

Ovation™ Green Solar PV Solutions

Emerson is a global technology and software leader with a deep history of solving our customer's most complex challenges across the world's most essential industries, including power and water. We help empower our customers to operate more sustainably while improving efficiency, reliability, safety and profitability.

Solar photovoltaic (PV) farm owners and operators require a reliable, open, scalable and integrated automation platform with a power plant controller (PPC) specifically designed to monitor, operate and manage assets at a single site or a fleet of sites. Emerson understands these challenges and we have optimized our automation technology to meet the unique needs of the solar PV industry. Our innovative, flexible and scalable renewable-specific Ovation™ Green solar PV solutions leverage decades of expertise and experience globally, the industry-leading Ovation™ Automation Platform and our comprehensive service and support programs.

Feature/Function	Emerson Solution	Value	
Core Solution			
Engineering	<ul style="list-style-type: none"> Completely open control logic configuration, editing and troubleshooting software Easy to use and interpret graphic-based engineering tools 	<p>Increase - Improve</p> <ul style="list-style-type: none"> Annual energy production Power output Return on investment Availability Reliability Operational flexibility Operating life <p>Reduce</p> <ul style="list-style-type: none"> Operation costs Maintenance costs Downtime Lost data Complexity <p>Full configuration ownership</p> <p>Unlimited data access</p> <p>Streamlines maintenance</p> <p>Seamless integration of all options</p> <p>Flexes and scales to meet your needs today and in the future</p> <p>Support network accessible 24/7</p>	
Connectivity	<ul style="list-style-type: none"> Comprehensive protocol suite connects to substation systems and provides seamless control over all the site assets, acting as a single unit to the grid operator. 		
Control	<ul style="list-style-type: none"> Industry-focused software provides fast response and precise performance specific to the owner's requirements High-speed data capture Full access to all parameters and logic Open logic permits user-configurable tuning and logic enhancements Available functions for real power, frequency response, power factor/reactive power control, automatic voltage regulation and more 		
Redundancy	<ul style="list-style-type: none"> Fully redundant options available for control, network, SCADA to support continuous site operations 		
Services & Support	<ul style="list-style-type: none"> All solutions are backed by comprehensive lifecycle service and support programs with a dedicated service application 		
Security	<ul style="list-style-type: none"> Market-leading cybersecurity technology is built into the platform Additional comprehensive cybersecurity solutions and services are available 		
Specific Solar PV Control Applications			
Real Power Output Ramp Rate	<ul style="list-style-type: none"> Real power output ramp rate control helps grid operators manage system frequency by limiting aggregated ramps of intermittent resources 		
Frequency Response	<ul style="list-style-type: none"> Fast response to grid over-frequency events by ramping real power down on an inverter-by-inverter basis Respond to under-frequency events by increasing full solar farm output by a user-defined amount at a defined ramp rate 		
Power Factor/Reactive Power Control	<ul style="list-style-type: none"> User-defined power factor or reactive power setpoint as measured at the POI Specify reactive limits to prevent exceeding an inverter-imposed limit. Switch capacitor banks as needed to maintain the goal at the POI while respecting inverter limits 		
Automatic Voltage Regulation	<ul style="list-style-type: none"> Input target voltage as measured at the POI; adjusts inverter reactive power to meet target accounting for varying impedance between inverters and the POI. 		
Steady State Real Power Output	<ul style="list-style-type: none"> Accurate control maximizes solar farm output while adhering to farm curtailment setpoint Optimizes farm revenue stream by adjusting inverters even during shade conditions 		

Challenges

The primary function of the power plant controller (PPC) is to unite the diverse site components (panels, inverters, trackers, transformers, etc.) into a single operating power plant. While doing so on a small scale seems straightforward, as a solar farm expands, it becomes increasingly more difficult to manage the quantities of equipment and data necessary to keep the site reliable, available and maintainable. Unfortunately, avoidable outages can have a significant impact on the bottom line.

Typical customer challenges when operating and maintaining solar PV farms include:

- Inability to isolate issues with plant equipment like inverters and panel arrays
- Difficulty accessing “black box” control logic to adapt to new grid or market requirements
- Aggregating large amounts of siloed data from a variety of components and equipment
- Monitoring the status and KPIs of large asset groups
- Interconnectivity between multiple sites for remote operations
- Appropriately adjusting multiple inverter outputs to balance and match demand requirements
- Interoperability between onsite battery storage systems
- Mitigate increased risk from cyber threats

Implementing modern, field-proven renewable power plant controllers and SCADA software can further the operator’s or owner’s ability to ensure site reliability and optimize maintenance.

