



SolarEdge Report

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Executive Summary

This report presents a concise evaluation of SolarEdge's Power Optimizer-based photovoltaic (PV) system, focusing on its safety features, performance benefits, cybersecurity capabilities, and alignment with long-term sustainability goals.

SolarEdge addresses key safety challenges in PV systems through advanced technologies. The Sense Connect feature enables early detection of faulty electrical connections, reducing fire risks. The SafeDC™ mechanism automatically reduces high DC voltage to safe levels during maintenance or emergencies, while the Rapid Shutdown function de-energizes each module individually, ensuring compliance with international safety codes and protecting first responders.

As PV systems are increasingly classified as critical infrastructure, cybersecurity has become a top priority. SolarEdge is a frontrunner in this area, with its inverters being the first to achieve certification under the EU Radio Equipment Directive (RED) Article 3.3 and the UK PSTI Act. These products incorporate secure data hosting in ISO 27001-certified facilities, encrypted communications, strong password protocols, multi-factor authentication, and a secure update mechanism providing robust protection against cyber threats.

In terms of performance, SolarEdge's module-level power electronics (MLPE) technology allows for the individual optimization of each solar panel. This mitigates mismatch losses caused by shading, dirt, or aging, and enables flexible system designs. The system supports longer strings and mixed orientations without compromising efficiency. A 25-year warranty further underlines the product's durability and long-term value.

The SolarEdge ONE energy management platform enhances system intelligence by offering real-time performance monitoring, smart automation of energy use, and integration with DC-coupled and AC-coupled storage systems. This not only maximizes self-consumption but also increases overall energy efficiency and cost-effectiveness.

Recognized among the Top 100 Most Sustainable Corporations by Corporate Knights, SolarEdge demonstrates strong environmental, social, and governance (ESG) practices. The company's technology is successfully deployed across diverse applications, including residential rooftops, commercial buildings, agriculture, floating PV, and flagship projects, delivering increased energy yield, safety, and system longevity.

Together, these capabilities position SolarEdge as a market leader in secure, high-performance, and future-ready PV system solutions.

Introduction and Background

The world is currently facing a pressing energy challenge driven by increasing global demand, the need for energy security, and the urgency to transition towards sustainable energy sources. As economies grow and electrification expands across various sectors, including transportation, industry, and residential applications, energy production must scale accordingly.¹ However, this expansion must be aligned with climate commitments and the reduction of greenhouse gas emissions.² In this context, renewable energy sources, particularly photovoltaic (PV) systems, have emerged as a cornerstone of the global energy transition.

PV technology plays a crucial role in meeting these growing energy demands while reducing reliance on fossil fuels. However, as PV systems become an integral part of critical infrastructure, ensuring their efficiency, reliability, cyber-security and safety is paramount³. System failures, electrical faults, fire hazards, and unsafe voltage levels during maintenance or emergency response situations pose significant risks that must be mitigated.⁴ Trust in PV technology is built on quality, and addressing all potential risks through robust system design and safety mechanisms is essential to maintaining this trust.

Module Level Power Electronics (MLPE) such as SolarEdge Power Optimizers have long been recognized as devices that increase system safety and performance. With the increasing adoption of bifacial and tandem solar modules, string mismatch is becoming more prevalent⁵, further emphasizing the role of solar optimizers in modern PV installations. Optimizers significantly enhance energy yield by optimizing the performance of individual modules, effectively managing shading losses, mitigating performance discrepancies, and improving overall system efficiency⁶ beyond their operational benefits. Optimizers also play a vital role in safeguarding PV systems against electrical hazards. Advanced safety features integrated into optimizers help mitigate potential risks, ensuring compliance with industry safety standards and regulatory frameworks.

This report offers a detailed review of SolarEdge's Power Optimizer-based PV system, providing insights into the SolarEdge system security, safety and performance. It also highlights the SolarEdge Power Optimizer's safety function and assesses its adherence to insurance industry safety requirements^{7,8}.

¹ Electricity Market Report 2023. International Energy Agency.

² Climate Change 2022: Mitigation of Climate Change. Intergovernmental Panel on Climate

³ World Energy Transitions Outlook 2023. International Renewable Energy Agency

⁴ Fraunhofer ISE 2021. PV Fire Safety & Risk Mitigation Strategies.

