



Solar panels are the ideal solution for the use of electrical devices far away from electricity grids.

Smart off-grid solutions

Off-grid PV: An overview of the challenges and opportunities of off-grid PV from Phocos AG, one of the leading manufacturers of solar charge controllers and components for independent solar power systems.

As more and more electrical devices are used far away from the electricity grids, the need for reliable, cost-efficient, and weather-independent off-grid power solutions is rising dramatically. The most important markets are rural electrification in developing countries, a wide variety of industrial and leisure applications, and a growing number of solar streetlights. Many of these applications call for new flexible and intelligent power management and charge control solutions.

Users of electrical systems who live in remote areas need expert information and support to find their individual

off-grid power solution. This offers tremendous opportunities for system integrators, wholesalers and power solution providers to offer entire systems with full service solutions engineered to meet individual application needs. This is even more important as the requirements differ greatly. Expertise in the off-grid power field create a significant competitive edge in this fast growing market.

Rural electrification

1.4 billion people worldwide do not have access to a power grid, states the analysis on energy poverty published by the

International Energy Agency, UNDP and UNIDO. To meet the United Nations Millennium Development Goals, experts calculate a total investment volume of 756 billion U.S. dollars.

Getting power to rural locations far away from the power-grid is not only a financial challenge but also a major structural one, especially in developing countries. Establishing a classic grid involves a lot of labor, time and cost, which is why many experts expect the developing countries to directly turn to decentralized power generation and distribution. In Africa and South America,

power is expected to be generated mainly from the sun, using solar modules, while coastal regions are predicted to use additional wind power for covering their needs. As both of these renewable power sources are intermittent resources, suitable power storage technologies and intelligent power management solutions are needed.

In rural homes, power is mainly required for operating electrical devices like lights, communication equipment, radios, mobile phones, TVs and other household equipment like refrigerators. For many people, access to electrical power means a significant improvement of living conditions. With electricity, the evenings can be used for reading and learning, safety is increased and food can be stored longer. Private households in developing countries typically consume between two and 300 watt hours a day, which can be easily be generated by small solar home systems.

Energy saving appliances also play a major role in complete off-grid power solutions for rural applications. Energy saving LED lamps with built-in batteries that can be charged by solar modules, like the Pico lamp by Phocos, open doors into a large range of usage possibilities. The Pico lamp features three light levels and an integrated charge controller that will accept direct charging from a solar module, a solar or car battery or an AC adapter. A USB port serves as a charging station for electrical devices (e.g., mobile phones). Energy saving refrigerators or TVs can also be part of a complete system. Wholesalers and system integrators offer the entire off-grid power solution spectrum matched to meet individual rural application requirements.

Industrial applications

Other relevant photovoltaic applications in rural areas are: supplying power to larger units like hospitals, schools, tourism facilities, telecom stations, and also to small manufacturers operating their machinery (e.g. water pumps, desalination systems or water purification systems). In these cases, energy consumption has a big variation from 100 watt hours to several tens of kilowatt hours, depending on the applications.

Customized, intelligent design enables the complete system to operate with high cost effectiveness and low maintenance over long periods of time. Appropriate



A mobile solar station set up in Tibet by Phocos in July 2010.

solar modules and batteries play a major role in these solutions, as do energy saving, long lasting appliances, and most of all, intelligent energy management by means of innovative charge controllers. Users demand easy operation and installation and the possibility of remote-controlling the complete system by the system operator or service provider.

Reliably supplying power to industrial applications requires intelligent power storage and management. A good example is a telecommunication system installation that Phocos equipped in Tibet. The system is located at a very remote location at the end of a bumpy road far away from the power grid. Daily energy consumption is in the range of one to over ten kilowatt hours.

To enable the reliable and cost effective unattended operation of the system over long periods of time it was specifi-

cally adapted to the local conditions and requirements. In addition to solar modules, it also uses wind and diesel generators to guarantee highest power supply availability.

Efficient energy management is provided by an intelligent Modular Power Management system (MPM) designed by Phocos. It enables easy, fast and individualized adaptation of a broad variety of control systems without requiring much effort or many different components. Via the Modular Central Unit (MCU) that synchronizes the power devices – e.g. Modular Power Switch (MPS), Modular Maximum Power Point Tracker (MPPT) – the customized system can easily be adapted to many different applications and requirements.

The MCU features a data logger, adjustable deep discharge thresholds for easy load management and control and alarm

functions through an integrated signal output. The MPM system is an ideal solution for off-grid power scenarios requiring high flexibility and reliability. Convenient remote monitoring by modem and the Phocos MODCOM software enable comfortable and fast configuration, control and surveillance even from the most remote location. The intelligent energy management concept allows individualized hybrid operation of all three power generators.

