



CHAPTER 5

CONCLUSIONS

SECTION 1. METHODOLOGICAL CONCLUSIONS

The Global Tracking Framework has built a robust data platform capable of monitoring global progress toward the SE4ALL objectives (table 5.1). This framework draws primarily on household surveys for data on energy access and on national energy balances for data on renewable energy and energy efficiency. Based on a comprehensive review of sources, it has been possible to cover between 126 and 181 countries depending on the indicator, which is equivalent to between 96 and 98 percent of the world's population.

CATEGORY	DATA SOURCES	COUNTRY COVERAGE (% OF GLOBAL POPULATION)
Electrification	Global networks of household surveys plus some censuses	212 (100)
Cooking fuels	Global networks of household surveys plus some censuses	193 (99)
Energy intensity	IEA and UN for energy balances WDI for GDP and sectoral value added	181 (98)
Renewable energy	IEA and UN for energy balances REN 21, IRENA, and BNEF for complementary indicators	181 (98)

TABLE 5.1 OVERVIEW OF DATA SOURCES AND COUNTRY COVERAGE UNDER GLOBAL TRACKING

NOTE: IEA = INTERNATIONAL ENERGY AGENCY; UN = UNITED NATIONS; REN 21 = RENEWABLE ENERGY NETWORK FOR THE 21ST CENTURY; IRENA = INTERNATIONAL RENEWABLE ENERGY AGENCY; BNEF = BLOOMBERG NEW ENERGY FINANCE; WDI = WORLD DEVELOPMENT INDICATORS (WORLD BANK); GDP = GROSS DOMESTIC PRODUCT.

Looking ahead, the Global Tracking Framework will be updated on a biannual basis to provide the international community with a regular report on the status of progress toward the SE4ALL objectives.

While the methodology here developed provides an adequate basis for basic global tracking, there are a number of significant information improvements that would be desirable to implement in the medium term (table 5.2). To effectively monitor progress through 2030 incremental investments in energy data systems will be essential over the next five years, both at the global and national levels. These represent relatively cost-effective high-impact improvements, whose implementation would be contingent on the availability of financial resources.

With regard to energy access, the first task will be to introduce the capability for medium-term global tracking using a simplified two-threshold framework. This would require modifying energy-related questions in the major

global household survey networks to gather specific and unambiguous information about the use of electric lighting and the presence or absence of an electricity connection, as well as sharpening questions about the cooking fuels and cookstoves used in the household, in part to determine whether the latter may be considered "improved" even where solid fuels continue to be used. This work will require dialogue and close coordination with the International Household Survey Network among others. Second, the full multi-tier frameworks for access to electricity and cooking solutions described in chapter 2 need to be piloted in a number of SE4ALL opt-in countries to validate them for wider application. The pilot process would require preparation of survey questionnaires capable of capturing the attributes necessary for classifying households within the multi-tier frameworks. Third, upon validation of the multi-tier methodology, the survey questionnaires could potentially be administered at the national level by all opt-in countries.

	RECOMMENDED TARGETING OF EFFORT OVER NEXT FIVE YEARS
Energy access	<p>Work to improve energy questionnaires for global networks of household surveys.</p> <p>Pilot country-level surveys to provide more precise and informative multi-tier measures of access to electricity and clean cooking</p> <p>Develop suitable access measures for heating.</p>
Energy efficiency	<p>Integrate data systems on energy use and associated output measures.</p> <p>Strengthen country capacity to collect data on sectoral (and ideally subsectoral process) intensities.</p> <p>Improve data on physical activity drivers (traffic volumes, number of households, floor space, etc.).</p> <p>Improve data on energy efficiency targets, policies, and investments.</p>
Renewable energy	<p>Improve data and definitions for bio-energy and sustainability.</p> <p>Capture renewable energy used in distributed generation.</p> <p>Capture renewable energy used off-grid and in micro-grids.</p> <p>Promote a more harmonized approach to target-setting.</p>

TABLE 5.2 MEDIUM-TERM AGENDA FOR THE IMPROVEMENT OF GLOBAL ENERGY DATABASES

SOURCE: AUTHORS.

Thereafter, the feasibility of applying such a multi-tier energy access survey at the global level could be addressed. One way to address this challenge would be to commission a globally active survey agency to conduct the survey across all relevant countries. Another would be to enlist the support of various development agencies in conducting the standardized survey as a part of their operations in countries where they have significant engagement. It would be best to explore both possibilities at this stage. In addition, new methodologies would need to be developed and piloted to measure access to energy for community and productive uses, and for heating purposes. Funding would be needed to implement the pilots, to carry out regular energy surveys in opt-in countries, to develop new methodologies, and to prepare periodic tracking reports.

