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CHAPTER 2 ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING

Main messages

- **Global trend.** In 2022, 74 percent (70–77)¹² of the global population had access to clean cooking fuels and technologies, an increase of 16 points from 2010. Despite the progress, some 2.1 billion (1.8–2.4) people were still using polluting fuels and technologies for most of their cooking.
- **Target for 2030.** Urgent efforts are required to accelerate progress toward universal access to clean cooking by 2030. If current trends continue, only 79 (75–81) percent of the world’s population are expected to have access to clean cooking fuels and technologies by 2030, leaving close to 1.8 billion reliant on traditional and inefficient stoves paired with solid fuels (wood, charcoal, coal, crop waste) and kerosene for cooking. It is estimated that if no action is taken, 6 out of 10 people lacking access to clean cooking will reside in Sub-Saharan Africa in 2030, with little or no improvement expected by 2050.
- **Regional highlights.** The access deficit has decreased consistently in Eastern Asia and South-eastern Asia since 2000, and in Central Asia and Southern Asia since 2010. By way of contrast, in Sub-Saharan Africa the deficit in access has a clear upward trend as progress toward clean cooking has not kept pace with the region’s growing populations.
- **Urban-rural divide.** Urban areas continue having greater access to clean cooking fuels and technologies compared to rural areas. But the urban-rural disparity is fading. Over the past decade, rural areas have benefited from a remarkable rise in access, while urban areas have seen slower rates of improvement. In 2010, 82 percent (78–84) of urban residents had access to clean cooking, rising slightly to 88 percent (85–90) in 2022. Meanwhile, the percentage of rural residents with access to clean cooking grew from 30 percent (27–35) in 2010 to 54 percent (49–59) in 2022, marking a five-fold improvement compared to urban areas during the same period.
- **The 20 countries with the largest access deficits.** The 20 countries with the largest access deficits accounted for 74 percent of the global population without access to clean cooking, including 10 countries in Sub-Saharan Africa, where in 2022 more than 923 (888–954) million people had no access to clean cooking fuels and technologies. In 14 of the 20 countries, less than half the population had access to clean cooking fuels and technologies. Moreover, in 8 of the 20 countries (all in Sub-Saharan Africa), less than 10 percent of the population had access.
- **Global and regional fuel trends.** In low- and middle-income countries (LMICs) in 2022, gaseous fuels (liquefied petroleum gas [LPG], natural gas, biogas) were used by 60 percent (55–64) of people (4 billion) as their main energy source for cooking. Unprocessed biomass (wood, crop waste, dung) was the main fuel for 26 percent (22–30) of people (1.7 billion); electricity, for 8 percent (6–11) of people (550 million); and charcoal, 4 percent (3–4) of people (241 million). In 2022, coal and kerosene were the main fuels for only 1 percent of people.
- Integrating electric cooking into a country’s broader electrification efforts creates synergies that enhance energy security, manage fuel costs, and align with global energy and climate goals on the path toward universal access to clean cooking.

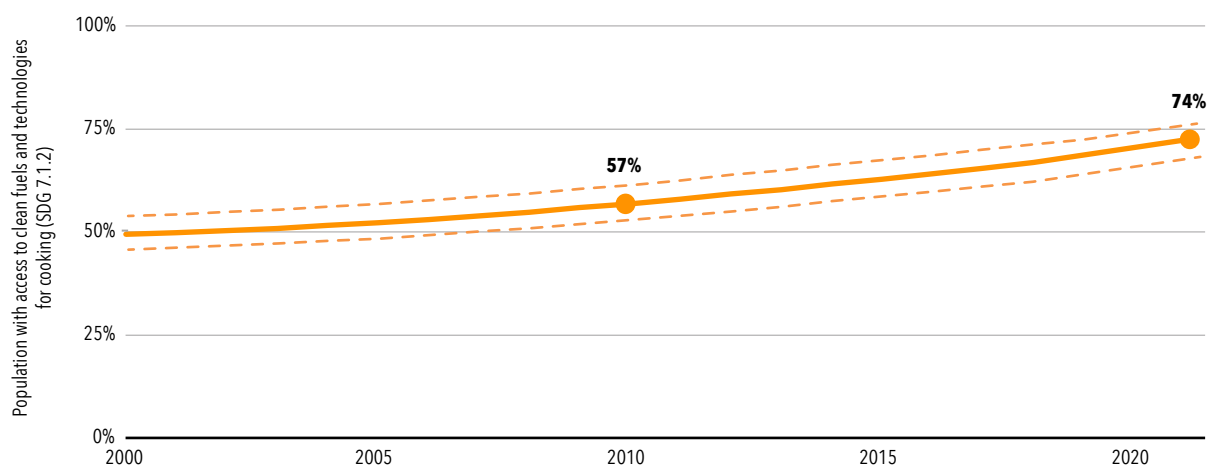
¹² Throughout the chapter, parenthetical figures appearing after estimates are 95 percent uncertainty intervals, as defined in the methodology section at the end of the chapter. Clean fuels and technologies include stoves powered by electricity, LPG, natural gas, biogas, solar, and alcohol. Clean fuels and technologies are as defined by the normative technical recommendations by the World Health Organization (WHO 2014). Detailed datasets with country data for the SDG 7 indicator discussed in this chapter can be accessed at no charge at <https://trackingsdg7.esmap.org/downloads>.

Are we on track?

The world is not on track to achieve universal access to clean cooking by 2030. In 2022, 74 percent (70–77) of the world’s population had access to clean cooking fuels and technologies (e.g., stoves powered by electricity, LPG, natural gas, biogas, solar, and alcohol). Approximately 2.1 billion (1.8–2.4) people still relied on polluting fuels and technologies (e.g., charcoal, coal, crop waste, dung, kerosene, and wood) as their main energy source for cooking. These estimates refer to the use of main fuels only and exclude the cookstove and fuel combinations.¹³

Some progress has been seen in the global access rate over the past two decades, as seen in figure 2.1. Yet if current trends continue, only an estimated 79 percent (75–81) of the global population will have access to clean cooking fuels and technologies by 2030. This falls far short of the 2030 target of universal access and leaves nearly 1.8 billion people exposed to the adverse effects of polluting cooking fuels and technologies on human health, livelihoods, and the environment.

FIGURE 2.1 • PERCENTAGE OF THE GLOBAL POPULATION WITH ACCESS TO CLEAN COOKING FUELS AND TECHNOLOGIES, 2000–22



Source: WHO 2024a.

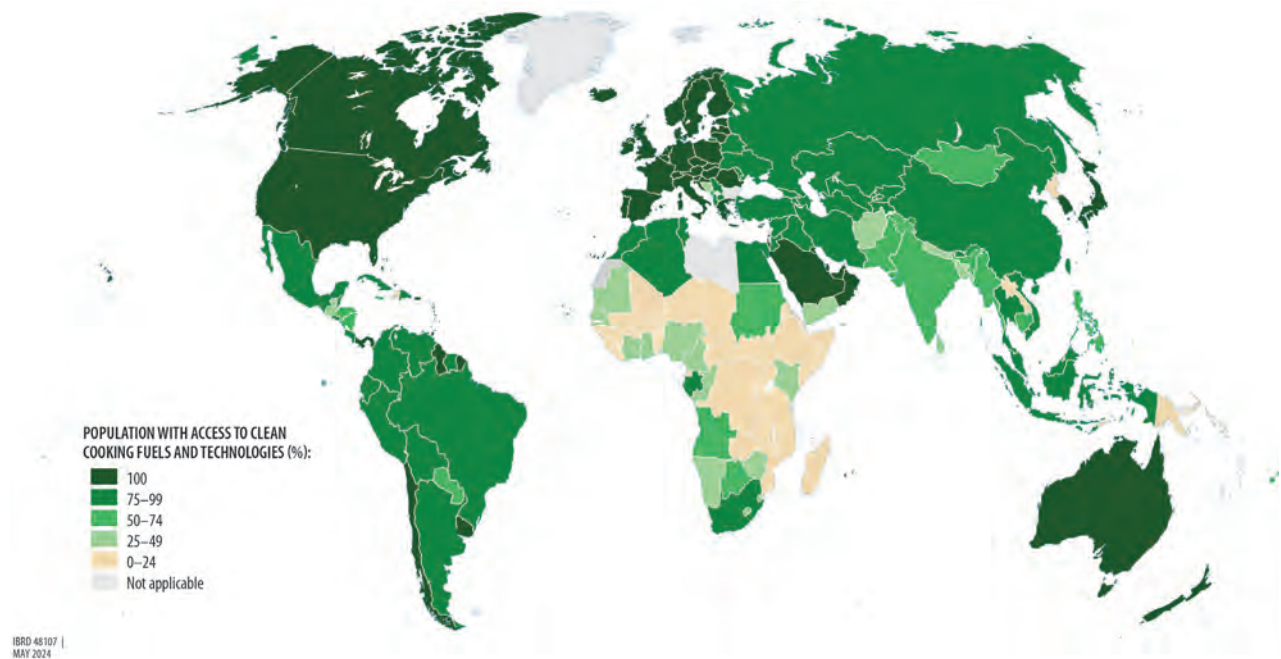
Note: Dashed lines are 95 percent uncertainty intervals.

