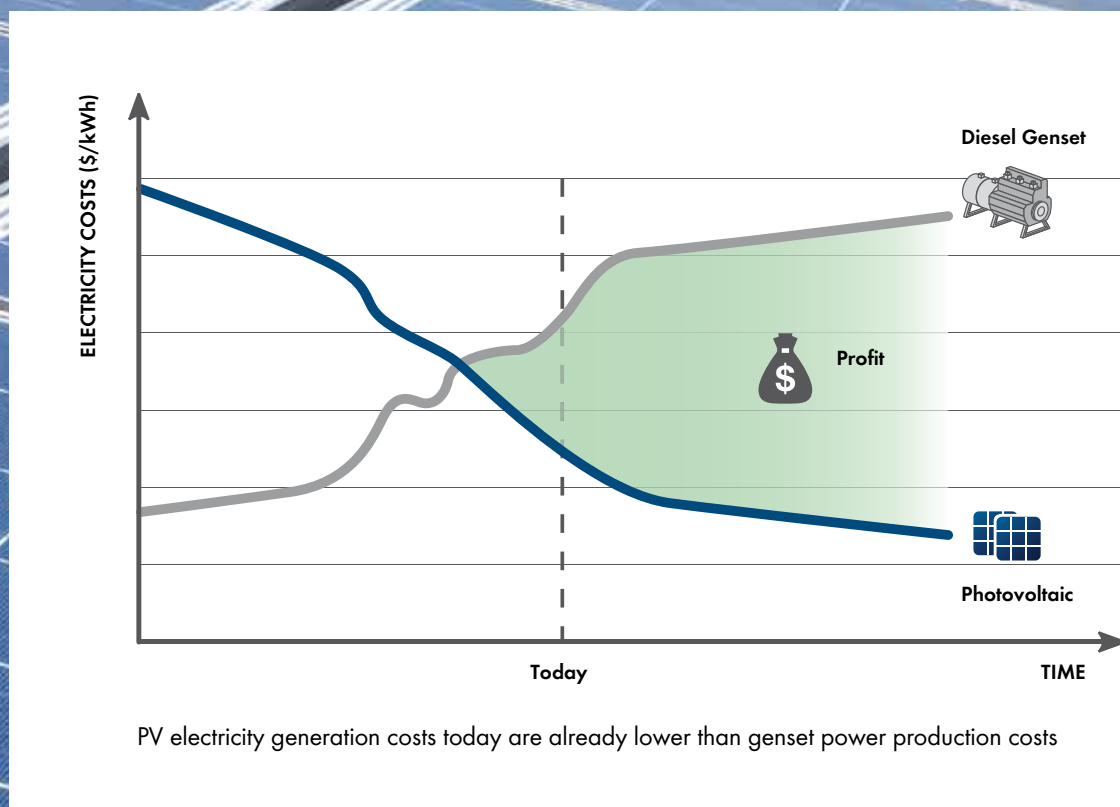




# SMA Fuel Save Solution



The SMA solution for industrial photovoltaic diesel hybrid systems



# SUN SAVES FUEL

## Decentralized energy from PV systems is shaping the energy supply of the future

Five hundred gigawatts (GW) of power from diesel gensets provide industrial companies with electricity worldwide. Diesel gensets are essential to power supplies both in regions with and without adequate grid infrastructure. Furthermore, in developing and newly industrialized countries that have shown strong economic growth, the International Energy Agency (IEA) has forecasted an increase in the primary energy demand. The demand for fossil fuel continues to rise which, in turn, increases harmful CO<sub>2</sub> emissions. Globally, climate is changing rapidly.

### The high costs of diesel fuel

Those who rely solely on diesel gensets to generate power must be prepared for the high operating costs tied to price increases and constant fuel consumption. There are several reasons for this, for example, fossil energy reserves will only last for approximately another 150 years, and in many regions the price for one liter of diesel has already exceeded one US dollar. In addition, if the fuel has to be transported to remote regions, effective costs increase even more as a result of the necessary transportation and storage. This can often double the price for a liter of diesel compared to that in the spot market. There are also expenses for CO<sub>2</sub> emissions trading certificates. Diesel-powered systems thus reach their economical limits very quickly.