With regard to energy efficiency, the main concern is to strengthen countries' capacity to produce more disaggregated data on sectoral, subsectoral, and process energy use, as well as the associated output measures. This will entail ensuring consistency in sectoral definitions and methodologies to facilitate country comparisons and regional aggregations. Moving from value-based to physical-based indicators will permit a better tracking of improvements in energy efficiency. Such a move will require data on drivers of physical activity such as passenger and freight traffic

volumes, residential and commercial floor space, and production volumes of energy-intensive products, which at present are available for only a few countries. These technical indicators will need to be complemented with other indicators more relevant to policy makers, including national energy efficiency targets, policies, and investments.

With regard to renewable energy, the first task will be to conduct assessments for the purpose of devising definitions and methods that will permit energy statistics to capture more accurately the full spectrum of existing renewable energy sources and applications. These assessments would cover the following areas: small, distributed, grid-connected electricity generation; off-grid and mini-grid power generation systems; direct production of heat and net energy from heat pumps; waste fuels; and renewable energy production in general. In a second stage, the new definitions, categories, and methodologies will have to be integrated into the questionnaires and procedures used to collect and report energy statistics at the country level. This exercise will necessarily involve the commitment and participation of the international organizations that maintain the primary data repositories in energy—notably the International Energy Agency, the International Renewable Energy Agency, the United Nations, and the World Health Organization.



In parallel, a review of methodological approaches—including definitions, indicators, and criteria—for assessing the sustainability of the main renewable energy technologies, and in particular modern and traditional uses of biomass, will have to be carried out and used as the basis for internationally accepted standards. Implementing the new methodologies and procedures will require capacity building efforts and should be preceded by piloting at the country level.

Finally, while many countries have already set national targets for renewable energy, these are expressed in such a wide range of units that they do not permit ready aggregation or comparison across countries. Going forward, it is proposed that countries express their renewable energy targets as a percentage of their total final energy consumption for consistency with the global tracking framework.

SECTION 2. SUBSTANTIVE CONCLUSIONS

The Global Tracking Framework presented in this report has made it possible to establish the following starting points against which progress will be measured under the SE4ALL initiative (table 5.3). The rate of access to electricity and primary non-solid fuel will have to increase from 83 and 59 percent, respectively, in 2010 to 100 percent by 2030. The rate of improvement of energy intensity will have to double from –1.3 percent for 1990–2010 to –2.6 percent for 2010–30. The share of renewable energy in the global energy mix will have to double from an estimated starting point of at most 18 percent in 2010, implying an objective of up to 36 percent by 2030.

of some 20 *high-impact countries* that have a particularly large weight in aggregate global performance. Overlapping groups of 20 high-impact countries in Asia and Africa account for about two-thirds of the global electrification deficit and four-fifths of the global deficit in access to non-solid fuels (figure 5.1). Meeting the universal access objective globally will depend critically on the progress that can be made in these countries. A third group of 20 high-income and emerging economies accounts for four-fifths of global energy consumption. The efforts of this group of countries to develop renewable energy and accelerate improvements in energy efficiency will ultimately determine the global achievement of the corresponding targets.

Global progress toward the achievement of each of the three SE4ALL objectives depends critically on the efforts

	OBJECTIVE 1		OBJECTIVE 2	OBJECTIVE 3
	Universal access to modern energy services		Doubling global rate of improvement of energy efficiency	Doubling share of renewable energy in global energy mix
Proxy indicator	Percentage of population with electricity access	Percentage of population with primary reliance on non-solid fuels	Rate of improvement in energy intensity*	Renewable energy share in TFEC
Historic reference 1990	76	47	–1.3	16.6
Starting point 2010	83	59		18.0
Objective for 2030	100	100	–2.6	36.0

TABLE 5.3 SE4ALL HISTORIC REFERENCES, STARTING POINTS, AND GLOBAL OBJECTIVES (%)

SOURCE: AUTHORS.

