

Kibbutz Be'erot Yitzhak, Israel - 600kW

System Owner: Kibbutz Be'erot Yitzhak

EPC: M.G.A Energy Solutions Ltd

Capacity: 600kWp

Location: Israel

Installation Date: September 18, 2013

Inverters: 20 x SE17k and 13 x SE16k

Modules: 2,348 x Jinko Solar JKM
255M-60 = 599kW DC

Power Optimizers: 1,175 x P600 SolarEdge
power optimizers (1 optimizer/2 modules)



“Understanding the complexities of commercial PV systems, SolarEdge provides its partners with pre-sale, technical design, and installation for improved project profitability. SolarEdge partners receive tailored support at every stage of a commercial project to help streamline the entire process while ensure increased energy output at minimized costs. At SolarEdge, we know that our success is measured by our partners’ success.”
Zvi Lando, VP Global Sales, SolarEdge

PROJECT BACKGROUND

Kibbutz Be'erot Yitzhak, which manages a poultry farm in central Israel, wanted to control its energy costs and maximize earnings. The local Feed in Tariff (FIT) program, approved in 2008 by the Israeli Public Utility Authority, provided the Kibbutz an opportunity to achieve its needs by installing a PV system. The feed-in-tariff would provide system owners with \$0.40/kWh for 20 years.

Looking to install a PV system, Kibbutz Be'erot Yitzhak chose M.G.A. Energy Solutions Ltd as the EPC to manage the 600kW project. Having already installed 30 MW of installed capacity, M.G.A. Energy Solutions Ltd had been using traditional string inverters on previous commercial systems since 2009 and planned to continue doing so for the Kibbutz Be'erot Yitzhak site. During the design process, M.G.A. Energy Solutions Ltd compared traditional inverters by thoroughly and methodologically analyzing energy outputs, system costs, and design capabilities. Following the analysis, M.G.A. Energy Solutions Ltd chose to partner with SolarEdge and selected its power optimizers and inverters for the Kibbutz Be'erot Yitzhak site.

“SolarEdge’s innovative approach is apparent during every company interaction – from its technology and support to its system design and monitoring tools. The easy-to-use module-level monitoring, which provides increased system uptime and reduces O&M costs, made our decision to include SolarEdge technology straightforward. The one power optimizer per two panel technology made it a particularly financially attractive option. By working with SolarEdge, not only do we expect the site’s ROI to improve, but we also had a true partner.”

Mr. Gil Ovnish, CEO/Founder at M.G.A Energy Solutions Ltd

SITE DESCRIPTION

- 5 separate commercial-size roofs
- 3 tables are connected in a typical single string
- The typical module arrangement is in tables of 12, three rows of 4 modules (Diagram 2), in landscape orientation
- Each table contains 12 modules connected to six power optimizers (2 modules in series per optimizer) as per diagram 2

