

More Than a Lightbulb

Five Recommendations to Make Modern Energy Access Meaningful for People and Prosperity

A Report of the Energy Access Targets Working Group

Summary

Energy is fundamental to modern life, but 1.3 billion people around the world live without "access to modern electricity." The current definition of modern energy access—100 kilowatt-hours per person per year—is insufficient and presents an ambition gap with profound implications for human welfare and national economic growth. This report summarizes the energy access problem, the substantial efforts underway to bolster power generation and access in the poorest regions, and highlights concerns about the specific indicators being used to measure progress. It then condenses a set of analytical and conceptual questions the working group grappled with, such as why and how to better measure energy usage and the multiple options that should be considered. The report concludes with five recommendations for the United Nations, International Energy Agency, World Bank, national governments, major donors, and other relevant organizations.

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Executive Summary

Energy is fundamental to modern life, but 1.3 billion people around the world live without "access to modern electricity." What exactly does that mean? The current commonly used definition is a mere 100 kilowatt-hours (kWh) per person per year for urban areas — just enough to power a single lightbulb for five hours per day and charge a mobile phone — and half as much in rural areas. Such a low bar can have profound implications for national targets, for international goals like Sustainable Development Goal 7, and on a wide range of critical investment decisions with long-term effects on development.

This report summarizes the energy access problem, the implications for both for human welfare and national economic growth, and the substantial efforts underway to bolster power generation and access in the poorest regions. It then condenses a set of analytical and conceptual questions the working group grappled with, such as why and how to better measure energy usage and the multiple options that could be considered. The report concludes with five recommendations for the United Nations, International Energy Agency, World Bank, national governments, major donors, and other relevant organizations.

- 1. Maintain the existing energy access threshold but rename it, more appropriately, the "Extreme energy poverty" line. The current 100 kWh per capita per year is a valuable initial indicator, but is the equivalent of an extreme poverty line rather than a measure of development success.
- 2. Measure and track household consumption at higher levels for "Basic energy access" and "Modern energy access." Thresholds should be added at 300 kWh per capita per year to capture basic household appliances and at 1,500 kWh to capture on-demand usage of multiple modern appliances within a household.
- 3. Create country categories of energy consumption to encourage ambitious national energy targets that go beyond household consumption. We propose categorizing countries by energy use per capita just as we do on average income per capita. The categories could be *Extreme low energy* (national average of less than 300 kWh per capita per year), *low energy* (300–1,000 kWh), *middle energy* (1,000–5,000 kWh), and *high energy* (more than 5,000 kWh).
- 4. Adopt these new thresholds to inform progress-tracking and investment decisions. These new household definitions and country categories could be used by the United Nations, the African Union, bilateral donors, the World Bank and regional development banks, the US government (e.g., for use in Power Africa monitoring and evaluation), and most especially by national governments.

5. Invest in data on energy consumption, utilizing new technology to improve

collection. Additional higher-quality data would allow a better understanding of energy use, help identify gaps, and enable better targeting of new investments.

Introduction

Access to energy is a building block of modern human progress. Energy is essential to the way humans work, eat, travel, communicate, and strive. Energy is fundamental to modern life.

1.3 billion people around the world do not have access to electricity.

The International Energy Agency (IEA) reports that 2.6 billion people depend on traditional biomass for cooking, while 1.3 billion people around the world remain without access to electricity. [1] According to the World Bank, between 2010 and 2012, some 222 million people gained access for the first time. [2] The globally agreed-upon Sustainable Development Goal number Seven (SDG 7) is to "Ensure access to affordable, reliable, sustainable and modern energy for all."

But what exactly does having "access to modern energy" (or not) actually mean? The extremes of access are easy to define. Someone living in a home with 24-hour electricity, heating and air conditioning on demand, refrigerated food, a car, phones and computers connected to the Internet—and working at a farm, factory, or office that has the same energy services—is a person living with what everyone would likely recognize as modern energy access. This person likely also has access to hospitals or clinics with 24-hour lighting, temperature control, refrigeration, and modern electricity-powered equipment. They likely get their food from supermarkets with refrigeration, freezers, and lighting. Their school and workplace likely have constant lighting, temperature control, computers, telecommunications, and everything else that defines a modern connected and productive life. This is an energy-rich person.

By contrast, someone who lives in darkness at night, cooks by wood or dung, travels solely on foot, and has no electronic communication is a person completely lacking modern energy access. Without access to energy-consuming technologies, their life is likely to be dominated by low-skilled, manual labor, subsistence farming, low productivity, and few prospects for the next generation. Their schools are lucky to have a roof, much less lights. Their local clinic probably has no reliable refrigeration for vaccines or medicines. This is an energy-poor person.

But where is the line between these two extremes? What threshold should define "modern energy access"? A physical connection to an electrical grid? A solar lamp? A diesel generator? A refrigerator? An air conditioner?

The definition of "modern energy access" is far too low: just enough for a lightbulb and a mobile phone.

The current commonly used definition of "modern energy access," per the IEA, is 100 kilowatthours (kWh) per person per year for urban areas and half this amount for rural areas. [3] That is enough for a city dweller to power a single light bulb for five hours per day and charge a mobile phone. Is that the appropriate threshold? Is this definition of modern energy access consistent with patterns of human energy consumption? Is this arbitrary line relevant to the aspirations of the world's energy poor? Is this definition useful to policymakers striving to expand electrification to underserved populations? Is a binary access estimate adequate at this level? Is this sufficient for global goals like the United Nations SDG 7?

The purpose of the Energy Access Targets Working Group is to grapple with these questions, to assess the current definitions, and to propose a better way forward that is more consistent with both human aspirations and the measurements that affect critical development policy decision making. Measuring energy access is difficult in itself. Precision is not the point. But such definitions have real-world effects, and the current approach of a single binary estimate at a low level of consumption could clearly be improved upon.

Notes

[1] IEA, "World Energy Outlook-Energy Access Database."

[2] SE4All, "Progress Toward Sustainable Energy," 3.

[3] OECD/IEA, "World Energy Outlook-Methodology for Energy Access Analysis."

The Scale and Implications of Energy Access Gaps

Energy poverty — a term used to describe a state of extremely low energy consumption — is endemic in most developing countries. This lack of access to energy takes different forms at different stages of development. In some countries, such as Liberia, electricity is a luxury for a handful of elites with private generators; in others, such as India, urban areas are covered but some rural populations remain unconnected to the grid. In South Africa and elsewhere, massive deficits in generation capacity mean rolling blackouts that cripple industry and household usage for hours at a time. But in each case, the lack of access to modern energy is both a symptom and a cause of underdevelopment.