SDG = Sustainable Development Goal.

The number of people worldwide without access to clean cooking continues to fall each year, although regional variability exists (figure 2.2). The number of people without access in Sub-Saharan Africa is growing at a rate of nearly 20 million people per year. Although there have been some improvements in the percentage of those with access, these gains have not kept up with the region’s population growth, to the detriment of the almost 1 billion people already suffering the negative effects of polluting cooking in the region. The growing access deficit in Sub-Saharan Africa, if not addressed, has the potential to stall or reverse the current upward trajectory in global access.

13 Because of the limited availability of source data in nationally representative surveys on stove stacking, this chapter examines cooking fuel rather than fuel and technology combinations. Considering this limitation, lack of reporting on stove stacking, where both clean and traditional fuels are used, might undermine the perceived health and environmental benefits, as it does not take into account the limited household air pollution exposure to GHG emission reductions. The Annex 1 provides additional details on the methodology. Population estimates are from 2022. 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.

FIGURE 2.2 • SHARE OF POPULATION WITH ACCESS TO CLEAN COOKING FUELS AND TECHNOLOGIES, 2022 (PERCENT)

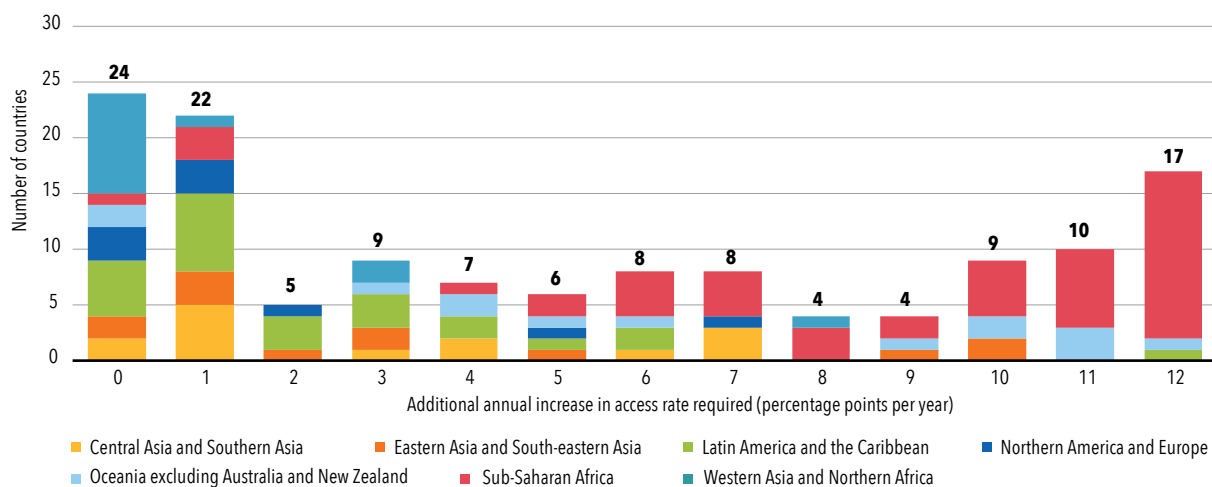


Source: WHO 2024a.

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 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.

Without a greater effort, the vast majority of LMICs will miss the 2030 universal access target. Greatly accelerated progress is therefore urgently needed if the world is to achieve universal access by 2030. In 44 countries, predominantly in Sub-Saharan Africa, a rise of 8-12 percentage points per year above current trends is needed to reach 100 percent access from 2022 to 2030 (figure 2.3).

FIGURE 2.3 • NUMBER OF COUNTRIES REQUIRING ADDITIONAL ANNUAL INCREASES IN ACCESS, ABOVE CURRENT TRENDS, TO ACHIEVE 100 PERCENT CLEAN COOKING BY 2030



Source: WHO 2024a.

Note: Additional required increases are calculated over the period 2022 to 2030 and rounded to the nearest percentage point. The number displayed above each bar represents the count of countries.
SDG = Sustainable Development Goal.

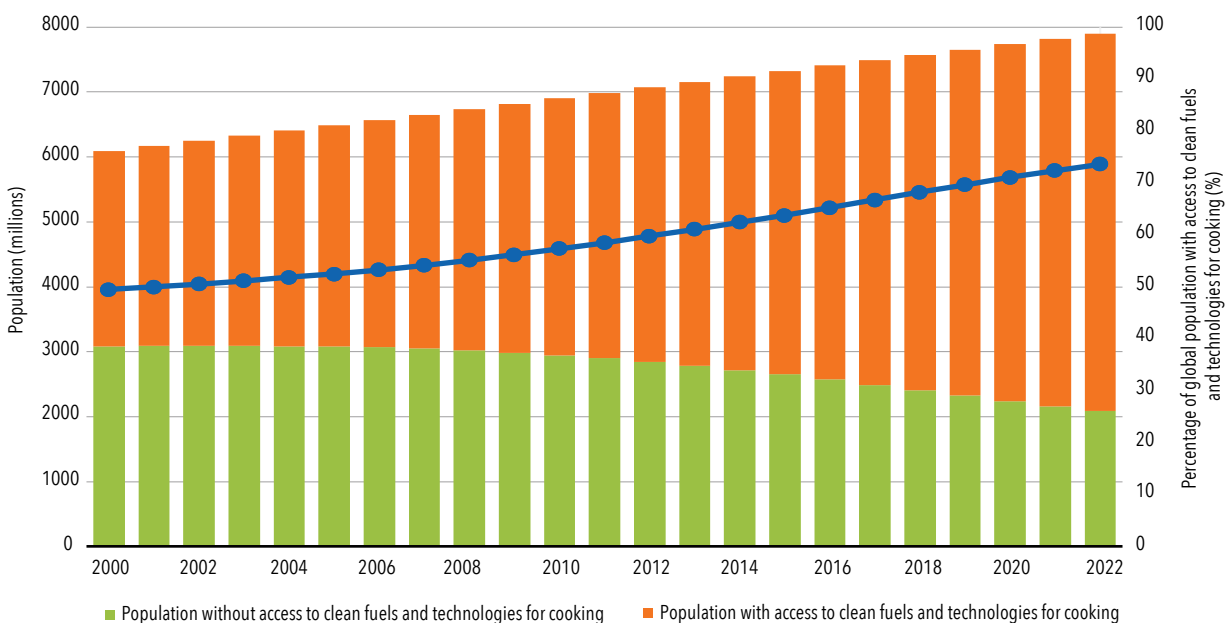
If these trends continue, as per most recent World Health Organization (WHO) estimates, only 408 million people will gain access to clean cooking between 2022 and 2025, while an additional 505 million people will gain access between 2025 and 2030. This indicates a significant and pressing need to ramp up efforts to ensure 1 billion more people obtain access to clean cooking solutions by 2025, as pledged by the Global Roadmap for Accelerated SDG 7 Action in Support of the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change (United Nations 2021).