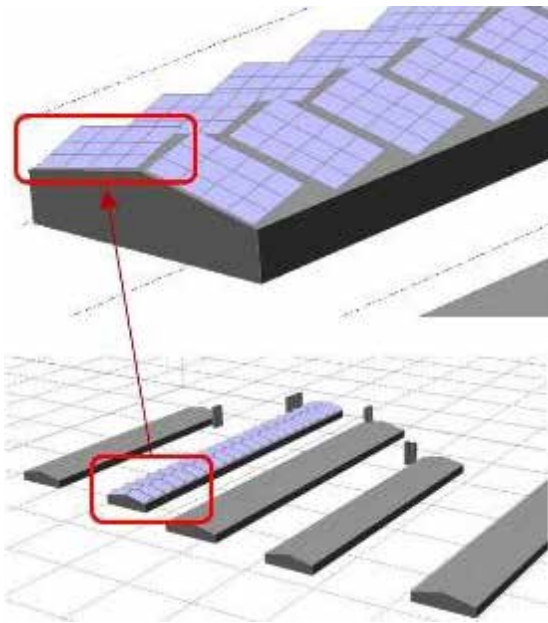


Diagram 1

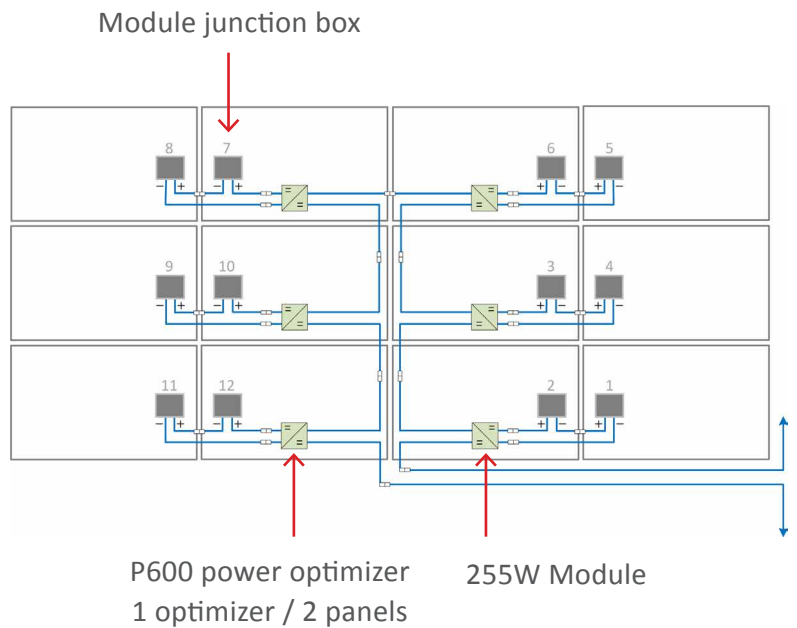


Diagram 2

ANALYSIS PROCESS

SITE DESIGN

After comparing the design of the SolarEdge system to that of a traditional inverter, M.G.A. Energy Solutions Ltd realized that the site design would be simpler and more cost-effective using SolarEdge technology.

The fixed-string voltage in a SolarEdge system allows fewer and longer strings compared to a traditional system and consequently a lower number of them - resulting in lower cable length as well as a reduced number of fuse boxes. A system with less strings reduces cost and simplifies the installation.

The unique flexible design allowed by SolarEdge **decreased DC BoS costs by a total of \$3,465** compared to using Power-One.

CABLE SAVINGS FOR 600kW SITE

DC cables cross section	Power-One (m)	SolarEdge (m)	% Cable Savings with SolarEdge
6mm	3,966	3,016	24%
10mm	1,802	705	61%
16mm	1,488	822	55%

* Figures estimates based on measurements from roof four which represents the full system

Diagram 3

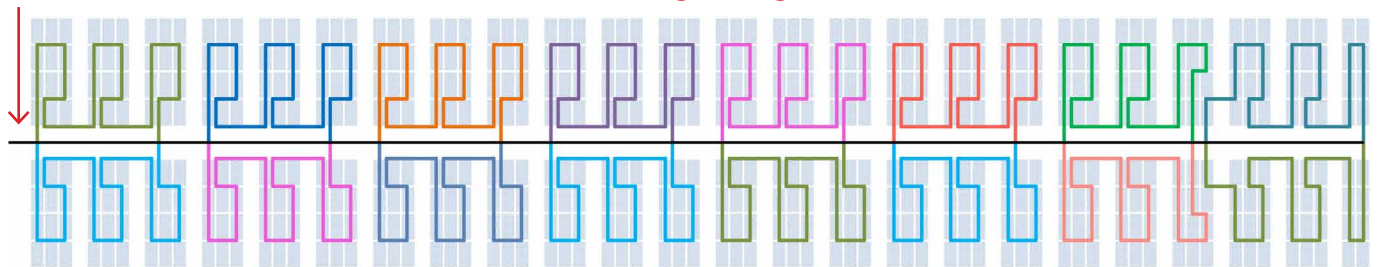
With a traditional inverter, this site would have required **105 strings**, but with the SolarEdge system it only needs **66 strings**. In addition, SolarEdge technology increased the strings' lengths to **36 modules** per string compared to only **23 modules** using Power-One. SolarEdge technology decreased this site's DC cable length by 2,713 meters compared to the Power-One system. With each string requiring a fuse box, the shorter strings of the Power-One system require more boxes than SolarEdge. Designed with SolarEdge, the project requires only 66 fuse boxes; however, if the project had been designed with Power-One, the system would require more than 100.