⁵ SAND2018-8627C Performance of Bifacial PV Modules with MLPE vs. String Inverters [D.Riley, J.Stein, C.Carmignani]

⁶ Performance and Safety Benefits of Solar Module-Level Power Electronics. National Renewable Energy Laboratory

⁷ Zurich Insurance (2024). Whitepaper on Photovoltaic System Safety

⁸ FM Global Property Loss Prevention Data Sheets, January 2024, FMDS0115_FM Global.pdf

1. System functions and safety measures

Ensuring safety in photovoltaic (PV) systems is a fundamental priority in solar energy deployment, especially as installations expand across residential, commercial, and utility-scale applications. High-voltage direct current (DC) electricity, common in PV systems, introduces significant risks, including electrical faults, fire hazards, arc faults, and unsafe voltage levels during maintenance or emergency situations. To mitigate these challenges, SolarEdge has developed an advanced safety framework, integrating multiple protective mechanisms into its system and Solar Power Optimizer technology.

This chapter provides a detailed description of the safety and reliability functions implemented in the SolarEdge Power Optimizer, highlighting how each feature contributes to system security and durability. The Power Optimizer incorporates multiple layers of protection and technical expertise which SolarEdge has developed since 2006, when SolarEdge pioneered power optimizer development.

Through a combination of robust safety mechanisms, stringent quality assurance, and reliability-focused design, SolarEdge ensures that its products meet the industry standards⁹. By minimizing system vulnerabilities, enhancing longevity, ensuring compliance with international safety regulations and even exceeding regulation requirements, these advanced features build trust in solar technology and reinforce SolarEdge's commitment to safe, reliable, and high-performance PV systems.

1.1. Safety Functions

The SolarEdge Power Optimizer incorporates multiple layers of safety mechanisms to address critical risks in PV systems, including electrical faults, islanding, fire hazards, and other emergency shutdown scenarios. These integrated safety features provide a proactive approach to risk mitigation, ensuring a significantly higher level of protection for system operators, maintenance personnel, and emergency responders. Independently tested and validated, these mechanisms align with industry best practices, meet and go beyond regulatory requirements, and insurance guidelines, reinforcing the Power Optimizer's role in improving the overall safety and reliability of solar energy systems.¹⁰



Figure 1: S-Series Power Optimizer_S1200_S1400_EU

SolarEdge Sense Connect – Proactive Detection of Faulty Connections and Electrical Arcing

One of the most common causes of PV system failures and fire hazards is faulty or loose electrical connections. Over time, environmental conditions such as thermal expansion and contraction, vibration, corrosion, and improper installation can lead to increased electrical resistance at connection

⁹ According to TNO Test Report. UL 1699B

¹⁰ https://knowledge-center.solaredge.com/en/search?search=&sort_by=search_api_relevance

points. This resistance generates excess heat, which, if left unaddressed, can result in electrical arcing—a high-energy discharge that can ignite surrounding materials, leading to severe fire risks.

In addition to systemic compliance with regulatory Arc Detection requirements, SolarEdge developed the Sense Connect function which provides an advanced layer of protection by directly monitoring the temperature at the connector points using short internal cables that transfer heat from the connector into the Power Optimizer. This allows the system to detect even slight temperature increases caused by poor connections before they reach hazardous levels.

Independent testing confirms that Sense Connect effectively prevents fire hazards by interrupting the heating cycle before dangerous temperatures are reached. This feature ensures that even if a faulty connection develops over time, the SolarEdge Power Optimizer will intervene long before it becomes a fire risk¹¹, shutting down power drawn by the power optimizer and reporting the event to the SolarEdge inverter.

SolarEdge Sense Connect enhances the safety and reliability of solar installations by offering early detection, automatic mitigation, and a fail-safe shutdown mechanism. It not only protects the PV system from potential hazards but also goes beyond compliance with safety requirements, reducing risks to surrounding assets. By proactively identifying and addressing faulty connections before they become dangerous, Sense Connect provides a critical layer of protection, improving overall system safety. This is achieved through continuous Connector Temperature Monitoring (CTM), where CTM events are triggered when abnormal temperature rises are detected at connector points, often due to loose or corroded connections, allowing the system to automatically alert operators, shut down affected modules, and prevent fire hazards before they occur.¹²

SafeDC™ – Automatic Reduction of High DC Voltage to Prevent Electrical Hazards

SafeDC™ is an essential safety feature in SolarEdge PV systems, designed to automatically reduce high DC voltage to safe levels during wake up, maintenance, fault conditions, and emergency situations.

The SolarEdge system features a module-level Rapid Shutdown function, which enhances safety by:

- De-energizing each module individually and causing the Power Optimizers to enter SafeDC™ mode rather than relying on centralized shutdown at the inverter level.
- Reducing system voltage to a safe level within 30 seconds, ensuring that no hazardous voltage remains on the roof or in wiring.
- Providing compliance with international safety codes, which mandate rapid de-energization for firefighter safety.

