

Energy Last Mile

The Problem

The vast majority of the population without access to electricity in India resides in rural areas. The electrification rate in urban areas is 97%, while rural electrification rate was 74% as of 2016 (IEA, 2017). Several dedicated programmes funded by the Government of India have been initiated in the past to address the challenge of rural electrification such as, the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) initiated in 2005, the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) initiated in 2015 and the most recent Saubhagya Scheme launched in 2017. While most government programmes focused on village level electrification, household electrification came to the forefront much later.

The number of people currently without electricity access is estimated at 239 million, which is a quarter of the estimated population globally without access to electricity (IEA, 2017). Successfully addressing the challenge of complete electrification will not only be a big achievement for India, it will also be a significant step towards achieving the global development goals.

Household electrification holds the potential to change the nature and quantum of productivity within home as well as in commercial enterprises. There is ample evidence to show the positive impacts of access to reliable electricity in developing countries (Samad & Zhang, 2016). The welfare benefits of electrification are realized through inter-related pathways such as that of lighting, health, education, productivity, labour participation, enterprise development and income generation (Khandker, et al., 2012).

As of October 2017, 10 districts in Rajasthan reported less than 50% achievement in household electrification. Of these, Bikaner district was selected for this study as it reported a relatively low 49% achievement on the intensive electrification (households) program and only 16% Below Poverty Line (BPL) households with access to electricity. Further, 62% of rural households in Bikaner, Rajasthan have been electrified and the balance 38% do not have access as per Saubhagya scheme online dashboard.

Solutions

Interventions	BCR	Benefit (INR Crores)	Cost (INR Crores)
Grid Electrification	1.01	2,736	2,717
Solar Micro Grids	0.72	8,126	11,350
Diesel Micro Grids	1.02	2,784	2,722

*All figures assume a 5 percent discount rate.

The full paper by **Gaurav Bhatiani**, Chief Operating Officer of IL&FS, and **Harsha Meenawat**, Assistant Manager of IL&FS is available on www.rajasthanpriorities.com/energy.

Grid Electrification

The Problem

Grid extension has been the focus of government measures to provide electricity access. As per the online dashboard statistics of Saubhagya scheme,

Ministry of Power, 62% of rural households in Bikaner district, Rajasthan have been electrified and the balance 38% do not have access to electricity.

The Solution

This intervention envisages connecting all un-electrified households to the electricity grid

serviced by Jodhpur Discom (JdVVNL) with daily continuous 24 hours supply. The grid is assumed to be predominantly coal fired and the cost of generating electricity has been calculated based on a representative new coal fired (supercritical technology) plant which performs at high efficiency..

Costs

The costs for this intervention is a sum of costs of additional electricity generated, capital costs (for transmission, distribution and meters), operation & maintenance costs and social cost of carbon.

The net present value of total cost for the intervention is estimated at INR 2,717 Crore at a discount rate of 5%

Benefits

Revenues are generated through recovery of tariff from the connected rural households. Salvage value of assets at the end of project life has also been included.

With electrification, various welfare benefits will be accrued by private citizens in the form of better lighting, improved outcomes of health, education and productivity. Further benefits accruing to private enterprises due to reliable supply of electricity are also factored.

The net present value of total benefit from the intervention is estimated at INR 2,736 Crore at a discount rate of 5%.

Solar Micro Grids

The Problem

While grid connectivity is the mainstay of providing electrification to rural households under central schemes, the geography and the average direct normal irradiance for Bikaner (5.47 kW/m2/day) makes it potentially a good location for setting up distributed solar power generation.

