw the launch of the International Just Transition Partnership—a USD 8.5 billion deal to support the decarbonization of South Africa's energy sector. This sector uses coal for more than 70 percent of its energy needs and is the 16th-highest emitter of greenhouse gases globally. Supported by France, Germany, the United Kingdom, and the United States, this model of international cooperation could act as a template, for developed and developing countries alike, on progressing toward the global climate goal.

Source: IRENA 2021a.

These findings are also echoed by the 2021 UN High-Level Dialogue on Energy, which stresses the role of international cooperation to catalyze public and private finance and investment to accelerate the energy transition. This is particularly important for developing countries and SIDS as COVID-19 exacerbated their financial constraints, limiting their ability to recover from the pandemic and realize the 2030 Agenda (box 5.3).

BOX 5.3 • Financing the energy transition and the UN High-Level Dialogue on Energy

In September 2021, the UN High-level Dialogue on Energy, the first leader-level meeting on energy held under the auspices of the UN General Assembly in 40 years, took place. One of its key outcomes was a global roadmap for accelerated SDG 7 action, issued by UN Secretary-General António Guterres. The report's milestones for financing include:

- An increase in annual investment of USD 35 billion for access to electricity and of USD 25 billion for clean cooking by 2025.
- Tripling of annual investment for renewable energy and energy efficiency globally by 2030.

The roadmap emphasizes that shifting subsidies from fossil fuels to renewables and carbon pricing are crucial for accelerating the energy transition (UN 2021a).

At the margins of the dialogue, governments and private sector actors announced a range of commitments to realize SDG 7 in the form of energy compacts. As of October 2021, this included commitments to invest USD 439 billion on top of the USD 1,490 billion from catalytic partnerships across 46 compacts (UN 2021d).

THE IMPACT OF THE COVID-19 PANDEMIC

The effects of the pandemic rippled through economies and societies in 2020–21, with the world gross domestic product contracting by 4.3 percent and a first rise in extreme poverty rate since 1998 (UN 2021c). In response to the economic and social impacts of COVID-19, governments across the world committed around USD 20.6 trillion of fiscal stimuli to COVID-19 by the end of 2021, out of which an estimated USD 3.8 trillion was dedicated to pandemic recovery efforts, 28 percent (USD 1.1 trillion) to green recovery (O'Callaghan et al. 2022). The IEA (2021a) estimates that the recovery involves USD 470 billion for clean energy measures across more than 50 major economies.

Analyses have highlighted the potential of using stimulus response measures to shape more inclusive, sustainable, and resilient economies and societies. For instance, IRENA finds that focusing on an accelerated energy transition, underpinned by a comprehensive framework, could help boost sustainable growth and create much-needed jobs, while closing the energy access gap (IRENA 2020b). More broadly, green recovery spending was associated with a two to seven times larger income multiplier than that of non-eco-friendly spending (Batini et al. 2021). Yet, while developed economies were able to mobilize and borrow money to finance ambitious recovery programs, the same fiscal flexibility was lacking in developing countries (Georgieva 2021).

Even before the pandemic, many developing countries, especially LDCs, faced challenges to mobilize financing for critically needed energy projects ranging from electrifying health clinics to powering industry and development. Their fiscal space for recovery and sustainable development efforts was further hampered by a premature phaseout of current fiscal support measures, difficulties in accessing finance, limited public and private investments, and continuing debt service obligations (UN 2021b). In 2020 alone, low- and middle-income countries paid an estimated USD 130 billion to service their debt (Stiglitz and Rashid 2020), underscoring challenges of unsustainable debt burdens (World Bank 2021a).

This is reflected in the stimulus packages to date in developing countries, which are smaller and often less focused on sustainability than those of advanced economies (Lüpke et al. 2020). There is concern that the recovery pathways of advanced and developing economies could diverge (IMF 2021b). Without further action, developing countries might be excluded from the opportunity to participate in and benefit from the move toward green economies.

As such, strong international cooperation, increased public financing, and strategic use of public funds are needed to ensure transformative investments that simultaneously address the recovery, SDG 7, and long-term socioeconomic and climate goals.

STRATEGIC USE OF PUBLIC FINANCE AND ENHANCED INTERNATIONAL COOPERATION

Public investments should be scaled up significantly and used strategically and efficiently to support a broad spectrum of areas, from emerging technologies and solutions and infrastructure projects to holistic measures that enhance the policy, regulatory, and financial environment. It is critical to create an enabling environment to scale up energy investments, as investor concerns about the perceived or real risks of investing in emerging and developing markets pose a significant barrier for many energy projects.

Risk-mitigation instruments such as guarantees, letters of comfort or intent, hedges against currency risks, letters of credit, and insurance products provide solutions but may not be easily accessible or affordable to market participants. Greater efforts are needed by DFIs and other providers of public capital to enhance the availability of such instruments (IRENA 2020c). Sharing of risks, returns, and financial expertise, along with greater pooling of capital, can also be encouraged through blended finance initiatives (OECD 2020). The participation of DFIs in blended finance structures has been found to lower perceived risks of third-party investors as well as the overall cost of capital (CFLI, 2019). Box 5.4 discusses the main interventions enabling private investments in renewables in Africa. While developing countries can adopt various measures to improve their domestic investment conditions, actions should be guided by each country's priorities. Ultimately, climate-safe energy transition efforts and a sustainable recovery require a concerted global effort. Key considerations for moving forward include the following:

- Fresh financing combined with debt relief measures are needed for developing countries to have enough fiscal space to recover from the pandemic (UN 2021b).
- Donors should seek at a minimum to meet their ODA and climate finance commitments as well as provide fresh financing for developing countries to enable inclusive growth and sustainable development, especially among LDCs and SIDS. Climate finance is particularly important in light of the close interlinkages between realizing SDG 7, tackling the climate emergency, and ensuring a sustainable recovery.
- Given the critical role of multilateral, regional, and national development banks and international financial institutions, accelerating the timetable for replenishing funds is essential for LDCs and emerging economies. Without adequate resources, donors are not able to fulfill their role of addressing investment gaps and market failures, mitigating risks, as well as providing long-term and countercyclical financing. Improving the efficiency and effectiveness of DFIs' fund disbursement will be critical to financing a sustainable recovery (UN 2021b). Tracking real disbursement to ensure that the funds reach developing countries in a timely manner as well as strengthening accountability should be prioritized.
- Policy making could enable a larger ecosystem for accessing and harnessing untouched pools of capital. Developing innovative instruments and digital platforms to attract capital and reorganize risks could unleash additional financial flows to help close funding gaps where public finance is constrained. National development institutions, international financial institutions, and Fintech and Insurtech companies in least-developed and middle-income countries could further develop and explore opportunities created by these new instruments. Market authorities could encourage financial sandboxes to adapt regulations to further test and scale up these instruments.

BOX 5.4 • Investment landscape and measures to de-risk private investment in Africa

Public financing dominated the investment landscape over the past two decades in Africa, while private investments in renewable energy have only recently begun to increase, particularly in the power sector. However, the distribution of capital flows remains heavily skewed toward a handful of economies.

Countries offering better risk-return prospects owing to their relatively developed policy and institutional environments, regulations, access to finance, and market characteristics (e.g., size, prospects, and stability) are better able to crowd in private capital. Those with a low prevalence of these enabling factors face significant political, financial, legal, operational, and credit risks that deter private investment.

Policy support in the form of structured procurement programs (feed-in-tariffs, auctions, etc.) mitigated uncertainty and transactional and industry-level risks, attracting a surge of private capital in the past 10 years (IRENA 2022). However, projects still rely on cofinancing and guarantees from development finance institutions (DFIs) (IMF 2021a), given their real and perceived risks. About 30 percent of the USD 61 billion committed for African independent power producers over 2010–20 was arranged by DFIs, who leveraged capital from private equity partners and commercial debt providers and also provided technical assistance (e.g., prefeasibility studies) and derisking instruments.

DFIs have a vital role to play in renewable energy investments in Africa, as they improve the bankability of projects by offering liquidity support, partial risk guarantees in lieu of sovereign guarantees, and security packages, among other solutions. For investors—and in particular lenders—to be comfortable with the risks involved, additional credit enhancement and risk mitigation cover is required.

International efforts are ongoing to enhance risk mitigation. The World Bank Group is the most prominent provider of credit enhancement and risk mitigation in Africa, in particular through the Sustainable Renewables Risk Mitigation Initiative (SRMI), launched at the 24th session of the COP in partnership with the Agence Française de Développement, the International Solar Alliance, the International Renewable Energy Agency, and Sustainable Energy for All (SEforAll). The initiative supports governments in developing and implementing sustainable and bankable renewable energy programs, by addressing the developmental and operational risks of privately financed renewable energy power plants. To date, SRMI enabled 2 gigawatts of solar PV, supported by USD 1 billion of approved World Bank investment, and successfully fundraised USD 650 million of climate financing that aims to cover various risks. It provides: (1) technical assistance to support competitive selection of private investors to reduce the risk of procurement; (2) public financing to improve grid reliability and reduce the risk of curtailment; and (3) risk mitigation instruments to cover the demand uptake risk for large-scale mini-grid projects or utility liquidity risks. To benefit fragile and coal-heavy countries, a new facility combining instruments to mitigate critical residual risks perceived by the private sector is being developed.

Facilities such as the Regional Liquidity Support Facility, GuarantCo, and European Fund for Sustainable Development-plus (EFSD and EFSD+) are providing additional liquidity cover. In addition, the use of blended financing approaches encompassed in initiatives such as the COVID-19 Off-Grid Recovery Platform, SPARK+ Africa Clean Cooking Ecosystem Fund, the Energy Access Relief Fund, and Climate Investor One (CI1) through the Climate Finance Lab helped leverage private capital.

Finally, emerging business and financing models such as green bonds, contract standardization, and project bundling are helping attract different investor classes. Other models such as results-based financing, pay-as-you-go, and crowdfunding are being increasingly employed in the off-grid sector, often successfully bringing in additional private investments.

Source: IRENA 2022.

METHODOLOGY

DATA SOURCES

The SDG indicator 7.a.1 uses two databases to account for international public financial flows. First is the CRS of the OECD's Development Assistance Committee (DAC), and second is IRENA's Renewable Energy Public Finance Database.

In the CRS, ODA and other official flows to developing countries together constitute the public financial support that donors provide to developing countries for renewable energy. These flows are defined as the sum of official loans, grants, and equity investments that "DAC countries" (ODA recipients listed by the DAC) receive from foreign governments and multilateral agencies for clean energy research to develop and produce renewable energy (including in hybrid systems). The OECD consolidates and categorizes these figures as self-reported by donors. For the purposes of our analysis, these figures were extracted from the OECD/DAC CRS as bulk downloads starting in the year 2000 and then filtered to reflect public investments in clean energy by excluding commitments with blanks or zeroes. Then, the purpose codes were filtered to include clean energy investments:

- 23210: Energy generation, renewable sources—multiple technologies. These are renewable energy generation programs that cannot be attributed to one single technology (codes 23220 through 23280 below). (Fuel wood/charcoal production should be included under forestry 31261.)
- 23220: Hydroelectric power plants—including energy-generating river barges.
- 23230: Solar energy for centralized grids.
- 23231: Solar energy for isolated grids and stand-alone systems.
- 23232: Solar energy—thermal applications.
- 23240: Wind energy—for water lifting and electric power generation.
- 23250: Marine energy—including ocean thermal energy conversion, tidal and wave power.
- 23260: Geothermal energy—use of geothermal energy for generating electric power or directly as heat for agriculture, and so on.
- 23270: Biofuel-fired power plants—use of solids and liquids produced from biomass for direct power generation. Also includes biogases from anaerobic fermentation (e.g., landfill gas, sewage sludge gas, fermentation of energy crops, and manure) and thermal processes (also known as syngas); waste-fired power plants making use of biodegradable municipal waste (household waste and waste from companies and public services that resembles household waste, collected at installations specifically designed for its disposal with recovery of combustible liquids, gases, or heat). (See code 23360 for nonrenewable waste-fired power plants.)
- 23410: Hybrid energy electric power plants.
- 23631: Electric power transmission and distribution (isolated mini-grids).

Finally, private donor flows (mostly from philanthropic organizations) were removed from the data sample (https://stats.oecd.org/Index.aspx?DataSetCode=crs1).

The flows covered by IRENA are defined as all additional loans, grants, and equity investments received by developing countries from all foreign governments, multilateral agencies, and additional DFIs (including export credits, where available) for the purpose of clean energy research and development and renewable energy production, including in hybrid systems. These additional flows cover the same technologies and other activities (research and development, technical assistance, renewable electricity distribution infrastructure, etc.) as listed above and, to avoid duplication of data, exclude all flows extracted from the CRS.

METHODS AND CLASSIFICATIONS

Deflating nominal USD prices to constant prices and exchange rates

Commitments are measured in millions of US dollars at constant prices for a base year. The base year for the constant prices and exchange rates is updated every year and usually reflects a two-year lag in the publication cycle (e.g., the 2020 cycle will report 2018 constant prices).

International finance 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 years, are expressed as the purchasing power of a US dollar in a recent year (2019 in this report). This is done using a combination of the OECD DAC deflators for the DAC donors and deflators calculated by IRENA for other international donors not included in the CRS database. The formula below converts the nominal investment amounts in current USD to USD at constant prices and 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).

The OECD publishes DAC deflators for each donor. (More information can be found at https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/informationnoteonthedacdeflators.htm.)

Regional aggregations and classifications

These data are for commitments directed to developing countries, defined as countries in developing regions, as listed in the UN M49 classification of regions.[16] Where commitments could not be categorized under specific countries or territories, the following classifications are used:

- 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: Oceania excluding Australia and New Zealand
- Residual/unallocated ODA: Sub-Saharan Africa
- Residual/unallocated ODA: Western Asia and Northern Africa
- Unspecified, developing countries

These classifications are expanded in chapter 7.

16 While the UN system does not have an agreed-upon definition of developing and developed countries, it introduced a distinction in the standard country or area codes for statistical use (known as M49) in 1996. The concept was removed in December 2021 to reflect that the distinction had increasingly become outdated and did not reflect the reality in many countries. Yet, in line with guidance from UN statistics, the concept may continue to be applied as a historic concept including for specific SDG 7 indicators (https://unstats.un.org/unsd/methodology/m49/).

Measuring financial flows through commitments

Financial flows in this context are recorded as donors' commitments. A commitment is defined as a firm obligation, expressed in writing and backed by the necessary funds. Bilateral commitments are recorded in the full amount of expected transfers for the year in which commitments are announced, irrespective of the time required for the completion of disbursements, which may occur over several weeks, months, or years. Tracking financial commitments can yield very different results compared with approaches that consider financial disbursements. Although disbursement information would provide a more accurate picture of the actual financial flows to renewable energy each year, consistent data on disbursements are often limited or not available. The focus on commitments allows for a more comprehensive and granular analysis of financial flows and ensures methodological consistency across different data sources. Measuring commitments, however, may produce large annual fluctuations in financial flows when large projects are approved. In addition, financial commitments may not always translate into disbursements, as contracts may be voided, canceled, or altered. Any changes must be reflected in annual values.

Financial instruments

The financial instruments used by public financial institutions were categorized based on the OECD list of financial types and the IRENA classifications for concessional loans and credit lines. The full taxonomy of financial instruments is shown in table 5.2. Note that not all these instruments have commitments allocated to them yet. This taxonomy excludes debt-relief mechanisms.

TABLE 5.2 • Taxonomy of financial instruments

Financial group/type	Financial instrument	Description
Debt	Standard loan	Legal debt obligations assumed by the recipient, composed of transfers in cash or in kind (the creditor also acknowledges the nontradability of obligations should any claim arise from nonpayment). Since payment obligations on standard loans are senior obligations—that is, creditors are entitled to receive payments against their claims before anyone else—they are also referred to as senior loans. These loans have better lending terms than those of private financial institutions, including longer payment terms, lower interest rates, and low or negligible grant elements. As such, these loans are not necessarily "market-rate" loans. In cases where no concessional information is found for commitments, we categorize them as loans, not concessional loans.
	Concessional loan	Loans that meet the 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 loans that are specified as "concessional" by the public donor itself within the International Renewable Energy Agency Public Investments database. Recipients could incur external debt after receiving transfers in cash or in kind through concessional loans, although at a significantly lower interest rate than what developed countries could get from commercial banks or private finance institutions.
Debt	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 payments are derived from and backed by a specific pool of underlying assets.
	Reimbursable grant	A contribution provided to a recipient institution for investment purposes, with the expectation of long-term reflows on conditions specified in the financing agreement. The provider assumes the risk of total or partial failure of the investment; it can also decide if and when to reclaim its investment.
	Other debt securities	

Grant	Standard grants	Grants are transfers in cash or in kind for which no legal debt is incurred by the recipient.
	Interest subsidy	A payment to soften the terms of private export credits, or 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 encashable at sight by the recipient institutions.
	Capital subscription on encashment basis	Payments to multilateral agencies in the form of notes and similar instruments, unconditionally encashable at sight by the recipient institutions.
Mezzanine finance	Subordinated loan	A loan that, in the event of default, will be repaid only after all senior obligations are satisfied. In compensation for the increased risk, mezzanine debt holders require a higher return on their investment than secured or more senior lenders.
	Preferred equity	Equity that, in the event of default, will be repaid after all senior obligations and subordinated loans are satisfied and will be paid before common equity holders. It is a more expensive source of finance than senior debt, and a less expensive source than equity.
	Other hybrid instruments	Including convertible debt or equity.
Equity	Common equity	A share in the ownership of a corporation that gives the owner claims on the residual value of the corporation after creditors' claims are met.
	Shares in collective investment vehicles	Collective undertakings through which investors pool funds for investment in financial or nonfinancial assets or both. These vehicles issue shares (if a corporate structure is used) or units (if a trust structure is used).
	Reinvested earnings	This item is applicable only to foreign direct investment. Reinvested earnings on foreign direct investment consist of the retained earnings of a direct foreign investment enterprise which are treated as if they were distributed and remitted to foreign direct investors in proportion to their ownership of the equity of the enterprise and then reinvested by them in the enterprise.
Guarantees	Guarantees/ insurance	A promise of indemnification up to a specified amount in the case of default or nonperformance of an asset, for example, a failure to meet loan repayments or to redeem bonds, or expropriation of an equity stake. Guarantees typically cover political and/or commercial (e.g., credit, regulatory/contractual) risks that investors are unwilling or unable to bear.
	Credit line	An arrangement between a bank and a borrower establishing a maximum loan balance that the bank will permit the client to maintain. Guarantees that funds will be made available, but no financial assets exist until funds are advanced.

Changes to the data

This year's public investments database had several revisions: most significantly, a historic revision of investments for 17 donor agencies, cancelled commitments, and reclassified commitments to different years (table 5.3. Furthermore, the US dollar amounts were updated to reflect 2019 prices and exchange rates. The largest differences correspond to a USD 1.3 billion loan recategorized from 2015 to 2017 and the cancellation of a USD 1.5 billion loan from 2015.

TABLE 5.3 • Magnitude of 2022 revisions to public investment figures for 2000–18

Year	Figure prior to revision (2018 USD millions)	Figure after revision (2019 USD millions)	Difference (2019 USD millions)
2000	1,414	1,424	10
2001	1,674	1,668	-6
2002	1,288	1,321	33
2003	3,178	3,097	-81
2004	2,194	2,116	-78
2005	1,925	1,961	36
2006	3,278	3,238	-40
2007	3,638	4,272	635
2008	2,573	2,778	205
2009	8,137	8,145	8
2010	10,552	11,171	618
2011	11,574	11,689	115
2012	10,813	10,294	-520
2013	13,808	13,580	-228
2014	16,978	15,691	-1,286
2015	15,111	12,660	-2,451
2016	20,093	20,410	318
2017	21,881	24,657	2,776
2018	13,972	14,244	272

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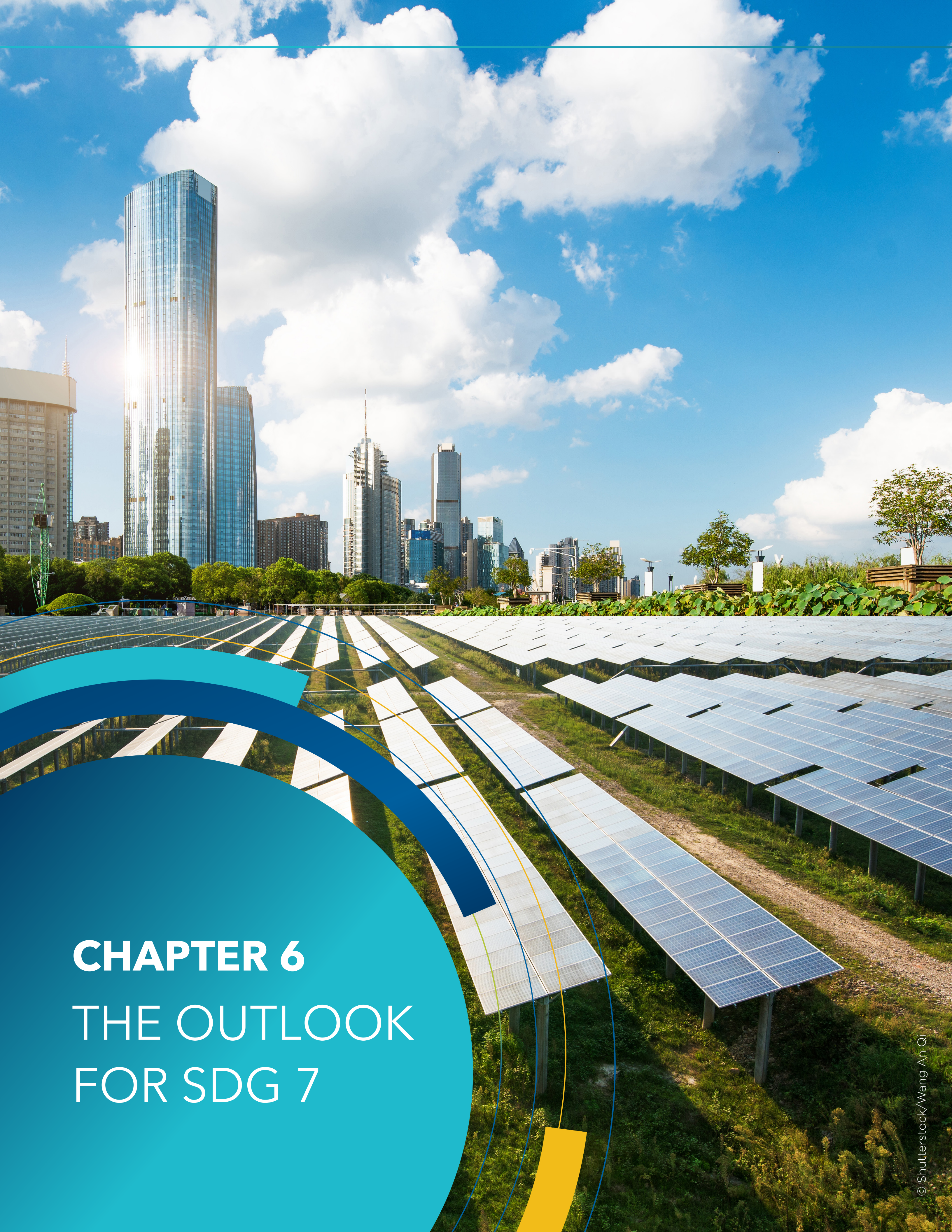

CHAPTER 6
THE OUTLOOK FOR SDG 7

MAIN MESSAGES

- **Outlook for progress toward 2030 goals:** The COVID-19 pandemic has continued to slow global progress on SDG 7. Efforts to reach universal access to clean cooking and electricity slowed during the pandemic, as did progress in energy efficiency, with renewables being the only area in which progress was consistently made throughout the pandemic. In response to the pandemic, however, many governments advanced new policies in support of energy-related Sustainable Development Goals (SDGs), particularly in advanced economies. Together with new concrete commitments coming out of the 26th Conference of Parties (COP26), adoption of these policies improved the outlook for progress toward achieving SDG 7.2 (on energy efficiency) and SDG 7.3 (on renewable energy). However, access setbacks associated with COVID-19 outweighed new policies advancing access, which slowed as developing economies directed their limited fiscal leeway toward maintaining the affordability of food and fuel amidst the crisis. This diversion of resources, along with delays incurred by lockdowns and global supply chain disruptions, has slowed global progress on universal access during the pandemic (2020–21). These trends and new policies are captured in the Stated Policies Scenario (STEPS) of the International Energy Agency (IEA) and the Planned Energy Scenario of the International Renewable Energy Agency (IRENA), both of which depict a trajectory that is off track for achieving the targets set forth in SDG 7. IEA's Net Zero Emissions by 2050 Scenario (NZE) and IRENA's 1.5°C Scenario lay out pathways to bridge the gap and put the world's energy system on track to achieve or surpass the SDG targets most closely related to energy (those in SDG 3.9, SDG 7, and SDG 13) and then achieve emissions levels in the energy sector that would have a 50 percent chance of limiting global temperature rise to 1.5°C in 2100.[1]
- **Outlook for access to electricity:** IEA's Stated Policies Scenario projects that 670 million people would still lack access to electricity in 2030—10 million more than last year's projection. The COVID-19 crisis continues to slow global progress on reaching universal access to electricity, reversing years of steady progress, particularly in Sub-Saharan Africa. The pandemic has slowed the rate of new access, particularly for stand-alone systems. In contrast, grid and mini-grid connections remained resilient during the pandemic in some regions. As a result, the number of people without access to electricity is likely to have increased by 2 percent in 2021, almost entirely in Sub-Saharan Africa, where more than four in five people without access now live. Swift actions by governments to provide lifeline tariffs during the pandemic helped improve outcomes in 2020 compared with projections. However, governments without strong access policy frameworks in place had little ability to quickly mobilize supports. Many of these supports are set to expire as the immediate pandemic situation comes under control, but the impact on household income will linger, especially for people on the lowest rungs of the economic ladder. The outlook for countries without institutions in place to address access thus appears unpromising. The outlook is better in countries that have strong access policy supports in place, such as Ethiopia, Senegal, and Kenya in Sub-Saharan Africa and countries in Developing Asia, which are still set to reach near universal access by 2030. Between 2020 and 2030, the connection rate needs to reach an average of 100 million a year, including 80 million in Africa, where the rate of new connections needs to triple. Urgent action is needed in the Democratic Republic of Congo, Ethiopia, Myanmar, Nigeria, Pakistan, Sudan, Tanzania, and Uganda, eight countries in which over half of the world's population without access lives.

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1 Most of this chapter is based on results from IEA's World Energy Model and analysis in the World Energy Outlook (IEA 2021). Unlike some other chapters, this chapter uses some geographical groupings used in the *World Energy Outlook*. "Developing Asia" refers to non-OECD Asia.

- **Outlook for access to clean cooking solutions:** If clean cooking fails to find a lasting place on the global political agenda, over 2.1 billion people would continue to rely on traditional uses of biomass, kerosene, or coal for cooking in 2030, according to IEA's Stated Policies Scenario. This reliance on polluting fuels will have dramatic consequences for the environment, economic development, and health, particularly of women and children. The number of people without access to clean cooking increased by 30 million between 2019 and 2021, a rise of 1 percent. The increase reflected the marked slowdown in progress in Developing Asia, where many people who had recently gained access to clean cooking fuels reverted to traditional fuels during the pandemic, especially as global fuel prices spiked during the recovery period. Many governments—including in Ethiopia, India, Indonesia, and Nigeria—intervened to maintain affordability for consumers who used liquefied petroleum gas (LPG) and provided financial support to energy providers during the pandemic. However, mounting subsidy burdens from before the pandemic are driving many countries, including Kenya, Zambia, and India, to phase out LPG fuel subsidies, implement fuel taxes, or announce plans to do so to shore up accounts. Reaching universal access to clean cooking by 2030 faces both administrative and cultural barriers, but technologies to help achieve the goal are available. Only a third of countries facing lack of access to clean cooking have dedicated programs and policies in place. They need to be established in the coming years to keep universal access to clean cooking within reach.
- **Outlook for renewable energy:** Although the COVID-19 pandemic stalled many energy projects in 2020, the use of renewables continued to grow, accounting for more than 80 percent of all new electricity capacity added in 2020. Supportive policies in all major regions and falling technology costs made this growth possible. In the power sector, both the IEA and IRENA scenarios conclude that solar photovoltaic (PV) and wind would account for most growth in renewables-based electricity generation by 2030 under stated policies. Although the renewable energy target under SDG 7 is not quantified, stated policies remain insufficient to stay on track to meet the goals agreed to under the Paris Agreement and are even farther from what is required to be achieve net-zero emissions in energy by 2050, in line with global agreement on what is needed to limit end-of-century warming to 1.5°C. IEA's Net Zero Emissions by 2050 Scenario shows that intensified policy support and cost reductions could push the share of modern renewables in total final energy consumption (TFEC) to 32 percent by 2030, in which case renewables would account for 60 percent of electricity generation. In IRENA's 1.5°C Scenario, the rise in renewables by 2030 would reach 38 percent of TFEC and 65 percent of electricity generation. Greater efforts are also needed to increase renewable penetration in transport and heating, both directly, through the use of biofuels and biogas, and indirectly, through electrification. Despite its large share of final energy consumption, heat receives limited policy attention globally compared with other end-use sectors.[2] The number of countries with national targets for renewable heat is less than one-third those with targets for renewable electricity. Policy support is also critical for transport, particularly in a lower oil and gas price environment.
- **Outlook for energy efficiency:** The rate of global energy intensity—the percentage decrease in the ratio of global total energy supply per unit of GDP—has slowed from the 2010–15 highs in recent years, as programs in China to replace the most inefficient industrial facilities have reached completion. In addition, the pandemic reduced household and business spending on energy efficiency. Government programs incentivizing retrofits and upgrades and strengthening appliance and building codes are set to overcome the previously projected near-term slump in energy efficiency, as seen in IEA's Stated Policies scenario, under which the annual rate of global energy intensity increases from 1.9 percent in 2010–19 to 2.3 percent in 2020–30. The annual rate of improvement would need to reach over 3.2 percent to achieve SDG 7 by 2030. Under IEA's Net Zero Emissions by 2050 Scenario, the rate would rise to 4.2 percent a year, reflecting the widespread implementation of minimum energy performance standards, building codes, incentives for retrofits of industrial facilities and housing, and bans on the sale of the most inefficient equipment in the coming decade. In IRENA's 1.5°C Scenario the rate of energy intensity improvement in 2020–30 would need to be 40 percent faster than it was in 2010–19.

2 "Heat" in this chapter refers to the amount of energy consumed to produce heat for industry, buildings, and other sectors. Heat as a final energy service refers to the energy available to end users to satisfy their needs, after considering transformation losses.

- **Investment needs:** Under IEA's Stated Policies scenario, investment in clean energy—which includes renewable power, renewable fuels, efficiency, end-use electrification, and grids and networks—would increase to USD 1.7 trillion a year by 2030, roughly 80 percent higher than in 2020. IEA's Net Zero Emissions Scenario projects that annual clean energy investment worldwide would need to more than triple by 2030 to USD 4 trillion. Much of this investment is directed to renewables and efficiency. However, reaching universal energy access by 2030 would require annual investment of USD 35 billion in electricity and USD 6 billion in clean cooking, according to IEA's Net Zero by 2050 Scenario. This level is only 15 percent of the levels tracked today by Sustainable Energy for All (SEforAll). Under IRENA's 1.5°C Scenario, investment in clean energy amounts to almost USD 5 trillion a year through 2030, a 60 percent increase over current plans and policies.

PRESENTATION OF SCENARIOS

This chapter describes the results of global modelling exercises undertaken to determine whether current policy ambitions are sufficient to meet the SDG 7 targets and to identify what additional actions might be needed. It also examines what investments are required to achieve the goals. Scenarios for the targets are taken from IEA's flagship publication World Energy Outlook (IEA 2021) and IRENA's World Energy Transitions Outlook: 1.5°C pathway (IRENA 2021). Both explore two types of scenarios: one in which energy trends evolve under today's policies and another that explores a pathway that delivers on all energy-related SDGs, including substantially reducing the air pollution that causes deaths and illness (SDG 3.9) and taking effective action to combat climate change (SDG 13).

IEA's Stated Policies Scenario explores how energy trends would evolve under today's policies, assuming that no additional policies are put in place. It holds a mirror up to policy makers' current plans, in order to evaluate whether they are sufficient to reach their long-term targets and goals. This scenario does not take countries' decarbonization pledges, Nationally Determined Contributions (NDCs), or access targets as givens but rather conducts bottom-up modelling that considers how policies, pricing policies, efficiency standards and schemes, electrification programs, and specific infrastructure projects would influence energy trends.

IEA's Net Zero Emissions by 2050 Scenario takes the SDG targets in 2030 and net-zero emissions in the energy sector by 2050 as its targets and works backward to determine what would be needed to achieve those outcomes in a cost-effective and plausible way.[3] Under this scenario, by 2030, universal access to both electricity and clean cooking is achieved, modern renewables reach 32 percent of TFEC, and energy efficiency gains exceed the SDG 7 targets, with average annual improvements in global energy intensity reaching 4.2 percent a year between 2020 and 2030. 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 over pre-industrial levels to 1.5°C.