The best available estimates of the scale of energy poverty are staggering: the IEA estimates that nearly 1.3 billion people globally lack access to electricity, and about half of these people live in sub-Saharan Africa. [1] While South Asia has far to go in reaching the "last mile" of its rural citizens, sub-Saharan Africa is both broadly and deeply energy poor: only 32 percent of the total population has "modern energy access" using even the minimal IEA definition. Even in urban areas, access averages only 59 percent. [2] While rates vary between and within countries, in at least 37 sub-Saharan countries, less than half the population has access to electricity. In extremely poor and postconflict countries — such as Liberia, South Sudan, and Sierra Leone — rates are less than 5 percent (see figure 1).

Figure 1

Rates of electrification in sub-Saharan Africa are low

Thirty-two percent of the population has "modern energy access" using even the minimal IEA definition.



Center for Global Development © Natural Earth

Source: OECD/IEA, "World Energy Outlook-Methodology for Energy Access Analysis" (2014).

For those whose homes or businesses are connected to an electrical grid, the actual flow of electricity is often sporadic and power outages frequent. Because of outdated and insufficient infrastructure, many countries do not generate enough electricity to meet growing demand, leaving actual consumption at extremely low levels. In the United States, annual per capita electricity consumption is 13,200 kWh. By contrast, the rate in India is 684 kWh and in Ethiopia, only 52 kWh. [3]

Human and Developmental Implications of Energy Access Shortages

The harm to people of living without electricity is very real. A major study on global disease burden in the *Lancet* estimated that indoor air pollution from biomass contributed to 3.5 million premature deaths per year. [4] In other words, cooking with wood or charcoal is killing more people worldwide than AIDS and malaria combined. Furthermore, some 60 percent of refrigerators used in health clinics have unreliable electricity, compromising the effectiveness of vaccines and pharmaceuticals used to fight these and other diseases. [5]

Living without power also affects education and human capital. Only 35 percent of primary schools in sub-Saharan Africa and 48 percent of primary schools in South Asia have electricity. [6] Not only does this preclude them from using modern learning tools like computers, it makes it difficult to provide adequate lighting, cooling or heating, or efficient meal programs to create a conducive learning environment. After school ends, students without electricity at home cannot study at night, decreasing learning hours and outcomes even further. [7], [8]

Women and girls bear the brunt of the added time and labor costs of living without electricity.

In households lacking electricity, women and girls tend to bear the brunt of the added time and labor costs, from collecting firewood to processing agricultural products. The efficiency gains from electricity access would allow girls more time for education and women to participate in the labor force at higher rates, earning more income and gaining a more empowered position within the household and society. An analysis of women in rural Brazil, for example, found that those with household access to electricity were 10 percent more likely to be employed than those without, and those with advanced energy appliances such as a washing machine were 6 percent more likely to be employed. [9], [10]

On a macroeconomic level, energy shortages are a massive drag on economic growth and job creation. While recent growth rates of African economies have been impressive, the African Development Bank (AfDB) estimates that the economic cost of power outages across the region can amount to more than 2 percent of gross domestic product (GDP) per year. [11] Similarly,

World Bank Group Enterprise Surveys have consistently pointed to the lack of reliable, affordable electricity as a top constraint on business expansion. [12] For instance, 76 percent of firms in Nigeria cite lack of electricity as the biggest constraint on their operations. This is not surprising since they lose 9 percent of annual sales owing to electricity outages, which occur on average 302 out of 365 days per year. [13]

This story of energy poverty should be a familiar one to many countries. As recently as 1930, only 1 in 10 rural Americans had access to electricity. In subsequent years, rapidly increasing power generation and electrical grid coverage across the country became a major pillar of the American battle against domestic poverty and a foundation for decades of economic growth and wealth creation. Today, energy access is universal in the United States. Reliable and affordable electricity is considered a basic necessity of life — an indispensable input to almost every aspect of modern living. This holds true for countries as diverse as Canada, Spain, Singapore, France, Australia, UAE, Chile, and South Korea.

Figure 2



Electricity consumption in Kenya and Nigeria lags far behind Thailand and Vietnam

Source: World Bank, World Development Indicators (2015).

Many later-industrializing nations have likewise completed successful electrification campaigns. China extended access to more than 650 million people in only 20 years, in the process achieving a rural access rate of 97 percent. [14] Brazil went from approximately 45 percent to nearly 100 percent access in the last four decades. [15] In Vietnam, just 1.2 million people had access to electricity in 1976, but by 2009, 82 million Vietnamese were connected to the grid (see figure 2). [16] That same transformation is possible today in large parts of the developing world. But it will require concentrated and sustained focus from governments, the private sector, and global supporters to create the governance environment and to make sufficient investments to close the gaps.

Notes

- [5] Gavi, the Vaccine Alliance, "National Ownership of Innovative Supply Chain Technologies."
- [6] Corbyn et al., Poor People's Energy Outlook, 17.
- [7] Millinger, Mårlind, and Ahlgren, "Evaluation of Indian Rural Solar Electrification."
- [8] ESMAP, "Rural Electrification and Development in the Philippines."
- [9] O'Dell, Peters, and Wharton, "Women, Energy, and Economic Empowerment."
- [10] Dinkelman, "The Effects of Rural Electrification on Employment."
- [11] African Development Bank Group. "Africa's Chronic Power Problems Have Escalated into a Crisis Affecting 30 Countries."
- [12] Ramachandran, Gelb, and Shah, Africa's Private Sector.
- [13] World Bank Group, "Enterprise Surveys: Infrastructure."
- [14] Peng and Pan, "Rural Electrification in China," 72.
- [15] Bazilian and Pielke Jr, "Making Energy Access Meaningful," 77.
- [16] World Bank, "One Goal, Two Paths," sec. A.1.7.

^[1] IEA. "Energy Access Database."

^[2] Ibid.

^[3] World Bank, "World Development Indicators."

^[4] Lim et al., "A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors and Risk Factor Clusters in 21 Regions, 1990–2010."

Efforts Under Way

Most important of all, the goal of achieving universal energy access has gained a strong foothold within the domestic agendas of many developing country governments. India's 12th Five Year Plan projects an additional 80,000 megawatts in generation capacity by 2017. [1] In Kenya's national energy policy, the government has set a goal of achieving 100 percent rural access by 2020 from a 6.7 percent baseline. [2],[3] The Private Sector Power Generation Project, a Kenyan government package of incentives begun in 2010, has already attracted a substantial financing package from the World Bank Group and private investors.

Governments, business leaders, and citizens agree: energy access is central to health, education, and jobs.