Looking beyond the main indicators

ACCESS AND POPULATION

The global rate of access to clean fuels and technologies for cooking reached 74 percent (70–77) in 2022. Figure 2.4 shows the access rate rising gradually over the past two decades, with gains totaling around 22 percentage points since 2000 and 16 percentage points since 2010.

FIGURE 2.4 • CHANGE IN THE ABSOLUTE NUMBER OF PEOPLE (LEFT AXIS, BARS) AND PERCENTAGE OF THE GLOBAL POPULATION (RIGHT AXIS, LINE) WITH ACCESS TO CLEAN COOKING, 2000–22

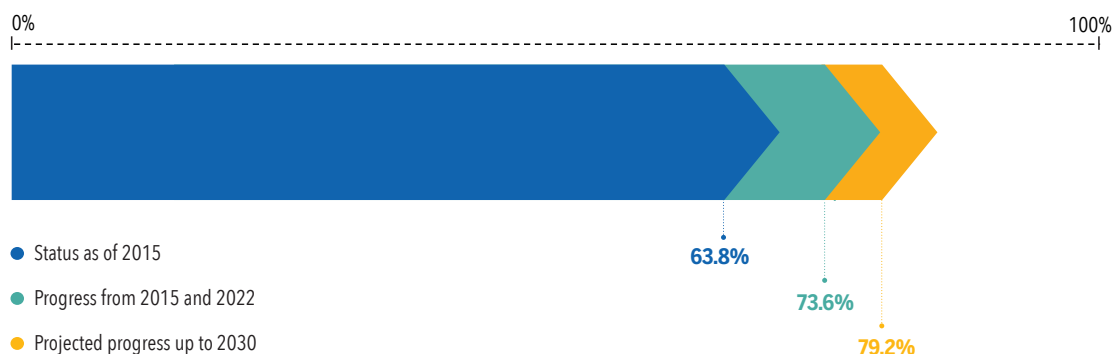


Source: WHO 2024a.

An assessment of the trajectory toward the 2030 target reveals that progress has been made in some parts of the world. The pace of change remains insufficient, however, to achieve the universal access target within the stipulated timeframe. Urgent action is needed to bridge existing gaps, particularly in regions with entrenched deficits, to ensure

equitable access to clean cooking fuels and technologies by 2030 and beyond. Despite global progress, only about 79 percent (75–81) of the population are projected to have gained access to clean cooking fuels and technologies by 2030 (figure 2.5).

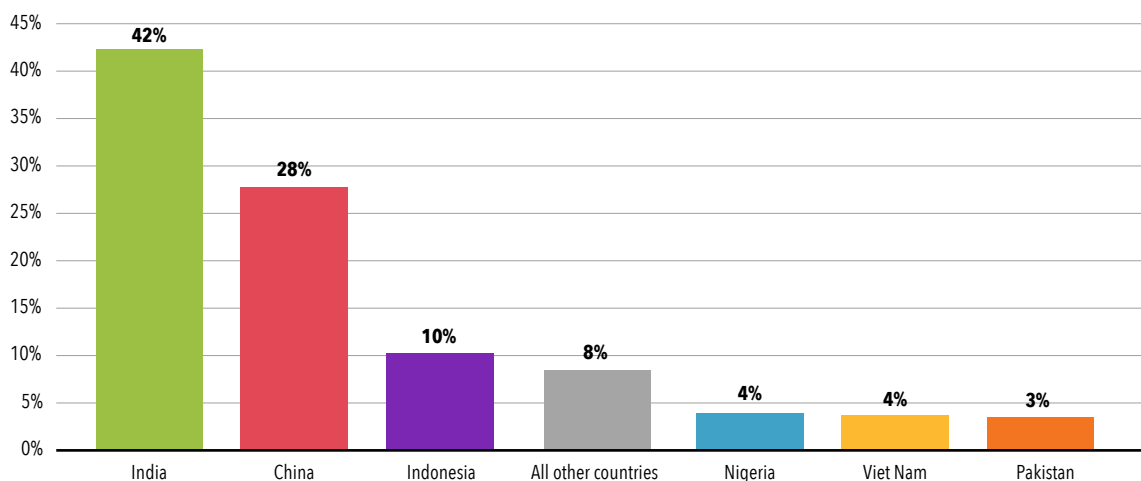
FIGURE 2.5 • PROGRESS TOWARD UNIVERSAL ACCESS TARGET, 2010–30 (IN PERCENTAGES)



Source: WHO 2024a.

Higher global access rates have largely been driven by progress in the most populous LMICs, such as India, China, Indonesia, Nigeria, and Pakistan (United Nations 2018). According to figure 2.6, 92 percent of progress in the global access rate since 2010 can be attributed to progress in only six countries, meaning only 8 percent of global gains were seen in all other countries combined (see the “Changes in Fuel Mix” subsection for breakdowns by fuel). This serves as another reminder that while good progress has been made in a handful of countries (four of which are the most populous globally), a number of less-populous countries have been lagging. If current trends continue, the overall access rate to clean cooking will reach only 61 percent in LMICs, excluding the five most populous LMICs.

FIGURE 2.6 • BREAKDOWN OF GLOBAL PROGRESS TOWARD UNIVERSAL ACCESS TO CLEAN COOKING SINCE 2010



Source: WHO 2024a.

LMICs = low- and middle-income countries.

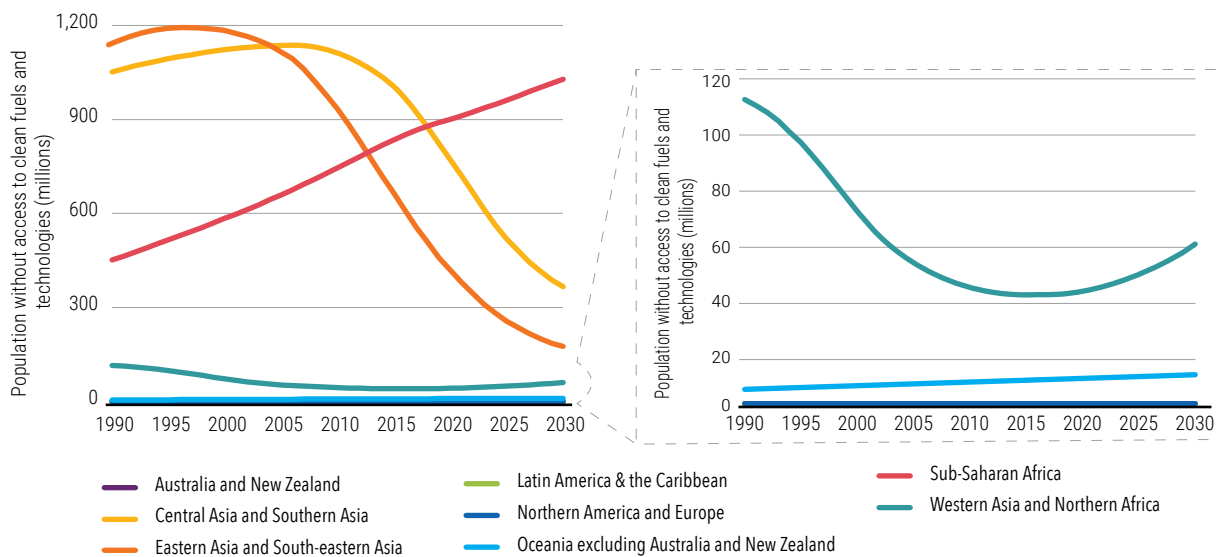
THE ACCESS DEFICIT

While gains have been made toward the 2030 target for universal access, major disparities persist. The slow pace overall highlights shortcomings in efforts to achieve the goal. On a global scale, the number of people with access to clean cooking has risen steadily over the past two decades (figure 2.5). But the total number of people with no access to clean cooking—an indicator of the number exposed to the damaging health and socioeconomic effects of polluting fuels and technologies, referred to here as the “access deficit”—began to drop only recently, from its historic high of around 2.9 billion people (2.7–3.2) in 2010 to 2.1 billion people (1.8–2.4) in 2022.

