In stand-alone systems, the fundamental difference in operating behaviour as compared to grid-connected systems is due to the storage battery. As stand-alone systems generally have to achieve a certain, pre-determined solar fraction within a given operating period, the decisive time within that period for the system sizing is the one during which the radiation level is lowest. The optimal tilt angle depends not only on the radiation characteristic but also on the system itself. Figure 17.36 shows the optimal tilt angle, for which the solar generator area is minimal for the relevant pre-determined solar fraction, and the corresponding solar generator power.

Whereas in summer, the storage capacity does not have any effect on the optimal tilt angle (solid line), a dependence can be observed in winter (dotted line); higher solar fractions lead to less steep inclinations, particularly for small storage capacities. The explanation for this difference is the variation in the daily radiation in winter. If the storage capacity is small, sunny days lead to surpluses, so that the available radiation cannot be fully used. Thus, on overcast days, the (weak) diffuse radiation must be used optimally, with a less steep slope (smaller tilt angle) as a result.

17.3.6 Energy-saving Domestic Appliances

On average, a four-person household in Germany consumes about 3500 kWh electricity per year, if electricity is used neither for space heating nor for water heating. In order to meet this demand, for example, with a grid-connected photovoltaic system, about 4-kW rated power, that is, a module area of about 40 m^2, would be needed in Southern Germany. With a module price of about 4 € per watt of rated power, the solar modules alone would cost €16 000. In view of these high investment costs, the potential for saving energy with the appliances used in the household should be exploited as far as possible, rather than investing in a large system.

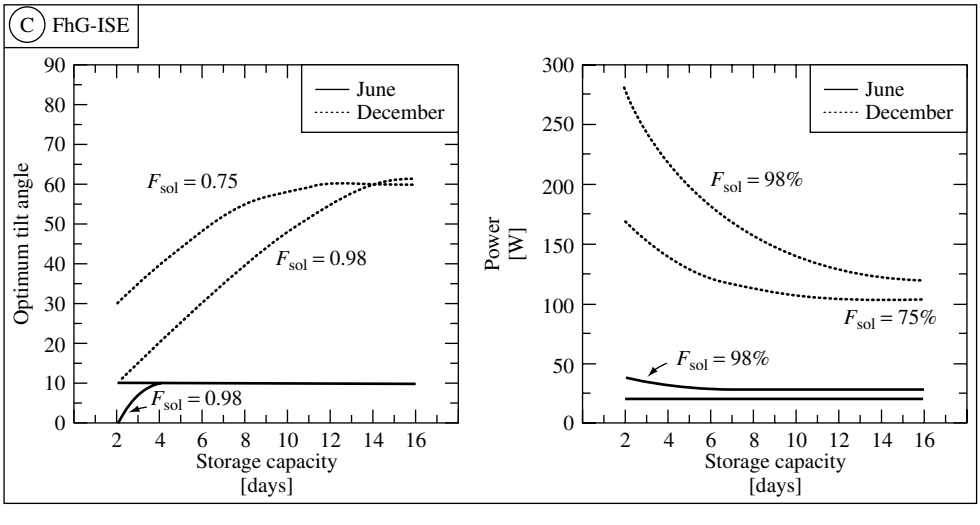

Figure 17.36 Optimal tilt angle for minimising the solar generator size and corresponding values of the solar generator power as a function of the storage capacity