IRENA's Planned Energy Scenario provides a perspective on energy system developments based on governments' energy plans and other planned targets and policies, including NDCs under the Paris Agreement. It also provides the reference case for IRENA's 1.5° Scenario, which describes an energy transition pathway aligned to limit global average temperature increase to 1.5°C by the end of the 21st century relative to pre-industrial levels. It is underpinned by six technological avenues and measures that would achieve major emission reductions between today and 2050, paving the way toward a net-zero carbon world by mid-century. The scenario also provides insights into the socioeconomic footprint of the global energy transition (box 6.1).

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3 More information on the IEA Net Zero Emissions by 2050 Scenario can be found at https://www.iea.org/reports/world-energy-model/net-zero-emissions-by-2050-scenario-nze.

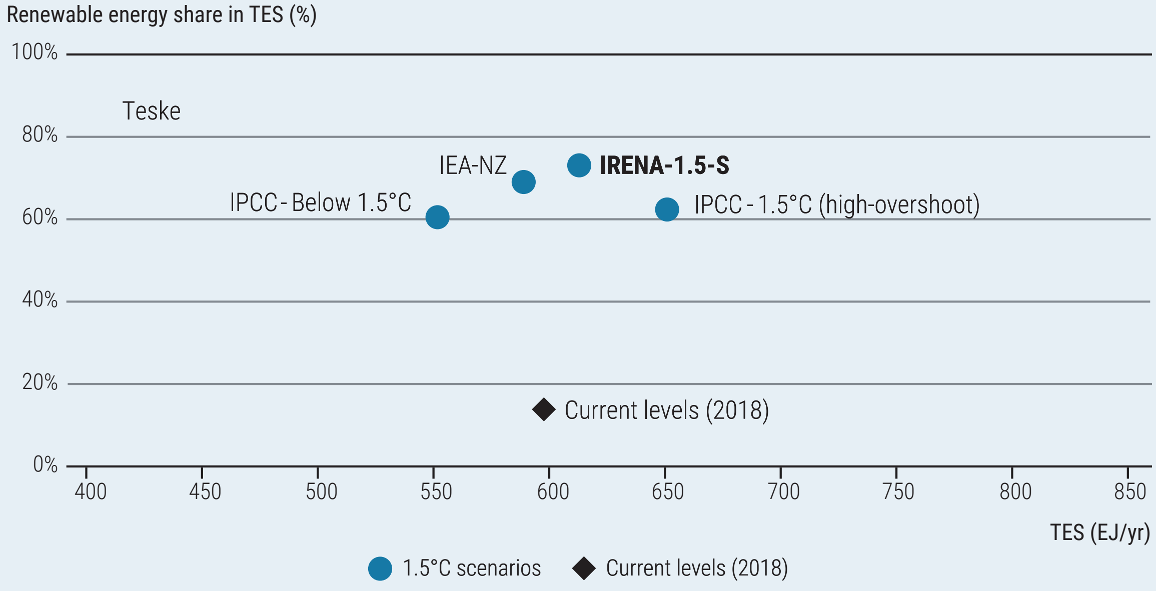
Box 6.1 • How do the IEA and IRENA scenarios compare with the 1.5°C scenarios of the Intergovernmental Panel on Climate Change?

Countries that together produce more than 70 percent of today's emissions have committed to reach net-zero emissions in the energy sector. If met in full and on time, these pledges would limit the median rise in global temperatures to 1.8oC by 2100. However, this target is still far from the target expressed in the Paris Agreement to make best efforts to limit global warming to 1.5°C by the end of the century. This gap has prompted both IEA and IRENA to design new scenarios to look at what would be needed in the energy sector to achieve the Paris goal, which focuses on reaching net-zero emissions in the energy sector by 2050.

There is no singular pathway to 1.5°C, but the direction of travel is clear: The energy sector must be one of the first to drive decarbonization, especially between now and 2030, the focus for achieving the current energy-related SDG targets. In the near term, the IEA and IRENA scenarios focus on efficiency, electrification, and power sector renewables; after 2030, they continue to advance these goals, bringing power sector renewables to 90 percent of the electricity mix by 2050. Both scenarios rely on clean fuels and carbon capture to help reduce emissions in hard-to-abate sectors, but they limit the reliance on negative emissions and non–energy sector offsets to contain global temperature rise through 2050.

The range of scenarios reflects the complexity and uncertainties of the speed and scale of the energy transition (figure B6.1.1). There is, however, broad consensus on the central role that renewables would play in electricity generation, especially in light of the growing recognition of the imperatives to tackle climate change.

Figure B6.1.1 • Share of renewables in total energy supply in 2018 and 2050 under various energy scenarios



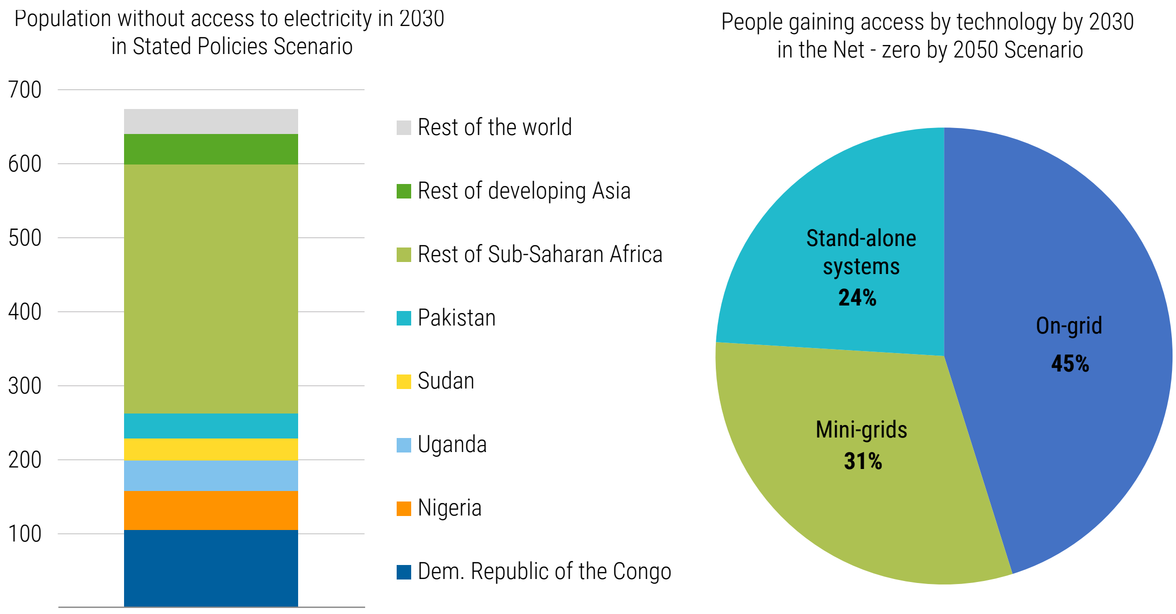
Sources: IEA's Net Zero Emissions by 2050 (IEA 2021), IRENA'S 1.5°C Scenario (IRENA 2021), the "Below 1.5°C" and "Above 1.5°C" scenario from the Intergovernmental Panel on Climate Change (IPCC 2018).

THE OUTLOOK FOR ACCESS TO ELECTRICITY

The economic downturn caused by COVID-19 is compounding the difficulties governments face as they try to reduce energy poverty and expand access. The pandemic has reversed progress on energy access in many parts of Africa, where the number of people without access to electricity is set to increase in 2021 and basic electricity services have become unaffordable for up to 10 million people who had recently gained electricity access. Many regions have implemented emergency financial relief to reduce these impacts, but as African countries and utilities face mounting debt levels, many of these programs are set to end before the need for them has been addressed.

After the setbacks from the pandemic fade, access to electricity is projected to increase through 2030. These trends vary significantly across regions, however, and remain far from sufficient to reach universal access by 2030. In the Stated Policies Scenario, 670 million people—roughly 8 percent of the global population—would remain without access by 2030, including 565 million (85 percent of the total) in Sub-Saharan Africa. SDG target 7.1 remains within reach in many countries in which adequate policies have been implemented for centralized and decentralized solutions; countries in which electrification plans and enabling frameworks are lacking are not on target (figure 6.1).

Figure 6.1 • Population without access to electricity in 2030 and delivery of electricity connections under the IEA Net Zero Emissions by 2050 Scenario, by technology



Source: IEA 2021.

Developing (non–OECD) Asia remains on track to reach access of 98 percent by 2030, close to a 20 percentage point improvement since 2010, and the highly populated countries of Bangladesh, India, Indonesia, and the Philippines are on a pathway to reach full access before 2030. Efforts need to be stepped up in other Asian countries, such as Afghanistan and Mongolia, if the region is to achieve 100 percent access in 2030. Central and South America are projected to continue to make steady progress, moving to 98 percent access in 2030, with only the most rural populations remaining without access. Haiti remains the only major country in the region in which a substantial share of the population is projected to lack access.

In much of Sub-Saharan Africa, the prospects for progress to 2030 remains bleak, with little evidence of effective policy making on the ground set to change the current trajectory. As of 2020, more than 40 percent of countries in Sub-Saharan Africa had not set electricity access targets or developed solid national plans and policies. Some 225 million people without electricity access live in these countries. If nothing changes, the number of people without access in these countries will increase by 20 percent by 2030.

There is also a possibility that the countries with the greatest need to improve access to electricity will face even greater challenges for accessing finance, impeding their capacity to increase access. This situation could further deteriorate as global inflation and price spikes exacerbate importing country indebtedness. The financial resources available for funding expansion and upgrades of electricity access have been much lower than needed to achieve SDG 7. On average, between 2013 and 2019, USD 12 billion a year was spent to improve electricity access in 20 countries representing 80 percent of the world's population without access to electricity. Most of this financing came in the form of debt from international institutions. Recent trends reveal an important increase in domestic public financing, which is helping mobilize more private finance participation (SEforAll 2021). The impact of the COVID-19 pandemic is likely to reduce the level of finance available, however, as evidenced by the downgrading of sovereign credit ratings across many low-income countries (box 6.2). Some countries are facing rising costs of capital, including some countries in Africa that are now financing costs that are seven times higher than they are in Europe and North America. SDG target 7.1 can remain within reach only if governments and donors put access at the heart of recovery plans and programs.

Box 6.2 • Tracking sustainable recovery measures in COVID-19 fiscal packages

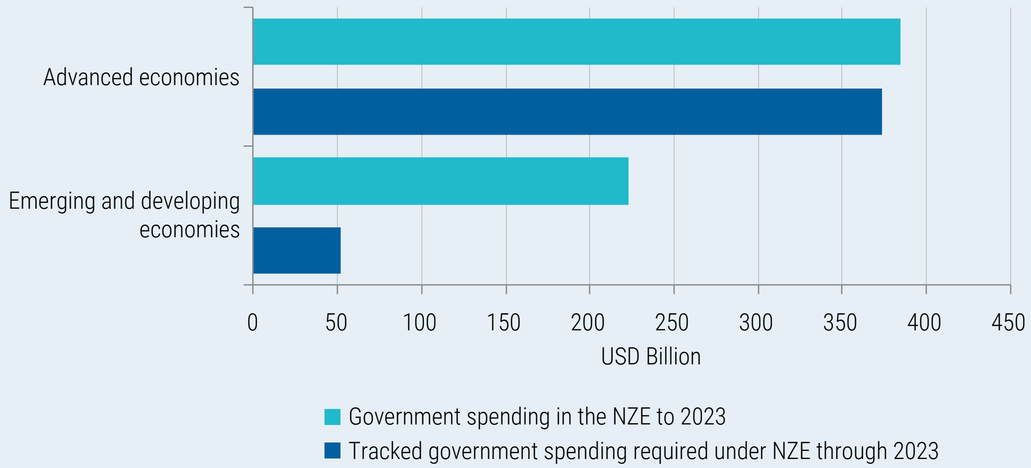
Governments worldwide have mobilized an unprecedented amount of fiscal support—over USD 18.2 trillion by March 2022—to manage the impacts of the pandemic on households, workers, and businesses. The vast majority of the spending (more than 80 percent of the total) has been for short-term emergency responses, such as supporting health systems and vulnerable segments of the economy and society, but some has taken a longer-term perspective, focusing on building back better and ensuring a sustainable recovery, including through investments crucial to achieving the energy-related SDGs.

Enabling the acceleration of energy transitions through recovery measures will enable countries to achieve multiple objectives. The IEA's detailed Sustainable Recovery Plan (IEA 2020), developed in cooperation with the International Monetary Fund, shows how increasing annual investments in clean energy by USD 1 trillion in 2021–23 would keep the globe on track with the SDGs and the Paris Agreement while boosting economic growth. The Sustainable Recovery Plan and IRENA's post-COVID recovery plan (IRENA 2020) are detailed in chapter 6 of last year's Tracking SDG 7 Report (IEA, IRENA, UNSD, World Bank, and WHO 2021).

To date, governments have directly earmarked more than USD 710 billion for sustainable recovery measures (IEA 2022). Of this amount, 60 percent is to be spent in the crucial recovery period to 2023, thus mobilizing an additional USD 1.6 trillion in investment. The latter figure is in line with government short-term public spending needs outlined in IEA's Net Zero Emissions by 2050 Scenario.

These encouraging global figures must not be allowed to obscure a severe geographical imbalance. Nearly 90 percent of the sustainable recovery spending intended by 2023 is concentrated in advanced economies (figure B6.2.1). In emerging and developing economies (EMDEs) it has been not only limited but also relatively short-lived, most having been withdrawn in 2021. This is due to EMDE governments' narrow fiscal leeway, constrained borrowing capacity, and mounting debt levels, which have led them to focus what fiscal latitude they have on short term emergency measures meant to support health systems and cushion the most vulnerable households and businesses from the shock caused by the pandemic. As a result, EMDE governments are spending less than a quarter of what would be needed in the short term to stay on track with IEA's Net Zero Emissions by 2050 Scenario. That level of spending contrasts starkly with the clean energy investments that EMDEs must take in this decade to stay on track with Paris Agreement goals and SDG 7.

Figure B6.2.1 • Sustainable recovery earmarks through 2023, by region, and government spending required by IEA's Net Zero Emissions by 2050 Scenario through 2023



Source: IEA 2022.
NZE = IEA Net Zero Emissions by 2050 Scenario

A small number of recovery plans actually targeted electricity and clean cooking access challenges. Nigeria included new spending to help finance solar home systems and liquefied petroleum gas cook stoves; it also provided monetary incentives for off-grid solar businesses to connect 25 million people. As part of its COVID-19 recovery response, Indonesia committed to provide poor households with 1 gigawatt of solar panels a year. The Brazilian government financed electrification in remote areas of the Amazon through recovery measures.

Fossil fuel price spikes in late 2021, reinforced by the Russian invasion of Ukraine are now pressuring many cash-strapped EMDE governments to reinstate affordability measures, mostly by freezing or cutting automobile fuel taxes (South Africa), raising consumer subsidies (Nigeria), or subsiding some categories of fuel-dependent activities (Morocco). But because fiscal reserves are widely depleted, very few countries can afford even short-term interventions. Development banks and other international financial institutions have provided some short-term relief to African countries through extended lending facilities, debt relief, or reimbursement alleviation instruments. But international catalysts such as development assistance will become even more essential to increasing clean energy investment during this decade.

Source: IEA 2022.

To bridge the gap and connect the remaining 670 million people without access by 2030, the connection rate would have to accelerate in most regions to 100 million a year between 2020 and 2030. Under IEA's Stated Policies Scenario, most of the acceleration would have to occur in Sub-Saharan Africa, where on average, efforts need to reach three times historical levels. Action needs to be stepped up in the Democratic Republic of Congo, Niger, Nigeria, Sudan, Tanzania, and Uganda, which together are home to half of the region's population projected to lack access in 2030.

The delivery technology varies by region under IEA's Net Zero Emissions by 2050 Scenario. In Sub-Saharan Africa, 43 percent of connections by 2030 would be directly to the grid, 31 percent would be mini-grid stand-alone systems, and the remainder would be stand-alone systems. In Developing Asia, just over half of connections would be directly to the grid, a third would be through mini-grids, and the remainder would be to stand-alone systems.

Under the Net Zero Emissions by 2050 Scenario, governments and donors put access at the heart of recovery plans and programs in order to achieve universal access by 2030. Doing so involves, for example, measures to support the emerging private sector, extend financial support to off-grid solutions, enhance access planning through stronger monitoring and the use of geospatial data and models, and build up dedicated programs to help coordinate implementation. In a world in which finance is constrained, access projects will need to be smart (linked with livelihood and public sectors like health and agriculture to unlock related benefits, for example); effective; and capable of being implemented quickly. Decentralized energy solutions will play an important role, particularly in reaching households, enterprises, farms, and public institutions that are far from a grid.

Some countries are already moving ahead. Integrated national electricity access plans using both centralized and decentralized solutions adapted to the local context are already showing benefits in Ethiopia, Ghana, Nigeria, Rwanda, and Senegal (IEA 2019). Many of these plans aim to maximize the benefits of energy access by considering the needs of health facilities, schools, agricultural enterprises, and similar organizations alongside those of households. Under the Net Zero Emissions Scenario, achieving universal access to electricity by 2030 requires annual investment of USD 35 billion through 2030 on generation, electricity networks, and decentralized solutions through smart and efficient integrated delivery programs. Current global spending is at only 15 percent of those spending levels.

Ultimately, energy access must look beyond basic access to electricity and clean cooking and facilitate the rising use of energy services sufficient to underpin socioeconomic prosperity and well-being.

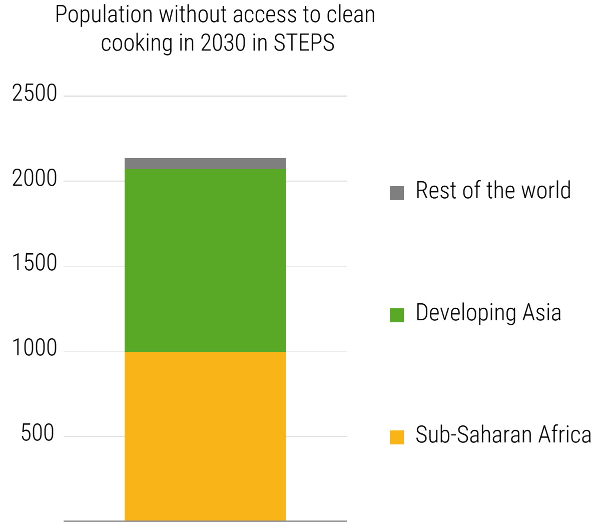
THE OUTLOOK FOR ACCESS TO CLEAN COOKING FUELS AND TECHNOLOGIES

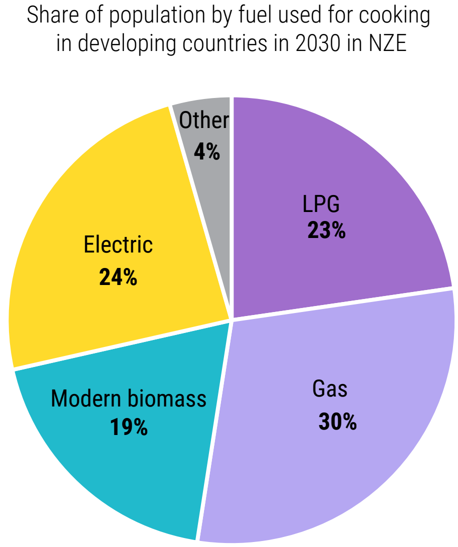
Globally, the number of people without access to clean cooking fell in recent decades. This decline reflects efforts to reduce the reliance of vulnerable populations on biomass, with the aim of improving indoor air quality, reducing the amount of time spent gathering fuel, and curbing deforestation and emissions from the incomplete combustion of biomass.

Progress has been uneven, however, and the number of people without access to clean cooking has continued to increase in Sub-Saharan Africa. The COVID-19 pandemic has set back modest advances, as consumers face the dual threats of reduced income and higher LPG and clean cooking fuel prices, which may remain elevated as a result of the Russian invasion of Ukraine. Some countries have implemented policies to counter this trend, but millions of people are reverting to traditional uses of biomass, especially in Sub-Saharan Africa.

The outlook for clean cooking remains of serious concern: Under today's policies, the world will be far from achieving universal access to clean cooking solutions by 2030 (figure 6.2). Progress slowed in 2020 and 2021. Although it is expected to return to pre-COVID levels of progress in certain regions, 2.1 billion people are projected to be without access to clean cooking in 2030. Forest degradation, sometimes leading to outright deforestation, is yet another grave consequence of the unsustainable harvesting of fuelwood, chiefly for the production of charcoal to be used in cities.

Figure 6.2 • Population without modern cooking solutions in 2030 and use of clean cooking technologies required





Source: IEA 2021.

In 2030, the population without access to clean cooking solutions is projected to be split almost equally between Developing Asia and Sub-Saharan Africa. In Developing Asia, the projected access rate in 2030 is 75 percent, leaving some 1.1 billion people without access. Significant progress is projected in India, which is expected to reduce the number of people without access from 490 million in 2020 to 282 million in 2030, achieving an access rate of 81 percent.

To satisfy the objective of the Net Zero Emissions by 2050 Scenario in line with SDG 7, every household in the world would have access to clean cooking by 2030, an achievement that would require providing access to over 280 million people each year.

To achieve the Net Zero Emissions by 2050 Scenario, access programs would need to be quickly ramped up. These programs need to help reduce the upfront cost of stoves; train people to use new cooking equipment safely and effectively; and provide cultural programming, such as cooking classes or recipes that help adapt culinary practices to improved cookstoves. Supporting infrastructure—such as fuel delivery and storage systems, a stable supply chain of cooking equipment in-country, and workers to help administer these programs—also need to be ramped up (IEA 2020). Scalable LPG solutions are already available in many regions, but fuel distribution services may not be consistently available, and LPG remains exposed to market prices, leaving users vulnerable to unaffordable price spikes without government intervention. Alternative fuels for cooking, such as biogas, could also play a role in rural areas, but biodigesters to produce biogas require support to cover the high upfront cost, sufficient feedstock, and training on their use. Electric pressure cookers powered by the grid or solar PV and a battery represent an increasingly popular mode of clean cooking, particularly in urban areas. In some countries, utilities and off-grid solution providers offer all-electric cooking bundles and programs, as increasing electric cooking can increase the profitability of providing electricity access. Improved biomass stoves (ISO Tier ≥ 1) can also be useful, especially in rural areas, and fuels such as ethanol can help cover gaps in certain regions. Reaching universal access to clean cooking by 2030 requires an all-solutions approach to meet the diverse needs in different countries and rural and urban environments.

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, long-term scenarios charting various paths for the energy sector to reach net zero by 2050 find that renewables' share of TFEC would need to reach well above 30 percent by 2030 to be on track.

Despite the impact of the COVID-19 pandemic, the outlook for renewables under IEA's Stated Policies Scenario and IRENA's Planned Energy Scenario remains positive in all regions helped by supportive policies and falling technology costs. Under IEA's Stated Policies Scenario, the share of all renewables (including traditional uses of biomass) is projected to rise from 17.7 percent of TFEC in 2019 to 22.0 percent in 2030, and the share of modern renewables is projected to increase from 11.5 percent in 2019 to 17.0 percent in 2030. These projections are substantially higher than in previous outlooks, as some of the world's largest economies—including the European Union, the United States, China, and India—incorporated renewable energy provisions in their recovery plans. In contrast, IRENA's Planned Energy Scenario sees the share of renewables in TFEC decreasing from 17.7 percent in 2019 to 16.0 percent in 2030, because of a more rapid phase-out of traditional uses of bioenergy, but the share of modern renewables would increase, from 11.5 percent in 2019 to 15.5 percent in 2030.

Power sector renewables remain the fastest-growing source of energy globally. Renewable sources of electricity have been resilient during the COVID-19 crisis, experiencing only minor setbacks. They are poised for strong growth, with annual capacity additions in 2020–30 rising by over 60 percent compared with 2015–19 trends, with solar PV and wind acting driving growth. Over the decade, renewables overtake coal as the primary means of producing electricity. Of the renewable sources of electricity, solar PV is the strongest performer, meeting almost one-third of electricity demand growth over the period, thanks to widely available resources, declining costs, and policy support in over 130 countries. Hydropower remains the largest low-emissions source of electricity globally through 2030. It also provide flexibility and other power system services.

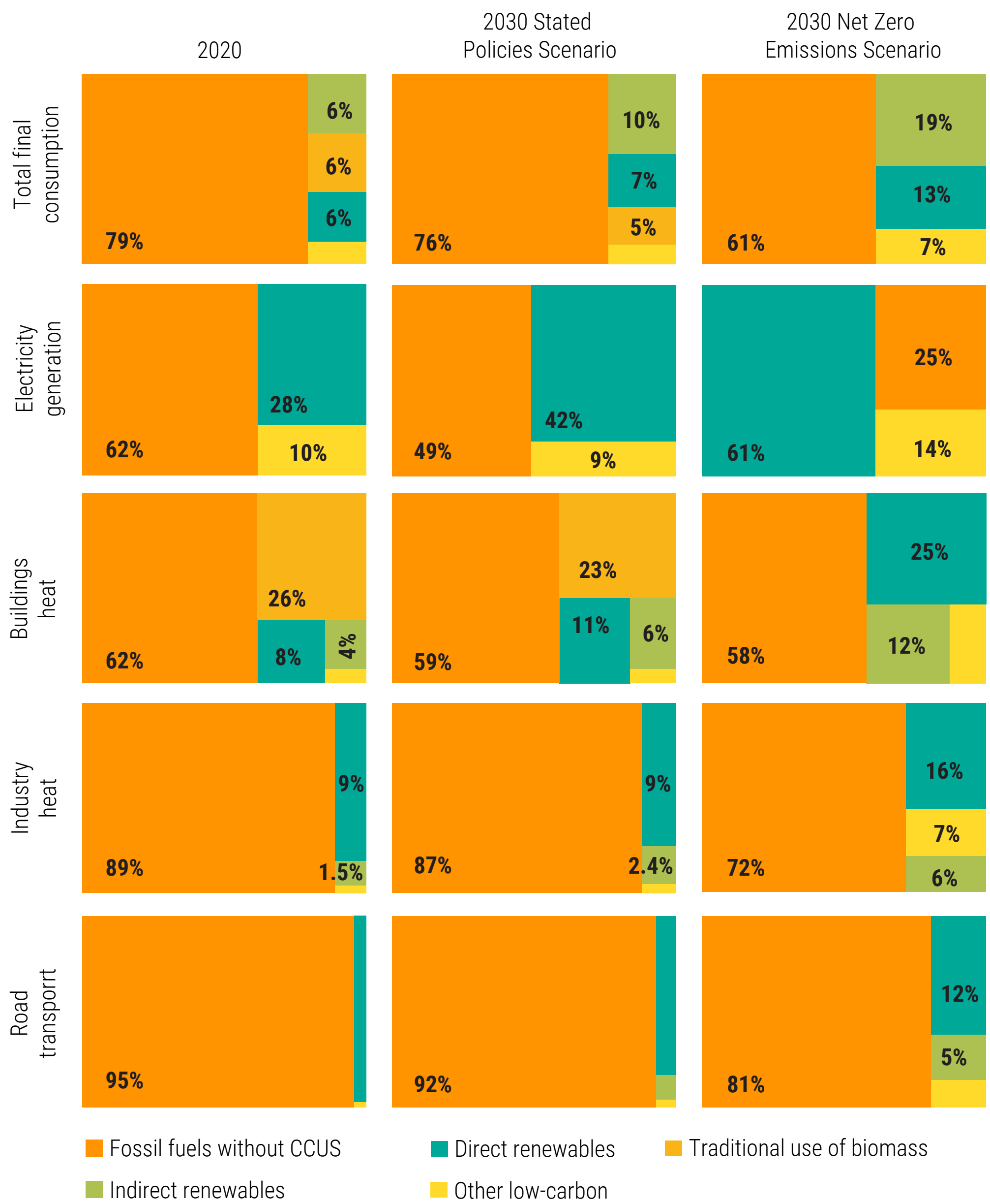
Expansion of the direct use of renewables in end-use sectors has been steady but slower. Modern bioenergy accounts for the lion's share of growth in end-use renewables through 2030. In the transport sector, biofuels see strong growth, although their use will be limited if new blending requirements are not adopted in places where they do not currently exist. Renewables for heat grow, with modern bioenergy accounting for the largest share of the growth, driven by renewable requirements in Europe and some pilots in China. Demand for biogas and modern biomass for heating also increases, driven by growth in industry (IEA 2021).

The outlook for growth for end-use renewables depends to a large extent on further policy action at a time of economic difficulty and competing budgetary pressures. There is a risk that some targets may not be enforced or that implementation dates may be delayed as a result of pressures arising from the COVID-19 pandemic. Supportive policies may play a big role in recovery packages, especially for transport biofuels, which would support agricultural production as well as emissions reductions.

INSIGHTS ON BRIDGING THE GAP FROM IEA'S NET ZERO EMISSIONS BY 2050 SCENARIO

The projected increases in the use of renewable energy that are likely to occur under stated policies fall short of what is required to achieve global goals for climate protection and sustainable development. Under IEA's Net Zero Emissions by 2050 Scenario, use of renewables increases twice as rapidly as under stated policies. Under this more ambitious scenario, modern renewables would reach just under 32 percent of TFEC in 2030 (figure 6.3).

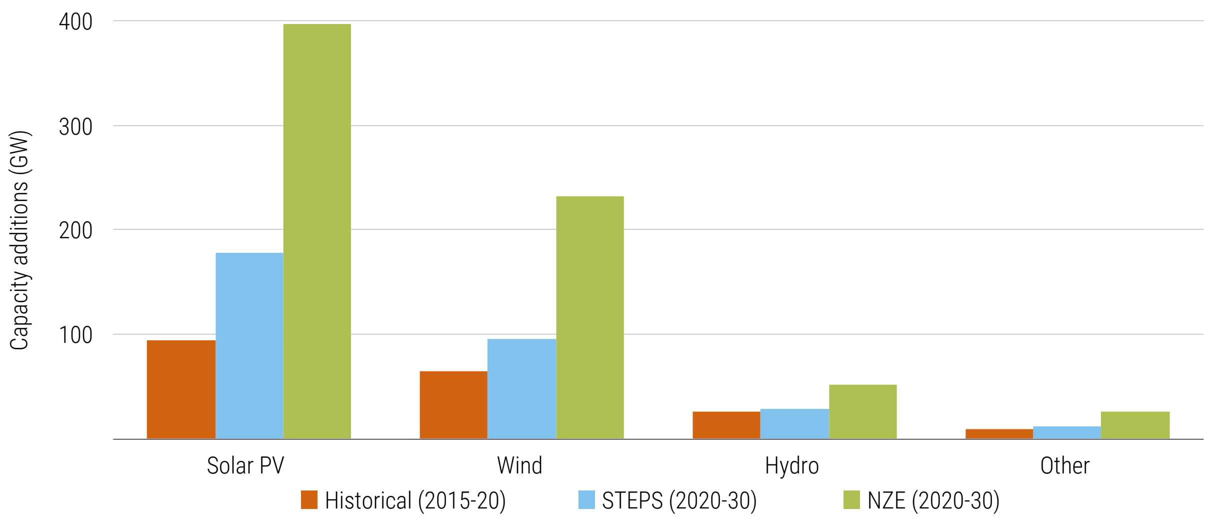
Figure 6.3 • Share of renewables in total final energy consumption under the IEA Net Zero Emissions by 2050 Scenario, 2010–30



Source: IEA 2021.

The share of renewables-based electricity generation increases most rapidly, increasing its current share to just over 50 percent by 2030, or almost 14 percentage points higher than in the Stated Policies Scenario. At the global level, electricity generation from renewables-based electricity generation increases by 8 percent a year to almost 16,200 terawatt-hours (TWh) by 2030, or more than five times the amount of electricity generated in the United States today from all sources (figure 6.4). Investment in renewables-based power doubles to over USD 600 billion a year, supported by additional spending on expanding and modernizing electricity networks and battery storage and enhancing the operational flexibility of existing assets to better integrate renewables.

Figure 6.4 • Annual additions to average renewable power generation capacity under the IEA Net Zero Emissions by 2050 compared with the Stated Policies Scenario and historical additions, by technology



Source: IEA 2021.

Under IEA's Net Zero Emissions by 2050 Scenario, increased electrification of energy end uses is a primary means to increase renewables' share of TFEC. The share of electricity in final energy demand rises to 26 percent by 2030, compared with about 23 percent under the Stated Policies Scenario. The electrification of transport and heat are the primary drivers of this electrification. Direct renewables, principally biofuels, make up 15 percent of road transport fuel, on average; combined with growing electrification, the share of renewables in transport rises to nearly 12 percent (IEA 2021).

The use of renewables for heat applies to space and water heating, cooking, industrial processes, and other uses. It can be provided directly by bioenergy, solar thermal, or geothermal or indirectly through electricity and district heat produced from renewable sources. Switching to the direct use of renewables—through the use of solar thermal water heating, biomass, and low-carbon gases, for example—can also reduce the use of fossil fuels. In 2020, renewables accounted for 8 percent of total energy consumed for heating worldwide. By 2030, this share increases to 18 percent under the Net Zero Emissions by 2050 Scenario. The share of traditional uses of biomass falls to 5 percent of TFEC by 2030 under the Stated Policies Scenario; under the Net Zero Emissions by 2050 Scenario, traditional uses of biomass are phased out completely, as developing countries replace them with more modern and efficient fuels and technologies.