As a result, alternative energy solutions are in high demand to combat the increase in prices and effects of

global warming which keep both CO<sub>2</sub> emissions as low as possible and offer economically viable options for consumers. The solutions of today are shaping our tomorrow.

### Minimizing fuel costs and CO<sub>2</sub> emissions

Already more than 120 countries worldwide have established governmental policies that support an increase in the percentage of renewable energy in the energy mix. In addition, the United Nations plan to establish a binding multilateral environmental agreement in the near future. SMA has developed a technology that is able to reduce fuel costs and CO<sub>2</sub> emissions in industrial applications. The SMA Fuel Save Solution combines diesel and photovoltaics into a hybrid system and minimizes fuel dependency.

### Profit from photovoltaics

In sunny regions, photovoltaics has already become the most economically viable way to generate power, even without subsidies. Prices for PV system technology have dropped by more than 50 percent within the last three years alone. PV systems with a total output of more than 100 gigawatts (GW) have been installed worldwide, proving that photovoltaics is a reliable technology and one from which more and more industrial companies are profiting. It is the perfect economical and ecological supplement to diesel systems.





# THE FUTURE IS HYBRID

**The combination of diesel and photovoltaic systems ensures large industrial consumers an attractive and reliable energy supply**

PV systems do not cause emissions. They require low-maintenance and have low operating costs. They have a modular design, are scalable and can be adjusted according to current energy demands. This means that, despite high, initial system costs, PV systems can be amortized in as little as three to five years in sunny regions. PV is thus the ideal supplement to a diesel-fuelled power supply for many energy-intensive industries in remote regions with little or no grid infrastructure.

## **Economical, environmentally friendly and efficient**

For industries such as mining; raw material processing; agricultural companies such as flower farms, water desalination systems or tourism facilities with hotels and amusement parks low power generation costs, quick operational readiness, maximum reliability and avail-

ability are fundamental. Exactly this makes hybrid systems with SMA Fuel Save Solution so attractive, providing the enormous advantages compared to pure genset systems:

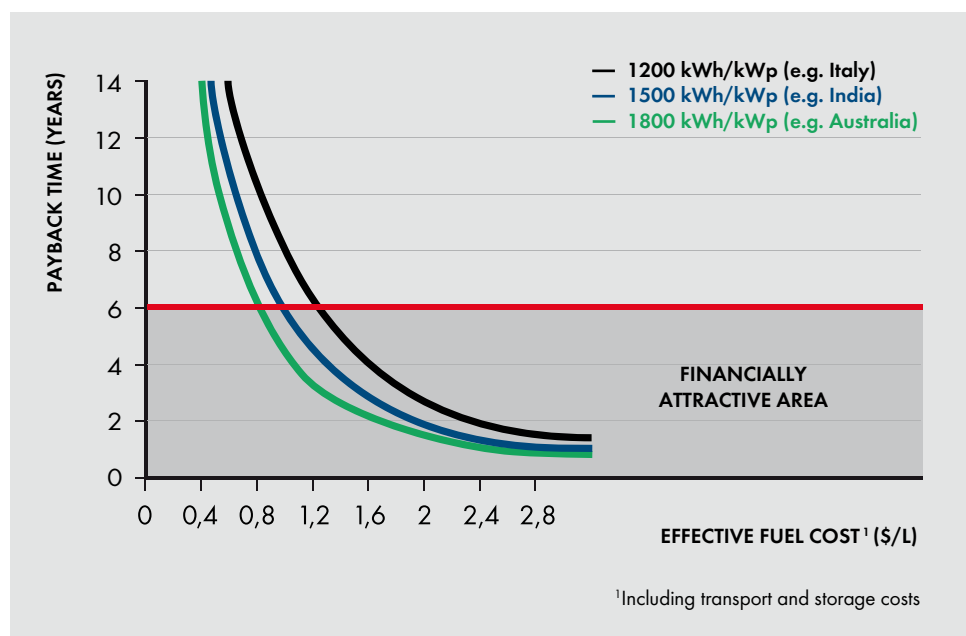
- Lower fuel costs
- Reduced risk of fuel price increases and supply shortages thanks to optimized planning
- Minimal CO<sub>2</sub> emissions for better CO<sub>2</sub> certificate trading
- Photovoltaics paints a "green" image