Countries in Sub-Saharan Africa, Central Asia, and Southern Asia dominate the global access deficit. In 2022, it is estimated that 79 percent (76–82) of the population in Sub-Saharan Africa and 33 percent (22–46) of people living in Central Asia and Southern Asia continue to rely on polluting fuels and cooking technologies. Figure 2.7 depicts how the access deficit has fallen 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 where the number of people without access continues to climb. The access deficit in Sub-Saharan Africa more than doubled between 1990 and 2022, primarily due to a rapid increase in population size (United Nations 2018), which translates into 923 million (888–954) people without access to clean cooking fuels and technologies in 2022. If no action is taken and current trends continue, the access deficit in Sub-Saharan Africa is projected to exceed 1 billion people by 2030.

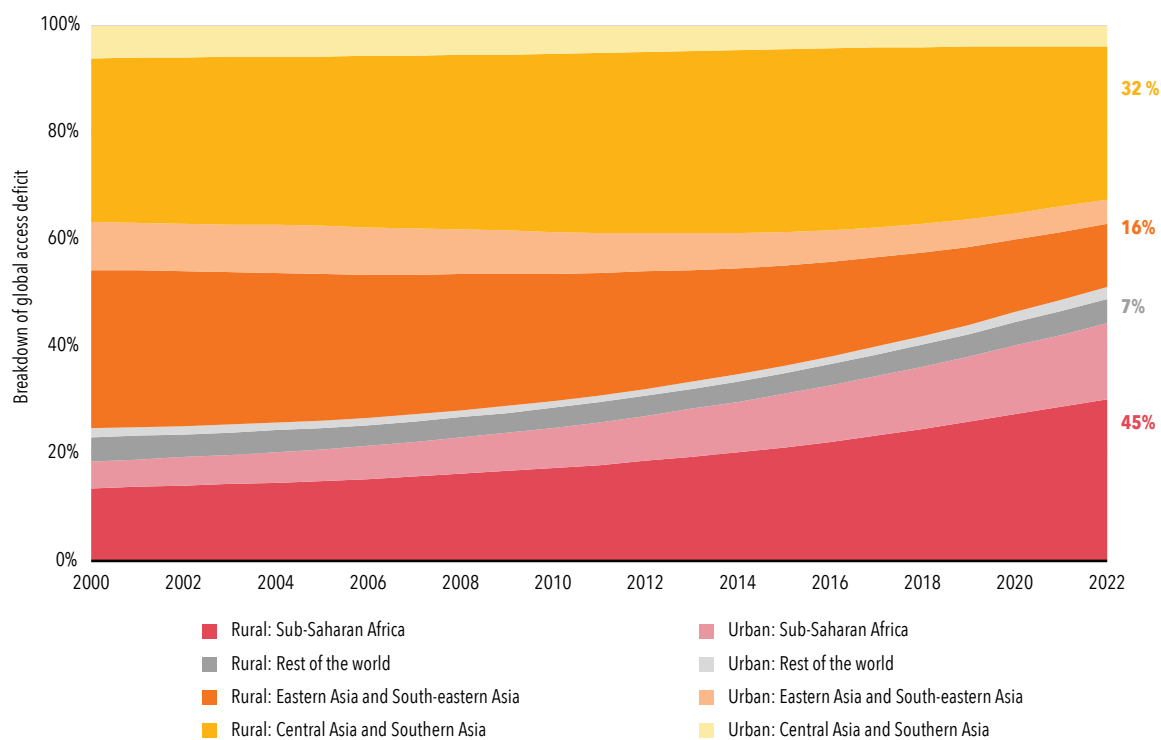
FIGURE 2.7 • NUMBER OF PEOPLE WITHOUT ACCESS TO CLEAN FUELS AND TECHNOLOGIES, BY REGION, 2000–22



Source: WHO 2024a.

Figure 2.8 illustrates the changing regional composition of the global population lacking access to clean fuels for cooking between 2010 and 2022. In 2000, 4 in 10 people lacking access to clean cooking lived in Central Asia and Southern Asia, 4 in 10 in Eastern Asia and South-eastern Asia, 4 in 10 in Eastern Asia and South-eastern Asia, and 2 in 10 in Sub-Saharan Africa. By 2022, 5 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 a stark rise in the deficit in Sub-Saharan Africa. If these trends persist, almost 6 in 10 people without access will reside in Sub-Saharan Africa by 2030.

FIGURE 2.8 • PROPORTION OF THE TOTAL GLOBAL ACCESS DEFICIT IN THE THREE LARGEST ACCESS-DEFICIT REGIONS AND THE REST OF THE WORLD, 2000–22



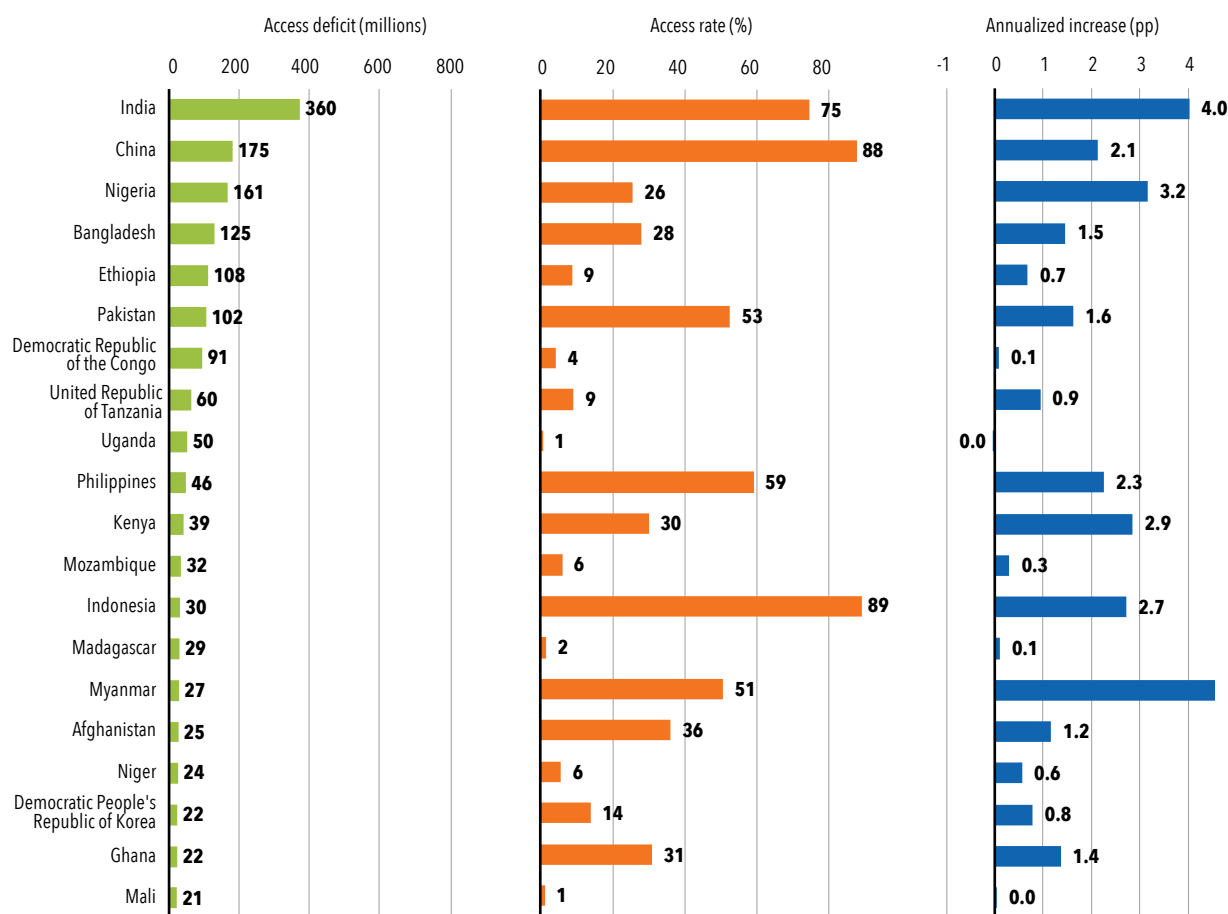
Source: WHO 2024a.

