STARTUP new sun ROAD

HOST EPRI

Demonstration of Local Microgrid Energy Management Controls

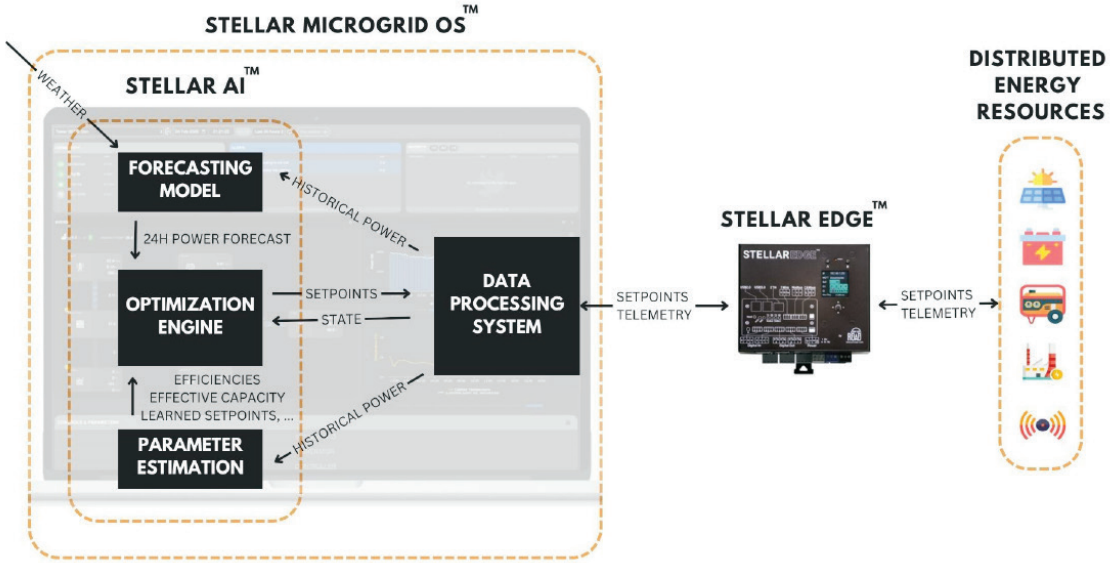
TECHNOLOGY SOLUTION

New Sun Road's energy management platform pairs hardware and software to enable remote monitoring, control and performance optimization of microgrids and distributed energy resources. Hybridized local and cloud-based architecture enables control optimization via machine learning and ensures availability of real-time insights.

The Stellar Edge™ controller is compatible across a wide range of communication protocols and power device OEMs. The Stellar Edge™ acts as a gateway, executing local commands while streaming data to the cloud to be visualized on Stellar Microgrid OS™. The Stellar Microgrid OS™ platform enables operators, maintenance providers, and asset managers to manage fleets of systems from a single dashboard. Key features include advanced data analytics and AI powered optimization.

New Sun Road's Stellar AI™ predictive control system dynamically optimizes power system controls using a combination of artificial intelligence models for forecasting and inference, optimization modeling, cloud-based data-processing and storage, edge computing, and device communications.

EPRI's SPIDER (Simulation Platform for Integration of Distributed Energy Resources) testbed enables hardware-in-the-loop testing for DER and microgrid controllers. It simulates DER operations and implements standard monitoring and control protocols such as IEEE 1547, DNP3, and SunSpec to support R&D, evaluate commercial control systems, and test systems before deployment.



PROJECT OVERVIEW

This pilot demonstration project was hosted by EPRI to demonstrate how the SPIDER testbed can be used to validate microgrid controls and to showcase New Sun Road's AI-based controls.

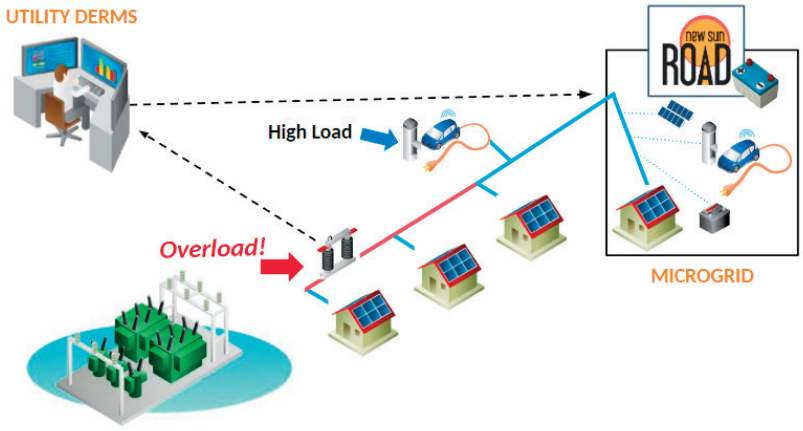
The pilot was constructed to model a grid-connected, utility-owned, 250 kW / 760 kWh islandable microgrid for resilience and disaster relief on a capacity constrained distribution system. High EV load on the system coincides with reduced solar generation at dusk. In a baseline scenario, this causes the distribution feeder to be overloaded, which would result in a service interruption. The pilot shows how the microgrid's energy storage can be recruited to meet this load and avoid service interruption.