It is never too late to start thinking about the future. The SMA Fuel Save Solution can be integrated into both new and existing power supply systems.

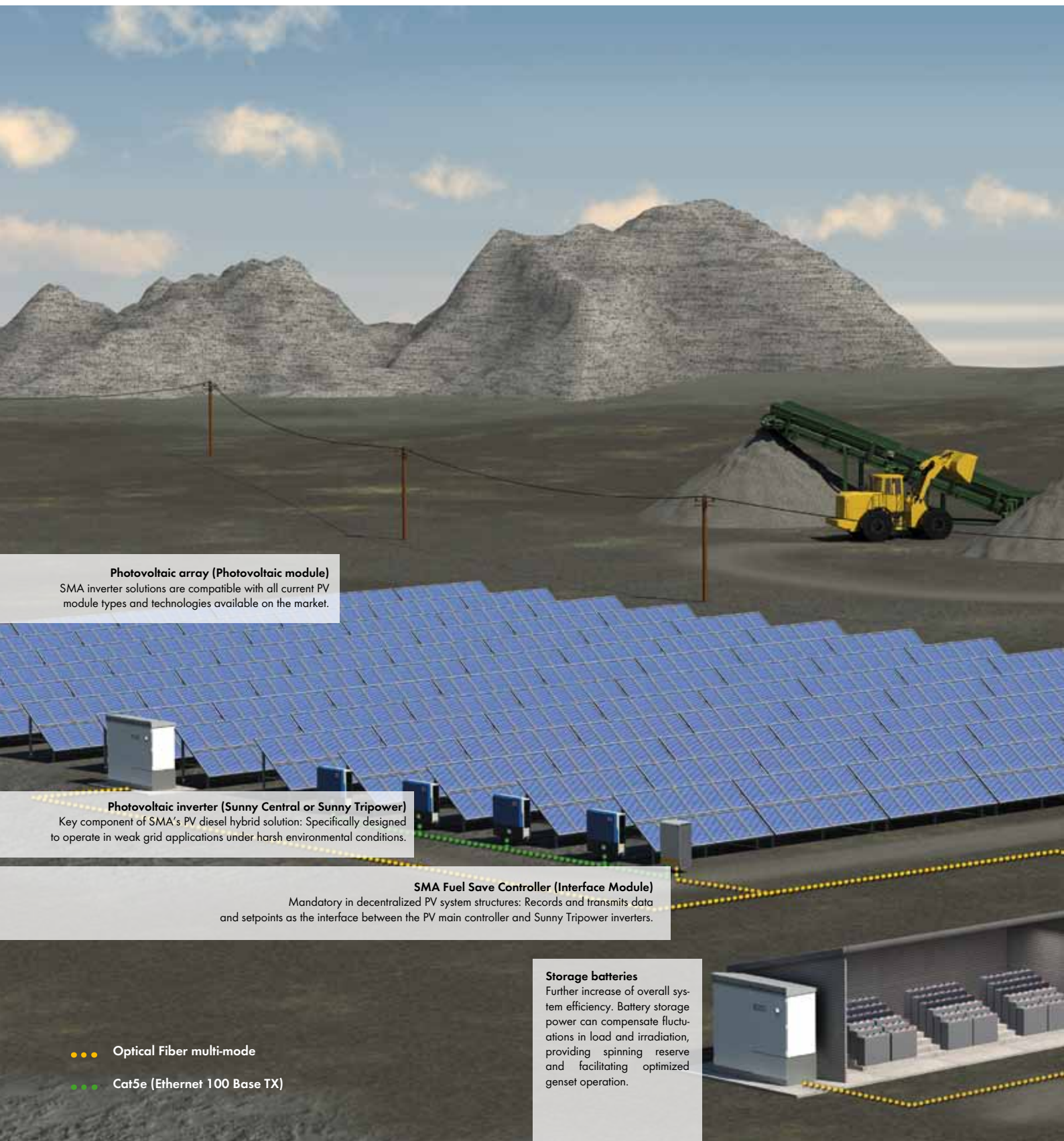


### Hybrid Pays Off

- When the effective cost of diesel exceeds one US dollar per liter
- When local solar irradiation conditions allow the use of PV (especially economically viable with PV yields above 1,500 kWh/kWp)
- When intelligent communication between the genset and PV systems facilitates demand-oriented use of PV power







**Photovoltaic array (Photovoltaic module)**

SMA inverter solutions are compatible with all current PV module types and technologies available on the market.

**Photovoltaic inverter (Sunny Central or Sunny Tripower)**

Key component of SMA's PV diesel hybrid solution: Specifically designed to operate in weak grid applications under harsh environmental conditions.

**SMA Fuel Save Controller (Interface Module)**

Mandatory in decentralized PV system structures: Records and transmits data and setpoints as the interface between the PV main controller and Sunny Tripower inverters.

