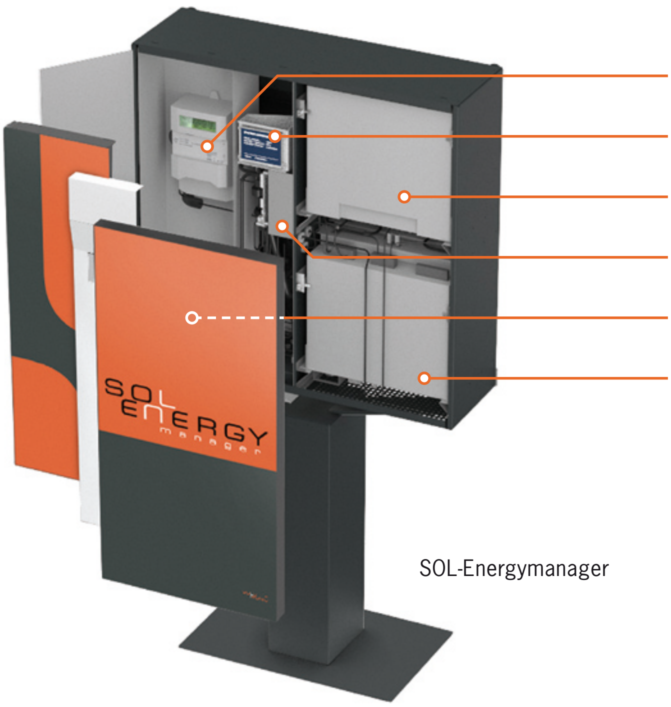
SOL-Energymanager



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One of the challenges faced in the effort to expand the use of renewable energy sources is to find a solution to the problem of decentralised storage and intelligent management of solar energy. The energy generated by the photovoltaic modules on the roof also needs to be available at times when the sun isn't providing the energy required to generate electricity. This is where the SOL-Energymanager comes in – a mini solar power plant comprising a PV inverter, battery inverter, energy management system and Li-ion battery. The purpose of the SOL-Energymanager is to source as little electricity from the grid as possible and to maximise the amount of self-generated power consumed. It's designed and configured to give the end customer maximum economy.

Customers are supplied with a compact, single-unit system. No complex, standalone pieces of equipment are necessary. The unit is ready to use immediately after installation. The system is connected to the electricity system of the building by means of a meter box integrated into the cabinet, and it manages in-house consumption fully automatically. There's no need for the owner to carry out any manual adjustments.

Energy flow directions

Viewed in its pure form, energy flows in different directions in the SOL-Energymanager system.

- PV → electrical consumers: the PV current supplies the electrical consumers directly.
- PV → grid: the energy generated by the solar generator is fed into the grid.
- PV → battery: the energy generated by the solar generator is fed to the battery.
- Battery → electrical consumers: the consumers are supplied with power from the battery.
- Grid → electrical consumers: the consumers are supplied with power from the grid.
- Battery → grid: the battery feeds energy into the grid.*
- Grid → battery: energy from the grid is used to charge the battery.*

* Owing to our goal of achieving optimum usage of self-generated power, these energy flow directions are currently not provided for.

In reality, it's more of a mixture of these modes, depending on the direction selected for the flow of energy and the availability and amount of electricity required in the building. In keeping with the aim of increasing the amount of self-generated energy consumed in-house, the system gives priority to supplying the in-house consumers over feeding power to the grid.

If we look at the battery's state of charge, the following statuses are possible depending on the size of the consumer and the level of insolation:

Battery fully charged:

- Power goes to the consumers
- Excess power is fed into the grid

Battery not fully charged: (depending on the level of insolation)

- Power goes to the consumers
- Excess power is fed to the battery

Emperor penguin

Efficient, intelligent and with staying power. The emperor penguin is a master of energy management. Its plumage provides insulation, its subdermal fat acts as an energy store and its limbs as heat exchangers. To protect themselves against the cold, a colony of emperor penguins forms a compact huddle that slowly ‚churns' around the edge of the formation, ensuring that each bird enjoys a period of protection on the inside of the throng. All are key characteristics for ensuring optimum utilisation of the energy available.

Battery efficiency and capacity utilisation

The efficiency of the battery depends on the battery's own internal resistance. This is influenced not only by the state of charge and „state of health" of the battery, but also by its temperature.To optimise the battery's efficiency and its longevity, it's utilised to max. 80% of its charge capacity and its power output (for supplying the electrical consumers) is limited to max. 1500 W. Outputs higher than 1500 W are always supplemented by drawing power from the mains. In this way, we achieve battery charging efficiency (charging and discharging) of 97% (including cell losses and contact resistance).

