



Figure 17.11 A typical PV powered battery-charging station in rural Thailand (*Source:* Fraunhofer ISE, Freiburg [14])

costs for a certain energy service needed, larger systems (i.e. consumption of several kilowatt hours a day) are typically constructed as “hybrid” systems, that is, the combination of a diesel generator and a photovoltaic generator. Depending on the availability of natural resources, other electricity generators like wind converters or hydroelectric power stations may be used to complement the power supply system. A battery bank ensures that power is available continuously. Under favourable weather conditions, the consumer’s total energy demand is met by the solar generator operating silently and without exhaust gases. Surplus energy is stored in batteries. During the night or unfavourable weather conditions, the energy demand is initially met by the batteries. If there is danger of battery deep discharge, the diesel or gas-fuelled generator provides the electricity and simultaneously charges the battery.

Even in Europe there are still many houses, hikers’ inns and mountaineering lodges that are not connected to the public grid because of the long distances and the resulting connection costs. The only option open to the owners up to now was to install a diesel generator. As they are used to directly supply the consumer load, the diesel generators are often operated in the inefficient partial load range and when they are switched off, no electricity is available at all. However, continuous operation of stand-alone motor generators is undesirable, not only because of the low partial load efficiency, the noise and the exhaust gases but also because of the limited lifetime of combustion motors. Therefore, the Rotwandhaus, a hikers’ inn in the Bavarian Alps, which is open throughout the year, was equipped with a hybrid system consisting of a photovoltaic generator, a wind energy converter and a diesel generator (Figure 17.12).