# A study of solar panel actual efficiency in Latvian climate conditions

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# Motivation

To reduce the greenhouse gas output into the atmosphere, renewable energy sources are getting more popular. Especially the photovoltaic technology due to its low maintenance cost and simple installation process.

To determine the efficiency of poly- and monocrystalline panels depending on their spatial orientation and the seasons a set of test panels was installed in 2018 in Riga, Latvia for long-term monitoring of the amount of generated power and produced energy.

# Types of solar panels

| Abbreviation | JA | LG |
|---|---|---|
| Model | JAP60-275/4BB | LG365Q1C-A5 |
| Panel type | Polycrystalline | Monocrystalline |
| Surface area, $m^2$ | 1.64 | 1.72 |
| Efficiency, % | 16 | 20 |
| Maximal power | 200 | 275 |

Efficiency coefficients of these panels are given per the standard test conditions (STC): 25°C ambient temperature, 1000 $W/m^2$ solar radiation intensity, etc.

According to the reference guides provided by the manufacturers, *LG* is expected to perform better on days with high solar intensity, whereas *JA* will perform better in an environment of lower solar intensity.

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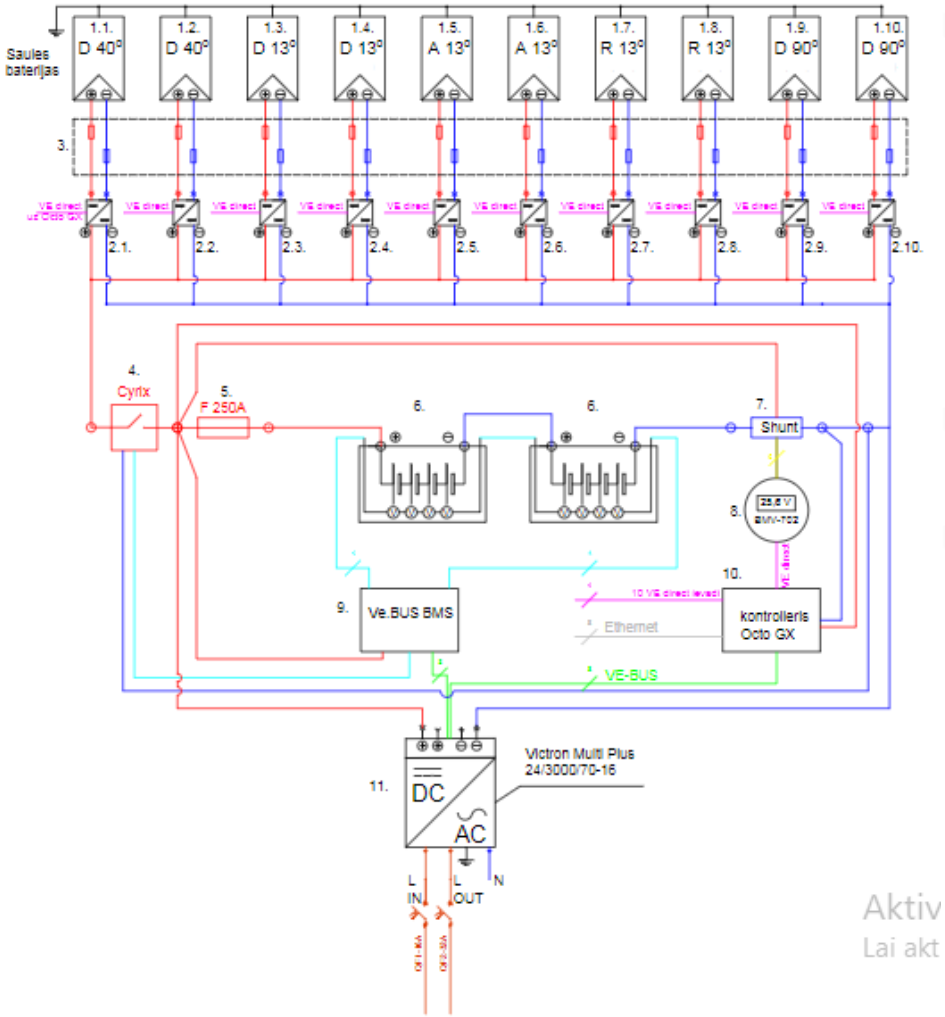
# System description

The panel system consists of 10 solar panels set up in five different orientations such that panels of either type, MC or PC, are tested for every orientation.