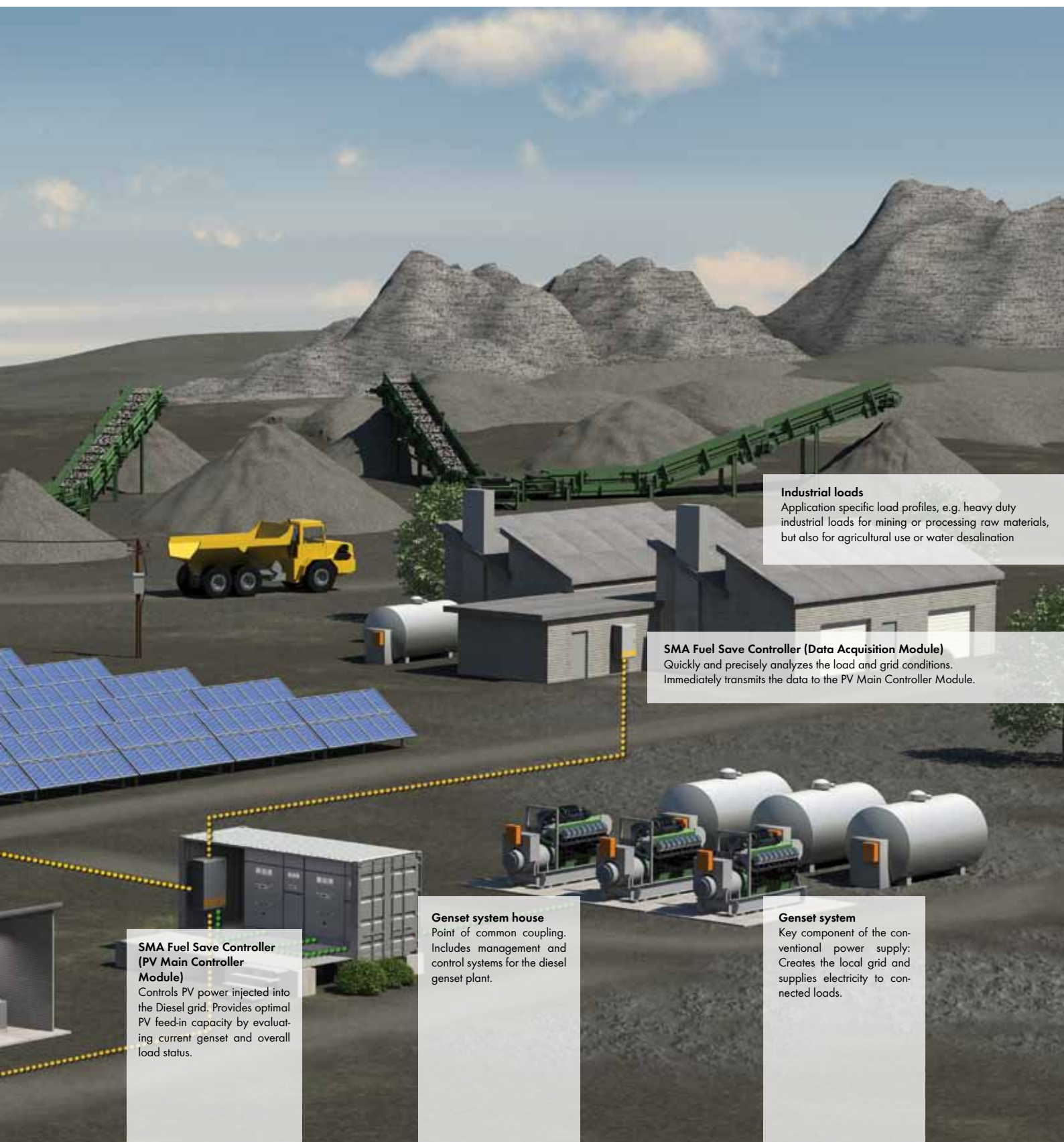
**Storage batteries**

Further increase of overall system efficiency. Battery storage power can compensate fluctuations in load and irradiation, providing spinning reserve and facilitating optimized genset operation.

● ● ● Optical Fiber multi-mode

● ● ● Cat5e (Ethernet 100 Base TX)

# SMA FUEL SAVE SOLUTION



**Industrial loads**  
Application specific load profiles, e.g. heavy duty industrial loads for mining or processing raw materials, but also for agricultural use or water desalination

**SMA Fuel Save Controller (Data Acquisition Module)**  
Quickly and precisely analyzes the load and grid conditions. Immediately transmits the data to the PV Main Controller Module.

**SMA Fuel Save Controller (PV Main Controller Module)**  
Controls PV power injected into the Diesel grid. Provides optimal PV feed-in capacity by evaluating current genset and overall load status.

**Genset system house**  
Point of common coupling. Includes management and control systems for the diesel genset plant.

**Genset system**  
Key component of the conventional power supply: Creates the local grid and supplies electricity to connected loads.

Intelligent integration of photovoltaics into diesel systems  
to ensure a self-sufficient energy supply with enhanced efficiency



# ADVANCED TECHNOLOGY

## Intelligent System Solutions for Every Application

SMA has been developing scalable hybrid solutions for the electrification of off-grid regions for more than 30 years. Moreover, SMA benefits from many years experience as a system technology supplier for installations of PV power plants with a total capacity in the three digit megawatt range. With over 32 GW of installed inverter power, SMA is the global market leader in the field of PV inverters. High-efficiency SMA inverters ensure the best yields worldwide and have an exceptional overload capacity, ensuring critical loads always operate reliably. More than 1,000 employees work daily researching and developing technologies to achieve the best in quality system solutions that include state-of-the-art technology at an affordable price – for each and every type of application.

tral inverters convert the direct current from PV modules into alternating current and feed it into power supply systems. The SMA Fuel Save Controller manages PV feed-in and the diesel genset remains unaffected. The SMA Fuel Save Solution can achieve 60 percent of PV capacity compared to installed genset capacity. It means 600 kW of PV power can be installed with each megawatt of operating genset power. In addition, an optional storage battery can raise the proportion of PV power in the system, and our remote monitoring via Sunny Portal provides system safety and facilitates easy system monitoring for operators. Should service be required, the SMA Global Service Network is quickly on-site. SMA guarantees premium quality and reliability, around-the-clock.