Ovation Green Solar PV Solutions

Whether building greenfield or retrofitting existing solar farm controls, Ovation Green solar PV solution provides a complete farm-to-grid control package that aggregates individual site components into a single farm control architecture. The Ovation automation platform interconnects into the grid system operator’s dispatch signals, automatically adjusting each inverter’s output capability to fulfill the real and reactive power demanded.

Emerson’s experienced project team develops the component datalink mapping, control logic and other deliverables to meet the customer work scope. This team also provides factory acceptance testing and field engineering support to assist with installation and commissioning.

The Ovation Green solar PV solutions are open, eliminating ‘black box’ logic lockdown, providing operators and owners flexibility and scalability to adjust the logic and system configuration to accommodate site expansion and market changes. Redundancy options are available for increased resiliency.



Ovation Green SCADA and Asset Management

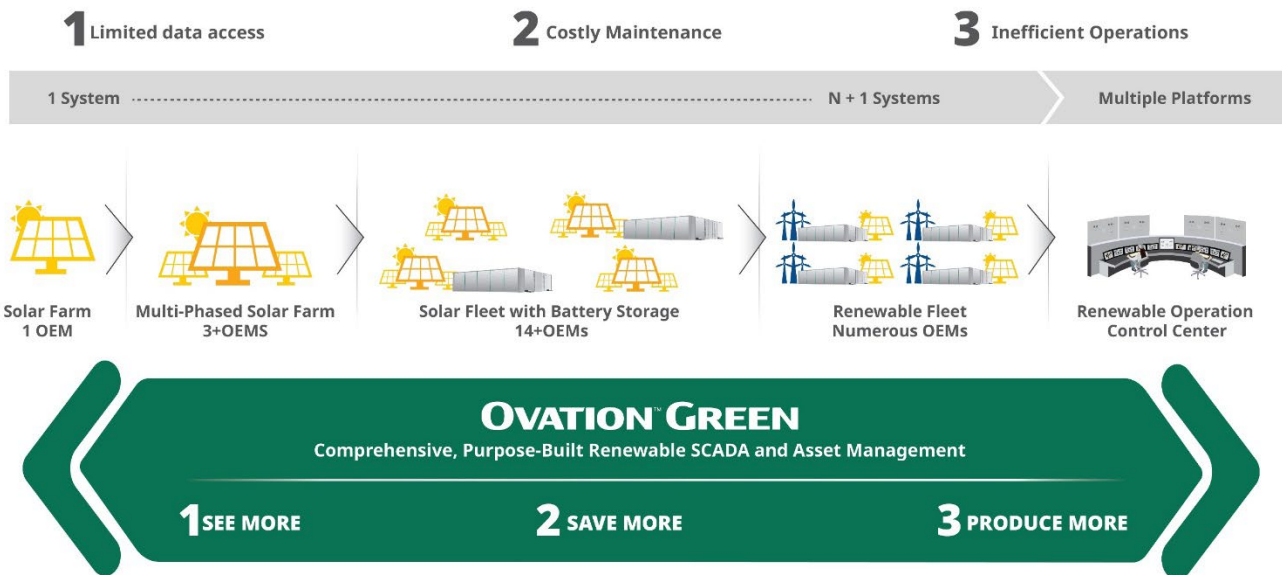
For visualization, monitoring, and KPIs, the Ovation Green SCADA software is a data-driven, open platform that is purpose-built for renewable energy applications including solar, wind, and battery storage. Whether one site or hundreds, Ovation Green SCADA's robust architecture can monitor and store millions of data points. With many functions ready out of the box, this software permits:

- Asset and component monitoring and operation
- Calculation and summation of IEC-61724 KPIs
- Alarming
- Trending
- Reporting
- User-configurable condition-based actions
- Historical data collection including high-resolution and summation information
- Analysis tools for alarm and historical data
- Issue detection using heat mapping



Renewable assets typically operate with equipment from multiple manufacturers and are managed by various control and monitoring technologies. To bridge the data gap, Ovation Green SCADA communicates with other systems using a variety of protocols, supporting the collection of all available asset data becoming the primary monitoring and decision-making tool.

Ovation Green SCADA has an integrated tool to automate the collecting, tracking and reporting of performance, reliability and availability of generating units. This is particularly useful for North American utilities with 20 MW or larger capacity to comply with North American Electric Reliability Corporation (NERC) Generation Availability Data System (GADS) reporting requirements and to meet similar global requirements. This same engine can generate reliability and performance reports of the plant's equipment, helping to identify underperforming assets and hidden operational issues.



Cybersecurity Solutions and Services

Emerson takes a proactive approach to helping customers address cyber threats. The Ovation automation platform includes basic security functions and features such as user and role account management, password management, workstation hardening and controller certifications for network communication robustness.

