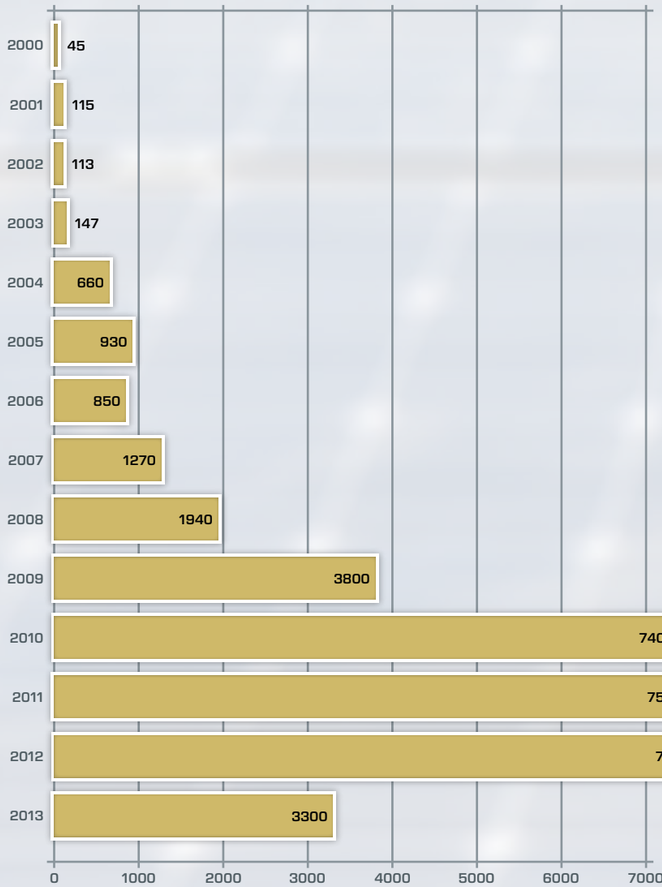
Basic Knowledge

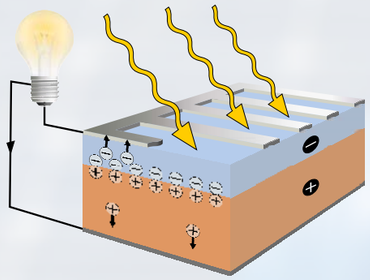
Photovoltaics

In recent years, economic incentives and successful technological developments have led to a significant growth in installed photovoltaic capacity.

The advantages of converting light into electricity directly are well known: solar power contributes to protecting the environment, reduces the cost of electricity transmission and provides an independent and affordable energy supply.



Annually installed photovoltaic capacity in Germany in MW_{pv} (Source: BSW-Solar)

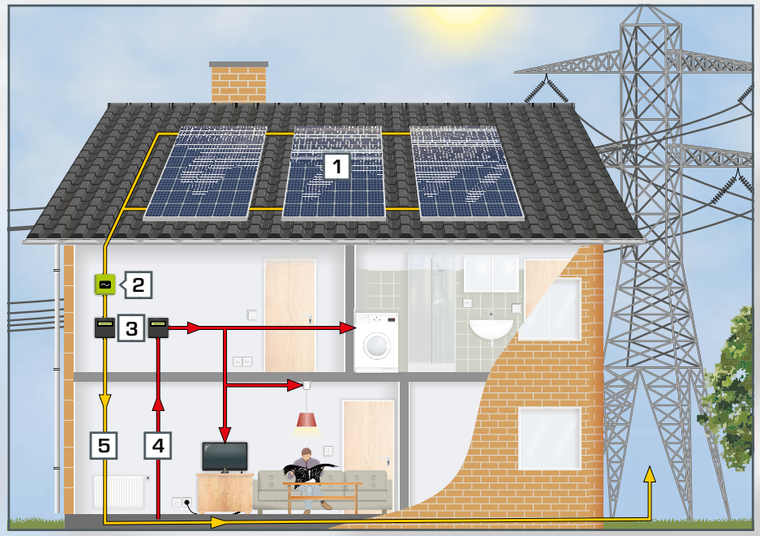


How semiconductor solar cells work

A semiconductor solar cell converts the radiation energy of light into electrical energy. This requires that the absorbed photons have sufficient energy and/or wavelength. An electron can only be released from the bond of the atomic crystal lattice if the absorbed energy in the semiconductor is sufficient. The mobile electron leaves a free space behind in the crystal lattice. This space, known as a hole, has a positive electrical charge and can also move freely in the semiconductor.

In order to be able to use this mobile electrical charge carrier, an electric field is established in the semiconductor by doping it with suitable impurity atoms.

Under the influence of this internal electric field, generated positive and negative charge carriers can be separated in the solar cell. This means it is possible to use the solar cell as a source in an electrical circuit.



1 photovoltaic modules
2 inverter
3 electricity meter
4 connection to consumers
5 feed into grid

Using solar power efficiently

In order to collect the photovoltaic solar power, for example 36 (for example) individual solar cells are combined into one single module. The subsequent use of the solar power can be divided into different concepts:

- stand-alone operation
- grid-connected operation
- grid-connected operation with storage

Stand-alone operation is suitable for applications in remote locations with no connection to a public power grid. In this case, some kind of storage is crucial for an uninterrupted electricity supply, in order to be able to use the electrical energy at night as well, for example.

Grid-connected photovoltaic installations feed the solar power directly into the public grid. This type of setup requires an inverter to convert the direct current of the photovoltaic modules into an alternating current with the appropriate frequency and voltage.

An excess supply of feed-in electricity can cause the public power grid to become unstable. To avoid this effect, there are financial incentives to encourage the private consumption of solar power in Germany. Storage systems are added to the necessary grid-connected photovoltaic installations. The proportion of solar power which is consumed at the point of generation can be considerably increased by skilfully managing consumption and storage load.