# Solar Energy

**Network “Communities of a sustainable Europe” (CoSE)**

**International network of RURAL villages and URBAN neighborhoods for bottom-up approach**

**For more information, see: http://communities-of-sustainable.eu/**

**Solar Energy**

- Abundant and inexhaustible
- Application on roofs
- For both heating and electricity generation
- Easy to install and low maintenance
- Individual households or connection to many households from a community building or field

## Solar energy, what is it?

The existence of nearly all life on earth is fuelled by light from the sun: plants grow directly on sun energy, animals and human beings grow and flourish indirectly from sun energy through food consumption. Ancient populations were already aware of this and started to grow when they were able to use solar power more efficiently. The development of solar energy technology as we know it today started in the nineteenth century. Sunlight reaches the earth every day in abundance (the amount of solar energy that reaches the earth is about 9000 times as much as all humans need), so why not make use of it?

## Technical aspects (preconditions / opportunities)

Solar energy is derived from the sun. The sun produces solar radiation every day. When the sun is above the horizon, solar radiation is noticeable as daylight. Solar radiation has two components that can be used to generate power: light and heat. Light is typically used for electricity generation. Heat can be used directly or indirectly for heating. Solar energy can generally be divided in two categories: passive and active.

### Passive solar energy

Passive solar energy technology refers to the use of solar energy without using special equipment. Also, solar energy is not converted into another form of energy. In the construction industry this means that buildings are orientated and/or designed in a way that solar energy is optimally used. For example: a smart design of a building makes optimal use of glazing and the buildings’ orientation to the sun. This involves both benefiting from the sun’s heat in winter as well as minimizing the sun’s heat in summer.

### Active solar energy

Active solar energy technology refers to the conversion of solar energy into another form of energy through the use of special equipment. It can be sub-divided into thermal and photovoltaic (PV) solar energy.

Solar thermal collector

### Thermal solar energy

Thermal solar energy refers to the use of the suns' *heat* by a solar thermal collector. Thermal solar energy is used to produce electricity in an indirect way: mirrors converge sunlight to one point (concentrated solar power). Fluid in tubes in this point is strongly heated and results in steam. The steam powers a generator; in other words the heat is converted into electricity. The heated fluid in tubes can also be used to heat water in a storage tank (this is called a sun boiler). This water can then be used as warm tap water or for central heating.

### PV solar energy

Photovoltaic (PV) panels are solar panels that use *light* to produce electricity; it is a means to produce electricity in a direct way. The transformation is done by so called 'photovoltaic cells'. These cells can be put together on a panel. PV panels can be placed on small devices (such as watches and telephone chargers), but they are mainly known as panels placed on rooftops. PV panels thus can provide devices or households with electricity.

## Scale

Solar energy can be used on small devices, per household but also on community buildings, large barns or even in specially designated fields. Solar panels, both for heat and electricity generation are independent of scale. Placing more panels creates no additional efficiency; capacity is simply increased in a linear way by adding an extra panel. However, it is emphasised that the installation costs per panel are often higher for relative small PV projects.

A typical solar panel is 1.5 $m^2$ and panels can be linked to each other to increase yield. An average (Western-European) household needs about 25 $m^2$ of photovoltaic panels to cover its electricity use.

In general maintenance costs of PV are insignificant. On the other hand, every PV system requires an inverter. Where PV panels have a lifespan of around 30 years, inverters have to be replaced about every 5 to 15 years depending on the type of inverter. As a consequence, these replacement costs have a substantial impact on the economical performance of relative small installations (up to ten panels).

One thermal solar collector can be sufficient for one household using it for hot tap water; three additional collectors can be sufficient for central heating. This is however dependent on the climate, insulation properties and size of the house.

