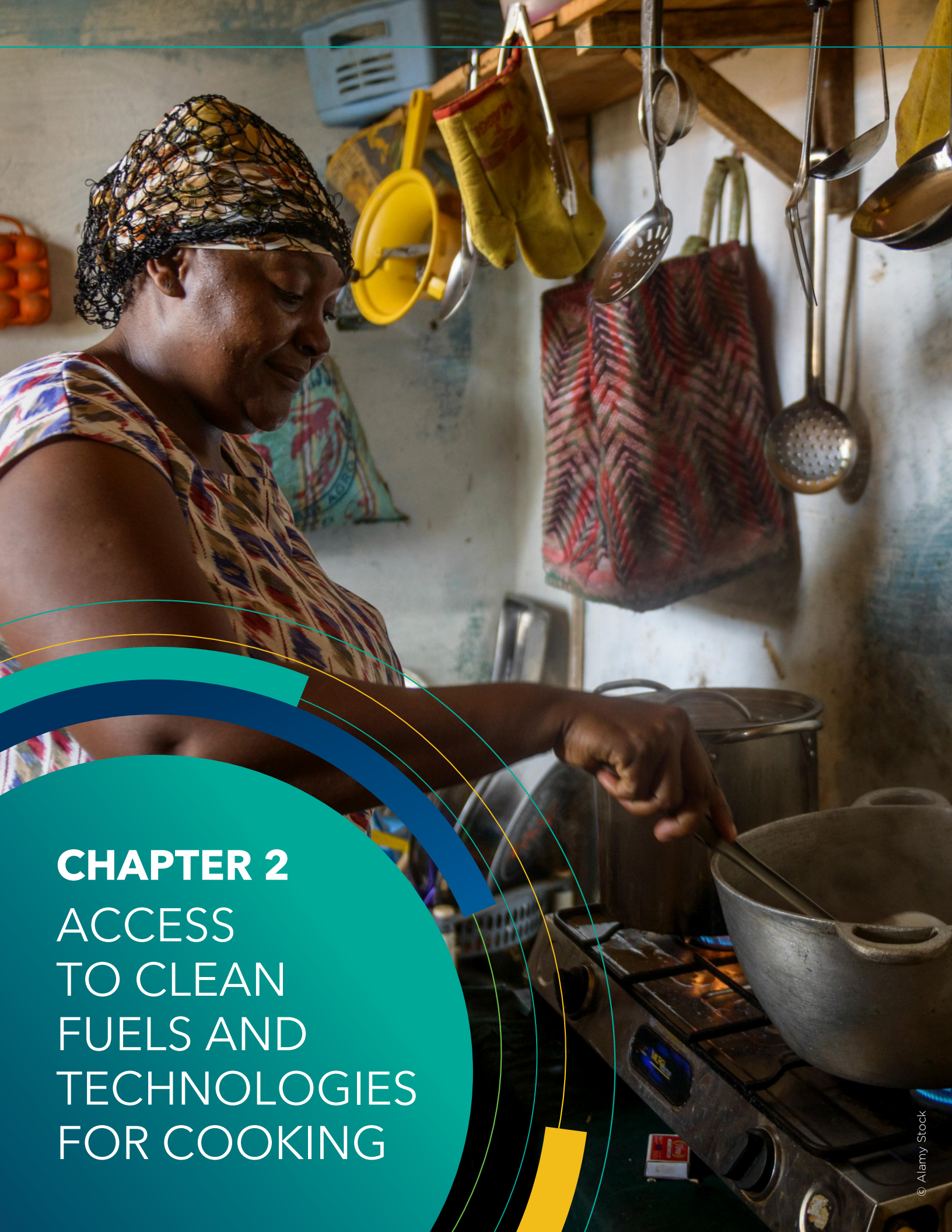


CHAPTER 2
ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING

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.

---

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).

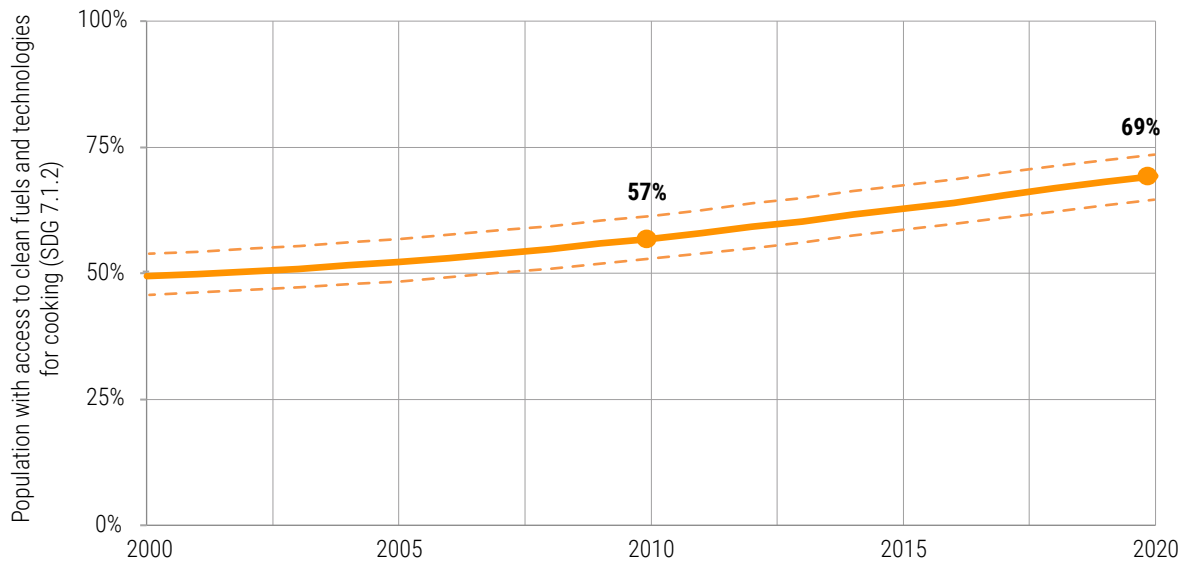
- **The 20 countries with the largest access deficits:** Between 2016 and 2020, the 20 countries with the largest number of people lacking access to clean cooking fuels and technologies accounted for more than 80 percent of the global population without access. In 16 of these countries, less than half 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

