

SOLAR ENERGY

An alternative energy sources is solar energy which is practically inexhaustible.

The solar radiation potential on Bulgaria's territory is considerable but there is considerable difference in sunlight intensity in the different regions. Data analysis shows that Bulgaria's territory can be divided into three solar zones; the average annual sunshine duration is roughly 2150 h which is about 49% of the maximum.

- **Central-east region** – occupies 40% of the country's territory with 30% of its population. That zone covers mountainous regions and is characterised by inconsistency of micro-climatic conditions.

- Average annual sunshine duration

✓ 31 March – 31 October	✓ 31 October – 31 March
✓ Up to 1640h	✓ Up to 400h

- Solar energy resource – 4kWh/m^2 per day or 1450 kWh/m^2 per year

- **North-east region** – occupies 50% of the country's territory with 60% of its population. That zone covers agricultural regions, the industrial region and part of the central north riverside strip.

- Average annual sunshine duration

✓ 31 March – 31 October	✓ 31 October – 31 March
✓ Up to 1750h	✓ 400 - 500h

- Solar energy resource – 4.25 kWh/m^2 per day or $1450 - 1500\text{ kWh/m}^2$ per year

- **Southeast and South-west region** – occupies 10% of the country's territory with 10% of its population. That zone includes the south coast.

- Average annual sunshine duration

✓ 31 March – 31 October	✓ 31 October – 31 March
✓ Over 1750h	✓ Over 500h

- Solar energy resource – 4.25 kWh/m^2 per day or 1550 kWh/m^2 per year

Economic expedience and possibility of using the solar energy potential for electricity generation

In analysing the prospects of solar energy potential for electricity generation the following facts have been considered:

Territorial barriers - analysing the opportunities for electricity generation from solar energy in a scale greater than the necessary facilities for meeting the producer's own needs, allowing him to participate on the green certificates market with the energy so produced, we have to consider the technical possibility of installing the transformation systems.

Assuming that 77% of the country's territory is in forests and arable land as well as territories protected by law as nature reserves, military bases etc., we can presume in theory that about 3% of the country's territory can be used.

Economic and technical characteristics of the systems for transforming solar energy into electricity

Flat panel photovoltaic cells

- ✓ *Application:* electricity generation
- ✓ *Power:* 5 -10 kWe
- ✓ *Efficiency:* 10% in electricity generation
- ✓ *Output of one module:* 200 kWh/y (at 10% efficiency per 1m² area)
- ✓ *Price of modules:* 4-5 USD per one installed W (if the necessary additional equipment is included in the price, it would be 5-8 USD per installed W)
- ✓ *Occupied area:* 2.2 ha/MWe (22 000 m²/MWe)

For a centralized system (photovoltaic power plant) connected to the national electricity grid (only thin-layer photovoltaic cells can compete with conventional systems) the price of electricity produced by such a system would be approximately *0.294 USD/kWh – 0.245 USD/kWh* while the price of electricity from a conventional system is *0.06 USD/kWh*.

Consequently the potential of photovoltaic systems is limited by the cost of their elements. They could become competitive and contribute to Bulgaria's energy balance if subsidies are envisaged for those technologies or if the price of conventional sources increases considerably.