ACCELERATING SDG 7 ACHIEVEMENT

POLICY BRIEF 15

TRACKING SDG 7.1 WITH THE MULTI-TIER FRAMEWORK MEASURING ENERGY ACCESS

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Developed by

The World Bank

Key Messages

To date, the SDG 7.1 target on access to affordable, reliable, and modern energy for all is measured through two binary indicators: the proportion of the population with access to electricity and the proportion of the population with access to clean cooking fuels and technologies.

Although convenient, these indicators do not report on the affordability and reliability aspects of people's energy access, leading to a discrepancy between the definition of the goal and the indicators used. Affordability is particularly important, as availability of energy becomes meaningless if the user cannot afford it, whereas inadequate quantity and quality of supply will significantly lower the usefulness of the energy access provided.

The Multi-Tier Framework (MTF) was developed by The World Bank's Energy Sector Management Assistance Program (ESMAP), in consultation with international partners under the Sustainable Energy for All (SEforALL) initiative. It goes beyond the traditional binary measurement of energy access to capture the multidimensional nature of energy access at the end user level, and the vast range of technologies that can provide energy access, while accounting for the wide differences in user experience.

The MTF offers a clear definition of what affordable, reliable, and modern energy access means, and proposes clear measuring indicators. It defines energy access as the ability to obtain energy that is adequate, available when needed, reliable, of good quality, affordable, formal, convenient, healthy, and safe for all required energy applications. It then defines 6 tiers of access, ranging from Tier 0 (no access) to Tier 5 (full access). Energy access is also measured across enterprises and community institutions, not just households, since energy is essential for enterprises in every sector, as well as for community institutions.

Currently available data do not allow for more elaborate indicators to track the SDG 7.1. MTF surveys have been (or are being) conducted in 17 countries so far, and surveys in 6 more countries will be initiated in the near future. Country Diagnostic Reports using the MTF approach have been published for several countries, providing more accurate, granular, and disaggregated data on the level of energy access of households, enterprises, and community institutions.

Countries are strongly encouraged to track energy access in a way that captures its multidimensional nature, by conducting MTF surveys to obtain baseline data and repeating data collection over time to track progress toward their own SDG 7.1 targets. To this end, a short MTF energy module that can be integrated into existing national household surveys is also being developed as a long-term tracking tool for SDG 7.1, in collaboration with the World Bank Living Standards Measurement Study (LSMS) team and the World Health Organization (WHO).

The MTF is shaping up to become a powerful tool for tracking SDG 7.1 progress, and for informing policy and investment decisions. In addition to being a useful tool for setting SDG 7.1 targets and tracking progress toward achieving them, the MTF aims to provide insight into the types of policy reforms and project interventions that drive higher levels of access to energy, while also facilitating monitoring and evaluation. In this way, MTF data analysis offers useful input for policy formulation, investment strategies, project design, utility performance accountability, and evaluations of project impact.

Background

The Energy Sector Management Assistance Program (ESMAP), in consultation with international partners under the Sustainable Energy for All (SEforALL) initiative, developed the Multi-tier Framework (MTF) to monitor and evaluate energy access by following a multi-dimensional approach. Their valuable support and advice have contributed in enhancing the robustness of the MTF approach as a tracking tool for the SDG 7.1. The MTF aims to improve the measurement of energy access, by going beyond the traditional binary measurement of energy access—for example, having or not having a connection to electricity, using or not using clean fuels for cooking—to capture the multidimensional nature of energy access and the vast range of technologies and sources that can provide energy access, while accounting for the wide differences in user experience.

In 2016, energy was included in the new Sustainable Development Goals (SDG), and energy access became the SDG 7.1, which aimed at ensuring 'access to affordable, reliable and modern energy for all.' Achieving such goal not only requires a wide range of interventions by various stakeholders, including international organizations, governments, and the private sector, but also a tool to measure progress toward this multi-dimensional goal.