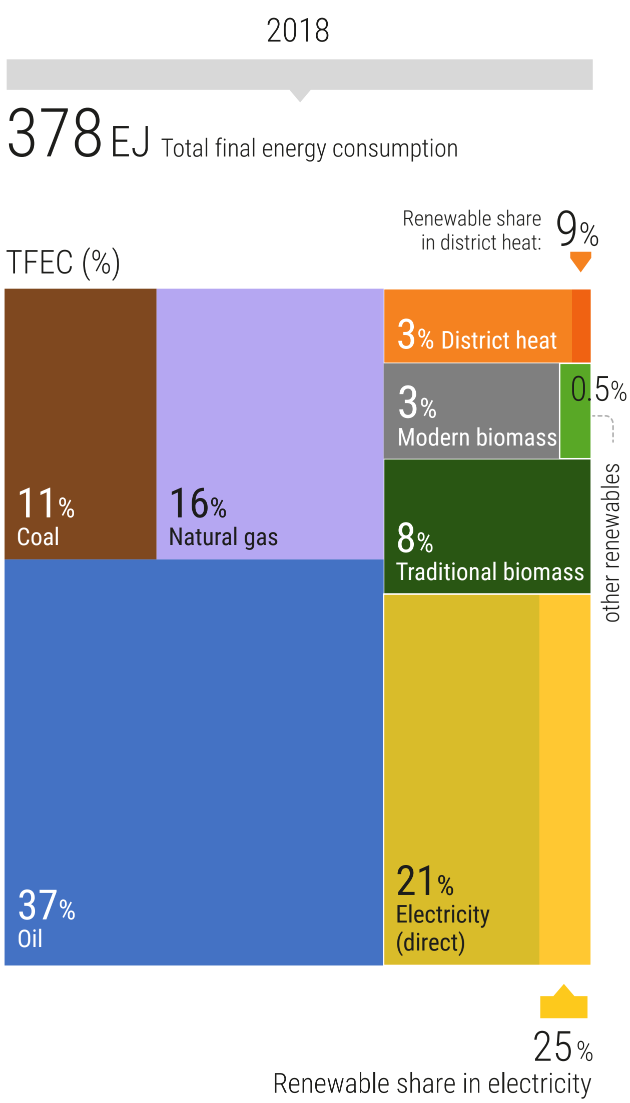
Across regions, variations in energy policy, socioeconomic trends, and natural resource endowments result in different growth trajectories for renewables. Developing economies account for two-thirds of the growth in electricity generation through 2030 under both the Stated Policies and Net Zero Emissions by 2050 Scenarios. Under the Stated Policies Scenario, the outlook for electricity generation from renewable sources ranges from 9 percent in the Middle East and 17 percent in North Africa, at the low end, to over 79 percent in Central and

South America, where hydropower is the backbone of the power mix. Under the Net Zero Emissions by 2050 Scenario, the share of renewable electricity generation increases in every region, approaching or surpassing half of all electricity generation by 2030 in many regions.

INSIGHTS ON BRIDGING THE GAP FROM IRENA'S 1.5°C SCENARIO

IRENA's 1.5°C Scenario requires the scaling up of all possible renewable energy and energy-efficient solutions (figure 6.5). It entails a massive transformation of how societies consume and produce energy. The decade to 2030 will be crucial for scaling up no-regret options such as electrification with renewable energy and energy efficiency solutions in industry, transport, and buildings. Under IRENA's 1.5°C Scenario, the share of renewables in TFEC will rise from 17 percent in 2018 to 38 percent by 2030.

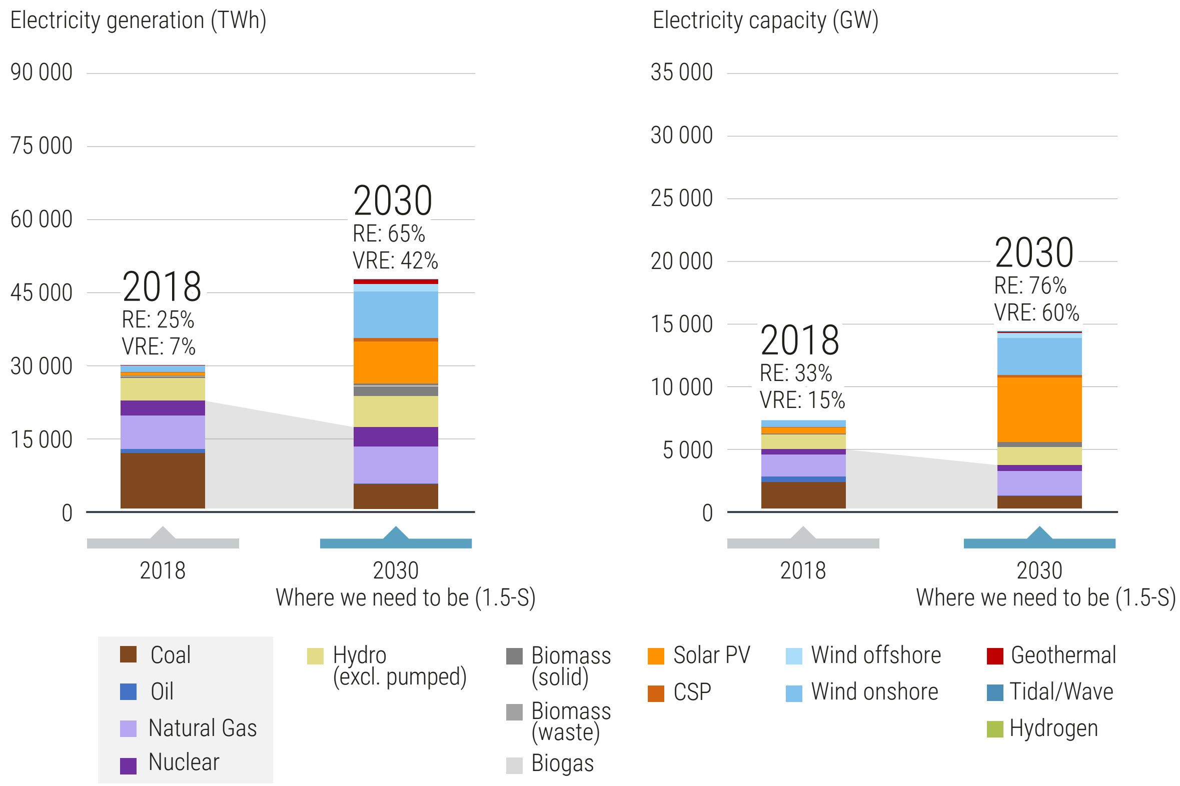
Figure 6.5 • Total final energy consumption by energy carrier in 2020 and 2030 under IRENA's 1.5°C Scenario



Source: IRENA 2021.
DH = district heat; RE = renewable energy.

Advancing the energy transition at the pace and scale needed would require the almost complete decarbonization of the electricity sector by mid-century. Under the 1.5°C Scenario, rapid electrification of heat and transport applications along with the rise of green hydrogen production would drive significant increased demand for electricity. By 2030, renewables would supply 65 percent of total electricity needs (figure 6.6). Such a transition in the global electricity sector could be realized by accelerating the deployment of all forms of renewable power technologies, including wind (onshore and offshore), solar PV, hydro, biomass, and geothermal. In parallel, additional flexibility in the power sector will be required. Although the types of technologies and solutions are power system specific, key technologies include storage, greater interconnection, market and regulatory reforms, and demand response, among many others.

Figure 6.6 • Electricity generation and capacity in 2018, 2030, and 2050 under IRENA's 1.5°C Scenario, by source



Source: Adapted from IRENA (2021).
Note: 1.5-S = 1.5°C; CSP = concentrated solar power; GW = gigawatts; PV = photovoltaic; RE = renewable energy; TWh = terawatt hours; VRE = variable renewable energy

Apart from deploying renewables in the electricity sector, direct uses of renewables—such as bioenergy, solar thermal, and geothermal—are bringing much-needed solutions in transport, buildings, and industry. Under the 1.5°C Scenario, the direct use of renewable energy would need to grow to 55 exajoules (EJ) in 2030, up from 45 EJ in 2020. TFEC will include approximately 111 EJ of direct electricity use by 2030.

Direct electricity consumption in end-use sectors (including direct use of electricity but excluding indirect uses, such as e-fuels) would increase by more than 31,000 TWh by 2030. Transport and hydrogen production would emerge as new electricity markets. In addition to the rapid rise in direct electrification needs, 5,200 TWh would be needed to produce green hydrogen by 2030. In total, the direct and indirect electrification share would reach 58 percent of final demand. Under the 1.5°C Scenario, transport would see the most accelerated electrification in the coming decades. The stock of electric cars would rise from 10 million in 2018 to over 380 million by 2030. The share of electricity in final energy consumption would rise from 1 percent in 2020 to 9 percent by 2030. Technological progress, including the evolution of batteries, has greatly improved the economic case for electric vehicles in recent years, and the scope of application is quickly expanding to a broader set of road vehicle segments and types of services.

Under IRENA's 1.5°C Scenario, green and blue hydrogen production would grow from negligible levels today to 19 EJ (154 million metric tons) by 2030. The production of clean hydrogen and its derivative fuels must ramp up from negligible levels today to 154 Mt by 2030.[4]

Under the 1.5°C Scenario, the role of carbon capture and storage (CCS) is limited to targeting process emissions from cement, iron and steel, hydrogen, and chemical production, with limited deployment for waste incinerators. Total carbon dioxide (CO2) captured from CCS, carbon capture and utilization, bioenergy coupled with CCS, and other CO2 removal measures[5] must be aggressively scaled up to reach 2.2 gigatons of carbon dioxide (GtCO2) by 2030, from 0.004 GtCO2 today.

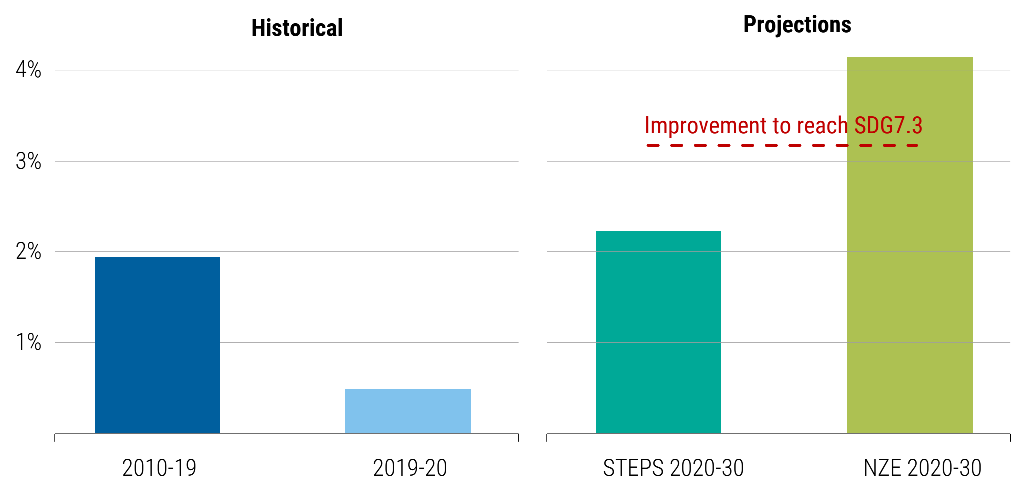
4 Clean hydrogen here refers to the combination of hydrogen produced by electrolysis powered from renewables (green hydrogen) and hydrogen produced from natural gas in combination with carbon capture and storage by steam methane reforming (blue hydrogen).

5 CO2 removal measures and technologies include nature-based measures such as reforestation as well as, direct CCS, bioenergy with CCS, and other approaches that are currently experimental.

THE OUTLOOK FOR ENERGY EFFICIENCY

Global energy intensity, measured by the ratio of total energy supply to GDP, is the key indicator used to gauge global progress on energy efficiency. The COVID-19 pandemic created distortions in this metric, as lockdowns constrained normal energy consumption habits and shifted GDP totals. However, it also slowed the progress of real energy efficiency gains, as the turnover of efficient equipment stocks slowed and projects to improve efficiency in buildings and industries slowed amidst constraints introduced by government responses to the pandemic. Early estimates for 2021 indicate a slight recovery, with an energy intensity improvement rate of 1.9 percent. Greater attention to energy efficiency policies and incentives for retrofits in Europe, North America, and East Asia raises the outlook in the Stated Policies Scenario to 2.3 percent, slightly stronger than progress on energy intensity over the decade ending in 2019 (figure 6.7).

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



Source: IEA 2021.

The improvement in the Stated Policies Scenario came against the background of a previous slowdown that occurred in the wake of strong improvements in energy intensity in the mid-2010s. That slowdown was in large part triggered by trends in China, where decades of progress in phasing out inefficient industrial capacity have now replaced most capacity with modern production processes. Increased action in China and elsewhere has helped compensate for the slowdown, but annual improvements are still far below where they need to be. Annual improvement until 2030 will now need to average 3.2 percent if the world is to meet the target set in SDG 7.3.

The lingering effects of COVID-19 are expected to continue to affect the trends in the Stated Policies Scenario, as improvements some sectors, such as aviation, remain lower than in previous years, even though economic activity in many parts of the world has recovered to pre-COVID levels. In addition, the large increase in industrial activity in China as a result of increased demand for durable goods worldwide during the pandemic is expected to subside in the coming year.

The COVID-19 crisis has also altered assumptions about the coupling of energy use and GDP. Increased teleworking and reduced business travel are expected to be lasting trends, and increased consumption of durable goods is likely to subside, as more people resume spending on services and travel. Accordingly, the Stated Policies Scenario in 2021 assumes that some of these impacts improve energy intensity while others, such as increased preference for SUVs, continue to reduce it.

Volatile fuel prices coming out of the pandemic have also informed global policy responses and could have an important influence on the rate of energy efficiency improvements. Many importing countries are already implementing policies to shield consumers from price spikes in natural gas (concentrated in Europe), coal (concentrated in China), and LPG (concentrated in developing economies). These price shocks have resulted in many governments providing financial supports that are draining government coffers and driving a renewed zeal for energy efficiency projects. Although payback periods were extended by 20–40 percent for end users at the peak of the pandemic, they have been all but erased by the price rallies, which are set to continue with the war in Ukraine. Enhanced energy efficiency mandates and incentives could be seen as a more economic alternative to household price supports and could inform the next phase of recovery response measures, alongside mandates for fuel storage facilities, the increased use of renewables, and extensions of the life of existing plants, all of which are under consideration in many countries to reduce dependence on oil and gas, particularly in Europe.

Energy efficiency is one of the building blocks of IEA's Net Zero Emissions by 2050 Scenario. As a result of the pandemic, TFEC declined in 2020 and 2021, but it is now set to recover. The accelerated improvements in energy efficiency under IEA's Net Zero Emissions by 2050 Scenario occur across all energy end uses and cause global energy to peak before 2025 and decline rapidly thereafter. In order to realize the Net Zero Emissions by 2050 scenario, the world must overshoot the SDG 7.3 target, improving energy intensity by 4.2 percent between 2020 and 2030, instead of the 3.2 percent needed to reach the target. This acceleration requires more stringent standards and incentives as well as bans of the sale of inefficient stock.

Under the IEA Net Zero Emissions by 2050 Scenario, global primary energy demand declines by 6 percent between 2020 and 2030, with advanced economies leading the way, decreasing total primary energy demand by 15 percent over this period. This decline occurs despite strong economic growth.

Early implementation of efficiency improvements across all sectors is essential to move to a more sustainable trajectory. In the transport sector, improvements in efficiency mean that on average, conventional passenger cars sold in 2030 will consume 30 percent less energy than they did in 2019, and new trucks will consume 20 percent less fuel. By 2030, electric cars will account for over 60 percent of car sales (up from 4.6 percent in 2020), and fuel cell or electric vehicles will account for 30 percent of heavy truck sales (up from less than 0.1 percent in 2020). There will also be substantial reductions in indirect emissions from appliances and air conditioners. By 2030, over 80 percent of household appliances and air conditioners sold in advanced economies will be the most efficient available technologies by 2025 under the Net Zero Emissions by 2050 Scenario. Emerging market and developing economies will reach this 80 percent level by the mid-2030s. In industry, the efficiency of industrial facilities will improve, thanks to the deployment of improved electric motors, heat pumps and agricultural irrigation pumps, and the wider implementation of energy management systems.

IEA's Net Zero Emissions by 2050 Scenario also requires a ramp-up of energy efficiency programs to incentivize efficiency construction of new buildings and efficiency retrofits. These programs also help manufacturers accelerate upgrades to production lines so as to produce higher-efficiency equipment. Improvements in efficiency across all end uses in the buildings sector, as well as the achievement of universal access to clean cooking, will cause total energy demand in residential buildings to decline by almost a quarter between 2020 and 2030, despite a 25 percent increase in the provision of energy services as a result of population and economic growth. In the existing building stock, deep energy retrofits can reduce energy use by more than 60 percent. Around 30 percent of the worldwide building stock that will exist in 2030 has yet to be built; in some countries, including India, the figure is over 50 percent. However, nearly three-quarters of countries do not have mandatory energy codes for new buildings. Under the Net Zero Emissions by 2050 Scenario, all countries introduce mandatory energy-related building codes, and existing codes become more rigorous, reducing the average energy intensity of new buildings by nearly 50 percent over the 2020–30 period.

Under IRENA's 1.5°C Scenario, the average annual rate of energy intensity improvement would need to increase by 40 percent over 2010–19 levels between 2020 and 2030. A key step is the deployment of energy efficiency measures that improve technical efficiency, such as more efficient boilers, air conditioners, motors, and appliances. In the buildings sector, all new building constructions would need to be zero energy from 2030 onward. For existing buildings, the rate of renovation will need to double, to 2 percent of the building stock a year through 2030.

INVESTMENTS NEEDED TO ACHIEVE SDG 7

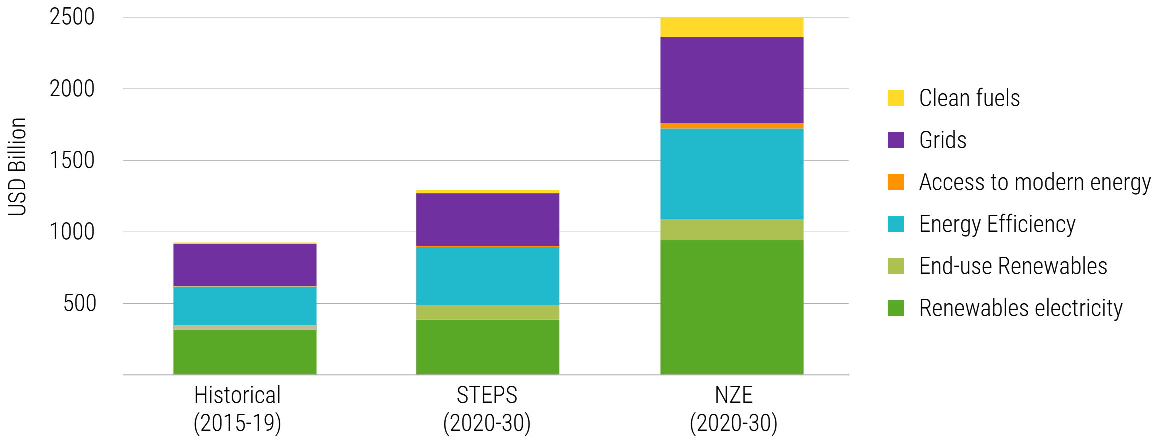
Outlooks from both IEA and IRENA stress the urgency of scaling up investments in the energy transition. Under IEA's Net Zero Emissions by 2050 Scenario, the total energy sector investments needed to achieve the SDG 7 targets must ramp up to USD 4 trillion by 2030, with an average of USD 2.7 trillion a year between 2020 and 2030 (figure 6.8). By 2030, investment under the Stated Policy Scenario reaches only USD 1.7 trillion, with the annual average being only USD 1.4 trillion.

The majority of the investment required to meet SDG 7 under the Net Zero Emissions by 2050 Scenario is directed toward the generation of renewable electricity (including batteries) and end-use efficiency, which account for USD 1,140 billion and USD 670 billion a year, respectively. Renewables-based power investment needs to be supported by additional average annual spending of USD 600 billion on the expansion and modernization of electricity networks.

Under the IEA Net Zero Emissions by 2050 Scenario, the average annual investment required from 2020 to 2030 to reach full energy access in developing economies is USD 35 billion for electricity access and USD 6 billion (more than six times the 2020 level) for clean cooking access; more than half of this investment takes place in Sub-Saharan Africa (IEA 2021). Reaching these levels of investment for access would represent only 2 percent of total energy investment worldwide in 2019.

Financial resources available for funding expansion and upgrades of electricity and clean cooking access have been inadequate to achieve full access. Between 2013 and 2019, an average of USD 12 billion a year was spent increasing electricity access in 20 countries representing 80 percent of the world's population without access to electricity; in the same period, about USD 70 million was spent each year on clean cooking in the 20 countries with the largest number of people lacking access (SEforAll 2019). International support through development aid and multilateral development banks will be essential to mobilizing these levels of investment and de-risking access and other energy investments in emerging market and developing economies.

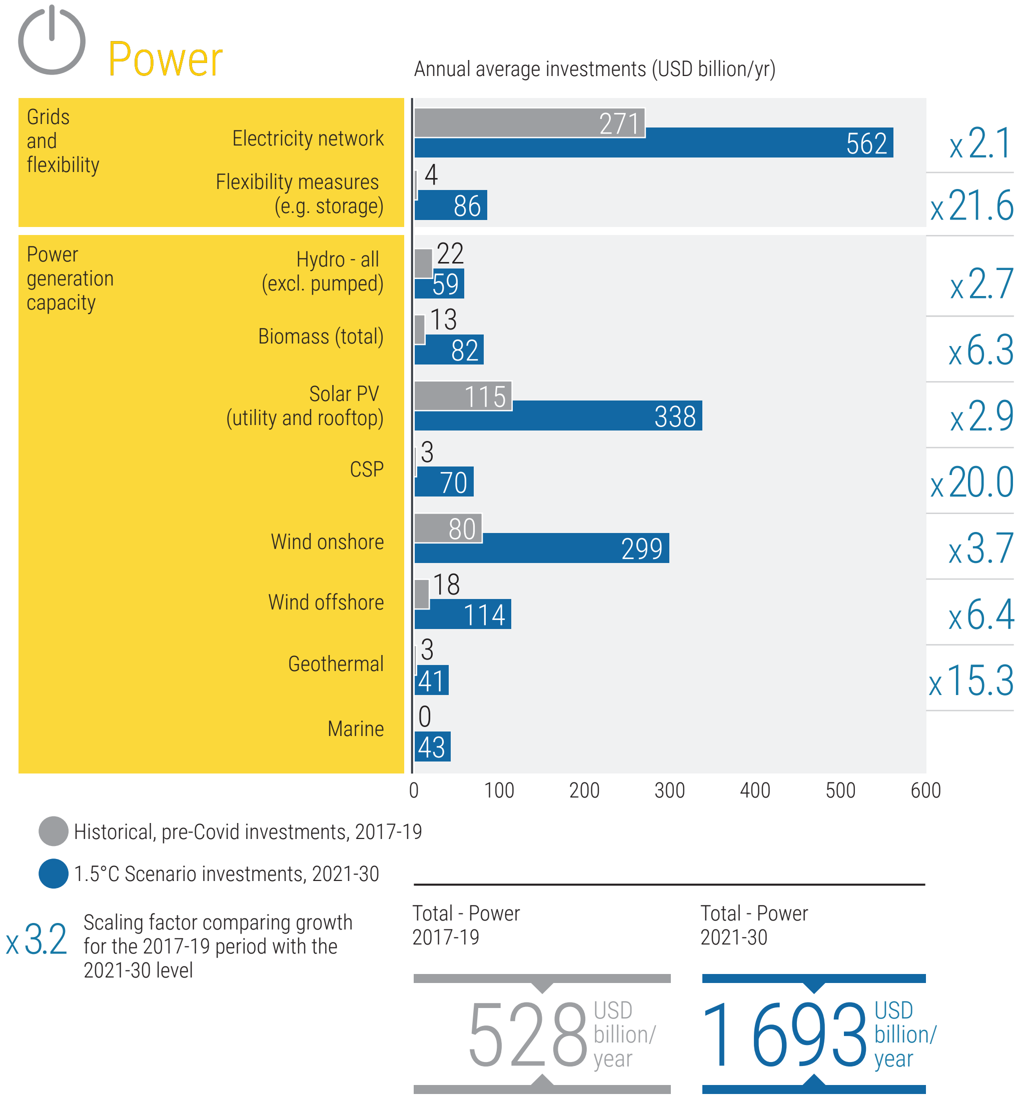
Figure 6.8 • Average annual investment in selected technologies under IEA's Net Zero Emissions by 2050 Scenario, 2020-30



Source: IEA 2021.

Under IRENA's 1.5°C Scenario, annual investment in renewables, efficiency, related electricity infrastructure/grids and flexibility measures, and hydrogen and biofuel supply amounts to just under USD 5 trillion a year through 2030 (figure 6.9)—more than a 60 percent over current plans and policies. In the power sector, increasing generation capacity would require accelerated investment of USD 1.7 trillion a year. Investments of USD 1.1 trillion a year would be required for related infrastructure, including grid extension and grid flexibility measures, ranging from better forecasting of renewable power generation to integrated demand-side flexibility and stationary battery storage (so-called Power to X). In the buildings sector, investment would be dominated by energy efficiency investments, which would account for USD 1.5 trillion a year. Investments in bioenergy supply would increase to USD 226 billion a year, and investments in electrolyzers, hydrogen supply infrastructure, and renewables-based hydrogen feedstocks for chemical production would average more than USD 88 billion a year. Investments in charging infrastructure for electric vehicles would rise to USD 26 billion a year. These increases in energy investment would have substantial socioeconomic implications for regions in which these investments are deployed (box 6.3).

Figure 6.9 • Average annual investments required between 2021 and 2030 under IRENA's 1.5°C Scenario, by technology and measure



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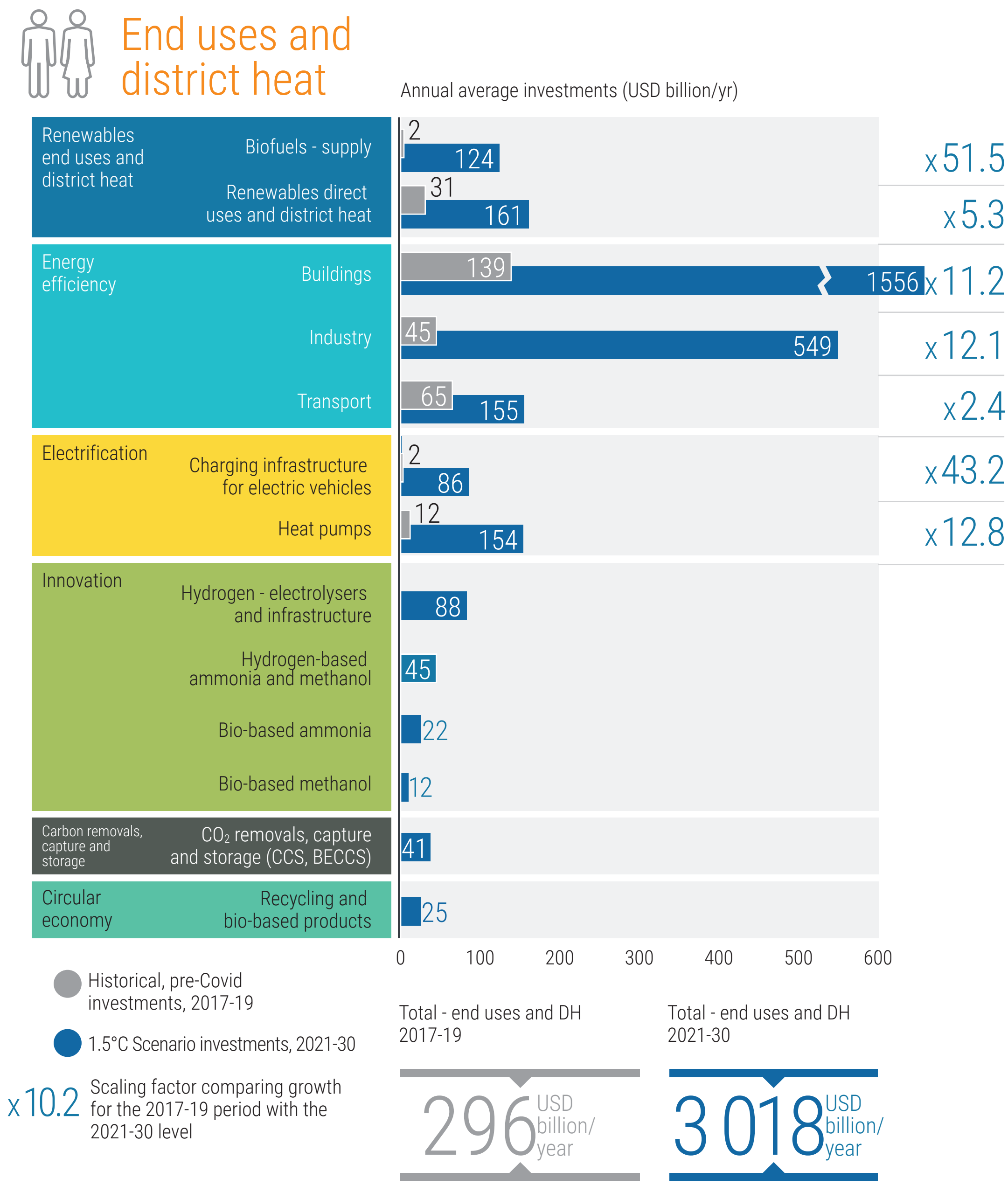


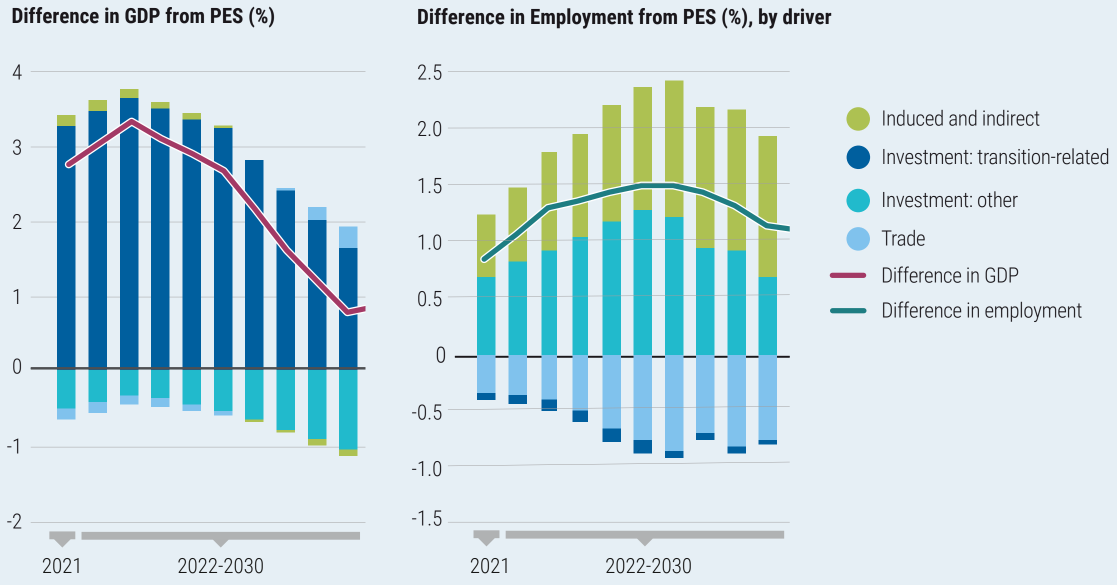
Source: Adapted from IRENA (2021).

Box 6.3 • Socioeconomic footprint of the energy transition

The energy transition will have positive impacts on socioeconomic structure. Compared with the Planned Energy Scenario, GDP is 2.4 percent higher under the 1.5°C Scenario over the period 2021–30. Investment under the 1.5°C Scenario, together with a set of enabling policies, also help create jobs throughout the economy, with the number of additional jobs peaking at 51 million in 2030.

As policy ambition and investment in the energy transition climb, so does energy sector employment. Sector employment is set to reach 137 million jobs under the 1.5°C Scenario, 26 million more than under the Planned Energy Scenario (figure B6.3.1). Nearly 80 percent of these jobs are energy transition related. By 2030, the number of jobs reaches 45 million in energy efficiency and almost 38 million in renewables—a total increase of 130 percent over 2021. Solar energy creates the largest number of jobs, followed by bioenergy and wind energy.

Figure B6.3.1 GDP and employment under the Planned Energy and 1.5°C Scenarios, 2021–30



Source: Adapted from IRENA (2021).

PES = Planned Energy Scenario

IRENA's Energy Transition Welfare Index captures five dimensions of prosperity and well-being—economic, social, environmental, distributional, and energy access—combining them in an index that ranges from 0 to 1. This index reaches 0.34 under the 1.5°C Scenario, well above the 0.25 under the Planned Energy Scenario. Reaching universal access under the 1.5°C Scenario contributes significantly to this improved outcome. It has cross-cutting impacts across several welfare dimensions, including economic (through higher incomes, consumption, and employment); social (through lower health impacts of traditional fuels); and distributional. The Energy Transition Welfare Index measures access itself (the share of the population with access) as well as its sufficiency over time (progression along the energy ladder). Use of both indicators concurrently facilitates a discussion beyond the achievement of universal access by 2030, which is usually defined in binary terms, to address inequalities in consumption across regions and opportunities to link energy access with income-generating services that generate strong socioeconomic dividends over the long term. In sum, the more ambitious transition pathway is not only fully compliant with the needs of the Paris Climate Agreement, but it also offers significant benefits in terms of GDP, jobs, and welfare.

