Grid-connected photovoltaic systems for the residential and commercial sectors

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Abstract

Photovoltaic (PV) systems are currently the most common method for producing solar electricity. Their great advantage lies in their many installation options and their variety of energy outputs, beginning with less than one kilowatt peak (kWp) systems, which can be installed on a single pole or small roof, up to systems of many Megawatts peak (MWp), covering extensive areas, which are suitable for power stations. The alternative solar thermal system is cheaper in terms of investment per installed kW and is more effective in terms of efficiency, space utilization and backup possibilities. However, the size required is at least of some dozens of MW and it is therefore suitable only for power stations.

Many countries offer incentives to encourage the installation of grid-connected PV systems that do not rely on batteries, under a Feed-In Tariff (FIT). The first country to introduce FIT was Germany, followed by most other European countries. In Israel, this kind of tariff was introduced for the first time in 2008. The contract with the Israel Electric Corporation (IEC) sets the sum received by the installer per kWh (after granting a permit) for 20 years, and includes the IEC's commitment to purchase all the electricity produced by the system. The initial FIT determined in 2008 by the Public Utility Authority–Electricity was 2.01 NIS per kWh (about 4 times the price of electricity sold to customers). Following reductions in cost of PV systems, the tariff was reduced and stands today at 1.67 NIS/ kWh.

Recently, some countries have reduced subsidizing of PV systems, due to the resulting burden placed on their utility companies. For example, sunny Spain was the first to retreat from the approach it had previously practiced. Today, it is permissible to sell electricity produced by a PV plant to the utility company for only 4 hours a day, and the income is taxed. Germany has also lowered the tariff and re-examines it every six months. The only exception in this regard is France, where the tariff is, to this day, 60 Eurocent per kWh.

The main issues related to grid-connected PV systems include: allocating quotas to installed systems at a special tariff; regulation, including standards and licensing to plants

and installers; encouraging local content in systems eligible to the special tariff; and allocating land to commercial systems, where installation on existing roofs is not involved. These issues and others were discussed in the Forum.

The number of grid-connected PV systems installed in Israel in the residential and commercial sectors has increased constantly ever since FIT was introduced in 2008. The total power produced by all installations today stands at about 50 MWp, out of the 110 MWp that had been licensed. About 60 companies are active in Israel in this area; regretfully, not all of them are professional. This area is new to Israel; there is no mandatory standardization, and there is a shortage of regulation and training of skilled manpower.

The cost of PV systems has decreased considerably in the last couple of years (some say – due to the global economic crisis) and stands today in Israel at 13,000 – 15,000 NIS per kWp installed (for systems of 50 kW). In parallel, the tariff, which started in 2008 at 2.01 NIS for kWh was reduced. A PV system produces, on national average, about 1760 kWh in one year per kWp. Accordingly, the investment payback period stands at about 8 years and is considered attractive in comparison to investments with a similar level of risk, such as real estate. The installation license carries a commitment to purchase the produced electricity for 20 years. In the future, electricity, and especially green electricity, will be a commodity in short supply and it is reasonable to assume that every Watt-hour produced will be purchased. Those who do not install today will experience a shortage tomorrow.

Renewable energy and PV systems in particular, should be considered as part of the future electricity market. The present high price is not the most important consideration, because we are approaching a situation of energy shortage. Furthermore, the current cost of a kWh from PV does not reflect all its beneficial components in terms of CO_2, air pollution, the cost of health and more, and when these elements are factored in, the "price" goes down. PV electricity is available when it is needed most, and can be used particularly as a measure for serving peak demand. Regarding installations on rooftops of residential buildings, every house has a refrigerator and other appliances that operate even when no one is home, and these few Amperes are transported today from the power station to the house, with more waste than real consumption, due to transmission losses. Local electricity production saves transmission as well as the production of electricity that will be wasted; it has a place in the future market as part of a diversified basket of renewable energies.

An interesting question that was raised during the discussions: Is PV technology green at all, in the global sense? One has to take into consideration that the panels are imported

from China, where their production consumes large amounts of energy and adds to global pollution.

