1.2.3 AC Coupling

The connection of all power consumers and generators on the AC side (see Fig. 1.4) offers a decisive advantage: it enables systems to be built up or expanded with standardized components on a flexible, modular basis.

Renewable and conventional power sources can be combined, depending on the application and the available energy carrier. This is a particular advantage in situations where the grid structure is weak. The connected energy sources charge the batteries and supply energy when it is needed. If inverters and combustion units are intended for that purpose, a connection to the public grid is possible. The system can easily be expanded by adding further generators, thus enabling it to handle a rising energy demand. Additionally connected AC sources result in a real increase in capacity on the AC side.

AC coupled systems can be used to supply all power consumers. Hence, they are ideally suited for applications in rural areas of developing and newly industrialized countries.

In the medium power range (2–100 kW), the structure of such supply systems does not require any additional control or monitoring unit. Battery inverters such as the Sunny Island automatically check the availability of the grid and the system components. This simplifies the operation of the system and keeps investment costs down.

From an economic perspective, stand-alone power systems with a storage battery in the kW power range are considerably more cost-effective than systems which use diesel generators only. Even larger hybrid systems which use a diesel generator to avoid long-term battery storage can be operated at lower cost than stations working exclusively with diesel units. This can be attributed to the high cost of maintenance, short service life, and very poor partial load efficiency of diesel generators.

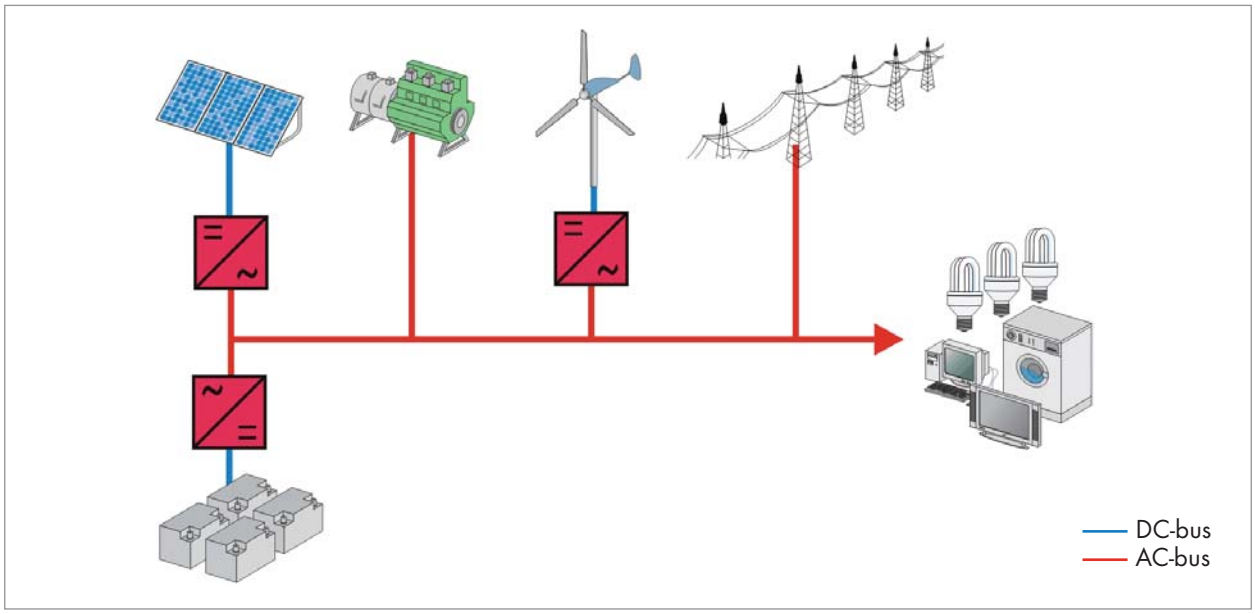


Fig. 1.4: Hybrid system with AC coupled components

Expandability and the type of connection of the individual components play a key role in off-grid power supply systems. The AC coupling with the Sunny Island enables power generators of all kinds as well as standard power consumers to be connected to the stand-alone power grid. The system is easy to expand both on the consumer and on the supply side (see Fig. 1.5).