NOTE: TFEC = TOTAL FINAL ENERGY CONSUMPTION

*Measured in primary energy terms and GDP at purchasing power parity

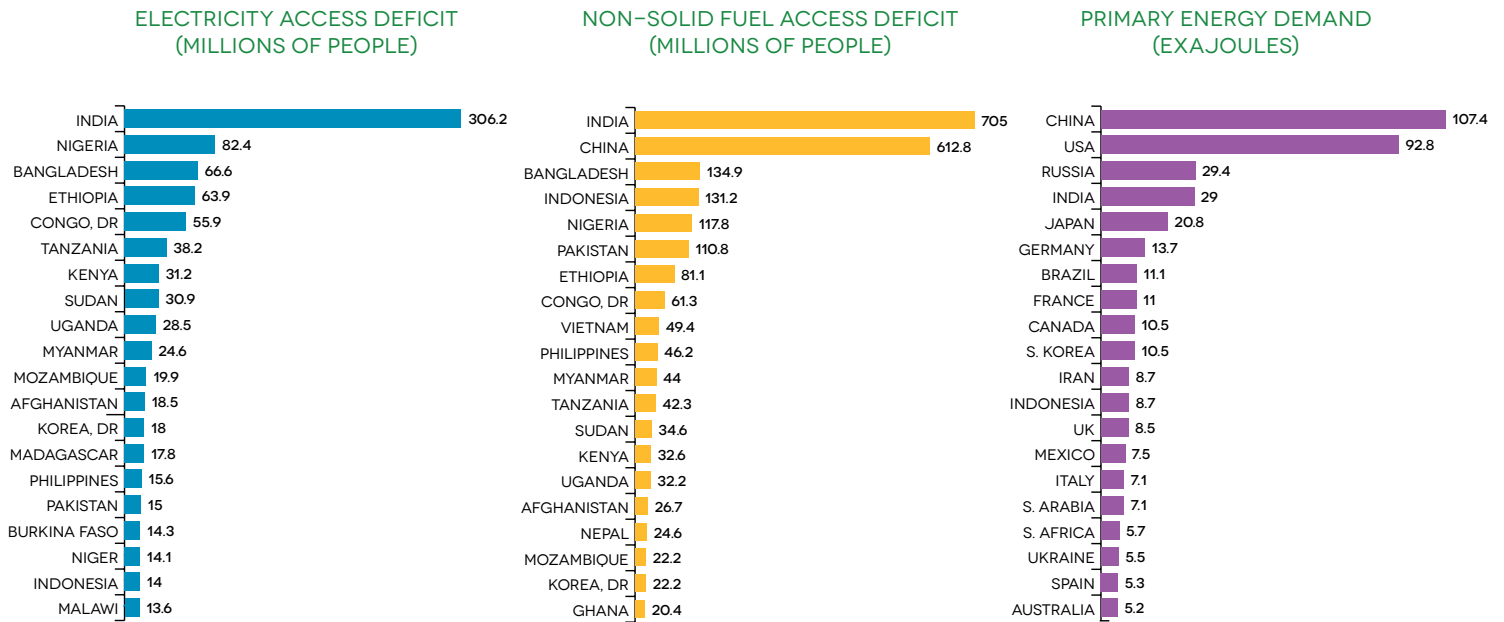


FIGURE 5.1 OVERVIEW OF HIGH-IMPACT COUNTRIES

SOURCE: IEA, WB GLOBAL ELECTRIFICATION DATABASE, WHO GLOBAL HOUSEHOLD ENERGY DATABASE.
NOTE: DR = "DEMOCRATIC REPUBLIC OF."

In charting a course toward the achievement of the SE4ALL objectives, it will also be important to learn from the experience of *fast-moving countries* that made particularly rapid progress on the three energy indicators between 1990 and 2010 (figure 5.2). In the case of electrification and cooking, even the fastest-moving countries have not been able to expand access by more than 3–4 percentage points annually. In the case of energy efficiency, the most rapid improvements in energy intensity, amounting to a compound annual growth rate of 4–8 percent, have been achieved in countries that began with high levels of energy intensity, where efficiency gains were relatively easy to make. In the case of renewable energy, the fastest-moving countries have experienced compound annual growth rates of 10–15 percent (excluding traditional biomass).

On all three aspects of energy sector development, China and India, stand out as being both high-impact *and* fast-moving countries.

Global energy model scenarios that gauge the scale of the global challenge implied by the achievement of these three objectives make it plain that business as usual will not remotely suffice to deliver the three SE4ALL objectives

(table 5.4). With regard to universal access, business as usual would leave 12–16 percent and 31–36 percent of the world’s population in 2030 without electricity and modern cooking solutions, respectively. With regard to energy efficiency, implementing all currently available measures with reasonable payback periods would be enough to meet or even exceed the SE4ALL objective. However, barriers prevent wider adoption of many of those measures, with the result that their current uptake ranges from around 20 percent for power generation and building construction to around 40 percent for manufacturing and transportation. With regard to renewable energy, few scenarios point to renewable energy shares above 30 percent by 2030.