The platform functions can be augmented with additional security functions provided by Emerson's Power and Water Cybersecurity Suite of solutions and services that help to safeguard your assets and strengthen your security posture.

Our forward-looking and adaptable cybersecurity programs bridge the gap between operational technology (OT) and information technology (IT) to mitigate risk and maintain reliable operation by proactively addressing threats, enhancing protection and streamlining security program management.

After a thorough application, review and testing process by the Department of Homeland Security (DHS) under the U.S. Support Anti-terrorism by Fostering Effective Technologies Act of 2022 (SAFETY Act), Emerson's Ovation control solution has been both Designated and Certified by DHS as Qualified Anti-Terrorism Technology.

This Designation and Certification provide significant tort protection for our customers for claims arising out of acts of cyber terrorism as defined under the SAFETY Act. In addition, and especially noteworthy for your company, should third-party claims, including business disruption claims, emerge after an Act of Terrorism, our customers will enjoy significant protection from claims that challenge their decision to deploy Ovation Technology.

For more information regarding how this determination may affect your company, please contact your counsel and refer to the Safety Act Offices at <https://www.safetyact.gov/>.



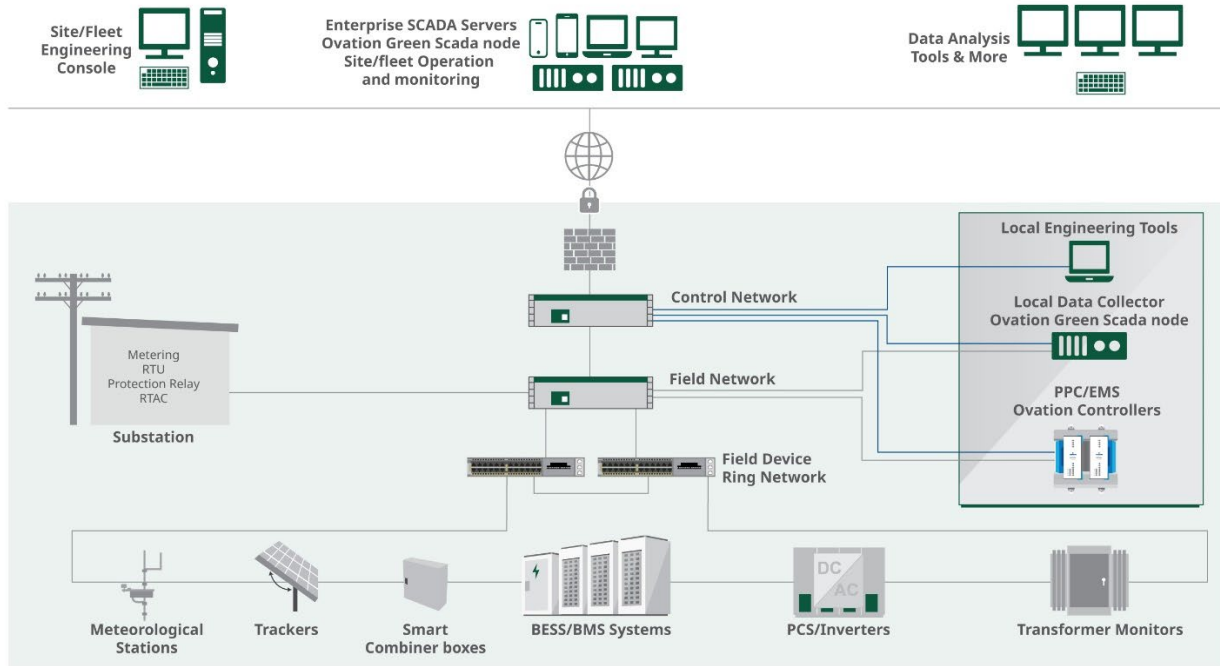
Complete Lifecycle Support

Emerson's Ovation Green Renewable Solution Portfolio extended well beyond control hardware and SCADA software. Emerson offers:

- A global engineering team to provide complete system project engineering with project management, factory acceptance tests, and commissioning
- Power industry experts to provide technical support and product enhancements
- 24/7 product and application phone support
- Professionally developed training courses available in classroom or virtual settings
- Product lifecycle contracts and evergreen programs
- Global field engineering offices for local, onsite support
- Guardian digital customer platform designed to maximize the full potential of your Ovation systems and software, providing users quick access to product support, secure management of software term licenses, obtain intuitive views into system health and interact with additional software and services
- Long-standing users' group community for peer knowledge exchange and collaboration with annual conference and dedicated website



Example Architecture



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