Advantages of AC Coupling

- Structure 100 % compatible with the public grid
- Simple installation, since standard household installation components can be used
- Addition of power of all components feeding into the grid
- Scalable as desired, even for relatively large systems (from 2 kW up into the megawatt range)
- Easily expandable
- Combinable with net-parallel and isolated power generators (diesel units, small hydroelectric plants, wind turbines, etc.)
- Top reliability due to redundant system structure

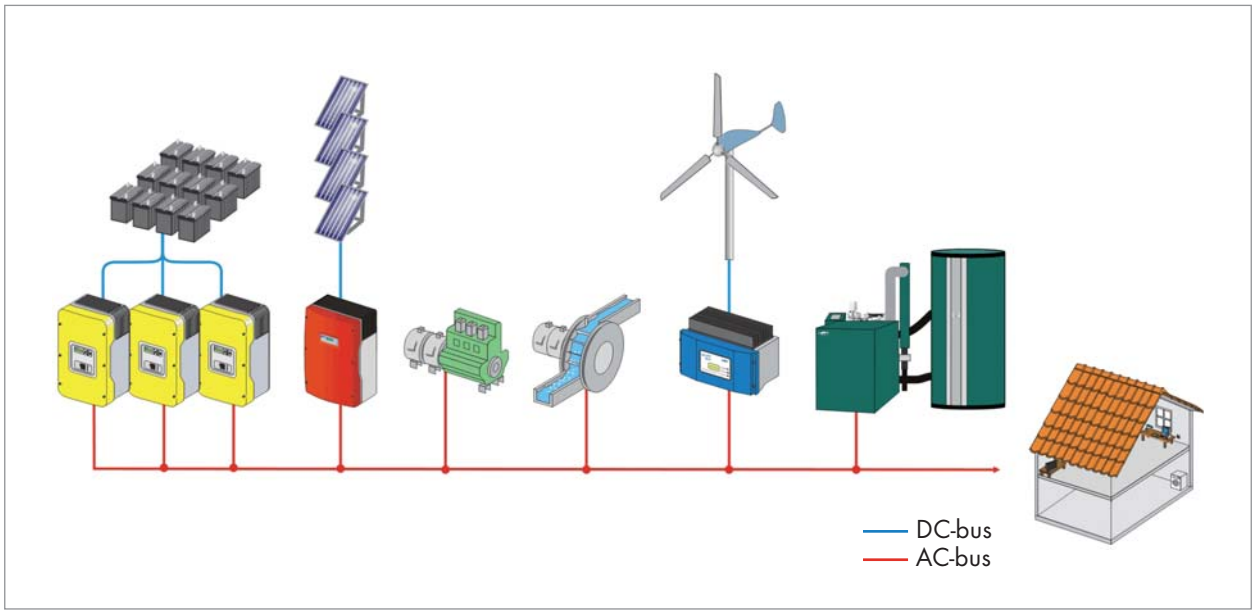


Fig. 1.5: Modular and flexible AC coupled hybrid system

1.3 Functionality

Stand-alone power inverters such as Sunny Island are connected to a battery bank and form the AC grid of the stand-alone power system. At the same time, they control the voltage and frequency on the AC side. Generators as well as power consumers are connected directly to the AC grid. Whenever there is a surplus of energy (e.g., when solar irradiation is high and consumption low), the stand-alone power inverter draws energy from the AC grid and uses it to charge the batteries. When there is an energy shortage (little or no solar irradiation and high consumption), Sunny Island uses the batteries to supply the grid (see Fig. 1.6).

Various power generators can be connected to the stand-alone power grid: PV plants with Sunny Boy inverters, wind turbines with Windy Boy inverters, hydroelectric power stations, and diesel generators. The latter can step in when the battery charge is low and there is not enough solar irradiation available for recharging.

