Solar Panel Analysis with SkySpark®

A BASSG Custom Solution for a Self-Storage Franchise

Demonstrating the power of building operational analytics to keep unattended distributed power systems functioning as intended.

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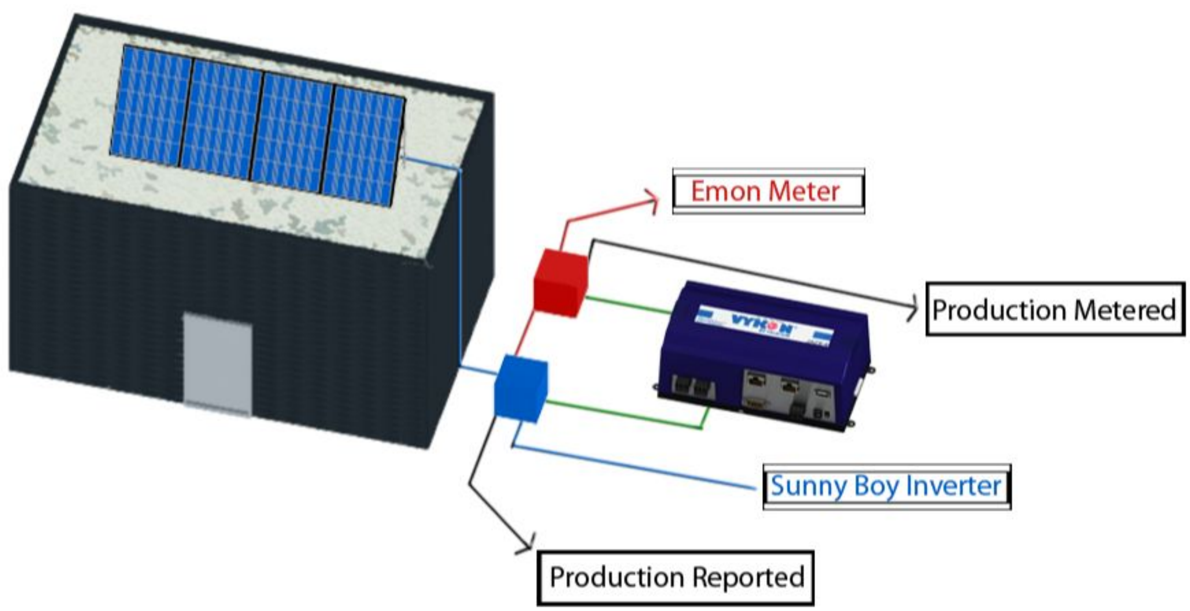
Background:
Low-rise buildings in sparsely-developed locations are ideal for the business of offering rentable storage units for the safekeeping of goods. With more Americans choosing to live in smaller urban spaces and the American tendency to buy a lot of stuff— there is no shortage of customers for these businesses. There are hundreds of self-storage operators with dozens of such facilities across the United States. Another good business match is between storage franchises and solar power generation. Their buildings have ample roof space for installing photovoltaic panels and typically have few obstructions to block the sun and compromise solar energy production. They save on energy costs and boost net operating income by setting up their own distributed power systems. However, such self-service-oriented businesses have an inherent challenge with their geographically-dispersed solar installations as well: lack of onsite operator oversight. There is not much sense in installing a distributed PV power generation network unless measures are in place to ensure that all the equipment is functioning as intended. The performance of individual panels can degrade and fail, power inverters can inefficiently convert from DC to AC, and sensors designed to detect PV function can be faulty. Other components and sub-processes can malfunction too. This is why, when one national storage chain recently added PV power generators to 23 of its self-storage sites from Texas to New Jersey, they hired BASSG to setup an intelligent energy management system that would enable ongoing remote monitoring of solar panel energy production.

As a SkySpark® partner, BASSG quickly customized a solution that captured, analyzed and presented the data flowing from PV inverters and power meters at each of the sites. The project described here was completed in just 5 days. While this is a relatively simple SkySpark® Analytics use case, it is prototypical of the way facility energy management teams can manage and derive value from the data streaming from the wide range of systems and devices found in today's intelligent buildings and equipment. We present it here as a learning opportunity for those just getting to know the power of building operational analytics. This case study walks through the process of 1) conceptualizing the data plan, or schema, that will deliver the desired insight 2) preparing the raw data according to the needs of that schema 3) defining the machine rules to run against that data and 4) interpreting the resulting visualizations.