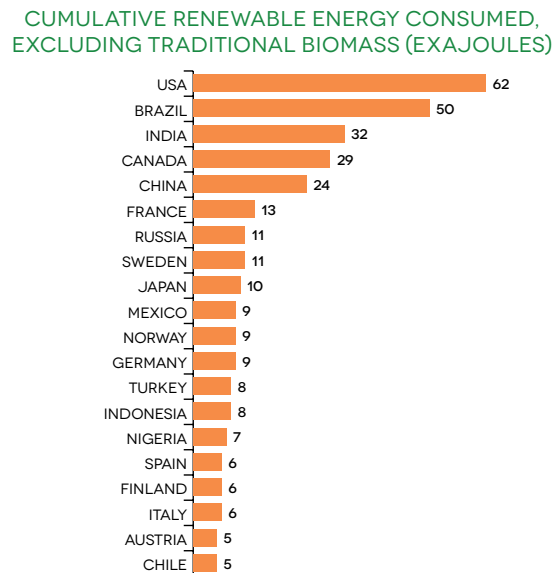
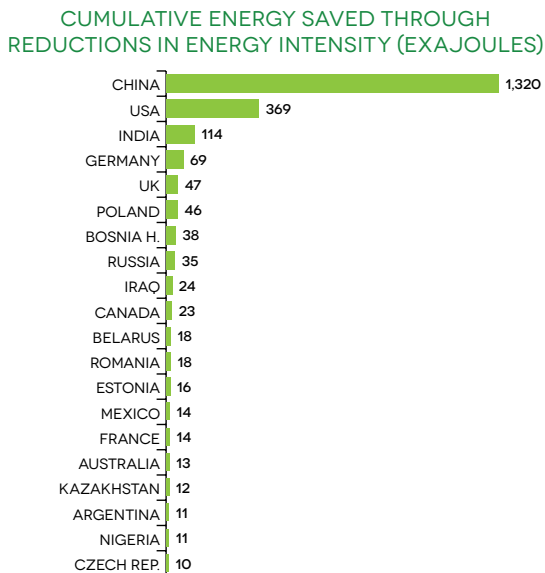
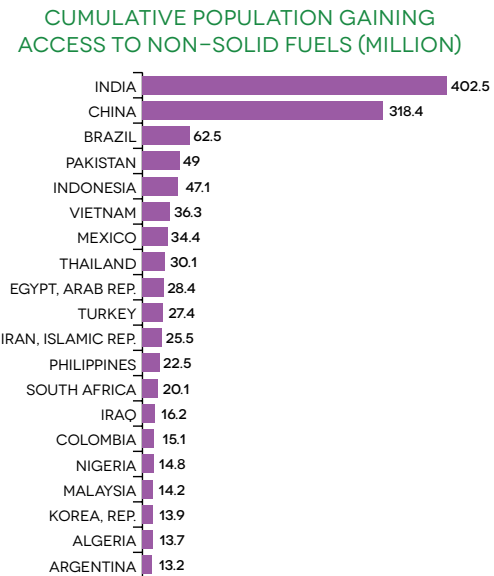
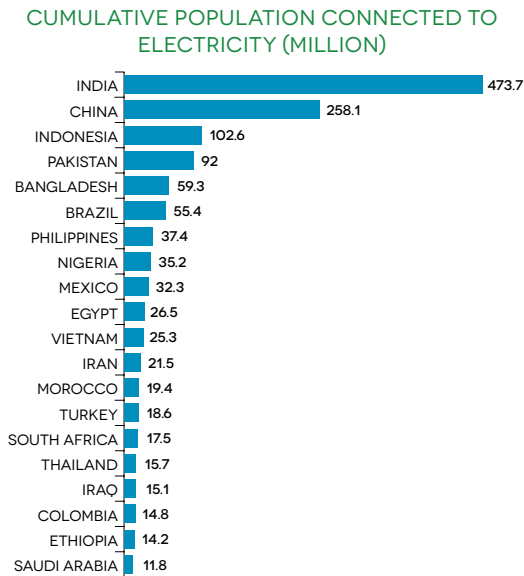


FIGURE 5.2 OVERVIEW OF FAST MOVING COUNTRIES (1990–2010)

SOURCE: IEA, UN, WB GLOBAL ELECTRIFICATION DATABASE, WHO GLOBAL HOUSEHOLD ENERGY DATABASE.
NOTE: BOSNIA H. = BOSNIA AND HERZEGOVINA.

