

## SolarMagic™ Reclaims Lost Energy, Boosts Power Production from Normally-Operating Array by 22.6%

“For over four years, our Oak Street installation has been helping residents pay less for electricity, and the addition of SolarMagic has dramatically boosted system performance,” said Jigar Shah, founder of SunEdison “SolarMagic is helping us get 22.6 percent more power out of the same panels, making the system even more productive and cost effective.”

**Jigar Shah, Solar Visionary**



**Site:** Oak Street Affordable Housing, Oakland, California  
 System Size: 30 kW  
 Modules: 204 Schott SAPC 175W  
 Strings: 17  
 Inverter: Xantrex  
 Monitoring: FatSpaniel  
 Installation date: January, 2005

**Owner:** Jigar Shah, Solar Visionary

### Performance Evaluation

- Conducted over three weeks in March and April 2009. Historical data also used
- Performance Ratio:
  - 77% (pre September 2007)
  - 67% (post September 2007)

### Findings

- Approximately 20,000 kWh lost
- Existing AC monitoring failed to detect problems

### Corrective Action

- Previously undetected faults corrected
- SolarMagic power optimizers installed on 6 strings (35%)

### Results

- AC production increased by 22.6%
- Better-than-new performance ratio of 82%
- 75% of power loss recaptured

### Is your Solar Array Performing Up to Its Potential?

Lack of effective power optimization and management may be the Achilles' heel of solar power systems. Even relatively new systems can significantly under perform—and seasoned operators following industry best practices may have no way to solve a problem or even recognize that a problem exists.

This occurs because traditional Photovoltaic (PV) arrays lacking SolarMagic technology, must be perfectly balanced to achieve maximum power output. This traditional approach allows even minor shading or electrical imbalances to significantly degrade system performance. In addition, traditional monitoring technology fails to continuously track solar array performance against forecast expectations and available sunlight, so substantial degradations go undetected and uncorrected long enough to significantly erode the financial return of the system. Even when you know you have a problem, traditional monitoring and service approaches do little to help you identify and diagnose problems in a timely fashion, and little or nothing to effectively correct them.

**About the owner...**Jigar Shah is a true leader in the modern Solar Energy business. He developed the concept of the Power Purchase Agreement and perfected its implementation, managing and overseeing the installation of many 10's of MegaWatts of solar systems in his tenure. When he was first approached about the potential benefits of SolarMagic with Active Power Management, he was skeptical, but he agreed to install the technology on a 30 kW solar array in Oakland, California that had been in operation for several years with no known problems.

## SolarMagic with Active Power Management

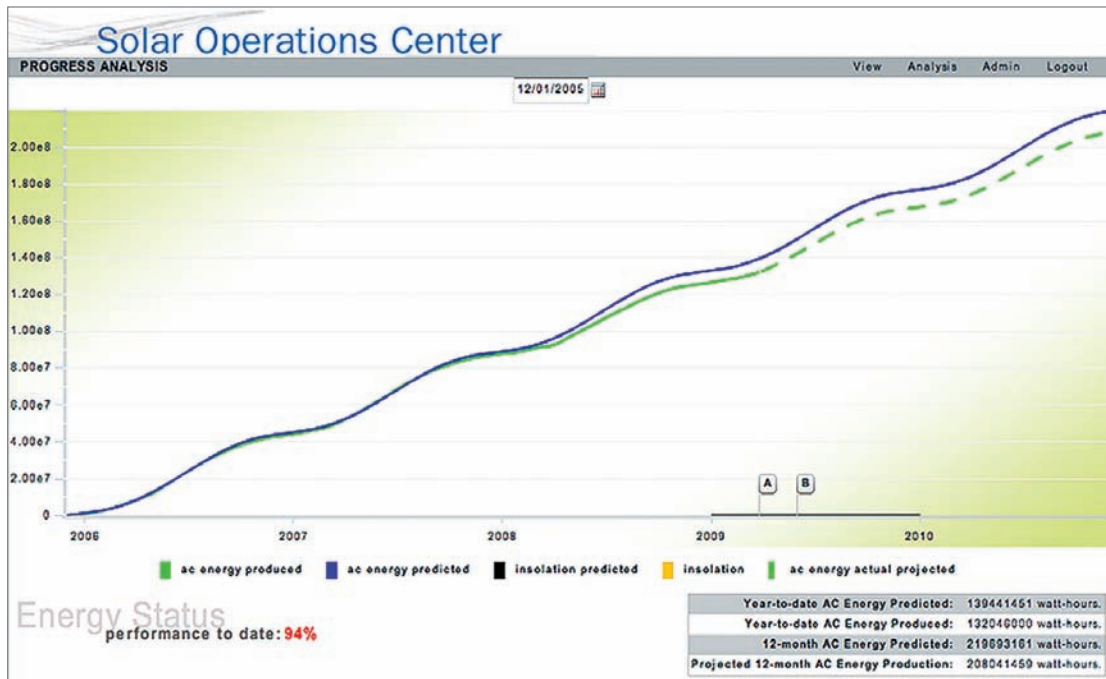
National Semiconductor’s SolarMagic with active power management is specifically designed to address system challenges. SolarMagic continuously tracks the individual maximum power of each panel, maintaining maximum array power and balance. While SolarMagic eliminates the need for on site corrections for most problems, if your system is underperforming active power management alerts you immediately with a diagnosis. The result is increased power output from a PV system, lower cost and more effective operations and management. SolarMagic with active power management greatly improves and assures the ROI of a solar system.