Testing and certification bodies have verified that the SolarEdge system's rapid shutdown capability effectively isolates the system and prevents voltage buildup, offering protection compared to conventional shutdown methods¹³. The standards that are complied with include for example the VDE-AR-E 2100-712:2018-12, which specifies measures for the DC area of a photovoltaic system to ensure electrical safety in the event of firefighting or technical assistance.

¹¹ TNO Test Report

¹² <https://monitoring.solaredge.com/solaredge-web/p/home>

¹³ TNO Test Report

When the inverter is powered down, disconnected from the grid, or a fault is detected, the Rapid Shutdown protocol is engaged, and SafeDC™ ensures that the system's DC voltage is reduced to 1V per module, preventing the risk of electrical shocks to maintenance personnel. Commercial applications may connect two modules per optimizer, and in this case, it will output 1V per two modules. This feature ensures workers can safely interact with the system without the danger of accidental electrical contact.

Rapid Shutdown and SafeDC™ also integrate with advanced arc fault detection and islanding detection systems. When an arc is detected, the inverter halts power production, halting the arc's progression before it can escalate into a hazardous situation, such as a fire or system failure. SafeDC™ then reduces the inverter input voltage to a safe level. In case of detecting an islanding condition, the inverter similarly halts power production and causes the Power Optimizers to enter SafeDC™ mode.

By reducing the DC voltage automatically and promptly in fault or emergency situations, SafeDC™ ensures compliance with global and local safety standards, which mandate de-energization of the PV system to protect maintenance workers and first responders. This proactive safety feature mitigates electrical hazards, providing greater safety and peace of mind for all involved.

Intelligent Alert System – Real-Time Risk Detection and Preventive Maintenance

A proactive safety system is essential for minimizing the risk of critical failures in a PV system. The SolarEdge system incorporates an advanced real-time alert system that continuously monitors key safety parameters to ensure the system operates safely and efficiently. This system evaluates connection integrity through Sense Connect, monitors the power lines to detect arc faults, and detects temperature irregularities.

When the system detects any anomalies or irregularities, it generates a real-time alert via the centralized Monitoring Platform and the mobile app, notifying the system operator of the issue. This helps to reduce system downtime and prevent small issues from escalating into more significant, costly failures.

By continuously assessing these safety parameters and providing timely alerts, reliability and safety of the entire PV system is enhanced.¹⁴ This allows operators to address issues proactively, significantly improving overall system safety, preventing equipment damage, and increasing the longevity of the system.

In conclusion, these integrated safety mechanisms have been independently tested and validated, confirming that they meet or exceed international safety standards and industry best practices. By addressing potential hazards proactively and minimizing risks, the SolarEdge Power Optimizer significantly enhances the overall safety and reliability of PV systems, extending the lifespan of the installation and reducing the likelihood of costly failures or catastrophic events. Through these advanced safety features, the SolarEdge system design and Power Optimizer play a vital role in creating a safer environment for all stakeholders involved in the operation, maintenance, security, protection and emergency response of solar energy systems.

¹⁴ <https://knowledge-center.solaredge.com/sites/kc/files/se-alerts-prioritization-using-the-impact-indicator-application-note-row.pdf>

1.2 Cybersecurity

In an increasingly digitalized world, cybersecurity plays a central role in ensuring the stability and integrity of information systems. The risks involved with digitization are amplified in the case of bulk power systems, given the growing role of PV systems in the overall power supply of entire countries. This growing realization is leading regulators and legislators across the world to consider PV technology as critical infrastructure and develop more rigorous cybersecurity regulations than have been required in the past. The challenges arising from global networking require a holistic approach that accounts for both national and international framework conditions.

Investors are also shifting their focus to security and quality. In the case of PV systems, with an investment time frame of 10-20 years, not only “classic” considerations such as extreme weather events and quality breakages are being considered, but also cybersecurity is becoming an increasingly important consideration. Regulatory authorities in Europe and elsewhere are paying closer attention to this issue, particularly due to concerns over the influence on and access to critical infrastructure. As a result, discussions are currently underway regarding potential restrictions from local governments on the remote control of certain products, and on the level of security features required for energy generating and storage devices, that are connected to the public electricity grid. These developments highlight the growing need for robust cyber security measures to ensure long-term reliability and security of PV infrastructure¹⁵.

RED Act Article 3.3 and UK PSTI for Cybersecurity in Europe and the UK

In recent years, the digitalization of the energy sector, alongside increased geopolitical instability, have led to a steady increase in cyber threats and attacks on power grids. Notable cases in which PV systems have been compromised by cyber intruders span from the [United States](#)¹⁶, to [Denmark](#)¹⁷ and the [Ukraine](#)¹⁸. US-based cybersecurity company DER Security Corp published a [2024 report](#)¹⁹ detailing 54 cybersecurity incidents related to residential and light-commercial PV systems alone.