Actual global investment in the areas covered by the three SE4ALL objectives has been estimated at around \$400 billion in 2010 (table 5.5). The *additional* investments required to *achieve* the three objectives are tentatively estimated to be at least \$600–800 billion per year, entailing a doubling or tripling of direct financial flows over current levels. The bulk of those investments are associated with the energy efficiency and renewable energy objectives, with access-related expenditures representing a relatively small percentage of the incremental costs (10–20 percent).

The global energy models also help to clarify the kinds of policy measures that would be needed to reach the three sustainable energy objectives. The IEA's *World Energy Outlook* (WEO) and the *Global Energy Assessment* (GEA) of the International Institute for Applied Systems Analysis (IIASA) coincide in highlighting the importance of phasing out fossil fuel subsidies, adopting measures to provide transparent price signals for carbon, embracing stringent and consistent technology standards for energy efficiency, and carefully designing targeted subsidies to increase access to electricity and clean cooking fuels.

Global models also serve to clarify the likely pattern of efforts across geographical regions toward the achievement of the three objectives, based on their starting points, their potential for improvement, and their comparative advantage. On energy access, greatest efforts are needed in Sub-Saharan Africa and South Asia. For energy efficiency, the highest rates of improvement—around –4 percent

annually—are projected for Asia (particularly China) and the countries of the former Soviet Union. For renewable energy, Sub-Saharan Africa and Latin America emerge as the regions projected to reach the highest share of renewable energy in 2030—in excess of 50 percent, while much of the rest of the world falls in the 20–40 percent range (table 5.6).

	OBJECTIVE 1		OBJECTIVE 2	OBJECTIVE 3
	Universal access to modern energy services		Doubling global rate of improvement of energy efficiency	Doubling share of renewable energy in global mix
Percentage in 2030	Population with electricity access	Population with primary reliance on non-solid fuels	Global rate of improvement in energy intensity*	Renewable energy share in total final energy consumption
IEA scenarios				
New policies	88	69	–2.3	20
Efficient world	88	69	–2.8	22
450	n.a.	n.a.	–2.9	27
GEA scenarios				
Baseline	84	64	–1.0	12
GEA Pathways	100	100	–3.0 to –3.2	34 to 41
2° Celsius	n.a.	n.a.	–1.8 to –3.2	23 to 41

TABLE 5.4 OVERVIEW OF PROJECTED OUTCOMES FOR 2030 FROM IEA WORLD ENERGY OUTLOOK AND IIASA GLOBAL ENERGY ASSESSMENT

SOURCE: IEA (2012) AND IIASA (2012).
n.a. = NOT APPLICABLE.

* IEA scenarios are presented in primary energy terms while GEA scenarios in final energy terms (GDP at purchasing power parity in both cases)

	OBJECTIVE 1		OBJECTIVE 2	OBJECTIVE 3	
Average annual investment 2010–30 (US\$ billion)	Universal access to modern energy services		Doubling global rate of improvement of energy efficiency	Doubling share of renewable energy in global mix	Total
	Electrification	Cooking	Energy efficiency	Renewable energy	
Actual for 2010	9.0	0.1	180	228	417.1
Additional from WEO	45.0	4.4	393	>>174	>>616.4*
Additional from GEA	15.0	71.0	259–365	259–406	604–858**

TABLE 5.5 OVERVIEW OF PROJECTED ANNUAL INVESTMENT NEEDS FOR 2010–2030 FROM WORLD ENERGY OUTLOOK AND GLOBAL ENERGY ASSESSMENT

SOURCE: IEA (2012) AND IIASA (2012).

* WEO estimates are taken to be those closest to the corresponding SE4ALL objective: the Energy for All Scenario in the case of universal access, the Efficient World Scenario in the case of energy efficiency, and the 450 Scenario in the case of renewable energy. The 450 Scenario corresponds to a 27 percent renewable energy share, which is significantly below the SE4ALL objective. The Efficient World Scenario corresponds to a –2.8 percent CAGR for global energy intensity, which is significantly above the SE4ALL objective.

** GEA estimates that a further \$716–910 billion would be needed annually for complementary infrastructure and broader energy sector investments not directly associated with the three objectives.