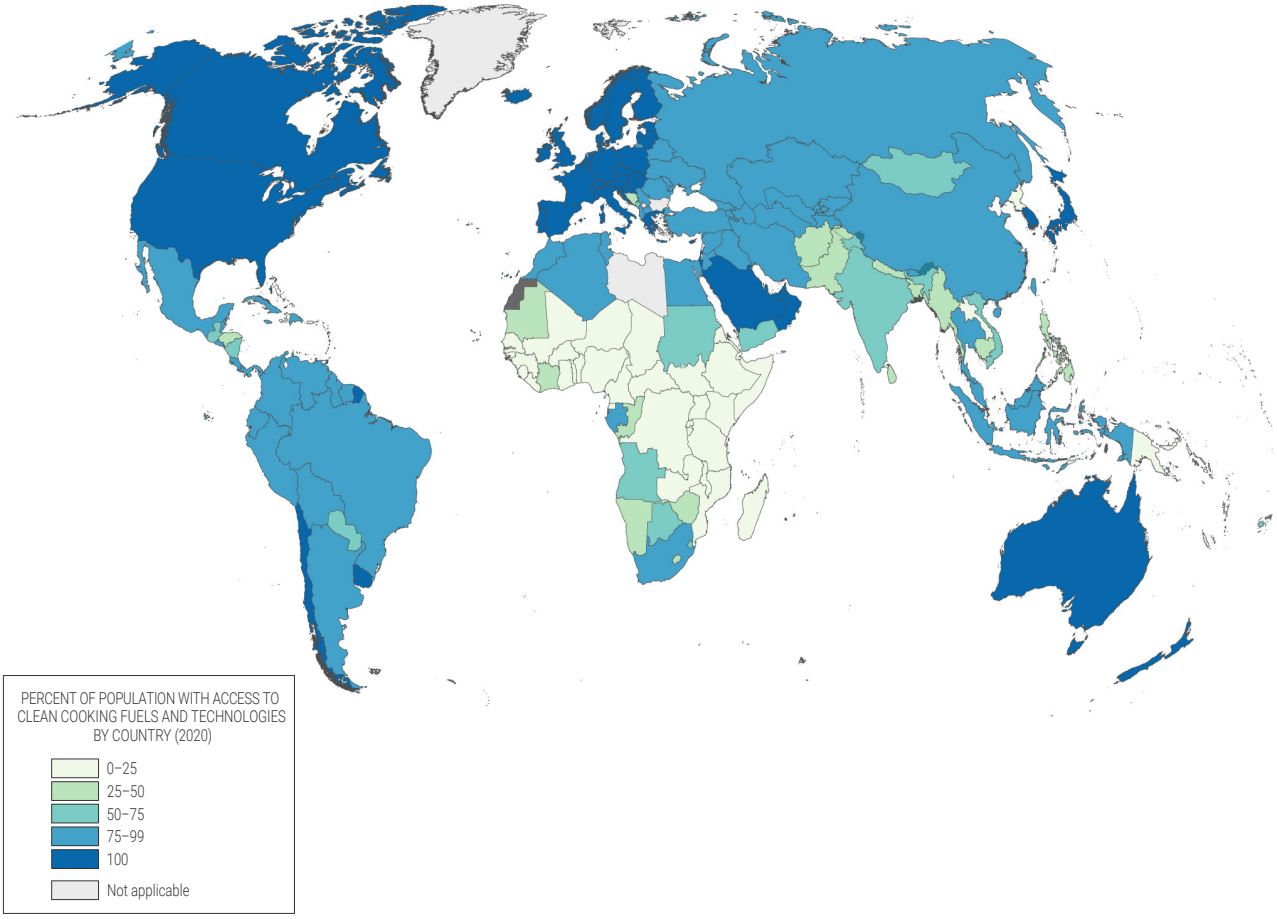


Source: WHO 2022.

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.

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



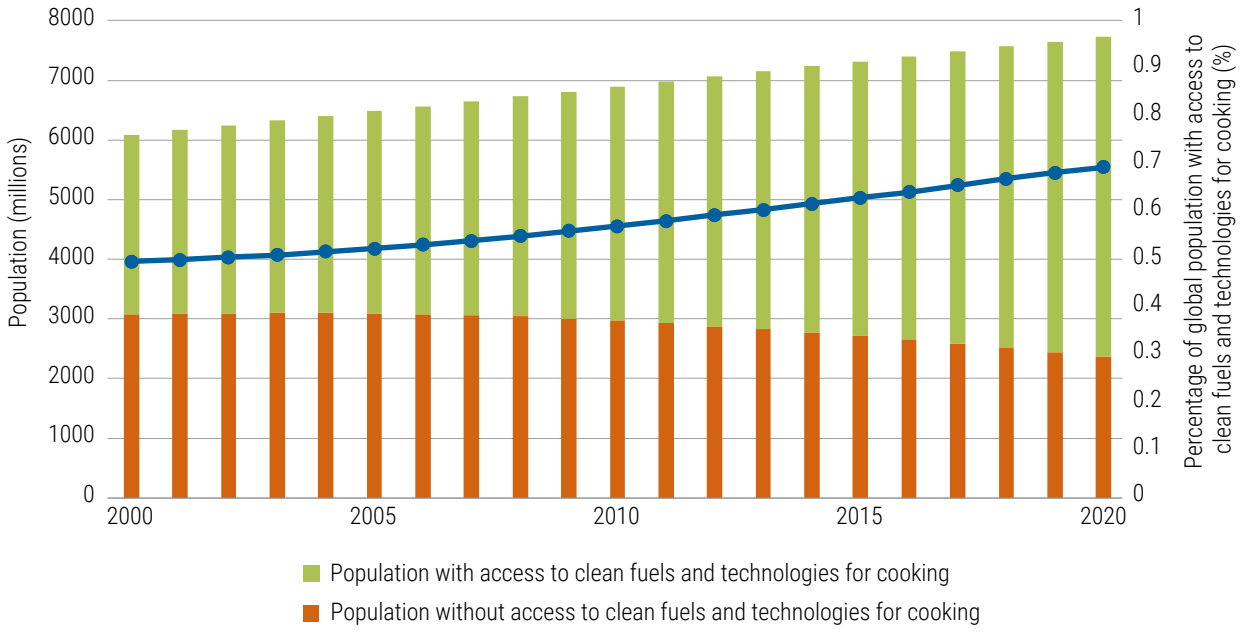
Source: WHO 2022.
Note/disclaimer: This map was produced by the Geospatial Operations Support Team of the World Bank based on the Cartography Unit of the World Bank. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of the 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).

