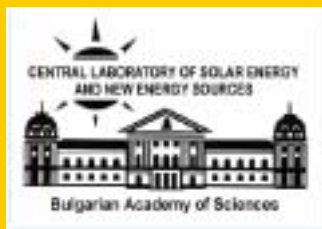


Utilization of Photovoltaic Systems for Autonomous Electricity Supply of High Mountain Huts

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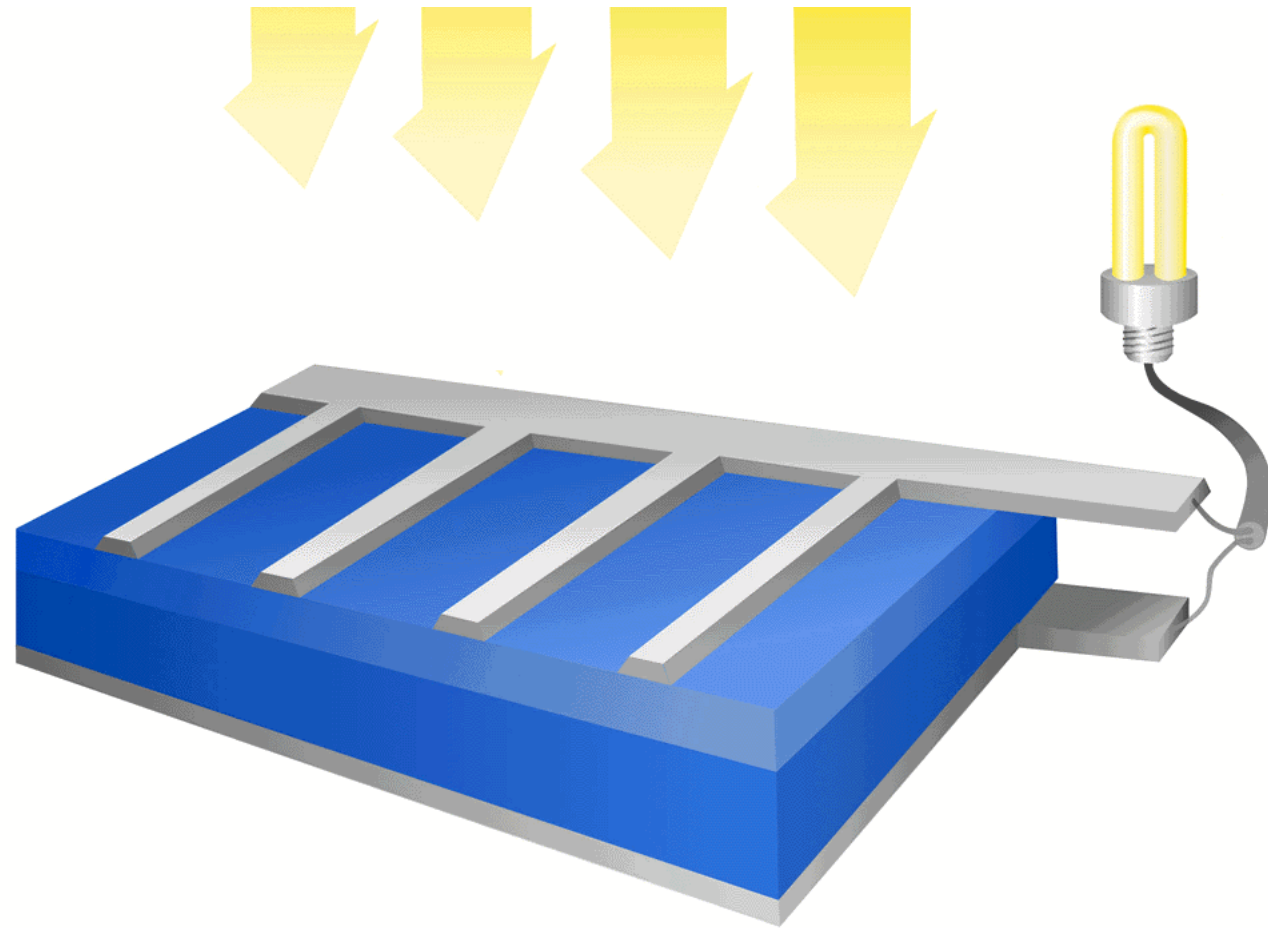
Introduction

Security of autonomous electrical supply by means of photovoltaic systems has become a competitive technical approach for the last years.

This approach was developed in the 50's for space apparatus, but with the development of technologies it is widely used for earth's sites in different spheres of life.

