

SOLAR POWERED

INDUSTRIAL SYSTEMS



OIL & GAS, MINING, LIGHTING AND OTHER APPLICATIONS VERSION 2





INDUSTRIAL SYSTEMS IN THE FIELD

From the Gulf Coast to the Arctic Circle, from megametropolitan centers to remote islands, solar electricity is powering industrial applications for good reason: it is simply the most cost-effective and reliable source of power available.

Unlike generators, solar electric systems have no moving parts, require no fueling, and have nearly zero maintenance requirements outside of maintaining batteries. Solar's inherently low operating costs (OPEX) and independence from the electrical grid provide even greater economy and dependability for an "outage free" solution. As an added benefit for "greening" the oilfield, solar produces no noise or pollution.

Finally, solar is easier to deploy and access. Even in the densest urban setting, obtaining a grid connection in a hard-to-access location (such as for a street lamp, security camera, or rooftop tower) may be prohibitively expensive and require local electricity generation. Solar is a self-contained, easily deployable and maintained local electricity solution.



WORLD'S LEADING SOLAR CONTROLLERS & INVERTERS

GOING SOLAR? HERE'S WHY LEADING INDUSTRY PROFESSIONALS CHOOSE MORNINGSTAR AS THEIR SOLUTION:

- With the lowest hardware failure rate, Morningstar has the highest reputation for reliability in the solar industry. That's backed by more than 4 million solar controllers and components sold in over 100 countries since 1993. Morningstar is the first choice among leading solar professionals. Our customers repeatedly comment, "It's the brand I should have chosen first."
- With the industry's highest dependability rate comes the benefit of reduced long-term costs. Our products simply far outlast our competitors'—sometimes by decades. And higher reliability means fewer field service calls, which can be dangerous as well as costly (such as on unmanned oil platforms).
- Morningstar now has the widest range of higher-powered solar controllers rated for hazardous locations (HazLoc), meeting both North American UL/CSA division/group and International IECEx/ATEX zone requirements.



(LEFT) Morningstar's unique heat-sink assembly used in the TriStar controllers. Ordinary heat-sinks use flat metal fins. The extruded aluminum Morningstar heat-sink uses tapered fins, which greatly improves ambient air natural heat convection and helps eliminate the need for cooling fans.

QUOTES

"JCE continues to use Morningstar due to their excellent reputation and ability to guarantee great global service, as well as their wide product range that's proven to continually operate over considerable lengths of time. Morningstar's **high-quality, reliable controllers** make them JCE's No. 1 partner when supplying power to many of the world's most remote, harshest environments."

-Lukas Geider, Business Development Assistant,
JCE Group, provider of (Ex) electrical control systems for hazardous and safe area environments

"We have chosen Morningstar products for our off-grid solar photovoltaic solutions **deployed at about 2,000 sites in the Middle East...** [they have] proved to be a **reliable** source of power supply even in the **harsh desert conditions.**"

-Agile Europe, provider of system solutions for oil & gas projects throughout the Middle East

"We love Morningstar and generally use it in most applications. **It's very rugged, sturdy equipment** rated for use among dangerous liquids and gasses, which is ideal because many of our projects aren't in the kindest environments. Equally important, we're putting our name on our projects and accepting responsibility for the entire system. It's important for us to have **tested, proven, reliable components...**"

-Justin Taylor, Sales Manager, Connexa, provider of remote security and surveillance systems

Solar for Oil & Gas Production

By nature, oil & gas production and pipeline operations occur in remote locations usually far beyond access to any grid electrical services. Vital functions including measurement and control, injection pumping, security monitoring, data and communications, RTUs and PLCs, field instrumentation (temperature, pressure, flow, level) cathodic protection, and others depend on stand-alone, on-site electricity generation through solar power. Unlike generators and wind turbines, solar has no moving parts and, consequently, no downtime and never needs fuel or an overhaul. Most important to oil & gas operations is safety and reliability. Morningstar meets critical industry safety standards for hazardous location use. And with over four million Morningstars installed in the field since 1993, there's no brand in the solar industry more proven for reliability.

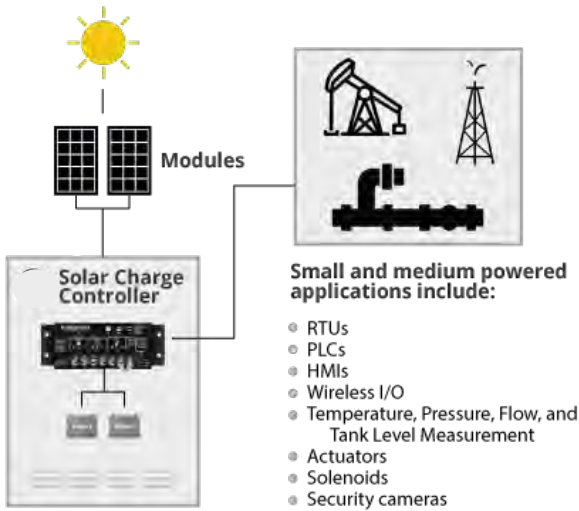
Solar for Lighting

Every corner of the world, every aspect of human activity, depends on lighting. In places where electricity is scarce, inaccessible or non-existent, lighting depends on solar. From remote mines and farms to the remotest corners of shopping mall parking lots, solar electricity is making lighting possible and practical. Around the globe, Morningstar charge controllers are at the heart of solar-powered lighting systems, combining battery charging functions with lighting control in a single, ultra-reliable, compact design with features to meet lighting system user's needs.

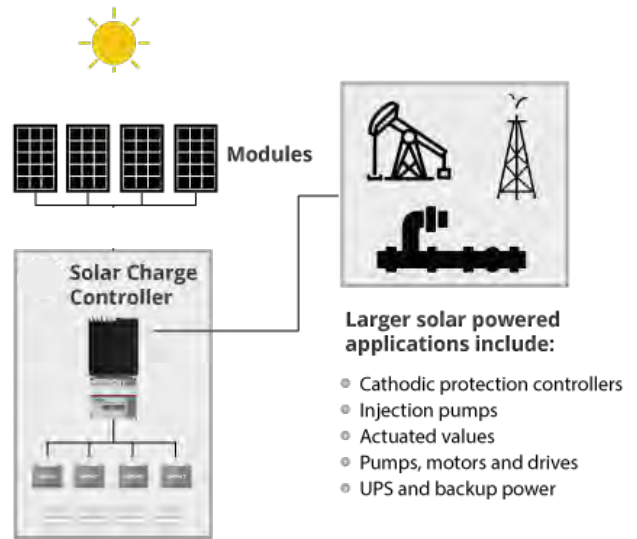
Solar for Security and Surveillance

Now one of the leading applications for solar electricity, security stations are often located at the edge of perimeters and far from any source of grid electricity—often high up and out of reach, making changing batteries impractical. Solar PV systems power security deployments incorporating video recording, motion-sensing, infrared imaging, and more. Morningstar charging technology is suitable for Power over Ethernet (PoE,) internet protocol (IP) video, internet-of-things (IoT) devices, pan/tilt/zoom (PTZ) cameras, and other tools vital to today's security professionals.