ANALYSIS OF THE TOP 20 ACCESS-DEFICIT COUNTRIES

Around three-quarters (74 percent) of the world’s population without access to clean cooking are found in only 20 countries. India has the largest share of the access deficit, with 360 million (157–631) people lacking access, followed by China at 175 million (67–341) (figure 2.9).

In 8 of the 20 countries, less than 10 percent of the population has access to clean fuels and technologies. These countries are the Democratic Republic of Congo, Ethiopia, Madagascar, Mali, Mozambique, Niger, Uganda, and the United Republic of Tanzania. Additionally, 14 of the 20 countries have access rates below 50 percent.

FIGURE 2.9 • THE 20 COUNTRIES WITH THE LARGEST ACCESS DEFICIT BY ABSOLUTE POPULATION (VIOLET), ACCESS RATE (ORANGE), AND ANNUALIZED INCREASE IN ACCESS (GREEN, BASED ON THE 2017–22 AVERAGE)

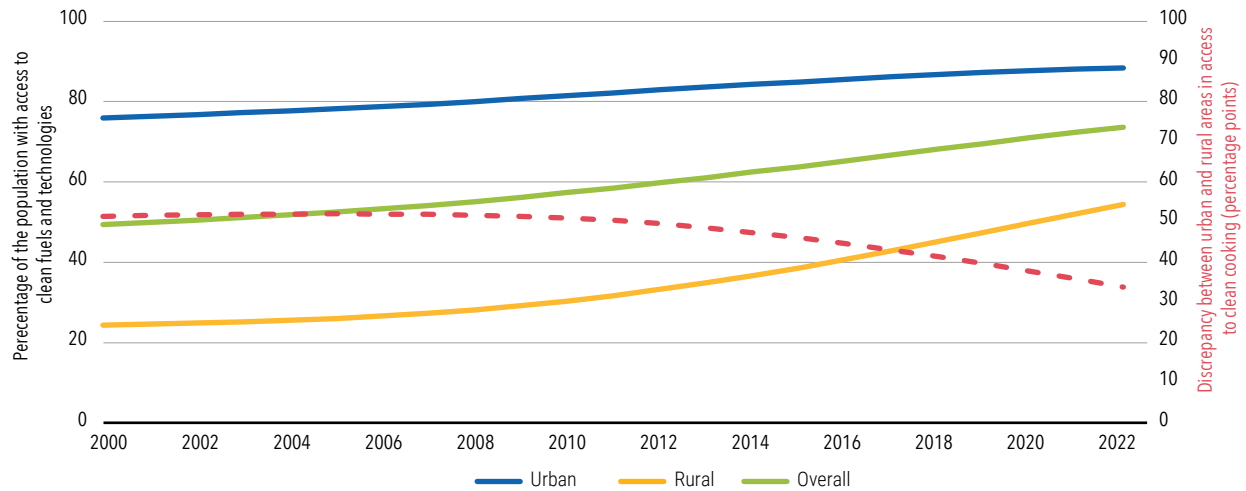


Source: WHO 2024a.
pp = percentage points.

URBAN-RURAL DIVIDE

Urban areas tend to adopt modern cooking fuels and technologies at a higher rate than rural areas. This may be due to better infrastructure (e.g., roads) and greater access to services and more reliable energy supply in urban areas. About 88 percent (85–90) of urban households globally have access to clean cooking, while only 54 percent (49–59) of rural households have access. Between 2010 and 2022, the percentage of people with access to clean cooking in urban areas only inched upward, from 81 percent (78–84) to 88 percent (85–90). On the other hand, the percentage of people with access in rural areas leaped from 30 percent (27–35) to 54 percent (49–59) during the same period, as illustrated in figure 2.10.

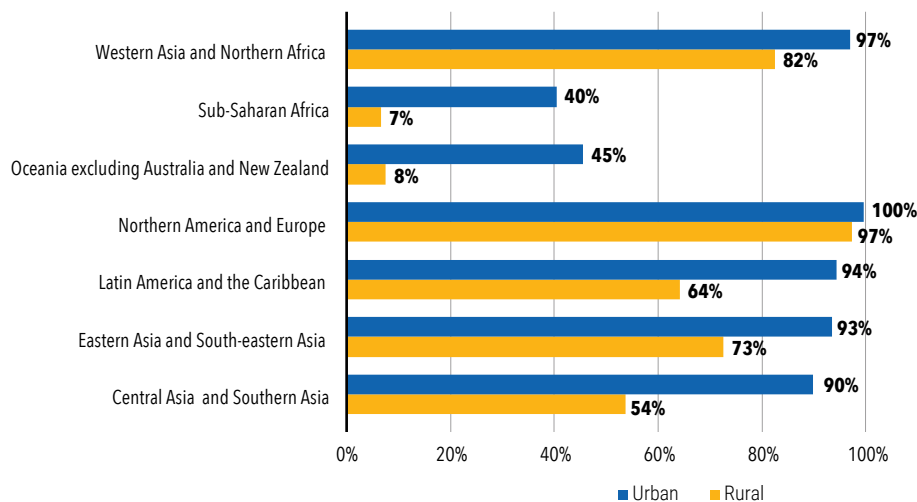
FIGURE 2.10 • PERCENTAGE OF PEOPLE WITH ACCESS TO CLEAN COOKING IN URBAN AREAS, RURAL AREAS, AND OVERALL (SOLID LINES), AND DISCREPANCY IN ACCESS BETWEEN URBAN AND RURAL AREAS (DASHED LINE)



Source: WHO 2024a.

The urban-rural gap across regions has been narrowing in all regions except Sub-Saharan Africa, where it is diverging dramatically. Notably, in Sub-Saharan Africa, only 7 percent (5-9) of rural households have access to clean cooking, while the figure is 40 percent (36-45) in urban areas (figure 2.11). Moreover, in Latin America and the Caribbean, one of the most urbanized regions in the world, 36 percent (29-44) of the rural population still lacks access to clean fuels and technologies for cooking. This discrepancy highlights the pronounced challenges faced by rural communities, where reliance on traditional biomass for cooking remains prevalent, affecting approximately 84 percent (80-87) of rural households in Sub-Saharan Africa. Such disparities disproportionately impacted the rural population and resulted in higher exposure to household air pollution, contributing to adverse health outcomes, particularly among women and children. Addressing this urban-rural gap requires evidence-based interventions that prioritize rural infrastructure development and targeted clean cooking initiatives.