Any system errors can be analyzed and fixed quickly. Periodical remote monitoring helps avoid potential system failure and saves logistic cost by minimizing the need of having to travel to the location.

Cost effectiveness and system efficiency can be further enhanced by using MPP trackers like the Phocos MPPT 100/30. The MPP trackers, which are slightly higher in price than conventional charge controllers, enable yield increases of up to 30 percent, depending on conditions like solar radiation, ambient temperature and battery charge status. Installation of a MPP tracker allows using cheaper, more conveniently available high voltage solar modules designed for on-grid applications. The MPP tracker converts the higher voltage of these modules into battery voltage, thus significantly reducing the complete system costs.

Some industrial applications – like fire, flood or tsunami warning systems, traffic control units, oil pipeline servicing and monitoring equipment – do not require much energy, often only between 0.1 and 50 watt hours a day, but definitely do re-



Bolivian women with the Pico lamp made by Phocos.

quire a reliable power supply. If they are unavailable due to a power outage, the safety of people and the systems they service may be at danger. This is the main reason why many operators are looking for complete power solutions that offer them reliability.

Street and roadway lighting

As lighting systems are subject to extreme weather conditions (moisture, rain, high temperature variations, dust, salt, corrosion, etc.), they have to be engineered to be weather proof and reliable in all scenarios. How this can be achieved shall be demonstrated in an off-grid street light application at a motorway in China.

The application uses 160 watt solar modules in combination with the fully encapsulated CIS charge controllers by

Phocos. CIS charge controllers were specifically developed for harsh weather and environment scenarios. They feature adjustable timer and dimmer functions, thus giving the operator of solar powered street lights the flexibility to define when the streets are to be fully lighted, when lighting is to be dimmed and when it can be switched off.

Renowned system integrators and wholesalers successfully build and distribute complete off-grid streetlight solutions.

Leisure applications

Light, communication and cooling is required in leisure applications like motor homes, sailboats, vacation homes, hunting cabins and mountain lodges. Usually these applications use batteries for stor-



This off-grid street light application on Jimo Heshan Road, Qingdao, uses Phocos' fully encapsulated CIS charge controllers.

ing electrical energy. Often solar panels are the only choice for recharging in remote areas.

These applications typically consume ten to 300 watt hours daily if running in standalone solar operation and up to several kilowatt hours in combined grid/solar operation. Users in this category expect professional complete solutions, customer service, and good aesthetics. The systems have to be able to store maintenance free in times when they are not needed and they have to last a long time. Users also want systems which can be installed quickly and easily.

Many applications combine solar module and battery, diesel generator, fuel cells or power grid, some even use more than one power source in so-called hybrid solutions. For all these scenarios intelligent power management, again, is an important feature in enabling more power autonomy and reliability.

System integrators and wholesalers provide custom-designed, application oriented power solutions that match individual requirements by combining the right solar module with the right type of battery and an intelligent charge man-

agement system. Mobile homes have sufficient roof space for easy installation of a solar module. In sailboats, meanwhile, where there is less space but more wind, hybrid combinations of solar modules and wind generators are used. Innovative charge controller features like smart timing, remote monitoring, data logging will support them in their task. Intelligent charge controllers like the Phocos CXN including related accessories make off-grid operation of electrical devices even more convenient. On the display the user can check panel and load current and battery voltage, or retrieve data of the past seven days from the integrated data logger. The system can also be remote controlled by the CXCOM software. This enables reading and collecting data at a location far away from the operating site, as well as remote reconfiguration and monitoring.


With intelligent power management and customized solutions, system integrators and wholesalers will have major opportunities for fast growth and business success. ♦

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PHOCOS AG

Phocos AG, headquartered in Ulm, Germany, is one of the leading manufacturers of solar charge controllers and components for solar off-grid systems. Products developed and manufactured by Phocos enable the use of renewable energy sources in efficient, environmentally-friendly ways. Phocos offers a successful range of intelligent charge control solutions, selling over 250,000 per year worldwide. Phocos devices are designed to meet the demanding requirements in a wide range of off-grid power scenarios. Phocos charge controllers come with a broad selection of features, for example weatherproofing against humidity and temperatures up to 60 degrees Celsius, remote monitoring and controlling options, data logging, intelligent timer functions, and advanced battery protection features. For off-grid use, Phocos also offers a range of intelligent energy-saving DC appliances, like lamps or cooling or refrigerating devices.

Phocos has sales offices in Eastern Europe, the United States, South America, Africa, and Asia and the company operates an international network. Phocos partners with international producers of solar modules and system integrators. Eighty percent of the company's turnover is generated outside of Europe.

 www.phocos.com