### For stable and safe systems

With SMA's Fuel Save Solution for large industrial applications, PV can be easily and efficiently integrated into diesel grids. The Sunny Tripower and Sunny Cen-

### **SMA Solar Technology – A Reliable Partner Worldwide**

The SMA Group generated sales of €1.5 billion in 2012 and is the global market leader in PV inverters, a key component of all PV systems and, as an energy management group, offers innovative key technologies for future power supply structures. It is headquartered in Niestetal, near Kassel, Germany, and is represented internationally in 21 countries. The corporate group employs a staff of over 5,000 employees worldwide.

SMA's broad product portfolio includes a compatible inverter for every type of module on the market. The product range includes both inverters for PV systems connected to the grid as well as inverters for off-grid systems. SMA is therefore able to provide unsurpassed technical inverter solutions for all system sizes and types.





# RELIABLE COMPONENTS



## FUEL SAVE CONTROLLER

### **The perfect interface between the gensets, PV systems and loads**

The SMA Fuel Save Controller is compatible with both Sunny Tripower and the Sunny Central inverters and manages demand-based PV feed-in according to load and generation profiles. This ensures maximum security with reduced fuel costs and also minimizes CO<sub>2</sub> emissions. The SMA Fuel Save Controller carries out comprehensive and demand-based grid management functions in conjunction with SMA inverters. SMA hybrid systems can be expanded on a modular basis at any time and provide optimal system control via remote monitoring.



SMA inverters with this label fulfill the unique requirements for hybrid power supply systems used in industrial applications:

- Broad frequency and voltage range for optimal operation outside of public utility grids
- Rapid communication between the PV system, genset and load for immediate response to load shedding and changes in PV feed-in
- Integrated grid management functions. Reactive power provision and active power limitation depending on frequency promise a stable grid operation
- Robust – applicable use worldwide, even in harsh ambient conditions



## SUNNY TRIPOWER

### **The ideal solution for larger PV power plants with decentralized system structures**

Sunny Tripower facilitates a considerable reduction in investment costs and secures exceptionally high yields with an efficiency of 98.5 percent. The device, available in a three-phase version, has excellent MPP tracking efficiency with SMA OptiTrac. Fast communication via Bluetooth® makes the Sunny Tripower TL Economic Excellence even more economical. Additionally, its ability to provide reactive current supports grid stability, and its integrated grid management functions guarantee the highest possible yields.



## SUNNY CENTRAL

### **Are designed specifically to be used in large central PV power plants and ground mounted systems**

With power classes between 500 kVA and 1800 kVA Sunny Central inverters make optimal system design possible. String monitoring and optional feed-in into the medium-voltage grid make Sunny Central inverters the first choice for homogeneously structured PV systems. They also remain extremely productive in harsh ambient conditions such as heat, moisture, salty air, sand and dust. Their high degree of efficiency and 110 percent of power in continuous operation at up to 25 °C ensure maximum yields. Sunny Central inverters also carry out grid management functions and meet the specific connection regulations of many countries.



# ALL-INCLUSIVE SERVICE

**Using a cooperative and holistic approach, SMA supports its customers through the entire process – from early on in the planning stages, to installation and all the way to commissioning – worldwide**

Thanks to optimal integration of PV power into genset systems the best economic results can be achieved. From the very start, the SMA Power Audit determines whether PV can be integrated into a diesel genset and how.

## **Maximum planning and investment security**

When system operators are not familiar with load profiles of the diesel genset we can loan them the appropriate measuring device with the SMA Power Audit. Skilled technicians can then perform measurements on-site. Based on the data, we are able to make a detailed calculation of the cost and savings potential and determine the system with optimal dimensions. SMA's web-based planning tool Sunny Design Hybrid enables a detailed project assessment. Thanks to a Discounted Cash Flow Analysis, we can provide you with important financial parameters such as amortization and current net value and thus ensure maximum planning security.