SolarEdge Design Flexibility

Typical String Inverter	SolarEdge Inverter
✗ Limited string length	✓ 26-60 modules per string (up to 11.25 kW)
✗ Must match string lengths per MPP tracker	✓ Uneven strings can work in parallel
✗ Shaded modules effect the entire string	✓ Only shaded modules are effected
✗ Cannot mix different types of modules	✓ Any modul type or size can be used
✗ Locked in to same orientation/ tilt per MPP tracker	✓ Any orientation/tilt

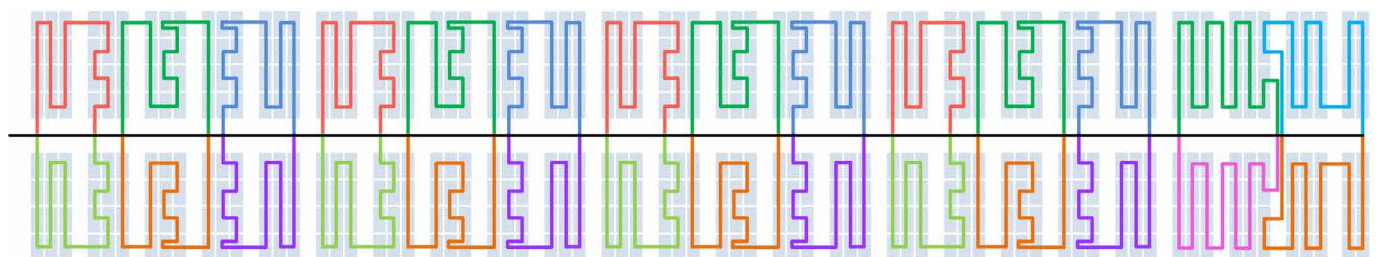
Conduit to inverter room

SolarEdge Strings



* Each color represents a different string

Power-One Strings



* Each color represents a different string

Diagram 4

The above diagram shows the layout of roof four from the Kibbutz Be'erot Yitzhak site. The layout of roof four is a typical roof layout for this site and is meant to act as an example for the entire system. It is important to note, that not only are there more strings with PowerOne, but in this project, **each string requires more cabling, despite containing less modules.**

ENERGY CALCULATION

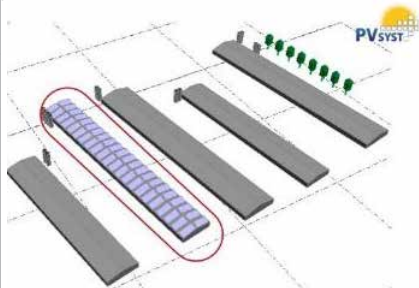
As part of the development process, M.G.A. Energy Solutions Ltd employed a PVsyst analysis comparing Power-One inverters to SolarEdge inverters and power optimizers. According to the PVsyst analysis, SolarEdge technology **improves the performance by 2.65% or 6.528 MWh/year** for the Be'erot Yitzhak site compared to Power-One.



TRIO 20.0 / 27.6



SE17k / SE16k

		Power-One	solar edge	Advantage, year 1
PVsyst Yield Forecast*	Annual AC Energy	1,057 MWh/yr	1,085 MWh/yr	2.65% 
	Performance Ratio	83.1%	85.2%	
	Shading Loss	3.8%	3.1%	
PVsyst Design	Inverters	21	33	
	Strings	105	55	
	Modules per String	16-23	34-36	

* Shading loss, PR and annual AC energy production are calculated by PVsyst.