Source: IRENA 2021.

CONCLUSION

Innovative policies and technologies continue to emerge and bring benefits to the energy sector, but the impact of the COVID-19 pandemic set progress back in ways that were not foreseen in 2019. Not only is the world not on track to reach SDG 7 under current and planned policies, some targets are even farther away than they were.

Recent improvements in increasing energy access in Africa are being reversed. After declining over the previous six years, the number of people without access to electricity increased in 2020.

At the same time, the perceived risk of lending money to a number of developing countries has increased dramatically, making it more expensive for those countries to raise debt finance for energy technologies and improve energy access.

The outlook looks more positive for renewables and efficiency. Low oil and gas prices were originally projected to be a barrier to the uptake of clean energy technologies and energy efficiency under IEA's Stated Policies Scenario. Rising prices in 2021 and recovery plans in key economies focused on renewables and efficiency make the outlook for renewables and efficiency stronger than it was a year ago. Recent price spikes and the crisis in Ukraine have also increased uncertainty in global oil and gas markets, putting renewed pressure on net importers to reduce exposure. Renewables, efficiency, and electrification are likely to play major roles in the policy responses to these events. These responses need to be substantial and reach beyond advanced economies if the world is to achieve the energy-related SDGs.

Continued efforts are also required in terms of annual improvements in global energy intensity need to double to an average of 3.2 percent if the world is to meet the target set in SDG 7.3; in the Net Zero by 2050 Scenario, energy intensity needs to reach 4.2 percent. The ongoing slump in economic activity and lingering economic uncertainty are likely to result in slower turnover of capital stock, but the inclusion of provisions for efficiency in some countries' economic recovery packages partially offsets that effect. Solar PV and wind remain the fastest-growing sources of energy globally. To align with the Net Zero by 2050 and 1.5° scenarios, more policy support for renewable integration, electrification, and decarbonization will be needed.

Getting on track toward meeting SDG 7 depends partly on how governments continue to support clean energy and energy access investments. In advanced economies, initial support from recovery plans needs to evolve to more nuanced support that relies less on direct cash injections into the economy and more on de-risking and guarantees to continue advancing these objectives. More pressingly, significant investments in the energy transition in emerging market and developing economies are needed, particularly in light of diminishing fiscal leeway.

As policy makers chart the path ahead, it is worth bearing in mind that an energy transition ambitious enough to fulfill SDG 7 can also help meet other social and economic objectives. With holistic policies in place, the energy transition can foster sustainable economic growth, create jobs, and improve welfare.

METHODOLOGY

IEA METHODOLOGY

The analysis presented in this chapter is based on results from the World Energy Model (WEM) and IEA analysis in the *World Energy Outlook* (WEO). Detailed documentation of the WEM methodology can be found at https://www.iea.org/reports/world-energy-model/documentation#abstract.

IEA models two scenarios. The Stated Policies Scenario is designed to give feedback to decision makers about the course they are on today, based on stated policy ambitions. This scenario assumes that the COVID-19 pandemic is brought under control in 2021. It incorporates IEA's assessment of stated policy ambitions, including the energy components of announced stimulus or recovery packages (as of mid-2020) and the NDCs under the Paris Agreement. Broad energy and environmental objectives (including country net-zero targets) are not automatically assumed to be met. They are implemented in this scenario to the extent that they are backed up by specific policies, funding, and measures. The Stated Policies Scenario also reflects progress with the implementation of corporate sustainability commitments.

The Net Zero Emissions by 2050 Scenario is a normative IEA scenario that shows a narrow but achievable pathway for the global energy sector to achieve net-zero CO2 emissions by 2050, with advanced economies reaching net-zero emissions in advance of others. This scenario also meets the key energy-related SDGs, achieving universal energy access by 2030 and major improvements in air quality. This scenario is consistent with limiting the global temperature rise to 1.5°C without a temperature overshoot (with a 50 percent probability), in line with reductions assessed by the IPCC in its *Special Report on Global Warming of 1.5°C*. This scenario is based on the following assumptions:

- Uptake 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.
- An orderly transition occurs across the energy sector 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 ACCESS TO ELECTRICITY AND ACCESS 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. IEA maintains databases on the levels of national, urban, and rural electrification rates. For the proportion of the population without clean cooking access, the main sources are the World Health Organization (WHO) Household Energy Database and IEA's Energy Balances. Both databases are regularly updated and form the baseline for WEO energy access scenarios to 2040.

The projections in 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 to reach universal access to both electricity and clean cooking facilities. For electricity access, the analysis incorporates a Geographic Information Systems (GIS) model based on open-access geospatial data, with technology, energy prices, electricity access rates and demand projections from the WEM. This analysis was developed in collaboration with the KTH Royal Institute of Technology, Division of Energy Systems Analysis (KTH-dESA), in Stockholm. Further details about the IEA methodology for energy access projections can be found at https://www.iea.org/reports/world-energy-model/sustainable-development-scenario-sds#abstract.

METHODOLOGY FOR RENEWABLE ENERGY PROJECTIONS

The annual updates to WEO projections reflect the broadening and strengthening of policies over time, including for renewables. The projections of renewable electricity generation are derived in the renewables submodule of the WEM, which projects the future deployment of renewable sources for electricity generation and the investment needed. The deployment of renewables is based on an assessment of the potential of and costs for each source (bioenergy, hydropower, photovoltaics, concentrating solar power, geothermal electricity, wind, and marine) in each of the 25 WEM regions. In all scenarios, IEA modelling incorporates a process of learning-by-doing that affects the costs. By including financial incentives for the use of renewables and nonfinancial barriers in each market, technical and social constraints, and the value each technology brings to system in terms of energy, capacity, and flexibility, the model calculates deployment as well as the resulting investment needs on a yearly basis for each renewable source in each region.

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 WEM 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 end use, at least six types of energy are shown: coal, oil, gas, electricity, heat, and renewables. The main oil products—LPG, naphtha, gasoline, kerosene, diesel, heavy fuel oil, and ethane—are modelled separately for each final demand sector.

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

- Socioeconomic variables: GDP and population are important drivers of sectoral activity variables that determine 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 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 25 WEM regions for energy demand are modelled in considerable sectoral and end-use detail:

- Industry is separated into six subsectors (with the chemicals sector disaggregated into six subcategories).
- Building 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 (REmap)

The IRENA energy transformation scenario outlined in this report was developed by the Renewable Energy Roadmaps (REmap) team at IRENA's Innovation and Technology Centre, in Bonn. Since 2014, this team has produced a succession of roadmaps with ambitious yet technically and economically feasible pathways for deploying low-carbon technologies to create a clean, sustainable energy future at the global, regional, and country levels.

The findings presented in this report are based on IRENA's 2021 flagship publication *World Energy Transitions Outlook: 1.5°C Pathway*. It considers policy targets and developments through April 2020. The analysis in this report does not reflect any policy changes and targets announced since then.

The Planned Energy Scenario provides a perspective on energy system developments based on governments' energy plans and other planned targets and policies, including NDCs under the Paris Agreement. It also provides the reference case for IRENA's 1.5° Scenario. The 2021 Planned Energy Scenario covers the first round of NDCs.

The 1.5°C Scenario describes an energy transition pathway aligned with the ambition of limiting the average increase in the global temperature by the end of the century to 1.5°C relative to pre-industrial levels. It prioritizes readily available technology solutions that can be scaled up at the necessary pace to meet the 1.5°C goal.

For more information on the scenarios, methodology and scope of this work, please visit www.irena.org/remap.

IRENA socioeconomic modelling

IRENA has been analyzing the socioeconomic implications of transition roadmaps since 2016. Based on a global econometric model with high regional and sectoral resolution (E3ME, from Cambridge Econometrics), IRENA's methodology holistically captures the multiple interactions between energy transition roadmaps with its accompanying policy baskets and global and national economic systems.

The resulting socioeconomic footprint is evaluated at a high level of detail, generating insights that inform policy making for a successful transition. Socioeconomic footprint results include GDP (aggregated economic activity); employment (economywide and with high resolution within the energy sector); and welfare (using an index with five dimensions—economic, social, environmental, distributional, and access—each informed by several indicators).

A detailed driver's methodology is used to facilitate understanding of the mechanisms producing the socioeconomic footprint results, providing clearer insights on the links between transition goals and policies and their resulting impacts.

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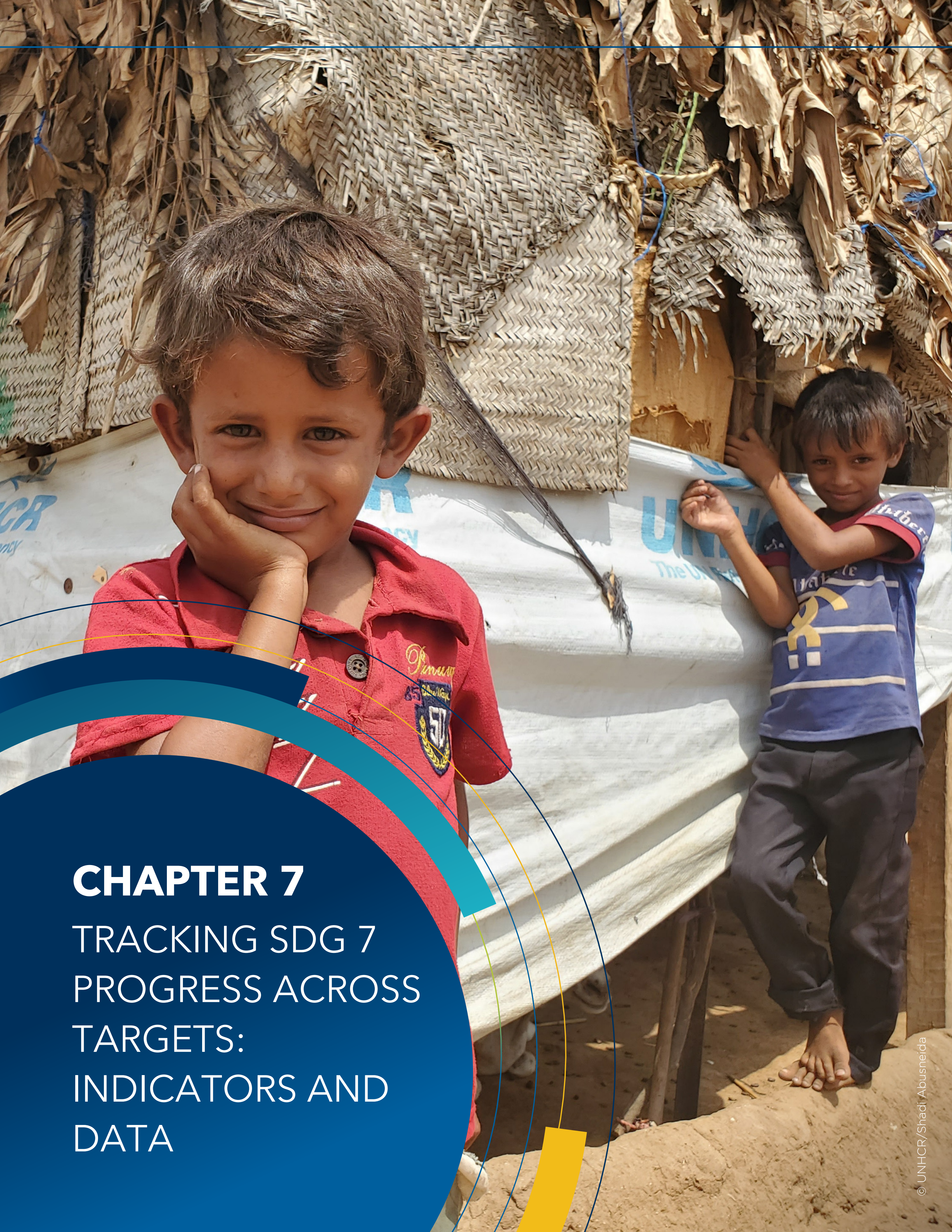

CHAPTER 7

TRACKING SDG 7 PROGRESS ACROSS TARGETS: INDICATORS AND DATA

A robust framework of indicators and statistical data is critical for tracking progress in policy goals, making evidence-based decisions, and ensuring accountability of stakeholders. Well-designed energy data collection with relevant resources strengthens national energy statistics and balances. The enhanced energy statistical systems help countries monitor their progress toward achieving Sustainable Development Goal (SDG) 7.

Continuous improvements in national data systems increase the quality of global tracking, as countries establish legal frameworks and institutional arrangements for comprehensive data collection of supply- and demand data for energy balances; implement end-user surveys (households, businesses, etc.); and develop quality-assurance frameworks. Institutional arrangements are set up to optimize data production, exchange, and governance across organizations, mainly statistical offices, and government agencies (energy ministries) responsible for implementing energy policies. Quality-assurance frameworks should be consistent with the United Nations' International Recommendations for Energy Statistics. Under IRES (United Nations 2018), data quality is marked by relevance, accuracy, and reliability; timeliness and punctuality; coherence and comparability; and accessibility and clarity. For quality-assurance frameworks, please refer to IRES, chapter IX.

The global tracking in this report is a collaboration among the custodian agencies responsible for the SDG 7 targets. Jointly, the agencies disseminate comparable datasets worldwide to improve the quality of global tracking. The World Bank and World Health Organization are responsible for tracking progress toward SDG target 7.1 (universal access). The International Energy Agency (IEA), International Renewable Energy Agency (IRENA), and United Nations Statistics Division (UNSD) are responsible for SDG target 7.2 (renewables). IEA and UNSD are responsible for SDG target 7.3 (energy efficiency). IRENA and the Organisation for Economic Co-operation and Development (OECD) jointly tracked target 7.a (international cooperation). IRENA is responsible for target 7.b (infrastructure and technology).

This chapter introduces the global indicators for the SDG 7 targets (table 7.1), followed by the data tables. For further information on the methodologies and approaches used for SDG 7 progress assessment, please refer to the final sections of each chapter or the United Nations' metadata repository for SDG 7 indicators.[1]

Table 7.1 • Targets and indicators for SDG 7

Target	Indicator
7.1—By 2030, ensure universal access to affordable, reliable, and modern energy services	7.1.1—Proportion of population with access to electricity
	7.1.2—Proportion of population with primary reliance on clean fuels and technology for cooking
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
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
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
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 countries (in watts per capita)

1 Metadata repository for SDG Indicators: https://unstats.un.org/sdgs/metadata/

ACCESS TO ELECTRICITY

Measuring access enables governments and practitioners to understand the status of electricity access and to implement the 2030 agenda in more efficient ways. Tracking progress on electrification is a complex process that must be conducted across interventions by national and international players, including governments, energy utilities, private sector companies, funding agencies, and multilateral development organizations. The socioeconomic complexity of low-income and fragile countries has raised particular challenges in tracking progress. In addition, the scaling-up of decentralized energy solutions encompasses a mix of technologies, such as grids, mini-grids, and off-grid solutions. Therefore, measuring cumulative progress requires a universally applicable and transparent approach.

Most microdata from household, enterprise, and agricultural surveys provide energy practitioners and ministries of energy with useful information. However, data collection requires substantial efforts to understand socioeconomic effects and energy access status. Thus, data should be standardized to help end users employ such datasets effectively in project design and policy formulation.

Assessments should include the number of people benefitting from the interventions and the nature and magnitude of improvements in electrification. To identify investment priorities and better track progress, several international agencies worked together to produce the Multi-Tier Framework (MTF), launched in 2016, which national statistical offices and international agencies use to measure a spectrum of service levels experienced by households—capacity, availability, reliability, affordability, quality, formality, and health and safety. The contributing agencies for the development of the MTF were the Energizing Development Program (EnDev), the Energy Sector Management Assistance Program at the World Bank, the Global Alliance for Clean Cookstoves, IEA, Practical Action Consulting, the UN Development Programme, the UN Industrial Development Organization, the World Bank, and WHO.

Where data are not available for multi-tier metrics, standardized country-level surveys and supply-side administrative data complement the MTF approach.

To improve the tracking of access to electricity, the capacity of national statistical offices to collect energy data must be further developed (e.g., workshops)[2] and the usability of datasets improved by helping governments and energy practitioners apply new technology and data analytics, as survey design can be interrupted by outdated surveys or infrequent publication of censuses. Finally, exploring the use of large-scale open databases, such as satellite data, will help identify energy access and quality gaps, as well as socioeconomic trends.

2 The World Bank and UN Economic and Social Commission for Western Asia organized a webinar on SDG indicator 7.1.1 to create a common understanding among data producers on data methodology. More details are available at https://www.unescwa.org/sites/default/files/event/materials/Report%20-%20ESCWA_World%20Bank%207.1.1.pdf

ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING

Cooking is a universal household energy need. To track progress away from health-damaging cooking practices, SDG 7.1.2 measures the number of people using clean fuels and technologies as their main energy source for cooking in the household. Households considered to have access to clean cooking are those primarily relying on electricity, biogas, solar, alcohol fuels, natural gas, and liquefied petroleum gas (LPG) for household cooking. Here, "clean" refers to the emission rate targets from specific fuels and technologies.

Household surveys are currently the main primary data source for analyzing the fuels and technologies used for cooking. The extent to which these surveys comprehensively capture modes and duration of fuel and technology use is therefore vital for designing, implementing, and monitoring the effectiveness and outcomes of clean cooking policies and programs. Improved data collection on the parallel use of multiple cooking solutions (also known as "stove stacking") in households in low- and middle-income countries delivers more complete representation of the population exposed to pollution and the resultant diseases. In addition, country-level estimates of clean cooking access are used to understand the disease incidence rate caused by household air pollution—ultimately the "mortality rate from the joint effects of ambient and household air pollution," an important SDG indicator for environmental health (SDG indicator 3.9.1).

Country and regional estimates are produced using a Bayesian multilevel model to monitor the SDG 7 on access to clean cooking as well as the SDG 3 target on health impacts from air pollution, as detailed in the methodology section of chapter 2.

Enhanced surveys can also better help monitor the trends and outcomes of clean cooking access. For instance, the clean cooking access estimates in this report were generated by combining advanced modeling techniques with robust data on the specific fuels mainly used by households for cooking. This enabled a richer disaggregation of estimates into the specific fuels used, including biomass, charcoal, coal, kerosene, gaseous fuels, and electricity across countries and regions (Stoner et al. 2021).[3] Employing the specific fuel-use estimates, decision-makers can more readily track the trends and outcomes of policy changes, such as subsidies and tariffs.

Refinement in household surveys and censuses enables countries to gain a more complete picture of household energy use, notably clean cooking fuels and technologies, and their effects on air pollution. Steps have already been taken in this direction to develop a harmonized and robust set of questions for national household surveys and censuses.

3 These estimates are available for download from https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/household-air-pollution.

RENEWABLE ENERGY

The share of renewables in total final energy consumption (TFEC) is assessed to track progress toward the SDG 7.2 target for renewable energy. Good tracking of renewable energy depends on comprehensive data across all energy sources (renewable and nonrenewable) and sectors of supply, transformation, and final consumption. The computation of the indicator is based on the availability of a full supply-demand energy balance and certain assumptions about electricity and heat. IRES (United Nations 2018) details the methodology used to derive TFEC, the total energy supply, and energy balances.

Two of the main methodological challenges in increasing the accuracy of tracking renewables are (1) monitoring the rapid development of geographically distributed sources, such as off-grid and micro-grid solar PV and wind, and (2) improving the capacity of countries to measure traditional uses of biomass (solid biofuels) by households, the largest share of renewable energy in developing countries.

Enhancements to national-level household and industry surveys are essential to improve the quality of data for solid biofuel use in households. Survey-based results are valuable in filling data gaps, and they commonly lead to significant revisions of previous estimates, affecting the tracking of SDG target 7.2.

A broader range of questions about biomass is needed to determine the extent to which its use can be considered sustainable. For example, traditional fuelwood harvesting is associated with deforestation, although forests are technically considered renewable.

ENERGY EFFICIENCY

Energy intensity is measured to track SDG target 7.3 for energy efficiency. It is defined as the ratio of total energy supply to economic output.[4] Total energy supply comprises energy production across all sectors and trade in all types of energy products. The supply information is collected from administrative sources or through surveys of higher-level players, such as energy suppliers.[5] The information includes commercially traded energy sources and is of fairly good quality in most countries.

Tracking energy intensity is best done in conjunction with analysis of demand drivers across sectors, such as industry, transport, and buildings—both residential and services. Due to the diverse nature of end users, demand-side data collection tends to be more complex, time-consuming, and expensive than supply-side collection. Direct consumer surveys can complement data collection when energy suppliers cannot provide detailed information on how much energy is consumed by different types of users.

To analyze sectoral energy efficiency countries need to monitor intensities at the end-use level, at least in priority sectors. Examples of energy efficiency indicators include energy per passenger-kilometer (or tonne-km for freight), by vehicle type, for transport; energy for space heating/cooling per area, for buildings; energy per amount of physical production of a good, for industry. A methodological framework for energy efficiency indicators, as well as country experiences, can be found in IEA (2014).

Along with finer disaggregation of data, energy efficiency indicators require more coordination across entities related to activities beyond the energy sector, encompassing building records, vehicle registrations, industrial reports, and so on. Many countries have begun to collect end-use data and compile energy efficiency indicators to support their policy-making and planning.[6]

4 For more details, see IRES (United Nations 2018).

5 Data collected by various agencies in response to legislation and/or regulation, not necessarily for statistical purposes, may be used to compile energy statistics after ensuring quality and addressing limitations related to their different purposes.

6 Examples of projects are the IEA energy efficiency indicators, https://www.iea.org/reports/energy-efficiency-indicators-overview for IEA member countries and beyond; and the Odyssee database for Europe, https://www.indicators.odyssee-mure.eu/.

INTERNATIONAL FINANCIAL FLOWS TO DEVELOPING COUNTRIES IN SUPPORT OF CLEAN AND RENEWABLE ENERGY

To improve international collaboration, SDG indicator 7.a.1 tracks international public financial flows to developing countries in support of clean energy research and development and renewable energy production, including hybrid systems. The measurement of public financial flows draws from the databases prepared by IRENA and OECD. Because data on financial flows are susceptible to changes, scrupulous attention is needed to ensure standardized data collection and management cycles, and to revise commitment values.

There are four components to good measurement of international public investment flows: (1) tracking financial flows; (2) standardizing commitment details; (3) centralizing data collection; and (4) presenting flows in a constant way.

To track public financial flows, it is critical to understand how aid recipients intend to spend the investments for end-use projects or programs. ("Recipients" include end-use organizations and projects run by public investors.) The amount of private finance leveraged through public funds, already tracked by the OECD in its data on mobilizing private finance, makes a good complement to analyses of public financial flows. After the initial commitment, international financial flows are generally disbursed in multiple phases, passing through local governments, ventures, or funds. Some commitments may be cancelled or modified, affecting the data gathered to that point. Thus, where reporting institutions revise financial investment figures, historical investment information covering several years should be included to disclose any changes in amounts.

Commitment details can be standardized by sharing best practices among public investors and donors, refining reporting directives, and encouraging public investors and donors to provide energy details that comply with international standards. Standardization increases reporting accuracy for public financial flows, while also improving the level of commitment details. Details about commitments include technology, type of finance (e.g., project-level finance, infrastructure, research, or technical assistance), type of financial mechanism, and so on.

Collections of investment data often fail to take in energy-related details. Currently, the collection of most data on public investments in clean energy and renewables remains decentralized, reducing consistency. Therefore, data collection should be centralized through the use of preformatted questionnaires and online data-entry portals for comparability across public donors. The OECD's CRS database is exemplary in this regard.

International commitments need to adjust exchange rates and inflation to compare flows across countries. The flows should be deflated properly by countries and other institutions to account for currency rate changes and inflation. OECD methodology is used to deflate international flows by adjusting for inflation from the year the flows occurred to a baseline year (2019) and by converting local-currency values to U.S. dollars using exchange rates from the baseline year (2019).

INSTALLED RENEWABLE ELECTRICITY-GENERATING CAPACITY IN DEVELOPING COUNTRIES

Indicator 7.b.1 tracks the installed capacity of power plants that generate electricity from renewable energy sources, divided by the total population of a country. Capacity is defined as the net maximum electrical capacity installed at year-end. Capacity is a useful measure progress toward this target because it reflects country priorities: Many countries have increased production of electricity (particularly, renewable electricity) as a priority in their transition to modern and sustainable services. Renewable sources, according to the IRENA statute, are the following: hydropower; marine energy (ocean, tidal and wave energy); wind energy; solar energy (photovoltaic and thermal energy); bioenergy; and geothermal energy.

The capacity data 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 over the previous two years. The validated data by country are published each year in late June in IRENA's Renewable Energy Statistics Yearbook. Population data are extracted from the World Population Prospects, published by the United Nations Population Division. The population data represent the total population of a country at mid-year (July 1).

A measure of indicator 7.b.1 in watts per capita is computed by dividing renewable electricity generating capacity at year-end by the total population of the country for each country and year. The capacity data are drawn from the computation, and the data account for the immense variations in needs between countries. Population data are used instead of GDP, as population is the most basic indicator of country demand for modern and sustainable energy services.

The focus of this indicator on electricity capacity does not capture trends in the modernization of technologies used to produce heat or provide energy for transport, since electricity only accounts for about one-quarter of total energy use globally and an even lower share in most developing countries. However, with the trend toward electrification of end uses, electricity will become an increasingly reliable indicator of progress on electrification in developing countries.

CONCLUSION

Tracking global progress toward the targets of SDG 7 requires high-quality and reliable data for informed and effective policy-making at the global, regional, and country levels. Along with common frameworks for surveys, standardized methodologies for indicators are also needed. The quality of data can be improved through national and international cooperation and solid statistical capacity at the national level.

Collaboration between national statistical offices and relevant international or regional organizations across policy domains optimizes the use of data-collection resources. For example, household surveys can be designed to support tracking at end-use levels across SDG 7 targets and even other SDG targets, such as health, air pollution, and quality of life. The World Bank and the WHO have prepared a guidebook to integrate energy access questions into existing national household surveys to better track household energy use toward SDG 7.1 target (World Bank and WHO 2021). More support is needed to develop statistical capacity in countries and regions.

International cooperation in the compilation of global databases raises awareness of the need for good-quality data. As the custodian agencies work together on global tracking of SDG 7, they have found ways to refine their collaboration and to strengthen their support to countries. As an example, thanks to dedicated funding from the European Union, the IEA program on Sub-Saharan Africa works to improve energy statistics in ten focus countries. The SDG 7 custodian agencies emphasize the need to integrate funding for national energy data collection within current and planned international programs on energy transitions.

The custodian agencies appreciate the dedication and hard work of all the colleagues who contribute to energy data collection across national administrations. Thanks to their devoted work, the custodians have been able to improve tracking as part of the international effort to achieve the SDG 7 targets.

REGIONAL CLASSIFICATIONS OF COUNTRIES/TERRITORIES

This report classifies countries and territories according to the United Nations' SDG classification for regions, the MDG (Millennium Development Goals) classification for developing countries, and the special groupings for the least-developed countries (LDCs), landlocked developing countries (LLDCs), and small island developing states (SIDS). The SDG regional groupings are not the same as the M49 regional grouping that more closely distinguishes the geographical location of countries. The United Nations discontinued the developing countries classification in late 2021. This report will continue to use the most recent UN classification of developing countries to ensure continuity for indicators 7.a.1 and 7.b.1/12.a.1.

The groupings used in this report are presented in the table below.

Classification group	Countries/territories
Northern America and Europe *57 countries*	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, Hungary, Iceland, Ireland, Isle of Man, Italy, Jersey, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, Saint Pierre and Miquelon, San Marino, Serbia, Slovakia, Slovenia, Spain, Svalbard and Jan Mayen Islands, Sweden, Switzerland, Republic of North Macedonia, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America
Sub-Saharan Africa *53 countries*	Angola, Benin, Botswana, British Indian Ocean Territory, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, French Southern and Antarctic Territories, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mayotte, Mozambique, Namibia, Niger, 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, Zambia, Zimbabwe
Latin America and the Caribbean *51 countries*	Anguilla, Antigua and Barbuda, Argentina, Aruba, Bahamas, Barbados, Belize, Bolivia (Plurinational State of), Bonaire, Sint Eustatius and Saba, Brazil, British Virgin Islands, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Curaçao, Dominica, Dominican Republic, 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 *25 countries*	Algeria, Armenia, Azerbaijan, Bahrain, Cyprus, Egypt, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, State of Palestine, Sudan, Syrian Arab Republic, Tunisia, Turkey, United Arab Emirates, Western Sahara, Yemen

Oceania, excluding Australia and New Zealand *23 countries*	American Samoa, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Caledonia, Niue, 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 *18 countries*	Brunei Darussalam, Cambodia, China, China, Hong Kong Special Administrative Region, China, Macao Special Administrative Region, Democratic People's Republic of Korea, Indonesia, Japan, Lao People's Democratic Republic, Malaysia, Mongolia, Myanmar, Philippines, Republic of Korea, Singapore, Thailand, Timor-Leste, Viet Nam
Central Asia and Southern Asia *14 countries*	Afghanistan, Bangladesh, Bhutan, India, Iran (Islamic Republic of), Kazakhstan, Kyrgyzstan, Maldives, Nepal, Pakistan, Sri Lanka, Tajikistan, Turkmenistan, Uzbekistan
Australia and New Zealand *6 countries*	Australia, Christmas Island, Cocos (Keeling) Islands, Heard Island and McDonald Islands, New Zealand, Norfolk Island
Developed countries *66 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, Hungary, Iceland, Ireland, Isle of Man, Israel, Italy, Japan, Jersey, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, New Zealand, Norfolk Island, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, Saint Pierre and Miquelon, San Marino, Serbia, Slovakia, Slovenia, Spain, Svalbard and Jan Mayen Islands, Sweden, Switzerland, Republic of North Macedonia, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America
Developing countries *181 countries*	Afghanistan, Algeria, American Samoa, Angola, Anguilla, Antigua and Barbuda, Argentina, Armenia, Aruba, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia (Plurinational State of), Bonaire, Sint Eustatius and Saba, Botswana, Brazil, British Indian Ocean Territory, British Virgin Islands, Brunei Darussalam, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Cayman Islands, Central African Republic, Chad, Chile, China, China, Hong Kong Special Administrative Region, China, Macao Special Administrative Region, Colombia, Comoros, Congo, Cook Islands, Costa Rica, Côte d'Ivoire, Cuba, Curaçao, Democratic People's Republic of Korea, Democratic Republic of the Congo, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Falkland Islands (Malvinas), Fiji, French Guiana, French Polynesia, French Southern and Antarctic Territories, Gabon, Gambia, 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, Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Martinique, Mauritania, Mauritius, Mayotte, Mexico, Micronesia (Federated States of), Mongolia, Montserrat, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, New Caledonia, Nicaragua, Niger, Nigeria, Niue, Northern Mariana Islands, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Pitcairn, Puerto Rico, Qatar, Republic of Korea, 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, Sudan, Suriname, Eswatini, Syrian Arab Republic, Tajikistan, Thailand, Timor-Leste, Togo, Tokelau, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Turks and Caicos Islands, Tuvalu, Uganda, United Arab Emirates, United Republic of Tanzania, 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 (LDCs) *46 countries*	Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan, Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Yemen, Zambia
Landlocked developing countries (LLDCs) *30 countries*[7]	Afghanistan, Armenia, Azerbaijan, Bhutan, Bolivia (Plurinational State of), Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Ethiopia, Kazakhstan, Kyrgyzstan, Lao People's Democratic Republic, Lesotho, Malawi, Mali, Mongolia, Nepal, Niger, Paraguay, Rwanda, South Sudan, Eswatini, Tajikistan, Turkmenistan, Uganda, Uzbekistan, Zambia, Zimbabwe
Small island developing states (SIDS) *53 countries*	American Samoa, Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bonaire, Sint Eustatius and Saba, British Virgin Islands, Cabo Verde, Comoros, Cook Islands, Cuba, Curaçao, Dominica, Dominican Republic, Fiji, French Polynesia, Grenada, Guam, Guinea-Bissau, Guyana, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, 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

7 The Republic of Moldova and the Republic of North Macedonia are categorised as LLDCs but also as developed countries. As such, both are excluded from the LLDC category and from indicators 7.a.1 and 7.b.1/12.a.1

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SDG 7.1.1 - ACCESS TO ELECTRICITY

