PV installations

Photovoltaic means the direct transformation of sunlight into electric current. In general, two types of PV-systems can be identified: there are systems with mains connection and isolated operated systems and these are the type of PV-systems standing-alone, which means that they have no connection to the public power supply system and therefore need a battery for storage.

PV installations constitute a long-term and relatively expensive investment. Therefore, it is essential that an exact design of a certain PV installation is carried out.

In order to be able to design a PV installation extensive and precise information of a wide range of parameters are required, e.g. climatic data, characteristics for PV-modules, configuration of PV-panels, placing of PV-panels, load on PV-panels, current inverter data, the wanted electricity production over a year etc.

On basis of this information it will be possible, via a computer and relevant software, with considerable accuracy to simulate the yield of a certain PV installation. Simulations like this can be calculated by knowledge centres and consulting engineers.

The technique of a PV-installation is based on the photovoltaic effect: if light (photons) hits a solar cell, electrons are released out of the crystal structure of the semiconductor material. This process results in an electrical current.

The main components of a PV-system are the solar cell, the solar module and the inverter. The solar cell is the part of the installation, in which the transformation of light into electric current takes place. More than 95 per cent of all solar cells that are produced in the world are made of Silicium. In order to get a useful performance, mostly 30 – 36 solar cells are put together to a solar module. The totality of the modules is called solar generator. The voltage of the PV-installation depends on the number of modules connected in series, whilst the number of modules connected parallel determines the electrical current.

The inverter creates the connection between the solar generator and the distribution net. As the produced electric is direct current, the inverter has to transfer it to alternating current, in order to deliver it to the public power supply system.

The performance (measured in %) of a PV-installation depends on different factors. These factors are apart from the position the slope, the orientation, the performance ratio and the efficiency of the inverter.

Estimated actual efficiency of modules (modules with silicon cells)	Standard	High-efficiency
Monocrystalline, close-packed	12%	15%
Polycrystalline, close-packed	10%	13%
Amorphous /thin film	5%	9%

Table. Estimated actual efficiency of modules

The performance ratio is the measure of the system efficiency of the PV-installation. With the help of this factor, PV-systems at different positions can be compared with

each other. It is the relation of the actually produced current to the theoretically expected current of the solar generator. The actually produced current is lesser than the theoretically expected, because it includes occurring losses. The higher the performance ratio of a PV-installation is, the better the proceeds of current will be.

Estimation of system coefficient	Detached	Building integrated
Optimal installation with high-efficient current inverter	0,8	0,75
Average installation with standard current inverter	0,7	0,65
Less optimum installation, e.g. some shadows	0,6	0,55

Table: Estimation of system coefficient

Other factors which characterise the energy efficiency of a PV-system are the night-consumption, the energy use in stand-by modus and the input start. All of these factors are measured in Watt (W). The lower these values are the less energy is used by the installation.

Technology	Relevant Indicators	Performance Requirements			Check Systems and standards
		2006 (Present situation)	Goal for next EPBD in 2011	BAT (Best Available Technology)	
PV Installations	Performance ratio [%] Inverter: Efficiency max. [%] < 10 kW > 10 kW night consumption [W] <10 kW >10 kW Stand By [W] <10 kW >10 kW Input start at [W] <10 kW >10 kW Annual kWh produced, Global Systems efficiency, Efficiency of the cells: Mono-cryst. Si Polychryst. Si	>85 >97 >97 <0,005 0 <9 <30 <15 <50 85% 15% 12%	>86 >97 >97 <0,005 0 <9 <30 <15 <50 20%	>85 >96 >96 <0,005 0 <9 <30 <15 <50 85% 15% 12%	IEC 61724 IEC 61727 UNE-EN 61215:1997
Note from Gaia Solar (PV): *The most important thing is not the efficiency, but the price per Wp installed. This can be optimised by installing large scale systems with standard components and involve PV entrepreneurs early in building phase, so the system can be optimised in best possible way and e.g. the existing lift in site can be used.*					