Diagram 5

Sample module layout: roof four

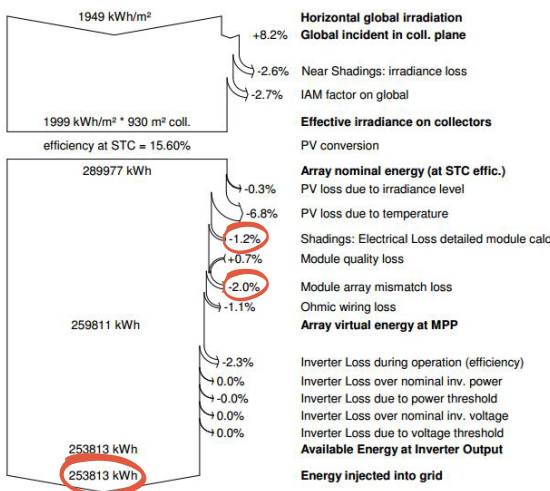
The above table shows the PVsyst comparison between Power-One and SolarEdge. According to the PVsyst prediction, roof four of the Kibbutz Be'erot Yitzhak site has an **improved performance ratio of 2.6%/year or 6.5MWh/year increase in energy production** with SolarEdge technology compared to Power-One.

* The time period measured corresponds with the table on page 5 that shows actual energy measured with the SolarEdge system for this site.

PVSYST REPORT FOR ROOF FOUR (144 KW)

Power-one:

Produced Energy **253.8 MWh/Year**
Performance Ratio PR **83.1%**



SolarEdge:

Produced Energy **262.3 MWh/Year**
Performance Ratio PR **85.2%**

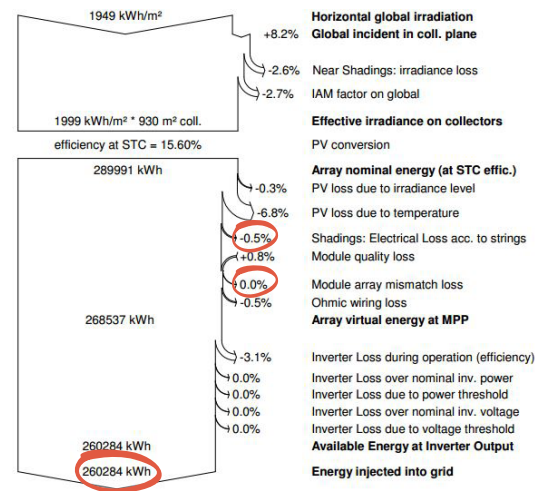


Diagram 6

The above diagram shows that the improved energy performance is due to SolarEdge technology recovering 60% of the Power-One system's shading loss and fully eliminating the 2% module mismatch loss.

MODULE-LEVEL MPPT

The increased energy output from SolarEdge technology is due to module-level MPPT that overcomes module-level mismatch. Module-mismatch has sources: tolerance, partial shading, soiling, thermal mismatch, uneven aging, and module orientation.

Monitoring Portal for Increased System Uptime

Responsible for the output guarantees, M.G.A. Energy Solutions Ltd wanted to gain improved visibility into the system performance. The unique module-level monitoring by SolarEdge, which enables accurate troubleshooting pinpointed on a virtual sitemap, would provide M.G.A. Energy Solutions Ltd not only improved transparency into the system performance, but also increased system uptime. In addition, M.G.A. Energy Solutions recognized that the module-level monitoring from SolarEdge helps maintain maximum system output overtime by providing real-time detection of unpredictable events.

The SolarEdge **monitoring portal is free for 25 years and does not require any additional hardware.** With traditional inverters, which offer string-level monitoring at best, additional hardware would cost \$112,000 and \$540 for first year subscription.