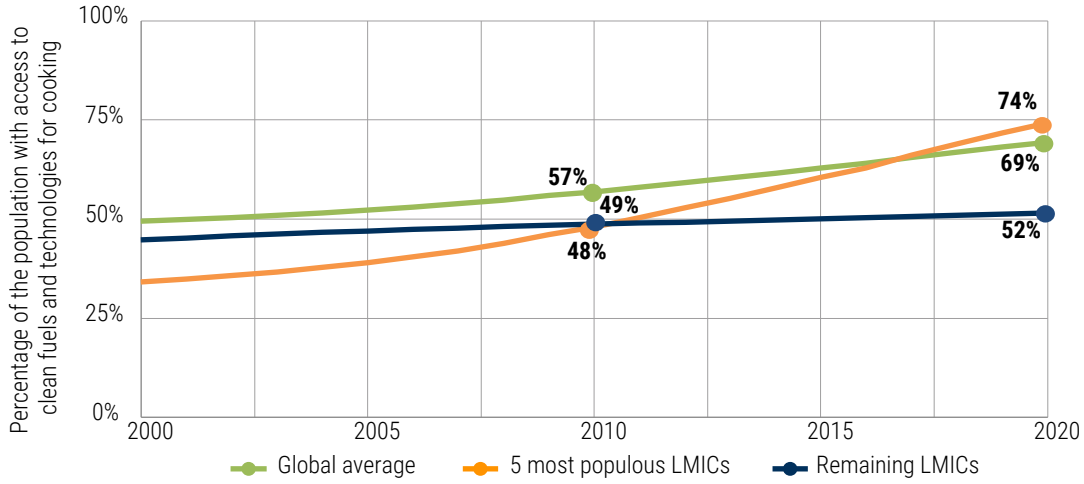
Figure 2.3 • Number of people and percentage of global population with access to clean cooking, 2000–20



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



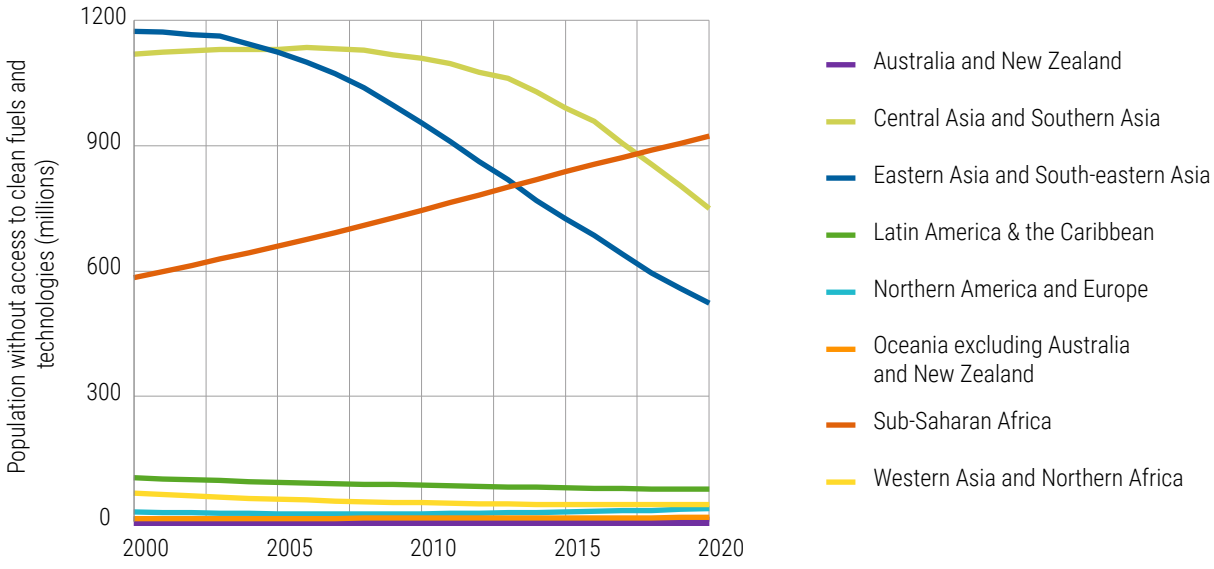
Source: WHO 2022.

