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Executive Summary

The Additional Value of Rooftop Solar

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The Program awards annual fellowships to outstanding Israeli graduate students. We train and deploy some of Israel's best and brightest young professionals to create pragmatic financing and economic policy solutions.. Our applied research and Financial Innovations Labs® are a launching pad for transformative change, using innovative financing mechanisms, programs and policies to bridge social, regional, economic and productivity gaps within Israel and between Israel and the world.
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Government resolutions No. 4450 of January 29, 2009, and No. 542 of September 20, 2015, set energy targets that Israel should generate at least 10% of its electricity by renewable energy by 2020 and 17% by 2030. To meet the Government's targets of 2020, Israel will need to install between 1,500 to 2,000 megawatts of solar energy, on top of the 1,000 megawatts already installed, and the 400 megawatts currently being installed. That is, in less than two and a half years, Israel will have to more than double its current solar capacity, which took more than five years to accumulate. So far, most of the solar capacity has been installed on ground-based solar fields. However, to achieve the government's targets by 2020, Israel will not be able to focus only on land-based solar fields, as the process for securing land use permits is lengthy and difficult, with competition from the army, agriculture, parks and reserves, and residential uses. Moreover, connecting the solar fields to the electricity grid is quite expensive and a long process by itself.

A possible solution to this problem is to install solar panels on rooftops. In contrast to solar fields, solar panels on rooftops do not require any additional land, and are relatively easy (though not cheaper) to install. The potential capacity of current rooftops (in terms of solar) in Israel is between a few thousand megawatts to more than ten thousand. Israel has about 400 megawatts on rooftops already, leaving room for absorption of additional capacity. The challenge in installing panels on rooftops is their cost – the installation of rooftop panels (mainly small systems) cost more per megawatt than the installation of solar fields. Therefore, without the right incentives, expanding the installation of rooftop panels will be too slow to achieve the country's goals. In this research, we examine whether rooftop solar provides additional value in comparison to solar fields, and if so, how do we prioritize it, and what can we do to encourage it. We examine the major benefits of rooftop solar, and quantify its monetary value in terms of kilowatt hours (kWh). It is important to note, however, that the purpose of this paper was not to quantify the full value of rooftop solar, but, the added value of building on rooftops, mainly when comparing it to solar fields. Understanding this incremental value may help the regulators in deciding the proper support for the installation of rooftop solar.

We find that the main benefits of rooftop solar (compared to solar fields) include a combination of direct and indirect benefits.

Direct Benefits:

- Savings on Connecting Power Lines – by installing rooftop solar, the Israel Electric Company (IEC) and eventually the electricity customers save the cost of the special connecting lines that are needed to connect the solar fields to the power grid, versus using existing trunk and lateral distribution lines already serving buildings.1
- Savings on Line Losses – by producing electricity at the local area of consumption (in buildings and blocks with nearby rooftop installations), operators and eventually the electricity customers save on the energy being lost (about 6.1% of production) when we transfer it at the distribution and transmission lines, from the far point of production (solar fields) to the point of consumption.

Indirect Benefits:

- Savings on Land – By using rooftops, less land will be consumed, and the limitations imposed on current open spaces in the future, as the country grows and the need for more land becomes vital, are reduced. The added-value of the land is calculated as the difference between the sum of money entrepreneurs need to pay for the lease of the agricultural land, and the estimated value of its potential produce and ecological value.
- Contribution to Security and Reliability – when it comes to energy, Israel is an island, since it cannot import electricity from its neighbors. By producing electricity on rooftops and decentralizing the means of energy production, the country reduces the economic costs of outages and distributes the production risks beyond a central grid.2
- Contribution to Employment – the installation of rooftop panels (mainly small panels) requires more labor than solar fields (for the same installed capacity). Therefore, rooftop panels provide more jobs on average.
- Contribution to Energy Efficiency (Shadowing) - when the sunlight hits the building, it warms the roof and thus heats the building. Installing solar panels will block the sunlight from hitting the roof, thereby prevent heat from entering the building. Hence, during the