ACTUAL SYSTEM PERFORMANCE

At the Kibbutz Be'erot Yitzhak site, SolarEdge technology provided a 3.25% increase in actual energy production compared to the PVsyst simulation.

PVsyst Simulations energy production (MWh/y)		Actual measured energy production (MWh/y)	
Power-One	SolarEdge	Actual measured energy production (MWh/y)	Increased actual energy production <u>more than</u> PVsyst estimations of SolarEdge
58,065	61,288	63,282	3.25%

Diagram 7

The above results show that PVsyst is conservative in its estimations, and that in practice, the installed SolarEdge system outperforms the PVsyst estimations for SolarEdge, as well as estimations for traditional string inverters. The test was performed on inverters 13-20 on October 7th, 2013 to February 29th, 2014.

The increased PR **improves the ROI of all stakeholder and specifically reduces risk and liability.**

The PV System at Kibbutz Be'erot Yitzhak suffers from module mismatch, even in the first year. With a typical inverter, this mismatch would cause decreased energy output. However, the SolarEdge system allows each individual module to perform at its maximum capacity.

Module mismatch sources that significantly decrease energy yield

Tolerance Mismatch



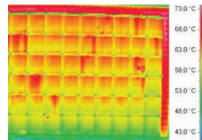
Partial Shading



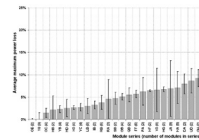
Soiling



Thermal Mismatch



Uneven Aging



Module Orientation



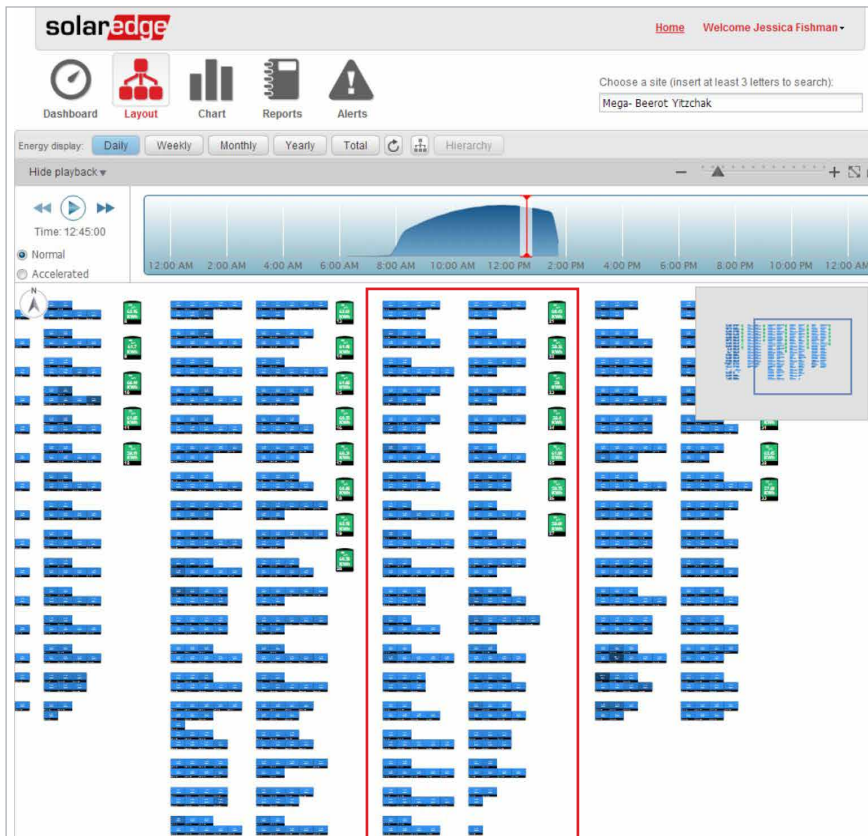


Diagram 8

This screenshot from the SolarEdge monitoring portal is of the Kibbutz Be'erot Yitzhak site (with roof four highlighted) on January 8, 2013 and shows power mismatch at the module level. The blue color code indicates the performance level of each module and proves that each module works in an individual capacity. The lighter the blue the more energy the module produces.