In support of the UN high-level political forum 2018, policy brief #27 on SDG 7 indicators, acknowledged the need for complementary indicators to capture affordability, reliability and quality of access (UNDESA 2018). It stated that current indicators could be refined and that data collection capacities needed to be enhanced. Also, the adoption of international methodologies for statistics and indicators was seen as a prerequisite for improved analytical quality, global coverage, and comparability. Finally, it stressed the need to consider the broader concept of energy for sustainable development, and measure progress towards all energy-related SDGs to reflect cross-cutting interconnections.

How can the MTF track SDG 7.1 and beyond?

To date, the SDG 7.1, defined as 'access to affordable, reliable and modern energy for all,' is measured through two binary indicators: the proportion of population with access to electricity and the proportion of population with access to clean cooking fuels and technologies, as available data do not allow for a more elaborate measure (Angelou et al. 2013; World Bank and IEA 2015; World Bank 2017a; World Bank 2018a). Although convenient, these indicators do not report on the affordability and reliability aspects of energy access, leading to a discrepancy between the definition of the goal and the indicators used. Being based on the attributes of energy access, the MTF offers a clear definition of what an affordable, reliable, and modern energy access means, it proposes clear measuring indicators for each aspect, as well as a method for combining all these aspects into one indicator to facilitate tracking (Figure 1).

Figure 1. MTF as a tool for tracking progress toward SDG 7.1

Source: Authors

Affordability is a key aspect, as energy access becomes meaningless if the user cannot afford to consume energy and, therefore, cannot benefit from the energy services. Affordability refers to whether users are able to pay for the energy they need. Affordability entails a complex interaction between the quantity of energy consumed, the price of energy, and the ability of the consumer to pay for the energy consumed. The ability to pay is a function of the income level as well as the expenditure priorities of the user. To overcome a series of measurement challenges that affordability entails, the MTF considers that in order for electricity access to be considered affordable, a standard consumption package of 365 kWh per year should amount less than 5 per cent of the household's income. Similarly, the MTF considers access to clean cooking solutions affordable if households spend less than 5 per cent of their expenditures on cooking fuels. Additional indicators for Affordability are suggested for energy access in enterprises and community institutions (for more details, see Bhatia and Angelou 2015).

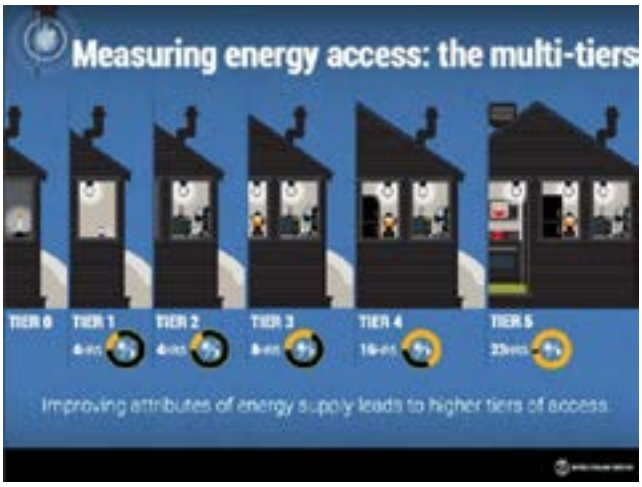
Reliability within the SDG 7.1 appears to be defined in a broader term, suggesting that energy supply should be available when needed. Indeed, inadequate quantity and quality of supply significantly lower the usefulness of energy access provided. The MTF refers to several indicators to measure such term. For electricity, it considers availability—measured by the amount of time during which electricity is available each day and during the evening; reliability—measured by the frequency and duration of unscheduled outages; and quality—measured by the occurrence of voltage issues preventing the use of desired appliances. With regards to access to clean cooking solutions, availability is considered adequate when the primary cooking fuel is readily available for most of the year. Several indicators are based on continuous variables and cannot be categorized into a binary metric, and thus need to be measured through multiple tiers (for more details, see Bhatia and Angelou 2015).