Against this background, the European Union’s RED Legislative Act (Radio Equipment Directive) Article 3.3 is among the first to have mandated cybersecurity baselines from any internet-connected PV inverter sold in Europe. Similarly, the United Kingdom passed in 2024 its own regulation called the UK PSTI Act (Product Security and Telecommunications Infrastructure), which also applies cybersecurity-oriented requirements on PV inverters sold in the UK.

Similar regulatory activities that span from legislation to standard development are now taking place across Europe, the United States and Australia. It is widely recognized that high power products such as PV inverters or EV chargers present a unique risk profile both to the individual system owner and to the broader public that relies on the power grid. By 2030, the EU’s Cyber Resilience Act and the NIS 2 Directive will also likely be set in place across the EU’s 27 member states, alongside the Network Code on Cybersecurity, which will add sector-specific requirements to the power sector.

It is expected that by 2030, mature cybersecurity requirements will be made mandatory for all grid-connected PV inverters in Europe. Due to the already significant contributions of residential PV

¹⁵ www.pv-tech.org/lithuania-to-block-chinese-inverters-with-cybersecurity-legislation

¹⁶ <https://cyberscoop.com/spower-power-grid-cyberattack-foia/#:~:text=A%20Utah-based%20renewable%20energy%20company%20was%20the%20victim,documents%20obtained%20under%20the%20Freedom%20of%20Information%20Act.>

¹⁷ <https://therecord.media/danish-energy-companies-hacked-firewall-bug>

¹⁸ www.reuters.com/business/energy/cyberattacks-renewables-europe-power-sectors-dread-chaos-war-2023-06-15/

¹⁹ https://dersec.io/reports/DERSec_Solar_Vulnerability_Summary_11-15-24.pdf

systems to the energy grid, these regulations are likely to be enacted retroactively on existing equipment. One example for retroactive requirements was evident in the United Kingdom in 2024, when installed EV chargers were given a “Rip & Replace” mandate by authorities due to retroactive cybersecurity regulations²⁰. A second example can be observed in Lithuania where PV systems that don’t comply with a November 2024 cybersecurity law were retroactively required to be disconnected²¹. This means they can no longer manage the systems remotely or turn devices on or off. As PV systems are a long-term investment, it is important to consider cybersecurity performance of a PV inverter today in order to avoid replacement costs that may be incurred in the coming years.

Certified Inverters from SolarEdge

Stable, reliable power generation from renewable energies is also an important criterion from an investor's point of view, and thus the cybersecurity of individual components – in the case of PV systems, particularly the inverters – is also coming into focus.

SolarEdge's inverter is a pioneer in obtaining certification according to the new European Radio Equipment Directive RED 2014/53/EU²² and to meet the European Commission's cybersecurity requirements under RED Article 3.3. This certification underscores SolarEdge's commitment to innovation and compliance with industry regulations.

Article 3.3 establishes a new regulatory framework for radio equipment and will impose cybersecurity requirements on all IoT products sold in Europe. This article sets out a new and comprehensive set of cybersecurity requirements for PV installations that rely on wireless connectivity. These requirements focus on improving network protection capabilities, protecting personal data and reducing the risk of fraud.

This new regulation is of particular relevance to the solar industry, given its significant contribution to global energy generation and its increasing importance as critical energy infrastructure in numerous countries. SolarEdge’s announced compliance builds on the company's earlier statement that its entire product range is compliant with the requirements of the UK's Product Safety and Telecommunications Infrastructure (PSTI) regulation.

SolarEdge actively participates in technical bodies that define many of the developing standards in this field, and designs its system according to these developments. Notable examples include NIST’s IR 8498 “Cybersecurity Standard for Smart Inverters” UL 2941 “Distributed Energy and Inverter-Based Resources Cybersecurity Certification” (United States) and the Network Code on Cybersecurity (Europe).

Data Security

SolarEdge provides an example of how robust cybersecurity mechanisms are essential to mitigating risks associated with cyber threats. The company's approach shows alignment with international best practices and validates the growing need for cybersecurity within the solar industry.

