

EVALUATION OF THE TOTAL COST OF DIFFERENT PV CELLS AND COMBINED PV-THERMAL SOLAR DESIGNS FOR THE FIRST RUSSIAN PV SOLAR 1 MW POWER PLANT

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Evaluation of the total cost of the first Russian PV Solar 1 MW Power Plant project was made, and comparative analysis of techno-economic efficiency of different constructions of PV modules for this project was fulfilled.

With about 50-65% of total investment, module costs are dominant in the total costs for this middle-size PV Solar Power Plant. The largest relative and absolute contributions to total module cost are silicon wafers manufacturing during cell production, cell interconnects and module assembly in the module production phase.

Various possibilities of the total cost decreasing were discussed and several ways seemed to be perspective. One of them is using of concentrated solar cells and parabolic trough concentrators of solar radiation (concentration ratio 20-25). The power output of the designed power plant has been increased by utilizing not only the electrical energy of the solar cells but also the heat absorbed by the cells (by extracting heat in closed loop water circulation).

Unfortunately the usual mass-produced solar cells could not be used for modules of this plant: their PV efficiency at 20-25 solar fluxes is too low and the emissivity of heat is too high for their surfaces [1].

In the preliminary experiments several effective models of the combined photothermal receivers [2] for the modules of this plant have been made. These receivers were supplied by silicon solar cells of special construction with many additional thin metal fingers on the top surfaces or with transparent conductive films so the surfaces of the designed thermal receivers had a very low value of the thermal emissivity and at the same time high PV efficiency.

The authors have calculated the contributions to the total module cost due to these additional expenses caused by several new operations in the technology process which was used to produce solar cells of special construction. It was shown that stable long-term performance of the solar power plant and its high electrical and thermal output capacity are much more important for overall techno-economical efficiency of this project than costs of several new operations in the technology.

The project was supported by local authorities of the region where the solar power plant is planned to be built by the end of this decade (city of Kislovodsk, a well-known mineral water resort in the South of Russia) due to its very low social costs and reduction of environmental damages.

References

- [1] M. M. Koltun, "Selective Optical Surfaces for Solar Energy Converters", Allerton Press, Inc., New York, 1981.
- [2] M. M. Koltun, "Solar Cells, Their Optics and Metrology". Allerton Press, Inc., New York, 1988.