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



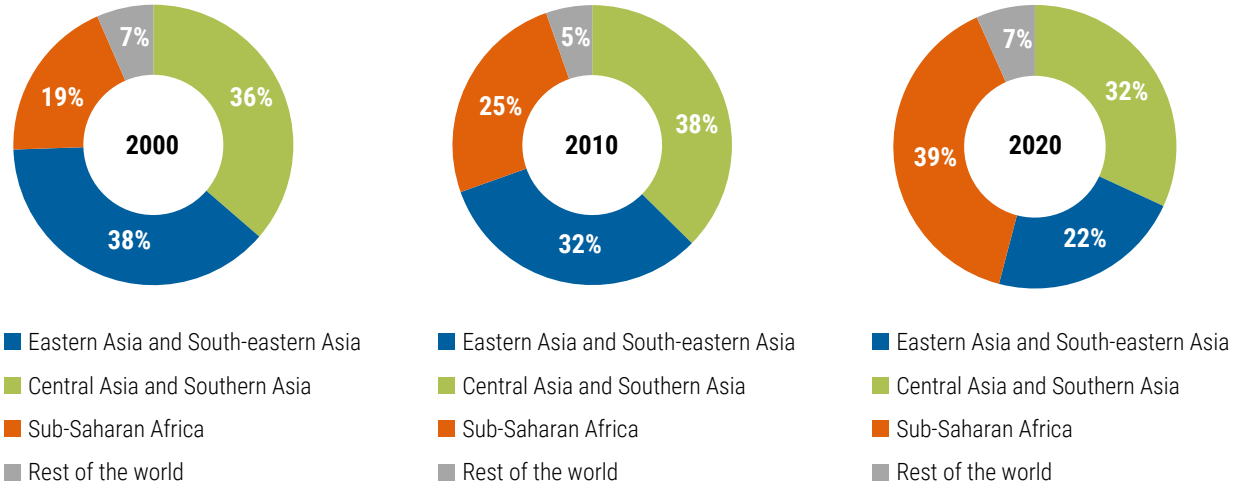
Source: WHO 2022.

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

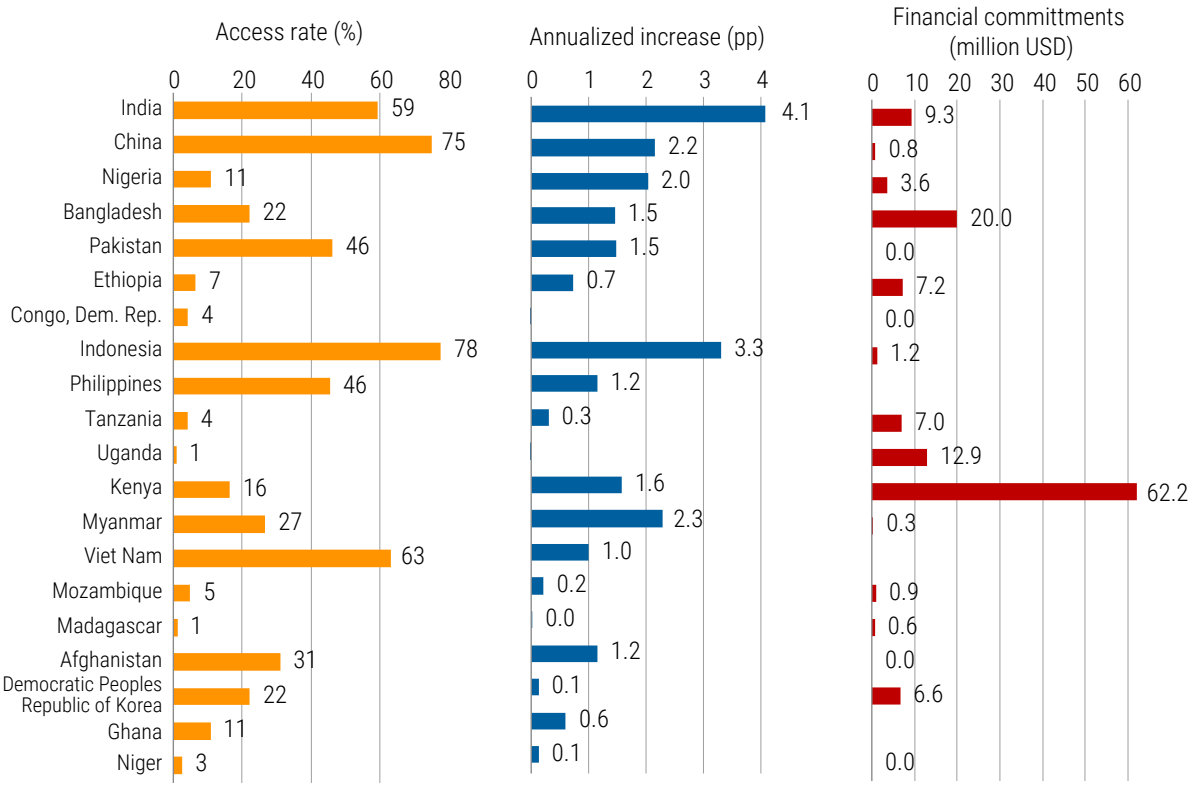


Source: WHO 2022.

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)



