

Reliable and Affordable Off-Grid Electricity Services for the Poor

Concept Note

IEG Learning Product

December 23, 2015

The purpose of this learning product¹ is to provide a synthesis of findings, good practices, and lessons from the Bank Group's support for off-grid electrification. This synthesis will be based mainly on the Independent Evaluation Group's (IEG) sector and project-level evaluations on the subject.

In recent years, IEG's evaluation of the World Bank Group's experience with rural electrification (IEG 2008) examined the experience with off-grid electrification as part of national electrification strategies. Since then, there has been a big shift in the technical, economic, and institutional conditions for off-grid electrification across the world, including in the Bank Group's client countries. The recent IEG evaluation *World Bank Group Support to Electricity Access FY2000–2014* (IEG 2015a) recognizes the increasing complementary role of off-grid electrification in parallel with the expansion of the traditional electricity grid. These findings are backed by detailed analyses of the Bank experiences with off-grid electrification through literature reviews, and desk- and field-based studies of projects with significant off-grid components. The Bank Group's directions paper (World Bank 2013) for the energy sector highlights the importance of promoting off-grid electrification, particularly from renewable energy sources, for rapid access scale-up. In this overall setting, this learning product will bring together the detailed evaluation findings and lessons from the available sector and project-level evaluations as inputs to Bank Group strategies and operations in this regard.

The learning product will cover various aspects of off-grid electrification, including target beneficiaries, policy frameworks, and institutional arrangements, service delivery models in different contexts; provisions for financial viability and affordability; developing technical capacity and quality assurance for off-grid products; and strategies for coordinating the interface with the growth of the traditional grid. It will draw on IEG's detailed background and portfolio analysis of the Bank Group's support for off-grid electrification, and additionally draw on evaluative and peer-reviewed evidence from experience beyond the Bank Group, including developmental financial institutions, bilaterals, and the private sector; it will also draw on an updated literature review.

¹ Per IEG guidelines, an IEG Category I Learning Product involves "a synthesis of evaluation findings from multiple sources, and identification of cross-cutting lessons and good practices."

A. Background and Context

About 1.1 billion people around the world, mostly poor, lack access to electricity; this holds them back from the potential for human development and quality of life that can result from such connectivity. In Sub-Saharan Africa alone there are more than 600 million people without electricity,² and this figure may rise significantly if the pace of new electricity connections remains at the average rate experienced during the 10-year period 2005–14 and population growth is taken into account (IEG 2015a).³

Against this background, the Bank Group has joined the United Nations in the Sustainable Energy for All (SE4All) initiative, which seeks to achieve universal access to energy by 2030, along with improving energy efficiency and the use of renewable energy. This initiative is reinforced by the Sustainable Development Goal (SDG) 7 (“ensure access to affordable, reliable, sustainable and modern energy for all”) and the Bank Group’s goals of reducing extreme poverty and increasing shared prosperity.

The large and growing gap in electricity access, especially in Sub-Saharan Africa, calls for a quantum leap in the pace of new connections and scale of investments in the electricity sector, if credible progress is to be made toward the SE4All and SDG goals. IEG’s recent evaluation of the World Bank Group’s contribution to electricity access (IEG 2015a) estimates that the pace of connections in low-access countries (those less than 50 percent access, mostly in Sub-Saharan Africa) needs to rise from the present average of 2 million per year⁴ to 14.6 million per year for the next 15 years, with a corresponding increase of investments from \$3.6 billion per year to \$37.1 billion per year, including new generation and overall rehabilitation requirements.

This huge increase in connections is unlikely to result from grid expansion alone, in the time frame contemplated by global access goals. Indeed, IEG’s access evaluation recognizes the positive and growing trend in adoption of off-grid electrification in several Bank client countries, and points to the huge potential of this.

THE ROLE OF OFF-GRID ELECTRIFICATION IN ELECTRICITY ACCESS SCALE-UP

Electrification has traditionally and predominantly been carried out through the expansion of the electricity grid because of proven technologies and economies of scale and the absence of and still-emerging growth of off-grid options. In many developing countries, and especially in Sub-Saharan Africa and fragile and conflict-affected states, the grid has seen little or no growth outside urban areas. There are several reasons for this, including a lack of government vision for electricity access, unfavorable or uncertain policies and regulatory frameworks; poor sector financial performance, inability to attract investments, and lack of capacity.

In this vacuum, as noted by IEG’s evaluation, off-grid electrification has emerged as a viable alternative for providing basic services (lighting, fans, and small televisions) and increasingly for commercial and

² 2015. Global Tracking Framework; <http://trackingenergy4all.worldbank.org/reports>.