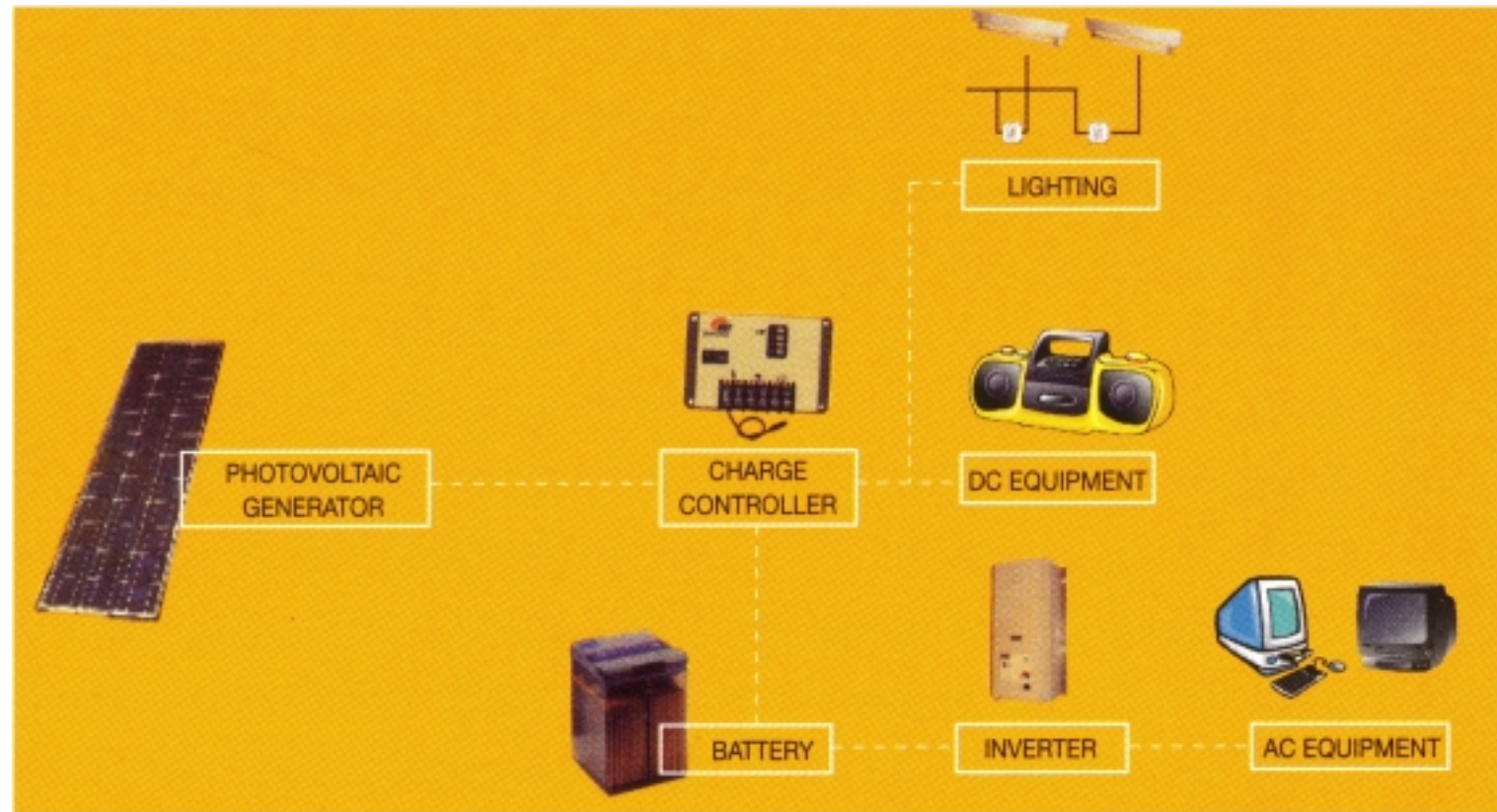
Main physical principles

The main physical principle is direct transformation of solar energy into electrical.



Principle scheme of a photovoltaic system for autonomous electrical supply.

Autonomous electrical supply



The most important element of a photovoltaic system is a solar generator.



It is constructed on a modular principle according to its capacity and is characterized with working voltage and nominal current.

The main components of the solar generator are the photovoltaic modules.

The electrical current, which is generated by the solar generator is proportional to the intensity of the sun shine and the area of the modules.



Advantages of the PV systems

Advantages of the PV systems

- natural resource - sun
- practically unlimited period of exploitation of the facilities
- minimal exploitation costs
- lack of noise and environmental pollution



As autonomous sources of electrical energy, they are with no competition for sites far from the electrical grid, for controlling and measuring systems, etc.