### Initial Performance Evaluation

The system was monitored using SolMan™ for 3 weeks in March and April 2009. SolMan uses wireless technology to acquire real-time voltage, current, DC energy and power data for each string in the array and transmits this data to National Semiconductor’s Solar Operations Center (SOC) where it’s automatically analyzed.

SolMan’s patent-pending Progress Analysis plots actual annual system AC production versus forecast production and insolation, making it immediately apparent how a system is performing. If productivity is decreasing, diagnostics report what actions are required and indicate whether the cost of a repair is economically justified in terms of the expected benefit.

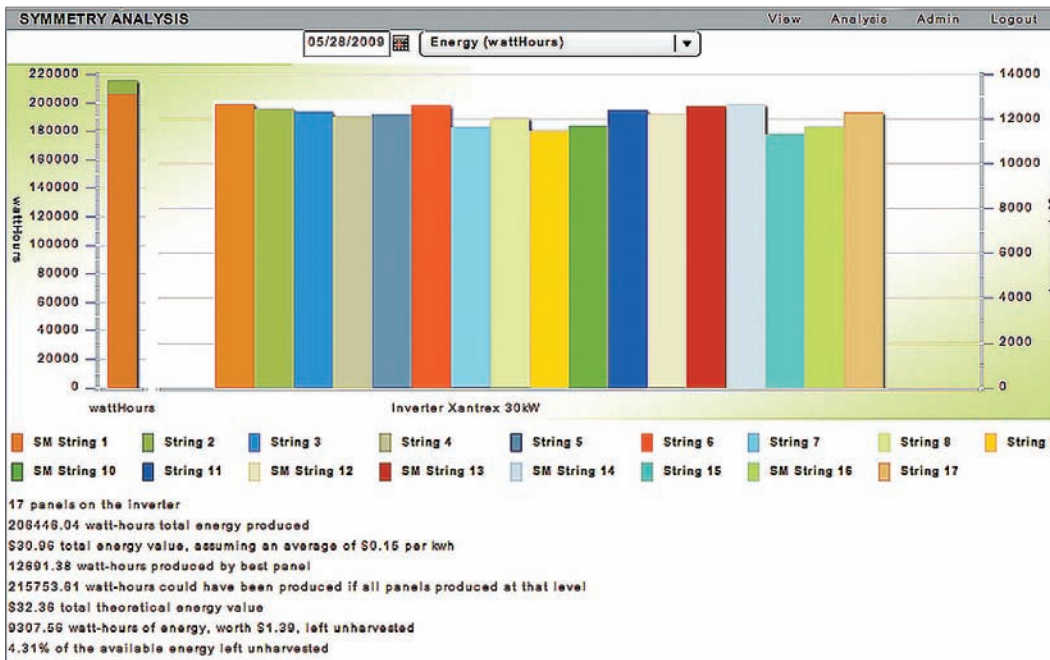
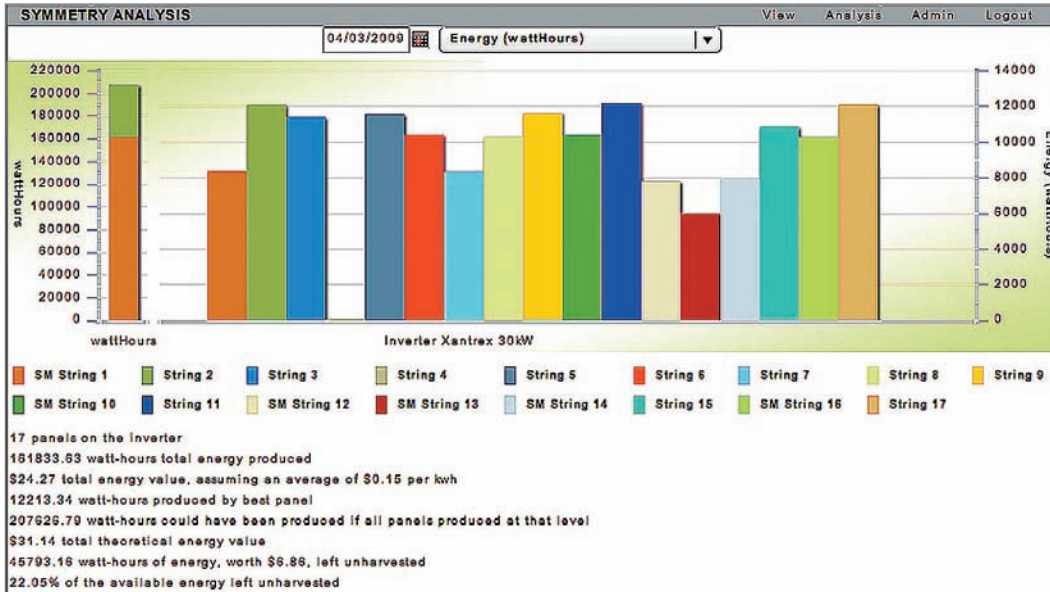
As can be seen in the Progress Analysis in **Figure 1**, the Oakland system achieved its standard 77% de-rate forecast until approximately September, 2007.



