Solar microgrids: An opportunity for improved energy access in schools

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Today, socio-economic development heavily relies on access to adequate, reliable, sustainable, and affordable modern energy services. The Sustainable Energy for All (SE4All) initiative aims to achieve universal access to modern energy services for households, productive uses, and community applications by 2030. Energy is one of the key drivers to progress towards education (SDG4) oriented sustainable development goal. Lack of affordable and clean energy poses barriers to the attainment of quality education.

Economic Survey (GoI, 2020) highlights that states with lower literacy rates also have low electricity rates at the schools and vice-versa. Access to quality and reliable energy improves the cooling, heating, and lighting in the school, thereby creating a conducive environment that improves both student's and teacher's productivity and efficiency. Modern teaching tools and techniques are rapidly emerging as promising solutions to enhance learning. The availability of reliable electricity enables the use of new technology even in remote areas. Thus, dedicated efforts to strengthen school's electrification are highly significant for a country like India. '

In India, government-run schools have the most extensive network, followed by privately managed schools. Available data suggest that government schools have a lower electrification rate than schools operated by the private sector (Table 1). Table 1 also suggests that 80% of the unelectrified schools in the country are government-run.

Table 1 All India electrification status by the school management

School Management	Number of schools	Electrified no. of schools	% Electrified schools
Government	10,83,747	7,59,558	70%
Aided	84,623	68,876	81%
Private	3,26,228	2,79,948	86%
Others	56,402	37,137	66%
Total	15,51,000	11,45,519	74%