Conceptualizing: "Finding What Matters™"

Building operators and facility managers that have long experience with their buildings can easily recognize the signs and signals of something going wrong — they know what matters. Their challenge is to translate that specialized, intimate knowledge into *rules* that a data analytics engine can process continuously and automatically when fed time-series data from building equipment. In the SkySpark environment machine rules and the alerts that result from rule violations are called *Sparks*.

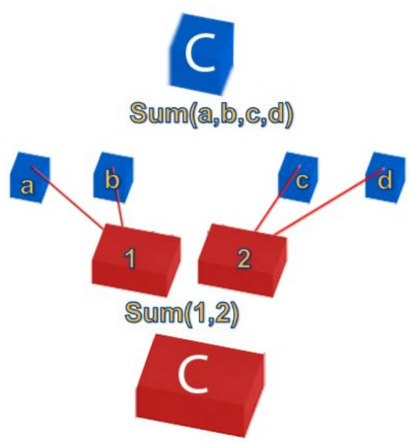
The solar energy systems that Lackland Storage installed at 23 sites feature the standard



configuration of a series of roof-top PV arrays that feed their production to solar inverters. The inverters convert the variable direct current (DC) output into alternating current (AC) so that it can be used to power the facility's lights, heating/cooling, security systems, etc. DC energy produced by each PV array is metered by multiple E-Mon sub-meters. And the multiple Inverters meter the amount of AC energy output. These readings are captured at standard 15 minute intervals.

It's difficult to glean any insightful information from the raw data streaming from the various individual sources. Calculated histories need to be derived to make clear how much total energy was produced and output by the various arrays and the PV system on the whole.
The data needs to be structured to find things that matter, such as:

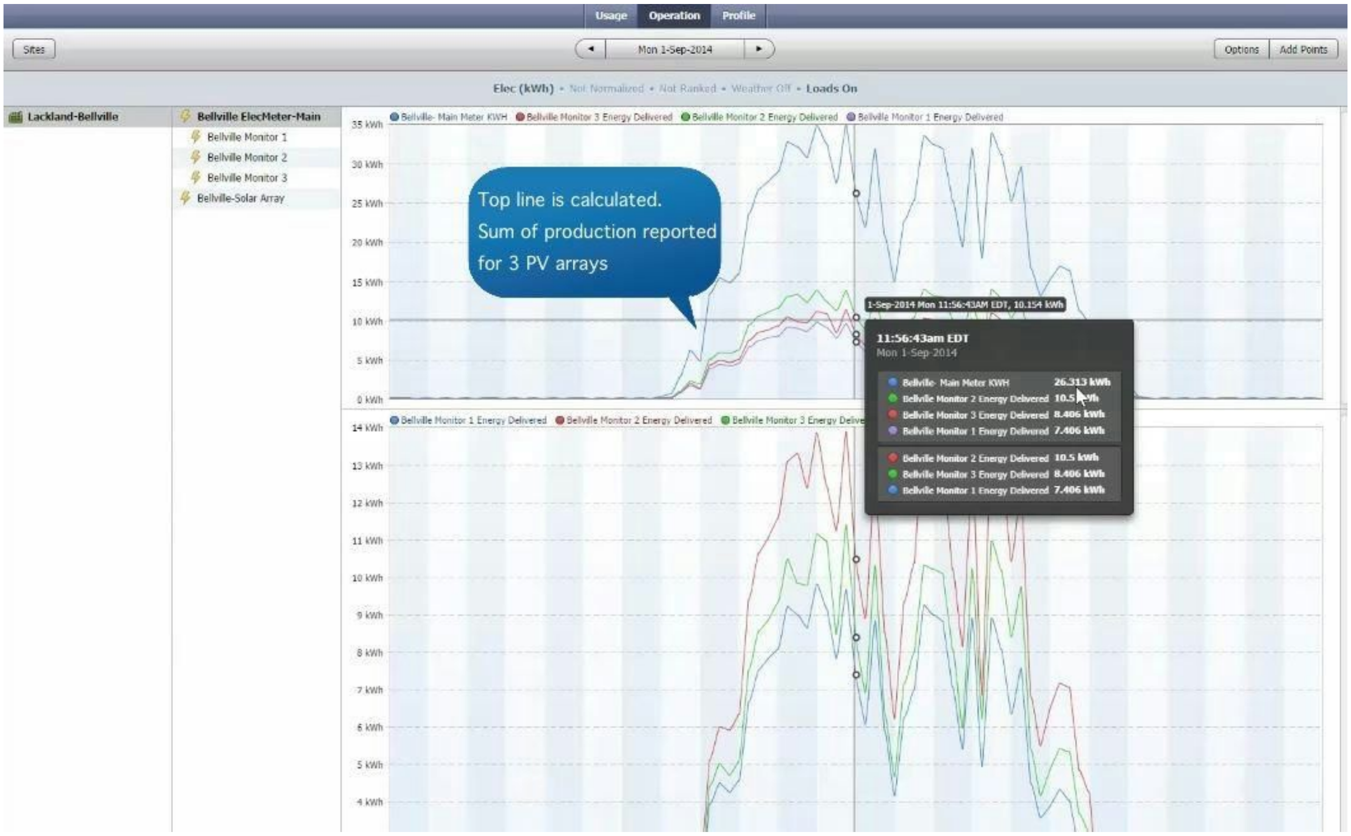
1. If total energy production metered before DC/AC conversion is significantly different than total energy production reported after, there is a problem at the inverter.
2. Likewise, if the arrays at a site are over-producing or under-producing compared to expectations, something is wrong.
3. Also, if identical arrays at different sites, under very similar solar conditions, are yielding significantly different energy output, the situation warrants looking into.



