developed that can cope with the often extreme restrictions of miniaturisation and the often lacking availability of sunlight or at least of artificial light. Highly efficient solar cell highly miniaturised and also efficient energy conversion and new product design adapted and suited to the energy source will be the key factors of a successful market penetration.

In parallel to the power supply of the appliances themselves, a need arises for repeaters of the signals to be transmitted, which will be lower in its energy and power demands but will have to guarantee permanent availability. As these repeaters will have to be located on peaks or tops of hills and mountains, grid connections will be very often too expensive. Therefore, low-maintenance hybrid systems will gain a natural market where they can compete with the extremely high requirements concerning reliability and ease of operation.

In all stand-alone applications, the storage unit is one of the technical components that still needs the most development. Often described as the weakest link in the chain, it is responsible for a large share of the costs in long-term operation. Thus, optimisation of the interaction of all components in the system with the aim of reducing the overall lifetime costs is today the main issue on this sector. As also the battery industry has recognised, there is a great need for the development of better battery management principles, adaptation of the existing battery technologies to the charging and discharging requirements in photovoltaic systems and the development of completely new and better suited storage units.

17.4.2 Future Developments in Grid-connected Photovoltaic Systems

Today's electricity supply systems in industrialised countries are based on a structure with large central power stations that supply consumers via a dense distribution grid. This structure will suffer increasingly in the liberalised markets, as it is not flexible enough in the choice of primary energy sources to allow energy flows and energy costs to be optimised. In addition, obtaining authorisation for large technological power plants or grid extensions will become more and more complicated. Furthermore, this type of capital-intensive structure could hardly be implemented for comprehensive electrification in developing countries. There are several ongoing approaches to develop novel grid structures, which enable both the optimisation of existing grids in industrialised countries and ecologically acceptable electrification in threshold countries. These approaches aim to help in a transition to a decentralised structure of small and medium sized generators. In these concepts new devices such as cogenerations sets, fuel cells, renewable energy systems, such as photovoltaics, wind, micro hydro, biomass and so on, can play a key role (Figure 17.37).

However, because of specific operational constraints of all these components, new devices have to be incorporated in such a structure to achieve an optimised use of these new technologies. Short-term energy storage consisting of locally installed batteries or flywheels, power quality management (also on the low voltage side to reduce voltage breakdowns and compensate harmonic distortions) and intelligent communication systems between the single components and a central energy management unit have to be applied.