Figure 17.12 Rotwandhaus with its solar generator and wind energy converter (*Source*: Fraunhofer ISE, Freiburg)

When the wind is strong enough, the wind energy converter supplies the power and charges the battery. As soon as the battery is fully charged, the wind energy converter is throttled. An inverter converts the direct current from the battery to 230 V alternating current so that all conventional electrical appliances can be operated. The necessary supply reliability even during extremely unfavourable weather conditions is guaranteed by the diesel generator. A computer monitors and controls the whole system to ensure that the supplied energy is used as effectively as possible.

Most of the hybrid PV-diesel-battery systems realised worldwide are so-called DC-coupled systems (see Figure 17.13).

Different generators are working via separate charge controllers/rectifiers to the DC storage battery. An inverter generates the desired AC sine wave, it builds the AC grid in frequency and voltage; if power generation and consumption are equal, the battery does not take part in the power flow. Otherwise, the battery stores the surplus of generated power or delivers the additional power that is needed by the load. In order to protect the battery against damage, a charge controller, in most cases the PV charge controller, disconnects the inverter before the battery becomes completely discharged. If there is not enough renewable power and if, at the same time, the state of charge of the battery is low or if the consumers need more power than the inverter can deliver, a back-up generator is started from the control system. In this case, the back-up generator supplies the consumers directly with AC power and charges the battery via its own rectifier.

The big advantage of the DC-coupled system layout is that it is proven in many applications and that reliable components are available on the market. The necessity