Source: World Bank

COUNTRY/REGION	TOTAL ELECTRICITY ACCESS RATE (%)										URBAN ELECTRICITY ACCESS RATE (%)		RURAL ELECTRICITY ACCESS RATE (%)	
	2000		2005		2010		2015		2020		2020		2020	
Afghanistan	2		25		43	*d*	72	*d*	98		100		97	
Albania	100	*m*	100	*m*	100	*m*	100	*k*	100	*m*	100	*m*	100	*m*
Algeria	99		99		99		99		100		100		100	
American Samoa														
Andorra	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Angola	24		30		35		42	*d*	47		74			
Anguilla	95		96		98		100		100					
Antigua and Barbuda	98		92	*d*	99		100	*m*	100	*m*	100	*m*	100	*m*
Argentina	96		97		99	*e*	100		100		100		100	
Armenia	99	*d*	100	*d*	100	*d*	100	*d*	100		100		100	
Aruba	92	*e*	100	*m*	93	*e*	100	*m*	100	*m*	100	*m*	100	*m*
Australia	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Austria	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Azerbaijan	99	*c*	99		100		100		100		100		100	
Bahamas	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Bahrain	100		100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Bangladesh	32	*d*	44	*g*	55	*g*	75		96	*g*	98	*g*	95	
Barbados	100	*m*	100		100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Belarus	100	*m*	100	*m*	100	*m*	100	*m*	100	*k*	100	*m*	100	*m*
Belgium	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Belize	79	*e*	84		90	*e*	92	*c*	97		98		96	
Benin	22		26		34	*g*	30	*k*	41		66		18	
Bermuda	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Bhutan	31	*g*	60	*e*	73	*c*	96		100		100		100	
Bolivia (Plurinational State of)	70	*h*	68	*h*	88		92	*h*	98		100		92	
Bosnia and Herzegovina	100	*m*	100	*m*	100	*m*	100	*k*	100	*m*	100	*m*	100	*m*
Botswana	26		38		52		62	*k*	72		91		26	

COUNTRY/REGION	TOTAL ELECTRICITY ACCESS RATE (%)					URBAN ELECTRICITY ACCESS RATE (%)	RURAL ELECTRICITY ACCESS RATE (%)
	2000	2005	2010	2015	2020	2020	2020
Brazil	94	97 *h*	99 *k*	100 *h*	100	100	100
British Virgin Islands	97	98	98 *e*	100 *m*	100 *m*	100 *m*	100 *m*
Brunei Darussalam	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Bulgaria	100 *m*	100 *m*	100 *m*	100 *m*	100 *g*	100 *g*	100 *m*
Burkina Faso	9	11	13 *d*	16	19	66	
Burundi	2	3 *c*	5 *d*	8	12	64	3
Cabo Verde	58	67 *d*	81 *e*	86	94	94	94
Cambodia	17 *d*	21 *d*	31 *d*	65	86 *g*	97 *g*	83
Cameroon	41 *c*	47	53	59	65	94	25
Canada	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Cayman Islands	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Central African Republic	6 *c*	7	10 *c*	13	15	34	2
Chad	3	5	6 *c*	8 *d*	11	41	2
Channel Islands	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Chile	98 *h*	98	100	100 *h*	100 *m*	100 *m*	100 *m*
China	97	98	100 *k*	100	100	100	100
China, Hong Kong Special Administrative Region	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
China, Macao Special Administrative Region	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Colombia	95 *d*	97 *d*	97 *h*	98 *h*	100	100	100
Comoros	40	51	70	75	87	100	81
Congo	29	34 *d*	40	44	50	66	15
Cook Islands	98	98	99	100 *g*	100	100	
Costa Rica	97 *k*	99 *h*	99 *h*	99 *h*	100 *g*	100 *g*	100
Côte d'Ivoire	49	59 *d*	58	63 *k*	70	94	43
Croatia	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Cuba	97 *k*	97	98	99	100	100	100
Curaçao	100	100	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*

COUNTRY/REGION	TOTAL ELECTRICITY ACCESS RATE (%)										URBAN ELECTRICITY ACCESS RATE (%)		RURAL ELECTRICITY ACCESS RATE (%)	
	2000		2005		2010		2015		2020		2020		2020	
Cyprus	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Czechia	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Democratic People's Republic of Korea					29		41		52		43		67	
Democratic Republic of the Congo	7	*c*	6	*g*	13		16		19		41		1	
Denmark	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Djibouti	56		56		56		58		62		72		25	
Dominica	81		88		94		100		100					
Dominican Republic	89	*h*	90	*h*	98	*h*	99	*h*	100		100		100	
Ecuador	94		96	*h*	97	*h*	99	*h*	99	*g*	100	*g*	97	
Egypt	98	*d*	99	*d*	99		99	*k*	100		100		100	
El Salvador	85	*h*	88	*h*	92	*h*	95	*h*	100		100		100	
Equatorial Guinea	66		66		66		66		67		91		1	
Eritrea	29		35		40		46		52		76		39	
Estonia	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Eswatini	20		34		46	*c*	64		80		92		76	
Ethiopia	13	*d*	14	*d*	25		29	*d*	51		93		39	
Faroe Islands	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Fiji	76		82		89		95		100		100		100	
Finland	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
France	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
French Polynesia	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Gabon	74	*d*	82	*g*	89		87		92		99		28	
Gambia	34	*c*	30	*c*	47		55		62		81		32	
Georgia	100		98	*c*	100	*k*	100	*k*	100		100		100	
Germany	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Ghana	44	*e*	41	*k*	64	*e*	74		86		95		74	
Gibraltar	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*

COUNTRY/REGION	TOTAL ELECTRICITY ACCESS RATE (%)										URBAN ELECTRICITY ACCESS RATE (%)		RURAL ELECTRICITY ACCESS RATE (%)	
	2000		2005		2010		2015		2020		2020		2020	
Greece	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Greenland	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Grenada	86		88		89		91		94					
Guam	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Guatemala	73	*h*	78		84		91		97		97		97	
Guinea	15		20	*d*	28		35		45		88		19	
Guinea-Bissau			5		6	*g*	20		33		56		15	
Guyana	75		78	*d*	83		88		93		97		91	
Haiti	34	*d*	35		37		41		47		81		2	
Honduras	67		69	*h*	81	*h*	90	*h*	93		100		84	
Hungary	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Iceland	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
India	59		68		76	*g*	88	*d*	99		100		98	
Indonesia	86	*g*	85		94	*g*	98	*g*	97	*k*	100	*k*	93	
Iran (Islamic Republic of)	98	*d*	99		99		100	*k*	100		100		100	
Iraq	97		98		98		99		100		100		100	
Ireland	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Isle of Man	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Israel	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Italy	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Jamaica	84		88		92	*g*	95	*g*	100		100		100	
Japan	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Jordan	99		99		100	*k*	100		100	*k*	100		99	
Kazakhstan	100		100	*k*	100	*k*	100	*c*	100		100		100	
Kenya	15		25		19	*d*	42	*d*	71		94		63	
Kiribati	55		70	*e*	63	*e*	91	*e*	92		88		96	
Kuwait	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Kyrgyzstan	100		99	*c*	99	*i*	99	*k*	100		100		100	

COUNTRY/REGION	TOTAL ELECTRICITY ACCESS RATE (%)					URBAN ELECTRICITY ACCESS RATE (%)	RURAL ELECTRICITY ACCESS RATE (%)
	2000	2005	2010	2015	2020	2020	2020
Lao People's Democratic Republic	42	57 *e*	70	90 *e*	100	100	100
Latvia	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Lebanon	99	99	99	100	100	100	100
Lesotho	4 *c*	10	17 *g*	32	47	78	35
Liberia			5	15	28	45	8
Libya	100 *k*	90	82	73	70	100	
Liechtenstein	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Lithuania	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Luxembourg	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Madagascar	13	16	12 *g*	23	34	70	11
Malawi	5 *d*	7	9 *d*	11 *d*	15	54	7
Malaysia	99	99	99	100	100	100	100
Maldives	84 *e*	91	99	100	100	100	100
Mali	10	18	27	38 *d*	51	94	16
Malta	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Marshall Islands	68	76	89	93	99	96	100
Mauritania	19	18 *f*	34	40 *c*	47	88	
Mauritius	99 *e*	99	100	99	100	99	100
Mexico	98 *h*	99 *h*	99 *h*	99 *d*	99 *k*	100 *k*	98
Micronesia (Federated States of)	46 *e*	55	65 *e*	74	83	97	79
Monaco	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Mongolia	67 *e*	86 *g*	79 *c*	88	98	100	95
Montenegro	100 *m*	100 *c*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Morocco	70	78	93	97 *g*	100	100	100
Mozambique	6	12	19	24 *d*	31	75	4
Myanmar	42	47	49 *g*	61 *g*	70	93	60
Namibia	37 *d*	40	45	52 *g*	56	75	36

COUNTRY/REGION	TOTAL ELECTRICITY ACCESS RATE (%)										URBAN ELECTRICITY ACCESS RATE (%)		RURAL ELECTRICITY ACCESS RATE (%)	
	2000		2005		2010		2015		2020		2020		2020	
Nauru	99		99		99		99	*g*	100	*m*	100	*m*	100	*m*
Nepal	29		46		69	*k*	83		90		94		89	
Netherlands	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
New Caledonia	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
New Zealand	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Nicaragua	73		74	*h*	78		83		89		100		73	
Niger	6	*c*	7	*g*	13		17	*g*	19		48		13	
Nigeria	43		47		48	*d*	53	*d*	55		84		25	
Niue	99		99		99		99		100		100			
North Macedonia	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Northern Mariana Islands	100	*m*	100		100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Norway	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Oman	100		100		100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Pakistan	70		71		71		71		75		100		61	
Palau	98		99	*e*	99		99		100	*m*	100	*m*	100	*m*
Panama	81	*e*	84		87	*e*	92		97		100		90	
Papua New Guinea	8		19		20	*g*	43		60	*d*	84	*d*	57	
Paraguay	89		95	*h*	97	*h*	99	*h*	100		100		100	
Peru	72	*h*	77	*h*	88	*h*	94	*h*	99		100		97	
Philippines	75		80		85		89	*f*	97		98		96	
Poland	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Portugal	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Puerto Rico	100		100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Qatar	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Republic of Korea	100		100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Republic of Moldova	100	*m*	99	*d*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Romania	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Russian Federation	100	*m*	100	*m*	100	*m*	96	*k*	100	*m*	100	*m*	100	*m*

COUNTRY/REGION	TOTAL ELECTRICITY ACCESS RATE (%)					URBAN ELECTRICITY ACCESS RATE (%)	RURAL ELECTRICITY ACCESS RATE (%)
	2000	2005	2010	2015	2020	2020	2020
Rwanda	6 *d*	5 *d*	10 *d*	23 *d*	47 *d*	86 *d*	38
Saint Kitts and Nevis	95	97	100	100 *m*	100 *m*	100 *m*	100 *m*
Saint Lucia	89	92	94 *e*	97	100	100	100
Saint Martin (French Part)	100	100	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Saint Vincent and the Grenadines	80	86	93	100	100	100	100
Samoa	88	91	96	99	100	100	100
San Marino	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Sao Tome and Principe	53 *c*	56	61	67	77	78	71
Saudi Arabia	100	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Senegal	38 *c*	47 *d*	57 *g*	61 *d*	70	95	47
Serbia	100 *m*	100 *c*	100 *c*	100 *k*	100 *m*	100 *m*	100 *m*
Seychelles	94	96	97 *e*	100 *m*	100 *m*	100 *m*	100 *m*
Sierra Leone	8	11 *c*	11 *c*	20	26	55	5
Singapore	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Sint Maarten (Dutch part)	100	100	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Slovakia	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Slovenia	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Solomon Islands	5	19	35	55 *d*	73	77	72
Somalia	2	15	52	51	50	70	32
South Africa	72	81 *g*	83 *g*	85 *g*	84	89	75
South Sudan			2 *e*	5	7	14	6
Spain	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Sri Lanka	70	78	85 *g*	94	100	100	100
State of Palestine	100 *g*	100 *g*	100 *g*	100 *k*	100	100	100
Sudan	23 *c*	30	38	47	55	82	41
Suriname	95	95	91 *c*	95	98	99	97
Sweden	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*
Switzerland	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*	100 *m*

COUNTRY/REGION	TOTAL ELECTRICITY ACCESS RATE (%)										URBAN ELECTRICITY ACCESS RATE (%)		RURAL ELECTRICITY ACCESS RATE (%)	
	2000		2005		2010		2015		2020		2020		2020	
Syrian Arab Republic	93		92		93	*g*	90		89		100		76	
Tajikistan	98	*c*	99	*c*	99		98	*k*	100		99		100	
Thailand	82	*d*	93		100	*f*	100	*c*	100		100		100	
Timor-Leste	18		33		38	*d*	67	*e*	96		100		94	
Togo	17	*c*	27		31	*c*	45		54		94		24	
Tonga	86		89		93		100	*k*	100		100		100	
Trinidad and Tobago	91	*e*	98		100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Tunisia	95	*g*	99	*g*	100	*j*	100	*k*	100		100		100	
Turkey	100		100		100	*i*	100	*e*	100		100		100	
Turkmenistan	100	*d*	100		100	*i*	100	*c*	100		100		100	
Turks and Caicos Islands	96	*e*	96		100	*m*	100	*m*	99	*c*	100	*m*	100	*m*
Tuvalu	95		96		97		98		100		100		99	
Uganda	7		9	*d*	12	*g*	19	*d*	42		70		33	
Ukraine	100	*m*	100	*c*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
United Arab Emirates	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
United Kingdom of Great Britain and Northern Ireland	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
United Republic of Tanzania	9		14		15	*d*	26		40	*g*	73	*g*	22	
United States of America	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
United States Virgin Islands	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*	100	*m*
Uruguay	98		98		99	*g*	100	*h*	100	*m*	100	*m*	100	*m*
Uzbekistan	100		100		100		100		100		100		100	
Vanuatu	22		31		44	*k*	52		67		96		58	
Venezuela (Bolivarian Republic of)	99	*h*	99		99		100	*g*	100		100		100	
Viet Nam	88		96	*d*	97	*k*	100		100		100		100	
Yemen	49		55		61		67		74		93		62	
Zambia	17	*e*	23		22	*e*	31	*g*	45		82		14	
Zimbabwe	34		36		39		34	*d*	53	*l*	86	*l*	37	

COUNTRY/REGION	TOTAL ELECTRICITY ACCESS RATE (%)					URBAN ELECTRICITY ACCESS RATE (%)	RURAL ELECTRICITY ACCESS RATE (%)
	2000	2005	2010	2015	2020	2020	2020
World	78	81	83	87	91	97	83
Northern America and Europe	100	100	100	99	100	100	100
Latin America and the Caribbean	92	94	96	97	99	100	94
Central Asia and Southern Asia	60	67	75	86	96	100	94
Eastern Asia and South-eastern Asia	92	94	96	97	98	99	97
Western Asia and Northern Africa	88	90	91	93	94	99	87
Sub-Saharan Africa	26	29	33	39	48	78	28
Oceania	80	82	82	87	91	99	74

Note: Unless otherwise noted, data are World Bank estimates based on the statistical model described in chapter 1.

a. Most surveys report data on the percentage of households with access to electricity rather than on the percentage of the population with access.
b. Rural data are calculated based on the urban and total population with access and are not based on a statistical model.
c. Based on Multi-Indicator Cluster Survey (MICS)
d. Based on Demographic and Health Survey (DHS)
e. Based on Census
f. Based on Living Standards Measurement Survey (LSMS)
g. Based on other National Surveys conducted by national statistical agencies
h. Based on Socio-Economic Database for Latin America and the Caribbean (SEDLAC)
i. Based on Europe and Central Asia Poverty Database (ECAPOV)
j. Based on Middle East and North Africa Poverty Database (MNAPOV)
k. Based on other official sources
l. Based on Multi-Tier Framework (MTF)
m. Based on assumption: where survey data were not collected, countries considered "developed" by the UN or "high income" by the World Bank are assumed to reach universal access.

SDG 7.1.2 - ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING

Source: World Health Organization

COUNTRY	TOTAL CLEAN COOKING ACCESS RATE (%)				RURAL CLEAN COOKING ACCESS RATE (%)				URBAN CLEAN COOKING ACCESS RATE (%)			
	2000	2010	2015	2020	2000	2010	2015	2020	2000	2010	2015	2020
Afghanistan	6	20	27	33	1	6	11	16	29	70	79	83
Albania	38	66	76	81	18	46	58	65	67	86	91	93
Algeria	97	99	100	100	93	98	98	99	100	100	100	100
American Samoa												
Andorra	100	100	100	100	100	100	100	100	100	100	100	100
Angola	41	44	47	50	8	7	8	8	80	77	78	78
Anguilla												
Antigua and Barbuda	100	100	100	100	100	100	100	100	100	100	100	100
Argentina	95	99	100	100	71	91	96	97	98	100	100	100
Armenia	80	96	98	98	54	92	95	96	94	99	100	100
Aruba												
Australia	100	100	100	100	100	100	100	100	100	100	100	100
Austria	100	100	100	100	100	100	100	100	100	100	100	100
Azerbaijan	70	93	96	97	44	86	92	94	96	99	99	99
Bahamas	100	100	100	100	100	100	100	100	100	100	100	100
Bahrain	100	100	100	100	100	100	100	100	100	100	100	100
Bangladesh	8	13	18	25	1	2	5	8	35	42	51	58
Barbados	100	100	100	100	100	100	100	100	100	100	100	100
Belarus	95	99	99	100	87	96	98	99	99	100	100	100
Belgium	100	100	100	100	100	100	100	100	100	100	100	100
Belize	80	84	83	82	67	73	73	73	94	96	96	95
Benin	1	4	4	4	0	1	1	1	1	8	8	7
Bermuda												
Bhutan	28	64	75	80	10	48	61	68	87	96	97	97
Bolivia (Plurinational State of)	63	76	83	86	18	39	52	59	92	97	98	99
Bosnia and Herzegovina	52	45	44	45	32	21	18	17	80	70	67	67

COUNTRY	TOTAL CLEAN COOKING ACCESS RATE (%)				RURAL CLEAN COOKING ACCESS RATE (%)				URBAN CLEAN COOKING ACCESS RATE (%)			
	2000	2010	2015	2020	2000	2010	2015	2020	2000	2010	2015	2020
Botswana	44	58	62	65	20	29	27	25	69	82	84	86
Brazil	89	94	95	96	55	70	76	79	97	98	99	99
British Virgin Islands												
Brunei Darussalam	100	100	100	100	100	100	100	100	100	100	100	100
Bulgaria												
Burkina Faso	3	6	8	11	1	1	1	1	12	22	28	35
Burundi	0	0	0	0	0	0	0	0	1	0	0	0
Cabo Verde	4	12	20	37	1	4	9	25	15	45	60	70
Cambodia	10	19	22	22	1	2	2	2	21	37	40	38
Cameroon	100	100	100	100	100	100	100	100	100	100	100	100
Canada	63	70	76	81	31	33	40	50	90	91	93	94
Cayman Islands												
Central African Republic	1	0	1	1	0	0	0	0	1	1	1	2
Chad	3	3	4	7	2	0	0	0	5	10	17	29
Channel Islands												
Chile	100	100	100	100	100	100	100	100	100	100	100	100
China	42	56	68	79	24	34	49	65	68	77	84	89
China, Hong Kong Special Administrative Region	78	86	90	93	33	43	53	66	93	97	98	99
China, Macao Special Administrative Region	1	3	6	8	0	1	2	3	1	7	13	17
Colombia	1	3	4	4	0	0	0	0	4	10	10	8
Comoros	9	17	25	35	1	2	3	4	15	26	37	49
Congo	81	81	78	76	47	43	39	35	97	98	98	97
Cook Islands	89	92	94	96	78	80	84	88	97	98	98	98
Costa Rica	19	18	23	32	3	2	1	1	37	36	47	62
Côte d'Ivoire	100	100	100	100	100	100	100	100	100	100	100	100
Croatia	71	90	93	94	35	80	85	87	85	95	96	97
Cuba												

COUNTRY	TOTAL CLEAN COOKING ACCESS RATE (%)				RURAL CLEAN COOKING ACCESS RATE (%)				URBAN CLEAN COOKING ACCESS RATE (%)			
	2000	2010	2015	2020	2000	2010	2015	2020	2000	2010	2015	2020
Curaçao	100	100	100	100	100	100	100	100	100	100	100	100
Cyprus	100	100	100	100	100	100	100	100	100	100	100	100
Czechia	100	100	100	100	100	100	100	100	100	100	100	100
Democratic People's Republic of Korea	4	6	8	10	1	1	0	0	4	8	10	12
Democratic Republic of the Congo	81	88	89	89	64	75	80	82	94	96	96	96
Denmark	84	88	89	92	67	69	71	76	95	95	95	96
Djibouti	88	94	94	94	70	83	85	85	99	99	99	99
Dominica	84	99	100	100	74	99	100	100	96	100	100	100
Dominican Republic	58	77	86	92	25	48	65	81	82	94	96	97
Ecuador	24	39	48	55	10	23	32	41	60	79	86	89
Egypt	19	23	24	24	4	5	5	4	30	34	34	33
El Salvador	4	8	9	9	0	1	1	1	11	20	21	20
Equatorial Guinea	100	100	100	100	100	100	100	100	100	100	100	100
Eritrea	1	2	4	8	0	0	0	0	3	10	18	29
Estonia												
Eswatini	28	32	40	51	10	13	18	28	47	50	58	70
Ethiopia	100	100	100	100	100	100	100	100	100	100	100	100
Faroe Islands	100	100	100	100	100	100	100	100	100	100	100	100
Fiji												
Finland	65	80	86	88	16	30	39	46	79	90	93	94
France	4	3	2	2	2	1	0	0	6	4	3	2
French Polynesia	48	66	79	89	10	35	59	79	86	93	96	97
Gabon	100	100	100	100	100	100	100	100	100	100	100	100
Gambia	6	16	21	22	1	4	7	9	14	30	36	34
Georgia												
Germany	100	100	100	100	100	100	100	100	100	100	100	100
Ghana												
Gibraltar	92	93	91	89	92	92	90	88	94	95	95	94

COUNTRY	TOTAL CLEAN COOKING ACCESS RATE (%)				RURAL CLEAN COOKING ACCESS RATE (%)				URBAN CLEAN COOKING ACCESS RATE (%)			
	2000	2010	2015	2020	2000	2010	2015	2020	2000	2010	2015	2020
Greece												
Greenland	41	38	43	50	17	11	12	14	68	62	67	75
Grenada	1	1	1	2	0	0	0	0	1	1	2	4
Guam	1	1	1	1	0	0	0	0	4	3	2	2
Guatemala	36	61	73	81	28	56	70	80	55	76	81	84
Guinea	3	4	4	4	1	1	1	1	6	7	7	7
Guinea-Bissau	31	42	46	48	9	15	19	23	56	70	72	73
Guyana												
Haiti	100	100	100	100	100	100	100	100	100	100	100	100
Honduras	100	100	100	100	100	100	100	100	100	100	100	100
Hungary	22	35	48	68	7	14	27	54	50	71	82	91
Iceland	6	41	67	84	2	24	50	75	13	62	85	93
India	93	96	97	96	87	92	92	92	98	99	99	99
Indonesia	74	95	98	99	58	90	96	98	82	98	99	99
Iran (Islamic Republic of)	100	100	100	100	100	100	100	100	100	100	100	100
Iraq												
Ireland	100	100	100	100	100	100	100	100	100	100	100	100
Isle of Man	100	100	100	100	100	100	100	100	100	100	100	100
Israel	76	86	85	83	54	75	78	78	98	96	93	90
Italy	100	100	100	100	100	100	100	100	100	100	100	100
Jamaica	100	100	100	100	99	100	100	99	100	100	100	100
Japan	84	92	93	93	69	84	86	87	97	98	98	98
Jordan	2	7	12	20	1	2	3	5	5	20	30	44
Kazakhstan	2	3	6	10	0	0	0	0	2	6	11	17
Kenya	2	6	8	12	1	1	1	1	3	9	13	18
Kiribati	100	100	100	100	100	100	100	100	100	100	100	100
Kosovo												
Kuwait	100	100	100	100	100	100	100	100	100	100	100	100
Kyrgyzstan	53	72	76	77	34	59	66	66	86	93	94	94

COUNTRY	TOTAL CLEAN COOKING ACCESS RATE (%)				RURAL CLEAN COOKING ACCESS RATE (%)				URBAN CLEAN COOKING ACCESS RATE (%)			
	2000	2010	2015	2020	2000	2010	2015	2020	2000	2010	2015	2020
Lao People's Democratic Republic	1	4	6	8	1	1	1	2	3	10	15	19
Latvia	100	100	100	100	100	100	100	100	100	100	100	100
Lebanon												
Lesotho	16	31	36	40	8	15	18	20	46	73	78	79
Liberia	1	0	0	0	0	0	0	0	1	0	0	0
Libya												
Liechtenstein												
Lithuania	100	100	100	100	100	100	100	100	100	100	100	100
Luxembourg	100	100	100	100	100	100	100	100	100	100	100	100
Madagascar												
Malawi	1	1	1	1	1	1	0	0	3	2	2	2
Malaysia	2	2	2	1	0	1	0	0	12	12	9	4
Maldives	98	98	97	96	95	95	93	92	99	99	99	98
Mali	53	93	98	99	39	90	97	99	96	99	100	100
Malta	1	1	1	1	0	0	0	0	2	2	2	2
Marshall Islands	100	100	100	100	100	100	100	100	100	100	100	100
Mauritania	16	53	62	64	2	2	1	1	23	70	82	85
Mauritius	30	42	43	43	13	18	18	18	53	69	68	64
Mexico	94	97	97	97	91	96	96	96	97	99	99	98
Micronesia (Federated States of)	82	85	85	85	47	52	53	59	98	95	93	91
Monaco	11	12	12	13	3	4	4	3	29	32	34	34
Mongolia	64	91	95	96	40	86	92	95	96	98	99	99
Montenegro	100	100	100	100	100	100	100	100	100	100	100	100
Morocco	23	35	44	52	2	7	11	15	41	50	61	69
Mozambique	67	63	61	62	46	41	41	44	83	75	72	72
Myanmar	91	96	98	98	80	92	95	96	100	100	100	99
Namibia	2	3	4	5	1	0	0	0	5	9	11	14
Nauru	3	10	20	31	1	3	6	11	6	26	52	76

COUNTRY	TOTAL CLEAN COOKING ACCESS RATE (%)				RURAL CLEAN COOKING ACCESS RATE (%)				URBAN CLEAN COOKING ACCESS RATE (%)			
	2000	2010	2015	2020	2000	2010	2015	2020	2000	2010	2015	2020
Nepal	34	41	44	47	11	11	12	13	77	76	75	72
Netherlands	100	100	100	100	100	100	100	100	100	100	100	100
New Caledonia	6	22	29	35	3	10	15	20	25	64	66	63
New Zealand	100	100	100	100	100	100	100	100	100	100	100	100
Nicaragua												
Niger	100	100	100	100	100	100	100	100	100	100	100	100
Nigeria	34	45	50	56	6	8	8	9	54	70	78	85
Niue	1	1	2	2	0	0	0	0	4	6	9	12
North Macedonia	1	2	5	15	0	1	2	4	2	4	11	30
Northern Mariana Islands	75	93	97	98	69	92	96	98	89	96	98	98
Norway	58	68	73	78	40	43	49	59	69	86	90	91
Oman												
Pakistan	100	100	100	100	100	100	100	100	100	100	100	100
Palau	100	100	100	100	100	100	100	100	100	100	100	100
Panama	24	36	42	49	5	11	17	26	66	82	86	86
Papua New Guinea	100	100	100	100	100	100	100	100	100	100	100	100
Paraguay	80	86	88	88	54	67	69	69	98	98	98	98
Peru	6	8	9	9	1	3	4	4	37	39	38	37
Philippines	49	57	65	69	17	28	36	41	73	77	84	86
Poland	43	66	76	85	5	13	24	42	61	84	91	96
Portugal	38	41	42	48	20	21	23	28	56	61	64	69
Puerto Rico	100	100	100	100	100	100	100	100	100	100	100	100
Qatar	100	100	100	100	100	100	100	100	100	100	100	100
Korea, Republic of												
Moldova, Republic of	100	100	100	100	100	100	100	100	100	100	100	100
Romania	72	83	86	88	48	69	75	79	95	96	96	96
Russian Federation	100	97	92	86	100	97	93	89	100	98	94	90
Rwanda	0	0	1	2	0	0	0	0	1	1	3	10
Saint Kitts and Nevis	19	27	31	36	9	18	23	29	46	56	61	65

COUNTRY	TOTAL CLEAN COOKING ACCESS RATE (%)				RURAL CLEAN COOKING ACCESS RATE (%)				URBAN CLEAN COOKING ACCESS RATE (%)			
	2000	2010	2015	2020	2000	2010	2015	2020	2000	2010	2015	2020
Saint Lucia	100	100	100	100	100	100	100	100	100	100	100	100
Saint Martin (French Part)	0	1	2	3	0	0	0	1	0	2	3	4
Saint Vincent and the Grenadines	100	100	100	100	100	100	100	100	100	100	100	100
Samoa	35	34	27	24	7	7	5	4	68	64	52	46
San Marino	58	67	73	80	31	44	52	64	82	86	89	92
Sao Tome and Principe	100	100	100	100	100	100	100	100	100	100	100	100
Saudi Arabia	0	0	0	1	0	0	0	0	0	0	1	1
Senegal	100	100	100	100	100	100	100	100	100	100	100	100
Serbia												
Seychelles	100	100	100	100	100	100	100	100	100	100	100	100
Sierra Leone	100	100	100	100	100	100	100	100	100	100	100	100
Singapore	9	8	8	9	4	2	2	1	38	37	37	37
Sint Maarten (Dutch part)	0	1	2	3	0	0	0	0	0	2	4	5
Slovakia	56	77	83	87	29	56	64	66	77	89	93	95
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0
Solomon Islands	100	100	100	100	100	100	100	100	100	100	100	100
Somalia	17	22	26	32	10	15	18	23	52	57	64	70
South Africa	100	100	100	100	100	100	100	100	100	100	100	100
South Sudan	86	95	95	94	93	96	96	94	76	94	96	97
Spain	96	96	95	94	97	97	96	96	96	96	96	96
Sri Lanka	8	32	45	55	6	23	36	47	18	55	64	68
State of Palestine	78	87	91	94	60	76	84	90	89	94	96	97
Sudan	100	100	100	100	100	100	100	100	100	100	100	100
Suriname	100	100	100	100	100	100	100	100	100	100	100	100
Sweden	99	99	98	97	98	98	98	97	100	100	99	99
Switzerland	36	70	77	82	21	60	70	77	79	95	97	97
Syrian Arab Republic	1	1	3	4	0	0	1	1	2	4	8	11
Tajikistan	57	74	79	84	44	63	70	77	86	88	89	90

COUNTRY	TOTAL CLEAN COOKING ACCESS RATE (%)				RURAL CLEAN COOKING ACCESS RATE (%)				URBAN CLEAN COOKING ACCESS RATE (%)			
	2000	2010	2015	2020	2000	2010	2015	2020	2000	2010	2015	2020
Thailand	2	5	8	14	0	1	3	4	4	12	21	31
Timor-Leste	0	3	7	10	0	0	1	1	1	8	15	21
Togo	36	60	72	84	23	51	66	81	80	89	92	94
Tonga	100	100	100	100	100	100	100	100	100	100	100	100
Trinidad and Tobago	94	99	100	100	92	99	99	100	96	100	100	100
Tunisia	90	94	95	95	77	83	84	84	99	99	99	99
Turkey	99	100	100	100	99	100	100	100	100	100	100	100
Turkmenistan												
Turks and Caicos Islands	16	49	64	71	12	28	34	36	19	67	86	93
Tuvalu	1	1	1	0	0	0	0	0	4	3	2	1
Uganda	92	94	95	95	85	87	88	87	95	98	99	99
Ukraine	100	100	100	100	100	100	100	100	100	100	100	100
United Arab Emirates	100	100	100	100	100	100	100	100	100	100	100	100
United Kingdom of Great Britain and Northern Ireland	100	100	100	100	100	100	100	100	100	100	100	100
Tanzania, United Republic of	100	100	100	100	100	100	100	100	100	100	100	100
United States of America	84	86	85	84	72	74	73	73	98	99	99	98
United States Virgin Islands	16	12	10	8	4	3	2	2	58	39	28	21
Uruguay	97	97	97	97	77	80	85	88	100	99	99	99
Uzbekistan	14	49	60	65	5	36	48	56	41	78	82	82
Vanuatu												
Venezuela (Bolivarian Republic of)												
Viet Nam	56	60	61	62	42	43	43	42	93	94	94	93
Yemen	14	16	14	10	1	2	2	2	38	38	30	20
Zambia	34	30	30	30	6	5	6	7	88	81	80	79
Zimbabwe												

COUNTRY	TOTAL CLEAN COOKING ACCESS RATE (%)				RURAL CLEAN COOKING ACCESS RATE (%)				URBAN CLEAN COOKING ACCESS RATE (%)			
	2000	2010	2015	2020	2000	2010	2015	2020	2000	2010	2015	2020
Australia and New Zealand	100	100	100	100	100	100	100	100	100	100	100	100
Central Asia and Southern Asia	26	37	48	63	9	16	26	46	57	73	82	88
Eastern Asia and South-eastern Asia	42	56	68	77	23	33	47	61	65	77	84	89
Latin America and the Caribbean	80	85	87	88	43	52	56	61	93	95	95	95
Northern America and Europe	98	98	98	97	94	95	95	95	99	99	99	98
Oceania excluding Australia and New Zealand	10	12	13	15	3	4	6	7	41	44	46	47
Sub-Saharan Africa	9	12	13	17	3	4	4	5	24	26	29	34
Western Asia and Northern Africa	80	89	91	92	66	79	82	83	92	97	97	97
World	49	57	63	69	25	30	38	48	76	81	84	86