³ The report’s estimates are indicative and based on average growth of connections in past ten years and projected population growth.

⁴ Predominantly household connections, though the breakup is not available.

industrial applications such as milling, pumping, and refrigeration. This trend has been made possible by rapid innovations in off-grid technology in recent years, significant reductions in costs, improvements in performance, emergence of innovative financing models, as well as the growing importance of the climate change agenda. All this has substantially increased the relative attractiveness of off-grid electrification, especially from renewable energy resources. The multitier framework is a useful conceptual framework in this regard. At the same time, it must also be kept in mind that off-grid electrification typically cannot provide the same service standards and range and scale of applications as traditional grid-based electricity.

A broad classification of off-grid electrification options (World Bank 2011) comprises the following:

- *Isolated small generation and small network systems*: serving local area demand through minigrids (generation based on diesel), minihydro, hybrid diesel and solar photovoltaics/wind, biomass, and so forth)
- *Individual systems* such as solar home systems, ranging from household-sized systems of 30–75 watt peak capable of powering a few bulbs, a fan, and/or a small television to institutional sizes (100-500 watt peak) for use in small community centers, schools, or health centers.
- *Portable retail products* such as solar photovoltaic lanterns for lighting, cell phone charging, and so forth.

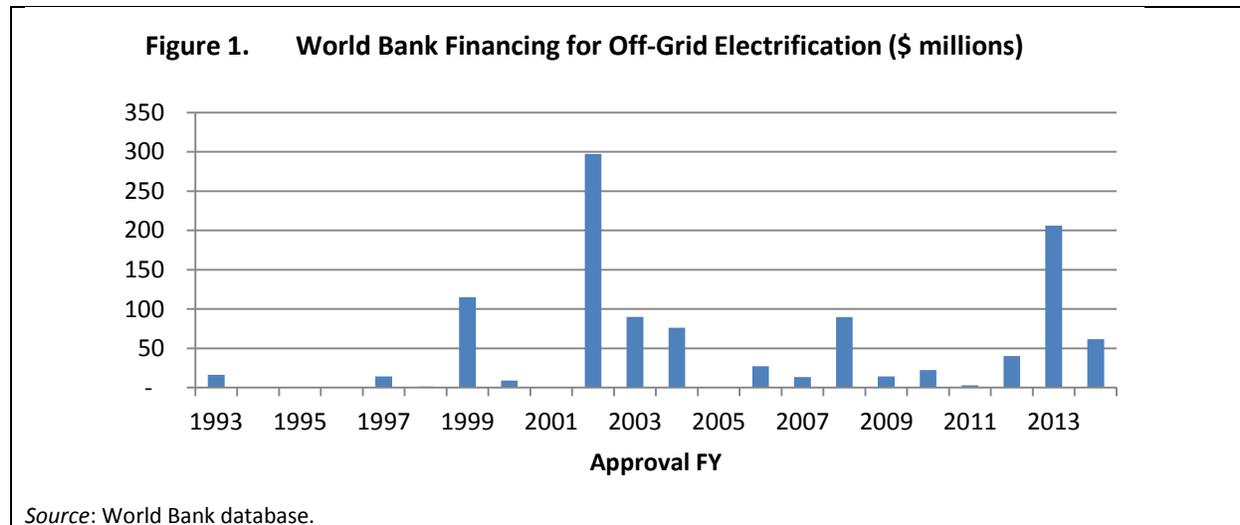
Of the various off-grid options, in the past decade, the use of individual home systems has grown sharply, with the addition of about 3 million off-grid connections in Bank client countries, though about 70 percent of this achievement is in seven countries – Argentina, Bangladesh (by far the largest, accounting for 40 percent of the total), Ethiopia, Mali, Mongolia, Nicaragua, and Sri Lanka. The joint Bank-International Finance Corporation Lighting Africa (Lighting Global) program has shown promising results in promoting the use of household and retail products such as solar lanterns or cell phone chargers. The lessons and findings for policy frameworks, institutional arrangements, service delivery systems, and viability quality assessments will be highlighted for different off-grid options in the learning product, with a view to informing future strategy. IEG will also examine evidence of the economic and welfare impact on the beneficiaries of off-grid services.

The IEG evaluation on electricity access also identified two clear niches for off-grid electrification – in “transitory off-grid areas” and “permanent off-grid areas” (Figure 1). Although off-grid electrification holds the potential to bring basic services to unserved areas rapidly, it is regarded at best as an intermediate option where grid extension is feasible but may not occur in the medium to long term (10-15 years). Over the years, the geospatial footprint of the transitional areas will shrink as the grid expands to cover them. In a systematically planned access expansion, there need to be appropriate technical and financial provisions to absorb transitory off-grid facilities into the grid. In remote and mountainous areas or small, dispersed islands, or for nomadic populations, off-grid sources may remain the only sources of electricity services.