Fortunately, aggressive internal efforts such as these have encouraged stronger alignment among current global economic and political agendas to fight energy poverty. [4] The invigorated focus on energy on the development agenda is a positive step reflecting what governments, business leaders, and citizens across the developing world agree on: increasing access to energy is a top priority and central to solving other challenges in health, education, and job creation.

The first set of UN Millennium Development Goals (MDGs) acknowledged energy's role in development but left energy access as an implicit step toward reaching other targets. Modi et al. (2005) quantified the explicit linkages between energy services and each of the human MDGs — from poverty and gender educational disparity to health service deficits. [5] Increasingly, such arguments have brought attention to the investments needed to accelerate the closing of the yawning gap in energy consumption. The United Nations SDGs have proclaimed that "a new agenda will need to set out the core elements of sustainable lifestyles that can work for all." [6] SDG 7 is meant to "ensure access to affordable, reliable, sustainable, and modern energy for all." [7] SDG Target 7.1 is slightly more precise: "By 2030, ensure universal access to affordable, reliable and modern energy services."

Other multilateral agendas have also increased their focus on energy. The World Bank and United Nations have launched a Sustainable Energy for All (SE4All) initiative, which aims to bring universal access by 2030. The World Bank within its own lending portfolio has been investing heavily in energy projects and infrastructure more broadly, as have all the multilateral development banks (MDBs) (see figure 3). At the AfDB, for example, the regional bank most engaged on energy poverty's front lines, power is a top priority and was the largest sector by approval amount in 2014. [8] The high demand for this kind of investment is also reflected in the emergence of the Asian Infrastructure Investment Bank (AIIB), a China-led institution that has attracted global membership and significant capital to fill the infrastructure gap, including for energy generation and electrification, in Asia. Other regionally focused bodies have also taken action, such as New Partnership for Africa's Development (NEPAD), the African Union's technical body, which launched the Africa Power Vision to "accelerate the implementation of critical energy projects" across Africa. [9]

Figure 3



Multilateral development banks are investing heavily in energy projects

Specific government support for energy projects has also grown. For example, in June 2013, US President Barack Obama launched Power Africa, the signature initiative of his administration in the region. The multiagency US government effort was further expanded in 2014 with the goal of boosting generation by 30 gigawatts and providing first-time access to 60 million homes or businesses through a mix of public- and private-sector tools. These highly ambitious goals translate into covering some 300 million Africans, or roughly half of those currently living without electricity. Initial public resource commitments total \$7.3 billion — principally from the US Export–Import Bank and the Overseas Private Investment Corporation (OPIC), plus some US Agency for International Development (USAID) technical assistance — as well as \$20 billion in private capital pledges from power development companies and investors. The initiative has also leveraged additional interest and investment from other multilateral and bilateral actors, such as \$5 billion from the World Bank and \$1 billion from Sweden. [10] Other governments have similarly boosted their efforts on power, including new investments in the sector in sub-Saharan Africa by China, Turkey, the United Kingdom, France, the European Union, and Japan, among others.

Source: 2014 MDB annual reports.

Notes

[5] Modi et al., "Energy Services for the Millennium Development Goals."

[6] "A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development."

[7] United Nations, "Open Working Group Proposal for Sustainable Development Goals."

[8] African Development Bank Group, "Annual Report 2014," xii.

- [9] NEPAD, "Africa Power Vision Launch in Addis Ababa and Washington, D.C."
- [10] The White House, "FACT SHEET: Powering Africa."

^[1] Government of India Planning Commission, Twelfth Five Year Plan (2012-2017), 136.

^[2] Republic of Kenya Ministry of Energy and Petroleum, "Draft National Energy Policy," 87.

^[3] World Bank, "World Development Indicators."

^[4] In the past year, bilateral programs such as the UK's Energy Africa campaign and France's Énergie Pour l'Afrique have been launched to mobilize investment to achieve sustainable and modern energy access in Africa. These campaigns have complemented similar multilateral initiatives like the United Nations' Sustainable Energy for All (SE4All) and the African Development Bank's New Deal on Energy for Africa.

Shortcomings of Current Data and Targets

The growing attention to energy access as a development priority has been built largely on a single statistic: the proportion of the population with access to electricity. Understanding the scope of the access gap is motivating for policymakers and useful for practitioners in targeting their efforts. However, the data behind energy-access statistics, reported by the IEA, are limited and potentially misleading. The IEA's compilation of sources includes the USAID-supported Demographic and Health Surveys (DHS), the World Bank's Living Standards Measurement Surveys (LSMS), national statistics agencies, and other sources in a "network of contacts" at various international agencies. [1] When using such a variety of sources, the definition of access is inherently muddled, absent a clear and universal standard that is comparable across countries. When policymakers and researchers (including ourselves) cite the statistic that 32 percent of sub-Saharan Africa has access to electricity, it remains unclear what kind of access those 32 percent really have. Is access based on self-reporting or a physical power-line connection? Or does it matter how much (if any) electricity flows through that connection? Does owning a generator count as access? [2]

Thirty-two percent of sub-Saharan Africans have access to electricity, but it's unclear what kind of access people really have.

There are also shortcomings with World Bank consumption data. Measuring consumption of electricity and other energy sources is another — and arguably superior — option for exploring the scope of energy poverty. Electricity use per capita as reported by the World Bank covers more countries than the IEA's access statistics. These data also provide a more useful comparison with energy-rich or developed countries since the 100 percent upper bound (inherent in binary access) severely limits disaggregated analysis. However, the current World Bank data on per capita consumption are not as relevant to individuals or households as they might initially appear. The World Bank explains that it measures electricity consumption per capita by measuring a country's total power generation, minus estimates of distribution losses, divided by population. This methodology is problematic because, first, it includes significant nonhousehold uses of energy, such as consumption by commercial enterprises. Although commercial uses of electricity are highly valuable, their inclusion masks the picture of individual access. Using a global average, households use just 30 percent of national electricity generation. [3] Second, national per capita averages obscure the inequality in distribution of access and consumption. [4] In Liberia, for example, average consumption is very low: 79 kWh per person per year. But even this number fails to illustrate the fact that the majority of consumption is driven by a handful of elites with private generators, while the remaining population essentially consumes zero electricity. In Monrovia, less than 1 percent of the population has access to public utility electricity, while public electricity utilities are wholly unavailable outside of the capital. [5]

Neither of these indicators effectively addresses the underlying purpose of electricity, which is to enable the use of energy services — lighting, cooking, refrigeration, heating and cooling, and communicating — that improve quality of life and serve productive economic purposes. Nor do these indicators incorporate the delineation between access to electricity and access to energy more broadly, which would also include fuel sources like kerosene or natural gas, which are often more cost-efficient for cooking or heating, or gasoline or diesel for transportation. For the purposes of this report, we focus primarily on electricity.