To be concise, we will designate a panel facing cardinal direction X at an angle Y to the horizon as XY. There are two groups of orientations:

- E13, W13, S13
- S40, S90, S13

# System description

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# System description

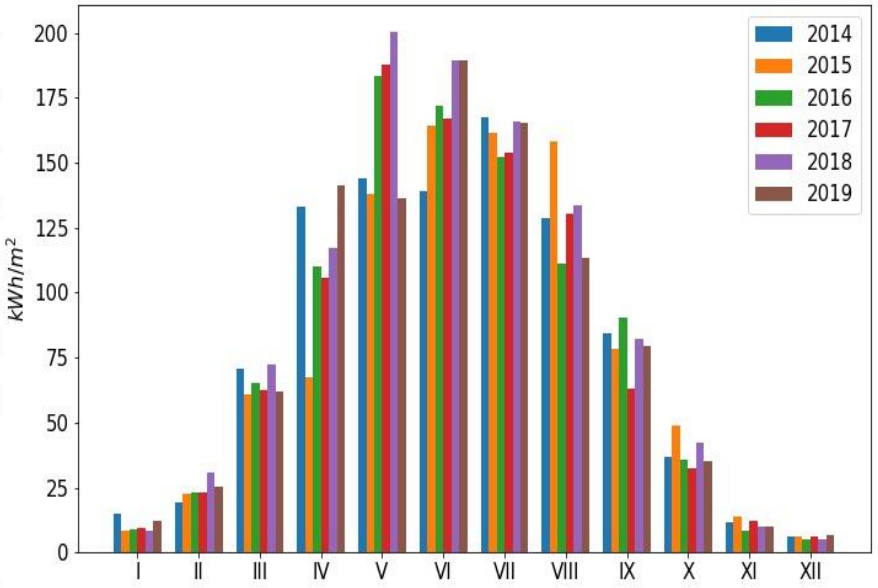
Data from the solar panels are transferred via internet connection and stored in the *Victron* energy database where from they are downloaded via *Victron Remote Management Portal*.

Ten parameters that describe the power output of the solar panels are selected, normalized by the panel surface area and used to calculate kilowatt-hours of produced energy.

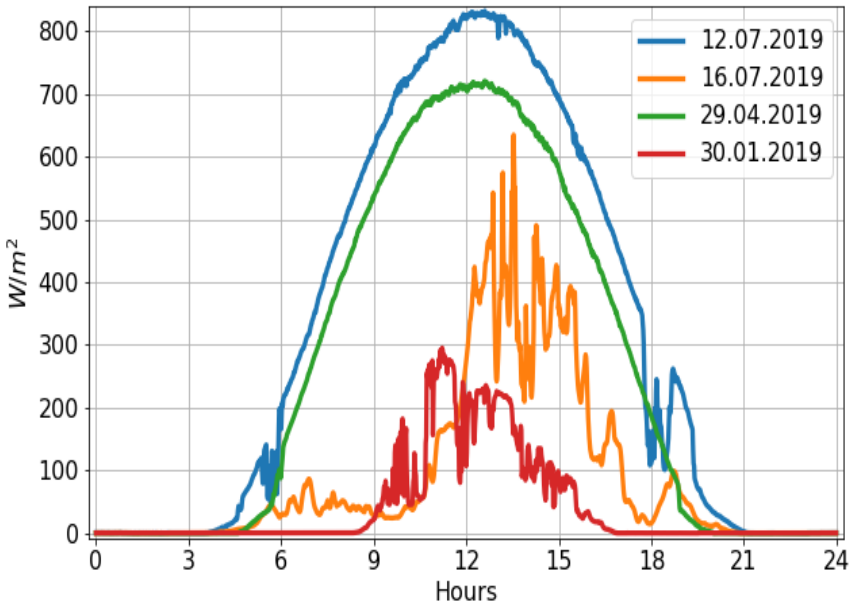
Several defects in datasets were found. Registered data points were non-uniform in time. There were also intervals, a few minutes long, with no recorded data.

# Results and discussion

The supplied solar energy to a horizontal surface over a period of six years




Solar radiation intensity over one day in different seasons and for different cloudiness