WORLD BANK GROUP INVOLVEMENT IN OFF-GRID ELECTRIFICATION

The Bank Group has wide-ranging experience across all three generic off-grid options: isolated small generation network systems, individual solar home systems, and solar products sold for lighting and charging cell phones and small devices. These efforts cover the provision of individual units (mainly solar home systems), as well as isolated mini and microgrids using conventional or hybrid sources of energy. Solar lighting products are promoted through the Lighting Global program. The Bank Group has worked with client countries to employ several business and service delivery models appropriate to each context, including the vendor/dealer, fee-for-service, and community-based approaches.

However, the Bank Group's assistance for off-grid electrification has averaged just \$52 million per year during FY99–FY14, about 1.5 percent of its overall lending for the electricity sector. The assistance for off-grid electrification is limited to a relatively small number of client countries (mainly Argentina, Bangladesh, Ethiopia, Mali, Mongolia, Nicaragua, and Sri Lanka) and has been sporadic and uneven during this period (Figure 1). Attempts to promote isolated mini- and microgrids have been small in scale and scope and have not yielded significant results. In some countries, (Kenya, Myanmar, and Rwanda), the Bank Group is supporting governments in using geographic information system-based national access rollout planning and managing the constantly shifting interface between off-grid electrification and grid expansion. IEG will delineate the reasons for the Bank Group's relatively limited engagement in off-grid electrification in client countries from the evidence. The findings of the Bank Group's Global Practice (Banerjee, Soni, and Portale 2014) will also be examined in the learning product.



B. Purpose, Objectives, and Audience

IEG's electricity access evaluation (2015a) and project-level evaluations demonstrate that, with rapid advances in technologies and growing commercial maturation of service delivery models, off-grid electricity service provision has emerged as a viable alternative in some countries for providing basic electricity services to large unserved populations in a relatively short period. The impressive growth of

household solar home systems in Bangladesh in the past decade is a noteworthy case in point, where largely commercially viable business delivery models and associated services and supply and delivery chains have been mainstreamed.

However, in many countries that stand to benefit from off-grid electrification, the implementing capacity – whether through the power utility or other entities – is far below that of the traditional grid rollout. Such countries are unable to make headway in providing off-grid services because of shortcomings in institutional arrangements, planning and implementation capacity at different levels, balancing affordability and financial viability, providing quality assurance, and employing appropriate business and service delivery models. Even where the framework and capacity for off-grid services are improving, the proven implementation capabilities and speed of grid rollout may still make it the predominant and safe option to pursue. The learning product will cover the experience with a coordinated growth of grid and off-grid electrification.

In this context, a stocktaking of evaluative lessons and findings on what works or has not in specific country and institutional contexts will be of value to inform both strategy and operations going forward. From this product, the Bank Group can see lessons to support client countries that are yet to make a significant start with off-grid electrification.

C. Methodology

The objective of this learning product is to synthesize the findings, cross-cutting lessons, and good practices from IEG evaluations of the Bank Group’s experiences in promoting affordable and reliable off-grid electricity services in client countries. The learning product will address what has worked and what has not, and why, and will examine the contextual variables with regard to the Bank Group support. The findings and lessons relate to the following issues that have been raised collectively in IEG’s sector and project-level evaluations:

- Developing well-defined policy frameworks and institutional arrangements for off-grid electrification scale-up on a programmatic basis
- Adopting financially viable service delivery models that can deal with the relatively higher costs of providing services to beneficiaries who may be located in remote or dispersed areas and have limited ability to pay for the services
- Attracting private sector participation
- Developing the technical and managerial capacity to provide quality assurance of off-grid facilities and products as well as sustainable electricity services
- Managing the constantly shifting interface between the off-grid and grid electricity space, as the grid expands and replaces existing off-grid facilities to a greater or lesser extent, so as to avoid off-grid assets falling into disuse or becoming stranded assets.

The learning product will draw on several resources: IEG evaluations covering FY00–15, Implementation Completion and Results Reviews, Project Performance Assessment Reports, and sector evaluations. An

indicative list of these documents is provided in the appendix of this concept paper. The study will also draw on the detailed background material compiled for IEG’s recent evaluation of the Bank Group’s contribution to electricity access.

Members of the IEG team for this study will meet with staff and management of the Energy and Extractives Global Practice working on off-grid electrification to get their views and confirm the findings and lessons. A draft of the learning product will be sent for comments and discussed with the Global Practice before being finalized and submitted to the Board’s Committee on Development Effectiveness for information.