Recommendations:

Standards and regulation: At present, Israel has no mandatory standards on the subject of PV. The Office of Standard and Regulations is acting to remedy the situation, while adopting foreign standards where possible, in order to expedite the process. Some argue that the PV system that feeds electricity into the national grid has to be of high-quality and adjusted to the grid, hence the justification for demanding and even enforcing high standards. As in other areas, standardization is obviously necessary, in order to differentiate high-quality systems that are given a stamp of approval from inferior systems without one, to enable the customer to consider his purchase properly.

Demand for local content and inputs: Grid-connected PV systems receive a considerable subsidy from the taxpayers' money. In a state such as Israel, which has no local PV industry, the subsidy finds its way to the importers and, through them, to the systems' manufacturers, located mainly in China. It is recommended to demand and even to enforce that each installation includes local content and inputs. The views of the Forum participants were divided regarding what percentage of the cost of the systems local content should constitute. For comparison, Canada requires 60% local content.

Design: to ascertain the planned income from any system, small or large, simulation tools should be used for the design. It is necessary to conduct acceptance tests, install radiation and temperature gauges and use a monitoring system for daily, weekly, or other monitoring.

Training the installers: There is no requirement in Israel today that installers be certified. The installation of a PV system includes a variety of elements: construction, electricity, and so on. The construction permit given to the constructor is signed by an engineer, and the electricity plan of the project must be approved by a certified electrician; however, the installation of the system in the field is not supervised at all. It is recommended that training of the installers and designers be mandatory and that courses on these subjects be opened.

Banks or other financial institutions that finance the installation of any PV system would be wise to demand that the system be installed by a certified installer.

Technical information: Most of the installation companies refrain on purpose from disclosing the installation details – there are no inverter data, current data, information

regarding the number of panels – in an effort to conceal information about the output. The IEC examines the electricity that leaves the inverter, but nobody knows what actually happens inside the system. The inverter supplier in Israel does not publish the information, because there is no official requirement for it. The result is totally unprofessional installations.

It is recommended that a central server be established and that it be mandatory that each installation company sends its data to that server. Such information will be very helpful to academic research and will also allow companies to be categorized and rated. A license for PV installation should be conditional on the transfer of such data.

Recycling: The whole lifecycle of the panels should be considered. What will happen to the tens of thousands of panels after their decomission? These panels contain substances such as cadmium and other harmful substances for which a disposal solution has to be found, through recycling or some other process, at the end of their life.

Land allocation: The rooftops of private houses have less than 10 square meters per person; this is certainly insufficient. Other rooftops, such as of parking lots, cowsheds and more should be exploited – without quota limitations. The use of cultivated land and desert areas that are considered agricultural land but will never be used for agriculture due to the shortage of water - should be allowed. Also, it is recommended to allow solar systems to be installed on greenhouses in Israel. Installing a covered part close to an exposed part still allows agricultural use of the greenhouse.

Quotas to systems with special tariff: Some of the Forum participants said that they are against quotas at a preferential tariff for PVs installed on private houses, because this creates companies that employ people; when the quota is filled, unemployment and resentment will result. The real value should be estimated, including the benefit to the economy. This kind of tariff is stable and it should be continuously updated; there would then be no need for quotas.

Consistent policy: The "zigzags" in policy are killing this industry. It is necessary to find an appropriate tariff and stabilize the system, thus avoiding constant disruptions, which cause problems in the continuity of the entrepreneurs' work. The regulation in Israel is one of the strictest in the world. In Thailand, for example, there is one central authority to which a summary of all the details are sent, after which the project is launched. In Israel, the interested party first obtains a conditional license, but there is no guarantee that he will be able to realize it. The result is that three times more offers are made than the existing

quota can absorb, and nobody really knows how much of these offers will materialize – perhaps half of the quota.

Recommended actions for removing the barriers to PV installation include: public information, simplifying and shortening the process of receiving permits, allocating long-term quotas for new projects, a high short-term tariff and commitment to design demands.