Realizing these limitations, new efforts have sought to create a better measurement tool for energy access. The SE4All Global Tracking Framework, managed by the World Bank's Energy Sector Management Assistance Program (ESMAP), introduced a multitier framework to measure energy access in 2013. Their five-tier system is based on energy services — not only binary access or average electricity consumption — with each tier allowing for operation of increasingly energy-intensive appliances (see figure 4). Pilot surveys in the Democratic Republic of the Congo, Uganda, and India using the multitier framework have revealed vast discrepancies between binary reporting of access and real access on the ground. [6] Thanks to the World Bank's prominent role in providing global public data, this measurement system will likely prove to be a strong analytical tool. But if it is to become a tractable global access target, the World Bank's energy-access levels need to be translated into simpler terms that governments and citizens can easily grasp (e.g., "Universal energy access" is more saleable than "Move from ESMAP Tier 3 to ESMAP Tier 5").

Figure 4

			Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
A t t r i b u t e s	1. Peak capacity	Power		Very low power ≥5 W	Low power ≥70 W	Medium power ≥200 W	High power ≥800 W	Very high power ≥2 kW
		Daily capacity		≥20 Wh	≥270 Wh	≥1.0 kWh	≥3.4 kWh	≥8.2 kWh
	2. Duration	Hours per day		≥4 hrs		≥8 hrs	≥16 hrs	≥23 hrs
		Hours per evening		≥2 hrs		≥2 hrs	≥4 hrs	≥4 hrs
	3. Reliability				≤3 disruptions per day	≤7 disruptions per week	≤3 disruptions per week of total duration <2 hrs	
	4. Quality					Voltage problems do not prevent the use of desired appliances		
	5. Affordability					Cost of a standard consumption package of 365 kWh per annum is <5% of household income		
	6. Legality					Bill is paid to the utility / prepaid card seller / authorized representative		
	7. Health and safety					Absence of past accidents and perception of high risk in the future		

Multi-tier Matrix for Access to Household Electricity Supply

Source: Adapted from Sustainable Energy for All, "Progress Toward Sustainable Energy: Global Tracking Framework 2015 Key Findings," 175.

Even with a clear target, the multi-tier framework is only part of the solution for mitigating the data gap in energy access. SE4All plans to expand the surveying exercise to additional countries and has proposed incorporating select questions into broader representative household surveys such as the DHS. However, adding a full module of the framework in enough countries to match the coverage of IEA access indicators would be prohibitively costly and take years to generate enough data from which to draw global conclusions. New technologies, such as remote sensing of electric utilities or mobile phone surveys, offer potential cost- and time-saving alternatives for gaining a more nuanced understanding of household electricity access. Similarly, researchers have proposed the new Multidimensional Energy Poverty Index (MEPI) as a way to capture deprivation of access to energy services. [7] But regardless of the measurement tool, establishing a relevant standard definition and threshold for modern energy access is an essential first step.

Notes

[1] IEA, "World Energy Outlook: Energy Access Database."

[2] The IEA itself is unclear on what it is reporting. The methodology annex reports, "Access to electricity involves more than a first supply to the household; our definition of access also involves consumption of a specified minimum level of electricity, varying based on whether the household is in a rural or an urban area, which increases over time. The initial threshold level of electricity consumption for a rural household is assumed to be 250 kilowatt-hours (kWh) per year and for an urban household it is 500 kWh per year. The higher consumption assumed in urban areas reflects specific urban consumption patterns. Both are calculated based on an assumption of five people per household.... Our definition is intended to be supportive of the objective to conduct forward-looking projections, but data availability means that it is not viable to apply it to our estimates of the number of people that do not currently have access to modern energy services. This definition cannot be applied to the measurement of actual data simply because the level of those that do not have access to electricity and those that rely on the traditional use of solid biomass for cooking. This is disaggregated (either with data or estimation) between those in urban and rural areas within a given country. This level of reporting is far from optimal but is driven by severe data limitations." See "World Energy Outlook — Methodology for Energy Access Analysis" at http://www.worldenergyoutlook.org/media/weowebsite/EnergyAccess_Methodology_2014.pdf .

[3] Author calculations using US Energy Information Administration (EIA) and UN Statistics Division data for a sample of 31 countries, which includes all countries with available data since 2011. See Appendix Table 3.

[4] A potential third shortcoming is that average consumption tells us little about availability or duration.

[5] World Bank, "Options for the Development of Liberia's Energy Sector," 7.

[6] World Bank and International Energy Agency, "Progress Toward Sustainable Energy 2015," 179.

[7] Nussbaumer, Bazilian, and Modi, "Measuring Energy Poverty."

Analysis and Deliberations of the Working Group

The Working Group considered a wide range of issues and questions. A brief summary includes the following:

Why bother to set targets? Specific measurable targets have the dual purpose of raising awareness and tracking progress. However, any meaningful energy access goals must reflect both the latent demand for modern energy and an allowance for future growth to that level. And because the push for energy access involves major infrastructure investments, aiming too low has potentially negative long-term consequences. An "ambition gap" in access targets thus threatens to waste an opportunity to build an energy system that will power the kind of development we hope to see and which countries also expect of themselves. [1]

Should we consider access to electricity or all types of energy? Energy access is, of course, much broader than just electricity access. Many people use energy for heating, cooking, and transportation from sources other than electricity, such as gas, biofuels, or diesel. However, for the sake of simplicity in considering modern energy access targets, the Working Group chose to focus largely on electricity.

What's wrong with the current access threshold? Per capita kilowatt hours is a very abstract notion. Once the energy services enabled by 100 kWh per person per year are made clear (see, for example, figure 5), it becomes obvious that the current definition is simply too low to qualify as "modern." If one believes that targets have any meaning — that they potentially affect the behavior of people, policymakers, and investors — then having insufficient targets could influence decisions in a harmful way. This is especially true for infrastructure development because of the high cost and long-term nature of such investments. As an extreme example, if a country aimed to provide just 100 kWh per person, then it would make investments in certain technologies and systems that could create path dependency that might not allow for energy consumption at higher levels conducive to future consumer demand or economic activities. In plain terms, for the foreseeable future, no one will be able to run a factory on a solar lamp.