²⁰ <https://www.telegraph.co.uk/news/2024/02/21/car-charger-withdrawn-hackers-could-attack-national-grid/>

²¹ <https://www.pv-tech.org/lithuania-to-block-chinese-inverters-with-cybersecurity-legislation/>

²² <https://investors.solaredge.com/news-releases/news-release-details/solaredge-announces-compliance-uks-cyber-security-regulatory>

SolarEdge uses secure data hosting in Germany, in ISO 9001:2015 certified facilities and complies with the ISO 27001:2022 information security standard. These facilities are protected by physical security measures such as CCTV, fire suppression, and alarm systems, with European-contained data architecture ensuring resilience against communication disruptions.

To enhance security, SolarEdge employs strong passwords, restricted internet access, and multi-factor authentication (MFA) for system access. Each inverter has a unique password, and only certified installers can perform the initial activation of devices and their registration through secure, encrypted channels. Inverters also disable any unused ports by default, and limit Wi-Fi signal uptime, to reduce potential attack vectors.

A secure software update mechanism allows inverters to request and validate updates with cryptographic authentication, protecting against malware injection as part of the software update process. SolarEdge inverters are equipped with an embedded security agent (EDR) to detect and prevent cyber-attacks and implement periodic restarts to flush out potential volatile execution malware. Additionally, one-way communication options, robust logging, and SOC feed-ins enhance monitoring and alerting capabilities, limiting exposure to cyber threats.

Table 1 – Cyber Features

Feature	Description
Secure Data Hosting Facility	Data stored in on-premises data centers in Germany, meeting ISO 9001 & ISO 27001 standards, ensuring high security in data hosting and compliance.
Strong Password and Access Control	Strong passwords and restricted access to inverters, with encrypted communication channels - Cryptographically sound passwords, based on NIST 800-63-B guidelines - Direct internet access to the inverter via real time validation and authorization by SolarEdge's main authorization system - Encrypted communication (TLS 1.2 and above).
Multi-Factor Authentication (MFA)	MFA for secure installer access to prevent unauthorized system modifications.
Secure Software Update Mechanism	Secure update system with end-to-end encryption and signed updates to ensure integrity and block unauthorized changes. - SolarEdge inverters are certified for ETSI 303 645. - Inverter checks and validates firmware cryptographically, rejecting compromised updates. - Inverter prohibits firmware downgrades to older, less secure versions. - Remote software update can only be performed after the device initiates a communication channel with the SolarEdge backend

Malware Protections	Embedded security agents to detect behavioral anomalies and prevent attacks. - SolarEdge inverters contain an embedded security agent (EDR) that collects and sends security telemetries about anomalous behaviors to a SOC. - SolarEdge inverters include a secure boot mechanism, which together with a periodic reboot routine will flush out any volatile memory malware.
Enhanced Security Features	One-way communication feature, security logging and guidelines for network whitelisting of essential services (FQDN). - Security-sensitive system owners can restrict all incoming commands to the device, unless a physical button on the inverter is pressed, which in turn will allow access for a time-limited window before reverting back to the enhanced security state.

In summary, SolarEdge's cybersecurity measures and system design focus on safeguarding PV systems from cyberattacks while ensuring operational safety and compliance with industry safety standards^{23 24}.

²³ SolarEdge Cybersecurity Technical Overview V 1.2, MKT-3580 Cybersecurity technical overview 19.3.25.pdf

²⁴ SolarEdge Manufacturer Declaration March 26th 2024, UKPST-SolarEdge - Security Declaration.pdf

2. Performance and Durability

The efficiency and performance of a PV system depend on multiple factors, including factors that cause power-generating mismatch between modules in the same system. These factors include manufacturing tolerances, the natural aging of modules, and external influences such as shading or contamination. Uneven module aging in conventional PV systems leads to efficiency losses over time. Variations in modules or in irradiance cause differences in power output between series-connected modules, leading to a mismatch that affects other modules, lowers the string's efficiency and reduces the power available to the inverter. Module-level power electronics address this issue by individually tracking the maximum power point of each module. This ensures optimal performance for each module, minimizing losses and delivering the maximum possible power to the inverter.²⁵

Reasons for overall performance loss at the module level can be manifold, e.g.

- Different inclination and orientation
- Thermal mismatch
- Manufacturing tolerances of the modules (see module data sheet - can be up to $\pm 5\%$)
- Aging of modules
- Shading
- Increased mismatch due to bifacial and tandem solar modules

2.1 SolarEdge Power Optimizer

This is where patented SolarEdge Power Optimizers come into play, addressing the above mentioned reasons and ensuring energy yield by individually managing and monitoring each solar module. By individually optimizing each module's output, module-level power electronics (MLPE) mitigate these effects, reducing mismatch losses and maintaining higher system efficiency throughout the PV system's lifespan²⁶. SolarEdge Power Optimizers ensure that each PV module maintains stable and efficient power generation over time. Unlike traditional string inverters, which are affected by the weakest-performing module in a string, SolarEdge's Power Optimizers enable independent optimization of each module.

