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Solar Energy for Education: Challenges and Opportunities
Assessment Findings and Strategy for Energy Transition

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For more than a decade, the Gaza Strip has continued to struggle to secure sufficient electricity supply to provide essential services for its two million inhabitants. Gaza relies primarily on imported electricity from Israel (approximately 120 MW), while the remaining amount - between 100-40 MW is generated by the Gaza Power Plant (GPP), which has a total generation capacity of 140 MW. Due to its inability to secure fuel, the GPP was generating only 25 MW until funds were committed to cover the cost of fuel, allowing it to generate 80-70 MW daily.

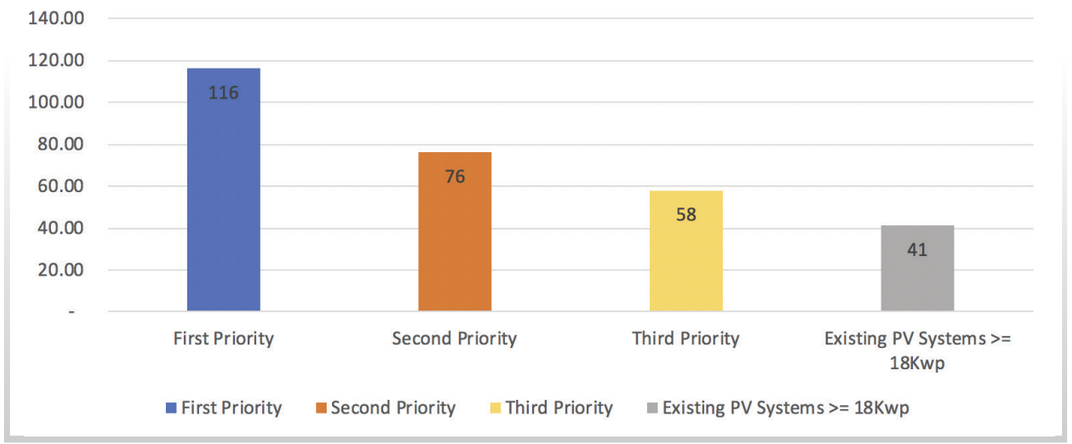
The education sector suffers from a chronic shortage of power supply which compromises students' access to an adequate learning environment. This has affected the students' ability to see in the classroom, especially during winter when daylight hours are shorter, and during early and late hours brought about by the double shift system in schools. There are 409 governmental schools serving 265,809 students (Annual Statistical Book for Education in Gaza Governorates 2019/2018), of which around %57.7 operate on double shift basis, and in few cases triple shifts. Thus, many students attending school are affected every day.

The rooftops of schools are ideal for installing solar panels to produce the energy needed to operate education facilities. Yet, a comprehensive assessment has not been conducted to determine the feasibility of solar electrification of schools in the Gaza Strip to perform a full transition. Therefore, UNDP and the Ministry of Education (MoE) jointly conducted an assessment of the potential of governmental school buildings to deploy renewable solar energy. The findings and recommendations are outlined in this report.

The assessment tools included a questionnaire administered by the joint assessment team, in addition to the utilization of satellite images and data provided by the MoE to investigate the school rooftops. Satellite images were used in assessing 133 out of 291 school buildings, serving 182 schools, and were found to be adequate for implementing solar systems. Field visits were carried out to schools where shading was covering parts of the schools, and applicability of installing solar system on their rooftops. In total, 117 school buildings serving 176 schools were field surveyed using a standard questionnaire. Despite that parts of 47 school buildings' roof tops (serving 77 schools) are shaded, the findings of the field visits indicated that the remaining space can still accommodate PV solar system with full capacity of 25 KWp. Additionally, 41 school buildings, serving 51 schools, were not visited as they already have a Photo Voltaic (PV) solar system with a capacity of 18 KWp or more, according to the MoE.

The full energy requirement for the schools was determined to be around 25 KWp, which will cover the needed energy loads in the majority of schools based on consultation with the MoE. According to the findings of the assessment, 175 school buildings, serving 250 schools, are still suffering from electricity shortages as they have no solar energy systems. Moreover, 75 school buildings, serving 108 schools, need upgrading of the existing solar system, since what have been installed is below the power needed for the school, estimated at less than 18 KWp. On the other hand, 41 school buildings serving 51 schools have adequate solar systems (with capacity of 18 KWp or more) to operate the school facilities; yet for most of them, energy efficiency is still needed for optimal utilization of the solar system. Therefore, for these schools, there is no need to install additional PV solar system, but rather to apply energy efficiency

Priorities for Proposed PV Systems No. at Governmental School Buildings



Analysis of the data collected revealed that deployment of the PV solar system to the schools can be categorized into four priority levels according to a set of criteria agreed upon with the MoE. The criteria included: number of school shifts and the grades served by the school. The schools were categorized as follows:

First Priority

Schools that have two shifts or more. 116 school buildings are under this category.