Ownership of energy-intensive assets such as fridges is low across Africa

Source: Demographic and Health Surveys (Ethiopia, 2011; Ghana, 2008; Kenya, 2008; Liberia, 2009; Nigeria, 2013; Tanzania, 2010) beta.statcompiler.com

Is the current threshold just an initial step on the energy ladder? The World Bank's ESMAP framework is helpful in suggesting that people move up an "energy ladder," starting with simple basic energy services and then graduating to higher-energy uses as conditions (e.g., income, urbanization, and economic opportunity) change. Some of the IEA language also suggests that the 100 kWh level is just an "initial threshold level" with expectations that demand will rise. [2] However, a source of confusion is that these same estimates are being (mis)used simultaneously as the definition for "modern energy access."

Should any threshold be global/universal or national/local/context-specific? There are inherent tensions in setting a useful universal goal for both South Sudan and South Africa, for example. Clearly, any national planning exercise for building a modern energy system must start from the current local conditions, national priorities, and the economic and other policy choices that nations must make. At the same time, there is value in providing a global universal definition

that is comparable across countries. For exercises such as the SDGs, World Bank tracking or even a common popular understanding of a useful and dignified definition of "modern energy access" seems worthwhile.

What to measure? (Or, why consumption?) There are multiple ways to measure energy, such as physical connections, total electricity generation, and energy services, accounting for efficiency improvements and various metrics of affordability and reliability. In the end, however, one single measure stands above the others because it captures all these aspects: consumption. Kilowatt hours per capita is a fairly reliable proxy for all these other measures. [3] There is, moreover, a strong correlation between human well-being and energy consumption (see figure 6, below).

Should we target averages, medians, or head counts above a specific threshold? Similar to the income and poverty measurement debates (between measuring average GDP per capita, median gross national income [GNI], or poverty head counts [4]), energy consumption could be measured in multiple ways. A single national access rate would fail to account for the quality and reliability of the energy supply. And while average per capita consumption has become a standardized metric for access, it cannot capture stark inequalities in modern energy usage within a country. For the purpose of defining "universal access to modern energy," the preferred measure is the percentage of a country's population above a specific level (or levels) of access. For the purpose of national energy targets, however, per capita generation may be more applicable.

Should any goal be for household use, or should it include industrial and commercial uses too? Measuring binary household connections or solely household consumption captures only a partial share of energy use in a country. At the same time, the current per capita measurements use national electricity generation divided by population, thereby vastly overestimating household use. For most countries, households use 25–35 percent of total national energy consumption; the global average is approximately 30 percent. [5] Household consumption may be the most visible use of energy, yet industrial and commercial uses are typically what governments have in mind for job creation and economic growth. Moreover, much household end-use consumption is enabled by less visible but much larger nonhousehold uses. For example, the energy required to charge a cell phone or run a laptop computer may be modest, but much greater energy supplies are needed to allow those items to function, such as those that power cell phone towers and Internet servers. Thus, for national energy targets, it seems most sensible to include uses beyond the household.

How best to define meaningful levels? The Working Group discussed multiple ways to estimate meaningful levels of electricity consumption that might provide a reasonable threshold:

• *Simple round numbers.* The international poverty line of US\$1 per day (recently adjusted to \$1.90 on purchasing power parity [PPP] exchange rates [6]) caught on in part because of its simplicity. This principle applies to 100 kWh or 1,000 kWh per capita thresholds as well, but on its own, it is largely devoid of any significance.

- *Complex econometric analysis.* Statistical analysis of energy consumption and other outcome indicators could be used to find possible discontinuities or thresholds (see Appendix Table 1 for a summary of studies).
- *Correlations with development outcomes we care about.* Energy consumption could be correlated with health, education, and other social and economic indicators that we understand as desirable development outcomes. The single simplest example of this is the United Nations Development Programme's Human Development Index (HDI), which is a composite of life expectancy at birth, mean years of education, and GNI per capita. [7] In use since 1990, the HDI is widely incorporated in economic studies as a proxy for development and human welfare and has a high level of international legitimacy. According to Pasternak (2000), a 0.9 score on the HDI correlates with electricity consumption of approximately 4,000 kWh per capita per year. [8] Looking at the most recent data, Cuba is the only country in the world that has managed an HDI score above 0.8 with per capita energy consumption below about 3,000 kWh/year (figure 6). [9] At the same time, no country with per capita energy consumption of more than 7,000 kWh/year falls below 0.8 on the HDI.

Figure 6



Higher electricity consumption is correlated with higher development and human welfare indicators

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Source: UNDP Human Development Index (2013); World Bank, World Development Index (2013).

A nutrition basket model. The United Nations calculates the nutritional requirements of the human body based on age, height, weight, and gender to estimate daily intake of calories.
 [10] For household use, a simple similar energy estimate might sum up the possible energy uses per year for basic household electricity (e.g., to run lights, fan, radio, shared refrigerator, shared television, and other appliances). This figure might equal 300–1,500 kWh per capita for individual use.
 [11] As a national generation goal, this approach would yield targets of 1,000–5,000 kWh per capita.

Notes

[1] Bazilian and Pielke, "Making Energy Access Meaningful."

[2] OECD/IEA, "World Energy Outlook: Methodology for Energy Access Analysis," note 25.

[4] Birdsall and Meyer, "The Median Is the Message."

[5] Ibid, note 30. The sample range was from 57 percent for Ghana to 14 percent for Korea, with an unweighted sample average of 30 percent. See also Appendix Table 3.

[6] World Bank, "FAQs Global Poverty Line Update."

[7] UN Development Programme Human Development Reports, "Human Development Index (HDI)."

[8] Pasternak, "Global Energy Futures and Human Development," 5.

[9] The HDI combines life expectancy, years of schooling, and income per capita. See Human Development Index and Its Components," http://hdr.undp.org/en/content/human-development-index-hdi. (Note that Iceland [HDI: 0.895, kWh/capita/year: 52,373] has been excluded from the graph.)

[10] Food and Agriculture Organization of the United Nations, "Human Energy Requirements," sec. 5.4.

[11] This basket could be adjusted in the future based on changing consumer expectations and trends in energy efficiency. For example, if a low-energy refrigerator or air conditioner became widely available, the energy required for a consumption basket could be adjusted downward.

^[3] Solely counting consumption does not, of course, account for waste or inefficiency. However, in contexts of extremely low consumption, this is a second-order issue. No reasonable expectations of efficiency gains will suffice in countries at the lowest levels of generation. Similarly, many people rely on forms of energy other than electricity for heating, cooking, and other tasks. For this report, we focus principally on electricity.