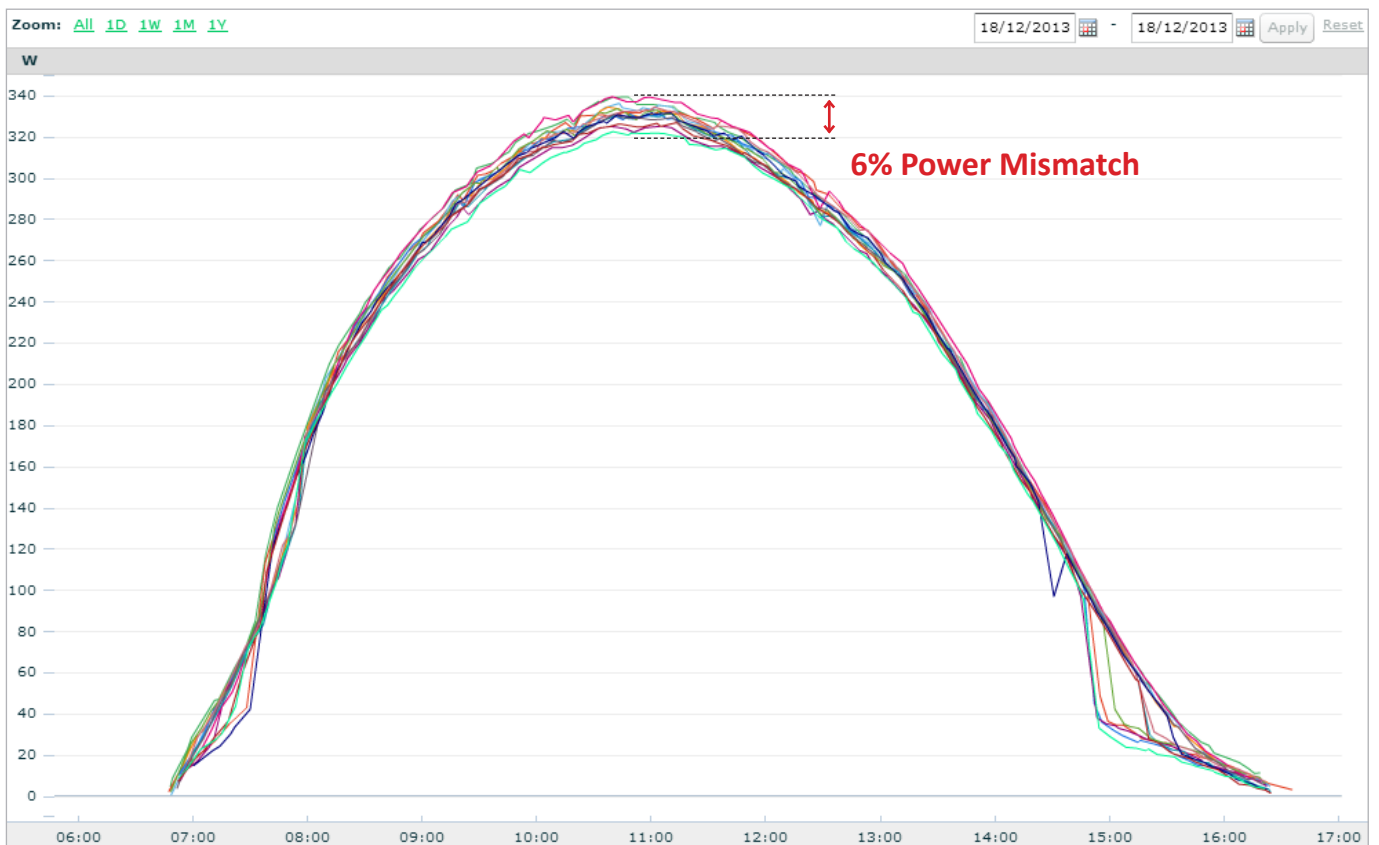


Diagram 9

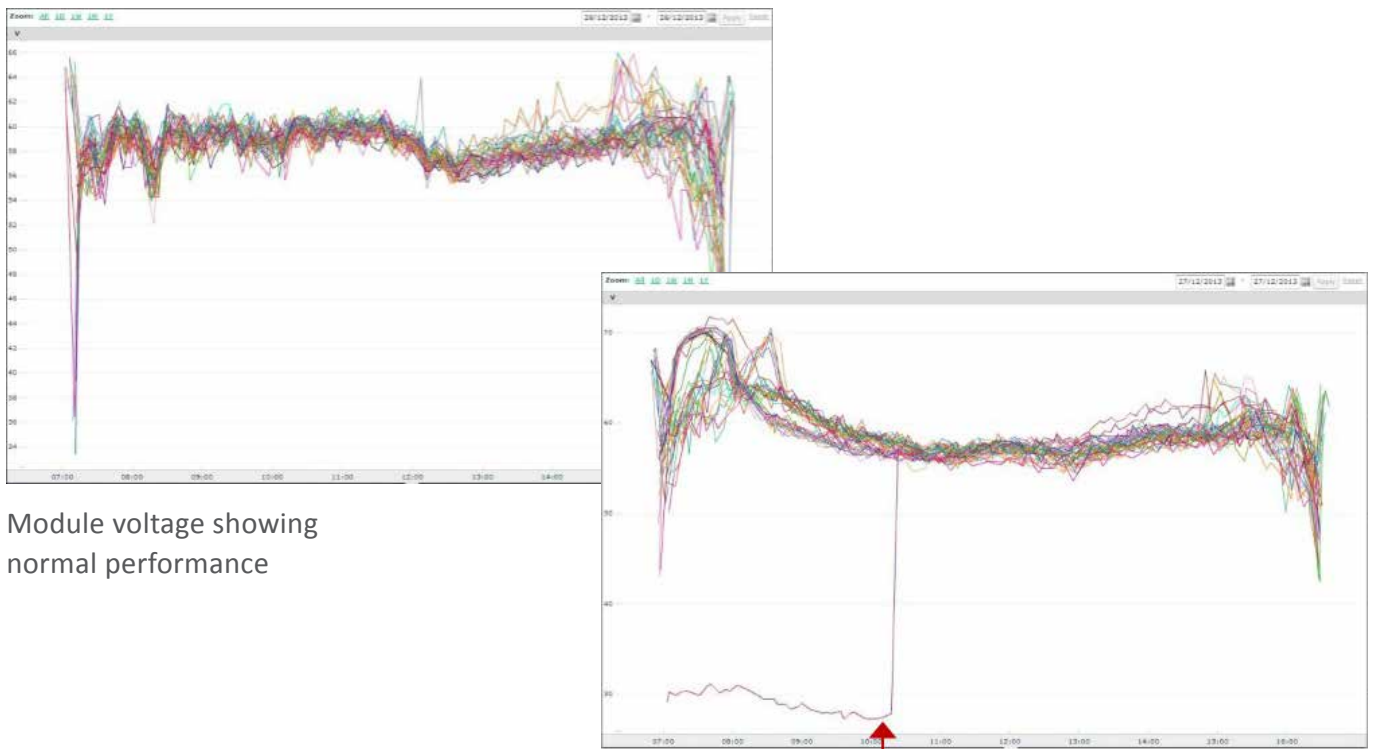
The above screenshot is from the SolarEdge monitoring portal and shows separate power curves of 68 modules from inverter 20 on roof four. This inverter has various sources of mismatch – shading, tolerance, temporary obstructions. The power mismatch between modules on the same string reaches up to 6%.