Modern energy usually refers to clean, safe, and, to a certain extent, convenient energy sources. Electricity is by definition a convenient energy source and is often considered a clean source, at least at the point of use. The MTF considers that electricity access is safe if the wiring installation in the household (or other facility) is done according to national standards, ensuring that people are protected from hazards that may arise from the operation of electricity. Safety is measured through the occurrence of past accidents (Bhatia and Angelou 2015). With regards to access to clean cooking solutions, the MTF defines modern energy through Cooking Exposure and Cookstove Efficiency (Padam et al. 2018; Dave et al. 2018; Koo et al. 2018). Cooking Exposure assesses personal exposure to pollutants from cooking activities, which depends on stove emissions, ventilation, and contact time. Cookstove Efficiency assesses the performance of the stove in regard to its thermal efficiency. Convenience is also considered, measured through the time spent acquiring fuel, as well as preparing the fuel and the stove for cooking. Finally, Safety is measured through the occurrence of past accidents.

How does the Multi-Tier Framework measure access to energy?

The MTF defines energy access as the ability to obtain energy that is adequate, available when needed, reliable, of good quality, affordable, formal, convenient, healthy, and safe for all required energy applications across households, enterprises, and community institutions. Based on this definition, the MTF measures energy access provided by any technology or fuel, based on a set of attributes that capture key characteristics of the energy supply that affect the user experience. Based on those attributes, it then defines 6 tiers of access, ranging from Tier 0 (no access) to Tier 5 (full access) (Figure 2).

Figure 2. The MTF approach



Source: Authors

Access to electricity is measured based on 7 attributes: capacity, availability, reliability, quality, affordability, formality, and safety. Tier 0 refers to households that receive electricity for less than 4 hours per day (or less than 1 hour per evening) or that have a primary energy source with capacity of less than 3 watts. Tier 1 refers to households with limited access to small quantities of electricity provided by any technology, even a small solar lighting system, for a few hours a day, enabling electric lighting and phone charging. Higher tiers are defined by higher capacity and longer availability of supply—enabling the use of medium- and high-load appliances (such as a refrigerator, washing machine, or air conditioner)—as well as by adequate affordability and reliability, quality, formality, and safety. A grid is the most likely source for achieving a higher tier, though a diesel generator or a large mini-grid may also do so. Technological advances in photovoltaic solar home systems (SHS) and direct current-powered energy-efficient appliances also make higher access possible.

Access to modern cooking solutions is measured based on 6 attributes: cooking exposure, cookstove efficiency, convenience, safety of the primary cookstove, affordability, and fuel availability. Attributes directly related to the cooking solution (cookstove and fuel), such as cooking exposure, cookstove efficiency, and safety of the primary cookstove, are the main concern in the lower tiers. Households with a 3-stone stove or traditional biomass stove are mostly in Tier 0 (no access), households with an improved biomass stove are more likely to reach Tiers 1–3, and households with a cookstove fueled with electricity, biogas, liquified petroleum gas (LPG), or natural gas reach Tier 4 or 5. Additional attributes—such as convenience, affordability, and fuel availability—come into play in higher tiers.

Along with reflecting the multi-dimensionality of energy access, the MTF also accounts for the wide range of energy access technologies—from solar lanterns to national grids and from 3-stone fires to LPG cookstoves—recognizing the significant differences in the performance of the energy supply from different solutions. The multi-tier approach is designed to be technology and fuel neutral, and captures all underlying factors that impact the user's experience while measuring energy access as a continuum of improvement (as opposed to a binary metric), by setting multiple tiers of access (from Tier 0 to Tier 5).

Beyond the attributes of energy supply, the MTF survey collects data on several related aspects of energy access such as consumption levels, appliance ownership, and energy expenditures, including on backup solutions. It also examines user perception of barriers to grid connection and willingness to pay (WTP) for a grid connection, a SHS, and an improved cookstove (ICS). Demographic and economic data pertaining to households (or enterprises) may be used to complement the diagnostic analysis. MTF data can be disaggregated by urban and rural areas, income quintile and gender of head of household, facilitating policy formulation targeting specific groups, such as the poor and female-headed households.