SDG 7.2 - RENEWABLE ENERGY

Data provided by the IEA and UNSD

UN COUNTRY NAME	SHARE IN TOTAL FINAL ENERGY CONSUMPTION (%)													FINAL CONSUMPTION OF RENEWABLE ENERGY (PJ)			TOTAL FINAL ENERGY CONSUMPTION (PJ)	SOURCE
	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Afghanistan	45.0	15.2	17.5	18.5	8	0	0	10.4	0	0	0.2	0	0	18.4	13.9	0	174.6	*a*
Albania	41.4	37.0	38.5	40.2	7.6	5.9	0	25.9	0	0	0.8	0	0	22.2	7.1	5	85.6	*b*
Algeria	0.4	0.3	0.1	0.2	0	0	0	0	0	0	0.1	0	0	2.3	0.4	0.1	1658.3	*b*
American Samoa	0.0	0.0	0.2	0.5	0	0	0	0	0	0	0.5	0	0	0	0	0	3.1	*a*
Andorra	14.5	18.7	19.3	18.4	0.4	0	0	15.8	0	0	0.3	0	2	1.6	0	0	8.8	*a*
Angola	73.4	52.5	47.8	54.7	46.9	0	0	7.7	0	0	0	0	0	33.8	204.9	0	436.4	*b*
Anguilla	0.2	0.1	0.3	0.5	0.1	0	0	0	0	0	0.4	0	0	0	0	0	1.6	*a*
Antigua and Barbuda	0.0	0.0	0.5	0.9	0	0	0	0	0	0	0.9	0	0	0	0	0	4.1	*a*
Argentina	9.8	8.8	9.4	10.7	2.9	2.9	0	4	0	0.7	0.1	0	0	113.1	59.4	65.4	2216	*b*
Armenia	7.2	9.4	10.7	10.3	3.4	0	0	6.4	0	0	0.5	0	0	6.5	3.8	0.1	101	*b*
Aruba	0.2	5.5	6.7	7.5	0.2	0	0	0	0	7.2	0	0	0	0.5	0	0	6.9	*a*
Australia	8.4	8.2	9.3	10.1	4.9	0.2	0.2	1.4	0	1.6	1.9	0	0	146.9	170	9.8	3225.7	*b*
Austria	26.4	31.2	34.8	33.8	15.7	1.9	0.3	12	0	2.2	1.2	0.1	0.3	166.4	171.7	29.1	1087.7	*b*
Azerbaijan	2.1	4.4	2.3	1.6	0.4	0	0	1	0	0.1	0	0	0.1	4.6	1.8	0.1	398.1	*b*
Bahamas	0.0	1.7	1.5	1.1	1.1	0	0	0	0	0	0	0	0	0	0.3	0	24.9	*a*
Bahrain	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	213.9	*b*
Bangladesh	59.1	40.3	31.9	24.8	24.5	0	0	0.2	0	0	0.1	0	0	3.8	325.7	0	1331.3	*b*
Barbados	14.3	9.1	3.2	4.3	2.9	0	0	0	0	0	1.4	0	0	0.2	0.3	0	12	*a*
Belarus	5.6	7.3	6.8	7.8	7.4	0.1	0	0.1	0	0.1	0.1	0	0	2.7	51.1	0.2	688.5	*b*
Belgium	1.4	6.2	9.4	10.2	4.5	1.5	0.5	0.1	0	2.2	1.1	0	0.3	60.7	58.3	21.7	1376.4	*b*
Belize	34.6	32.9	30.3	29.1	25.1	0	0	3.9	0	0	0.1	0	0	1.5	2.6	0	13.9	*a*
Benin	70.3	47.2	49.9	46.5	46.4	0	0	0	0	0	0	0	0	0.1	85.8	0	184.8	*b*
Bermuda	0.5	0.4	0.6	0.8	0.1	0.2	0	0	0	0	0.1	0	0.4	0	0	0	4.9	*a*

UN COUNTRY NAME	SHARE IN TOTAL FINAL ENERGY CONSUMPTION (%)													FINAL CONSUMPTION OF RENEWABLE ENERGY (PJ)			TOTAL FINAL ENERGY CONSUMPTION (PJ)	SOURCE
	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Bhutan	91.4	90.8	86.7	82.3	70.3	0	0	12	0	0	0	0	0	8.2	48.1	0	68.5	*a*
Bolivia (Plurinational State of)	29.7	15.3	8.0	8.7	4.7	0.3	0	3.4	0	0.1	0.2	0	0	10.9	12.3	0.8	276.3	*b*
Bonaire, Sint Eustatius and Saba	0.0	0.0	13.5	12.4	0.4	0	0	0	0	9.5	2.5	0	0	0.1	0	0	0.9	*a*
Bosnia and Herzegovina	19.4	19.6	25.3	37.0	28.7	0	0	7.9	0	0.3	0	0	0	14.4	50.3	0.1	175.3	*b*
Botswana	38.5	29.4	25.6	25.6	25.5	0	0	0	0	0	0.1	0	0	0	19	0	74.2	*b*
Brazil	42.7	46.8	43.6	47.6	21.5	10.3	0.1	13.1	0	1.8	0.7	0	0	1512.8	1842	900.6	8944.9	*b*
British Virgin Islands	1.0	0.7	1.0	1.2	1	0	0	0	0	0.2	0.1	0	0	0	0	0	1.4	*a*
Brunei Darussalam	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	39.9	*b*
Bulgaria	8.0	14.3	17.9	19.3	12.6	1.9	0.3	1.8	0	0.8	1.2	0.4	0.5	18.3	51.6	7.7	401.6	*b*
Burkina Faso	85.4	81.5	72.7	64.8	64.1	0	0	0.5	0	0	0.3	0	0	1.3	112.7	0	175.8	*a*
Burundi	93.2	92.6	91.1	84.8	83.9	0	0	0.9	0	0	0	0	0	0.5	48.4	0	57.8	*a*
Cabo Verde	27.9	21.2	26.3	22.2	18.8	0	0	0	0	3	0.4	0	0	0.2	1.4	0	7.3	*a*
Cambodia	81.6	64.8	60.6	53.4	47.2	0	0	6	0	0	0.1	0	0	17.8	133.6	0	283.9	*b*
Cameroon	84.6	78.8	78.1	79.4	75	0	0	4.4	0	0	0	0	0	14.6	244.5	0	326.2	*b*
Canada	22.0	21.9	22.7	22.1	5	1.2	0.1	14.4	0	1.2	0.2	0	0	1244.3	366.6	110.6	7785.4	*b*
Cayman Islands	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	5.9	*a*
Central African Republic	88.9	93.8	92.9	91.3	89.9	0	0	1.4	0	0	0	0	0	0.5	33	0	36.7	*a*
Chad	88.7	79.0	77.3	77.8	77.8	0	0	0	0	0	0	0	0	0	62.2	0	79.9	*a*
Chile	31.4	27.0	25.1	25.3	15.6	0	0.1	6.2	0	1.3	2	0.1	0	122.1	166.2	2.2	1149.8	*b*
China	29.6	12.3	12.2	14.4	4.3	0.2	0.4	5	0	1.6	2.1	1	0	6171.2	5129	284.5	80175.4	*b*
China, Hong Kong Special Administrative Region	0.0	0.1	0.2	0.2	0	0.1	0	0	0	0	0	0	0.1	0.4	0.1	0.3	337.2	*b*
China, Macao Special Administrative Region	0.2	5.5	5.4	8.4	0.1	0	0	0	0	0	0	0	8.3	2.6	0	0	31.3	*a*

UN COUNTRY NAME	SHARE IN TOTAL FINAL ENERGY CONSUMPTION (%)													FINAL CONSUMPTION OF RENEWABLE ENERGY (PJ)			TOTAL FINAL ENERGY CONSUMPTION (PJ)	SOURCE
	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Colombia	28.0	29.7	31.6	30.7	14.8	2.3	0	13.6	0	0	0	0	0	170.2	175	27.8	1214.2	*b*
Comoros	69.9	66.4	64.2	53.4	53.4	0	0	0	0	0	0	0	0	0	3.8	0	7.1	*a*
Congo	64.9	54.8	64.2	68.7	67	0	0	1.6	0	0	0	0	0	1.3	54.6	0	81.4	*b*
Cook Islands	0.0	0.0	1.4	3.7	0	0	0	0	0	0	3.7	0	0	0	0	0	1	*a*
Costa Rica	32.9	40.4	38.3	35.8	13.6	0	0	15.5	0	3.6	0.1	3	0	36.3	21.4	0	161.3	*b*
Côte d'Ivoire	63.7	75.4	64.5	62.5	59.7	0	0	2.8	0	0	0	0	0	8.8	186.1	0	312.2	*b*
Croatia	26.8	29.8	33.1	31.6	17.3	0.9	0.8	9.5	0	2.4	0.4	0.3	0	37.7	47.7	3.3	280.7	*b*
Cuba	34.4	15.6	21.1	21.5	17.8	3.4	0	0.1	0	0	0.2	0	0	2.3	53.7	0	260.4	*b*
Curaçao	0.1	0.5	1.6	2.7	0	0	0	0	0	2.4	0.2	0	0	0.7	0	0	24.8	*b*
Cyprus	3.1	6.5	10.5	12.0	2.2	0.7	0.7	0	0	1.2	5.7	0.1	1.4	1.7	5.8	0.4	66	*b*
Czechia	5.9	11.0	14.8	15.8	11.6	1.4	1.3	0.5	0	0.2	0.6	0	0.2	23.9	120.5	15	1005.3	*b*
Democratic People's Republic of Korea	8.7	13.6	23.3	11.3	6.3	0	0	5	0	0	0	0	0	28.7	37.3	0.9	591.9	*b*
Democratic Republic of the Congo	97.9	96.8	95.8	96.2	92.6	0	0	3.6	0	0	0	0	0	29.8	754.7	0	815.2	*b*
Denmark	10.7	21.2	32.9	37.5	19.7	1.6	0.9	0	0	11	1.1	0	3.2	86.5	112.4	10.2	557.4	*b*
Djibouti	31.4	32.5	28.2	27.9	27.9	0	0	0	0	0	0	0	0	0	2.2	0	7.7	*a*
Dominica	11.1	10.3	8.8	8.0	3.8	0	0	4.1	0	0.1	0	0	0	0.1	0.1	0	1.6	*a*
Dominican Republic	19.1	16.9	14.9	14.0	11.8	0	0	1.1	0	0.6	0.4	0	0	6.4	32.9	0	281.2	*b*
Ecuador	19.4	11.8	13.1	17.7	3.8	0.2	0	13.6	0	0	0	0	0	72.6	18.9	1	521.5	*b*
Egypt	8.3	5.6	5.4	5.3	2.9	0	0	1.7	0	0.5	0.2	0	0	52.8	66.3	0.2	2251.1	*b*
El Salvador	33.5	32.6	21.0	19.4	8.2	0	0.1	4.9	0	0	1.6	4.7	0	16.2	6.7	0	118	*b*
Equatorial Guinea	45.8	5.7	4.6	6.6	5.7	0	0	0.9	0	0	0	0	0	0.6	3.8	0	67.1	*a*
Eritrea	76.6	81.1	77.6	73.7	73.4	0	0	0	0	0	0.3	0	0	0.1	17.4	0	23.7	*b*
Estonia	19.8	25.3	28.2	31.3	26.9	1	0.5	0.1	0	2	0.2	0	0.7	7.4	28.3	1.4	118.6	*b*
Eswatini	59.4	72.4	71.7	65.9	60.7	0	0	5.2	0	0	0	0	0	4.7	23.2	0	42.4	*a*

UN COUNTRY NAME	SHARE IN TOTAL FINAL ENERGY CONSUMPTION (%)													FINAL CONSUMPTION OF RENEWABLE ENERGY (PJ)			TOTAL FINAL ENERGY CONSUMPTION (PJ)	SOURCE
	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Ethiopia	95.6	94.1	91.6	88.9	86.7	0	0	2.2	0	0.1	0	0	0	39.6	1521.9	0.2	1756.3	*b*
Falkland Islands (Malvinas)	1.5	4.6	4.7	4.6	1.1	0	0	0	0	3.5	0	0	0	0	0	0	0.5	*a*
Faroe Islands	2.8	3.4	7.5	5.4	0	0	0	3.6	0	1.8	0	0	0	0.5	0	0	9.5	*a*
Fiji	50.1	26.5	32.7	26.5	18.4	0	0	7.9	0	0	0.2	0	0	1.9	4.1	0	22.6	*a*
Finland	31.7	33.4	43.2	45.8	34.4	1.8	0.6	5.3	0	2.6	0.1	0	1.1	135.1	308.5	19.4	1011.6	*b*
France	9.3	12.0	13.3	15.5	7	2.5	0.3	2.7	0	1.7	0.7	0.1	0.4	303.4	444.3	140.8	5721.1	*b*
French Guiana	23.8	29.4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*a*
French Polynesia	9.9	7.5	7.8	7.7	0.3	0	0	5.2	0	0	2.1	0	0	0.7	0.1	0	10.3	*a*
Gabon	72.8	85.9	81.9	89.9	87.9	0	0	2	0	0	0	0	0	3.5	153.4	0	174.6	*b*
Gambia	62.9	56.6	48.9	49.2	49.2	0	0	0	0	0	0.1	0	0	0	5.4	0	11	*a*
Georgia	47.3	39.1	28.1	25.2	5.9	0	0	18.7	0	0.2	0.1	0.4	0	31.9	11.1	1.2	174.9	*b*
Germany	3.7	11.6	14.6	17.2	5.6	1.4	2	0.7	0	4.5	2	0.1	0.9	706	601	129	8364.8	*b*
Ghana	71.6	51.9	44.0	41.8	35.6	0	0	6.1	0	0	0	0	0	21.2	122.7	0	344.4	*b*
Gibraltar	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	8.6	*b*
Greece	7.8	11.4	17.5	18.5	5.6	1.3	0.5	2.4	0	4.3	4.5	0.1	0	59.6	49.1	8	630.5	*b*
Greenland	8.8	9.7	12.7	12.6	0	0	0	12.6	0	0	0	0	0	0.9	0	0	7.1	*a*
Grenada	10.5	10.5	11.1	10.4	10.1	0	0	0	0	0	0.3	0	0	0	0.4	0	3.5	*a*
Guadeloupe	2.6	3.0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*a*
Guam	0.0	0.0	1.3	3.0	0	0	0	0	0	0	3	0	0	0.2	0	0	5.6	*a*
Guatemala	62.7	67.2	63.4	62.9	59.9	0	0	2.5	0	0.2	0.1	0.2	0	22.6	292.2	0	500.3	*b*
Guernsey	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	*a*
Guinea	85.5	75.7	76.2	65.4	63.1	0	0	2.3	0	0	0	0	0	3.8	103.1	0	163.4	*a*
Guinea-Bissau	91.2	87.8	87.2	86.2	86.2	0	0	0	0	0	0	0	0	0	24.5	0	28.4	*a*
Guyana	29.8	30.3	24.9	11.4	11.2	0	0	0	0	0	0.1	0	0	0.1	3.3	0	29.6	*a*
Haiti	80.8	79.0	76.1	76.4	76	0.2	0	0.2	0	0	0	0	0	0.3	110.1	0	144.4	*b*
Honduras	55.2	52.2	52.7	46.0	39.3	0	0	3.4	0	1.2	1.6	0.4	0	13.7	66.6	0	174.9	*b*

UN COUNTRY NAME	SHARE IN TOTAL FINAL ENERGY CONSUMPTION (%)													FINAL CONSUMPTION OF RENEWABLE ENERGY (PJ)			TOTAL FINAL ENERGY CONSUMPTION (PJ)	SOURCE
	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Hungary	5.2	13.5	15.6	13.6	9.9	1.1	0.3	0.1	0	0.4	0.9	0.7	0.2	19.3	74.2	9.1	751.8	*b*
Iceland	60.7	76.0	77.3	81.1	0	0.7	0	36.9	0	0	0	43.4	0	65.5	33	1	122.7	*b*
India	46.9	36.2	33.4	32.9	28.8	0.2	0.2	2.1	0	0.8	0.8	0	0	929.9	6986.1	58.4	24218.2	*b*
Indonesia	45.6	34.8	26.7	19.1	14.2	3.1	0	1.1	0	0	0	0.7	0	155.9	890.7	169.9	6372.7	*b*
Iran (Islamic Republic of)	0.4	0.9	0.9	1.0	0.3	0	0	0.6	0	0	0	0	0	49.1	21	0.1	7132.5	*b*
Iraq	0.4	1.7	0.8	0.4	0.1	0	0	0.3	0	0	0	0	0	3.1	0.9	0	945.3	*b*
Ireland	2.0	5.3	9.2	12.3	1.9	1.7	0.2	0.6	0	7.2	0.1	0	0.6	39.2	10.4	8	466.6	*b*
Isle of Man	0.0	1.9	2.2	1.9	0	0	0	0.3	0	0	0	0	1.6	0	0	0	2.4	*a*
Israel	6.0	8.6	3.7	4.5	0.1	0	c	c	0	0.1	4.2	0	0	10.4	16	0	589.6	*b*
Italy	5.1	12.8	16.6	17.3	6.8	1.6	0.9	3.6	0	1.6	2	0.6	0.3	400.4	330.3	69.9	4635.6	*b*
Jamaica	9.4	9.0	12.1	9.1	5.9	1.8	0	0.5	0	0.8	0.1	0	0	1.3	5.2	1.6	88.6	*b*
Japan	3.7	4.7	6.2	7.7	2.4	0.2	0	2.5	0	0.2	2.2	0.1	0.1	588.3	175.4	28.5	10299.2	*b*
Jersey	0.0	4.8	15.9	17.7	0	0	0	0	0	0	0	0	17.7	1.1	0	0	6.1	*a*
Jordan	2.1	3.0	3.2	8.2	1.1	0	0	0	0	1.1	6	0	0	9.8	12.1	0	268	*b*
Kazakhstan	2.5	1.4	1.7	1.7	0.1	0	0	1.4	0	0.1	0.1	0	0	26.6	1.5	1.4	1731.4	*b*
Kenya	78.9	76.5	72.0	68.1	64.4	0	0	1.3	0	0.5	0	1.9	0	29.2	500.4	0	777.9	*b*
Kiribati	55.8	48.4	45.7	41.0	39.9	0	0	0	0	0	1.1	0	0	0	0.5	0	1.3	*a*
Kosovo	28.3	20.8	20.4	26.1	24.7	0	0	0.9	0	0.4	0.1	0	0	0.8	15.7	0	63.4	*a*
Kuwait	0.0	0.0	0.0	0.1	0	0	0	0	0	0	0	0	0	0.4	0	0	652.1	*b*
Kyrgyzstan	35.2	25.6	23.3	27.9	0.1	0	0	27.8	0	0	0	0	0	40.7	0.1	0.1	146.6	*b*
Lao People's Democratic Republic	81.5	64.9	53.3	48.4	37.7	0	0	10.7	0	0	0	0	0	14.5	50.7	0	134.5	*a*
Latvia	35.8	33.1	38.1	41.5	33.4	1	1.4	4.8	0	0.3	0	0	0.6	11.7	54.9	1.8	164.6	*b*
Lebanon	4.9	5.7	4.2	5.5	2.9	0	0.1	1.4	0	0	1.1	0	0	3.6	8.4	0	219	*b*
Lesotho	56.7	53.0	44.9	39.5	33	0	0	6.5	0	0	0	0	0	2.8	14.5	0	44	*a*
Liberia	90.9	88.6	83.9	87.2	86.8	0	0	0.4	0	0	0	0	0	0.4	78.3	0	90.2	*a*

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	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Libya	2.0	2.4	3.1	2.8	2.8	0	0	0	0	0	0	0	0	0	10.9	0	391.8	*b*
Liechtenstein	53.9	52.3	55.5	56.1	6.8	0	0.8	35.1	0	0	13.4	0	0	1.4	0.3	0	3.1	*a*
Lithuania	17.2	21.5	29.0	33.5	21.2	1.4	1	1.7	0	7.4	0.5	0	0.4	27.6	45.2	3.4	227	*b*
Luxembourg	6.8	3.7	9.1	16.5	4.2	3.4	1.1	1.5	0	3.8	1.8	0	0.6	16.8	3.5	5.8	159	*b*
Madagascar	82.6	86.7	80.6	82.8	81.6	0	0	1.1	0	0	0	0	0	3.1	214.5	0	262.9	*a*
Malawi	82.6	81.2	80.9	73.0	65.2	0	0	7.6	0	0	0.2	0	0	5.5	45.2	0	69.5	*a*
Malaysia	4.4	2.0	3.4	5.1	0.1	0.7	0.1	4	0	0	0.1	0	0	94	0	15.5	2144	*b*
Maldives	2.3	1.4	1.4	1.1	0.7	0	0	0	0	0	0.3	0	0	0.1	0.2	0	21.2	*a*
Mali	83.5	79.2	79.9	76.6	74.5	0	0	2.2	0	0	0	0	0	3.4	109.8	0	147.6	*a*
Malta	0.0	1.2	6.0	7.7	0.3	2.1	0.3	0	0	0	5	0	0	0.9	0.3	0.5	22.5	*b*
Marshall Islands	19.6	13.3	11.3	11.7	11.3	0	0	0	0	0	0.4	0	0	0	0.2	0	1.7	*a*
Martinique	1.7	2.5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*a*
Mauritania	44.4	34.0	28.2	24.7	23.5	0	0	0	0	0.5	0.7	0	0	0.7	14.1	0	60	*a*
Mauritius	20.4	12.8	11.5	8.9	6.5	0	0.2	0.9	0	0.1	1.2	0	0	2.3	0.9	0	36.2	*b*
Mayotte	16.2	10.0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*a*
Mexico	12.2	9.4	9.2	10.3	6.7	0	0	1.5	0	1.1	0.7	0.3	0	160.8	321.7	0.6	4670.1	*b*
Micronesia (Federated States of)	1.3	2.0	1.4	1.8	1.1	0	0	0	0	0.2	0.5	0	0	0	0	0	1.4	*a*
Mongolia	5.7	4.5	3.6	3.3	2.1	0	0	0.2	0	0.9	0.2	0	0	2.3	3.8	0	184.5	*b*
Montenegro	..	49.1	43.0	38.7	19.3	0	0	16.5	0	3	0	0	0	6.1	6.1	0	31.8	*b*
Montserrat	0.0	0.0	0.0	0.4	0	0	0	0	0	0	0.4	0	0	0	0	0	0.2	*a*
Morocco	15.3	13.9	11.3	10.7	7.4	0	0	0.5	0	2	0.7	0	0	21.8	50.5	0.3	679	*b*
Mozambique	93.6	84.9	80.8	78.1	67.4	0	0	10.6	0	0	0	0	0	36.7	230.5	0	342.2	*b*
Myanmar	80.2	84.9	70.4	57.9	54.1	0	0	3.7	0	0	0	0	0	30.8	450.1	0	831.3	*b*
Namibia	34.7	31.0	29.0	30.7	12.2	0	0	17.5	0	0.1	1	0	0	13.8	9.3	0	75.5	*b*
Nauru	0.0	0.0	0.1	0.6	0	0	0	0	0	0	0.6	0	0	0	0	0	0.5	*a*

UN COUNTRY NAME	SHARE IN TOTAL FINAL ENERGY CONSUMPTION (%)													FINAL CONSUMPTION OF RENEWABLE ENERGY (PJ)			TOTAL FINAL ENERGY CONSUMPTION (PJ)	SOURCE
	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Nepal	88.3	87.3	85.0	77.4	71.2	0	2.1	4.1	0	0	0	0	0	23.7	421.9	0	575.8	*b*
Netherlands	1.7	3.9	5.7	8.5	2.4	1.6	0.5	0	0	2	1	0.3	0.8	72.5	60.8	27.5	1880.9	*b*
New Caledonia	7.5	4.8	5.1	5.4	0.3	0	0	2.9	0	0.6	1.6	0	0	1.7	0.2	0	35.4	*a*
New Zealand	29.1	31.7	31.2	29.6	7.8	0.1	0.2	14.3	0	1.3	0.1	5.9	0	115.1	51.4	0.6	563.7	*b*
Nicaragua	58.4	54.4	50.0	50.7	45.9	0	0	0.6	0	2	0.1	2.1	0	7.6	46.7	0	107.1	*b*
Niger	87.6	80.7	78.9	80.8	80.7	0	0	0	0	0	0.1	0	0	0.2	104.9	0	130	*b*
Nigeria	86.2	86.5	82.1	81.4	81	0	0	0.4	0	0	0	0	0	21.2	4550	0	5615.9	*b*
Niue	0.6	26.7	22.4	22.4	0.5	0	0	0	0	0	21.9	0	0	0	0	0	0.1	*a*
North Macedonia	19.4	22.3	23.9	16.3	9.7	0	0.3	5.5	0	0.5	0.1	0.2	0	5.1	8	0	80.3	*b*
Northern Mariana Islands	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	3.7	*a*
Norway	60.2	56.4	58.1	62.4	4.9	2.6	0.4	51.3	0	2.3	0	0	0.8	401.6	45.2	25.5	757.2	*b*
Oman	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	852.2	*b*
Pakistan	51.1	47.4	45.9	43.4	40.8	0	0	2.3	0	0.3	0.1	0	0	98.7	1504.2	0	3696.3	*b*
Palau	0.0	0.0	0.0	0.3	0	0	0	0	0	0	0.3	0	0	0	0	0	2.2	*a*
Panama	27.7	20.6	21.9	18.9	7	0	0	9.9	0	1.4	0.6	0	0	18.3	10.7	0	153.1	*b*
Papua New Guinea	66.4	55.3	55.1	53.1	49.9	0	0	2.1	0	0	0	1	0	4.6	71.8	0	143.9	*a*
Paraguay	70.4	63.6	60.5	60.1	39.9	3	0	17.2	0	0	0	0	0	46.2	107.4	8.1	269.2	*b*
Peru	38.6	32.2	27.4	27.1	12.5	2	0	11.6	0	0.6	0.5	0	0	108	108.8	15.3	855.5	*b*
Philippines	33.4	32.6	30.7	26.7	20.9	1.6	0	1.6	0	0.2	0.2	2.1	0	65.1	309.1	21.3	1479.8	*b*
Poland	6.9	9.5	11.9	12.2	8.3	1.5	0.3	0.2	0	1.6	0.2	0	0.1	76.9	229.5	44.8	2882.6	*b*
Portugal	20.1	27.8	27.2	28.2	13.1	1.8	0.2	4.5	0	7	1.3	0.1	0.2	90.4	81.7	12.3	654	*b*
Puerto Rico	0.5	0.7	1.9	2.4	0	0	0.1	0.2	0	0.8	1.3	0	0	1.4	0	0	57.9	*a*
Qatar	0.1	0.1	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0.3	0	654.4	*b*
Republic of Korea	0.7	1.3	2.7	3.4	1	0.6	0.1	0.2	0	0.2	0.8	0.2	0.2	88.9	65.3	27.4	5411.6	*b*
Republic of Moldova	5.7	20.0	24.7	22.0	21.1	0	0.1	0.8	0	0.1	0	0	0	1.2	26.6	0	126.3	*b*
Réunion	11.7	16.4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*a*

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	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Romania	16.4	24.1	23.7	23.5	14.8	1.8	0.1	4.4	0	1.9	0.5	0.1	0	66.7	145.6	18.9	981.9	*b*
Russian Federation	3.5	3.3	3.2	3.2	0.6	0	0	2.6	0	0	0	0	0	426.4	113.8	51.6	18373.1	*b*
Rwanda	86.8	90.7	86.3	77.9	76.4	0	0	1.4	0	0	0.1	0	0	1.3	68.9	0	90.2	*a*
Saint Helena	7.1	9.2	13.0	9.4	3.6	0	0	0	0	3.8	2	0	0	0	0	0	0.2	*a*
Saint Kitts and Nevis	26.6	1.0	1.6	1.6	0	0	0	0	0	1.1	0.4	0	0	0	0	0	2	*a*
Saint Lucia	24.1	13.2	11.5	9.7	9.5	0	0	0	0	0	0.3	0	0	0	0.5	0	5.5	*a*
Saint Pierre and Miquelon	0.5	1.5	1.0	0.9	0.9	0	0	0	0	0	0	0	0	0	0	0	0.6	*a*
Saint Vincent and the Grenadines	8.5	5.1	4.3	5.7	2.2	0	0	3.2	0	0	0.3	0	0	0.1	0.1	0	2.5	*a*
Samoa	59.7	41.3	37.5	34.2	29.3	0	0	3.3	0	0	1.6	0	0	0.2	1.5	0	4.9	*a*
Sao Tome and Principe	54.7	43.8	40.2	37.1	36.2	0	0	0.8	0	0	0.1	0	0	0	0.8	0	2.2	*a*
Saudi Arabia	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	1.2	0.3	0	4471.4	*b*
Senegal	47.5	49.5	39.1	37.2	36.4	0	0	0	0	0.1	0.7	0	0	1.3	42.4	0	117.3	*b*
Serbia	22.1	20.5	21.2	21.5	13.1	0	0.2	7.4	0	0.7	0	0.1	0	28.3	46.5	0.4	349.7	*b*
Seychelles	1.5	0.7	1.4	1.5	0.6	0	0	0	0	0.5	0.3	0	0	0	0	0	5	*a*
Sierra Leone	91.3	84.9	75.0	75.4	74.4	0	0	1	0	0	0	0	0	0.6	42.8	0	57.5	*a*
Singapore	0.3	0.5	0.6	0.8	0.2	0	0	0	0	0	0.3	0	0.4	4	0	0.3	512.2	*b*
Sint Maarten (Dutch part)	0.0	0.0	0.0	0.1	0.1	0	0	0	0	0	0	0	0	0	0	0	7.7	*a*
Slovakia	3.7	10.3	13.4	17.6	11.4	1.5	0.7	3.2	0	0	0.5	0	0.2	20.9	48.1	7	430.9	*b*
Slovenia	18.0	20.1	21.4	20.9	10.8	2	0.2	6.9	0	0	0.7	0.3	0	15.3	22.5	4.2	202	*b*
Solomon Islands	55.3	45.1	48.6	48.4	48.2	0	0	0	0	0	0.2	0	0	0	3.2	0	6.7	*a*
Somalia	93.3	93.6	94.5	95.0	95	0	0	0	0	0	0	0	0	0.1	112.3	0	118.2	*a*
South Africa	16.3	11.8	10.3	10.5	9.1	0	0	0.1	0	0.7	0.7	0	0	33.8	250	0.5	2708.3	*b*
South Sudan	..	..	26.7	26.6	26.6	0	0	0	0	0	0.1	0	0	0	5.6	0	21	*b*
Spain	7.9	14.4	16.3	17.3	5.7	2.1	0.2	2.3	0	5.2	1.8	0	0.1	309.3	197.2	73.5	3358.9	*b*
Sri Lanka	64.2	61.8	52.9	49.9	45.9	0	0	3.7	0	0.3	0.1	0	0	17.5	196.1	0	428.1	*b*

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	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
State of Palestine	17.5	14.1	11.0	13.9	4.8	0	0	0	0	0	9.1	0	0	3.3	6.3	0	69	*a*
Sudan	80.4	61.3	63.0	62.2	56.6	0	0	5.6	0	0	0	0	0	29.6	298.7	0	527.4	*b*
Suriname	23.6	22.1	11.6	14.4	3.9	0	0	10.4	0	0	0.1	0	0	3	1.1	0	29.1	*b*
Sweden	39.8	44.7	51.9	52.9	26.7	5.5	0.5	13.8	0	4.2	0.2	0	2.1	257.6	346.2	63.9	1262.7	*b*
Switzerland	18.2	20.6	23.9	24.8	5.5	1	0.4	15	0	0.1	1.2	0	1.6	116.7	52.6	14.2	741.3	*b*
Syrian Arab Republic	2.0	1.3	0.6	1.0	0.1	0	0	0.9	0	0	0	0	0	1.9	0.2	0	205.1	*b*
Tajikistan	62.4	61.8	48.1	38.6	0	0	0	38.6	0	0	0	0	0	50.5	0	0	130.9	*b*
Thailand	21.8	22.8	22.6	24.0	18.2	2.8	1	0.7	0	0.4	0.6	0	0.2	122.9	576.8	90.9	3299.7	*b*
Timor-Leste	0.0	34.8	18.0	11.7	11.6	0	0	0.1	0	0	0	0	0	0	0.7	0	6.4	*a*
Togo	77.1	65.8	81.0	76.2	74.4	0	0	1.8	0	0	0	0	0	1.6	66.3	0	89.1	*b*
Tonga	2.5	1.0	1.9	1.8	0.7	0	0	0	0	0	1.1	0	0	0	0	0	1.9	*a*
Trinidad and Tobago	0.8	0.4	0.4	0.4	0.4	0	0	0	0	0	0	0	0	0	0.5	0	110.1	*b*
Tunisia	14.2	12.6	12.5	12.2	10.7	0	0	0.1	0	0.4	1	0	0	2.3	38.7	0	335.9	*b*
Turkey	17.3	14.2	13.3	14.1	1.6	0.2	0.2	6.4	0	1.6	1.5	2.6	0	394.2	182.3	9.5	4150.9	*b*
Turkmenistan	0.1	0.1	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0	0.4	0	757.3	*b*
Turks and Caicos Islands	0.4	0.3	0.4	0.4	0.3	0	0	0	0	0	0.1	0	0	0	0	0	3.2	*a*
Tuvalu	0.0	0.3	3.9	8.2	0	0	0	0	0	0	8.2	0	0	0	0	0	0.1	*a*
Uganda	95.0	93.2	91.1	90.2	88.8	0	0	1.4	0	0	0	0	0	11.4	696.3	0	784.3	*a*
Ukraine	1.3	2.9	4.1	7.4	5.6	0.2	0.1	0.9	0	0.3	0.4	0	0	30.8	109.7	5.5	1962.3	*b*
United Arab Emirates	0.1	0.1	0.1	0.7	0.1	0	0	0	0	0	0.6	0	0	12.4	1.8	0	2130.2	*b*
United Kingdom of Great Britain and Northern Ireland	1.0	3.7	8.6	12.2	4.4	1.4	0.6	0.4	0	4.2	0.9	0	0.3	391.7	147.7	76.3	5031.8	*b*
United Republic of Tanzania	93.7	89.7	84.6	85.2	84.2	0	0	1	0	0	0	0	0	8.1	669.7	0	795.4	*b*
United States of America	5.4	7.4	9.0	10.4	3.6	2.8	0.1	1.5	0	1.6	0.7	0.1	0.1	2410.8	2250.1	1581.7	59892	*b*
United States Virgin Islands	0.0	0.0	4.2	3.7	0	0	0	0	0	0	3.6	0	0	0.1	0	0	2	*a*
Uruguay	38.7	53.3	59.4	60.8	41.6	2.1	0	10.4	0	6.1	0.5	0	0	40	76.8	3	197.3	*b*