Spark rules and visualizations are needed to find any of these potential scenarios. And prior to running these rules through the data analytics engine, the raw data needs to be prepared with these queries in mind.

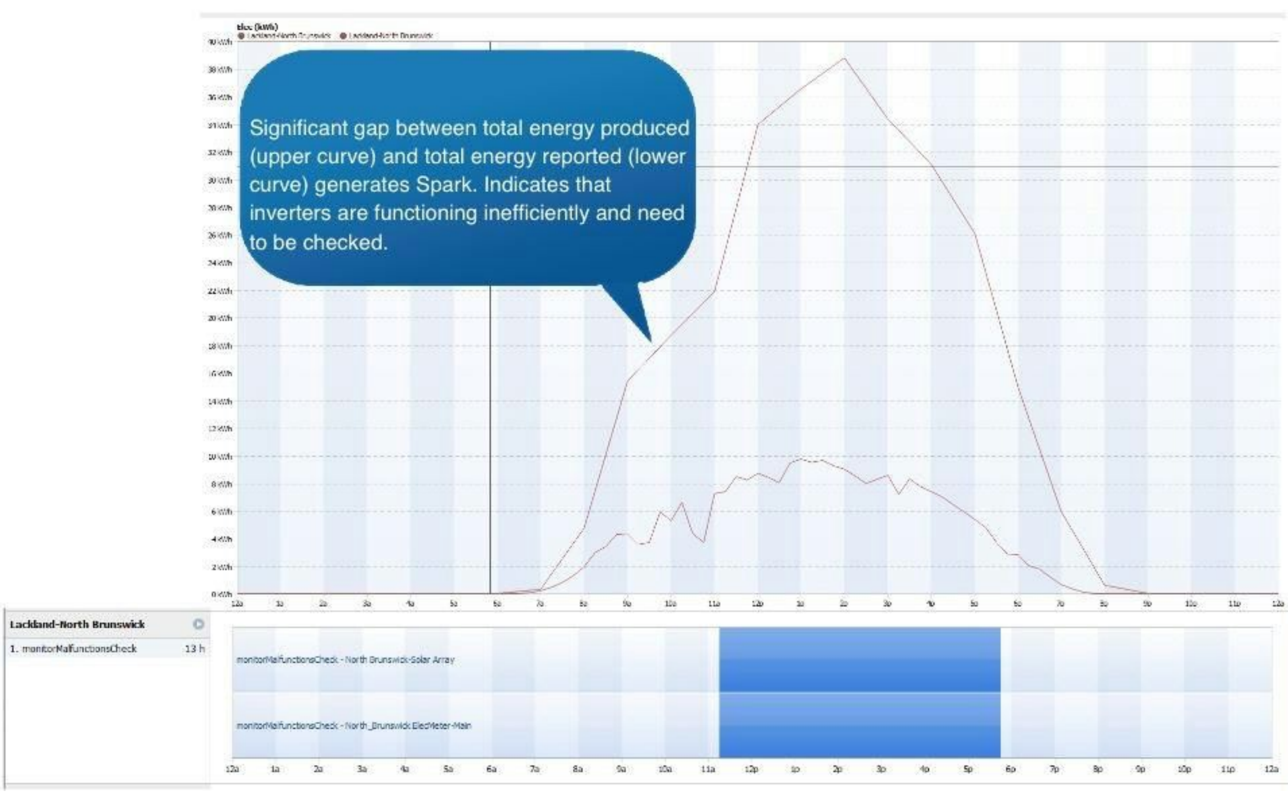
Preparing the Raw Data

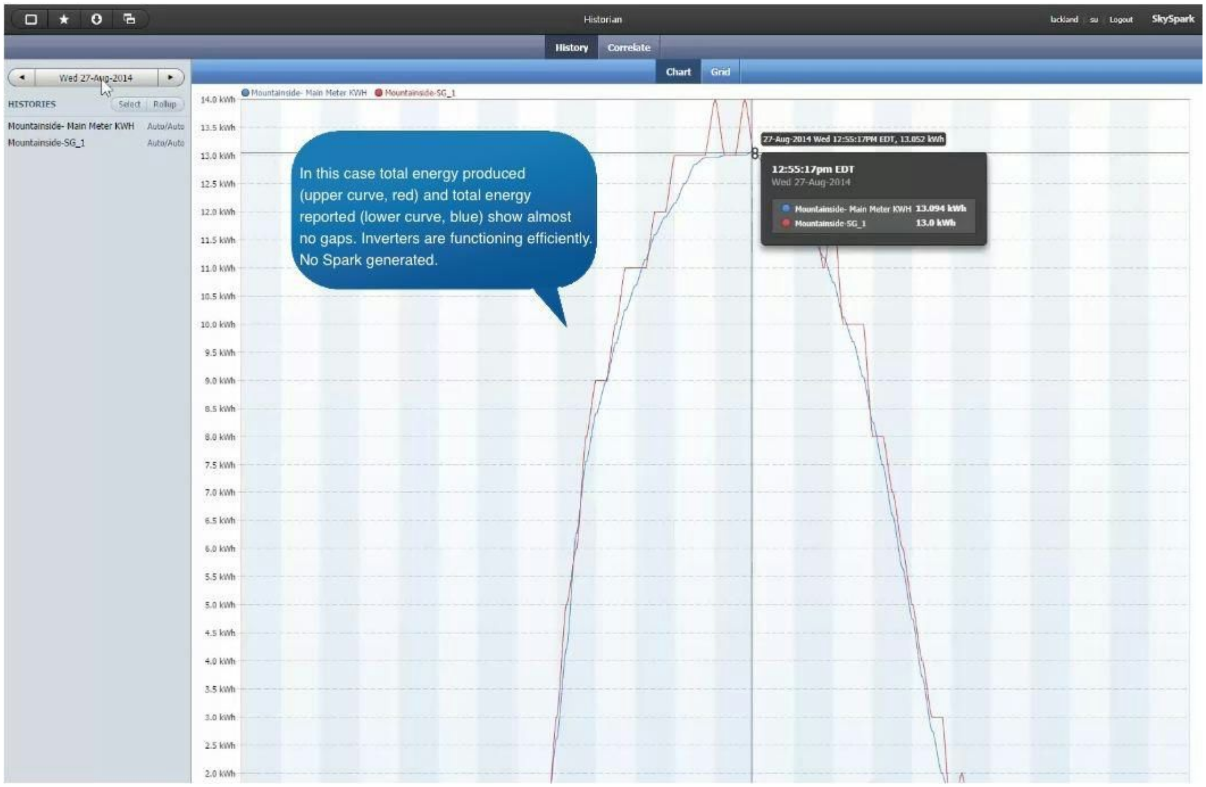
To efficiently verify that the inverters are functioning correctly for each site, totals are needed for DC energy produced and for AC energy reported per interval, i.e. point in time. To create these calculated histories, the time-stamped production data from each E-Mon sub-meter is put through a summing operation in SkySpark and, likewise, the interval data from each inverter at the site is summed.



