U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

Houston, We Have a Problem—and a Solution: Solar Performance Initiative Helps Federal Building Boost Rooftop Production

In 2014, the Mickey Leland Federal Building in Houston, Texas, installed a 192-kW photovoltaic (PV) system on top of its parking structure (Figure 1). To monitor and optimize its performance, the General Services Administration (GSA), which manages the site, responded to the Federal Energy Management Program's (FEMP's) request for federal agency participation in the FEMP Solar PV Performance Initiative.

Understanding PV System Performance

To gauge the PV system's performance, the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) researchers compared measured PV production at the site from 2015–2020 to modeled production using NREL's System Advisor Model (SAM) (Figure 2).

NREL researchers evaluated three performance indicators for the PV system:

Figure 1. Mickey Leland PV system. *Image credit: Juan Griego, GSA*

1. **Availability** is the measured number of hours of production divided by the modeled hours of production—a measure of system downtime.
2. **Performance ratio** is the measured energy production divided by modeled production when the system is available—a measure of system efficiency when operating.
3. **Energy ratio** is the total measured energy production divided by total modeled production, considering both downtime and inefficiencies.

Over the five years and two months' worth of data analyzed for this performance assessment, the PV system had an availability of 94%, a performance ratio of 85%, and an energy ratio of 80% (Figure 3).

Year-over-year performance metrics (Table 1) show noticeable declines in performance and energy ratios for 2018 and 2019.

PV Production Data Indicates Equipment Malfunction

The PV production data indicated an anomalous dip in production around August 2018, which was attributed to a problem with an inverter. GSA staff worked with their operations and maintenance (O&M) contractor to identify the specific issue. After the repair was completed in August 2019, PV

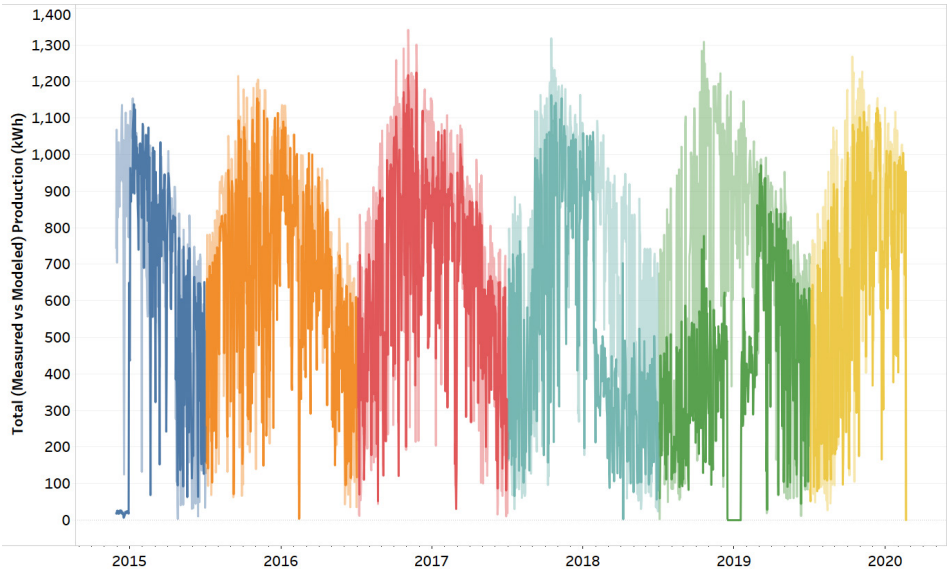

Figure 2. System performance at the Mickey Leland site. This graph shows the total daily measured production (darker shade) compared to total daily modeled estimate (lighter shade) across 5 years and 2 months of production (kWh).