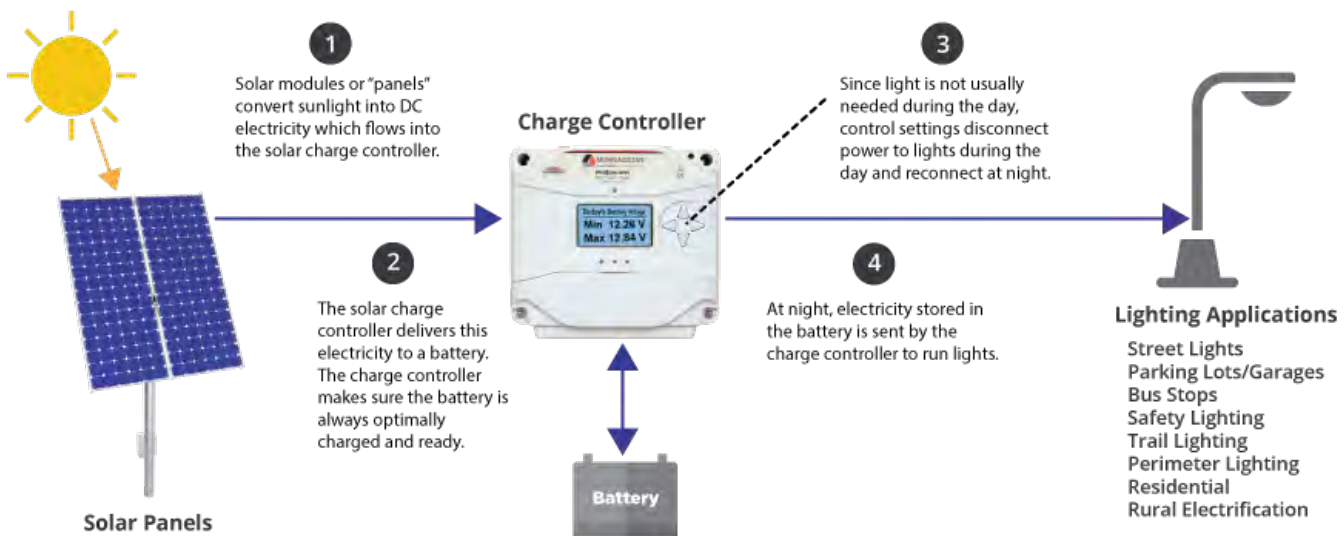
OIL & GAS (smaller & medium power applications)



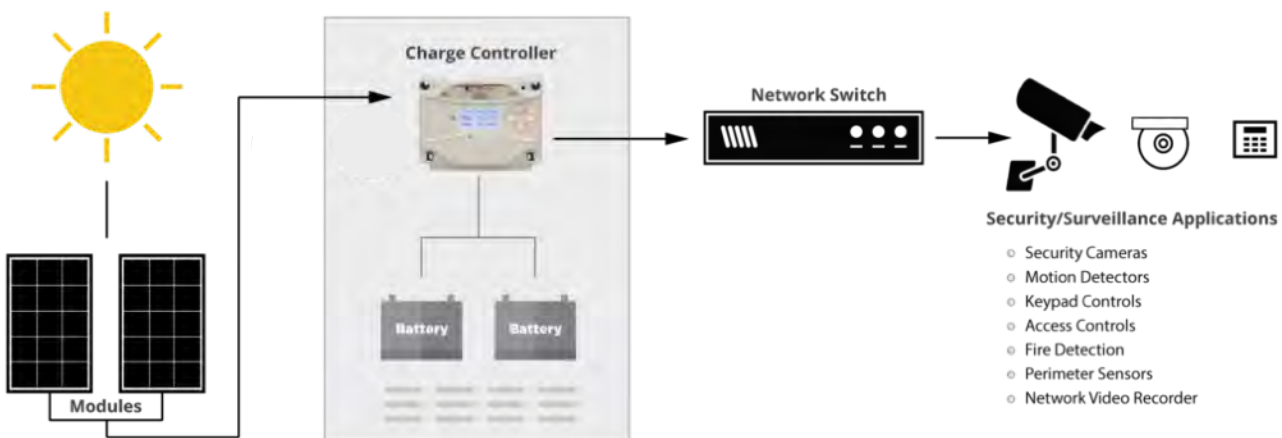
OIL & GAS (larger power applications)



LIGHTING



SECURITY



The industry's **most comprehensive line** for safely specifying solar electricity into industrial applications in hazardous locations



Of the many thousands of solar charge controller models from the over 700* brands in the business, only a handful have earned hazardous location certification. Out of those, nearly 20 of them are Morningstars. With HazLoc-rated controllers capable of supporting solar electric systems up to 1100 Watts—including MPPT models allowing larger, more efficient systems than ever—Morningstar has emerged as the leader in the field.

It's not surprising, since Morningstar's very first product—the SunSaver solar charge controller in 1993—was designed with industrial users in mind and oil & gas applications specifically. Over the following three decades with some 4 million controllers sold, Morningstar “grew up” in industrial applications to become the brand leader, one renowned for reliably powering remote systems in extreme locations ranging from mountain tops and ocean platforms to rainforests and deserts.



Technical innovation and excellence— including fanless design, use of over-spec components, and superior hardware and software engineering— is behind Morningstar's ability to earn both North American UL/CSA and International IECEx/ATEX hazardous location certifications for selected charge controllers, including models in higher power ranges. With Morningstar's wide HazLoc product range, operators of oil and gas fields around the world— as well as mines and other mission-critical environments— can now use efficient, reliable and cost-effective solar electricity to power essential systems on-site, greatly improving both economics and safety.

The short form: Morningstar ProStar, SunSaver and SunKeeper charge controllers are **certified for use in hazardous locations in North America according to UL/CSA standards for Class 1/ Division 2/Groups A-D**. This means that they are rated for use in situations where explosive concentrations of hazardous gases, vapors and liquids are NOT normally present but MAY accidentally exist, and those substances include Group A (Acetylene), Group B (Hydrogen), Group C (Ethylene, Carbon Monoxide) and Group D (Propane, Gasoline, Naphtha, Benzene, Butane, Ethyl Alcohol, Acetone, Methane).

Morningstar ProStar and SunSaver charge controllers are **certified for use in hazardous locations according to IECEx/ATEX (International/European) standards for Zone 2**, where an explosive atmosphere is unlikely to occur under normal conditions EXCEPT for short periods, from atmospheres containing propane, ethylene, or gases and vapors of equivalent hazard.

*ENF Solar Trade Platform and Directory of Solar Companies <https://www.enfsolar.com/>

ProStar MPPT	ProStar MPPT	ProStar PWM	ProStar PWM	Sun Saver MPPT	SunSaver PWM
with meter, 25A or 40A	without meter, 25A or 40A	with meter, 15A or 30A	without meter, 15A or 30A	15A	6A, 10A or 20A

All models available in 12V and 24V (except SunKeeper, 12V only)

SunKeeper PWM
6A or 12A

Product	IECEx Marking	ATEX Marking	UL 121201/CSA C22.2 #213
ProStar MPPT	Ex ec ic IIC TX* Gc	Ex II 3G Ex ec ic IIC TX* Gc	Class 1, Division 2, Group A-D, TX*
ProStar PWM	Ex ec ic IIC T5 Gc	Ex II 3G Ex ec ic IIC T5 Gc	Class 1, Division 2, Group A-D, T5
SunSaver MPPT	Ex ec IIC TX* Gc	Ex II 3G Ex ec IIC TX* Gc	Class 1, Division 2, Group A-D, TX*
SunSaver PWM	Ex ec IIC TX* Gc	Ex II 3G Ex ec IIC TX* Gc	Class 1, Division 2, Group A-D, T5
SunKeeper PWM			Class 1, Division 2, Group A-D, T5

*TX refers to either/both T4 or T5 : When ambient temperature range is -40°C to + 60 °C, device meet T-4 (135 °C, 275 °F)
 When ambient temperature range is -40°C to + 45°C, device meet T-5 (100 °C, 275 °F)

"...We standardised on using Morningstar MPPT solar controllers in our Hazardous Area Zone-certified solar power systems for use in safety-critical power systems for offshore oil and gas assets. Their **high efficiency is uniquely suited for our needs**... Most important... with Morningstar, we know we won't have to go back for expensive service calls in the field."

- Remco Vonk, General Manager Asia & Pacific, Orga BV, a global provider of offshore power, helideck lighting, and marine & aviation navigation marking systems for safety-critical infrastructure assets



CERTIFICATION

INTEGRITY

Morningstar components and solar are the perfect match for maximum dependability under challenging conditions. This guide covers a decade of Morningstar installations proving that point.