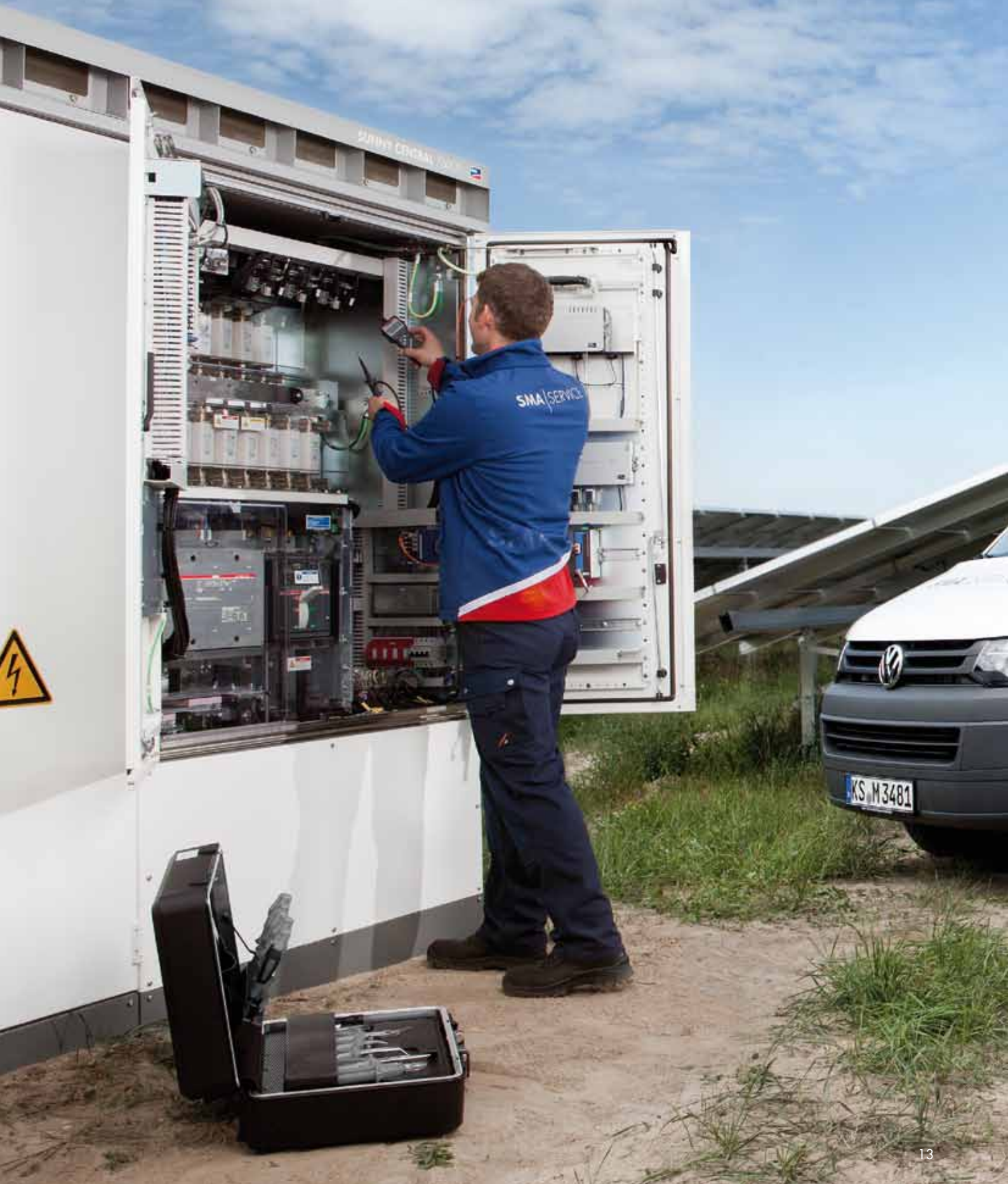
## **Always close to the customer**

SMA employees provide support directly on-site during installation and commissioning. Thanks to our years of experience worldwide, we work with the most reputable companies in the relevant photovoltaic markets. In this way we are always able to guarantee the best possible support for our customers. Should service be required our Global Service Network provides competent assistance wherever our inverters are installed, be it in the desert, the rain forest, in steppe regions or in the arctic. Our 21 subsidiaries worldwide further strengthen our ability to provide fast service, 24 hours a day, seven days a week – in even the most remote regions. SMA represents a safe, clean and economical power supply throughout the world.