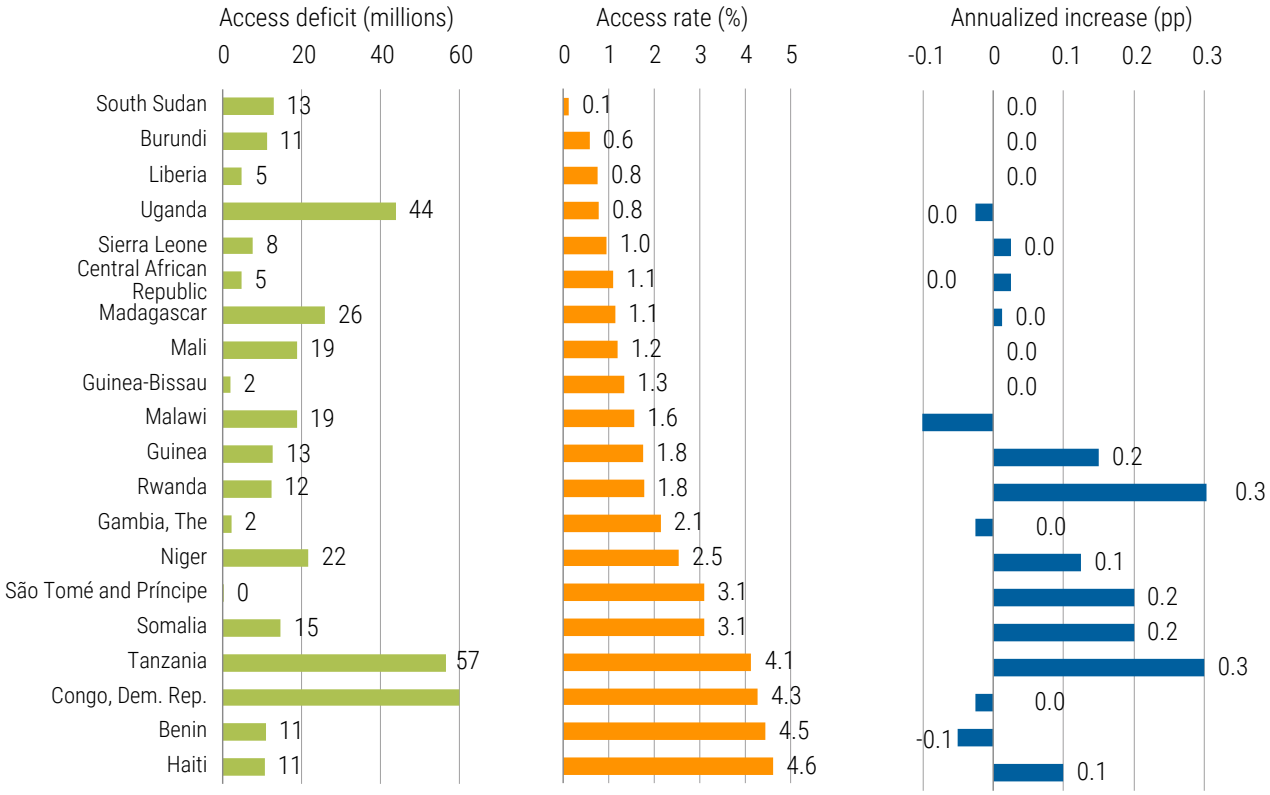
Source: WHO 2022.

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).

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

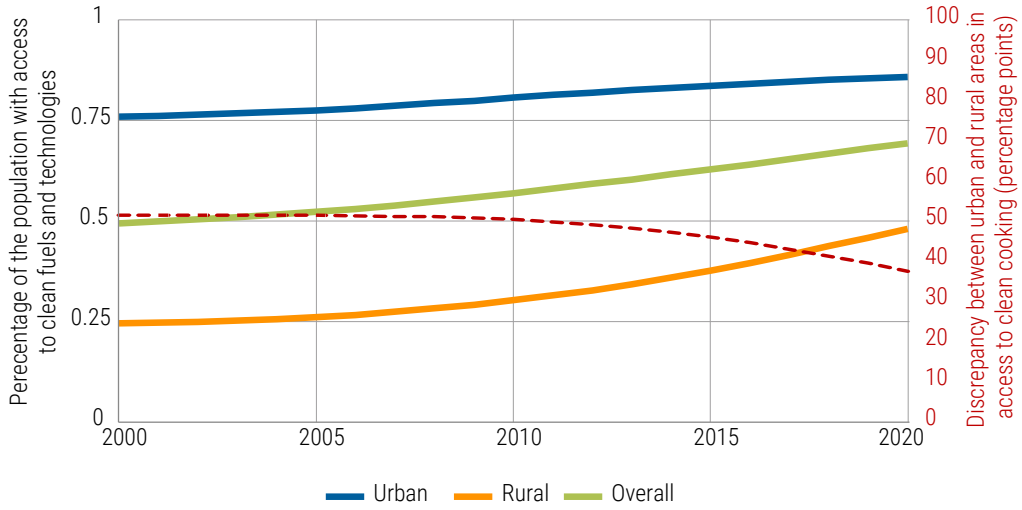


Source: WHO 2022.

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).

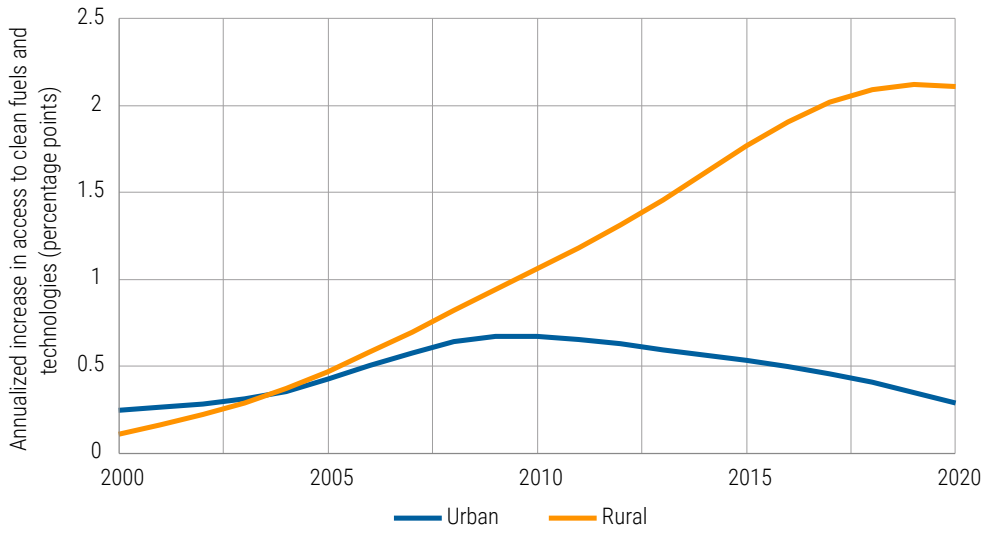
Figure 2.9 • Percentage of people with access to clean cooking in urban and rural areas, 2000–20



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.

