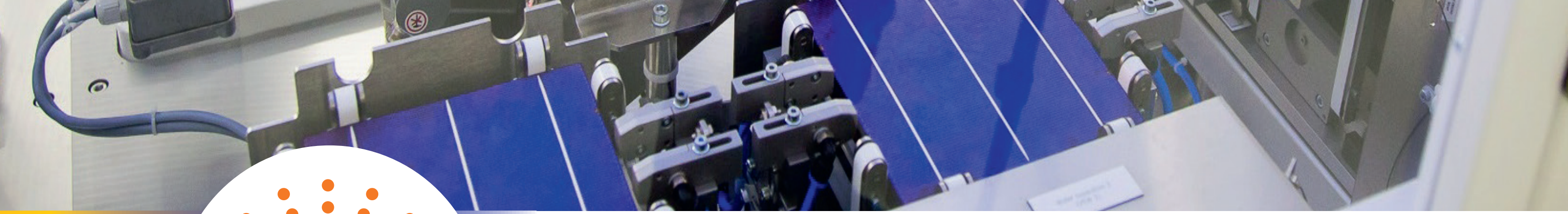

SUPER PV

Fact Sheet

In recent years continuing improvements in solar cells and their production process has resulted in an increased power output per photovoltaic module (PV-module) and shortened the amortization period for PV-installations.

The time needed to recover the energy for the PV-module production (energetic pay-back time) by the electricity generated by monocrystalline silicon PV-modules has dropped to 1.5-2.5 years [1]. It can be even shorter for thin-film photovoltaic modules. The average financial pay-back time for a PV-installation investment is 6-8 years [2].

For the first time in 2018 the costs of a kWh of electricity generated by photovoltaic module for best-case scenarios in Europe fell to a level equal or below the production costs of electricity in conventional thermal power plants [3].

Unlike electric power purchased at the local supplier for a price per kWh which contains taxes and fees for a number of services, photovoltaic electricity generated on site if directly consumed is mostly free of such taxes and fees. Therefore consumption of photovoltaic electricity at the site of production has become more and more attractive when compared to feeding this electricity into the grid, especially since the tariffs paid to the producer are decreasing from year to year.

The larger PV-installations are, the higher the risk of partial shading by trees, buildings or the neighbouring row of solar panels; the former being less of an issue in rooftop installations. Such issues can be solved in the design phase of a building or a PV-installation with the use of appropriate software tools. Therefore one task of the Super PV project is to integrate the PV-specific part into existing simulation software.

Two hardware components are required to prevent the whole PV-installation from damage or from suffering higher losses than necessary:

To ensure that the PV-module is not irreversibly damaged by partial shading, a **bypass diode** bridges the affected string of cells while shaded. A new and cheaper type of such diode is being developed by the Super PV project.

Power electronic inverters usually collect the dc-power of many serially connected PV-modules or parallely connected strings of PV-modules to convert it into ac-power which can be fed into the electricity grid. Cost-reduction and lifetime extension of these electronic units are necessary to meet the same warranty periods of 25 years for PV-modules. The Super PV project is developing new micro-inverters controlling the power output of a single PV-module. The latter allows for an individual optimization of each module even under unfavorable illumination conditions or a shut down of individual modules in case of shading, which would otherwise cause a shut down of whole parts of PV-installations.

Beside partial shading, the homogeneous power-reduction due to soiling of a standard PV-module (1.5m^2, cost €80-105 [4]) with an annual electricity generation of 270-500 kWh/a [5] accounts for up to 10% [6-10] in dry and dusty environments and represents an annual energy loss of 27-50kWh per module. With the kWh-prices €0.10-0.31 [11-13] in the EU in 2018, this corresponds to an annual financial loss of up to €15 per module.

One of the goals of the Super PV Project is to demonstrate that PV-modules fitted with dust-repelling **coatings** perform better compared to non-treated modules (Lotus-effect). This coating with nanometer-size transparent particles additionaly provides an anti-reflection effect for the usable visible light and reflects the unusable infrared light to reduce harmful heat-up of the module and results therefore in extra power output to be quantified in the Super-PV project.

An important goal of the Super PV project is the combination of PV-modules with micro-inverters with low-cost sensor-electronics to improve the overall energy performance of the electric installation of a building (including electricity and heat storage) and its integration into the electricity network. The latter would allow control of energy flows, taking into account information such as periodic energy demands or weather data (**PV information management**).

[1] http://www.bipv.ch/index.php/en/technology-top-en/environmental-aspects/energy-pay-back-time) (accessed September 4, 2019)

[2] https://news.energysage.com/understanding-your-solar-panel-payback-period/ (accessed September 4, 2019)

[3] C. Kost et. al., „Stromgestehungskosten Erneuerbare Energien". Fraunhofer-Institut für solare Energiesysteme ISE. Freiburg im Breisgau. März 2018. https://www.ise.fraunhofer.de/content/dam/ise/de/documents/publications/studies/DE2018_ISE_Studie_Stromgestehungskosten_Erneuerbare_Energien.pdf (accessed September 4, 2019)

[4] www.pvxchange.com/de/preisindex (accessed September 4, 2019)

[5] http://re.jrc.ec.europa.eu/pvg_download/map_index_c.html

[6] https://europe.solar-asset.management/new-updates-source/2016/10/31/the-pv-modules-soiling-issue-our-final-solutions (accessed September 4, 2019)

[7] https://www.nature.com/articles/s41598-018-32291-8 (accessed September 4, 2019)

[8] L. Micheli. M. Muller "An investigation of the key parameters for predicting PV soiling losses" Prog. Photovolt. Res. Appl. 25 (2017) 291-307

[9] Mohammad Reza Maghami et al., "Power loss due to soiling on solar panel: A review" Renewable and Sustainable Energy Reviews 59 (2016) 1307-1316

[10] A. Massi Pavan, A. Mellit, D. De Pieri „The effect of soiling on energy production for large-scale photovoltaic plants" Solar Energy 85 (2011) 1128-1136

[11] https://selectra.co.uk/energy/guides/electricity-prices-europe (accessed September 4, 2019)

[12] https://www.energy.eu/electricity_natural-gas_prices_european_union/ (accessed September 4, 2019)

[13] https://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_price_statistics (accessed September 4, 2019)

The SUPER PV project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 792245

Find us on:

#SuperPV

@SUPERPV_H2020

www.superpv.eu