System efficiency = nighttime efficiency

The energy generated by the solar generator is fed to the battery during the day and then transferred to the power system or to the electrical consumers, later (during the night).
In this system, the DC/DC converter of the solar inverter achieves 99% efficiency. The solar inverter itself is up to 98.1% efficient. The electrically isolated battery DC/DC converter reaches peak efficiency figures of up to 98.2%. All in all, the full storage process (from the PV generator to the battery and into the grid) chalks up an overall nighttime efficiency rating of 90.8%.
To further optimise the system as a whole, care has been taken when designing the enclosure to ensure that the waste heat from the battery does not dissipate in the direction of the inverters, so that they remain as cool as possible. Moreover, the SOL-Energymanager also achieves excellent levels of efficiency at the low end of its output range when providing electricity at night, even though it has to operate below its rated output point.

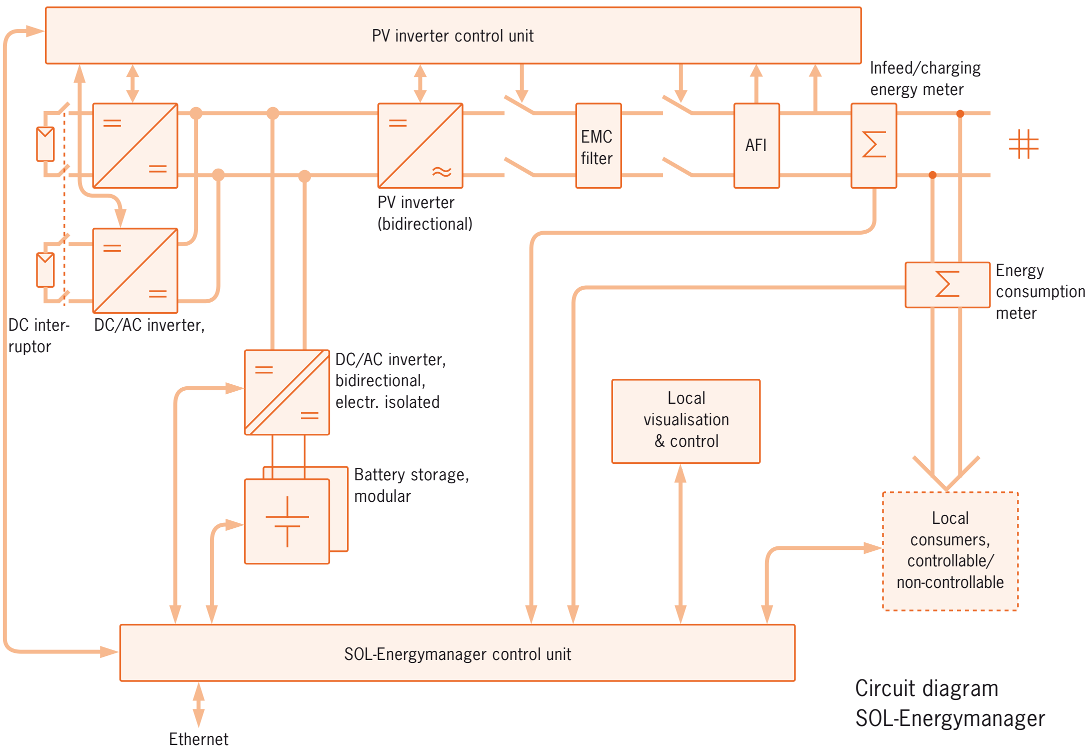
The SOL-Energymanger is based on the system of a central, intermediate DC link. This offers the following advantages:

- a compact unit thanks to a compact enclosure (weight/size)
- a central control unit
- no need for a redundant DC/AC inverter
- maximum efficiency

Battery size and design

The SOL-Energymanager is a system designed specifically for households with an annual electricity consumption of up to 6000 kWh. Panels with a combined maximum DC output of 4800 W can be connected to the solar inverter that comes with the system, which means even small roofs are suitable. The design target when dimensioning the battery storage capacity (taking into account annual consumption) is to see between 90 and 100% of self-generated electricity consumed during the months from spring to autumn. At wintertime, the battery principally serves to cover daytime power consumption. The battery can, however, also be used as kind of 'night storage power supply', being charged with off-peak electricity for use during the next day.