SMA Worldwide







# INTERNATIONALLY EXPERIENCED



## The first SMA hybrid system was put into practice in Ireland

SMA installed its first autonomous hybrid system on the Irish island Cape Clear as a pilot project established by the European Union in 1987. The modular SMA system combined two wind turbine systems, each having 30 kW of nominal power, a diesel genset with 72 kW (90 kVA) and battery storage capacity of 100 kW hours. Thanks to its intelligent system technology, the diesel genset could be shut off entirely in high winds, allowing frequency and power control to be taken over by the battery power converter. The battery storage facilitates the reduction of start-stop cycles in the diesel genset thus extending the electrical endurance of the genset.



## The Scottish island relies on hybrid supply

The Scottish island of Eigg has never been connected to a utility grid. Since 2008, the approximately 100 residents of the island have thus been operating their own stand-alone grid. They successfully converted their power supply, stepping away from diesel, and now generate power using virtually 100 percent renewable energy sources. This hybrid off-grid system from SMA with Sunny Island off-grid inverters has an installed renewable power generation capacity of 166 kW. It integrates solar power, wind and hydropower, a storage battery and two diesel gensets as a back-up.

This provides sustainable and economical electrical power around-the-clock with energy costs having dropped more than 60 percent since the conversion. The high modularity, with four clusters each having three Sunny Island devices, makes the stand-alone grid virtually fail-safe.

1987  
Commissioning of the  
first hybrid system

1981  
SMA founded

1987  
First transistor inverter  
developed for PV  
systems

1991  
Series production of the  
first inverter

1995  
First PV inverter  
with string  
technology



### Largest PV System in India

One of the largest PV systems in India was connected to the grid in early 2013. The PV power plant began operation in Nagaur in the federal state of Rajasthan. The 40-MW system was equipped with a total of 37 Sunny Central 800CP inverters and has cut CO<sub>2</sub> emissions by 66,000 tons per year. SMA service technicians at various customer service stations commissioned the PV power plant within a single week and also provided preliminary support to the experts from the Indian solar energy producer Azure Power during preparations leading up to commissioning. The project is the largest PV power plant to be installed within the framework of the governmental "National Solar Mission" program in India to date.



### 100 Percent Solar Power Supply for Tokelau

Tokelau is one of the world's most remote countries – and since 2012, the first to generate its energy supply using only photovoltaics. SMA delivered 93 Sunny Island inverters to control the off-grid systems on the three coral islands and 205 Sunny Boy inverters to convert the direct current produced by the PV modules into the alternating current necessary for operation of electrical appliances. The 1 MW system is one of the largest off-grid systems in the world and replaces approximately 200 liters of diesel consumption every day.

### Megawatt Photovoltaic Diesel Hybrid System in South Africa

Thabazimbi is a sparsely populated region characterized by mines in the South African province of Limpopo. The utility grid is located far away, connection possibilities are limited and the transport of diesel fuel is expensive. However, high solar irradiation provides ideal conditions for the use of solar energy. Since November 2012, a PV system has been supplementing the existing diesel power supply to a chrome ore mine with 63 Sunny Tripower 17000TL inverters and a capacity of 1 MW. With up to 1.8 GWh of solar energy per year, the mine operator can save up to 450,000 liters of diesel per year and significantly reduce CO<sub>2</sub> emissions.

2000  
First U.S. subsidiary  
founded

2008  
IPO

2012  
SMA Fuel Save Controller

1999  
Introduction of the  
Sunny Island off-grid  
inverter

2003  
Series production of the  
central inverter begins

2007  
SMA is the first manu-  
facturer to open its own  
solar technology test  
center

ENERGY  
THAT  
CHANGES

