

# Hybrid Remote Area Power Supply (RAPS) Systems

RAPS installations offer a unique opportunity for bringing 24-hour electricity to remote villages or areas where it would otherwise be too costly or difficult to install a traditional power infrastructure. A hybrid RAPS system is 'next generation' technology involving a renewable energy source such as the sun, batteries for energy storage, and a diesel generator for back-up power and battery charging. By using each of these components in the most efficient way, cost effectiveness and reliability are maximized.

1

Photovoltaic (PV) panels are used to capture energy from the sun. The panels are made up of many individual cells and can be sized according to the amount of solar energy needed. A PV cell works by collecting solar light (sunshine) and converting it to electricity. PV panels are very durable, are fuelled by perhaps the most abundant renewable resource (the sun) and produce zero emissions. The main drawback to PV use is their requirement for sunshine, which limits their power-generating capability to daylight hours.

2

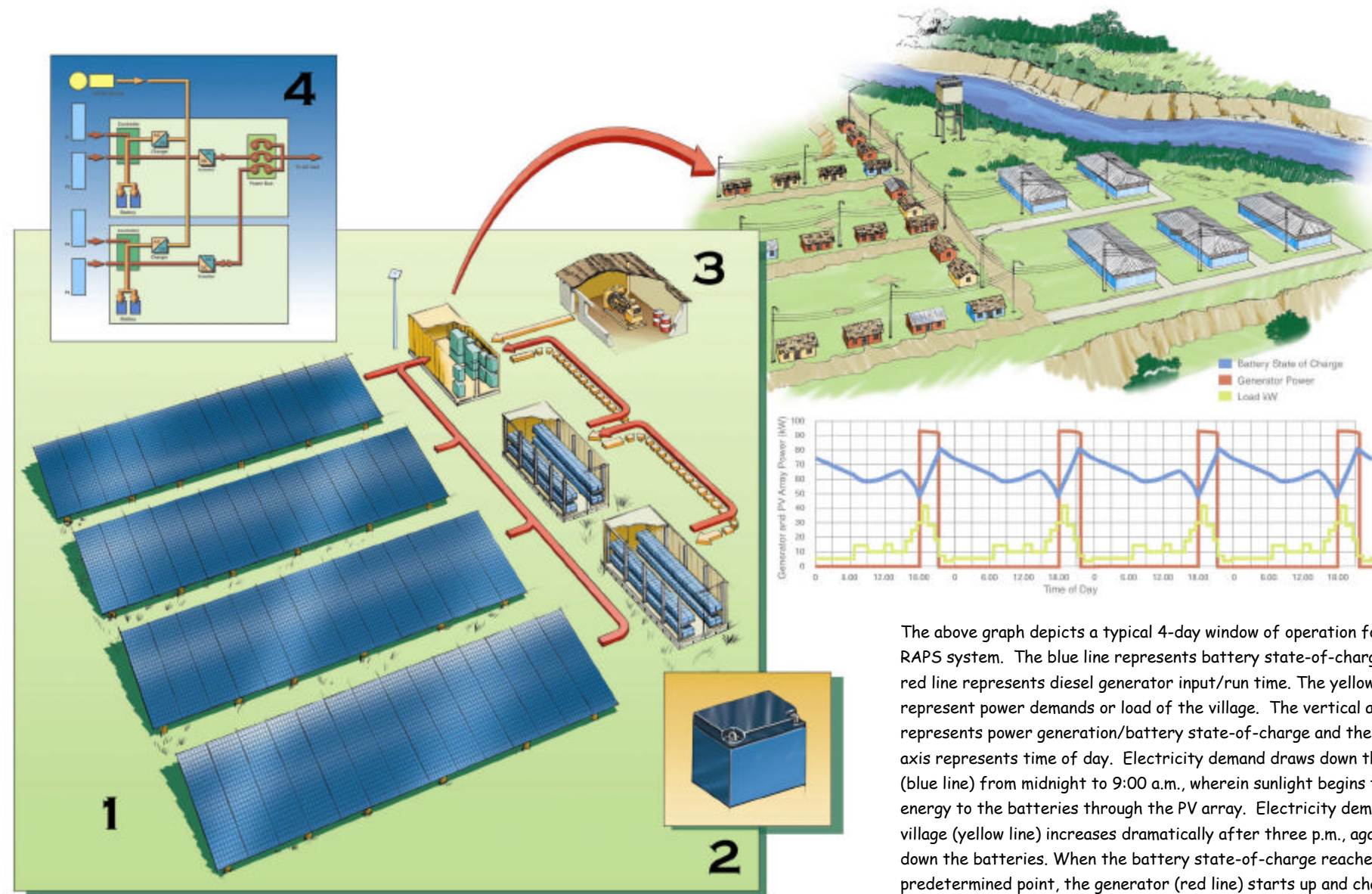
To ensure 24-hour power availability, some of the electricity collected from the solar panels during the day must be stored for night-time use. There are several ways to store this energy, but batteries remain the most cost effective. A new design of lead-acid battery has recently come to market that has a longer life and requires much less maintenance than previous systems. The batteries are charged using the PV panels by day and a diesel generator is used to charge and condition the batteries each evening.

3

Diesel generators have long been used to provide electricity in remote areas. They are cost effective and reliable, but produce significant emissions. In a hybrid RAPS system, the generator is limited to a supporting role of battery charging, enabling it to be run in its most efficient mode, and for less time than in a traditional generator-only system. The PV panels and batteries supply power - silently - 24 hours a day, and diesel generator run time is minimized, resulting in reduced maintenance, fuel use and emissions.

4

Although designed for difficult, remote applications, RAPS systems are very sophisticated power plants requiring a variety of electronic controls to collect, direct and monitor power production and distribution throughout the village. The power control system is the heart of a hybrid RAPS installation. It collects the energy from the photovoltaic arrays and the diesel generator, directs the energy to the batteries and the load and assures optimized charging rates to promote long-term battery life. Data covering all parts of the system is collected and can be monitored via satellite from remote management/service centers.



The above graph depicts a typical 4-day window of operation for a hybrid RAPS system. The blue line represents battery state-of-charge and the red line represents diesel generator input/run time. The yellow line represent power demands or load of the village. The vertical axis represents power generation/battery state-of-charge and the horizontal axis represents time of day. Electricity demand draws down the batteries (blue line) from midnight to 9:00 a.m., wherein sunlight begins to replace energy to the batteries through the PV array. Electricity demand in the village (yellow line) increases dramatically after three p.m., again drawing down the batteries. When the battery state-of-charge reaches a predetermined point, the generator (red line) starts up and charges the batteries. When the batteries are sufficiently charged and conditioned, the generator shuts down and the process begins anew. This behind-the-scenes process is invisible to the villagers who have access to the same level of power throughout the day and night.