# Benefits for the community

## Costs

- A photovoltaic panel costs around € 450.00 including VAT and installation (if you buy several, installation costs are relatively lower). It will produce approximately 230 kWh per year. Depending on the energy prices in your region this can save € 30.00 to € 50.00 of electricity per year. Calculating the number of panels needed for self-reliance is easily done based on your electricity use.
- Prices for solar water heating system for a household range from € 2,000.00 to € 5000.00 excluding VAT and installation. You can save up to half of your energy costs with it (around 210 $m^3$ of natural gas).
- Photovoltaic panels are technically advanced and need to be bought as a final product and (preferably) installed by experts. Although it is sometimes advocated that you can easily install a solar water heating

system yourself, it is stressed that the installation of these systems is complex as well since they often interact or are connected with central heating systems.
- Off course maintenance costs should not be forgotten: maintenance costs for sun boilers are about 50-150 per 5 years, maintenance costs for PV panels are about one per cent of the cost price. However, one should keep in mind that other features of the installation such as the inverter have a shorter lifespan than the panels itself.
- Subsidies can lower the cost price of solar panels but subsidy regulation is subject to change. Still, without subsidies solar panels provide a positive return on investments.
- Some countries have feed-in electricity tariffs in order to lower the costs of renewable energy production.

### Revenues (economic and ecological)

- Solar energy is a clean and everlasting source of energy.
- Prices of photovoltaic panels have been decreasing over the last few years.
- Solar energy can be used virtually everywhere.
- Even during cloudy weather electricity is generated by photovoltaic cells.
- Solar panels provide a positive return on investment.

### Social aspects (cohesion)

In operation solar panels don't have any active link to the community. They are (nearly) free of maintenance for many years. However in acquisition and installation there is a big role for the community. Large orders can give discounts and houses can be linked to buildings with large roof areas.

Furthermore, solar panels are mainly produced in China and Taiwan. You should ask your supplier whether and how they monitor the production process with regard to damage done to the environment and working conditions.

## Where has it been implemented?

### Examples CoSE communities

In Ashton Hayes, United Kingdom, and Reda, Poland, the first solar PV panels have been installed on private houses.

The town of Bocs, Hungary, has made an inventory of the available roofs for solar energy.

### Success and Fail Factors for implementation

- Consider the number of sun hours (climatic conditions) for your community.
- The efficiency of solar panels (PV) is strongly influenced by their orientation to the sun, both horizontally and vertically, and (partial) shading.
- Compare the prices (cost and maintenance) and services of various solar panel providers; this may vary.
- The political climate influences the return on investment in solar panels: in some countries it is possible to return excessively generated solar power (electricity) to the grid and receive similar or in some case even higher prices as you would pay if you bought it from the grid. In other countries this is not the case: if you buy in additional electricity (e.g. in case of electricity use peaks) the price is much higher than if you sell excessive electricity to the grid.

# How to get started?

## European legislation

The European Commission (EC) sets a target of 20 per cent renewables within the EU by 2020. Renewables include wind, solar, hydroelectric and tidal power as well as geothermal energy and biomass. Increasing the share of renewables in the EU will contribute in cutting down greenhouse emissions and make it less dependent on imported energy. To reach this ambitious goal the EC has presented the 2009 Renewable Energy Directive.

Besides setting a target, the Directive also improves the legal framework for promoting renewable electricity, requires national action plans that establish pathways for the development of renewable energy sources including bioenergy, creates cooperation mechanisms to help achieve the targets cost effectively and establishes the sustainability criteria for biofuels.

Each Member State has a national target, which differs between them. Annex I of the 2009 Renewable Energy Directive shows the various national targets. An annual report on the progress of each Member State is presented on the website of the EC. These reports include various aspects such as the current share of renewables, updates on national legislation, all support measures taken, system of guarantees of origin, administrative procedures and many other relevant national measures. Under further reading a link to the national reports can be found.

## Local knowledge (CoSE partners)

The CoSE partner communities discussed in the examples above can be contacted for questions about solar energy, specifically photovoltaic panels. Whether you want some more information on technical specifications, raising funds or organising the community, feel free to get in touch with them.

Ashton Hayes, United Kingdom
Garry Charnock, co-chair
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+44 7968 063 624
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Bocs, Hungary
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## Finding partners

Many communities (Bocs, Bukkaranyos, Strem, Beckerich and Ashton Hayes) have indicated to want to place photovoltaic panels, mostly on community buildings like an elderly house, supermarket or community centre. Installing PV panels on private houses is generally considered the next step.