Morningstar offers both serial and Ethernet communications using industry-standard Modbus™ protocol with many different solar controllers including the ProStar™ and TriStar™ lines. Selected Morningstar components are now also SNMP-compatible (Simple Network Management Protocol), an internet standard protocol that is used to manage and monitor devices on an IP network. Within an existing network infrastructure, SNMP allows for a simple and convenient way to view and modify the status of critical system components on a private Local Area Network (LAN) or across a WAN (Wide Area Network), if so desired. Morningstar's SNMP-enabled Ethernet MeterBus™ Converter EMC-1 provides this capability.



Morningstar's proprietary TrakStar™ solar harvesting technology and fanless design make for inherently more reliable and efficient systems. With over four million products installed in the field since 1993, Morningstar is the first choice for leading solar contractors in mission-critical installations around the globe.

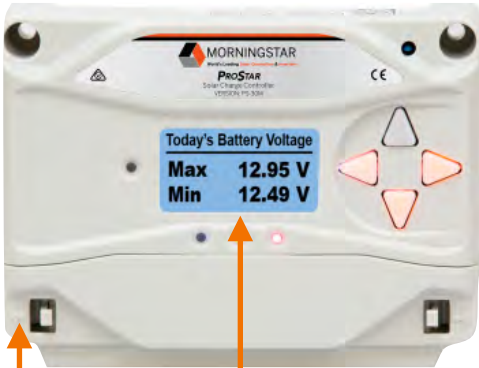


FANLESS DESIGN

*ADVANCED HEATSINK
MANUFACTURING
TECHNOLOGY DELIVERS
SUPERIOR THERMAL
PERFORMANCE AND
GREATER DEPENDABILITY*

Core Features and Technologies: the Morningstar Difference

ProStar PWM™



Large format, high-resolution backlit LCD

Crisp, high contrast display for easier set-up and operation

Lexan polycarbonate UL-listed case

Protects the precision electronics inside with an impact strength 30 times greater than the acrylic thermoplastics commonly found on lesser controllers

Premium high-frequency Coil Craft surface mount inductors (ProStar MPPT models)

Provides the faster power "tracking" that allows engineering this much power and control into a compact design

High-frequency circuit design (ProStar MPPT models)

Improves control response which guards against system transients, regulation overshoot, and overcurrent/overload conditions

Advanced electronic protection

Includes on-board surge protection

DirectFET™ MOSFET power devices (ProStar MPPT models)

Allows surface-mounting critical components next to the heat sink, reducing heat travel distance and keeping electronics even cooler

Extruded aluminum heatsink

Provides superior heat management and eliminates the need for a cooling fan

Rated for Hazardous Locations

UL/CSA Class 1, Division 2, Groups A-D plus IECEx/ATEX Zone 2.

Ideal for use at oil & gas operations, mining, and other mission-critical applications

ProStar MPPT™



TrakStar™ Technology (ProStar MPPT models)

Morningstar's hallmark MPPT technology precisely seeks and locks onto the true maximum power point quickly and accurately, to ensure the highest output possible from a solar array

Self-diagnostics

Monitors and analyzes system performance

5-year warranty

Up to 2.5 times longer than some competitors in this class

Lithium foldback circuit

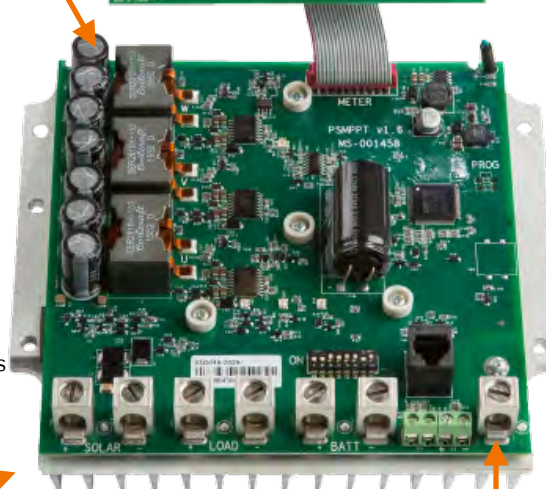
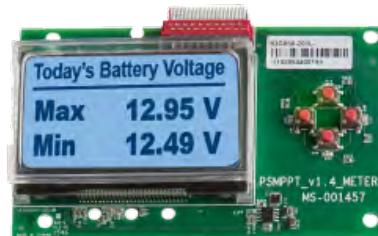
Lithium batteries are expensive and vulnerable to cold temperatures. When it gets close to freezing, the controller refrains from charging to avoid damaging batteries

High-speed ARM processor

All-digital calibration for high accuracy, using the same efficient technology found in advanced mobile devices

Speaks Modbus, and SNMP

(with the EMC-1 adapter) for system monitoring and cloud connectivity



Large diameter, high torque, corrosion-resistant terminals

SunSaver™ MPPT

TrakStar™ Technology (SunSaver MPPT)

Morningstar's hallmark MPPT technology precisely seeks and locks onto the true maximum power point quickly and accurately, to ensure the highest output possible from a solar array

High-frequency circuit design

Improves control response and guards against system transients, regulation overshoot, and overcurrent/overload conditions

Advanced electronic protection

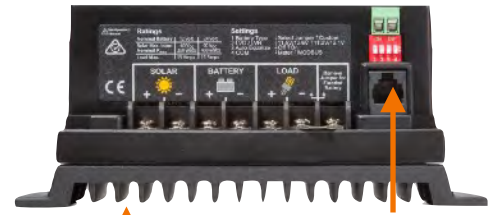
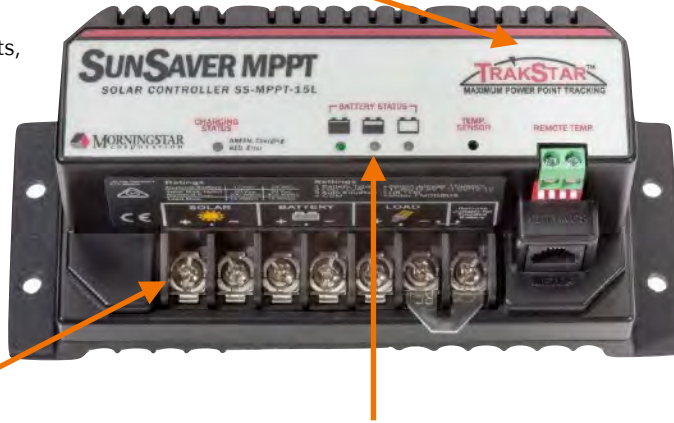
Includes on-board surge protection

High-torque, marine-rated corrosion-resistant terminals

Make installation easier and ensure long-term connection integrity

Self-diagnostics

Monitor and analyze system performance



Speaks Modbus, and SNMP (with the EMC-1 adapter)



Extruded aluminum heat sink

Provides superior thermal management and eliminates the need for a cooling fan



Hazardous location rating

UL/CSA Class 1, Division 2, Groups A-D plus IECEx/ATEX Zone 2. Ideal for use at oil & gas operations, mining, and other mission-critical applications

SunSaver™ PWM

Hazardous location rating

UL/CSA Class 1, Division 2, Groups A-D plus IECEx/ATEX Zone 2. Ideal for use at oil & gas operations, mining, and other mission-critical applications



Hardened for field use

Through a combination of anodized aluminum enclosure, epoxy encapsulation, marine-rated terminals and high-impact plastics

Advanced electronic protection

Includes on-board surge protection high-torque, marine-rated

Corrosion-resistant terminals

Make installation easier and ensure long-term connection integrity



Self diagnostics

Monitor and analyze system performance

Extruded aluminum cover with built-in heat sink

Provides superior thermal management and eliminates the need for a cooling fan

Epoxy encapsulation

Unique, premium formula with high thermal conductivity and low electrical conduction; protects internal electronics in extreme conditions

SOLAR POWERING OIL & GAS APPLICATIONS



Photo courtesy of JCE Energy



Solar Powers Offshore Oil Rigs in Southeast Asia

Location: Gulf of Thailand

Year: 2019

Product: TriStar

System size: Solar power systems on eight wellhead platforms with a battery bank producing 15 kWh/day

Partners include: Orga BV, PTTEP

Offshore unmanned wellhead platforms are automated oil and gas assets designed for remote operation controlled by onshore teams. Deploying maintenance crews in harsh sea conditions is treacherous and expensive, so reliability is of the utmost importance when it comes to the power generation systems deployed on these assets.