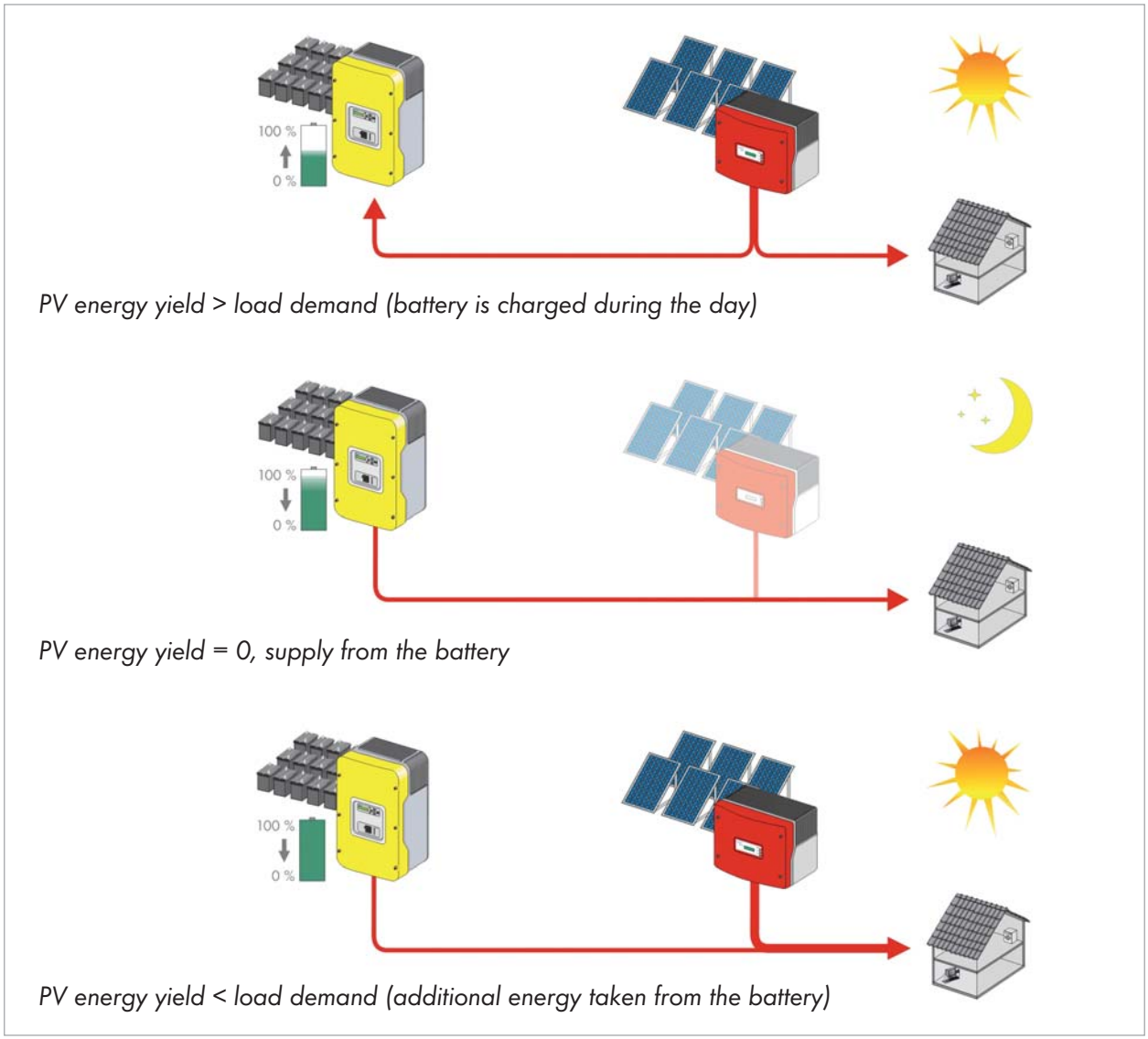
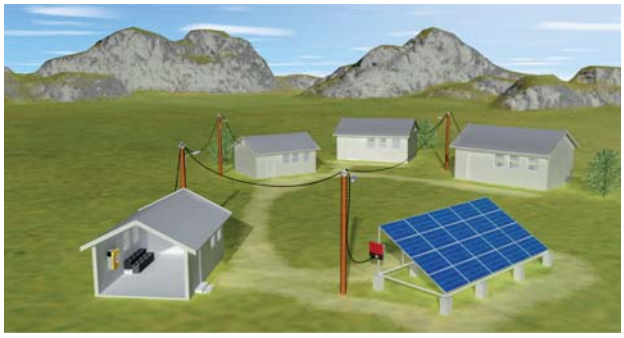