The Solution

This intervention envisages providing electricity to all un-electrified households by installing solar microgrids distributed across villages as per local capacity requirement. These micro grids may be serviced by the Discom or provided through franchisee models; alternatively, these may be

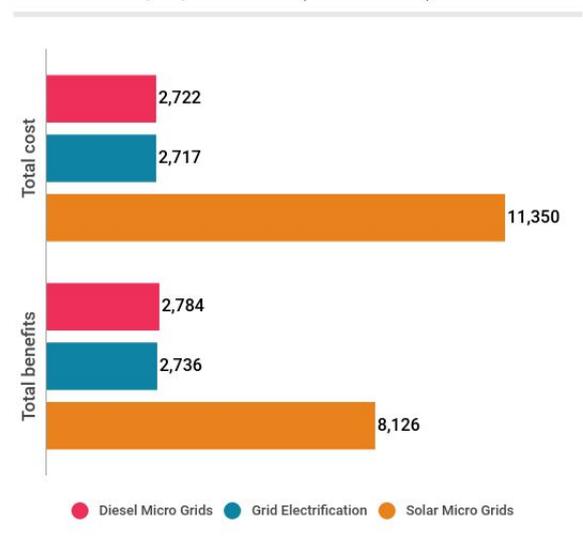
contracted out to community enterprises or even private players to set-up, operate and maintain.

Costs

The costs for this intervention is a sum of capital cost, cost of battery replacement, operations and maintenance cost.

The net present value total cost for the intervention is estimated at INR 11,350 Crore at a discount rate of 5%.

Costs and benefits of electricity access to unserved population (Rs. crore)



Benefits

The benefits due to this intervention are grid tariff as approved by the state regulator is used for revenue estimation escalated by the real wage growth to capture increasing willingness to pay. Salvage value of assets created has also been included.

Further same welfare benefits would accrue to private citizens as accrued in the grid electrification intervention. These benefits are paid through the tariffs and captured in the electricity revenue stream of benefits. Some additional minor benefits are also generated in the form of employment and enterprise to maintain the solar micro grid.

The total benefit from the intervention is estimated at INR 8,126 Crore at a discount rate of 5%.

Diesel Microgrid

The Problem

The base data for Saubhagya scheme presented on the online dashboard maintained by the Ministry of Power, Government of India, states that 62% of rural households in Bikaner, Rajasthan have been electrified and the balance 38% do not have access to electricity.

The Solution

This intervention envisages developing diesel generator based microgrids distributed across villages as per local capacity requirement to provide electricity to all un-electrified households.

Costs

The cost for this intervention is a sum of Capital costs for diesel gensets, Cost of diesel as fuel for power generation, Network connection costs, Operating and maintenance costs and Cost of additional carbon generated from diesel combustion in gensets.

The net present value of total cost for the intervention is estimated at INR 2,722 Crore at a discount rate of 5%.

Benefits

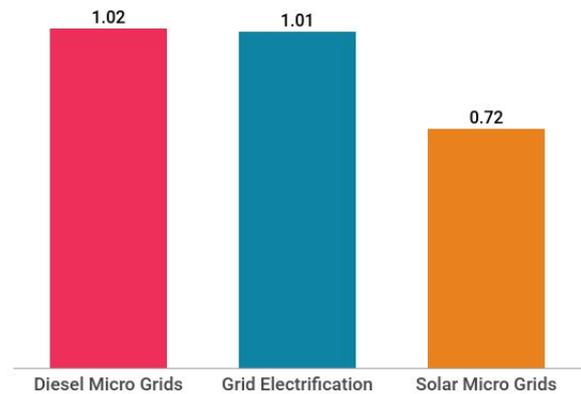
Based on the estimated capacity addition in the intervention design, electricity provision will be comparable to grid connectivity. Grid tariff in the form of monthly fixed and per unit energy charges is charged to households for revenue collection. It is

escalated by the projected real growth rate annually. An additional benefit of salvage value of assets created for this project at the end of project life has been included.

Welfare benefits would accrue to private citizens as accrued in the grid electrification intervention. Some additional minor benefits are also generated in the form of employment and enterprise to maintain the diesel microgrid.

The net present value of total benefit from the intervention is estimated at INR 2,784 Crore at a discount rate of 5%.

Benefit-to-cost ratio (BCR) of electricity access to unserved population



Source: Authors paper