By dynamically adjusting the operating voltage of each module, ensuring optimal power output even under real-world conditions such as dirt accumulation, shading, or other environmental factors. By implementing per-module Maximum Power Point Tracking (MPPT) through an input control loop, Power Optimizers mitigate energy losses while also enabling real-time performance monitoring at the module level.

Beyond module-level optimization, SolarEdge's approach also stabilizes the overall system DC voltage. Inverter maintains a fixed string voltage, independent of string length or variations in individual module performance, and the Power Optimizers adapt their output voltages accordingly. This ensures that the inverter consistently operates at its optimal DC-AC conversion efficiency, improving overall system performance and reliability.

²⁵ Performance of Bifacial PV Modules with MLPE vs. String Inverters

²⁶ Photovoltaic Degradation Rate Affected by Different Weather Conditions: A Case Study Based on PV Systems in the UK and Australia

Extended 25-year warranty

SolarEdge provides a 25-year warranty for its Power Optimizers, which far exceed the standard warranties offered for many other PV components, reflecting SolarEdge's confidence in quality, durability, and long-term reliability.

The 25-year warranty covers material and workmanship defects. This is particularly important because photovoltaic systems are typically designed to operate for at least 25-30 years. With such an extensive warranty, system owners can be confident that they are protected against unexpected failures or performance degradation, as defective Power Optimizers will be repaired or replaced within the warranty period.

In the event of a warranty claim, SolarEdge ensures a fast-handling process through its RMA system, typically shipping replacement units within 48 hours²⁷. This direct responsibility guarantees efficient and trustworthy support for customers when needed.

2.2 System Design

The system design offers several practical benefits. The ability to connect mismatched modules within the same string increases design flexibility and allows for longer strings—a limitation in traditional systems. Maintaining a stable inverter input voltage also reduces stress on inverter components, enhancing long-term reliability and efficiency. Additionally, longer string lengths contribute to lower balance of system (BoS) costs and reduced installation complexity.

Another advantage is the enhanced system flexibility that comes with module-level optimization. Unlike traditional string inverters, requiring all parallel-connected strings to be of equal length and uniformly aligned, SolarEdge allows for strings of unequal length. This provides benefits for systems installed on complex rooftops or with partial space availability. Additionally, modules with different orientations or on different roofing materials can be combined without negatively affecting overall system performance.

Buck & Boost technology

SolarEdge Power Optimizers' integrated Buck & Boost technology empowers optimizing energy efficiency and ensuring stable operation across various types of systems under varying environmental conditions. It is designed to efficiently manage power from multiple DC sources by maintaining each module at its maximum power point (MPP), while outputting a voltage and current which can be either lower or higher than the MPP current and voltage.

By allowing precise voltage regulation, and both up-conversion and down-conversion of MPP voltage values, Buck & Boost technology enhances MPPT efficiency, reduces energy losses caused by mismatches, enables variable string length while maintaining regulated DC bus voltage, and extends the operational lifespan of system components.

²⁷ <https://www.solaredge.com/sites/default/files/solaredge-warranty-may-2021.pdf>