Second Priority

Schools that have one shift and serve Secondary stage. 76 schools are under this category.

Third Priority

Schools that have one shift and serve Primary stage. 58 schools are under this category.

The below table illustrates the different priorities with proposed PV solar system capacity and corresponding costs in US Dollar

Priorities	No. of Schools Buildings	Proposed PV Capacity in (KWp)	Total PV investment Cost (US$)	Total Energy Efficiency Cost (US$)
First	116	2,786.50	9,195,450	928,000
Second	76	1,816.5	5,994,450	608,000
Third	58	1,450	4,785,000	464,000
Existing PV Solar System that cover all school loads	41	–	–	176,000
	291	6,053.00	19,974,900	2,176,000
Total PV Solar System+ EE Cost in US $			22,150,900	

The transition to renewable energy will contribute to solving the electricity shortage face by governmental schools and contribute to addressing the energy crisis in the Gaza Strip. The system effectiveness will also be tracked during winter and at times when there is inadequate sun light (i.e. in the early morning and in the late afternoons). It will support the quality of the education services delivered to 228,538 students across the Gaza Strip annually, by ensuring that all governmental schools have access to continuous source of energy, while reducing the energy consumption from the utility grid.

While a battery backup storage capacity may be required, it could be limited to four hours for double shift schools to optimize the PV solar energy system. In order to mitigate potential environmental hazards, safe and sustainable measures must be put in place for the disposal of depleted batteries.

A collaboration and coordination framework for solar energy in the Gaza Strip has recently been established amongst UN agencies and NGOs, in order to engage all relevant stakeholders working on efforts to transition from dependency on grid electricity and fuel-run generators, to renewable energy systems. The coordination group is led by UNSCO and UNDP at the strategic level, and UNDP and UNOPS/PMU at the technical level. The on-going mapping exercise led by the technical group is expected to contribute to harmonizing the activities and engagement of donors, international and national implementing entities, international agencies, and relevant local authorities. This database will help decision makers in making well-informed decisions regarding solar Energy Sector in the Gaza Strip.

Finally, the main findings and recommendations are summarized as follows:

01 The school buildings are in line with the Palestinian Solar Initiative planned by PENRA to mainstream solar renewable energy utilizing the roof tops of all governmental school buildings in full compliance with the preset national standards and strategies.

02 School buildings operating on double shifts or more are recommended to be targeted as the first priority, since each one is hosting around 1255 students on average.

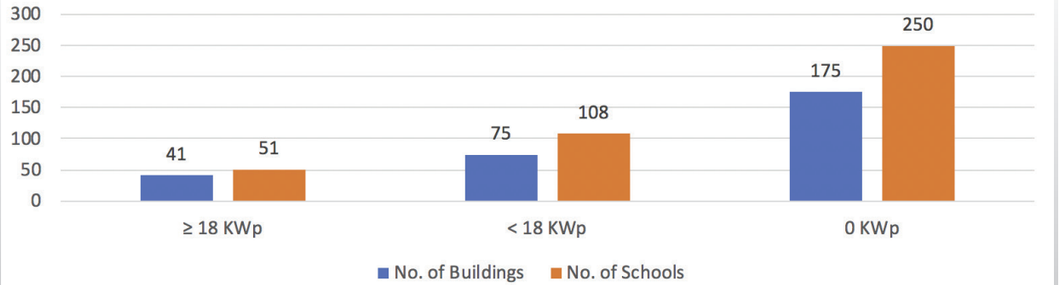
03 Since the use of schools is mostly during day time, the on-grid PV solar system with maximum 04 hours battery backup is recommended for adoption to supply electricity to school facilities.

04 Energy efficiency measures must be part of the intervention of any solar system for schools, as it yields considerable savings with minimum inputs compared to other investments.

05 The available space on the roof tops of the school buildings can accommodate more PV cells, and therefore, excess energy produced beyond what is required for the schools can serve the local communities.

06 To sustain the benefits of significant investments in a new source of energy for the education sector, a clear operation and maintenance scheme with relevant capacity building measures are recommended to be part of the planned interventions, and properly budgeted.

Categorization of school buildings and schools according to the availabilty and capacity of solar system



The PV solar energy potential for all governmental school facilities are estimated at 6 MWp, which will require an investment of US$ 22.15 million, which includes Energy Efficiency (EE) measures .

Annual savings of US$ 1,84 are expected from the reduced electricity consumption supplied by the public grid, as a result of the deployment of PV solar systems combined with application of energy efficiency measures in the targeted schools. The investment is expected to pay back within 12 years.