Defining Rules to Generate Sparks

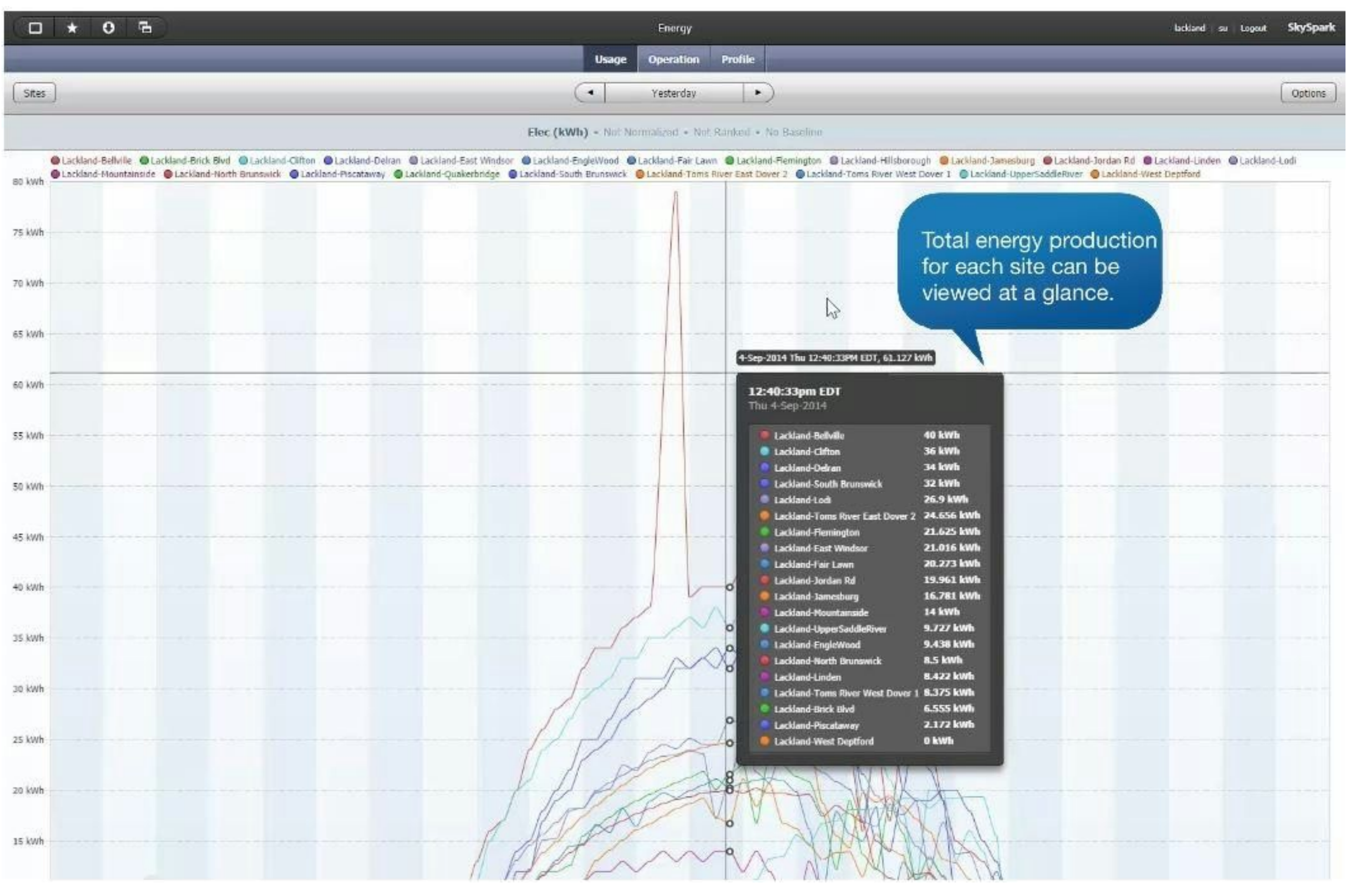
Once the data has been prepared to reflect totals, it is straightforward to write a rule for SkySpark analytics to automatically detect inverter inefficiency faults.



