Millennium Project

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Energy: A Critical Input to the Millennium Development Goals

McKinsey & Company recently undertook a pro bono engagement with the United Nations Millennium Project (MP), focusing on "costing energy-related inputs to the UN Millennium Development Goals (MDGs)". The MDGs, which include such goals as halving the number of people living on $1/day between 1990 and 2015, and reducing child mortality by two-thirds over the same period, are internationally agreed targets that aim to make significant inroads into addressing some of the world's most important development challenges.

The Millennium Project — an advisory body to the UN Secretary-General, directed by Professor Jeffrey Sachs, Special Advisor to Kofi Annan on the MDGs — has been tasked with developing and recommending an operational framework that will allow all developing countries to meet the MDGs by 2015. With a small secretariat housed at the United Nations Development Program (UNDP) in New York, the MP coordinates the work of ten thematic Task Forces. The role of the Task Forces is to map out the interventions needed to achieve the MDGs; identify necessary resource requirements and corresponding financing strategies; develop a sequence of investments until 2015, and create an analytical framework for achieving the MDGs. The MP's effort is presently concentrated on seven case study countries—Bangladesh, Bolivia, Cambodia, Ghana, Malawi, Tanzania, and Uganda—for which initial intervention costing studies are being undertaken.

Improved access to energy is a critical input for reducing poverty and achieving the MDGs. For instance, where it replaces traditional biomass, modern energy contributes to improved health by lowering indoor- and outdoor air pollution; reduces the burden on women and young girls many of whom spend hours each day collecting and carrying firewood; and frees up time for income-generation. Also, energy is a critical input for providing a host of social services, from education and health care, to communication.

In the absence of internationally-agreed upon targets for access to energy, an initial assessment of the energy requirements necessary to support achievement of the MDGs was made for six countries: Bangladesh, Cambodia, Ghana, Malawi, Tanzania, and Uganda. The analysis began by defining the minimum energy requirements to provide basic services. A "Parallel Energy MDG", was outlined as follows: "Reduce by half, between 2005 and 2015, the proportion of urban and rural households without access to adequate lighting; Reduce by half, between 2005 and 2015, the proportion of urban and rural households reliant on cooking methods that are not MDG-compatible; and By 2015, provide adequate, clean and efficient energy services to all educational and health facilities". Next, a detailed set of energy services considered to be "MDG-compatible" was defined. For example, open fires and candles for lighting, and unprocessed biomass for cooking were deemed unacceptable, while kerosene hurricane lamps and electric bulbs for lighting, and kerosene and LPG for cooking were deemed acceptable. Next, the study outlined a portfolio of potential energy service interventions from which governments could choose, ranging in cost and operational complexity. Next, a set of criteria that governments could use in creating country-specific intervention plans were developed.

LEAP, an integrated energy-environment scenario analysis tool developed by the Boston Center of the Stockholm Environment Institute (SEI), was used to develop scenarios for each country case study.

On the demand-side, key data describing household energy services in each country in both urban and rural areas were gathered. These included electrification rates, the proportion of households using each of six lighting methods (candles and open fires, kerosene wick lamps, kerosene hurricane lamps, gas lamps, and electric bulbs) and each of six cooking methods (unprocessed biomass in stone fires, improved wood stoves, charcoal, kerosene, gas, and electricity). Energy carrier and technology mix and coverage targets for MDG-compatible services were then applied against a backdrop of expected population growth and urbanization rates to determine how many households will need to receive each energy intervention between 2005 and 2015. Similarly, energy provision to meet social service MDGs (healthcare and education) was estimated, based on the number of facilities expected to be in operation in 2015, and their average electric and thermal energy consumption.

On the supply-side, the increase in power plant capacity and the annual generation rates required to meet the increased demand for electricity was modeled, using small unit gas turbines as a proxy for the type of generation capacity that would be installed to meet new demand. The difference in cost between current and projected energy service provision options represents the "gap" that an "MDG energy program" will cost in total.

Relatively detailed base case data on both cooking and lighting methods allowed for a more rigorous analysis in Ghana and Tanzania. However these two countries may not be representative of the type of analysis that could be done in other countries, where it can be difficult to find information on household energy use patterns, particularly for cooking. For the other countries, a lack of data on lighting and cooking methods meant that broad assumptions had to be used in estimating costs.

For each case study country, four groups of costs were estimated: end-use device costs, fuel costs, electrical connection costs, and power plant costs. Electrical connection costs are those costs linked to electrifying households, be this through individual home systems, mini-grid, or central grid. Where households are electrified through individual solar panels and batteries, for instance, connection costs would reflect the cost of this system. Conversely, where electrification is planned using grid systems, connection costs served as a proxy for transmission and distribution system costs.

Fuel costs comprised on average some 40 percent of total costs, due to the fact that they are recurrent in nature, and thus figure on an annual basis. While kerosene and LPG would typically have similar unit costs, the efficiency of end-use devices with which they are used determines the volumes of each fuel consumed in providing heating and illumination. Hence, the technology/fuel mix selected by a government will influence the proportion of total costs that are made up by fuel costs. Electrical connections—the only "one-off" costs in our model—are the second most significant cost driver, accounting for 25 percent of total costs. Where grid-based electrification is concerned, population dispersion is the most important driver of unit costs—the close geographic proximity in which households live in urban areas greatly reduces the average length of cabling required to connect additional households to the electricity grid (a major cost saving given that low- and medium voltage cable systems and transformers typically costs $10,000-14,000 per kilometer of wire laid).

A country's electrification starting point has a significant impact on the share of connection costs linked simply to maintaining current electrification rates. For instance, Ghana has a current urban electrification rate of 78 percent. In the MDG scenario, Ghana would achieve urban electrification of 82 percent by 2015. However, simply keeping its present rate steady at 78 percent between 2005 and 2015 makes up over 40 percent of "total connection costs to 2015".

End-use device costs and costs associated with construction and operation of power generation facilities carry equal weight, each making up about just under 20 percent of total costs. As with fuel costs, end-use device costs are affected by the particular MDG-compatible intervention mix chosen by a government: charcoal stoves, for instance, are the cheapest, costing 10 dollars each, with a relatively short usage lifespan. Kerosene stoves, which can be expected to last longer than charcoal pots cost at least twice as much. They are nonetheless much less expensive than LPG stove systems (including canisters). The capital costs associated with end-use devices vary greatly, but should not be viewed in isolation since the life-cycle costs are a function of efficiency, lifetime and fuel cost.

These initial assessments have pointed to a number of policy implications, notably that governments of the poorest countries will need to undertake focused investments on energy services in order to facilitate the realization of the MDGs. While energy investments required to support the MDGs are significant and comparable to those required in other sectors, the financial cost is perhaps not the most important issue. Nevertheless, meeting the MDGs will demand unprecedented scaling of grid expansion and implementation of modern thermal technologies. Consequently, governments will need to craft multi-faceted, country-specific energy strategies that balance developmental aspirations with a country's starting point in terms of current access to modern energy services, natural resource endowments, and financial and administrative capacity.

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