	OBJECTIVE 1				OBJECTIVE 2		OBJECTIVE 3	
	Universal access to modern energy services				Doubling global rate of improvement of energy efficiency		Doubling share of renewable energy in global mix	
	Percentage of population with electricity access		Percentage of population with primary reliance on non-solid fuels		Rate of improvement in energy intensity*		Renewable energy share in total final energy consumption	
	2010	SE4ALL	2010	SE4ALL	1990–2010	SE4ALL	2010	SE4ALL
Sub-Saharan Africa	32	100	19	100	1.1	2.2–2.4	56	60–73
Centrally Planned Asia	98	100	54	100	5.2	3.6–3.9	17	27–31
Central and Eastern Europe	100	100	90	100	3.1	2.6–3.0	8	28–36
Former Soviet Union	100	100	95	100	2.4	3.7–4.3	6	27–48
Latin America and Caribbean	95	100	86	100	0.7	2.6–3.0	25	49–57
Middle East and North Africa	95	100	99	100	-0.9	1.8–2.1	3	13–17
North America	100	100	100	100	1.7	2.4–2.6	8	26–34
Pacific OECD	100	100	100	100	0.7	2.9–3.4	6	30–41
Other Pacific Asia	89	100	57	100	1.2	3.6–4.0	18	30–37
South Asia	74	100	38	100	2.9	2.7–2.9	47	25–32
Western Europe	100	100	100	100	1.1	3.2–3.5	11	27–43
World	83	100	59	100	1.5	3.0–3.2	17	34–41

TABLE 5.6 GLOBAL ENERGY ASSESSMENT: REGIONAL PROJECTIONS UNDER SE4ALL SCENARIOS

SOURCE: IIASA (2012). ACCESS TO ELECTRICITY FOR 2010 IS FROM WB GLOBAL ELECTRIFICATION DATABASE, 2012. ACCESS TO NON-SOLID FUEL FOR 2010 IS FROM WHO GLOBAL HOUSEHOLD ENERGY DATABASE, 2012.

* Measured in final energy terms and GDP at purchasing power parity

Moreover, the global energy models clarify how the three SE4ALL objectives interact with each other and contribute to addressing global concerns such as climate change. The IEA finds that neither energy efficiency nor renewable energy measures *alone* will be sufficient to contain global warming to two degrees Celsius, but that the two, in tandem, take us much closer to the target. Achieving universal access to modern energy would have a negligible effect on global carbon dioxide emissions, adding only 0.6 percent. The GEA estimates that the probability of limiting global warming to two degrees Celsius increases to between 66 and 90 percent when the SE4ALL objectives for renewable energy and energy efficiency are *simultaneously* met—higher than if either objective were met individually (Rogelj

and others 2013). The achievement of the universal access objective for modern cooking, which would increase reliance on typically fossil-based non-solid fuels for cooking, would have a small offsetting effect, reducing the share of renewable energy in the global mix by some two percentage points, with a negligible impact on the probability of achieving the two degree Celsius target.

In conclusion, the Global Tracking Framework has constructed a robust data platform capable of monitoring global progress toward the SE4ALL objectives. Looking ahead, the consortium of agencies that has produced this report recommends a biannual update on the status of the three SE4ALL objectives that will build on this framework.

The methodology of the SE4ALL Global Tracking Framework provides an adequate basis for basic global tracking, but that tracking effort could be vastly improved if several measures were implemented over the next five years. These cost-effective, high-impact improvements to global energy databases will be contingent on the availability of financial resources. For energy access, the focus will be to move beyond binary measures of energy access to a multi-tier framework that better captures the quantity and quality of electricity supplied, as well as the efficiency, safety and convenience of household cookstoves, including those that make use of biomass. For energy efficiency, the main concern is to strengthen countries' capacity to produce disaggregated data on sectoral and subsectoral energy consumption that are fully integrated with measures of the output of those same sectors. In the case of renewable energy, the main priority will be to improve the ability to gauge the sustainability of different forms of renewable energy, particularly traditional biomass.

Finally, given the scale of the challenge of meeting the three SE4ALL objectives for energy, it is apparent that bold policy measures, combined with a regulatory and institutional environment that supports innovation and encourages investment, will be required to produce the requisite increases in the energy sector's capacity to widen access, boost the output derived from a given unit of energy, and raise the share of renewable energy in the overall energy mix. A detailed analysis of the policy environment at the country level lies beyond the immediate scope of this Global Tracking Framework, which has focused on the monitoring of global progress toward the stated SE4ALL objectives. However, it will be an important focus for future work in support of the critical social, economic, and environmental goals that the SE4ALL initiative addresses.



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