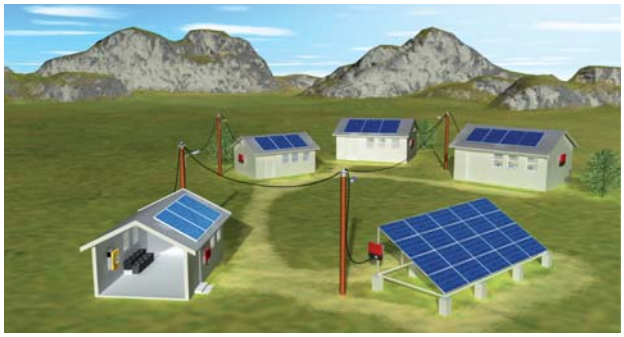
Fig. 1.6: PV energy yield and load demand

1.4 Growth and Connecting of Stand-Alone Power Systems

Stand-alone power grids with Sunny Island can be gradually expanded into large-scale systems as a result of the parallel connectability of all energy suppliers and consumers. They are particularly well suited for the supply of grid-isolated areas such as remote villages.

Fig. 1.7 shows the layout and the expansion possibilities for an AC coupled village power supply. The autonomous energy system can easily be expanded by further power generators when the power demand rises. One further advantage of the stand-alone power system: Thanks to the storage batteries, energy not needed during the day will be available at night, e.g., for street lighting.





Legend Fig. 1.7
1: PV generator
2: PV inverter Sunny Boy
3: Battery inverter Sunny Island
4: Storage battery
5: Generator
6: Wind turbine

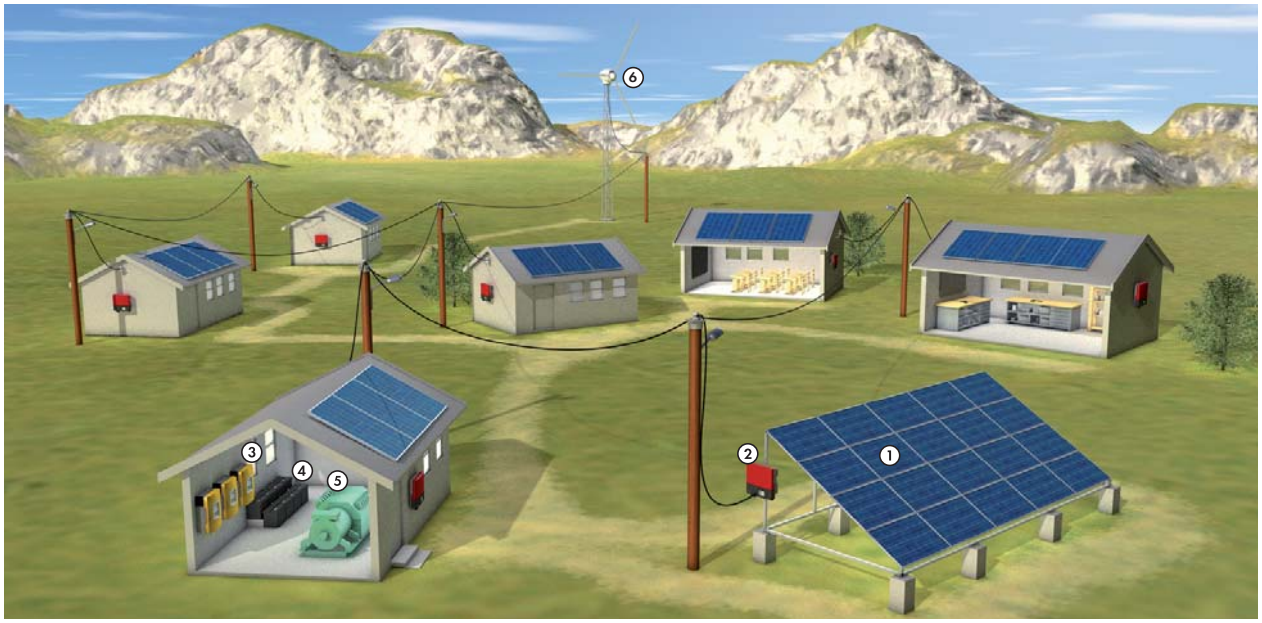


Fig. 1.7: Expansion options of an AC coupled hybrid system for a village electricity supply