Conclusions: Five Recommendations for Tracking Energy Access

Given the shortcomings of the current approach to defining and measuring modern energy access, the United Nations, IEA, World Bank, national governments, major donors, and other relevant organizations should consider the following recommendations:

- 1. Maintain the existing energy access threshold but rename it, more appropriately, the "Extreme energy poverty" line. The current use of 100 kWh per person per year remains valuable as an indicator for the initial rung on the energy ladder. But this level of energy consumption could be more fittingly titled to clarify that it is consistent with the usage of only very basic lighting and a phone charger. This is the notional equivalent of the extreme poverty line when measuring income merely a bare minimum starting point rather than the finish line of development success.
- 2. Measure and track household consumption at higher levels for "Basic energy access" and "Modern energy access." Instead of the current single low-level definition, access to energy should be measured at consumption thresholds that balance the competing needs of target simplicity and alignment with evidence of energy demand and historical development patterns. Just as the international community attempts to measure income at different levels, such as by calculating the income required to be "middle class," a similar approach should apply to energy access. Therefore, in addition to estimating the population above the 100 kWh per person per year extreme energy poverty line, the following two measurements should be added:
 - *Basic Energy Access at 300 kWh/person/year*, which would enable running basic appliances, such as a fan, a shared refrigerator, or a television, that are commonly in demand once families have modest additional income [1]
 - *Modern Energy Access at 1,500 kWh/person/year*, a level of consumption consistent with the label "modern" that includes on-demand usage of multiple modern appliances, including air conditioning
- 3. Create energy-level country categories to encourage ambitious national energy targets that go beyond household consumption. Modern competitive economies require high levels of energy, the vast majority of which is consumed outside households, in the commercial and industrial sectors. Just as countries are categorized as low, lower middle, upper middle, and high income, energy categories could be established for:
 - Extreme low energy (national average of less than 300 kWh/person/year)
 - Low energy (300-1,000 kWh/person/year)

- Middle energy (1,000-5,000 kWh/person/year)
- *High energy* (greater than 5,000 kWh/person/year)

These recommended levels are not intended to be precise but rather to give a suggested order of magnitude that is consistent with the evidence and historical trends. These proposed country thresholds are also consistent with the proposed household definitions above, assuming that global average household energy consumption amounts to 30 percent of national energy use. Were these categories to be adopted, the current global picture would approximate figure 7 below and table 2 in the appendix.

Figure 7

Energy Use Is Highly Correlated with a Country's Income Category Size represents population.



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Source: World Bank, World Development Indicators (2013).

- 4. Adopt these new thresholds to inform progress-tracking and investment decisions. Most immediately, the UN Statistical Commission's Inter-agency and Expert Group on Sustainable Development Goal Indicators should measure energy access for Indicator 7.1.1 at both the extreme energy poverty line (100 kWh/person/year) and at least one of the higher household levels (300 kWh or 1,500 kWh). These new household definitions and country categories could also be adopted by the African Union, the World Bank and regional development banks, bilateral donors, the US government for use in Power Africa monitoring and evaluation, and most especially, by national governments in formulating their own plans for building modern energy systems to serve their populations and their economies.
- 5. Invest in data collection on energy consumption, utilizing new technology to improve collection. This project would include adding energy questions across existing surveys and much greater use of new technologies to collect data, potentially including mobile phone polling, geocoded household surveys, satellite mapping, and other emerging applications. Such approaches would enable collection of actual information about household consumption via surveys and foster better understanding of which methods are robust and which are highly imperfect. Additional higher-quality data would ensure a better understanding of energy use, help identify gaps in access, and enable better targeting of new investments.

Notes

^[1] This level is roughly equivalent to SE4All's Multitier Global Tracking Framework Tier 4, and suggestive based on a reasonable consumption basket using the current technologies available. As per footnote 47, however, this standard could be revisited in the future if large technological or energy efficiency gains took place.

Model	Estimate terminology	kWh/cap/year*	Methodology	Household needs
Goldemberg, et al. (1985)	Energy for basic human needs	8766 total; 3506 noncommercial	Incorporates direct electricity and fuel needed to meet basic human requirements, including direct residential and indirect commercial consumption needs	Direct Residential: cooking, hot water, refrigeration, lights, TV, clothes washer; Indirect residential: transportation, manufacturing, agriculture, mining/construction
Pasternak (2000)	Electricity threshold for maximum HDI	4000	Human Development Index is plotted against annual per-capita electricity consumption, value of consumption that maximizes HDI (at 0.9) set as threshold	N/A
Pachauri and Spreng (2002)	Energy Poverty Line	4383	Aggregates energy consumption across urban and rural households, using Indian consumption data as basis, incorporating direct and indirect consumption.	Lighting, cooking, hot water, refrigerator, radio, TV
Pachauri and Spreng (2004)	Energy Poverty Line	2360 (rural)	Breaks down estimates above for rural consumption	
Chidebell- Emordi (2014)	Minimal energy poverty line	3068 (urban)	Survey data from Nigeria. Estimates requirements for basic household energy needs	Five light bulbs, a refrigerator, three fans, a television, a radio, a DVD player, an iron, a two-plate electric cooker, other tasks at sunset
Sierra Club (2014)	Access to energy (Tier 2)	10	Projects energy efficiency improvements to household appliance usage in tiered model	General lighting, TV, fan
Prayas (2015)	Dignified living	2344	Multiple estimation approaches for the year 2031	N/A
IEA Standard	Modern energy access	100 urban; 50 rural	N/A	N/A
ESMAP	Annual consumption level for energy access (Tier 4)	250	Multi-tier matrix of energy services and appliances available at each level, multiplied by daily use estimates	Task lighting, general lighting, phone charging, radio, fan, television, food processing, washing machine, refrigerator, iron

APPENDIX Table 1: Summary of Studies Estimating Energy Access Requirements

* Assumes five individuals per household for household-level models.