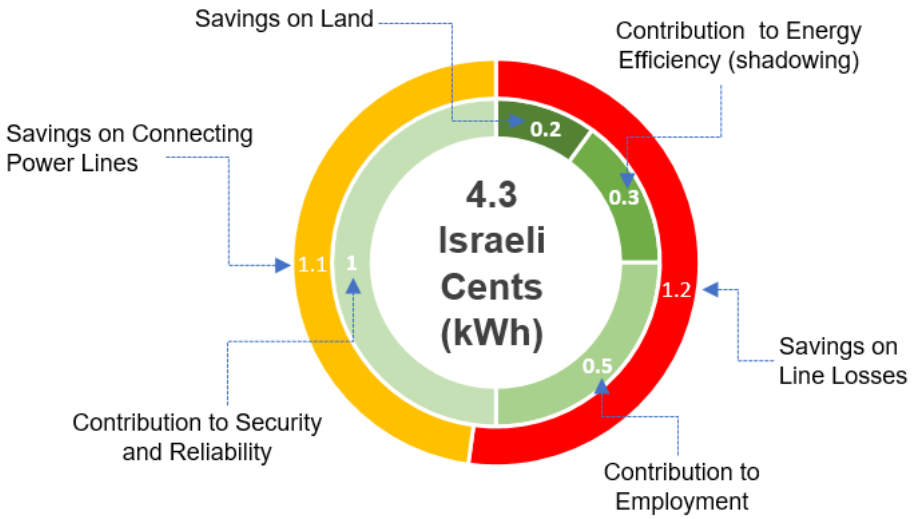
[1] In addition to the savings on the connecting power lines, by producing power at the area of consumption, we might be able to defer or avoid transmission upgrades. Yet, at high levels of solar penetration, we may need to transfer more energy at the local grid (during hours of production but no consumption), and hence we may need to upgrade the local distribution lines. Thus, the savings from the transmission lines could be offset by the need to invest at the distribution lines.

[2] Currently, due to regulation in Israel the solar panels are automatically disconnected when a gird failure occurs. Yet, with the right directive it could be quite easy to solve.

intense heat of the summer seasons, by installing rooftop solar we might be able to save on air conditioning hours.

The figure bellow presents the value of each of the benefits described above.3 When possible, we tried to be conservative in our estimates, and thus the additional value of rooftop solar may be higher.

Fig 1. The Additional Value of Rooftop Solar



Source: Milken Innovation Center, 2017.

The estimated value is in fact the savings from installing rooftop solar (in place of solar fields) and its contribution to the economy and society.3

Recommendations

- To incentivize the installation of rooftop solar, the Government should give solar entrepreneurs a premium on top of the tariff that they would get for installing solar fields. The premium should include at least the direct benefits (savings on connecting power lines and line losses – 2.3 Israeli Cents per kWh).
- To encourage the public to install more solar capacity, the government should allow the public to sell its surplus (in the current net-metering regulation) beyond its average consumption, provided that the grid is free and able to receive the extra energy.4

[3] For solar rooftops that are far from the consumption area, the estimated benefits in terms of line losses are smaller.

- The Government can market the benefits of rooftop solar and the use of the net metering. The net-metering regulation is profitable for operators and owners even in its current format, yet there is limited awareness about this option. In particular, the Government could act as a role model in deploying rooftop solar systems and net metering to illustrate the use and benefits of these systems in Government buildings.
- A major part of the cost of solar panels is the "soft costs" - non-hardware costs associated with going solar. To reduce those costs, which are relatively high because of the limited market, the government should encourage more players to join the market. Moreover, to expand the installation of rooftop solar, the government should focus on solving the financing barriers of residential systems.
- The Government should create land use regulation and building permits that will encourage homeowners who share the same roof (e.g. apartment buildings) to install solar panels and use net-metering system.

[4] Net-metering allows solar panels or other renewable energy generators that are connected to a public utility power grid to sell back the surplus power to the grid, allowing customers to offset the cost of power drawn from the utility.

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