INSTALLATION

The simple installation of SolarEdge power optimizers includes clipping the power optimizer to a module frame or attaching it to the rail with a single screw. Utilizing the existing power line for communication (PLC), SolarEdge simplifies installation by eliminating the need to add dedicated communication wires. Having a lighter weight inverter, compared to the typical string inverter, SolarEdge inverters are easy to transport and mount.

O&M SAVINGS

A typical 600kW site needs bi-annual site visits in which a two-person team performs module diagnostics. The diagnostics include a visual inspection of the modules, DVM voltage checks of every string, and a potentially lengthy troubleshooting. With SolarEdge module-level monitoring and remote maintenance this requirement for bi-annual on-site diagnostics is removed, thus eliminating this fixed O&M cost, which is approximately \$3000 per year. This number is estimated by M.G.A. Energy Solutions Ltd.



Module voltage showing normal performance

One module is under-performing (in this case due to shading). Any performance issues can be diagnosed remotely, down to the module level

Diagram 10

The charts above show module voltages from an inverter on roof four on the Kibbutz Be'erot Yitzhak site on a sunny day. The first chart is from December 26, 2013 and shows normal module performance. The second chart is from December 27, 2013 and clearly indicates when one module is underperforming. The monitoring portal allows immediate detection of problems, eliminating on-site scheduled diagnostics.

SolarEdge power optimizers come with a 25-year warranty, inverters with 12-year warranty, and module-level monitoring is free for 25 years. The replacement cost of a SolarEdge inverter is 40% less than Power-One inverters. SolarEdge technology allows the use of different types of modules in one string as opposed to traditional inverters. Since modules of different power classes and brands can work as substitutes for failing modules, there is no need to pre-order module stock and there are no restrictions on panel replacements. This eliminates the need to pre-order module stock, as there are no restrictions on panel replacements.

SOLAREEDGE BANKABILITY

Having established the DC power optimizer segment in 2006, SolarEdge continues to be this segment market leader with more than 70% market share. SolarEdge's financial strength is demonstrated through more than \$100 million already invested in the company. With more than 3 million power optimizers and 100,000 inverters shipped around the world, SolarEdge continues to grow at the rate of more than 200% annually. SolarEdge has strategic partnerships across the PV value-chain from module manufacturers to sales through leading integrators and distributors in more than 50 countries and a local sales presence in 11 countries. Bankable in major European and North American solar financing institutes and banks, SolarEdge has strategic financial partners, such as Norwest Venture Partners, Lightspeed Venture Partners, GE Energy Financial Services, and Genesis Partners. The company has 19 patents with the US Patent database.

"We are incredibly pleased with our decision to include SolarEdge in our commercial system. As a partner, SolarEdge provided us with technical expertise. While its technology has proven to increase the energy output of our commercial system. Knowing that the financials of a commercial system can be particularly risky, we will continue to partner with SolarEdge in all our future commercial systems in order to ensure meeting the performance ratio commitment."

Mr. Gil Ovnish, CEO/Founder at M.G.A Energy Solutions Ltd

ABOUT M.G.A. ENERGY SOLUTIONS LTD.

M.G.A. Energy Solutions Ltd. specializes in the solar industry and electrical production business within a variety of fields such as generators, residual heat, natural gas, and more. The company was established in 2006 in Beit Shean, Israel by two businessmen - CPA Eli Menachem and Mr. Gil Ovnish. The company is part of a group of companies engaged in energy, real estate, and logistics.

With dozens of power plant projects operated by generators in factories and kibbutzim, the company holds hundreds of PV installations - from the initial planning stages to the installation and O&M stage.

Its offices are located in Beit Shean, in the northern part of Israel. As a leader in the energy field, M.G.A. manages projects nationwide and has installed more than 30 MW.

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