Table 2: Income Levels and Proposed Energy Categories by Country

	Low Income Countries Lower Middle Income Countries Upper Middle Income Countries (< \$1,045 per capita) (\$1,046-\$4,125) per capita (\$4,126-\$12,735 per capita)		ries a)	High Income Countries (> \$12.736 per capita)				
High energy (>5,000 kWh/capita)			Kazakhstan Montenegro			Australia Austria Bahrain Belgium Canada Czech Republic Denmark Estonia Finland France Germany Greece Iceland	Ireland Israel Italy Japan Korea, Rep. Kuwait Luxembourg Netherlands New Zealand Norway Oman Qatar Russia	Saudi Arabia Singapore Slovak Republic Slovenia Spain Sweden Switzerland Trinidad and Tobago United Arab Emirates United Kingdom United States
Middle energy (1,000–5,000 kWh/capita)		Armenia Egypt Georgia Kosovo Kyrgyz Rep. Moldova Tajikistan Ukraine Uzbekistan Vietnam	Albania Algeria Argentina Azerbaijan Belarus Bosnia & Herzegovina Botswana Brazil Bulgaria China Colombia Costa Rica Cuba	Dominican Rep. Ecuador Gabon Iran Iraq Jamaica Jordan Lebanon Libya Macedonia Malaysia Mauritus Maxico	Mongolia Namibia Panama Paraguay Peru Romania Serbia South Africa Thailand Tunisia Turkey Turkmenistan	Chile Croatia Cyprus Hungary Latvia Lithuania Malta Poland Portugal Uruguay Venezuela		
Low energy (300–1,000 kWh/canita)	Mozambique Zimbabwe	Bolivia Nicaragua Ghana Pakistan Guatemala Philippines Honduras Sri Lanka India Yemen, Rep. Indonesia Zambia Morocco	El Salvador					
Extreme low energy (<300 kWh/capita)	Congo DR Eritrea Ethiopia Haiti Tanzania Nepal Togo	Bangladesh Kenya Cambodia Myanmar Cameroon Nigeria Congo, Rep. Senegal Côte d'Ivoire Sudan	Angola					

Country	Total Household Consumption, kWH (billions)	Net National Consumption, kWh (billions)	Household/National ratio
Korea, Rep.	64.13	450.24	0.14
Slovak Republic	4.55	26.55	0.17
Poland	26.05	137.73	0.19
Italy	68.09	311.30	0.22
Mexico	47.52	212.40	0.22
Germany	122.52	543.75	0.23
Brazil	106.83	455.73	0.23
Czech Republic	14.24	60.41	0.24
Romania	11.79	49.98	0.24
South Africa	51.94	218.20	0.24
Austria	17.38	65.08	0.27
Finland	22.91	85.06	0.27
Canada	151.20	543.73	0.28
Mauritius	0.72	2.43	0.29
Iran	56.69	186.17	0.30
Portugal	14.90	48.62	0.31
Latvia	2.01	6.52	0.31
Hungary	11.50	36.74	0.31
Japan	312.02	994.80	0.31
Uruguay	2.96	9.32	0.32
Spain	78.38	245.99	0.32
Bulgaria	10.61	31.60	0.34
Ireland	8.76	24.58	0.36
Norway	40.47	113.16	0.36

Table 3: Ratio of Household Electricity Use to National Electricity Consumption by Country

United Kingdom	119.31	320.21	0.37
Albania	1.94	5.19	0.37
United States of America	1,512.28	3886.40	0.39
Croatia	6.27	15.73	0.40
Philippines	23.42	56.84	0.41
Bolivia	3.09	6.46	0.48
Ghana	3.77	6.62	0.57

Note: This table represents all countries with available household census data after 2010. The most recent year represented is 2011.

Sources: World Energy Council, EIA International Energy Statistics; UN Statistics Division Demographic Yearbook; authors' calculations.

References

African Development Bank Group. "Africa's Chronic Power Problems Have Escalated into a Crisis Affecting 30 Countries. This Tolls Heavily on Economic Growth and Productivity." *Africa Infrastructure Knowledge Program*, 2011. http://www.infrastructureafrica.org/key-msg/sector/africa%E2%80%99s-chronic-power-problems-have-escalated-crisis-affecting-30-countries-crisis--1.

-------. "Annual Report 2014." Abidjan, Côte D'Ivoire: 2015. http://www.afdb.org/en/documents/document/annual-report-2014-53328/.

"A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development." United Nations, 2013. www.un.org/sg/management/pdf/HLP_P2015_Report.pdf.

Bazilian, Morgan, and Roger Pielke Jr. "Making Energy Access Meaningful." *Issues in Science and Technology* 29, no. 4 (Summer 2013). http://issues.org/29-4/making-energy-access-meaningful/.

Birdsall, Nancy, and Christian Johannes Meyer. "The Median Is the Message: A Good-Enough Measure of Material Well-Being and Shared Development Progress." Working Paper No. 351. Center for Global Development, January 23, 2014. http://papers.ssrn.com/abstract=2383977.

Corbyn, Drew, Mattia Vianello, Katie Welford, Helen Morton, Lucy Stevens, Astrid Bourne, Nipunika Perera, and Laya Taheri. *Poor People's Energy Outlook*. Practical Action Publishing, 2013.

Dinkelman, Taryn. "The Effects of Rural Electrification on Employment: New Evidence from South Africa." *The American Economic Review* 101, no. 7 (2011): 3078–108.

Energy Sector Management Assistance Programme (ESMAP). "Rural Electrification and Development in the Philippines: Measuring the Social and Economic Benefits." Report 255/02. The World Bank, May 31, 2002.

http://documents.worldbank.org/curated/en/2002/05/2087958/rural-electrification-development-philippines-measuring-social-economic-benefits.

Food and Agriculture Organization of the United Nations. "Human Energy Requirements: Report of a Joint FAO/WHO/UNU Expert Consultation." FAO Food and Nutrition Technical Report Series 1. Rome, October 17–24, 2001. http://www.fao.org/docrep/007/y5686e/y5686e08.htm.

Gavi, the Vaccine Alliance. "National Ownership of Innovative Supply Chain Technologies," Partners Forum 2012 Session. http://www.gavi.org/library/pf2012-sessions/11-%E2%80%93-national-ownership-of-innovative-supply-chain-technologies/.

Government of India Planning Commission. *Twelfth Five Year Plan (2012–2017): Three Volume Set.* SAGE Publications, 2013.

International Energy Agency. "World Energy Outlook: Energy Access Database." 2015. http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/.

Lim, Stephen S, Theo Vos, Abraham D Flaxman, Goodarz Danaei, Kenji Shibuya, Heather Adair-Rohani, Mohammad AlMazroa, et al. "A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors and Risk Factor Clusters in 21 Regions, 1990– 2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *The Lancet* 380, no. 9859 (2010): 2224–60. doi:10.1016/S0140-6736(12)61766-8.

Millinger, M., T. Mårlind, and E. O. Ahlgren. "Evaluation of Indian Rural Solar Electrification: A Case Study in Chhattisgarh." *Energy for Sustainable Development* 16, no. 4 (December 2012): 486–92. doi:10.1016/j.esd.2012.08.005.

Modi, Vijay, Susan McDade, Dominique Lallement, and Jamal Saghir. "Energy Services for the Millennium Development Goals." International Bank for Reconstruction and Development/The World Bank and the United Nations Development Programme, 2005: xii, 104. http://unmillenniumproject.org/documents/MP_Energy_Low_Res.pdf.