The size of battery required to provide the maximum possible in-house consumption depends on the household's load profile: at what times of day are the inhabitants at home, what electrical loads are in use and whether they can be controlled, and how high the annual power consumption is?



Circuit diagram
SOL-Energymanager

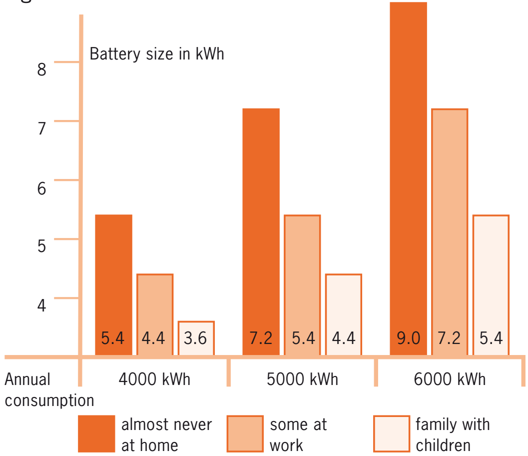
SOL-Energymanager

Brief data sheet

Max. DC power	4800 W
Number of MPP trackers	2
Battery storage capacity	5,4 kWh
DC start voltage	150 V
Weight	98 kg plus Battery
Protection class	IP 23
Dimensions in mm (W x H x D)	980 x 980 x 390
installation	wall-mounted; base optional

The bar chart (fig. 1) shows how to calculate the size of battery required for three different types of consumer, based on their annual consumption. These calculations were made on the assumption that the battery holds it charge throughout the night in spring and autumn.
Provided there is a certain level of daily consumption (that “matches” the insolation profile), a 5.4-kWh battery fits the bill in the majority of cases – which is the size supplied with the standard configuration of the system. As of mid 2012, we will be offering an optional add-on comprising one or two additional storage modules, each with a capacity of 1.7 kWh.

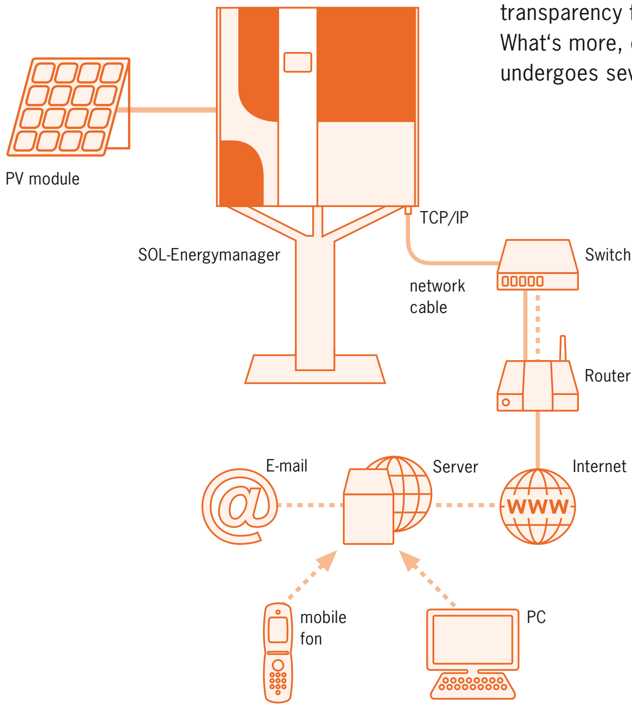
Figure 1



Communication concept
The various components that make up the SOL-Energymanager system communicate with each other via serial ports. Customers can read out all the relevant data regarding insolation, in-house consumption and battery charge level on the integral touchscreen. And if the SOL-Energymanager is connected to the internet, its data can also be accessed remotely using a PC or smartphone. (fig. 2)

Safety
Device, customer and installation safety are key criteria for the SOL-Energymanager. Each and every component of the system has been tested and approved. The inverter conforms to the relevant VDE standard and the battery unit offers maximum safety by means of electrical isolation.

Figure 2



Quality of the components
All system components are sourced from competent partners from the fields of energy management and battery development.

The inverters of the SOL-Energymanager and the inverter logic are „Made in Germany“, right from their conception through development, their assembly to quality control, enabling us to work hand in hand with selected and renowned partners. This guarantees a high degree of transparency from start to finish. What‘s more, every single device undergoes several test steps.