Over the last 20 years, many offshore oil and gas operators have switched to solar-based power generation solutions to minimize maintenance and maximize power availability in the confined space available on these units. For example, Orga BV outfitted eight of PTTEP's wellhead platforms in the Gulf of Thailand with solar. Orga chose to use Morningstar components because their MPPT technology minimizes expensive enclosure space requirements while automated resetting offers extended maintenance intervals..



Off-Grid Power at South Texas Oil and Gas Sites

Location: South Texas

Year: 2014

Products: TriStar MPPT and SunSaver controllers

System size: 800W array; 24V gel lead-acid batteries

Partners include: Ameresco Solar, Deka Solar



An off-grid application at the Eagle Ford Shale site in South Texas uses TriStar MPPT solar charge controllers to regulate battery charging to power supervisory control and data acquisition (SCADA) equipment, RTUs, and cathodic protection. The world's largest oil and gas companies choose Morningstar products because of their reputation for reliability and strong customer support.



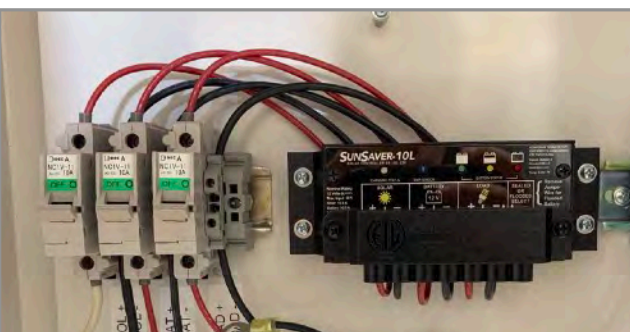
Solar Powered Helideck Lighting

Location: Brunei, Southeast Asia
Year: 2019
Product: TriStar
System size: ~<100 W of solar
Partners include: Orga BV, Shell



Jack-up platforms often serve as offshore hotels and heliports for workers and visitors commuting by helicopter to and from oil and gas wellhead platforms. Aviation safety status lights are critical to operations, providing visual warnings to alert pilots whether a helideck is safe for landing. To simplify installation complexities, this critical warning light system often requires its own reliable and robust solar power system with high power availability, autonomous operation, and simple routine maintenance.

Orga BV provides dependable, effective status lighting systems powered by solar to meet the tough demands of these applications. One example is Shell's Champion project. Orga chose to use Morningstar products because they are 'fit and forget,' reducing expensive service calls. They are also suitable for use in the potentially explosive environment.



Reliable Controls for Automated Solutions

Products: ProStar, SunSaver controllers
Partners include: Automation-X



As a provider to the oil and gas industry, Automation-X uses Morningstar charge controllers in its battery boxes and solar applications for durable, reliable solutions.



Solar Powers Offshore **Satellite Communications** in Malaysia

Location: Malaysia/Southeast Asia

Year: 2021

Products: TriStar TS-MPPT-60-48V controllers

System size: 23kW of 320W solar panels with five sets of 48V, 1965Ah battery banks

Partners include: Swift Energy, PTTEP, Honeywell

Coming out of a challenging year with the COVID-19 severely affecting the global economy and causing a significant drop in demand for crude oil, national petroleum exploration and production company PTTEP is glad to get back on track with the installation and start-up of the Pemanis gas facility. The project's wellheads sit offshore Malaysia's Kuching shipyard and transmit information in regard to pressure, temperatures, gas metering, etc. back to an operations center on land via satellite.



PTTEP commissioned Swift Energy to provide a solar installation to power remote data gathering on the wellheads. The system included 48V VRLA batteries, 72 320W zone 1 solar panels wired in 48V, and eight Morningstar TriStar controllers. The TriStars include a Modbus interface which gathers data and passes it along to a Honeywell remote terminal unit (RTU) cabinet that transmits back to the operations center. The efficiency and dependability of Morningstar's MPPT technology, along with its range of online resources to help simplify sizing and easily perform site and cost software analysis, made Morningstar a good choice for this and other Swift Energy projects.



A Hybrid, Cost-Effective Oil & Gas Platform Powering System for the North Sea

Location: Danish sector of the North Sea

Year: 2016

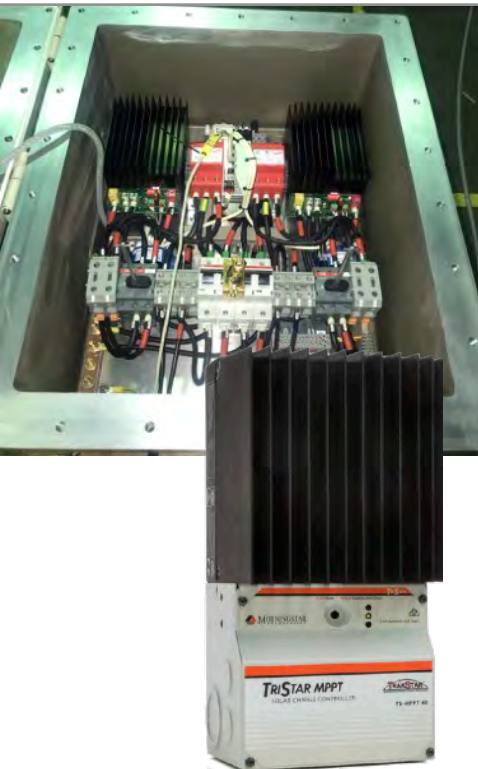
Products: TriStar TS-MPPT-60 and TS-MPPT-45 controllers

System size: ~10kW for a 800W continuous load and a 24V, 4800Ah battery bank

Partners include: JCE Energy

JCE Energy's client sought a cost-effective system to supply power to telecommunications systems, navigation aid systems, bird deterrent systems, foghorns and other applications on its unmanned platform in the Danish North Sea. Operating on an unmanned platform in a remote location at sea, the system had to be fully operational without any human supervision, and sufficiently weatherized to withstand the harsh conditions of the North Sea. JCE also had to consider the weight of the system to accommodate transportation and loading onto the deck, along with compliance with the Hazardous Location Zone system.

JCE engineered a Zone 1 hybrid power system comprising a Zone 2 wind turbine, solar panels and battery enclosures, accompanying Zone 1 battery isolators and a Morningstar controller. This system is fully autonomous, requiring minimal maintenance and generating significant cost savings. As a world leader in the design and manufacture of electrical control systems for hazardous areas, JCE Energy relies on Morningstar to help power critical applications in some of the most remote and harsh environments in the world.



Off-Grid Power Systems for Remote Wellheads

Location: Java Sea, Indonesia

Year: 2020

Products: TriStar TS-MPPT-60 controllers

System size: 25kW for a 1.6kW continuous load with 24V, 5,500Ah battery banks

Partners include: JCE Energy

Wellhead platforms in the Java Sea play a vital role in oil and gas development, but their remote location in a harsh, hazardous environment requires a more durable and powerful means of generating electricity for critical on-board systems. JCE Energy supplies larger, more powerful solar electric systems including nickel-cadmium batteries, a monitoring and alarm system, power distribution boards, solar panels, and a Morningstar controller suitable for use in Zone 1 hazardous areas. These systems power locally installed instrumentation, telecom equipment, navigational aids and process equipment/motors on each platform.