New Partnership for Africa's Development (NEPAD). "Africa Power Vision Launch in Addis Ababa and Washington, D.C."

http://www.nepad.org/regionalintegrationandinfrastructure/news/3559/africa-power-vision-launch-addis-ababa-and-washington (accessed December 1, 2015).

Nussbaumer, Patrick, Morgan Bazilian, and Vijay Modi. "Measuring Energy Poverty: Focusing on What Matters." *Renewable and Sustainable Energy Reviews* 16, no. 1 (January 2012): 231–43. doi:10.1016/j.rser.2011.07.150.

O'Dell, Kathleen, Sophia Peters, and Kate Wharton. "Women, Energy, and Economic Empowerment: Applying a Gender Lens to Amplify the Impact of Energy Access." Deloitte University Press, September 18, 2014. http://dupress.com/articles/women-empowerment-energy-access/.

Organisation for Economic Co-operation and Development/International Energy Agency. "World Energy Outlook—Methodology for Energy Access Analysis," 2014. http://www.worldenergyoutlook.org/media/weowebsite/EnergyAccess_Methodology_2014.pdf

Pasternak, Alan D. "Global Energy Futures and Human Development: A Framework for Analysis." Oak Ridge, TN: US Department of Energy, October 2000. http://newmaeweb.ucsd.edu/courses/MAE119/WI_2015/PDF-PublishedDocuments/GlobalEnergyFutures_and_HumanDevelopment_Pasternack-2000.pdf. Peng, Wuyuan, and Jiahua Pan. "Rural Electrification in China: History and Institution." *China & World Economy* 14, no. 1 (February 1, 2006): 71–84. http://iis-db.stanford.edu/pubs/22224/Rural_Electrification_China_Peng.pdf.

Ramachandran, Vijaya, Alan H. Gelb, and Manju Kedia Shah. *Africa's Private Sector: What's Wrong with the Business Environment and What to Do about It.* CGD Books, March 23, 2009. http://www.cgdev.org/publication/9781933286280-africas-private-sector-whats-wrong-business-environment-and-what-do-about-it.

Republic of Kenya Ministry of Energy and Petroleum. "Draft National Energy Policy," February 24, 2014.

Sustainable Energy For All (SE4All) "Progress Toward Sustainable Energy: Global Tracking Framework 2015 Key Findings." ESMAP, 2015. http://www.worldbank.org/content/dam/Worldbank/Event/Energy%20and-%20Extractives/Progress%20Toward%20Sustainable%20Energy%20-%20Global%20Tracking%20Framework%202015%20-%20Key%20Findings.pdf.

United Nations. "Open Working Group Proposal for Sustainable Development Goals." UN Sustainable Development Knowledge Platform, 2014. https://sustainabledevelopment.un.org/index.php? page=view&type=400&nr=1579&menu=1300.

United Nations Development Programme Human Development Reports, "Human Development Index (HDI)." http://hdr.undp.org/en/content/human-development-index-hdi.

United Nations Development Programme. *Human Development Report 2015: Work for Human Development.* "Table 1: Human Development Index and Its Components." http://hdr.undp.org/en/content/human-development-index-hdi-table.

The White House Office of the Press Secretary. "FACT SHEET: Powering Africa: Increasing Access to Power in Sub-Saharan Africa," August 5, 2014. https://www.whitehouse.gov/the-press-office/2014/08/05/fact-sheet-powering-africa-increasing-access-power-sub-saharan-africa.

World Bank. Data: "World Development Indicators." http://databank.worldbank.org/data/reports.aspx? source=2&country=&series=EG.ELC.ACCS.RU.ZS (accessed February 9, 2016).

------. "FAQs: Global Poverty Line Update," September 30, 2015. http://www.worldbank.org/en/topic/poverty/brief/global-poverty-line-faq (Accessed February 9, 2016). ———. "One Goal, Two Paths: Achieving Universal Access to Modern Energy in East Asia and the Pacific." Washington, DC: The World Bank, 2011. http://documents.worldbank.org/curated/en/2011/01/15156077/one-goal-two-paths-achieving-universal-access-modern-energy-east-asia-pacific.

-------. "Options for the Development of Liberia's Energy Sector." Washington, DC: The World Bank, 2011. https://openknowledge.worldbank.org/handle/10986/12607.

World Bank Group. "Enterprise Surveys: Infrastructure," n.d. http://www.enterprisesurveys.org/data/exploretopics/infrastructure#sub-saharan-africa (accessed February 9, 2016).

World Bank and International Energy Agency. "Progress Toward Sustainable Energy 2015: Global Tracking Framework Report." Washington, DC: The World Bank and the International Energy Agency, 2015.

http://trackingenergy4all.worldbank.org/~/media/GIAWB/GTF/Documents/GTF-2105-Full-Report.pdf.

About the Working Group

The Center for Global Development (CGD) convened the Energy Access Targets Working Group over the course of 2015 in response to the growing global attention to the energy needs of the poor, the severe gaps in energy access, and a concern about the specific indicators being used to measure progress. The Working Group was in large part inspired by an essay by Morgan Bazilian and Roger Pielke Jr., "Making Energy Access Meaningful" (*Issues in Science and Technology*, 2013), which made a compelling case that current definitions were both inadequate and potentially problematic. The Working Group includes a diverse set of expertise and perspectives, and members were invited to participate in a strictly personal capacity, not as representatives of their employers or organizations. In keeping with the spirit of CGD's Working Groups to be independent, rigorous, and, when necessary, bold, this report is not a consensus document but rather reflects the discussions, debates, and input of the members.

Working Group Members (affiliations listed for identification purposes only)

Co-Chairs:

Mimi Alemayehou, Black Rhino Group Todd Moss, CGD

Members:

Nicolina Angelou, ESMAP, World Bank Yaw Ansu, Africa Center for Economic Transformation Morgan Bazilian, World Bank Yael Borofsky, MIT Steve Brick, Clean Air Task Force Jonah Busch, CGD Afua Djimi, Black Rhino Group Emily Huie, ONE Campaign Ben Leo, CGD Vijay Modi, Columbia University Scott Morris, CGD Philippe Niyongabo, African Union Ted Nordhaus, Breakthrough Institute Queen Nworisara-Quinn, Kupanda Capital Alex Rugamba, African Development Bank Kathryn Russell, ONE Campaign Bill Savedoff, CGD

Kartikeya Singh, Fletcher School, Tufts University Peter Teague, Breakthrough Institute Johannes Urpelainen, Columbia University Catherine Wolfram, Energy Institute at Haas, UC Berkeley Davida Wood, World Resources Institute

Research support:

Priscilla Agyapong, CGD Madeleine Gleave, CGD