FIGURE 2.11 • POPULATION WITH ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING BY SDG REGION (PERCENT)



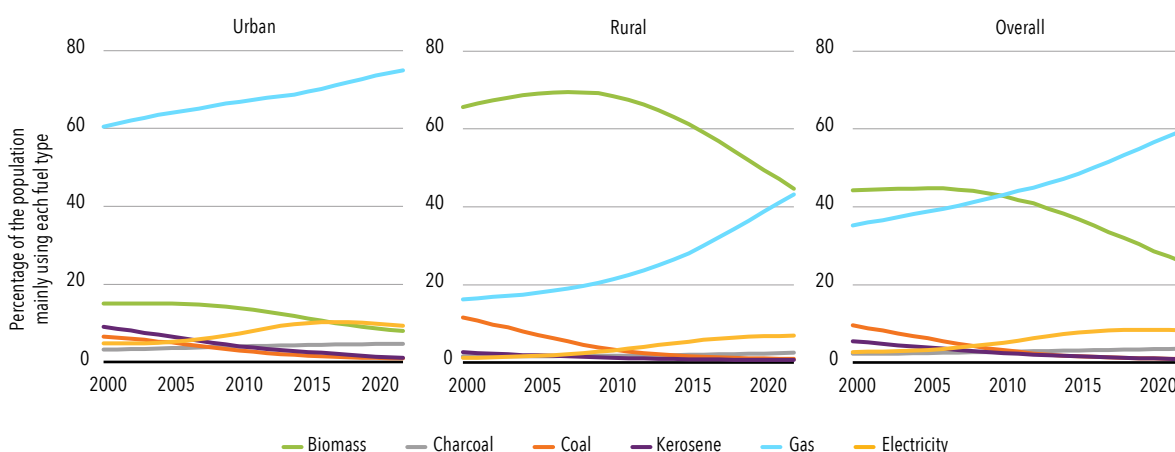
Source: WHO 2024a.

SDG = Sustainable Development Goal.

CHANGES IN THE FUEL MIX

A deeper look at the specific fuels and technologies used by LMICs in 2022 reveals that gaseous fuels (LPG, natural gas, and biogas)¹⁴ remain the main energy source for cooking among 60 percent (55–64) of people (4 billion) (figures 2.12 and 2.14); electricity was the main fuel for 8 percent (6–11) of people (550 million). Unprocessed biomass (wood, crop waste, and dung), a polluting alternative, was the main fuel for 26 percent (22–30) of people (1.7 billion) and charcoal for 4 percent (3–4) (241 million). Coal and kerosene were used as primary cooking fuels by only 1 percent (0–2) (65 million) and 0.8 percent (0.5–1.8) (59 million) of people, respectively.

FIGURE 2.12 • PERCENTAGE OF PEOPLE MAINLY USING EACH TYPE OF COOKING FUEL IN LOW- AND MIDDLE-INCOME COUNTRIES, URBAN, RURAL, AND OVERALL



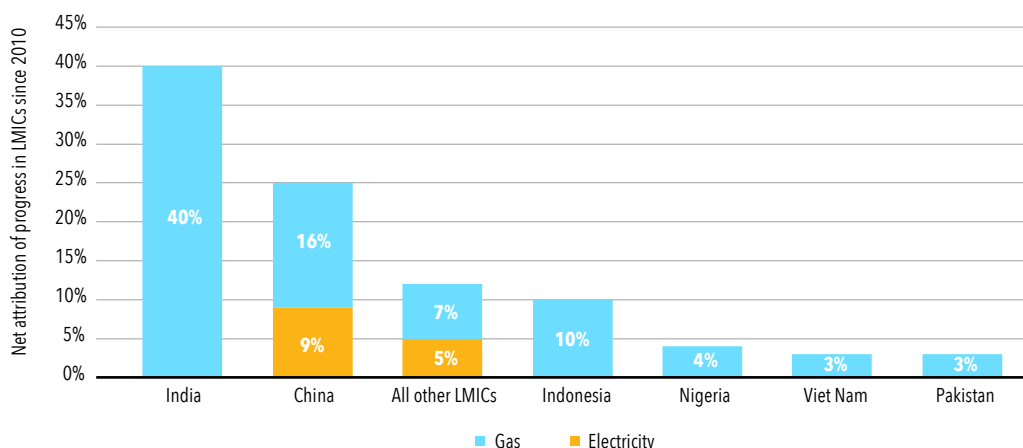
Source: WHO 2024a.

In around 2010, gas surpassed unprocessed biomass as the most commonly used fuel in LMICs owing to the rapid expansion of LPG programs in Ecuador and Bolivia, among other countries. Yet biomass continues to be the main fuel for cooking for 45 percent (40–50) of people (1.4 billion) in rural areas in 2022, more than any other type of fuel. Although the use of unprocessed biomass may be decreasing in both urban and rural areas, the reliance on charcoal is increasing in both areas. This is especially true among those living in LMICs and urban areas of Sub-Saharan Africa, where 30 percent (26–34) of people (146 million) primarily used charcoal for cooking in 2022.

Additionally, while considering the contributions since 2010 of different countries and fuel types toward universal access to clean cooking in LMICs (figure 2.12), we can see gas playing a dominant role; China being the only major contributor where electricity also plays a significant role. India, Indonesia, Nigeria, Viet Nam, and Pakistan rely entirely on gas for their contributions, indicating a lower adoption of electric cooking solutions in these countries (figure 2.13).

14 Gaseous fuels (or gas) refers to LPG, natural gas, and biogas together, as most input surveys do not differentiate among the three.

FIGURE 2.13 • BREAKDOWN OF PROGRESS TOWARD UNIVERSAL ACCESS TO CLEAN COOKING IN LMICs SINCE 2010 BY FUEL



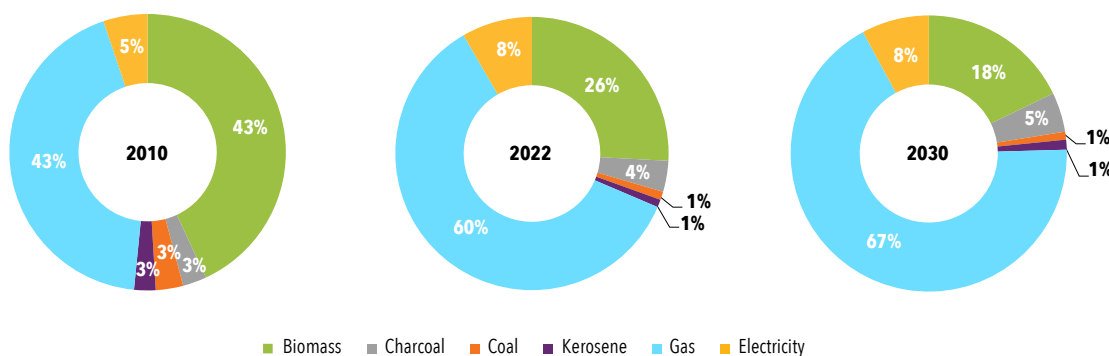
Source: WHO 2024a.

LMICs = low- and middle-income countries.

The use of gas as the primary fuel is increasing more quickly than electricity in rural areas and overall. In urban areas, however, the use of electricity is rising more quickly than gas. In 2022, the use of electricity in LMICs was the highest in Northern America and Europe, at 24 percent (15–35), or about 51.4 million people, followed by Eastern Asia and South-eastern Asia, at 17 percent (10–26), or about 360 million people.

Examining the historical progress in the proportion of people using clean fuels and technologies for cooking shows that it has been accompanied by steep declines in the use of unprocessed coal and kerosene. In 2010, coal was mainly used by 3 percent (1–6) of the population (180 million people) in LMICs, with 80 percent (150 million) residing in Eastern Asia and South-eastern Asia. In 2010, kerosene was the main cooking fuel of 2 percent (2–3) of the population in LMICs (142 million people), including 17 percent (11–25) of those in urban areas of Oceania (excluding Australia and New Zealand) and 16 percent (12–19) of those in urban areas of Sub-Saharan Africa. In 2022, kerosene or coal were the primary fuels for cooking among less than 2 percent of the combined population in LMICs.

FIGURE 2.14 • COMPARISON OF THE PERCENTAGES OF PEOPLE IN LOW- AND MIDDLE-INCOME COUNTRIES USING VARIOUS FUEL TYPES IN 2010 AND 2022, WITH PROJECTIONS FOR 2030



Source: WHO 2024a.