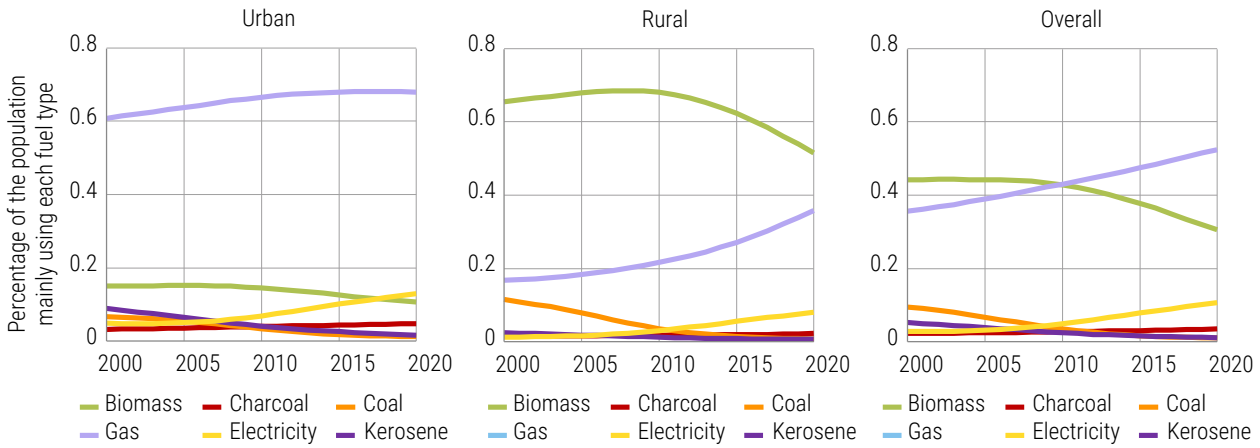
The wider gap in access to clean cooking in rural areas resembles that for access to electricity, although urban access has plateaued at a much higher level (97 percent since 2016).

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.

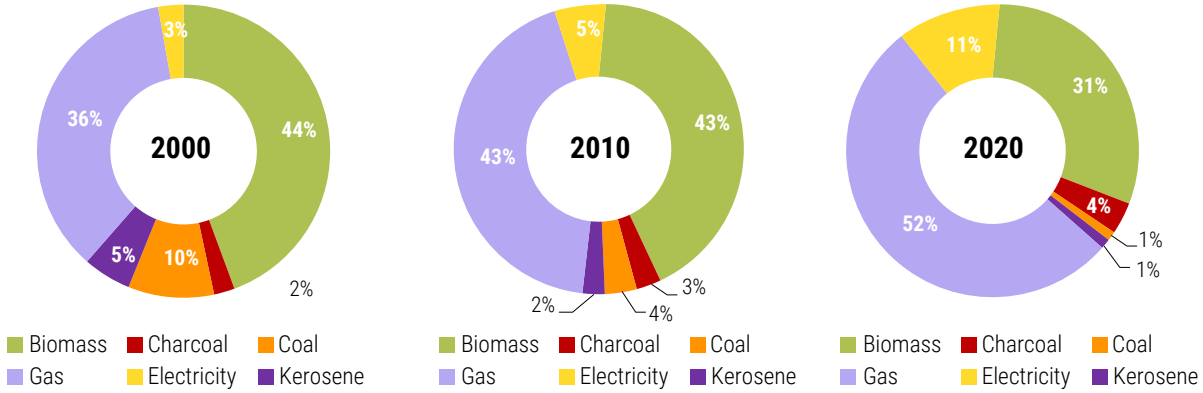
Figure 2.11 • Main cooking fuels used overall and in urban and rural areas of low- and middle- income countries, 2000–20

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 (CO2) 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 CO2. 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 (international 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

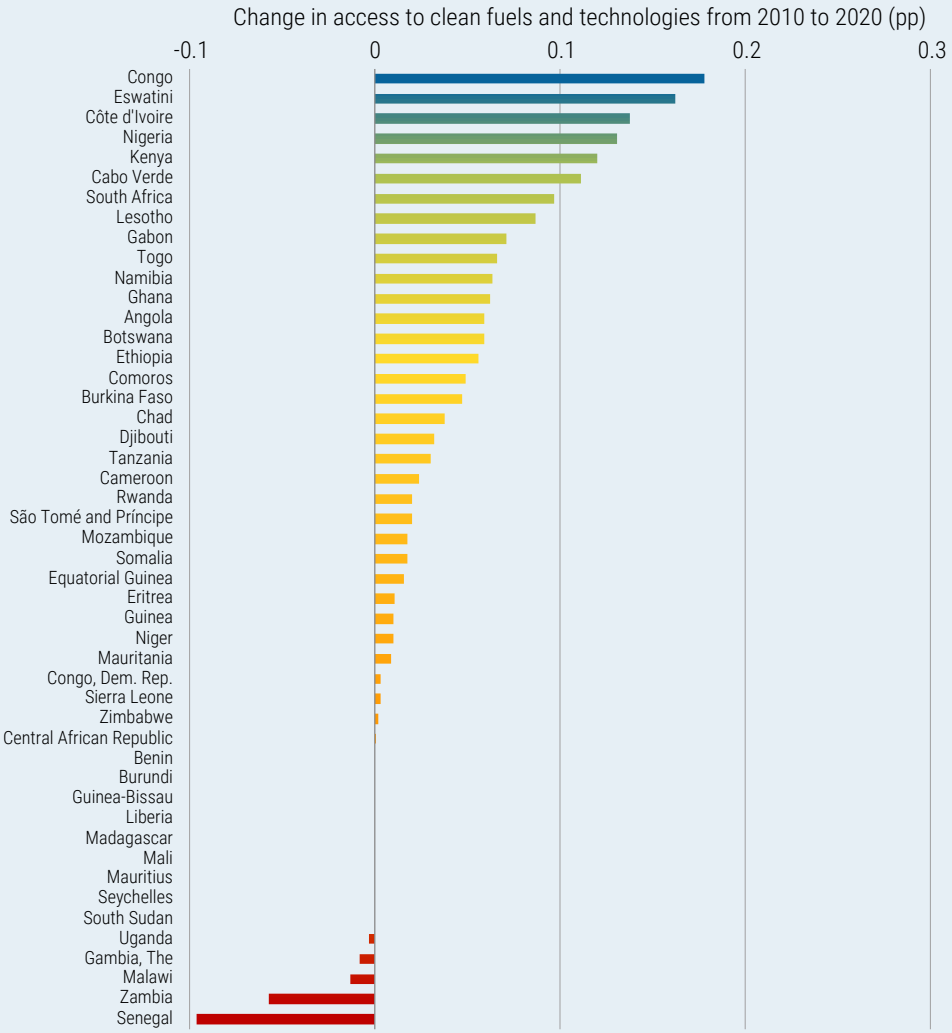
Financing commitments for clean cooking are urgently needed in Sub-Saharan Africa. The Democratic Republic of Congo, Madagascar, and Mozambique (where 96 percent of the population lacks access to clean cooking solutions) each received less than USD 1 million in finance commitments in 2019—less than 1 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.