D. Quality Assurance

Quality assurance of the concept paper will be handled internally through the IEG Methods Advisor, department heads, and IEG management. The concept paper will be peer reviewed by Morgan Bazilian, Lead Energy Specialist, and Raihan Elahi, Senior Energy Specialist, Energy and Extractives Global Practice, who bring strong research and operational experience in off-grid electrification in client countries. They will also peer review the final learning product.

E. Expected Outputs

Circulate draft concept note for virtual review	December 7, 2015
Deadline for comments on concept note	December 18, 2015
Report preparation	Dec 2015–March 2016
Draft report completion	April 8, 2016
One-stop meeting	April 22, 2016
Final report completion	May 20, 2016

DISSEMINATION

The main audience for this learning product is the Global Practice for Energy and Extractives. Energy practices in other multilateral development banks and bilateral donors may also find it of interest to their own activities. After the standard process of review and comments from the Bank Group management, the learning product will be disclosed publicly, per IEG’s policies. It will be disseminated through the IEG website and through presentations at appropriate forums.

F. IEG Staff Resources

Ramachandra Jammi (task team leader): Senior Evaluation Officer
Varadarajan Atur: Lead Evaluation Officer
Mario Marchesini: Senior Evaluation Officer
Katsumasa Hamaguchi: Evaluation Officer
Arun Sanghvi: Senior consultant and electricity access expert
Thao Thi Phuong Nguyen: consultant, data analysis

APPENDIX A

Recent IEG Products Covering Off-Grid Electrification

I. Major Sector Reports

- IEG. 2015a. *World Bank Group Support to Electricity Access: 2000–2014*. Washington, DC: World Bank.
- IEG 2015b. *World Bank Group Support to Electricity Access: 2000–2014—Volume II: Together for Energy: How Partnership Programs Support Energy Access*. Washington, DC: World Bank.
- IEG 2009. *Climate Change and the World Bank Group, Phase I: An Evaluation of World Bank Win-Win Energy Policy Reforms*. Washington, DC: World Bank.
- IEG. 2008. *Welfare Impact of Rural Electrification: A Reassessment of Costs and Benefits*. Washington, DC: World Bank.

II. IEG Field-Based Project Performance Assessment Reports

- IEG. 2014. “Bangladesh: Rural Electrification and Renewable Energy Development and Power Sector Development Technical Assistance Project.” Project Performance Assessment Report No. 88546, World Bank, Washington, DC.
- IEG. 2014. “Sri Lanka: Renewable Energy for Rural Economic Development Project.” Project Performance Assessment Report No. 88547, World Bank, Washington, DC.
- IEG. 2014. “Vietnam: Transmission, Distribution, and Disaster Reconstruction Project: Rural Energy Project, and System Efficiency Improvement, Equitization, and Renewables Project.” Project Performance Assessment Report No. 88543, World Bank, Washington, DC.

III. IEG ICR Reviews (Partial list; all projects with off-grid components FY00–16 will be covered)

- Argentina: Renewable Energy in the Rural Market Project, No. ICR1336, June 26, 2013.
- Mali: Household Energy and Universal Access Project, No. ICR2627, March 28, 2013.
- Mexico: Renewable Energy for Agriculture Project, No. ICR0044, January 29, 2007.
- Nicaragua: Off-Grid Rural Electrification Project, No. ICR1340, June 16, 2012.
- Peru: Rural Electrification Project, No. ICR2358, December 26, 2013.
- Senegal: Electricity Services for Rural Areas Project, No. ICR2699, June 21, 2013.
- Uganda: Energy for Rural Transformation Project, No. ICR1288, December 23, 2009.

Other Selected World Bank Group Publications

- Banerjee, Sudeshna, Ruchi Soni, and Elisa Portale. 2014. *Measuring the Results of World Bank Lending in the Energy Sector*. Washington, DC: World Bank.
- International Finance Corporation. 2012a. *From Gap to Opportunity: Business Models for Scaling Up Energy Access*. Washington, DC: World Bank.
- International Finance Corporation 2012b. *Lighting Asia: Solar Off-Grid Lighting—Market Analysis of India, Bangladesh, Nepal, Pakistan, Indonesia, Cambodia and Philippines*. Washington, DC: World Bank.
- World Bank. 2013. *Toward a Sustainable Future for All: Directions for the World Bank Group’s Energy Sector*. Washington, DC: World Bank.
- World Bank. 2012. *Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices*. Washington, DC: World Bank.
- World Bank 2011. *One Goal, Two Paths: Achieving Universal Access to Modern Energy in East Asia and the Pacific*. Washington, DC: World Bank.
- World Bank 2010. *Addressing the Electricity Access Gap*. Washington, DC: World Bank.