Buck & Boost vs. Only Buck

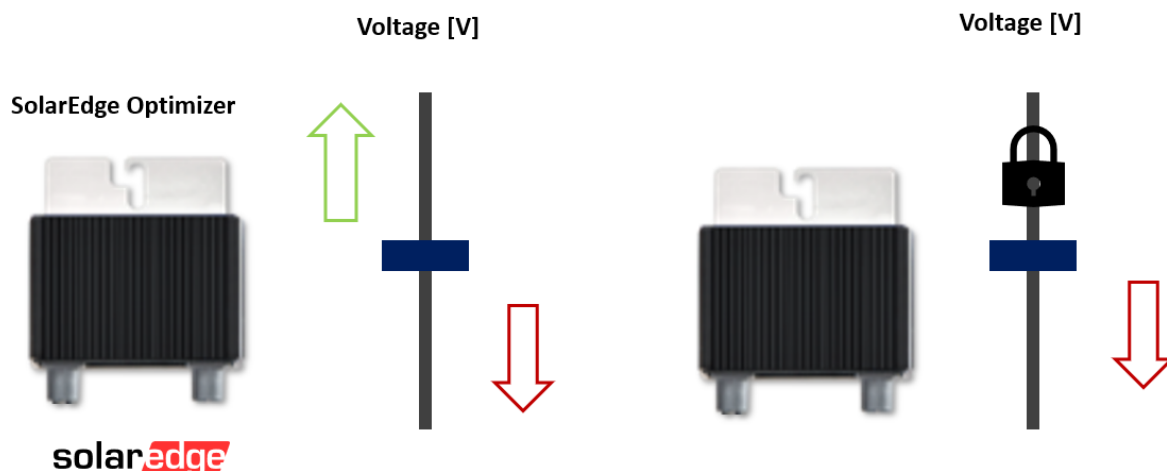


Figure 2:
SolarEdge

SolarEdge ONE

In addition to the main components of a SolarEdge system – inverters and Power Optimizers – the third essential component is the SolarEdge ONE Monitoring platform. This platform enables users to monitor the performance of their solar system in real time. It provides detailed insights into energy production, consumption and the status of the system. By analyzing this data, system operators can identify potential problems at an early stage and optimize their systems. Additionally, having this data available could reduce operational costs, by reducing site visits and improving maintenance efficiency.

The intelligent control within SolarEdge ONE enables the automation of certain processes, such as optimizing self-consumption. This means that the system can control the timing of energy use in a way that minimizes the cost of purchasing electricity from the grid²⁸. For example, the system can use energy from the solar array during periods of maximum production and reduce the purchase of grid electricity during periods of high electricity rates. As a state-of-the-art energy management system, SolarEdge ONE guarantees efficient optimization of self-consumption in real time – based on external and internal data integration, such as current electricity prices and household data. The intelligent energy operating system utilizes every savings potential and supports dynamic electricity tariffs, TOU (time of use), and fixed electricity tariffs.

At the time of the preparation of this report, SolarEdge ONE is free of charge and operates without monthly fees. Any household with a SolarEdge storage system can simply download and use the manufacturer's update.

²⁸ SolarEdge Whitepaper Reducing Energy Bills Using SolarEdge One, Rv 11/2023, [se-reducing-energy-bills-using-solaredge-one-whitepaper-eu.pdf](#)

Integrating Storage Systems

SolarEdge provides both Residential and Commercial & Industrial (C&I) battery storage, enabling efficient energy management by storing excess solar power for later use and seamless integration with SolarEdge ONE. SolarEdge's residential DC-coupled configurations provide high efficiency and cost benefits by enabling direct DC/DC conversion from solar panels to batteries, minimizing energy conversion losses.

For C&I installations, SolarEdge offers an AC-Coupled solution, that comes pre-assembled for minimal on-site work and fewer installation faults. It is suitable for indoor and outdoor and powered by SolarEdge ONE for C&I, optimization and monitoring platform that enables optimized energy production for a wide range of sectors and needs.

By supporting both AC-coupled and DC-coupled storage systems, SolarEdge ONE enhances energy efficiency, lowers total system losses, and provides a more cost-effective and resilient solar + storage solution for modern energy needs.

2.3 How does SolarEdge implement sustainability?

SolarEdge systems not only improve the efficiency of PV systems but also enable precise analysis of energy production with SolarEdge ONE platform. In this manner it is possible to optimize the yield from solar systems while reducing the consumption of resources.

In addition, the use of Power Optimizers enables effective PV system installation in locations which are not suitable for string inverters, which makes it possible to supply electricity from renewable energies in alpine regions, for example, and thus supports sustainability.

For the second year in a row, SolarEdge was included in the Corporate Knights' 2025 list for the 100 Most Sustainable Corporations in the World²⁹. SolarEdge was recognized as a sustainability leader for creating smart and renewable energy products and solutions that promote a low-carbon economy, and for the company's advanced environmental, social and governance (ESG) practices. SolarEdge achieved the 28th best sustainability ranking among >8,300 analyzed companies with over US\$1 billion in revenue. The Corporate Knights Global 100 list is widely recognized as a leading global sustainability index assessing companies across 25 key performance indicators.

Transparent reporting and corporate governance

Sustainability also requires transparent communication about progress and challenges. SolarEdge has a proactive management approach to sustainability goals and publishes regularly ESG reports. These reports provide stakeholders with insight into SolarEdge's progress in achieving sustainability goals and demonstrate a commitment to ethical business practices. This transparent approach not only strengthens confidence in the company but also motivates other players in the industry to take similar measures.³⁰

²⁹ www.corporateknights.com/issues/2025-01-global-100-issue/100-most-sustainable-companies-still-betting-greener-world/

³⁰ SolarEdge Sustainability Report 2023, <https://sustainability.solaredge.com/sustainability-report-2023/>

3. Use Cases

SolarEdge has positioned itself as one of the leading companies in the development of innovative solutions for the photovoltaic industry. The technologies offered by SolarEdge offer a wide range of applications to ensure that the PV System performs under the best safety and efficiency.