If current trends continue through 2030, 67 percent of the population in LMICs will mainly use gas, while 18 percent will continue to rely on unprocessed biomass. About 8 percent of the population will use electricity for cooking, 5 percent will use charcoal, while 1 percent will use kerosene or coal. It is worth noting that the use of gaseous fuels, rather than electricity, is expected to account for most of the growth in the share of the population using mostly clean fuels and technologies.

“Stove stacking” refers to the simultaneous use of various cooking fuels and technologies. Although this remains a common practice, the statistics consider only the primary cooking fuel (figure 2.15). Survey methodologies tend to overlook stove types as well as secondary fuels, implying that the count of individuals relying exclusively on clean fuels may be considerably lower than what the figures report. This presents challenges for accurately characterizing the exposure to household air pollution from the use of polluting fuels and technologies and the associated health, social, and environmental/climate impacts. A comprehensive analysis of all cooking stoves and fuels used along with household energy use more broadly, including other energy uses (e.g., heating and lighting), requires survey takers to devise and implement survey questions that capture the full range of fuels and technologies employed at home (World Bank and WHO 2021).

FIGURE 2.15. EXAMPLE OF A HOUSEHOLD USING MULTIPLE CLEAN AND TRANSITIONAL/POLLUTING FUELS AND TECHNOLOGIES SIMULTANEOUSLY IN INDIA



Photo credit: Jessica Lewis.

Policy insights

As the world faces compounding crises like pandemics, economic downturns, and climate change, the need to achieve universal access to clean cooking has become more important than ever. In 2022, it was estimated that 74 percent (70-77) of the world's population had access to clean cooking solutions. Despite some progress, many households worldwide still rely on polluting cooking fuels and technologies that disproportionately affect the most vulnerable: women and children. These practices pose health risks and environmental damage and perpetuate cycles of poverty. Moreover, the lack of access to clean household energy exacerbates gender inequalities, as women and children are often tasked with household cooking and fuel collection, which can hinder their educational and economic opportunities. Cooking with polluting fuels and technologies is also a major source of greenhouse gas (GHG) emissions and climate pollutants such as black carbon, which account for over half of human-induced black carbon emissions. The benefits of clean cooking are estimated in box 2.1.

While progress has been made toward the 2030 goal of universal access, the current trajectory indicates that only 79 percent (75-81) of the world's population will have access to clean cooking solutions by then, leaving around 1.8 billion people still without access. The discrepancy in access between urban (88 percent) and rural (54 percent) areas worldwide is stark. In Sub-Saharan Africa, only 7 percent (5-9) of rural households have access to clean fuels and technologies for cooking, compared to 40 percent (36-45) in urban settings. In Latin America and the Caribbean, only 64 percent (56-70) of the rural population has access to clean fuels and technologies for cooking, compared to 94 percent (89-96) in urban areas, despite the region being one of the most urbanized in the world. Urban areas tend to have better access to clean cooking fuels and technologies due to better infrastructure, greater service availability, and more reliable energy supply compared to rural areas.

Across Eastern Asia, South-eastern Asia, Central Asia, and Southern Asia, access to clean cooking has been rising since the early 2000s. Sub-Saharan Africa remains the sole region where the number of people lacking access is still increasing. The number more than doubled between 1990 to 2022 due to population growth. This has resulted in 923 million (888-954) individuals without access to clean cooking technologies in 2022. If the current trend persists, the access deficit in Sub-Saharan Africa could surpass 1 billion by 2030, impeding the achievement of the 2030 target. Immediate and focused interventions are necessary to tackle this growing challenge.

Box 2.1 • Global cost-benefit analysis on clean cooking transitions using the Benefits of Action to Reduce Household Air Pollution tool

Switching from polluting fuels such as wood, dung, and charcoal for cooking to cleaner energy sources like liquefied petroleum gas and electricity can bring substantial gains in health, environment, climate, and gender equity. Quantifying and estimating the value of these benefits and costs of transition can help make a case for investment in policies and programs for promoting widespread adoption of clean household energy. The World Health Organization Clean Household Energy Solutions Toolkit (CHEST) includes the Benefits of Action to Reduce Household Air Pollution (BAR-HAP) tool, which allows users to model the costs and benefits of transitions to cleaner cooking fuels and technologies with different policy options.

A recent analysis applied the BAR-HAP model to estimate the regional and global costs and benefits of policies that support households in transitioning to cleaner technologies. The analysis considered three types of policy actions—(1) stove subsidies alone, (2) stove and fuel subsidies, or (3) stove subsidies plus financing (e.g., installment)—under three transition scenarios: (1) promotion of clean solutions only; (2) a mix of clean and other improved solutions, one with a larger share of the transition targeted toward clean solutions; and (3) a mix of clean and other improved solutions, one with a smaller share of the transition targeted toward clean solutions.

This analysis provides realistic, evidence-based estimates of the impacts of policy interventions on cleaner cooking transitions while remaining conservative about factors such as stove usage rates, subsidy leakage rates, and exposure levels. Despite these conservative assumptions, the results show that policies promoting a clean cooking transition would generate net benefits of USD 1.4 trillion between 2020 and 2050 across 120 low- and middle-income countries. Policies that include some promotion of improved stoves produce lower net social benefits. Most monetized benefits are from health, particularly reductions in mortality, followed by averted carbon dioxide equivalent emissions.

Specifically, for the clean solution scenario, the most socially beneficial policies can save millions of disability adjusted life years and about 21 billion hours per year associated with fuelwood collection. Additionally, the policies can avoid emissions of 380 million tonnes of carbon dioxide equivalent per year (310 and 70 million, in rural and urban areas, respectively), and the annual unsustainable forest loss avoided is about 80 billion kilograms of wood harvest.

Although substantial investment will be required to achieve these benefits, the economic case for scaling up clean cooking policy action is strong. Identifying the most effective policies to achieve more exclusive clean fuel use would only increase benefits. There is a lot of evidence that shows the need to act to reduce the heavy health, time, and environmental burdens of traditional cooking technology. The results of this policy analysis suggest that even with considering conservative assumptions about the partial transition to clean cooking, there are significant benefits. Greater policy action will also enhance learning on which options are most effective for realizing the full potential of clean cooking energy and make a stronger case for increased investments to tackle global energy poverty.

PATH TO PROGRESS IN SCALING UP CLEAN COOKING: URGENT ACTION REQUIRED FOR UNIVERSAL ACCESS BY 2030

Sizeable gains have been made in certain regions to expand access to clean cooking solutions. China, Ghana, India, and Kenya have all emerged as some exemplars, showcasing advancements propelled by steadfast political endorsement, advocacy, and substantial financial allocations. This momentum underscores a palpable shift toward cleaner cooking practices, establishing a precedent for emulation by others.

Yet it is crucial to sustain the prominence of clean cooking on the global political agenda. With impending milestones such as the voluntary review of SDG 7, which includes clean cooking, at the High-Level Political Forum, along with other pivotal events and initiatives such as the Global Stocktaking for SDG 7 implementation in April 2024, the International Energy Agency's Summit on Clean Cooking in Africa in May 2024, and the World Bank's clean cooking fund, world leaders and governmental bodies have a critical opportunity to emphasize their commitment to clean cooking. Highlighting its vital role in promoting health, climate resilience, and various cross-cutting objectives, prioritizing clean cooking at these forums represents a unified effort to achieve a healthier and more sustainable future for all.

At the country level, integrating clean cooking into the Nationally Determined Contributions (NDCs) under the Paris Agreement provides a structured pathway to strengthen efforts to reduce GHG emissions, improve air quality, benefit ecosystems, and protect health. By setting specific targets for clean cooking in NDCs, countries can demonstrate their commitment to public health and environmental sustainability and leverage resources and climate finance mechanisms to support these efforts and achieve their goals. Access to clean cooking fuels and technologies also has a direct impact on food security. Institutional cooking, such as in schools and hospitals, would greatly benefit from clean cooking solutions. This would ensure that large-scale meal preparation emits less pollution, is more energy-efficient, and provides safe, nutritious meals to vulnerable populations to support better education and health outcomes.