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	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Uzbekistan	0.7	1.3	1.7	1.6	0	0	0	1.6	0	0	0	0	0	18.6	0.2	0.8	1248.5	*b*
Vanuatu	48.7	38.4	35.9	31.9	29.4	0.1	0	0.9	0	0.7	0.6	0	0	0.1	0.8	0	2.8	*a*
Venezuela (Bolivarian Republic of)	15.3	13.8	15.3	15.6	1.6	0	0	14	0	0	0	0	0	119.1	14	0	851.7	*b*
Viet Nam	57.7	34.6	30.3	18.7	9.5	0.2	0	8.3	0	0.1	0.6	0	0	235.8	230.7	5.4	2529.9	*b*
Wallis and Futuna Islands	0.0	0.4	0.6	0.7	0	0	0	0.5	0	0	0.2	0	0	0	0	0	0.2	*a*
Yemen	1.0	0.8	2.0	3.1	2.1	0	0	0	0	0	1	0	0	1.1	2.2	0	105.1	*b*
Zambia	90.0	88.6	83.1	84.5	73.1	0	0	11.3	0	0	0.1	0	0	38	244.4	0.1	334.4	*b*
Zimbabwe	69.3	82.3	80.8	81.5	78.1	0.4	0	2.9	0	0	0	0	0	12.4	313.8	1.7	402.4	*b*
World	16.9	16.1	16.8	17.7	10.4	1.1	0.2	3.4	0	1.2	0.9	0.3	0.1	20977.3	41285.2	4381.8	376643.5	*c*
Northern America (M49) and Europe (M49)	7.4	10.1	12.0	13.1	5	1.9	0.3	3.1	0	1.7	0.7	0.1	0.2	8091.1	6942.2	2612.8	134892.2	*c*
Northern America (M49)	7.3	9.1	10.8	11.8	3.8	2.6	0.1	3.1	0	1.5	0.6	0.1	0.1	3719.5	2615.7	1683.7	67690	*c*
Europe (M49)	7.4	11.0	13.2	14.3	6.1	1.2	0.5	3.2	0	1.9	0.8	0.2	0.3	4314.8	4325.7	949.3	67202.2	*c*
Latin America and the Caribbean (MDG=M49)	28.4	29.2	28.5	30.9	15.6	4.5	0	8.9	..	1.2	0.6	0.1	0	2668.3	3557.8	1026.6	23507.8	*c*
Central Asia (M49) and Southern Asia (MDG=M49)	34.4	27.5	26.5	26.1	22.8	0.1	0.2	2	0	0.5	0.5	0	0	1284.8	9519.3	61.7	41661.2	*c*
Central Asia (M49)	3.6	2.8	3.3	3.4	0.1	0	0	3.2	0	0	0.1	0	0	127.6	2.2	4.8	4014.8	*c*
Southern Asia (MDG=M49)	39.5	31.0	29.1	28.5	25.2	0.1	0.2	1.9	0	0.6	0.5	0	0	1153.6	9517.1	57.4	37646.4	*c*
Eastern Asia (M49) and South-eastern Asia (MDG=M49)	23.1	13.4	13.2	14.3	5.6	0.4	0.3	4.2	0	1.2	1.7	0.8	0	7702.9	8052.6	636.4	114665.4	*c*
Eastern Asia (M49)	19.8	10.5	11.0	13.1	3.9	0.2	0.3	4.5	0	1.4	2	0.8	0	6927.2	5410	332.6	97031.2	*c*
South-eastern Asia (MDG=M49)	38.2	30.1	25.9	21.1	15.2	1.9	0.2	2.9	0	0.1	0.2	0.4	0	773.3	2642.6	305.7	17634.2	*c*
Western Asia (M49) and Northern Africa (M49)	8.4	6.2	5.5	5.9	2.6	0	0	1.7	0	0.4	0.6	0.5	0	566.8	719.8	9.6	22109.7	*c*
Western Asia (M49)	6.1	4.5	3.9	4.5	0.6	0	0.1	1.9	0	0.4	0.8	0.7	0	464.1	254.6	8.6	16266.2	*c*

UN COUNTRY NAME	SHARE IN TOTAL FINAL ENERGY CONSUMPTION (%)													FINAL CONSUMPTION OF RENEWABLE ENERGY (PJ)			TOTAL FINAL ENERGY CONSUMPTION (PJ)	SOURCE
	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Northern Africa (M49)	15.0	11.2	10.1	9.8	7.9	0	0	1.2	0	0.4	0.2	0	0	103.6	465.5	0.9	5843.5	c
Sub-Saharan Africa (M49)	72.5	71.0	68.6	68.3	66.2	0	0	1.7	..	0.1	0.1	0.1	..	378.1	12174.2	4.9	18391.4	c
Oceania (M49)	13.1	12.8	13.9	14.4	7	0.1	0.2	3.2	0	1.5	1.6	0.8	0	264.8	303.9	12.2	4039	c
Oceania (M49) excluding Australia and New Zealand (M49)	46.4	36.5	38.4	36.9	33	0	0	2.7	0	0.1	0.5	0.6	0	9.5	82.5	0	249.6	c
Australia and New Zealand (M49)	11.4	11.4	12.4	12.9	5.3	0.1	0.2	3.2	0	1.6	1.6	0.8	0	254.9	221.4	12.2	3789.4	c
Least Developed Countries (LDCs)	83.9	76.2	72.9	69.4	65.8	0	0.1	3.4	0	0	0.1	0	0	407.9	7600.5	0.2	11531.7	c
Small island developing States (SIDS)	25.4	17.8	18.5	18.1	16.1	0.5	0	0.7	0	0.3	0.3	0.1	0.1	33.4	325.8	2.4	1992.3	c
Landlocked developing countries (LLDCs)	43.6	41.8	44.3	43.1	38.6	0.1	0.1	4.1	0	0	0	0	0	442.7	4124.1	20.8	10650.4	c
Africa (M49)	60.7	56.6	54.8	54.2	52.1	0	0	1.6	..	0.2	0.2	0.1	..	478.3	12639.8	5.9	24234.9	c
Asia (M49)	24.2	15.8	15.3	16.2	9.3	0.3	0.2	3.4	0	0.9	1.3	0.6	0	9403.2	17827.7	696.5	172592.8	c
Americas (m49)	11.8	14.3	15.6	16.8	6.8	3.1	0.1	4.7	0	1.4	0.6	0.1	0	6476	6173.3	2710.8	91197.8	c
Caribbean (M49)	25.5	18.3	20.7	20.8	18.7	1	0	0.4	..	0.4	0.3	..	..	13.8	204	1.6	1053.4	c
Central America (M49)	18.1	16.5	16.5	17.7	13.2	0	0	2.3	0	1.1	0.7	0.5	0	273.4	768.6	0.9	5898.8	c
Eastern Africa (M49)	88.1	87.5	84.5	83.0	79.8	0	0	2.9	..	0.1	0	0.2	..	194	4696.2	2	5892.2	c
Eastern Europe (M49)	4.3	5.7	6.3	6.6	3.5	0.4	0.1	2.2	0	0.3	0.1	0	0	690.7	974.3	159.5	27604.4	c
Melanesia (M49)	54.2	43.2	43.8	41.9	37.9	0	0	2.9	0	0.1	0.3	0.7	0	8.4	80.2	0	211.4	c
Micronesia (M49)	4.8	4.7	5.2	5.8	4.5	0	0	0	0	0	1.2	0	0	0.2	0.7	0	16.6	c
Middle Africa (M49)	88.1	79.0	76.0	79.0	74.9	0	0	4.1	0	0	0	0	0	82.9	1511.8	0	2019.7	c
Northern Europe (M49)	15.4	19.0	25.6	28.5	12.2	2.1	0.6	7.6	0	4.2	0.6	0.5	0.8	1438	1130.1	212	9739.4	c
Polynesia (M49)	17.6	10.2	12.3	12.0	6.9	0	0	3.2	0	0	1.8	0	0	1	1.6	0	21.6	c
South America (M49)	32.8	34.5	33.2	36.1	16.3	6.3	0	11.7	..	1.3	0.5	0	0	2367.9	2585.2	1024.8	16555.6	c
Southern Africa (M49)	18.4	13.9	12.2	12.1	10.6	0	0	0.2	0	0.6	0.6	0	0	40.2	316.1	0.6	2944.4	c

UN COUNTRY NAME	SHARE IN TOTAL FINAL ENERGY CONSUMPTION (%)													FINAL CONSUMPTION OF RENEWABLE ENERGY (PJ)			TOTAL FINAL ENERGY CONSUMPTION (PJ)	SOURCE
	RENEWABLE ENERGY				SOLID BIOFUELS	LIQUID BIOFUELS	BIOGASES	HYDRO	TIDE	WIND	SOLAR	GEOTHERMAL	MUNICIPAL WASTE (RENEW)	ELECTRICITY CONSUMPTION (1)	HEAT RAISING (2)	TRANSPORT (3)		
	2000	2010	2015	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	
Southern Europe (M49)	8.7	15.4	18.2	19.1	7.7	1.6	0.5	3.8	0	3.2	1.8	0.3	0.2	981.5	846.7	177.1	10524.2	c
Western Africa (M49)	83.3	81.9	77.4	75.9	75	0	0	0.8	0	0	0	0	0	67.4	5650.2	0	7535.1	c
Western Europe (M49)	6.7	11.8	14.3	16.4	6.1	1.8	1.1	2.4	0	2.9	1.4	0.1	0.7	1423.6	1389.1	362.9	19334.3	c
Developing regions (MDG)	32.2	23.0	22.0	22.7	15.4	0.8	0.2	3.9	0	0.9	1.1	0.5	0	12012.2	33910.6	1719.7	209630.2	c
Developed regions (MDG)	7.2	9.7	11.6	12.7	4.8	1.7	0.3	3.1	0	1.6	0.9	0.1	0.2	8964.2	7361.1	2652.4	149636.5	c
Northern Africa (MDG)	7.3	5.4	4.7	4.6	3.1	0	0	0.8	0	0.5	0.3	0	0	75.6	166.9	0.7	5316.1	c
Sub-Saharan Africa (MDG)	72.7	70.7	68.5	68.1	65.9	0	0	1.8	..	0.1	0.1	0.1	..	407.2	12472.9	5.1	18918.8	c
Eastern Asia (MDG)	25.5	11.5	11.6	13.7	4.1	0.2	0.4	4.7	0	1.5	2	0.9	0	6333.8	5234.6	305	86732	c
Western Asia (MDG)	5.7	3.9	3.6	4.3	0.6	0	0.1	1.8	0	0.4	0.7	0.7	0	413.6	215.8	7.7	14936.7	c
Oceania (MDG)	46.4	36.5	38.4	36.9	33	0	0	2.7	0	0.1	0.5	0.6	0	9.5	82.5	0	249.6	c
Caucasus and Central Asia (MDG)	4.7	3.9	4.2	4.0	0.4	0	0	3.5	0	0.1	0.1	0	0	164.2	18.8	5.8	4688.7	c

REFERENCE
a. Source: Energy Balances, UN Statistics Division (2021)
b. Source: IEA (2021), World Energy Balances
c. Sources: IEA (2021), World Energy Balances; Energy Balances, UN Statistics Division (2021)

DEFINITIONS
Final consumption of renewable energy:
(1) Electricity consumption: Covers final consumption of renewable electricity in all sectors excluding transport
(2) Heat raising: Covers final consumption of renewable energy for heat raising purposes (excluding electricity) in manufacturing, construction and non fuel mining industries, household, commerce and public services, agriculture, forestry, fishing and not elsewhere specified.
(3) Transport:Covers final consumption of renewable energy (including electricity) in the transport sector.

NOTES
Allocation of renewable electricity and heat to final energy consumption.:
To establish the contribution of each technology to the final consumption, the aggregated figures for electricity and commercial heat have to be allocated to the relevant technology. This can be done based on the proportions exhibited in production data, attributing the losses proportionally (GTF 2013). For instance, if total final consumption table reports 150 TJ for biogases, while total final consumption of electricity is 400 TJ and heat 100 TJ, and the share of biogases in total electricity output is 10 percent and 5 percent in heat, the total reported number for biogases consumption will be 195 TJ (150 TJ+400TJ*10%+100TJ*5%).

SDG 7.3 - ENERGY EFFICIENCY

Data provided by the IEA and UNSD

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Afghanistan	1.6	2.5	2.4	2.4	4.2%	-0.7%	0.3%	*a*
Albania	4.1	2.9	2.7	2.5	-3.7%	-1.1%	-1.8%	*b*
Algeria	4.2	4.4	5.1	5.3	0.6%	2.7%	1.3%	*b*
American Samoa	..	..	..	..	..	..	..	*a*
Andorra	..	..	..	..	..	..	..	*a*
Angola	3.7	2.6	2.9	2.9	-3.4%	1.8%	0.7%	*b*
Anguilla	..	..	..	..	..	..	..	*a*
Antigua and Barbuda	3.1	4.1	4.0	3.5	2.6%	-0.4%	-3.5%	*a*
Argentina	3.7	3.3	3.4	3.4	-1.2%	0.6%	0.0%	*b*
Armenia	6.8	3.9	4.1	3.5	-5.4%	1.1%	-3.8%	*b*
Aruba	14.4	16.2	3.3	3.2	1.2%	-27.4%	-0.6%	*a*
Australia	6.2	5.3	4.7	4.3	-1.4%	-2.6%	-2.1%	*b*
Austria	3.2	3.3	3.0	2.8	0.2%	-1.8%	-1.6%	*b*
Azerbaijan	14.5	3.8	4.3	4.6	-12.5%	2.2%	2.0%	*b*
Bahamas	2.3	2.1	2.3	2.5	-0.8%	1.7%	2.1%	*a*
Bahrain	10.4	9.6	9.1	8.7	-0.8%	-1.2%	-0.9%	*b*
Bangladesh	3.1	2.9	2.7	2.4	-0.7%	-1.7%	-3.2%	*b*
Barbados	3.8	4.6	3.9	3.5	1.8%	-3.3%	-2.2%	*a*
Belarus	12.9	7.0	6.1	6.0	-5.9%	-2.8%	-0.4%	*b*
Belgium	5.5	4.8	3.9	3.9	-1.4%	-3.9%	-0.5%	*b*
Belize	6.7	5.4	5.8	6.1	-2.1%	1.4%	1.2%	*a*
Benin	4.9	6.0	5.8	5.7	2.1%	-0.7%	-0.4%	*b*
Bermuda	1.5	1.5	1.6	1.7	0.1%	0.7%	0.9%	*a*
Bhutan	18.4	10.1	8.7	7.9	-5.8%	-3.0%	-2.3%	*a*
Bolivia (Plurinational State of)	3.5	4.1	4.1	3.8	1.4%	0.1%	-1.6%	*b*
Bonaire, Sint Eustatius and Saba	..	..	..	..	..	..	..	*a*

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Bosnia and Herzegovina	6.8	6.7	6.0	6.1	-0.2%	-2.3%	0.7%	*b*
Botswana	4.0	3.3	3.2	2.7	-2.1%	-0.6%	-3.8%	*b*
Brazil	3.9	3.9	4.1	3.9	-0.1%	1.0%	-0.7%	*b*
British Virgin Islands	..	..	..	..	..	..	..	*a*
Brunei Darussalam	4.3	5.2	4.3	6.4	1.7%	-3.4%	10.0%	*b*
Bulgaria	9.3	5.8	5.5	4.7	-4.7%	-1.0%	-3.5%	*b*
Burkina Faso	5.5	5.4	4.9	4.5	-0.1%	-1.8%	-2.4%	*a*
Burundi	10.4	7.9	7.4	7.6	-2.6%	-1.4%	0.8%	*a*
Cabo Verde	3.3	3.0	2.6	2.6	-0.8%	-2.7%	-0.4%	*a*
Cambodia	7.9	5.1	4.6	4.7	-4.4%	-1.9%	0.5%	*b*
Cameroon	6.2	4.7	4.8	4.3	-2.8%	0.4%	-2.3%	*b*
Canada	9.3	7.2	6.9	6.9	-2.6%	-0.7%	0.1%	*b*
Cayman Islands	1.9	2.1	1.9	2.1	1.0%	-1.8%	1.8%	*a*
Central African Republic	7.7	6.8	9.4	8.4	-1.3%	6.8%	-2.8%	*a*
Chad	8.2	4.0	3.3	3.8	-7.1%	-3.5%	3.3%	*a*
Chile	4.4	3.6	3.4	3.7	-2.1%	-1.0%	2.0%	*b*
China	10.9	8.9	7.2	6.3	-1.9%	-4.2%	-3.3%	*b*
China, Hong Kong Special Administrative Region	2.5	1.6	1.5	1.3	-4.4%	-1.1%	-2.9%	*b*
China, Macao Special Administrative Region	1.1	0.5	0.6	0.5	-7.2%	3.1%	-4.3%	*a*
Colombia	3.0	2.4	2.5	2.5	-2.2%	1.1%	-0.2%	*b*
Comoros	2.7	2.8	2.7	3.2	0.4%	-0.9%	4.6%	*a*
Congo	2.2	3.2	4.6	6.6	3.9%	7.8%	9.1%	*b*
Cook Islands	..	..	..	..	..	..	..	*a*
Costa Rica	2.4	2.5	2.2	2.1	0.3%	-2.1%	-1.3%	*b*
Côte d'Ivoire	4.2	4.6	4.0	3.3	0.9%	-3.1%	-4.3%	*b*
Croatia	4.3	3.8	3.4	3.1	-1.4%	-2.0%	-2.5%	*b*
Cuba	3.5	1.9	1.6	1.3	-6.1%	-3.2%	-5.1%	*b*
Curaçao	22.2	20.2	22.3	8.3	-1.0%	2.0%	-21.8%	*b*

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Cyprus	3.9	3.3	2.9	2.7	-1.9%	-2.0%	-2.3%	*b*
Czechia	6.7	5.4	4.6	4.1	-2.2%	-3.1%	-2.8%	*b*
Democratic People's Republic of Korea	..	..	..	..	..	..	..	*b*
Democratic Republic of the Congo	16.5	14.9	14.9	13.3	-1.0%	0.0%	-2.8%	*b*
Denmark	3.0	2.9	2.3	2.0	-0.3%	-4.7%	-3.2%	*b*
Djibouti	6.0	4.4	2.4	1.9	-3.2%	-11.1%	-6.0%	*a*
Dominica	2.5	3.0	3.1	3.0	1.9%	0.8%	-1.2%	*a*
Dominican Republic	3.9	2.6	2.2	2.1	-4.1%	-2.9%	-1.5%	*b*
Ecuador	3.3	3.5	3.3	3.3	0.6%	-1.3%	0.0%	*b*
Egypt	3.3	3.7	3.5	3.4	1.1%	-1.1%	-0.3%	*b*
El Salvador	3.5	3.9	3.4	3.4	1.2%	-2.8%	-0.1%	*b*
Equatorial Guinea	1.6	2.4	3.3	3.0	4.2%	6.8%	-2.1%	*a*
Eritrea	..	..	..	..	..	..	..	*b*
Estonia	8.0	6.8	5.6	4.5	-1.6%	-3.7%	-5.3%	*b*
Eswatini	6.2	5.2	5.0	4.7	-1.8%	-0.9%	-1.6%	*a*
Ethiopia	21.4	12.7	9.2	7.5	-5.1%	-6.2%	-4.9%	*b*
Falkland Islands (Malvinas)	..	..	..	..	..	..	..	*a*
Faroe Islands	..	..	..	..	..	..	..	*a*
Fiji	2.8	2.3	2.3	2.2	-1.8%	0.1%	-1.8%	*a*
Finland	6.6	6.2	5.5	5.2	-0.5%	-2.4%	-1.4%	*b*
France	4.4	4.0	3.7	3.3	-0.8%	-1.8%	-2.6%	*b*
French Guiana	..	..	..	..	..	..	..	*a*
French Polynesia	..	..	..	..	..	..	..	*a*
Gabon	3.0	9.1	7.2	6.0	11.6%	-4.5%	-4.6%	*b*
Gambia	3.1	2.9	3.5	3.0	-0.7%	3.6%	-3.9%	*a*
Georgia	6.0	3.6	4.2	3.8	-5.1%	3.4%	-2.2%	*b*
Germany	4.0	3.6	3.1	2.8	-1.1%	-2.9%	-2.8%	*b*
Ghana	5.0	3.4	3.0	2.9	-3.8%	-2.4%	-1.5%	*b*
Gibraltar	..	..	..	..	..	..	..	*b*

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Greece	3.6	3.1	3.2	2.9	-1.5%	0.6%	-2.3%	*b*
Greenland	..	..	..	..	..	..	..	*a*
Grenada	2.5	2.8	2.4	2.7	1.4%	-2.9%	2.4%	*a*
Guadeloupe	..	..	..	..	..	..	..	*a*
Guam	..	..	..	..	..	..	..	*a*
Guatemala	4.0	4.1	4.2	4.2	0.3%	0.1%	0.5%	*b*
Guernsey	..	..	..	..	..	..	..	*a*
Guinea	9.1	7.7	6.4	5.6	-1.6%	-3.8%	-3.3%	*a*
Guinea-Bissau	11.2	10.5	9.7	8.6	-0.6%	-1.6%	-3.0%	*a*
Guyana	5.8	4.7	4.0	4.0	-2.1%	-3.2%	-0.1%	*a*
Haiti	5.6	5.9	5.6	5.8	0.4%	-0.9%	0.9%	*b*
Honduras	4.7	4.9	5.0	4.3	0.5%	0.5%	-3.8%	*b*
Hungary	5.3	4.5	3.9	3.5	-1.5%	-3.0%	-2.6%	*b*
Iceland	11.2	15.0	13.6	12.3	3.0%	-2.0%	-2.5%	*b*
India	6.4	5.3	4.8	4.3	-1.8%	-2.1%	-2.9%	*b*
Indonesia	5.4	4.2	3.3	3.2	-2.5%	-5.0%	-0.8%	*b*
Iran (Islamic Republic of)	7.8	8.4	10.0	11.1	0.7%	3.5%	2.8%	*b*
Iraq	5.1	5.3	4.4	5.6	0.5%	-3.9%	6.3%	*b*
Ireland	3.1	2.5	1.6	1.3	-2.4%	-7.7%	-5.3%	*b*
Isle of Man	..	..	..	..	..	..	..	*a*
Israel	3.9	3.7	2.9	2.5	-0.5%	-4.5%	-3.6%	*b*
Italy	2.9	2.9	2.6	2.5	-0.2%	-1.9%	-1.6%	*b*
Jamaica	5.9	3.8	3.9	4.5	-4.3%	0.4%	3.5%	*b*
Japan	4.8	4.4	3.6	3.3	-0.9%	-3.8%	-1.9%	*b*
Jersey	..	..	..	..	..	..	..	*a*
Jordan	4.6	3.6	3.8	3.8	-2.3%	1.2%	-0.3%	*b*
Kazakhstan	9.8	8.6	5.4	6.3	-1.3%	-8.8%	3.9%	*b*
Kenya	6.4	5.9	5.8	5.3	-0.8%	-0.3%	-2.2%	*b*
Kiribati	5.1	6.8	5.8	5.9	2.9%	-3.2%	0.7%	*a*
Kosovo	8.1	7.0	6.1	5.4	-1.4%	-2.9%	-2.7%	*b*

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Kuwait	6.9	7.4	7.1	7.4	0.7%	-0.9%	1.1%	*b*
Kyrgyzstan	6.4	5.1	5.8	5.0	-2.3%	2.6%	-3.9%	*b*
Lao People's Democratic Republic	3.8	3.3	3.8	4.4	-1.3%	2.9%	3.3%	*a*
Latvia	5.3	4.3	3.4	3.2	-2.1%	-4.6%	-1.6%	*b*
Lebanon	3.7	2.8	3.3	3.6	-2.9%	3.3%	2.6%	*b*
Lesotho	14.0	11.1	8.3	8.1	-2.3%	-5.6%	-0.4%	*a*
Liberia	10.1	13.5	13.0	14.3	3.0%	-0.8%	2.5%	*a*
Libya	7.4	6.1	10.8	8.9	-1.9%	12.2%	-4.8%	*b*
Liechtenstein	..	..	..	..	..	..	..	*a*
Lithuania	6.2	4.0	3.3	3.1	-4.3%	-3.7%	-1.8%	*b*
Luxembourg	3.4	3.2	2.5	2.3	-0.3%	-5.2%	-1.5%	*b*
Madagascar	6.0	6.1	6.7	8.6	0.1%	1.9%	6.4%	*a*
Malawi	5.3	3.9	3.4	3.2	-3.1%	-2.7%	-1.4%	*a*
Malaysia	5.5	5.2	4.7	4.3	-0.4%	-2.1%	-2.6%	*b*
Maldives	1.7	2.3	2.4	2.7	2.6%	1.3%	2.9%	*a*
Mali	4.8	4.9	5.2	4.6	0.1%	1.4%	-3.2%	*a*
Malta	2.6	2.6	1.5	1.4	-0.2%	-10.0%	-2.5%	*b*
Marshall Islands	9.4	10.5	10.7	9.7	1.2%	0.4%	-2.4%	*a*
Martinique	..	..	..	..	..	..	..	*a*
Mauritania	2.5	2.8	2.9	3.2	1.0%	1.3%	2.5%	*a*
Mauritius	3.0	2.6	2.4	2.1	-1.3%	-1.8%	-2.8%	*b*
Mayotte	..	..	..	..	..	..	..	*a*
Mexico	3.6	3.7	3.3	3.1	0.2%	-2.2%	-1.8%	*b*
Micronesia (Federated States of)	7.2	4.1	5.7	5.5	-5.5%	6.6%	-0.6%	*a*
Mongolia	9.2	8.1	5.9	7.0	-1.3%	-6.2%	4.4%	*b*
Montenegro	..	4.6	3.7	3.4	..	-4.1%	-1.9%	*b*
Montserrat	..	..	..	..	..	..	..	*a*
Morocco	3.6	3.5	3.3	3.3	-0.4%	-1.3%	0.6%	*b*
Mozambique	26.9	12.7	13.0	11.9	-7.3%	0.5%	-2.0%	*b*
Myanmar	10.5	3.7	3.4	3.6	-10.0%	-1.5%	1.3%	*b*

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Namibia	3.6	3.6	3.3	3.5	0.0%	-1.5%	1.5%	*b*
Nauru	17.4	8.7	5.4	5.1	-6.7%	-9.1%	-1.6%	*a*
Nepal	6.8	5.9	5.5	5.2	-1.5%	-1.3%	-1.2%	*b*
Netherlands	4.2	4.0	3.4	3.1	-0.3%	-3.3%	-2.6%	*b*
New Caledonia	..	..	..	..	..	..	..	*a*
New Zealand	5.7	4.6	4.5	4.0	-2.0%	-0.6%	-2.7%	*b*
Nicaragua	5.2	4.7	4.5	4.7	-1.0%	-1.0%	1.0%	*b*
Niger	5.8	5.5	5.5	5.0	-0.6%	0.1%	-2.3%	*b*
Nigeria	10.0	6.8	6.0	6.4	-3.8%	-2.4%	1.4%	*b*
Niue	..	..	..	..	..	..	..	*a*
North Macedonia	5.4	4.3	3.6	3.4	-2.2%	-3.9%	-1.1%	*b*
Northern Mariana Islands	..	..	..	..	..	..	..	*a*
Norway	4.3	4.6	3.8	3.3	0.7%	-3.7%	-3.1%	*b*
Oman	4.1	7.6	8.2	7.2	6.3%	1.7%	-3.1%	*b*
Pakistan	5.8	5.1	4.7	4.6	-1.2%	-1.6%	-0.6%	*b*
Palau	11.2	10.7	8.7	9.6	-0.5%	-4.0%	2.6%	*a*
Panama	2.3	1.9	1.5	1.5	-2.0%	-4.1%	0.5%	*b*
Papua New Guinea	5.9	5.7	5.4	5.3	-0.4%	-1.0%	-0.5%	*a*
Paraguay	3.6	3.1	3.0	3.4	-1.3%	-0.7%	3.0%	*b*
Peru	3.3	2.5	2.6	2.6	-2.7%	0.4%	0.3%	*b*
Philippines	4.7	3.1	3.0	2.7	-4.0%	-1.2%	-2.5%	*b*
Poland	6.0	4.6	3.8	3.4	-2.6%	-4.0%	-2.4%	*b*
Portugal	3.3	2.9	2.9	2.5	-1.2%	-0.5%	-2.9%	*b*
Puerto Rico	0.1	0.2	0.5	0.6	7.3%	16.1%	7.3%	*a*
Qatar	8.9	6.4	6.3	6.8	-3.3%	-0.2%	1.8%	*b*
Republic of Korea	7.3	6.1	5.8	5.3	-1.7%	-1.3%	-2.0%	*b*
Republic of Moldova	8.1	6.4	5.3	4.8	-2.4%	-3.7%	-2.3%	*b*
Réunion	..	..	..	..	..	..	..	*a*
Romania	5.6	3.6	2.8	2.4	-4.4%	-4.6%	-4.0%	*b*
Russian Federation	12.1	8.5	7.8	8.1	-3.5%	-1.7%	1.1%	*b*

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Rwanda	7.8	5.6	4.6	3.9	-3.3%	-3.8%	-3.7%	*a*
Saint Helena	..	..	..	..	..	..	..	*a*
Saint Kitts and Nevis	3.1	2.7	2.6	2.6	-1.3%	-1.3%	0.2%	*a*
Saint Lucia	3.1	3.2	3.0	2.8	0.4%	-0.9%	-1.6%	*a*
Saint Pierre and Miquelon	..	..	..	..	..	..	..	*a*
Saint Vincent and the Grenadines	2.4	2.7	2.7	2.5	1.1%	0.0%	-2.3%	*a*
Samoa	5.3	3.8	4.3	4.4	-3.4%	2.8%	0.7%	*a*
Sao Tome and Principe	4.5	4.0	3.6	3.5	-1.3%	-1.9%	-1.1%	*a*
Saudi Arabia	4.7	6.1	5.8	5.6	2.6%	-0.8%	-1.1%	*b*
Senegal	4.0	4.7	4.2	3.7	1.7%	-2.2%	-3.3%	*b*
Serbia	8.5	6.2	5.6	5.0	-3.1%	-2.0%	-2.6%	*b*
Seychelles	2.9	3.3	2.9	3.1	1.2%	-2.3%	1.4%	*a*
Sierra Leone	11.1	6.6	6.2	5.4	-5.1%	-1.2%	-3.3%	*a*
Singapore	3.5	2.5	2.7	2.6	-3.3%	1.6%	-1.1%	*b*
Sint Maarten (Dutch part)	..	..	8.2	8.6	..	..	1.3%	*a*
Slovakia	8.8	5.5	4.4	4.1	-4.7%	-4.1%	-1.8%	*b*
Slovenia	5.2	4.5	4.0	3.5	-1.5%	-2.6%	-3.0%	*b*
Solomon Islands	7.0	6.2	5.0	4.3	-1.2%	-4.2%	-3.9%	*a*
Somalia	11.2	11.9	11.4	11.6	0.6%	-0.9%	0.6%	*a*
South Africa	10.1	8.8	7.6	8.0	-1.3%	-3.0%	1.4%	*b*
South Sudan	..	..	..	..	..	..	..	*b*
Spain	3.6	3.1	2.9	2.6	-1.6%	-1.4%	-1.9%	*b*
Sri Lanka	3.1	2.2	1.9	1.8	-3.4%	-2.5%	-2.2%	*b*
State of Palestine	2.9	2.6	2.8	2.8	-0.9%	1.4%	-0.5%	*a*
Sudan	7.9	4.8	4.7	4.6	-4.8%	-0.5%	-0.5%	*b*
Suriname	4.2	3.0	3.6	4.0	-3.3%	3.7%	2.8%	*b*
Sweden	5.5	4.8	3.8	3.8	-1.5%	-4.6%	0.3%	*b*
Switzerland	2.4	2.1	1.8	1.7	-1.5%	-3.1%	-1.7%	*b*
Syrian Arab Republic	15.5	14.0	10.1	10.5	-1.0%	-6.3%	1.0%	*b*
Tajikistan	10.9	5.1	4.6	4.8	-7.4%	-2.0%	1.4%	*b*