1. Residential

One of the most common SolarEdge applications is in the residential sector. Here, solar panels are equipped with Power Optimizers that maximize the energy production of each individual module. The main advantage of Power Optimizers is the ability to mitigate mismatch between panels, which occurs in all PV systems. Mismatch can be caused by various reasons such as shading, soiling, manufacturing tolerance, aging, bi-faciality and temperature differences. An example of this is a single-family home in an urban environment, where the roof is partially shaded by surrounding trees. In an internal analysis³¹ conducted on residential sites on behalf of a large client, the SolarEdge system harvested on average 4% - 10,5% more energy per year than an equivalent string systems - even when using multiple MPPTs. On simple sites (no shading, single facet) considered in the study, SolarEdge gained on average 4% energy, while on complex sites (with shading and/or multi-facet roofs), SolarEdge gained on average 10.5% more energy.

2. Commercial applications

Based on SolarEdge research on aggregated data from over 4M systems installed globally, in commercial applications, companies are increasingly turning to SolarEdge solutions to reduce operating costs and achieve their sustainability goals. In commercial applications, SolarEdge systems under study frequently outperform reference systems by several percentage points.

One example is a food wholesaler that used a large flat roof to install a solar energy system. By implementing SolarEdge technology, the wholesaler was able to maximize the efficiency of its solar energy system while significantly reducing energy costs. In addition, the integrated monitoring system enables real-time monitoring of energy production and consumption, allowing for proactive maintenance and optimization of system efficiency.

3. Agricultural use

As Agri-PV and PV installations on farmland rapidly increase globally, SolarEdge MLPE technology allows wide range of benefits to address the unique consideration Agricultural PV.

The power of Agri-PV to bring farmers more control over their profitability and their energy future is being increasingly recognized worldwide. Reducing operational costs, protecting crop yields and adding stable revenue streams are just some of the big benefits solar can bring to commercial farming. Agri-PV is based on dual-use of farmland for energy production and agricultural production; therefore, SolarEdge's Optimization, Safety, and Monitoring capabilities are crucial for such installations.

Moreover, farmers use solar systems to operate their businesses sustainably and reduce dependence on fossil fuels. A specific example is a greenhouse that has been equipped with SolarEdge Power Optimizers. This technology makes it possible to maximize energy production even under difficult light

³¹ SolarEdge internal Analysis

conditions, enabling greenhouse lighting and climate control to be operated efficiently. The returns from savings on energy costs lead to a rapid return on investment³².

4. PV Tree flagship project in Sölden



Figure 3:
HELIOPLANT®

The HELIOPLANT® project in Sölden, implemented with SolarEdge, is an approach to using renewable energy, especially in high lying regions.

Due to the large amounts of snow, it is necessary to find a shape that can not only withstand the prevailing forces of wind and snow on site but also remains permanently free of snow. This poses great challenges, especially for the modules and the electrical wiring.

The solar modules are designed in such a way that they can be integrated into the tree-like structure without compromising functionality. As the modules are mounted vertically and as snow piles form around the “trees” in the winter months, causing additional reflection, the system design is associated with considerable irradiance mismatch. SolarEdge's Power Optimizers compensate for these different outputs from module to module due to the shading and ensure that each module can generate the maximum possible output.

Due to the prevailing conditions in these alpine regions, the SolarEdge solution offers the opportunity to generate energy where it was previously not possible due to the general conditions and to use it where it is needed, without long transportation routes. This enables the implementation of the sustainability strategy in alpine areas, protects the natural environment and makes the use of solar systems in the alpine region more sustainable.

³² <https://iea-pvps.org/key-topics/dual-land-use-agriculture-solar-power-production/>

With this project, SolarEdge demonstrates how creative problem-solving approaches can help overcome today's challenges.

5. Floating PV

Floating PV systems (FPV) offer a cost-effective investment in renewable energy, particularly where land is scarce or unsuitable for ground-based solar installations. These innovative power plants offer additional benefits, such as reduced water evaporation, but also present some unique challenges.

SolarEdge's floating PV solution utilizes MLPE to ensure each module generates the maximum possible power while reducing energy losses due to mismatch, an even greater impact with bifacial modules. The System is further optimized by longer string lengths, fewer strings and shorter cables to reduce further installation costs. A SolarEdge system allows cost-effective system construction by locating the inverters directly onshore next to the transformer. Maintenance is facilitated by automated fault reporting, allowing remote control and reducing on-site visits. SolarEdge components are resistant to ammonia corrosion and can operate even in high humidity and over a wide temperature range.

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