**Figure 1:** SolMan Progress Analysis shows the Oakland solar array significantly underperforming forecast expectations starting September 2007.

After that point, the system’s performance dropped to an effective de-rate of 67%. The existing monitoring generated no alert regarding this loss of productivity, so no action was taken, resulting in substantial lost power production.

The reason for this loss becomes apparent in a Symmetry Analysis of the system, another patent-pending feature of SolMan. **Figure 2** shows that 22% of the available power was going unharvested as a result of array imbalance and asymmetric string production.



**Figure 2:** SolMan Symmetry Analysis before and after fault correction and installation of SolarMagic on just six strings (designated with SM in figure). Afterward, the power production from all strings is evenly matched, and the array is close to its theoretical maximum production. (Columns at left show actual production in orange relative to total production. Green indicates the power that remains unharvested.)

## SolarMagic Corrects Imbalance

National Semiconductor has developed its SolarMagic technology to maximize the energy output of each solar panel in an array, enabling each panel to produce its maximum energy regardless of the performance of other panels in the array. SolarMagic technology maximizes the energy harvest of each individual PV panel using advanced algorithms combined with leading-edge mixed-signal technology, recouping up to 57% of the energy lost to mismatches and asymmetry.

In the Oak Street system, SolarMagic was installed on strings 1, 10, 12, 13, 14 and 16, and the whole system continues to be managed and monitored with SolMan. With SolarMagic installed on just six of the seventeen strings, the energy loss to asymmetry has dropped from 22% to only 4.3%. The strings assisted by SolarMagic have gone from the poorest performing strings to the best performing, despite the continued presence of the original causes of asymmetry: shading, and panel and wiring imbalances.

As a result, the system is now averaging a 22.6% improvement in AC output and running at an effective de-rate of approximately 82%; this is well in excess of its forecast production rate. The system is now producing more power than it did when newly installed.

## The Active Power Management Advantage

Even while using standard solar array monitoring and management best practices, issues with site power production had gone undetected for over a year. This resulted in a loss of over 20,000 kWh of production since September 2007. Applying National Semiconductor's active power management techniques at this site made it possible to diagnose and correct these issues. Losses would have continued to mount if the asymmetries had not been corrected.

The unique algorithms used in the SolMan active power management system make it possible to detect and quickly diagnose a variety of faults that can impair the output of a solar array. SolarMagic power optimizers let you overcome the effects of asymmetry caused by shading and other impairments. Together, these technologies provide an innovative and effective solution to challenges facing traditional solar systems. They achieve this by making it possible to significantly boost power production in the face of shading or other conditions that may be difficult or previously impossible to correct.

Visit [www.solarmagic.com](http://www.solarmagic.com) for more information



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