Road Tracers



Power Chargers



GSM Chargers

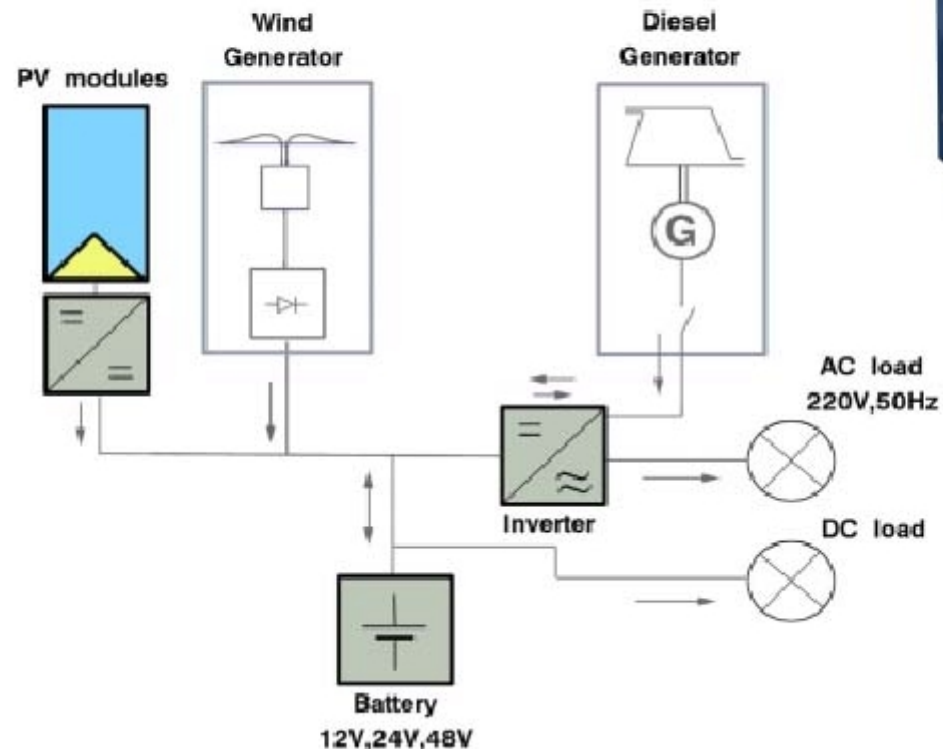


High-mountain huts are particularly suitable sites for utilization of PV systems due to the following factors:

- remoteness from the electrical grid
- they are in hardly accessible places and the investment costs for installation of electrical cables are high;
- for life important needs, it is necessary small electrical capacity for: lightning, radio connections, TV, charging of mobile phones;
- the electrical energy is not utilized for comfort: heating, cooking, hot water, etc.

There are some variants for security of electrical supply of high mountain huts:

- water turbines
- diesel or gasoline gen set
- wind energy
- photovoltaic systems, utilizing solar energy



The most competitive are the two systems

- diesel gen set

- photovoltaic systems





The climatic conditions in Bulgaria are particularly suitable for utilization of solar facilities. It should be mentioned, that the total solar radiation in the high mountain is much greater due to the clean air, the irradiation from the snow and the lack of shading. The experience shows that there the maximum generated capacity exceeds with 20 to 30% those, achieved in urban conditions.

Particularly strong is the effect in solar winter days, which to some extent compensates the losses due to the greater presence of cloudiness in the mountain.



Comparative data for autonomous electrical supply

Electricity consumption	Photovoltaic system (PV)	Diesel gen set
	2 kWh/day	2 kWh/day
Photovoltaic generator 600 Wp	2400\$	Diesel gen set 5 kVA
Inverter of 220 AC	400\$	Depreciation period 10 years
Charge controller	80\$	mounting
Accumulating battery for 10 kWh (420Ah, 24V)	500\$	cables
attaching constructions and cables	400\$	Restructuring of premises for work
mounting	200\$	Accumulating battery
		Charging device
Total sum of the investment costs for 25 years	3980\$	Total sum of the investment costs for 20 years
		4200\$
fuel	0	fuel
transport	0	Transport of fuel
		maintenance:
		- oils
		- spare parts

1500\$
300\$
200\$
!
500\$
200\$

!!
!!!
!!
!!