Solar Simplifies Shell Oil Rigs with **Fewer Emissions**

Location: North Sea

Products: Relay Driver (RD-1), MeterHub (HUB-1), Communications Adapter (RSC-1), Remote Temperature Sensor (RTS), TriStar TS-MPPT-60 controllers

Year: 2015

System size: Solar installation connected to a 24V battery system

Partners include: Shell, Tideland Signal, Marlec

Shell is working on reducing the net carbon footprint of its energy production, an initiative that includes retrofitting offshore facilities including platforms and NUIs (Normally Unmanned Installations) with solar power. Because NUIs see decades of operational use in the harsh weather of the North Sea, with plenty of snow and cloud cover, remote management is difficult. Instead of continuing with two diesel generators constantly online, in 2015, Shell began to simplify the normally unmanned installation by removing process equipment that was no longer useful or redundant and retrofitting with solar.

Tideland Signal selected Morningstar TriStars, among other components, for use in its systems designed to meet the European Union's ATEX-certification for use in hazardous locations. The controllers are ideal for the application, featuring everything necessary to reliably operate in the harsh environment.

The solar installation makes it easier to maintain the NUIs with simpler equipment and lower emissions. Now, generators are only used for emergencies.





Enabling Monitoring and Control in Remote Oil Fields

Year: 2010

Products: SunKeeper controllers

Partners include: SunWize



It may sound ironic, but solar power has a significant role in the oil and gas industry, largely due to the remote locations of most drilling operations. The variety of energy needs involved in oil and mining, including supervisory control and data acquisition (SCADA) and telemetry, make solar energy a cost-effective way to provide power to production sites.

SunWize provides ruggedly designed remote power systems to ensure safety and efficiency while minimizing operation and maintenance costs. SunWize chose Morningstar's SunKeeper controller for many of its sites because it can withstand the harsh environments of many drilling locations.



Remote Power for Hazardous Locations

Location: Several locations on the East Coast of the United States

Year: 2019

Product: SunSaver SS-20L-12V

System size: 160W of solar and 108 Ah, 12V battery bank

Partners include: SunWize, Equipment & Controls [ECI]

Natural gas plays an increasingly important role in the U.S. energy portfolio. With its growth, safety remains a top priority for distribution and transmission utilities. Any issues must be detected and isolated quickly before there is any chance of failures that could lead to health or safety risks.



For example, one of the largest fully-regulated utility companies in the United States serves approximately 3.5 million natural gas customers. It selected SunWize to design and build over 700 systems for monitoring low-pressure gas lines in several states across the East Coast, equipped with Class 1 Division 2 electrical components rated for use in hazardous locations (HazLoc). This network of systems allows the utility to greatly increase its monitoring and response capabilities for any abnormal pressure situations that may arise, allowing dangerous conditions to be identified and responded to much more quickly than previously.

The locations in which these systems were installed required components meeting UL/CSA Class 1 Division 2 certifications for areas where hazardous gases, vapors and liquids *may* accidentally exist, including hydrogen, propane, methane and gasoline. Naturally, SunWize selected the SunSaver as the solar charge controller due to its UL/CSA certification and field-proven reliability. Bussman fuses and fuse holders were used in place of circuit breakers to provide a cost-effective hazardous location-rated control panel. The systems also used one 160W rated Class 1 Division 2 solar module along with SunWize's side-of-pole mount and C4 enclosure.



Solar Light Systems Provide Crucial Light Sources in Remote Kuwait Oil Fields

Location: Kuwait

Year: 2018

Products: TriStar TS-MPPT-60 controllers, TriStar-45 controllers (load control) and Communications Adapter (RSC-1)

System size: 1 kW with 24V, 960Ah NiCd battery bank (five sites)

Partners include: EcoSol Energy Systems



Kuwait is a dry and arid country with extreme temperature shifts from desert summers to frigid winters. Kuwait's economy is heavily dependent on fossil fuels; oil accounts for more than half of its GDP and 95% of the government's income. Because oil is so vital, the government-owned Kuwait Petroleum Corporation oversees the production of crude oil through a network of subsidiaries. Kuwait Oil Company relies on a reliable, steady source of electricity to power the exploration, drilling and production of oil and gas.



With most oil and gas sites in remote areas with restricted access, Kuwait Oil requires backup battery solutions with high performance, total reliability and low maintenance to power essential equipment and systems. EcoSol Energy Systems developed a lighting system to keep the oil fields running safely and efficiently. It turned to Morningstar to keep systems running without interruption with a nickel-cadmium (NiCd) battery system with TriStar TS-MPPT-60 controllers. This power system is fully reliable in extreme temperatures, can withstand rugged wear-and-tear, and supplies off-site communications to keep systems running.



Morningstar Controllers in Solarcraft Projects

SolarCraft provides high-quality engineered solutions to integrate, power, shelter and deploy critical field automation. It chooses to use Morningstar controllers for their ruggedness and reliability in customer applications.

Location: Evans, Colorado

Year: 2018

Products: TriStar TS-MPPT-60 controllers, Relay Driver (RD-1)

System size: 24V solar system, augmented by a generator, designed to power 15A at 48V

Customer: End 2 End



Location: Beaumont, Texas

Year: 2017

Products: TriStar TS-MPPT-60 controllers

System size: 24V solar system, 46W load

Customer: Scallon Controls, Inc.



Location: Big Spring, Texas

Year: 2018

Products: TriStar TS-MPPT-60 controllers

System size: 100W load

Customer: Plains All American



Location: Eldorado, Texas

Year: 2019

Products: TriStar TS-MPPT-60 controllers

Customer: Magellan Crude Oil Pipeline



SOLAR POWERING INDUSTRIAL APPLICATIONS



Photo courtesy of Ameresco



Photos courtesy of Automation-X



Mining Companies Turn to Solar for Solutions

Location: Brazil, Chile, Peru, Angola, United States

Products: TriStar TS-MPPT-60 controllers, TriStar Meter-2, ProStar PS-MPPT-40 controllers, SunSaver SS-MPPT-15L controllers

System size: Mobile repeaters with deep-cycle batteries from 110 Ah to 3,520Ah (30+ sites)

Partners include: Trailers RD

Mining companies increasingly rely on solar energy to generate electricity at remote sites, which require reliable surveillance, communication and lighting for secure, continuous operation 24/7.

Trailers RD-Minas specializes in renewable mining applications. It chose Morningstar products for more than 30 mining, construction, road and airport sites throughout North America, South America and Africa. These projects include mobile radio repeaters, surveillance cameras and light towers.

Minas' engineering and Morningstar's technology rapidly improve one of the world's oldest industries to ensure that Brazil and other developing countries maintain their economic momentum.





Powering Marine Navigation Equipment in Harsh Environments

Location: Papua New Guinea

Year: 2018

Products: TriStar TS-MPPT-60 controllers, SunSaver SS-10L, and ProStar-PS-15 and PS-30 controllers

Partners include: M-NAV Solutions

Lighthouses, buoys and beacons are crucial for assisting navigators in choosing a safe course of passage. Officially known as Marine Aids to Navigation (AtoN), these structures also are used as platforms for communication and surveillance equipment for weather and ocean monitoring. A non-operational AtoN in a key location could have catastrophic consequences.

These systems are most often in remote environments that are difficult to access and exposed to severe environmental conditions. System reliability is so critical that the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), which sets standards for AtoN operation, requires an operational availability rate between 97.0% and 99.8%.

M-NAV has used Morningstar controllers in Papua New Guinea AtoN systems, like this one linked to a solar and battery system at the Jomard Island Coastal Monitoring Station in Milne Bay Province, for more than 10 years because the products offer a high availability rate and operate reliably in extreme environments. M-NAV Solutions is also recommending Morningstar controllers in AtoN contracts in the Philippines.