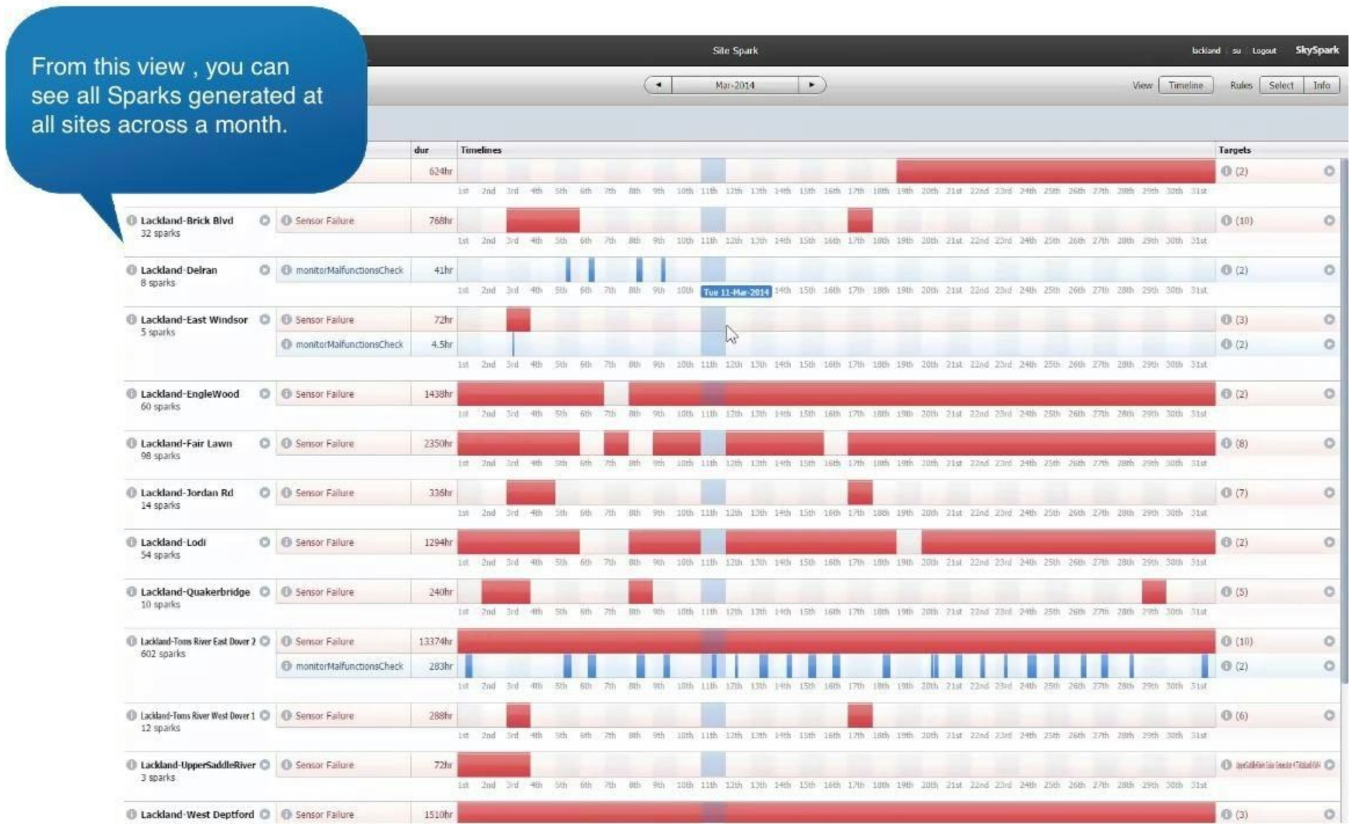


Interpretting Alternate Views

Calculated histories also ease comparisons of whole buildings, or whole sites, as in this case.



This SkySpark Analysis looks at the *max energy produced* value recorded at each site across an entire month.



Rules can also be defined to generate Sparks when sub-par production results or total gaps in energy production are recorded, indicating potential PV failures.

Another concept for the future would be to create a calculated history for production ratings based on weather data. The flexibility of the SkySpark platform allows the sophistication of analyses to grow to meet the needs of the application.

SkyFoundry wants to thank BASSG for this Case Study. Find them at: http://bassg.com/

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