The community of Ommerkanaal also has plans to generate power from PV panels for its community centre. In addition they have a concrete plan for solar thermal collectors. Many people in the community are interested in solar thermal collectors for their private houses. In addition solar thermal collectors are wanted for the primary school. The community combines all the orders in a tender to get a good price for the collectors.

The community of Measolle, France, would also like to use solar thermal energy for hot water and heating of houses.

## Building a strategy and plan

In designing a strategy or plan to realise an *individual* solar energy project, several steps are important to consider. The following steps provide assistance and should by no means be interpreted as fixed.

- Finding and acquiring a suitable location (in case of PV panels: maybe your roof, maybe several neighbours want to participate, maybe the roof of someone else). Several factors might influence the siting:
  - Optimisation of energy production.
  - Visual influence.
- Consulting various stakeholders (locals, municipality, local businesses), to see whether they are interested in or have resistance against this form of renewable energy production or want to cooperate.
- Assessing the local solar conditions such as number of sun hours, intensity of solar radiation.
- Orientating towards several solar panel providers.
- Consider storage of solar generated energy. Both heat and electricity from solar panels will not be produced at times of energy demand peaks. No electricity is produced during the evening and at night, while in darkness there is a high electricity demand (lighting). Also, solar heat is lower in winter than in summer decreasing the solar water heating systems' yield, while when it is cold there is a high demand for heat (heating your house). Backup from another energy source might therefore be necessary at these times.
- Seeking the required local, regional and/or national permits (this can be done by the supplier).
- Install the solar panels or let it be done by your supplier.
- Maintain your solar panel installation.

In designing a strategy or plan to foster the use of solar energy on a *national* level, it can be considered to draw lessons on success stories from other countries and make an overview of possible policy instruments:

- Regarding PV solar power: Germany (because of regulation and regulatory players), Italy (because of mixing net-metering and a feed-in tariff) and Spain (because of legislation). Investment based support (subsidies, tax credits and bank loans), quota, tendering, tradable green certificates are potential policy instruments.
- Regarding concentrated solar power technology: Spain and Germany have world leadership. Feed in laws and public promotion are potential policy instruments.

## Further reading

- European legislation:
  - Homepage: http://ec.europa.eu/energy/renewables/targets_en.htm
  - Progress reports: http://ec.europa.eu/energy/renewables/electricity_en.htm
  - 2009 Renewable Energy Directive: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:01:EN:HTML
- Laws and regulations in some European countries (examples):
  - http://www.epia.org/policies/sustainable-market-development/regulatory-framework/national-policies/
  - http://www.academia.edu/830640/
  - The_Legal_Status_of_Solar_Energy_in_some_European_Countries_and_Iran
  - Summaries of legislation: http://europa.eu/legislation_summaries/energy/index_en.htm
- European solar associations:
  - Photovoltaic: http://www.epia.org/home/
  - Solar thermal: http://www.estif.org
- Solar costs:
  - http://solarcost.org

# Network “Communities of a sustainable Europe” (CoSE)

## International network of RURAL villages and URBAN neighborhoods for bottom-up approach

**An initiative of the communities of:**
Ashton Hayes (village in Cheshire-West, United Kingdom)
Beckerich (municipality-village in Luxemburg
Betlejem (quarter of Reda, near Gdansk, in Poland
Böcs and Bükkaranyos (municipality-villages in Bükk-Mak-Miskolc-Region, Hungary)
De Stoere Houtman (quarter of Arnhem, the Netherlands)
Measolle (village in France)
Ommerkanaal (village of Overijssel, the Netherlands)
Strem (municipality-village in Öko-Energie-Bürgerland, Austria)

Other communities invited into the network:
Blacon (quarter of Chester, United Kingdom
Feldheim (invited, village of Treuenbrietzen, Germany)
Frankenwald (invited, village near Hof, Germany)
Jühnde ( invited, independent village in Germany)
Schönau (Schwarzwald, Germany)
Vauban (quarter of Freiburg, Germany)

**For more information, see: http://communities-of-sustainable.eu/**

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