Beyond households, the MTF measures access to enterprises and community institutions as well. Energy is not only needed at the household level, but is also essential for enterprises in every sector, as well as for community institutions. Energy is one of the key inputs of the production process for most, if not all, enterprises. Access to energy for productive uses increases income, productivity, and employment, while delivering higher-quality and lower-priced goods. It often translates into higher energy demand density and more reliable capacity to pay. Access to energy for community infrastructure (such as schools, health facilities, and government offices) is fundamental for socioeconomic development, as it drives improvements in human capital, and governance. Healthier and better educated people with access to basic community infrastructure have better chances of escaping the poverty trap. The MTF developed specialized matrices measuring access to energy in enterprises, health facilities, schools, and other community infrastructure (Bhatia and Angelou 2015). Similar to households, it captures the multiple attributes that influence access to energy for enterprises and community institutions, in order to inform policy and investment. Access to energy to community services also relates to the achievements of other SDGs.

How can policy makers and private investors use the MTF?

The MTF aims to provide insight into the types of policy reforms and project interventions that would drive higher levels of access to energy, along with facilitating monitoring and evaluation. The richness of MTF data can provide valuable market intelligence for the private sector to identify the market potential. In several countries, results from the MTF survey are helping to deepen sector dialogue and inform policies and investments to meet ambitious access targets. As such, MTF data analysis offers useful input for policy formulation, investment strategies, project design, utility performance accountability, and evaluations of project impact. The MTF is also a useful tool for setting SDG 7.1 targets and track progress toward achieving them.

Inform project design. More accurate measurement of energy access and an improved understanding of the underlying shortfalls are crucial for the success and sustainability of energy projects. MTF data can inform project design during preparation and provide better ex-ante estimation of the likely impact of projects on access. In addition, MTF data on energy consumption, WTP, and several socio-economic variables for households and firms complement and enhance upstream planning activities such as geospatial electrification planning, market assessments for off-grid technologies, assessment for the potential for productive uses development, and demand forecasting for least cost planning. For example, following MTF survey results, the World Bank Renewable Energy Project in Rwanda intends to support the uptake of off-grid systems through the promotion of purchases in instalments. MTF data indicate that the average household expenditure on traditional energy sources for lighting (candles, dry-cell batteries, and kerosene) by households without access to electricity is US$ 1.25 per month. When looking at the richest 40 per cent of off-grid households, the average expenditure rises to US$ 2.5 per month. This implies that about 750,000 off-grid households would be able to afford solar lighting products at an instalment of around US$ 2.5 per month (World Bank 2017c). Under the Ethiopia Electrification Program, an affordability study using MTF data and a geospatial least-cost plan, will be conducted to inform the government's 2019 connection cost policy (World Bank 2018b). In Kenya, MTF data collected in 14 underserved counties were used in designing the Kenya Off-Grid Solar Access Project (KOSAP) in 2016. The MTF data established a baseline and provided nuanced information on the off-grid solar use and potential for scale up. The data were also useful in understanding the WTP and developing a financial plan (subsidies and instalments) that would be affordable for the communities: the analysis showed that over half a million households could theoretically afford a Tier 1 SHS; and that pay-as-you-go (PAYG) is beginning to find its way into underserved counties, as 37 per cent of households that bought a (Tier 1) solar lighting system indicate that they paid in instalments (World Bank 2017d).

Prioritize investment and interventions. By shedding light on the constraints that prevent energy end-users

from achieving higher tiers of access, MTF data can be used to prioritize investments and interventions aiming to move users into higher tiers. MTF data help identify specific gaps and assess deficiencies in the performance of the energy supply, as well as spot opportunities in improving energy access of specific target groups. For example, policy makers could consider increasing electricity generation to increase duration of supply in areas where grid-connected customers are held back in lower tiers due to short duration of electricity supply. For instance, in Rwanda, the data suggest that increasing evening availability and addressing the causes of voltage fluctuations could move most of the households from Tier 3 to a higher tier and enable greater benefits from electricity consumption. Similarly, households that primarily cook with an LPG stove but continue to rely on charcoal as secondary solution, due to frequent shortages of LPG cylinders for instance, could benefit from interventions aiming to improve LPG supply chains, which may lift them into higher tiers of access.

