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## Photovoltaic Systems

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### **17.1 INTRODUCTION TO PV SYSTEMS AND VARIOUS FORMS OF APPLICATION**

The modular nature of photovoltaic generators – consisting of photovoltaic modules – means that energy supply systems can be constructed for an extremely wide power range. The power spectrum ranges from a few milliwatts for wristwatches or scientific calculators, to kilowatt systems in remote area power supplies, for example, for mountaineering lodges or water pumps, to large central photovoltaic (PV) power stations in the megawatt range. An overview on the manifold application areas of photovoltaic systems is given in Figure 17.1.

Photovoltaics are generally considered to be an expensive method of producing electricity. However, in off-grid situations photovoltaics are very often the most economic solution to provide the required electricity service. The growing market all over the world indicates that solar electricity has entered many areas in which its application is economically viable. Additionally, the rapidly growing application of photovoltaics in grid-connected situations shows that photovoltaics are very attractive for a large number of private people, companies and governments who want to contribute to the establishment of a new and more environmentally benign electricity supply system. In parallel, considerable cost reductions are envisaged with the mass production of photovoltaic systems, leading to further attractiveness of this technology and its extension to other fields of applications. In Figure 17.2 the market development for photovoltaic modules is shown, indicating outstanding rates of growth of more than 15% per year in the eighties and early nineties cumulating in up to 40% annual increase in the late nineties and the year 2000.

As can be seen from Figure 17.2, about 45% of all modules installed in 2000 have been connected to the public electricity grid. These applications include both smaller decentralised systems, with the solar modules typically installed on rooftops, as well as