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Thailand	4.9	5.1	5.1	4.5	0.3%	-0.1%	-2.9%	*b*
Timor-Leste	..	1.4	1.8	2.1	..	4.9%	4.9%	*a*
Togo	10.6	12.5	9.2	8.0	1.7%	-6.0%	-3.3%	*b*
Tonga	3.0	3.1	2.7	3.4	0.4%	-2.6%	5.9%	*a*
Trinidad and Tobago	19.5	21.6	19.9	19.9	1.0%	-1.6%	0.0%	*b*
Tunisia	4.3	4.0	3.9	3.8	-0.7%	-0.7%	-0.8%	*b*
Turkey	3.3	3.1	2.7	2.6	-0.7%	-2.8%	-0.4%	*b*
Turkmenistan	29.9	21.7	16.0	12.9	-3.2%	-5.9%	-5.3%	*b*
Turks and Caicos Islands	3.4	5.4	4.8	4.7	4.8%	-2.5%	-0.2%	*a*
Tuvalu	3.5	3.9	2.6	2.6	1.2%	-7.5%	-0.3%	*a*
Uganda	13.4	10.7	10.2	10.0	-2.2%	-0.8%	-0.7%	*a*
Ukraine	15.8	10.3	8.1	7.0	-4.2%	-4.7%	-3.7%	*b*
United Arab Emirates	4.1	5.5	5.6	3.4	3.0%	0.3%	-11.8%	*b*
United Kingdom of Great Britain and Northern Ireland	4.1	3.2	2.6	2.3	-2.5%	-4.2%	-3.0%	*b*
United Republic of Tanzania	12.3	9.1	7.5	6.2	-3.0%	-3.9%	-4.6%	*b*
United States of America	6.7	5.5	4.9	4.5	-2.0%	-2.5%	-2.0%	*b*
United States Virgin Islands	..	..	..	..	..	..	..	*a*
Uruguay	2.7	2.6	2.8	2.8	-0.3%	0.9%	0.2%	*b*
Uzbekistan	28.2	14.2	7.9	8.4	-6.6%	-11.2%	1.6%	*b*
Vanuatu	3.7	3.7	3.6	3.5	0.1%	-0.5%	-0.5%	*a*
Venezuela (Bolivarian Republic of)	..	..	..	..	..	..	..	*b*
Viet Nam	5.1	5.5	5.1	4.9	0.7%	-1.3%	-1.0%	*b*
Wallis and Futuna Islands	..	..	..	..	..	..	..	*a*
Yemen	..	..	..	..	..	..	..	*b*
Zambia	12.8	7.9	7.4	7.1	-4.7%	-1.2%	-1.1%	*b*
Zimbabwe	9.4	12.7	10.4	10.5	3.1%	-4.0%	0.3%	*b*
World	6.2	5.6	5.0	4.7	-1.0%	-2.1%	-1.6%	*c*
Northern America (M49) and Europe (M49)	5.9	5.0	4.4	4.1	-1.8%	-2.4%	-1.6%	*c*

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Northern America (M49)	6.9	5.7	5.0	4.7	-2.0%	-2.3%	-1.7%	c
Europe (M49)	5.2	4.5	3.9	3.7	-1.5%	-2.6%	-1.5%	c
Latin America and the Caribbean (MDG=M49)	3.7	3.5	3.4	3.3	-0.5%	-0.4%	-0.9%	c
Central Asia (M49) and Southern Asia (MDG=M49)	6.8	5.9	5.3	4.9	-1.5%	-2.1%	-1.9%	c
Central Asia (M49)	16.0	10.7	7.0	7.4	-3.9%	-8.0%	1.3%	c
Southern Asia (MDG=M49)	6.3	5.5	5.1	4.7	-1.3%	-1.4%	-2.2%	c
Eastern Asia (M49) and South-eastern Asia (MDG=M49)	7.0	6.7	5.7	5.2	-0.5%	-3.0%	-2.4%	c
Eastern Asia (M49)	7.6	7.3	6.3	5.6	-0.3%	-3.2%	-2.5%	c
South-eastern Asia (MDG=M49)	5.2	4.3	3.8	3.6	-1.7%	-2.4%	-1.5%	c
Western Asia (M49) and Northern Africa (M49)	4.5	4.7	4.4	4.2	0.4%	-1.1%	-1.4%	c
Western Asia (M49)	4.6	4.9	4.5	4.2	0.7%	-1.7%	-1.7%	c
Northern Africa (M49)	4.2	4.1	4.2	4.2	-0.2%	0.4%	-0.1%	c
Sub-Saharan Africa (M49)	9.0	7.2	6.4	6.3	-2.2%	-2.2%	-0.3%	c
Oceania (M49)	6.1	5.2	4.7	4.3	-1.5%	-2.3%	-2.1%	c
Oceania (M49) excluding Australia and New Zealand (M49)	5.1	5.0	4.8	4.7	-0.1%	-0.8%	-0.6%	c
Australia and New Zealand (M49)	6.1	5.2	4.7	4.3	-1.5%	-2.3%	-2.2%	c
Least Developed Countries (LDCs)	7.6	5.6	5.2	4.8	-3.0%	-1.5%	-1.8%	c
Small island developing States (SIDS)	3.8	3.1	3.0	2.8	-2.0%	-0.9%	-1.9%	c
Landlocked developing countries (LLDCs)	11.1	7.9	6.2	6.2	-3.4%	-4.5%	0.0%	c
Africa (M49)	7.0	6.0	5.6	5.5	-1.6%	-1.2%	-0.4%	c
Asia (M49)	6.6	6.3	5.5	5.0	-0.5%	-2.7%	-2.2%	c
Americas (m49)	6.0	5.0	4.5	4.3	-1.8%	-1.9%	-1.4%	c
Caribbean (M49)	..	..	..	..	..	..	..	

UN COUNTRY NAME	2000	2010	2015	2019	2000-2010	2010-2015	2015-2019	SOURCE
Central America (M49)	3.6	3.6	3.3	3.1	0.2%	-2.1%	-1.6%	c
Eastern Africa (M49)	11.0	8.7	7.7	7.0	-2.2%	-2.4%	-2.4%	c
Eastern Europe (M49)	10.3	7.3	6.3	6.2	-3.4%	-2.7%	-0.6%	c
Melanesia (M49)	4.9	4.8	4.6	4.5	-0.3%	-0.8%	-0.6%	c
Micronesia (M49)	8.8	14.3	13.3	12.9	5.0%	-1.5%	-0.8%	c
Middle Africa (M49)	6.4	5.2	5.6	5.6	-2.1%	1.5%	0.1%	c
Northern Europe (M49)	4.4	3.7	3.0	2.7	-1.7%	-4.3%	-2.6%	c
Polynesia (M49)	..	..	..	..	..	..	..	
South America (M49)	3.7	3.5	3.6	3.5	-0.7%	0.5%	-0.4%	c
Southern Africa (M49)	9.7	8.4	7.2	7.6	-1.4%	-3.0%	1.2%	c
Southern Europe (M49)	3.4	3.1	2.9	2.7	-0.8%	-1.5%	-1.8%	c
Western Africa (M49)	8.1	6.2	5.5	5.5	-2.5%	-2.4%	-0.1%	c
Western Europe (M49)	4.1	3.7	3.3	3.0	-0.9%	-2.7%	-2.5%	c
Developing regions (MDG)	6.3	6.0	5.3	5.0	-0.6%	-2.2%	-1.8%	c
Developed regions (MDG)	5.8	4.9	4.3	4.1	-1.7%	-2.5%	-1.6%	c
Northern Africa (MDG)	3.9	4.0	4.1	4.1	0.2%	0.5%	-0.1%	c
Sub-Saharan Africa (MDG)	8.9	7.1	6.3	6.3	-2.3%	-2.1%	-0.3%	c
Eastern Asia (MDG)	9.8	8.4	6.9	6.1	-1.6%	-3.7%	-3.1%	c
Western Asia (MDG)	4.5	5.1	4.6	4.3	1.1%	-1.8%	-1.7%	c
Oceania (MDG)	5.1	5.0	4.8	4.7	-0.1%	-0.8%	-0.6%	c
Caucasus and Central Asia (MDG)	14.9	8.9	6.4	6.7	-5.0%	-6.4%	1.3%	c

REFERENCE
a. Source: Energy Balances, UN Statistics Division (2021)
b. Source: IEA (2021), World Energy Balances
c. Source: IEA (2021), World Energy Balances; Energy Balances, UN Statistics Division (2021)

DEFINITIONS
Energy intensity: Energy intensity is defined as the energy supplied to the economy per unit value of economic output.

SDG 7.A.1 - INTERNATIONAL FINANCIAL FLOWS TO DEVELOPING COUNTRIES IN SUPPORT OF CLEAN ENERGY

Source: International Renewable Energy Agency, Organisation for Economic Co-operation and Development

COUNTRY	INTERNATIONAL COMMITMENTS (2019 USD MILLIONS)					
	2000	2010	2015	2019	2010-19	2000-19
Afghanistan	0.00	36.00	5.00	5.00	534.00	626.00
Algeria	0.00	0.00	1.00	0.00	4.00	8.00
Angola	0.00	0.00	0.00	0.00	94.00	95.00
Anguilla	0.00	0.00	0.00	0.00	0.00	0.00
Antigua and Barbuda	0.00	0.00	7.00	0.00	29.00	29.00
Argentina	0.00	1.00	110.00	474.00	4,678.00	4,786.00
Armenia	0.00	92.00	23.00	73.00	448.00	488.00
Azerbaijan	5.00	187.00	78.00	0.00	265.00	273.00
Bahamas	0.00	0.00	0.00	1.00	1.00	1.00
Bangladesh	3.00	0.00	8.00	137.00	1,635.00	1,851.00
Barbados	0.00	0.00	0.00	34.00	43.00	43.00
Belize	0.00	0.00	0.00	0.00	18.00	23.00
Benin	0.00	0.00	572.00	0.00	846.00	865.00
Bhutan	5.00	23.00	126.00	1.00	192.00	315.00
Bolivia (Plurinational State of)	0.00	5.00	2.00	1.00	2,035.00	2,155.00
Botswana	0.00	10.00	0.00	0.00	13.00	20.00
Brazil	126.00	135.00	2.00	51.00	2,127.00	2,509.00
Burkina Faso	0.00	1.00	0.00	46.00	205.00	254.00
Burundi	0.00	13.00	2.00	90.00	377.00	377.00
Cabo Verde	0.00	69.00	3.00	1.00	129.00	132.00
Cambodia	0.00	680.00	8.00	0.00	1,292.00	1,788.00
Cameroon	0.00	54.00	2.00	7.00	1,983.00	1,994.00
Central African Republic	0.00	0.00	1.00	50.00	87.00	92.00
Chad	0.00	0.00	0.00	20.00	61.00	93.00
Chile	0.00	3.00	113.00	0.00	4,314.00	4,583.00
China	244.00	131.00	92.00	202.00	3,036.00	4,387.00
Colombia	0.00	3.00	23.00	153.00	2,021.00	2,263.00
Comoros	0.00	0.00	1.00	17.00	29.00	29.00

COUNTRY	INTERNATIONAL COMMITMENTS (2019 USD MILLIONS)					
	2000	2010	2015	2019	2010-19	2000-19
Congo	0.00	0.00	0.00	0.00	138.00	654.00
Cook Islands	0.00	0.00	18.00	0.00	53.00	53.00
Costa Rica	0.00	8.00	596.00	1.00	1,678.00	1,835.00
Côte d'Ivoire	14.00	1.00	1.00	25.00	620.00	633.00
Cuba	1.00	4.00	77.00	6.00	241.00	251.00
Democratic People's Republic of Korea	0.00	0.00	0.00	1.00	4.00	5.00
Democratic Republic of the Congo	0.00	0.00	1.00	0.00	1,459.00	1,726.00
Djibouti	0.00	12.00	1.00	27.00	95.00	106.00
Dominica	0.00	0.00	0.00	9.00	33.00	33.00
Dominican Republic	11.00	0.00	0.00	43.00	209.00	233.00
Ecuador	2.00	2,812.00	32.00	60.00	4,337.00	4,356.00
Egypt	11.00	1,025.00	239.00	340.00	4,406.00	5,250.00
El Salvador	0.00	0.00	151.00	1.00	530.00	532.00
Equatorial Guinea	0.00	0.00	0.00	0.00	3.00	468.00
Eritrea	0.00	0.00	113.00	0.00	199.00	199.00
Eswatini	0.00	0.00	1.00	13.00	14.00	24.00
Ethiopia	2.00	92.00	301.00	57.00	2,011.00	7,081.00
Fiji	0.00	0.00	2.00	0.00	19.00	116.00
French Polynesia	0.00	0.00	0.00	0.00	0.00	0.00
Gabon	0.00	6.00	13.00	0.00	60.00	467.00
Gambia	0.00	0.00	0.00	12.00	102.00	102.00
Georgia	0.00	8.00	7.00	24.00	588.00	625.00
Ghana	4.00	25.00	7.00	3.00	588.00	1,552.00
Grenada	0.00	0.00	2.00	0.00	6.00	6.00
Guatemala	0.00	10.00	0.00	57.00	123.00	144.00
Guinea	0.00	0.00	1.00	820.00	2,474.00	2,483.00
Guinea-Bissau	0.00	0.00	0.00	0.00	9.00	17.00
Guyana	0.00	1.00	3.00	15.00	50.00	55.00
Haiti	1.00	2.00	50.00	40.00	185.00	201.00

COUNTRY	INTERNATIONAL COMMITMENTS (2019 USD MILLIONS)					
	2000	2010	2015	2019	2010-19	2000-19
Honduras	33.00	21.00	391.00	1.00	1,244.00	1,283.00
India	486.00	373.00	899.00	786.00	11,153.00	13,641.00
Indonesia	2.00	46.00	378.00	216.00	4,429.00	5,785.00
Iran (Islamic Republic of)	62.00	0.00	0.00	0.00	4.00	357.00
Iraq	0.00	158.00	0.00	0.00	534.00	637.00
Jamaica	5.00	0.00	88.00	0.00	244.00	259.00
Jordan	0.00	7.00	252.00	74.00	1,712.00	1,727.00
Kazakhstan	0.00	1.00	48.00	280.00	842.00	1,264.00
Kenya	0.00	729.00	546.00	166.00	4,055.00	4,360.00
Kiribati	0.00	1.00	0.00	0.00	11.00	16.00
Kyrgyzstan	8.00	2.00	0.00	86.00	166.00	175.00
Lao People's Democratic Republic	0.00	11.00	82.00	2.00	6,151.00	7,217.00
Lebanon	0.00	2.00	5.00	0.00	41.00	42.00
Lesotho	0.00	0.00	0.00	14.00	27.00	28.00
Liberia	0.00	0.00	253.00	38.00	542.00	543.00
Madagascar	0.00	0.00	5.00	44.00	128.00	158.00
Malawi	7.00	15.00	64.00	102.00	244.00	251.00
Malaysia	141.00	0.00	0.00	0.00	6.00	148.00
Maldives	5.00	10.00	6.00	4.00	68.00	74.00
Mali	4.00	0.00	9.00	45.00	679.00	769.00
Marshall Islands	0.00	0.00	4.00	0.00	48.00	62.00
Mauritania	0.00	0.00	0.00	1.00	340.00	365.00
Mauritius	0.00	2.00	9.00	14.00	167.00	167.00
Mexico	2.00	82.00	226.00	339.00	2,707.00	2,806.00
Micronesia (Federated States of)	0.00	0.00	4.00	27.00	49.00	69.00
Mongolia	5.00	12.00	1.00	11.00	452.00	504.00
Montserrat	0.00	0.00	2.00	0.00	18.00	20.00
Morocco	0.00	8.00	234.00	413.00	4,532.00	5,485.00
Mozambique	0.00	91.00	10.00	188.00	545.00	578.00

COUNTRY	INTERNATIONAL COMMITMENTS (2019 USD MILLIONS)					
	2000	2010	2015	2019	2010-19	2000-19
Myanmar	0.00	0.00	58.00	41.00	330.00	769.00
Namibia	0.00	47.00	0.00	0.00	100.00	147.00
Nauru	0.00	0.00	9.00	22.00	36.00	39.00
Nepal	12.00	23.00	18.00	333.00	1,296.00	1,647.00
New Caledonia	0.00	0.00	0.00	0.00	4.00	4.00
Nicaragua	0.00	97.00	67.00	8.00	591.00	618.00
Niger	0.00	0.00	0.00	109.00	413.00	418.00
Nigeria	0.00	1.00	47.00	1,173.00	7,617.00	7,638.00
Niue	0.00	0.00	0.00	0.00	4.00	10.00
Pakistan	0.00	265.00	1,233.00	303.00	8,627.00	9,381.00
Palau	0.00	0.00	5.00	1.00	6.00	17.00
Panama	0.00	2.00	65.00	90.00	827.00	827.00
Papua New Guinea	0.00	0.00	8.00	0.00	86.00	86.00
Paraguay	0.00	0.00	0.00	1.00	132.00	324.00
Peru	1.00	91.00	85.00	1.00	1,932.00	2,033.00
Philippines	12.00	81.00	23.00	2.00	449.00	856.00
Residual/unallocated ODA: Eastern and South-eastern Asia	3.00	23.00	82.00	57.00	710.00	780.00
Residual/unallocated ODA: Latin America and the Caribbean	2.00	10.00	116.00	60.00	1,024.00	1,254.00
Residual/unallocated ODA: Oceania excl. Aus. and N. Zealand	0.00	1.00	2.00	22.00	36.00	37.00
Residual/unallocated ODA: Sub-Saharan Africa	10.00	30.00	153.00	680.00	2,596.00	2,861.00
Residual/unallocated ODA: Western Asia and Northern Africa	0.00	1.00	34.00	4.00	300.00	306.00
Réunion	0.00	0.00	2.00	0.00	47.00	47.00
Rwanda	0.00	2.00	0.00	2.00	295.00	374.00
Saint Helena	0.00	0.00	1.00	0.00	1.00	2.00
Saint Kitts and Nevis	0.00	0.00	0.00	0.00	18.00	19.00
Saint Lucia	0.00	0.00	0.00	0.00	11.00	11.00
Saint Vincent and the Grenadines	0.00	0.00	0.00	0.00	35.00	35.00

COUNTRY	INTERNATIONAL COMMITMENTS (2019 USD MILLIONS)					
	2000	2010	2015	2019	2010-19	2000-19
Samoa	0.00	0.00	0.00	0.00	39.00	39.00
Sao Tome and Principe	0.00	0.00	0.00	0.00	6.00	9.00
Senegal	0.00	1.00	32.00	69.00	543.00	683.00
Seychelles	0.00	0.00	0.00	0.00	2.00	2.00
Sierra Leone	0.00	9.00	0.00	0.00	48.00	160.00
Solomon Islands	0.00	0.00	7.00	46.00	258.00	258.00
Somalia	0.00	0.00	0.00	21.00	29.00	29.00
South Africa	7.00	261.00	726.00	164.00	3,052.00	3,109.00
South Sudan	0.00	0.00	0.00	0.00	32.00	32.00
Sri Lanka	1.00	45.00	0.00	0.00	873.00	1,342.00
State of Palestine	0.00	1.00	23.00	19.00	98.00	104.00
Sudan	0.00	85.00	0.00	207.00	327.00	1,645.00
Suriname	0.00	0.00	0.00	23.00	27.00	27.00
Syrian Arab Republic	0.00	5.00	0.00	0.00	5.00	5.00
Tajikistan	0.00	7.00	0.00	54.00	535.00	636.00
Thailand	0.00	4.00	56.00	99.00	924.00	953.00
Timor-Leste	0.00	5.00	0.00	0.00	9.00	17.00
Togo	0.00	0.00	5.00	1.00	33.00	33.00
Tokelau	0.00	0.00	0.00	4.00	9.00	9.00
Tonga	0.00	6.00	14.00	2.00	123.00	124.00
Tunisia	4.00	131.00	9.00	80.00	479.00	897.00
Turkey	131.00	271.00	389.00	360.00	6,028.00	6,851.00
Turkmenistan	0.00	0.00	0.00	0.00	6.00	6.00
Tuvalu	0.00	1.00	9.00	6.00	43.00	43.00
Uganda	27.00	29.00	521.00	66.00	2,992.00	3,695.00
United Republic of Tanzania	0.00	9.00	37.00	6.00	477.00	568.00
Unspecified, developing countries	20.00	832.00	217.00	587.00	4,522.00	4,862.00
Uruguay	0.00	1.00	518.00	0.00	1,393.00	1,426.00
Uzbekistan	0.00	0.00	0.00	66.00	502.00	528.00
Vanuatu	0.00	1.00	7.00	0.00	44.00	57.00

COUNTRY	INTERNATIONAL COMMITMENTS (2019 USD MILLIONS)					
	2000	2010	2015	2019	2010-19	2000-19
Venezuela (Bolivarian Republic of)	1.00	1,273.00	0.00	0.00	1,630.00	2,442.00
Viet Nam	0.00	94.00	6.00	251.00	1,391.00	2,395.00
Yemen	1.00	0.00	0.00	1.00	156.00	170.00
Zambia	0.00	397.00	1,791.00	79.00	2,912.00	3,199.00
Zimbabwe	0.00	0.00	0.00	0.00	344.00	345.00
World	1,424.77	11,171.15	12,660.84	10,887.33	145,288.08	175,313.02
Sub-Saharan Africa	75.15	1,904.20	5,228.11	3,983.93	39,641.10	49,808.71
Central Asia and Southern Asia	585.92	800.71	2,397.01	2,091.87	27,009.14	32,483.84
Eastern Asia and South-eastern Asia	404.59	1,072.22	704.16	845.34	20,143.91	24,962.69
Latin America and the Caribbean	186.72	4,562.89	2,727.81	1,465.99	34,492.97	37,420.85
Western Asia and Northern Africa	152.72	1,990.12	1,297.71	1,780.99	18,609.04	24,735.93
Oceania excluding Australia and New Zealand	0.00	9.10	89.08	131.76	869.94	1,039.12
Unspecified, developing countries	19.68	831.92	216.97	587.45	4,522.01	4,861.89
Least Developed Countries (LDCs)	61.59	1,543.26	4,090.65	2,742.12	30,752.76	41,972.51
Landlocked developing countries (LLDCs)	74.31	961.57	3,075.23	1,603.44	24,263.76	33,207.33
Small Island Developing States (SIDS)	22.69	102.48	335.92	311.77	2,412.79	2,686.47

SDG7.B.1 - INSTALLED RENEWABLE ELECTRICITY-GENERATING CAPACITY (WATTS PER CAPITA)

Source: International Renewable Energy Agency

COUNTRY	WATTS PER CAPITA			
	2000	2010	2015	2020
Afghanistan	9.216	8.273	8.794	9.348
Algeria	8.91	7.021	7.851	15.644
American Samoa	0	0	43.293	91.78
Angola	14.369	34.024	37.047	115.427
Anguilla	0	0	79.908	100.72
Antigua and Barbuda	0	1.136	36.336	167.981
Argentina	235.622	239.961	247.367	311.281
Armenia	333.659	391.733	440.702	484.04
Aruba	0	296.07	365.156	356.855
Azerbaijan	113.508	110.413	119.909	127.353
Bahamas	0	0.845	3.466	5.678
Bahrain	0	0.551	4.147	6.133
Bangladesh	1.802	1.8	2.447	3.125
Barbados	0	3.544	31.543	174.061
Belize	125.47	196.874	239.357	258.714
Benin	0.073	0.054	0.161	0.284
Bhutan	582.643	2171.216	2218.72	3026.404
Bolivia (Plurinational State of)	45.245	58.163	58.658	90.526
Bonaire, Sint Eustatius and Saba	0	530.061	463.962	674.65
Botswana	0	0.07	1.015	2.614
Brazil	364.678	457.596	550.887	705.901
British Virgin Islands	0	20.507	23.844	22.985
Brunei Darussalam	0	3.088	2.892	3.198
Burkina Faso	2.8	2.281	2.258	4.678
Burundi	8.505	6.323	5.694	4.826
Cabo Verde	0	14.818	63.494	63.636
Cambodia	0.83	1.506	62.79	95.027
Cameroon	46.365	35.607	31.758	29.821

COUNTRY	WATTS PER CAPITA			
	2000	2010	2015	2020
Cayman Islands	0	0	0	193.807
Central African Republic	5.178	4.32	4.262	3.968
Chad	0.239	0.168	0.154	0.203
Chile	290.177	360.953	470.343	669.287
China	58.775	170.408	340.551	621.736
Colombia	210.84	208.967	247.424	266.328
Comoros	0	2.099	1.863	1.665
Congo	27.563	20.17	42.557	41.105
Cook Islands	2.565	4.676	181.105	413.915
Costa Rica	359.695	429.941	486.679	613.335
Côte d'Ivoire	36.709	29.492	26.223	33.821
Cuba	5.199	55.074	55.516	105.789
Curaçao	22.702	53.624	250.86	346.74
Democratic People's Republic of Korea	200.27	161.277	178.289	187.455
Democratic Republic of the Congo	52.858	38.941	33.166	30.957
Djibouti	0	0	0.328	0.366
Dominica	110.266	99.045	98.771	98.832
Dominican Republic	53.732	55.594	72.481	120.716
Ecuador	135.21	156.293	160.288	300.293
Egypt	42.526	41.529	39.668	58.35
El Salvador	97.819	132.59	146.123	232.163
Equatorial Guinea	9.238	5.934	107.481	90.675
Eritrea	0	0.261	2.598	6.495
Eswatini	103.239	116.653	153.011	145.695
Ethiopia	6.125	21.699	25.972	40.994
Falkland Islands (Malvinas)	89.872	799.449	842.736	686.19
Fiji	133.849	170.557	222.017	236.376
French Guiana	702.292	598.16	640.567	598.392
French Polynesia	199.758	189.747	276.649	316.4
Gabon	138.559	105.656	170.869	149.563

COUNTRY	WATTS PER CAPITA			
	2000	2010	2015	2020
Gambia	0	1.075	1.62	1.404
Georgia	587.032	659.272	714.921	962.414
Ghana	61.506	47.893	58.305	54.279
Grenada	0	2.438	10.064	29.808
Guadeloupe	114.442	246.458	369.96	474.147
Guam	0	0.564	197.404	207.693
Guatemala	62.267	89.608	134.028	160.214
Guinea	15.559	12.639	33.374	29.056
Guinea-Bissau	0	0	0.18	0.594
Guyana	29.397	70.943	71.975	67.598
Haiti	6.65	5.712	5.438	7.063
Honduras	66.666	76.052	149.977	187.32
India	23.661	42.34	59.899	97.287
Indonesia	25.887	28.35	33.184	38.585
Iran (Islamic Republic of)	30.629	116.428	145.892	154.077
Iraq	28.514	76.469	64.962	61.903
Jamaica	20.805	33.742	37.194	85.652
Jordan	2.811	2.327	16.526	186.503
Kazakhstan	151.447	140.017	164.65	266.151
Kenya	24.065	24.735	32.944	40.743
Kiribati	0.735	3.808	20.815	23.961
Kuwait	0	0	1.455	24.761
Kyrgyzstan	598.165	565.111	616.953	563.61
Lao People's Democratic Republic	120.526	408.184	652.44	1022.179
Lebanon	73.384	57.001	45.676	50.348
Lesotho	37.101	36.456	36.48	35.063
Liberia	1.404	1.029	0.907	18.701
Libya	0	0.597	0.763	0.744
Madagascar	6.71	6.18	7.143	7.122
Malawi	26.903	20.631	22.417	21.429

COUNTRY	WATTS PER CAPITA			
	2000	2010	2015	2020
Malaysia	119.039	99.149	249.445	268.759
Maldives	0	4.533	12.198	31.097
Mali	7.746	19.366	21.359	20.979
Marshall Islands	0.788	5.678	17.565	27.469
Martinique	0	74.747	183.099	342.233
Mauritania	0	0	12.991	26.219
Mauritius	111.328	116.262	141.212	198.157
Mayotte	0	39.978	55.139	55.518
Mexico	109.889	118.456	141.935	219.941
Micronesia (Federated States of)	3.648	0.871	2.23	5.183
Mongolia	6.267	12.6	28.227	84.366
Montserrat	0	0	0	50.01
Morocco	42.625	48.266	66.555	93.522
Mozambique	124.088	93.399	81.747	73.99
Myanmar	7.365	44.592	62.017	63.364
Namibia	134.276	115.476	151.815	197.346
Nauru	0	3.996	20.243	179.712
Nepal	11.762	25.979	30.614	46.785
New Caledonia	367.987	467.307	453.358	697.356
Nicaragua	30.184	64.835	98.563	110.41
Niger	0.044	0.128	0.35	1.117
Nigeria	17.052	13.163	11.797	10.443
Niue	0	33.909	211.801	581.582
Oman	0	0	0.516	31.084
Other non-specified areas in Eastern Asia	94.924	124.461	170.432	384.538
Pakistan	36.362	39.08	40.738	56.165
Palau	0.209	16.264	51.514	96.451
Panama	206.017	262.84	517.331	532.131
Papua New Guinea	36.366	41.206	41.07	37.263
Paraguay	1388.262	1410.114	1323.039	1238.302

COUNTRY	WATTS PER CAPITA			
	2000	2010	2015	2020
Peru	109.353	121.126	154.285	201.089
Philippines	48.528	51.189	55.085	62.393
Puerto Rico	27.201	43.102	93.568	126.713
Qatar	0	0	16.357	14.96
Republic of Korea	34.055	56.887	141.996	409.567
Réunion	194.92	338.986	440.524	478.539
Rwanda	5.18	5.049	9.598	10.918
Saint Barthélemy	0	0	0	2.428
Saint Kitts and Nevis	0	44.888	71.088	77.831
Saint Lucia	0	0.115	4.243	20.885
Saint Martin (French Part)	0	0	72.494	12.934
Saint Vincent and the Grenadines	52.325	52.097	58.551	67.69
Samoa	86.04	67.354	73.402	141.797
Sao Tome and Principe	16.308	12.862	12.229	12.11
Saudi Arabia	0.017	0.086	0.765	11.853
Senegal	1.051	2.231	2.332	14.692
Seychelles	0	0	78.058	99.532
Sierra Leone	0.872	8.432	12.614	12.418
Singapore	37.951	25.608	44.906	93.639
Solomon Islands	0.754	1.311	3.439	5.285
Somalia	0	0	0.215	1.641
South Africa	27.762	19.384	61.906	162.5
South Sudan	0	0	0.015	0.058
Sri Lanka	61.588	71.139	89.825	109.828
State of Palestine	0	0	2.649	22.969
Sudan	14.951	48.935	46.355	48.436
Suriname	382.211	340.475	336.045	325.777
Syrian Arab Republic	93.518	40.131	87.752	85.698
Tajikistan	653.279	637.947	595.345	552.879

COUNTRY	WATTS PER CAPITA			
	2000	2010	2015	2020
Thailand	56.768	71.569	115.961	171.795
Timor-Leste	0	0.422	0.853	0.808
Togo	13.687	10.39	9.327	8.718
Tokelau	13.548	18.601	762.63	782.222
Tonga	0.582	1.154	28.577	73.332
Trinidad and Tobago	4.215	2.132	2.611	2.151
Tunisia	7.569	11.048	29.834	33.92
Turkey	178.496	240.141	401.327	585.705
Turkmenistan	0.266	0.236	0.216	0.199
Turks and Caicos Islands	0	0	0.834	24.278
Tuvalu	0.639	19.865	185.963	196.065
Uganda	11.002	14.287	20.444	25.887
United Arab Emirates	0	1.266	14.706	256.84
United Republic of Tanzania	18.209	13.896	12.808	11.433
United States Virgin Islands	0	0	88.175	48.773
Uruguay	466.799	540.145	827.759	1075.169
Uzbekistan	64.433	62.874	60.833	60.018
Vanuatu	3.244	18.225	29.447	37.841
Venezuela (Bolivarian Republic of)	546.286	514.263	505.74	583.691
Viet Nam	42.534	100.185	174.883	366.237
Yemen	0	0.043	2.264	8.476
Zambia	173.029	142.247	145.548	138.231
Zimbabwe	61.423	65.791	63.536	80.606
Zimbabwe	61.423	65.791	63.536	81.536

COUNTRY	WATTS PER CAPITA			
	2000	2010	2015	2020
World	64.501	101.972	155.847	245.667
Sub-Saharan Africa	26.823	24.173	27.980	37.634
Central Asia and Southern Asia	29.930	47.278	61.460	90.588
Eastern Asia and South-eastern Asia	54.601	133.608	256.437	459.701
Latin America and the Caribbean	245.944	284.719	333.124	424.570
Western Asia and Northern Africa	66.562	76.692	105.739	152.265
Oceania excluding Australia and New Zealand	52.024	59.024	67.834	73.834
Least Developed Countries (LDCs)	17.413	25.045	29.466	37.884
Landlocked developing countries (LLDCs)	79.228	83.378	86.521	97.559
Small Island Developing States (SIDS)	30.747	43.429	53.774	79.937

Attribution—Please cite the work as follows: IEA, IRENA, UNSD, World Bank, WHO. 2022. Tracking SDG 7: The Energy Progress Report. World Bank, Washington DC. © World Bank.

The Energy Progress Report is a joint report of the Custodian Agencies – 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).

It receives inputs from the SDG 7 Technical Advisory Group which comprises more than 30 organizations around the world and has been made possible with the support of our partners.

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