Women and girls are disproportionately affected by household air pollution and the labor-intensive and time-consuming nature of fuel collection. Policies and interventions should prioritize gender-sensitive solutions that recognize and tackle the specific needs and challenges that women face in relation to household energy and empower them through involvement in educational or entrepreneurial activities and decision-making processes.

Governments, international organizations, and partners across sectors should prioritize investments in infrastructure and technology that promote the uptake and adoption of clean cooking solutions. It is crucial to develop comprehensive policy frameworks and subsidies/financial incentives to encourage the shift from traditional and polluting fuels and technologies to clean alternatives. This is particularly important in LMICs where the initial cost of clean fuels and technologies could be the biggest obstacle to the transition toward clean household energy. Moreover, raising public awareness of the health, social, economic, and environmental benefits of clean cooking is crucial to encourage positive behavior changes. Collaborative efforts that focus on scalable and sustainable policies and interventions across governments, nongovernmental organizations, the private sector, and communities are the key to achieving universal access to clean cooking by 2030 and bringing about long-lasting health, social, and climate benefits.

CLEAN AND POLLUTING FUEL USE FOR COOKING IN HIGH-INCOME COUNTRIES

The issue of access to clean cooking is typically associated with LMICs, as many of these places still rely heavily on polluting fuels and technologies for cooking. In high-income countries (HICs), however, clean cooking presents a slightly different set of challenges. While access to modern and efficient cooking fuels and technologies is generally high in these nations, the impacts of cooking still manifest in several ways.

Cooking is a contextualized system with no one-size-fits-all solution. Each country should have a customized approach to the clean cooking transition, taking into account its stage of economic development and progress in access to clean cooking (box 2.2). In HICs, the impacts of cooking also consider the efficiency and sustainability of fuels and technologies. For example, natural gas stoves release methane—a GHG that is 86 times more potent than carbon dioxide—through post-meter leaks and incomplete combustion (Lebel and others 2022; Balmes and others 2023). There has been a growing emphasis on lowering the carbon footprint of household cooking through adoption of technologies that are more energy efficient and the use of sustainable energy, such as stoves powered by electricity from renewable sources. Therefore, for HICs, in addition to ensuring universal access to clean cooking, there should also be a focus on decarbonizing cooking and setting a more ambitious pace for the transition to net zero than LMICs.

HICs play a crucial role in transitioning the cooking sector globally toward clean cooking and achieving net-zero emissions. They can contribute to the research and development of clean cooking technologies and support LMICs in accessing and adopting them. Investments in innovation and implementation can lead to the creation of more efficient, affordable, and user-friendly solutions that can benefit not only HICs but also support global efforts to address clean cooking challenges. Although clean cooking in HICs might not involve the lack of access seen in lower-income settings, it is intertwined with dimensions involving health, environment, and socioeconomic standing. Addressing these challenges requires a holistic approach encompassing policy intervention, consumer education, and technological innovation.

Box 2.2 • Estimating polluting fuel use in high-income countries

A recent analysis conducted by the World Health Organization estimated the percentage of the population relying on clean fuels and technologies for cooking among 59 high-income countries (HICs) in 2022. Using the Global Household Energy Model (Stoner and others 2020, 2021), results were modeled as a function of gross national income per capita and a model error. Preliminary analysis estimated that 98 percent of the population (1.19 billion people) in included HICs used clean fuels and technologies for cooking, while 2 percent of the population (24 million) still lacks access to clean cooking solutions. Although access to modern and efficient cooking fuels and technologies is generally high in HICs, universal access has not yet been reached. Additional efforts are needed to bridge the gap and ensure that no one is left behind.

ANNEX 1.

METHODOLOGICAL NOTES

Chapter 2. Access to clean fuels and technologies for cooking

DATA SOURCES

The WHO Household Energy Database contains nationally representative household survey data (WHO 2024). Regularly updated, it relies on several sources (table A1.1) and serves as the basis for all modelling efforts in this report. The database contains more than 1,600 surveys conducted in 171 countries (including high-income countries) between 1960 and 2022. A quarter of the surveys cover the years 2013 to 2018; 284 new surveys cover 2016 to 2022. Modeled estimates are provided only if there is underlying survey data on cooking fuels, so there are no estimates for Lebanon, Libya and Bulgaria.

Population data are from the United Nations Urbanization Prospects (2018).

TABLE 2.1 • OVERVIEW OF DATA SOURCES FOR CLEAN FUELS AND TECHNOLOGY

NAME	ENTITY	NUMBER OF COUNTRIES	DISTRIBUTION OF DATA SOURCES (IN PERCENT)	QUESTION
Census	National statistical agencies	109	18.4	What is the main source of cooking fuel in your household?
Demographic and Health Survey (DHS)	Funded by USAID; implemented by ICF International	82	17.2	What type of fuel does your household mainly use for cooking?
Living Standards Measurement Survey (LSMS), income expenditure surveys, and other national surveys	National statistical agencies, supported by the World Bank	26	3.00	Which is the main source of energy for cooking?
Multiple Indicator Cluster Surveys (MICS)	UNICEF	90	10.90	What type of fuel does your household mainly use for cooking?
Study on Global AGEing and Adult Health (SAGE)	WHO	6	0.40	NA
World Health Survey	WHO	50	3.80	NA
National surveys		117	35.80	NA
Other		84	10.30	NA

MODEL

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

- unprocessed biomass (e.g., wood)
- charcoal
- coal
- kerosene
- gaseous fuels (e.g., LPG)
- electricity

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

GHEM is implemented using the R programming language and the NIMBLE software package for Bayesian modelling with Markov chain Monte Carlo (MCMC). Summaries can be obtained to provide both point estimates (e.g., means) and measures of uncertainty (e.g., 95 percent credible and 95 percent prediction intervals). The GHEM is 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 specific polluting fuels and two specific clean fuels for cooking by country for each year from 1990 to 2019. Further details on the modelling methodology and validation can be found in Stoner and others (2020), and a more detailed analysis of individual fuel use can be found in Stoner and others (2021).

Only surveys with less than 15 percent of the population reporting “missing,” “no cooking,” and “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 (59 countries) in the 2022 fiscal year were assumed to have transitioned to clean household energy. They are, therefore, reported as having 100 percent access to clean fuel and technologies; no fuel-specific estimates were reported for high-income countries. In addition, no estimates were reported for low- and middle-income countries without data suitable for modelling (Bulgaria, Lebanon, and Libya). Modeled fuel-specific estimates were reported for 129 low- and middle-income countries plus 3 countries with no World Bank income classification (Venezuela, Niue, and Cook Islands); estimates of overall clean fuel use were reported for 191 countries.

UNCERTAINTY INTERVALS

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

Moreover, for some countries, a lack of recent survey data (e.g., in the last 10 years) naturally leads to very wide uncertainty intervals associated with estimates for 2022 and preceding years. For countries with very wide uncertainty intervals, point estimates should be treated with some caution.

GLOBAL AND REGIONAL AGGREGATIONS

Population data from the United Nations Population Division's World Urbanization Prospects (United Nations 2018) 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.

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

ANNUALIZED GROWTH RATES

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

$$(Access\ Rate\ Year\ 2 - Access\ Rate\ Year\ 1) / (Year\ 2 - Year\ 1)$$

This approach takes population growth into account by working with the final national access rate.

PROJECTIONS

Projected access rates, access deficits, and fuel use can be estimated using the GHEM, where uncertainty increases the further into the future estimates are calculated, reflecting how country trends may shift based on how unsettled they were during the data period.

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

ANNEX 2.
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