In many cases, battery storage is not necessary. For PV-powered water pumping, the water is pumped and stored while the sun is shining. For the grid-connected homes (one the fastest growing applications) and office buildings, the photovoltaics produces energy during the day and the grid supplies the energy during the night or on cloudy days, thus eliminating the need for batteries, simplifying system design, and reducing BOS costs. In PV-powered generating plants, the electricity is produced while the sun shines. The success of grid-connected PV applications is very sensitive to price competition with conventional electricity (even if the PV electricity is subsidized, as it occurs in Europe and Japan). Luckily the expensive batteries do not hamper this competition.

PV modules produce direct current (DC) which is suitable for directly charging batteries or powering a small number of special products. However, most appliances run on alternating current (AC). Consequently, an inverter must be used to convert the DC into AC. Inverters are widely used for many industrial applications. They are fabricated in large quantities as uninterruptible power supplies (UPS), to convert the DC electricity stored in batteries into AC electricity in the case of grid failure. They are used in hospitals and other installations where electricity failure is not tolerable. Small UPSs are often used in computers that must operate continuously. The PV inverter has an additional and important role: to vary the electrical operating point of the PV array to maintain its output at the maximum value, that is, the variable bias point at which the PV array produces highest power extraction. Changes of temperature and insolation change the voltage where maximum power extraction occurs. The electronics of the inverter typically include maximum power tracking. The inverters used in photovoltaics and the rest of the power conditioning electronics are explained in Chapter 19. Inverters have often been the source of poor reliability in early systems. Feedback to manufacturers and more robust components has greatly reduced these problems.

Because of the cost, the electronics for power conditioning is sometimes considered as a serious hindrance in the development of photovoltaics. However, we think the appearance of a significant market will reduce costs to reasonable limits. One fresh approach is to have a small inverter on the back of every module instead of a centralized inverter for the entire system. This modular approach has many advantages and is being put into production in USA [73] and Germany [74], but at present it is more expensive and will be so unless mass production reduces costs with respect to the theoretically cheaper bigger inverters.

The system-mounting structure is also important, in particular, in concentrating systems. In fact, this is the second most important cost element in concentrating PV systems, after the modules. In contrast, the power conditioning cost is comparable to many other small costs associated with the plant construction. This can be seen in Figure 1.14, where we present the breakdown of costs for a TFSC ($CuInSe_2$, an ancestor of today's $Cu(InGa)Se_2$) flat module central plant and a concentrating central plant. Both sets of calculations are based on the same criteria for the two technologies involved (but based on realistic but futuristic assumptions) and presented in Chapter 21.

The plant cost is about twice the module cost: more for concentrators, less for "flat-plate" modules. Notice, that the cost of land is absolutely negligible land (provided the plant is built where land prices are low). It has to be stressed again that modules at the costs in the figure are not yet achievable.