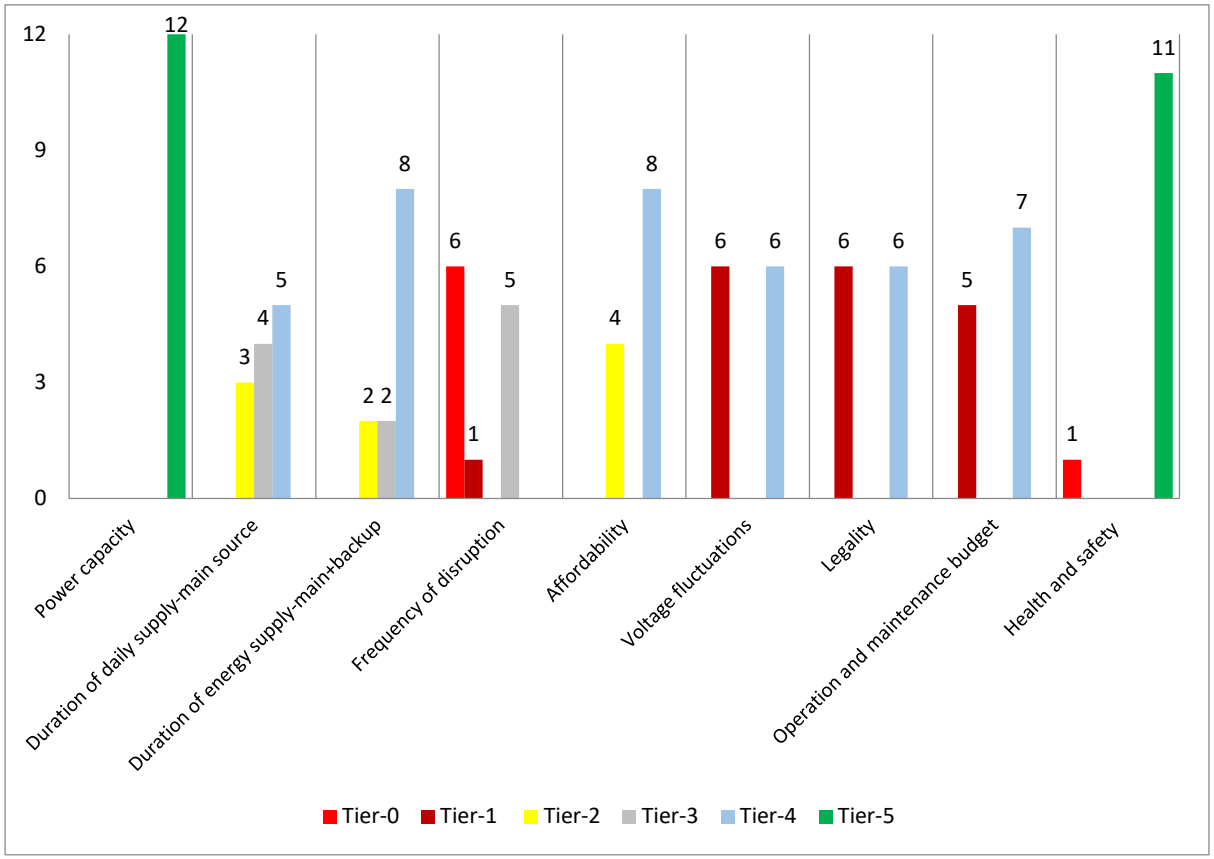
Source: UDISE 2018-19

Mere access to electricity connection does not serve the purpose of community facilities like schools. It is essential to have an adequate, reliable, and quality electricity supply for the proper

functioning of the facility. As the primary focus in the past has been on electricity connections, there is limited secondary data available on problems associated with electricity supply quality.

A survey of 12 non-residential senior secondary schools in Jharkhand, across 3 out of 24 districts namely Ranchi, East Singhbhum, and Deoghar, by IRADe indicates significant ground to be covered to improve the electricity access situation. A multi-tier framework (MTF) analysis of these schools (Figure 1) highlights that none of the schools falls in Tier-5/ advanced energy access in terms of duration of electricity supply, reliability, and quality (voltage fluctuations), adding to the challenge of energy access.

Figure 1 Distribution of non-residential senior secondary schools according to MTF attributes



Source: IRADe primary survey

IRADe's study reports an average daily availability of electricity for 3 to 5 hours during the working hours in the non-residential schools of Jharkhand. Some of these schools have inverters as a secondary source of electricity supply. But inverter's capacity is insufficient to cater to the total power demand in these schools. Therefore, electricity usage is limited to carrying out administration work and running computer labs. The study also assessed electricity access at three Kasturba Gandhi Balika Vidyalaya residential schools having solar rooftops with battery backup. Solarisation of these residential schools has markedly improved the

availability and reliability of electricity access. However, the quality of electricity supply from the grid remains a challenge.

Computer laboratory equipped with backup power at Kasturba Gandhi Balika Vidyalaya, Ranchi

"Energy is vital in education institutes; smart classes have made knowledge delivery easy and effective. Adequate fans and lights make the atmosphere comfortable for the students and have improved the student learning graph",

Headmaster, Kasturba Gandhi Balika Vidyalaya (KGBV), Ranchi

The solarised schools gain immensely in terms of electricity access to improve the quality and availability of educational services. The development of efficient solar PV systems and the fall in prices have made solar microgrids a leapfrogging approach for providing electricity access in schools where grid services have either not reached or are unreliable. Such micro-grids can provide instant, reliable, cost-effective, and portable sources of power to rural schools. Unfortunately, most of the existing educational infrastructure of India is solely dependent on grid electricity, and the benefits and opportunities of putting solar panels on academic buildings have been an untapped resource so far. Solar microgrids can be customised depending on the operational needs and have immense opportunities for impact if supported with appropriate policies and awareness creation.

The crucial factors for selecting the appropriate solar microgrids are the local grid supply conditions, the size, timing of the electrical loads, capital cost, and prices of alternative fuels. Most school buildings have large flat roofs that are perfect for solar panel installation. Secondly, the non-residential schools are operational during the daytime when adequate solar energy is available. Solar-plus battery storage microgrids are a better fit for residential schools requiring reliable electricity supply during the evening and night hours. Creating a robust local power source provides resilience to schools during primary grid failures and bears hope for improved education outcomes. Solar-based energy solutions will allow decouple school's energy dependence from the grid supply, from which quality of supply is a significant concern.

Installation of solar microgrids will allow the schools to save funds on fossil fuel-based secondary energy sources, which cannot be operated throughout the power cut duration due to limited budget and expensive fuel. Solar power can help reduce emissions from using carbon-intensive energy sources at schools. Installation of energy-efficient appliances at schools will cut the peak power demand and the size of the solar power system to cater to these demands. Furthermore, with ground-level assessments of energy use scenario, energy efficiency, peak power demand, cost-benefit analysis, by type of schools, i.e., primary, secondary, senior secondary, etc., we can better understand investment opportunities for solarising schools. There is a need to leverage the opportunities where solar microgrids can promote clean and reliable energy for improved service delivery at schools.

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