Advantages and disadvantages

Photovoltaic system

1. No fuel costs
2. Works completely autonomously and does not require maintenance
3. Secures constant electrical supply
4. Does not get amortized
5. The system is highly reliable and with small probability of technical damages
6. It is not influenced by low temperatures

Advantages

Photovoltaic system

1. The generated electrical energy depends on the day and night and seasonal changes of the solar radiation
2. The energy output decreases in bad climatic conditions: cloudy weather and fog

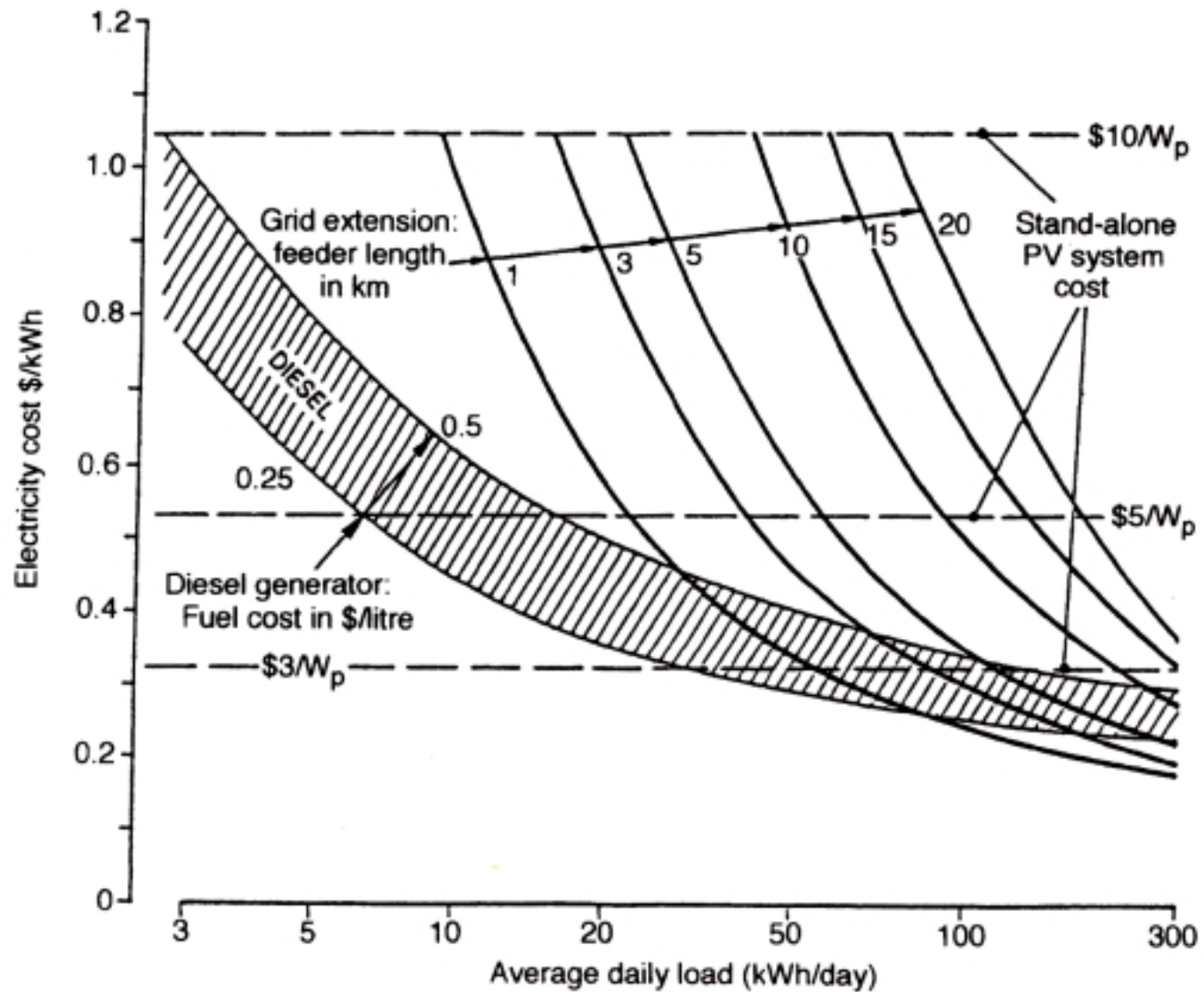
Disadvantages

Diesel gen set

1. Autonomous with regard to the climatic factors and seasons
2. It could work at full capacity at presence of fuel

Diesel gen set

1. It has no automatic mode and requires maintenance
2. No constant electricity supply is secured, if there are no accumulators
3. Requires fuel supply
4. Probability of mechanical damages and work interruptions
5. Requires maintenance and storage of fuel



Comparative assessment of the price-cost per kWh with the different methods of electricity supply. The price-cost is determined on the base of the investment costs and the electrical energy consumed for 20 years.



Utilization of PV systems in high mountain sites in Bulgaria

- spare autonomous electricity supply for Meteorological stations on peak Musala and Cherni vruch;
- autonomous electricity supply of meteorological station "Murgash" - 500 W
- autonomous electricity supply of hut "Murgash" - 300 W