

However, the following restrictions apply to the use of inverters with a rectangular waveform:

- Because the voltage level at the zero crossing is not clearly defined, the function of some appliances with electronic controls (e.g. modern washing machines) is affected.
- The steep voltage gradients destroy resistors in simple power supplies (e.g. in freezers) by overloading.
- The steep voltage gradients result in increased noise and heat generation in transformers and motors. Further, a reduction of about 10% in the efficiency value must be expected.

17.3.4 Auxiliary Generators

In general, diesel generators are used today in larger photovoltaic hybrid systems with an energy demand of around 10 kWh/day. For systems with a daily energy demand of a few hundred watt hour up to a few kilowatt hour, small combustion motors, small fuel cells, thermoelectric generators (TEG), thermophotovoltaic generators (TPV) or appropriate thermodynamic converters such as small Stirling motors all come into question in principle. If adequate commercial availability is regarded, at present the choice is narrowed essentially to small combustion motors (diesel, petrol) with a coupled generator, and thermoelectric generators. While the investment costs and the availability in nearly all countries make petrol and diesel generators very attractive, the inherently high reliability, low maintenance and the almost silent operation and simple remote starting facilities speak for the application of thermoelectric generators in small photovoltaic hybrid systems (Table 17.2).

Table 17.2 Comparison of the characteristics of small, commercially available auxiliary generators [30]

	Small combustion motors		Thermoelectric
	Petrol	Diesel	
Electric power range	>0.3 kW	>3 kW	>0.03 kW
Efficiency value at full load	App. 5–15%	App. 20–25%	App. 3%
Adjustability	Good	Good	Limited
Remote starting	Yes, >3 kW	Yes	Yes
Reliability	Medium	Medium	High
Maintenance demand	High	High	Low
Environmental acceptability	Pollution emission CO ₂ emission Noisy	Pollution emission CO ₂ emission Noisy	Pollution emission CO ₂ emission Almost silent
Commercial manufacturers available	Globally	Globally	Few
Fuel:			
Type	Petrol	Diesel	e.g. propane/butane
Availability	Medium	High	Medium
Consumption	0.6–1 l/kWh	0.4–0.5 l/kWh	2–2.5 kg/kWh