Solar Skids Power Sensors in the Chilean Desert

Location: Antofagasta, Chile

Year: 2020

Products: SunSaver SS-MPPT-15L controllers

System size: One 330W solar panel with 50Ah, 24V lithium battery per skid (54 total)

Partners include: Connexa, RELiON

Antofagasta lies between the Pacific coast and Northern Chile's Atacama Desert. Corrosive salt in the air and harsh desert extremes combined with dangerous gasses and liquids potentially present in industrial applications create a demanding environment for power electronics.

A client sought a way of remotely powering sensor systems to monitor liquids in this challenging setting. Logistics posed yet another concern: any solution had to fit in a small pickup truck and be manageable with a two-person installation.

Connexa's team constructed 54 container-loaded skid systems. Each included one solar module, a RELiON lithium battery, a Morningstar SunSaver SS-MPPT-15L charge controller, and a stainless steel enclosure. Connexa specifies SunSaver controllers because they're approved for use in hazardous locations: Class 1, Division 2. Also, RELiON is a member of Morningstar's Energy Storage Partner Program, which ensured a reliable, seamless solution.



Street & Airfield Lighting in Indonesia

Location: Malinau Kota, Borneo, Indonesia

Products: SunLight SL-10L-12V controllers

Partners include: PT AZET

The only transportation to the town of Malinau, the administrative capital of the Regency, is by air. More than 70 Morningstar SunLight 10L to 12V, 20W DC PL lamps help light the way for planes to safely land, as well as providing essential street lighting.



Controlling Railroad Signaling Power Systems

Location: United States

Products: TriStar TS-MPPT-45 controllers with meter

System size: 3,360W of solar

Partners include: Ameresco, EMI

Morningstar's TriStar helps control solar-powered railroad wayside signaling applications, such as this intermediate signal. Three 20-foot towers make up the system and each retractable tower applies over 1kW with two TriStar TS- MPPT-45 units (each regulating 580W).

EMI exclusively manufactures each tower for Ameresco Solar. The systems are shipped complete and assembled in the field. On-site training and audits ensure proper operation. Currently, Ameresco Solar has several hundred of these systems installed in North America on all Class 1 railroads.



Photos courtesy of PT AZET

Venezuelan Surveillance and Lighting System

Location: Caurimare, Caracas, Venezuela

Year: 2017

Products: ProStar PS-30 controllers

System size: 275W solar panel and two 155Ah, 12V sealed batteries

Partners include: Luis Raygada

This building surveillance and lighting features the Morningstar ProStar PS-30 controllers, along with a 275W, 72-cell solar panel, four LED lights, and a USB charger.



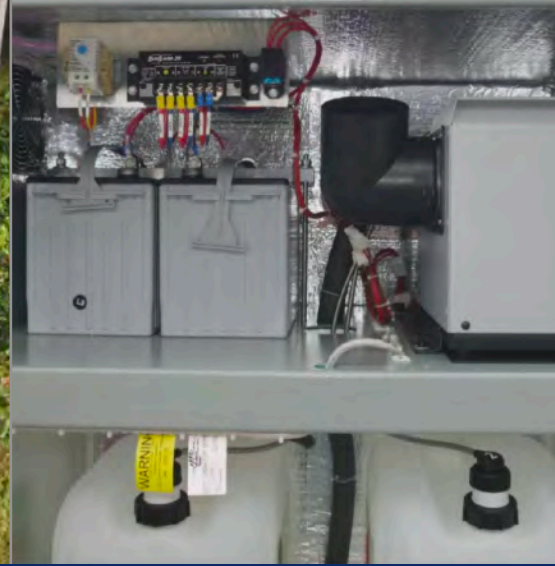
Street Lighting in Korea

Location: Jinhae, Korea

Products: SunLight controllers

Partners include: Lightron Lighting & Advancement

The newly constructed harbor city of Jinhae includes 30 Morningstar SunLight controllers for street lighting. The lights automatically turn on at dusk and off at dawn. Installers chose Morningstar controllers for their high quality reputation in harsh environments, and their easily adjustable PV-based lighting control settings. Sunlight controllers are available in 4 different models with 10 or 20-A charge ratings that support 12 or 24-V battery systems.



Integrating Renewable Energy and Fuel Cell Technology

Location: Global

Products: SunSaver SS-20, ProStar MPPT

Partners include: SFC Energy



Generating electricity in remote locations where applications require power 24/7 is always a challenge, especially when conditions prevent solar panels from capturing available sunlight. That's why innovative solution providers are turning to another electrical-generating technology also originally developed for extended space missions: the fuel cell. For example, SFC in Germany offers its EFOY line of fuel cells, integrating renewable energy and fuel cell technology to power remote systems for years without refueling. This hybrid system shifts from fuel cells to solar energy to keep systems operating regardless of weather or time of day.

SFC choose to use Morningstar components in its systems because of their unmatched reliability, advanced technology and competitive pricing. As these systems reach into increasingly challenging and inhospitable environments, Morningstar components will ensure continual uptime with minimum human intervention.



Photo Courtesy of Surveillance Security Intelligence Group and SunWize.

Video Surveillance System

Products: SunSaver controllers

Partners include: SunWize



Morningstar SunSaver controllers are increasingly used to power video surveillance systems such as this one.



Illuminating the **Solar Superhighway** of Brazil

Location: Rio de Janeiro, Brazil

Year: 2015

Products: TriStar TS-MPPT-45 controllers

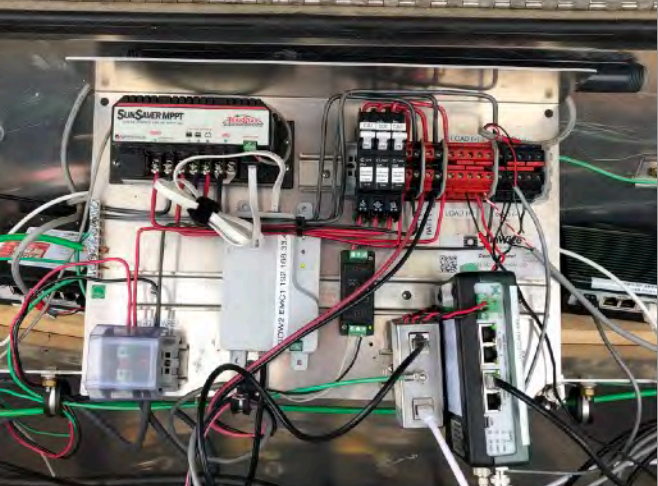
System size: Solar-powered streetlight kit with three modules, four 240Ah, 12V batteries and a 150W LED lamp (4,300 units)

Partners include: Soter Energia, Kyocera Solar

The Arco Metropolitano is a 145km arch of highway in the state of Rio de Janeiro. The arch skirts the booming metropolis of Rio de Janeiro city, providing a vital connection to the five major highways that crisscross the state. But hazardous weather conditions and high crime made driving on the highway at night difficult and dangerous. To keep the highway open, the government needed a reliable lighting solution to provide around-the-clock illumination on the most trafficked and dangerous stretches.

Japanese electronics firm Kyocera Solar partnered with Brazilian engineering company Soter to develop and install a street lighting system capable of producing 2.8GWh of solar energy per year without burdening the already fragile local energy grid. The Kyocera streetlight kit depends on a lead battery system connected to a charge controller, capable of storing up to three days worth of energy. The Morningstar TriStar TS-MPPT-45 serves as a critical component for this single-source energy solution.