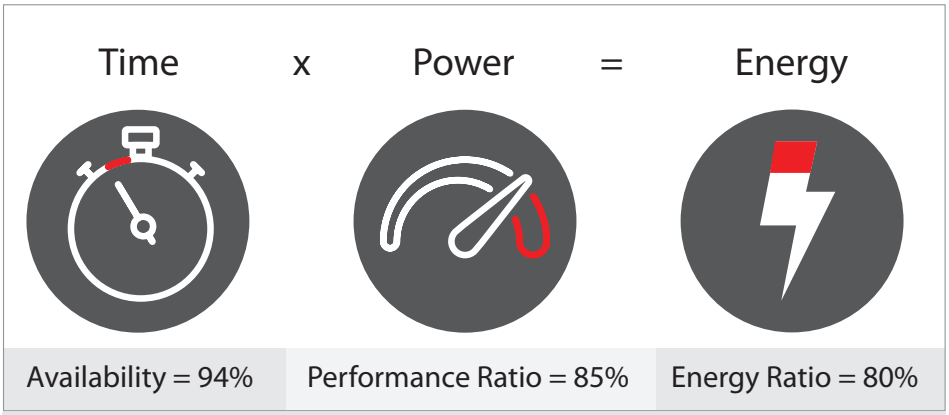

Figure 3. Mickey Leland performance metrics.

Table 1. Annual PV Performance Metrics for the Mickey Leland Site

	2015 (June–December)	2016	2017	2018	2019	2020 (January–August)	Total
Availability	85%	98%	98%	97%	89%	97%	94%
Performance Ratio	99%	91%	91%	78%	66%	91%	85%
Energy Ratio	81%	90%	90%	77%	58%	89%	80%

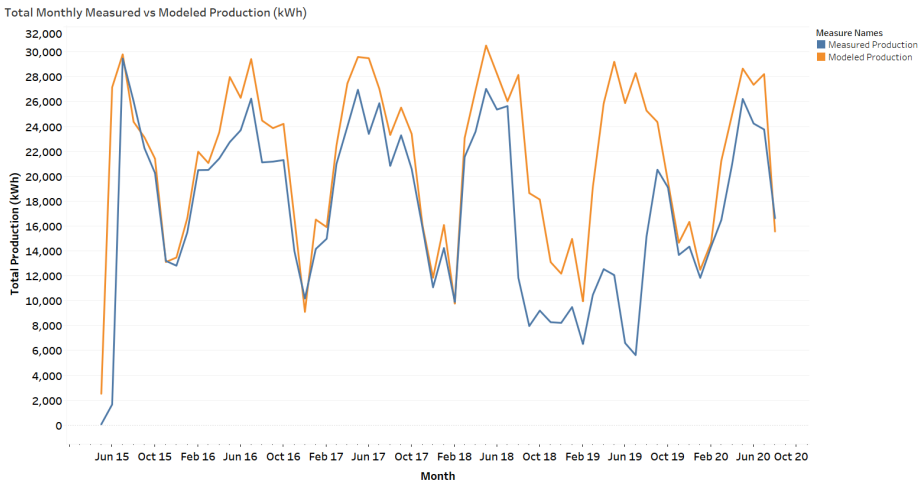

Figure 4. Monthly measured versus modeled production.

production returned to expected levels—as is shown by the improved system performance metrics (Figure 4).

Routine Monitoring and O&M Keep PV Systems Performing Optimally

This incident underscores the importance of regular PV performance monitoring and routine O&M. By identifying PV performance issues and making repairs early, lost production and lost energy cost savings can be avoided. Federal agency staff and their O&M support staff can program monitoring systems to alert site staff when PV production falls below expected levels. At a minimum, agency staff should keep track of cumulative PV production data—this number should always be increasing—and any sudden plateaus or changes in the slope of that graph are cause for further investigation.

Learn More

For more information on O&M best practices to ensure optimal PV performance at federal sites, visit FEMP's Optimizing Solar Photovoltaic Performance for Longevity at energy.gov/eere/femp/optimizing-solar-photovoltaic-performance-longevity.

Learn more about NREL's System Advisor Model (SAM) at sam.nrel.gov/.

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