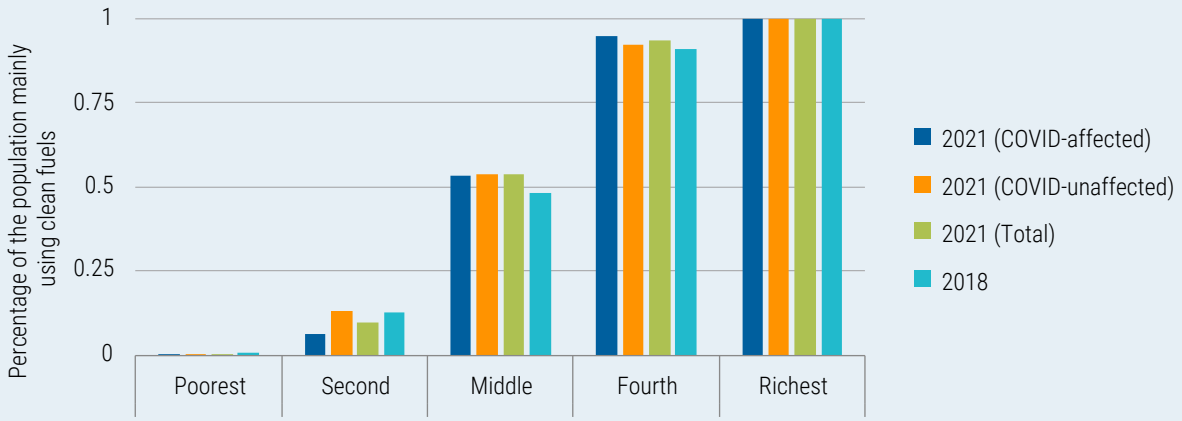
A World Bank study of Kenya (Zhang and Li 2021) illustrates how the onset of the COVID-19 pandemic and the associated lockdown reduced mobility, raised food and fuel price, reduced household income, and increased the number of household members at home during the day. These and other factors have had 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.

REFERENCES

Bailis, R., D. Broekhoff, and C.M. Lee,. 2016. *Supply and Sustainability of Carbon Offsets and Alternative Fuels for International Aviation.* Stockholm Environment Institute Working Paper 2016-03, Seattle, WA, USA. http://assets.wwf.org.uk/downloads/sei_wp_2016_03_icao_aviation_offsets_biofuels.pdf.

Bisaga, I., and L. S. To. 2021. "Clean Cooking in Refugee Camps and COVID-19: What Lessons Can We Learn?" MECS programme briefing note, Modern Energy Cooking Services, April. https://mecs.org.uk/wp-content/uploads/2021/04/Clean-cooking-in-refugee-camps-and-COVID-19-what-lessons-can-we-learn-1.pdf.

Bonjour, S., H. Adair-Rohani, J. Wolf, N. G. Bruce, S. Mehta, A. Prüss-Ustün, M. Lahiff, E. A. Rehfuess, V. Mishra, and K. R. Smith. 2013. "Solid Fuel Use for Household Cooking: Country and Regional Estimates for 2018–2010." Environmental Health Perspectives 121, 7. https://ehp.niehs.nih.gov/doi/10.1289/ehp.1205987

Brutinel, M., F. Nabourema, N. Angelou, B. Bonsuk Koo, E. Portale, and D. Rysankova. 2020. *Niger: Beyond Connections—Energy Access Diagnostic Report Based on the Multi-Tier Framework*. Washington, DC: World Bank.
http://hdl.handle.net/10986/34712.

Clean Cooking Alliance. 2021a. "Clean Cooking Critical to Achieving COP26 Climate Goals." https://cleancooking.org/wp-content/uploads/2021/11/Clean-Cooking-NDCs-Factsheet_COP26.pdf.

Clean Cooking Alliance. 2021b. "Reducing Time Poverty and Unpaid Care Work." https://cleancooking.org/wp-content/uploads/2021/07/530-1.pdf.

Dave, R., S. Keller, B. Bonsuk Koo, G. Fleurantin, E. Portale, and D. Rysankova. 2018. *Cambodia—Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework (English)*. Washington, DC: World Bank. Group. https://openknowledge.worldbank.org/handle/10986/29512.