Setting country-specific energy access targets. The multi-tier measurement of energy access enables governments to set their own SDG 7.1 targets, by selecting any energy access tier above Tier 0. Such targets will depend on the country's current context, its development status, the needs of its population, and the budget available. Where funding is limited, governments will need to make trade-offs, for example between moving more people to Tier 1 or 2 and raising some percentage of the population to higher tiers. Both Ethiopia and Rwanda are using the MTF terminology to set or adjust their energy access targets. In 2016, the government of Rwanda started reframing the country's access target following the MTF methodology. It set the ambitious target of reaching Tier 1 electricity access for all by 2020: the overall access target rate of 70 per cent included 31–35 per cent on grid access, 13–17 per cent off grid access through systems providing at least Tier 2 access, and the remaining 22 per cent off grid access through systems providing at least Tier 1 access (World Bank 2017b; World Bank 2017c). In Ethiopia, the MTF helped the World Bank team to advise the government to adjust its definition and measurement of energy access. In the past, the Ethiopian government tracked access at the village, town, or community levels only (through the existence of a MV/LV interconnection). The MTF encouraged the government to shift its approach and track energy access at the household level. The MTF also assisted the government in adopting a tiered (and not binary) tracking framework for electrification. Also, the government recognized the importance of off-grid services as integral part of its electrification program. This resulted in a new baseline for Ethiopia electrification rate at 44.3 per cent in 2018, compared to the historically underestimated rate of 20 per cent.

Support policy formulation. The MTF captures detailed information on the quantity and quality of energy access. MTF data show the distribution of energy access technologies across the country, including grid and off-grid solutions, as well as the range of cooking solutions (cookstoves and fuels) used, and report on the attributes of the energy supply and other related energy aspects. Thus, detailed baseline data can help support policy formulation. For example, in Rwanda, MTF data revealed that the main barrier preventing households from connecting to the grid was the high connection fee. In response to this issue, Rwanda's Ministry of Infrastructure revised its grid connection policy in 2017, to ease the connection requirements for customers that could not afford to pay upfront the US$ 50 connection fee. The amount required could instead be paid in instalments over a number of years (Republic of Rwanda 2018). The government of Rwanda has also initiated public awareness campaigns on the benefits of off-grid electrification, which, coupled with measures improving affordability of low-income households, shall lead to higher electricity consumption (World Bank 2017b). Also, affordability analysis by income quintile can shed light on the impact of energy price increases on households' expenditures.

Assessing the contribution of broader energy interventions in improving energy access. Defining and measuring energy access by considering attributes of energy supply yields a better understanding of how various interventions improve access (Angelou and Bhatia 2014). Energy access projects are typically thought of as those that either provide additional grid connections or disseminate off-grid systems, such as solar lanterns or SHS. However, other types of projects also contribute to improving energy supply and may have a positive effect on access. For example, a generation project may allow for longer hours of supply

and address voltage issues; an energy efficiency intervention may increase the duration of energy supply or improve affordability.

Tracking progress toward SDG 7.1 and beyond. Regular and sustained data collection can be used to evaluate the progress made by a given country toward achieving the SDG 7.1, as well as reflect the contributions of various projects toward improving energy access. In addition, MTF data may lead to a better assessment of the linkages between energy access and economic growth, poverty reduction, human development, and gender equality. The National Institute of Statistics of Rwanda (NISR) has already integrated a part of the MTF short survey module into the national household survey (EICV 5) to track the progress in the tier distribution.

Current MTF survey implementation status

MTF surveys are currently implemented in a growing number of countries, and data will be available on energydata.info and the upcoming MTF website. Country Diagnostic Reports analyzing MTF data have been published for Ethiopia, Cambodia, and Rwanda (Padam et al. 2018; Dave et al. 2018; Koo et al. 2018). As a long-term tracking tool for SDG 7.1, an MTF energy module and a guidance note for statistical offices on how to integrate energy questions into existing national household surveys is also being developed with the World Bank Living Standards Measurement Study (LSMS) team and the World Health Organization (WHO) (World Bank and WHO, Forthcoming). By providing more accurate, granular, and disaggregated data on the level of energy access of households, enterprises, and community institutions, the MTF is gearing up to become a powerful tool for tracking the SDG 7.1, informing policy and investment decisions.

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7 AFFORDABLE AND CLEAN ENERGY