The utility/distribution system operator uses a DER management system (DERMS) to monitor the distribution feeder and issue "grid services requests" to the microgrid. The grid services requests signal the microgrid to supply power or reduce its consumption to prevent overloading the feeder.

New Sun Road's Stellar Edge™ site controller and Stellar Microgrid OS™ software coordinate and optimize DERs within the microgrid. An AI algorithm incorporates time-of-use electricity pricing and day-ahead forecasts of solar generation and load in order to minimize energy costs, maximize renewable energy generation, and respond to grid services requests. EPRI's SPIDER testbed simulates DERs and validates the controls in the test scenarios.

RESULTS & LEARNING

The project compared three scenarios: (1) a "baseline" scenario without energy storage in the microgrid; (2) a "controlled" scenario with energy storage and a grid services request; and (3) a "cost-minimization" scenario that uses storage to minimize microgrid energy costs with time-of-use pricing and net-metering without a grid services request.



EPRI defined the performance metrics for the grid service request response, renewable generation, and energy costs. In the controlled scenario, the microgrid met the request, staying within the limits with zero violation penalties on a 5-minute timescale. Renewable generation was equal in all scenarios. In the "baseline" scenario, the microgrid netted $188 over the day from exporting energy. This increased to $229 in the "controlled" scenario because the grid services request commands the microgrid to export power during peak pricing. New Sun Road controls increased this further to $249 in the "cost-minimization" scenario by exporting additional power during peak pricing.

> This IEL project allowed EPRI to evaluate the performance of a commercially available microgrid controller, as well as validate the DER emulation capabilities of the Simulation Platform for the Integration of DER (SPIDER) testbed. Device interoperability and dispatching of microgrid controller services during grid-connected operations will be a key part of effectively leveraging microgrid controllers for grid operations as installations grow.
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> **Jackie Baum, Technical Leader, EPRI**

There are four important learnings from the project process and outcomes:

- Microgrids with advanced controls and sufficient energy storage can be leveraged to support the grid: The performance results show that with control by New Sun Road's Stellar Microgrid OS™ platform and a utility DERMS, the microgrid can support the grid during peak load and remove line overloading. The test system included a battery sized to serve the microgrid load autonomously for 18 hours. While this is typical for a resilience microgrid, a system with a smaller battery may not have sufficient capacity to perform grid services.
- A trusted DER simulator accelerates R&D and validates controls: EPRI's SPIDER testbed allowed New Sun Road to test their control algorithm running in real-time with real-world communications. This allowed New Sun Road to rapidly prototype, identify, and fix issues before a field deployment. Standardized performance metrics allow utilities to compare and evaluate different controllers.

- Interoperable communications protocols accelerate integration: The microgrid controller used DNP3 and SunSpec to communicate with simulated DERs. This streamlined integration; however, the basic SunSpec model needed to be expanded to control battery charging.
- Adapting commercial software for simulation can present challenges in timing and data flows: New Sun Road's software includes routines for collecting and processing data, including training and executing forecasting models that are primarily triggered by real clock time and using online data sources. The SPIDER testbed uses simulated time and offline data sources. Synchronizing time between systems and merging online and offline data sources was one of the major project challenges.

IMPLICATIONS & NEXT STEPS

The power grid is under increasing stress to supply electricity. Utilities face new demands to serve their customers, provide electricity for vehicles and buildings, and address the challenges of climate change.

The SPIDER testbed fills an important gap in validating DER controls. To integrate large numbers of DERs into the grid and evaluate power and energy management systems like Stellar Microgrid OS™, the industry needs a reliable tool to simulate DER operations over minutes to days using generic models and standard protocols. The SPIDER testbed does exactly this in a much more scalable way than traditional hardware-in-the-loop simulators.

Jonathan Lee, PhD
Director of Research, New Sun Road

This pilot demonstrated New Sun Road's ability to meet utility performance requirements while adhering to common interoperability standards and communication protocols. In practice, this translates to an accessible and cost-effective solution for utilities seeking to build a portfolio of microgrids and DERs for resilience and grid support.

New Sun Road is open to follow-on work with EPRI as an extension of this demonstration. Additionally, New Sun Road seeks to deploy these new capabilities with utility partners. The EPRI SPIDER testbed could be used in collaboration with utilities seeking to evaluate New Sun Road's technology in a simulation environment before deploying in the field.

New Sun Road is a Public Benefit Corporation on a mission to accelerate the deployment of renewable energy to remote and underserved communities. New Sun Road's Stellar Microgrid OS™ platform manages more than 1,000 power systems in over 20 countries. The key learnings from the collaboration with EPRI will be applied to advance New Sun Road's product offering with current and future utility customers.

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