Reliable Power to Detect Earthquakes and Other Seismic Events

Location: Oregon and Washington

Products: SunSaver SS-MPPT-15L controllers, Ethernet MeterBus Converter (EMC-1)

Partners include: The Pacific Northwest Seismic Network

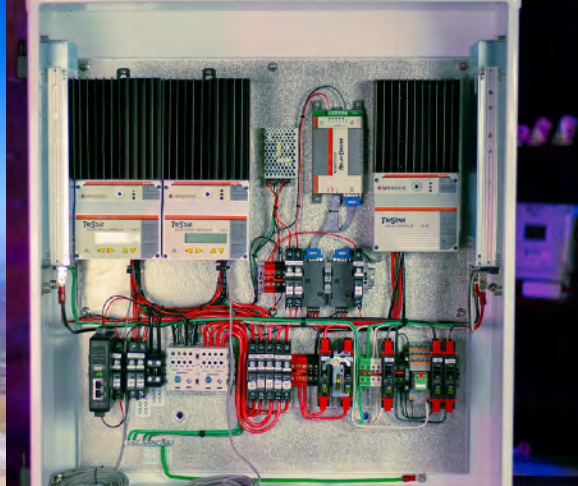
Unlike severe weather, which can be tracked and mapped for days and even weeks before landfall, earthquakes appear suddenly and without warning. Advances in technology now allow detecting earthquakes within life-saving seconds before shaking has begun.

The Pacific Northwest Seismic Network (PNSN) monitors ground motion and generates real-time earthquake information to emergency responders, the press, and the public. The project has more than 400 stations, making it the second largest seismic network in the United States. Strong-motion instrumentation, especially with real-time digital communications, requires a reliable power source. Because weather hazards often cause widespread power outages, each system must have a backup battery system with enough capacity to operate continuously for four days.

battery system with enough capacity to operate continuously for four days.

Morningstar's SunSavers enable many of PNSN™ power supply systems. The Ethernet MeterBus Converter (EMC-1) adapter allows monitoring critical data in real-time, alerting technicians of any issues. The EMC also integrates with the Simple Network Management Protocol (SNMP) to help PNSN engineers plan for maintenance.





Remote Power for **Wireless Communication Mohave Desert**

Location: Mount Perkins Radio Site, Lake Mead National Recreation Area, Arizona

Year: 2021

Products: TriStar TS-MPPT-60, TriStar TS-45, Relay Driver RD-1, Communications Adapter (RSC-1), TriStar Digital Meters TS-M-2

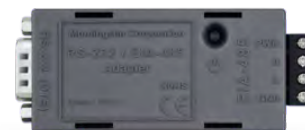
System size: 5.84kW of solar and 1,075 Ah/48V battery bank

Partners include: SunWize, Commdex

The use of wireless communication is expanding rapidly both in the United States and across the globe. From critical government closed-loop communication systems to last-mile rural ISPs for end-users, wireless data transmission has become a critical layer of our industrial infrastructure. Wireless communications technology makes it possible to “leapfrog” the running copper lines and networks, greatly reducing the time and cost it once took to deliver services to remote users. Because of this, wireless infrastructure is often placed in rural or remote locations without access to grid power.

Lake Mead National Recreation Area has a primary remote communication site located at Mount Perkins in Mohave County, Arizona. SunWize provided a hybrid system to power this equipment, consisting of a solar electric system and backup generator designed to support continuous operation of a 472W load. Output voltages of +12Vdc, +24Vdc, and -48Vdc accommodate different onsite equipment.

Requirements include operation at temperatures up to 130° F, components rated to withstand 90+ mph wind speeds, PE stamps on drawings, adherence to applicable NEC and IEEE standards, UL-certified components, VRLA batteries, and SNMP communication on the controller. In addition to the Morningstar components used, battery charging from the solar array is complemented by x2 Meanwell DBU 3200 battery charging units providing 110A of rating input at 48Vdc. All equipment is contained within a compact, durable enclosure.





Powering Public Radiation and Weather-Monitoring Stations

Location: Nevada

Products: SunSaver SS-MPPT-15L controllers

System size: 50 and 60W solar panels on 24 sites

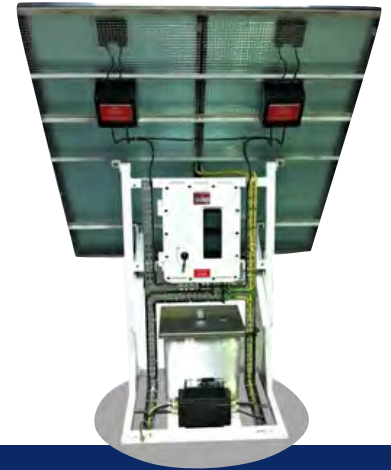
Partners include: The Desert Research Institute

The Desert Research Institute (DRI) of the Nevada System of Higher Education administers the Community Environment Monitoring Program (CEMP) to watch the ambient environment for radiation from past nuclear testing, ensuring the safety of nearby communities. The program encompasses 24 publicly accessible radiation and weather-monitoring stations.

Solar panels (50W and 60W) operate in conjunction with a deep-cell battery to power all CEMP station instrumentation. Morningstar solar charge controllers have kept these systems reliably running for more than two decades.

Direct participation in collecting data and disseminating information from these stations gives residents a greater sense of security. All information collected from automated sensors at these stations is posted online and updated at least hourly.





Deterring Birds in Hazardous Off-Grid Locations

Location: Persian Gulf Coast, Middle East

Year: 2000

Products: SunSaver SS-MPPT-15L controllers

System size: 200W with 12V or 24V, 120Ah battery banks

Partners include: JCE Energy



One of the many hazards unmanned offshore installations face in daily operation is that seabirds like to use them for roosting. Not only does the waste they produce impair the efficiency of solar modules, but it can also cause serious corrosion and continual shutdowns with material failures. The challenge lies in implementing a bird deterrence system that can continually operate without access to a source of power on board.

That's why two decades ago JCE Group successfully certified the world's first Ex Solar Power Pod (SPP) consisting of a PV module, battery, and solar controller on a steel frame. Capable of powering bird deterrent devices, they are designed to continuously operate in hazardous locations and in the presence of flammable gasses and are ATEX-approved for Zone 1 and 2 areas for use in navigation aids, alarm systems, gas detection, bird scaring, camera surveillance, ship-to-shore communications and more.

The solution's success prompted JCE to create a dedicated renewable energy division. Today, through JCE Energy, SPPs continue to provide solutions, thriving along with Morningstar controllers in extreme environments including desert, jungle, offshore and sub-zero climates.



Creating a Sustainable Marine Experience in Greyhope Bay



Location: Aberdeen, Scotland

Year: 2020

Product: TriStar TS-MPPT-60 controller

System size: 6kW with a 48V, 900Ah battery bank

Partners include: JCE Energy

Torry Battery is a landmark artillery installation that has overlooked Aberdeen's Greyhope Bay harbor since 1860. Today, it's known for its spectacular panoramic views of the city and coast, as well as the largest bottlenose dolphins in the world. Conservationists wanted to renovate the Battery to create an educational marine center for the community with a zero-footprint, sustainable design.

Based in the Aberdeen region, JCE Energy stepped in to provide a renewable solution to power the center plus a community space and cafe at the remote site. The system includes shipping containers equipped with rooftop solar arrays to charge batteries inside. Ultimate project goals include replacing the supplemental generator still in place with a wind turbine for a 100% green energy solution.



Seismic Measuring Systems in Italy

Location: Italy

Products: TriStar TS-45 controllers

System size: 30 PV systems

Partners include: Solara AG

Over the last 2,000 years, more than 400 destructive earthquakes have been documented in Italy, with 15 major earthquakes since 1905. Therefore, early detection is critical to saving lives. Solar powers more than 30 Electronica measurement systems in Italy. Each station is equipped with two Solara AG solar modules, two Morningstar TriStar TS-45 controllers and two VRLA gel batteries. The systems power two seismic detection sensors for earthquakes, one radio bridge for remote data transmission and one GSM modem for alarms transmission.