Dubey, S., E. Adovor, D. Rysankova, E. Portale, and B. Bonsuk Koo. 2020. *Kenya—Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework*. Washington, DC: World Bank. http://hdl.handle.net/10986/35268.

ESMAP (Energy Sector Management Assistance Program). 2020a. Cooking with Electricity: A Cost Perspective. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/34565

ESMAP 2020b. *Regulatory Indicators for Sustainable Energy (RISE): Sustaining the Momentum*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/34937.

ESMAP. 2020c. *The State of Access to Modern Energy Cooking Services.* Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/34565.

IRENA (International Renewable Energy Agency). 2021. *Off-Grid Renewable Energy Statistics 2021.* Abu Dhabi: IRENA. https://irena.org/publications/2021/Dec/Off-grid-renewable-energy-statistics-2021.

IRENA and AfDB (African Development Bank). 2022. *Renewable Energy Market Analysis: Africa and Its Regions*. Abu Dhabi and Abidjan: IRENA and AfDB. https://irena.org/-/media/Files/IRENA/Agency/Publication/2022/Jan/IRENA_Market_Africa_2022.pdf.

Koo, B., D. Rysankova, E. Portale, N. Angelou, S. Keller, and G. Padam. 2018. *Rwanda—Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework.* Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/30101.

Koo, B., H. Kyul Yoo, S. Keller, D. Rysankova, and E. Portale. 2019. *Myanmar—Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework*. Washington, DC: World Bank. http://hdl.handle.net/10986/32381.

Luzi, L., Y. Lin, B. Bonsuk Koo, D. Rysankova, and E. Portale. 2019. *Zambia—Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework.* Washington, DC: World Bank. http://hdl.handle.net/10986/32750.

National Statistical Office of Mongolia and UNICEF (United Nations Children's Fund). 2021. "Multiple Indicator Cluster Survey Plus Results." https://mics.unicef.org/mics-plus/mics-plus-results#mongolia.

Pachauri, S., M. Poblete-Cazenave, A. Aktas, and M. Gidden. 2021. "Access to Clean Cooking Services in Energy and Emission Scenarios after COVID-19." Nature Energy 6 (11): 1067–76.

Padam, G., D. Rysankova, E. Portale, B. Bonsuk Koo, S. Keller, and G. Fleurantin. 2018. *Ethiopia—Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework.* Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/30102.

Pinto, A., H. Kyul Yoo, E. Portale, and D. Rysankova. 2019. *Nepal—Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework.* Washington, DC: World Bank. http://hdl.handle.net/10986/35266.

Rockefeller Foundation. 2022. "Nigeria's Vice President, H.E. Professor Yemi Osinbajo, Launches World-Class Integrated Energy Planning Tool." The Rockefeller Foundation, February 3, 2022. https://www.rockefellerfoundation.org/news/nigerias-vice-president-h-e-professor-yemi-osinbajo-launches-world-class-integrated-energy-planning-tool/.

Samad, H. A., B. Bonsuk Koo, D. Rysankova, and E. Portale. 2019. *Bangladesh—Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework.* Washington, DC: World Bank. http://hdl.handle.net/10986/35267.

Stoner, O., G. Shaddick, T. Economou, S. Gumy, J. Lewis, I. Lucio, G. Ruggeri, and H. Adair-Rohani. 2020. "Global Household Energy Model: A Multivariate Hierarchical Approach to Estimating Trends in the Use of Polluting and Clean Fuels for Cooking." *Journal of the Royal Statistical Society: Series C: Applied Statistics* 69 (4): 815–39.

Stoner, O., J. Lewis, I. L. Martínez, S. Gumy, T. Economou, and H. Adair-Rohani. 2021. "Household Cooking Fuel Estimates at Global and Country Level for 1990 to 2030." *Nature Communications* 12: 5793. https://doi.org/10.1038/s41467-021-26036-x.

SEforALL (Sustainable Energy for All). 2021. *Energizing Finance: Understanding the Landscape.* Vienna: SEforALL. https://www.seforall.org/system/files/2021-10/EF-2021-UL-SEforALL.pdf.

UNHCR (United Nations High Commissioner for Refugees). 2020. "UNHCR Rwanda Operational Update—September 2020." https://data2.unhcr.org/en/documents/details/83967.

UNHCR. 2021. "Good Practices: Alternative Cooking Fuel: Access to Clean Cooking Energy Solutions in Refugee Camps in Rwanda—The Roll Out of Liquified Petroleum Gas (LPG) Cooking Fuel as Alternative to Use of Firewood in Mahama Refugee Camp." https://globalcompactrefugees.org/article/alternative-cooking-fuel.

WHO (World Health Organization). 2014. *WHO Guidelines for Indoor Air Quality: Household Fuel Combustion.* Geneva: WHO. https://www.who.int/publications/i/item/9789241548885.

WHO. 2018. "Household Energy Database." https://www.who.int/data/gho/data/themes/air-pollution/who-household-energy-db

WHO. 2021. "Household Energy Policy Repository." https://www.who.int/tools/household-energy-policy-repository.

WHO. 2022. "Increasing Access to Clean Cooking through Subsidies." Policy Brief, WHO, Geneva. https://www.householdenergypolicies.org/assets/subsidies.pdf?sfvrsn=6a5a5a19_5.

World Bank and WHO. 2021. *Measuring Energy Access: A Guide to Collecting Data Using "the Core Questions on Household Energy Use."* Washington, DC: World Bank. https://www.worldbank.org/en/programs/lsms/publication/MeasuringEnergyAccess.

Zhang, Y., and Z. Li. 2021. "COVID-19's Impact on the Transition to Clean Cooking Fuels : Initial Findings from a Case Study in Rural Kenya." Brief, Live Wire 2021/115, World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/35258.