International Certification Agency Selects Morningstar for Success Story

Location: Massachusetts

Product: All

Partners include: TÜV Rheinland



When the people responsible for certifying compliance and safety for the industry want to profile your brand for a case study, you know you're doing something right. At Morningstar, we're proud that TÜV Rheinland—an international organization at the forefront of testing, standards, and certification for everything from consumer products to industrial and medical devices—selected us for its own case study in solar.

As the case study notes, in the solar industry, standards and regulations change quickly, with new standards emerging at a rapid pace. Morningstar's advanced designs and proven reliability provided TÜV with an ideal partner to showcase in this category.



Products Featured



TriStar MPPT™ and TriStar PWM™ solar controllers

30A, 45A or 60A at up to 150 Voc

Iconic, industry-leading design for larger (up to 3kW) engineered systems. Parallel scalability of chargers and load controllers to power rating of up to 45kW; ideal for large hybrid system design. Highest peak efficiency for off-grid controllers in the industry: 99% (TS-150). TriStar MPPT has TrakStar solar harvesting technology; PWM version provides charging plus load and diversion control. Fully rated for operation at temperatures up to 45°C. Fanless design for long-term reliability. Speaks Modbus, and SNMP with the optional EMC-1 adapter

“...one of the best charge controllers out there...these things are tanks.”

“It is a Morningstar, what do you expect! It is great.”



ProStar MPPT™ and ProStar PWM™ solar controllers

25A or 40A at up to 120 Voc

Proven in over two decades of use and continually improving, both “are the legend and the latest in a single product.” An advanced controller for mid-range systems up to 1,100W. MPPT version has TrakStar solar harvesting technology for maximum solar harvesting. Fanless design for long-term reliability. **Both versions now rated for use in Hazardous Locations, certified for UL/CSA Class/Division and IECEx/ATEX Zone applications.** Speaks Modbus, and SNMP with the optional EMC-1 adapter

“Best of the best. Have used and seen many others. This is the most durable...”

“...you get what you pay for, and this one is worth every penny ... count on Morningstar.”



Simple Network Management Protocol
SNMP
COMPATIBLE

SunSaver MPPT™ and SunSaver PWM™ solar controllers

15A at up to 75V

The “single most successful charge controller in the solar industry.” SunSaver MPPT with TrakStar technology is the perfect charging solution for smaller off-grid solar systems up to 400W. Hardened, tropicalized PWM version is the industry’s leading choice for use in extreme environments and provides load control. MPPT version speaks Modbus, and SNMP with the optional EMC-1 adapter. **Both versions now rated for use in Hazardous Locations, certified for UL/CSA Class/Division and IECEx/ATEX Zone applications**



“...This is the only one I'd use...it's the one I wish I bought first.”



SunKeeper PWM™ solar controllers

6A or 12A at 12V

Compact “point of use” design that mounts directly to the solar panel junction box or module/panel frame in its own IP65-rated case; ideal for small, single-module solar industrial systems. **Rated for use in Hazardous Locations, certified for UL/CSA Class/Division applications**



“This is a great little unit ... an outstanding charge controller.”

SunLight PWM™ solar controller

10A or 20A at 12V or 24V

World’s leading solar lighting controller for street and pathway lighting, parking areas, bus stations, signage, and much more. Provides 10 lighting options with accurate onboard timer. Rugged design with anodized aluminum enclosure, epoxy encapsulation and corrosion-resistant terminals



“Bulletproof and dependable, I will use them again and again.”

SureSine™ DC-to-AC inverter

300W; 12 Vdc input, 115 or 220 Vac output

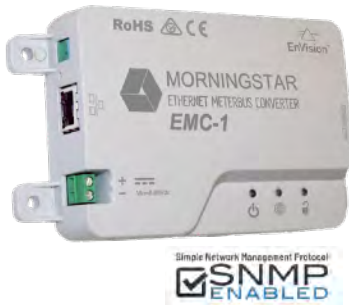
Compact, powerful and proven in demanding rural electrification projects around the globe. Ideal for industrial communications, security, and other applications using DC electricity generated from solar to power AC-based systems up to 300W with 600W peak/surge power. Cast, anodized aluminum enclosure and encapsulated circuitry plus no internal cooling fan needed ensure long-term reliability under the harshest conditions. Speaks Modbus, and SNMP with the optional EMC-1 adapter.



Simple Network Management Protocol
SNMP
COMPATIBLE

“...how all inverters should be made. Thank you, Morningstar.”

Featured Accessories



Ethernet MeterBus Converter™ (EMC-1)

Connects to any enabled controller or inverter to provide enhanced data and network features, including SNMP or Simple Network Management Protocol, an important feature for maintaining telecommunications power systems, and Modbus. EMC-1 allows MeterBus-enabled products to send data to the internet.



Relay Driver™ (RD-1)

Logic module providing high-level system control functions such as high/low voltage alarms, load control, and generator start. Controls four independent relay driver outputs by reading digital data inputs from Morningstar's TriStar controller or by reading battery voltage when used in systems with other controllers.



The MeterHub™ (HUB-1)

Allows up to 15 Morningstar products on a single MeterBus network. Electrically isolates devices that supply power to the network, preventing damage to the network in the event of grounding problems. Five status LEDs indicate the proper network connection to each port. In multi-controller systems the TS-M-2, TS-M-2-600V, and TS-RM-2 are networkable using Morningstar's MeterHub to display individual controller data and aggregate system data together on a single meter—multiple controllers can share a TriStar Meter or Relay Driver. Suitable for either wall or DIN rail mounting.



EIA-485 / RS-232 Adapter (RSC-1)

Converts RS-232 to EIA-485 connector. Allows up to 128 Morningstar products to communicate on the same communications bus and over much greater distances than with RS-232. All data is transmitted via MODBUS™ protocol.

The Digital Oilfield is Going Solar...



From wellhead to pipeline, operators are using solar to power a range of applications: injection pumping, security monitoring, data and communications, RTUs and PLCs, field instrumentation (temperature, pressure, flow, level), actuated valves, cathodic protection, and much more. With no moving parts, no fuel needed, and little maintenance required, solar works out to be a reliable, cost-effective solution for upstream and midstream systems.

...and the solar brand it's going with is Morningstar

Used in over 100 countries and with over four million sold, Morningstar's reliability and technology has been tested and proven in mission-critical installations for nearly 30 years. Now with comprehensive hazardous location certifications—UL/CSA (North America) and IECEx/ATEX (International/Europe)—Morningstar has the widest, most dependable line of HazLoc solar controllers in the industry.

Morningstar's line of ProStar™ and SunSaver™ charge controllers, UL/CSA and IECEx/ATEX rated for use in hazardous locations (ProStar HazLoc models available soon)



"...We standardised on using Morningstar MPPT solar controllers in our Hazardous Area Zone-certified solar power systems for use in safety critical power systems for offshore oil and gas assets. Their **high-efficiency is uniquely suited for our needs...** Most important, with Morningstar, we know we won't have to go back for expensive service calls in the field."

--Remco Vonk, General Manager Asia & Pacific, Orga BV, a global provider of offshore power, helideck lighting, and marine & aviation navigation marking systems for safety critical infrastructure assets

"Morningstar's **high-quality, reliable controllers** make them JCE's No. 1 partner when supplying power to many of the world's most remote, harshest environments."

--Lukas Geider, Business Development Assistant, JCE Group, provider of (Ex) electrical control systems for hazardous and safe area environments

"We have chosen Morningstar products for our off-grid solar photovoltaic solutions deployed at about 2000 sites in the Middle East... [they have] proved to be a **reliable source of power** supply even in the harsh desert conditions."

-- Agile Europe, provider of system solutions for oil & gas projects throughout the Middle East



Morningstar SunKeeper™ UL/CSA rated controller, for single-module systems

Get the free guide to *Solar Powered Industrial Systems* and see how operators around the globe achieve solar success with Morningstar
HERE: <https://www.morningstarcorp.com/getindustrialguide>



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World's Leading Solar Controllers & Inverters



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