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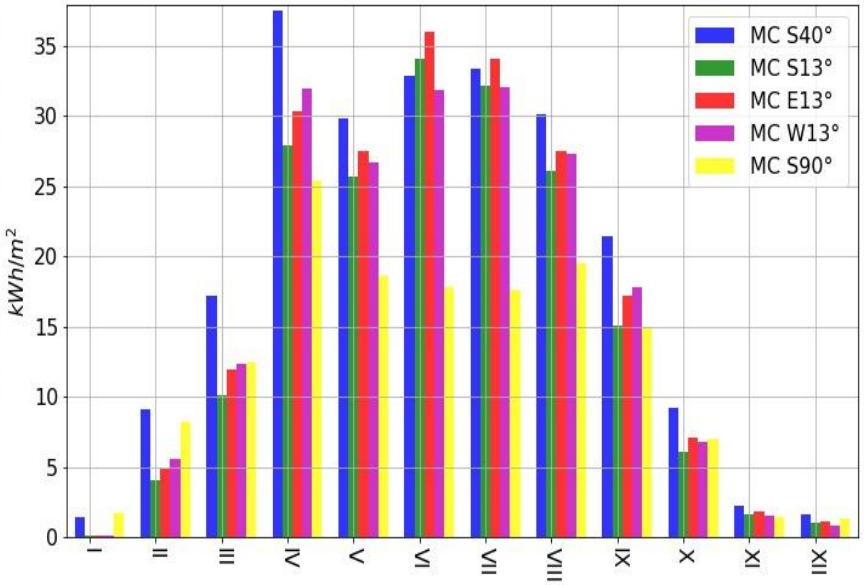
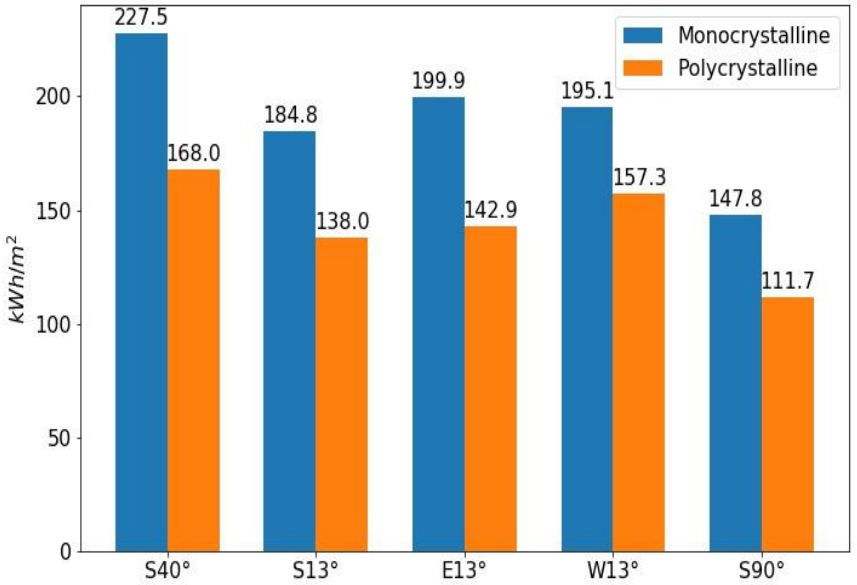
# Results and discussion

Energy generated by MC panels each month by different orientations




The total generated energy in 2019 by differently orientated panels

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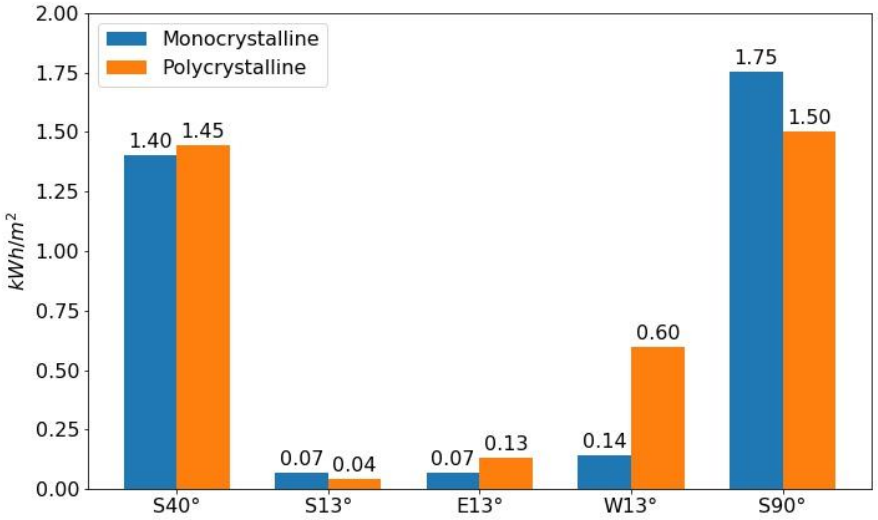
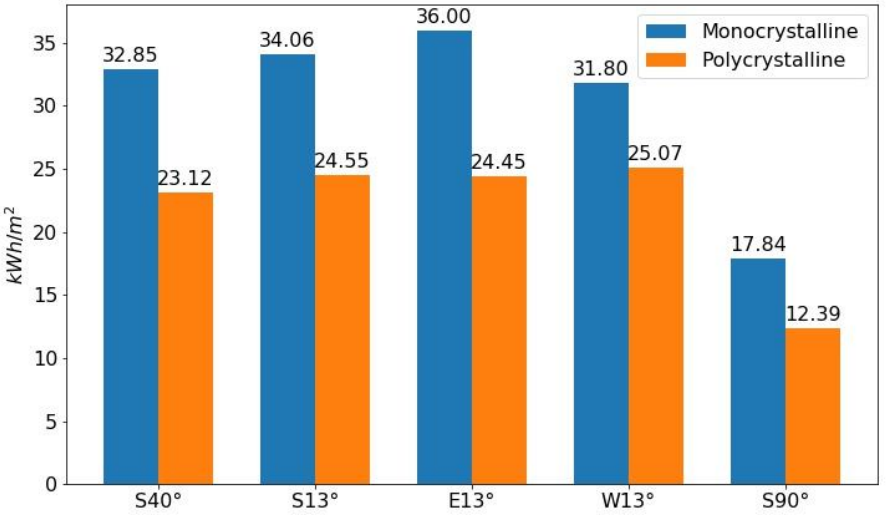
# Results and discussion

Comparison of the generated energy for PC and MC panels in January 2019




Comparison of the generated energy for PC and MC panels in June 2019

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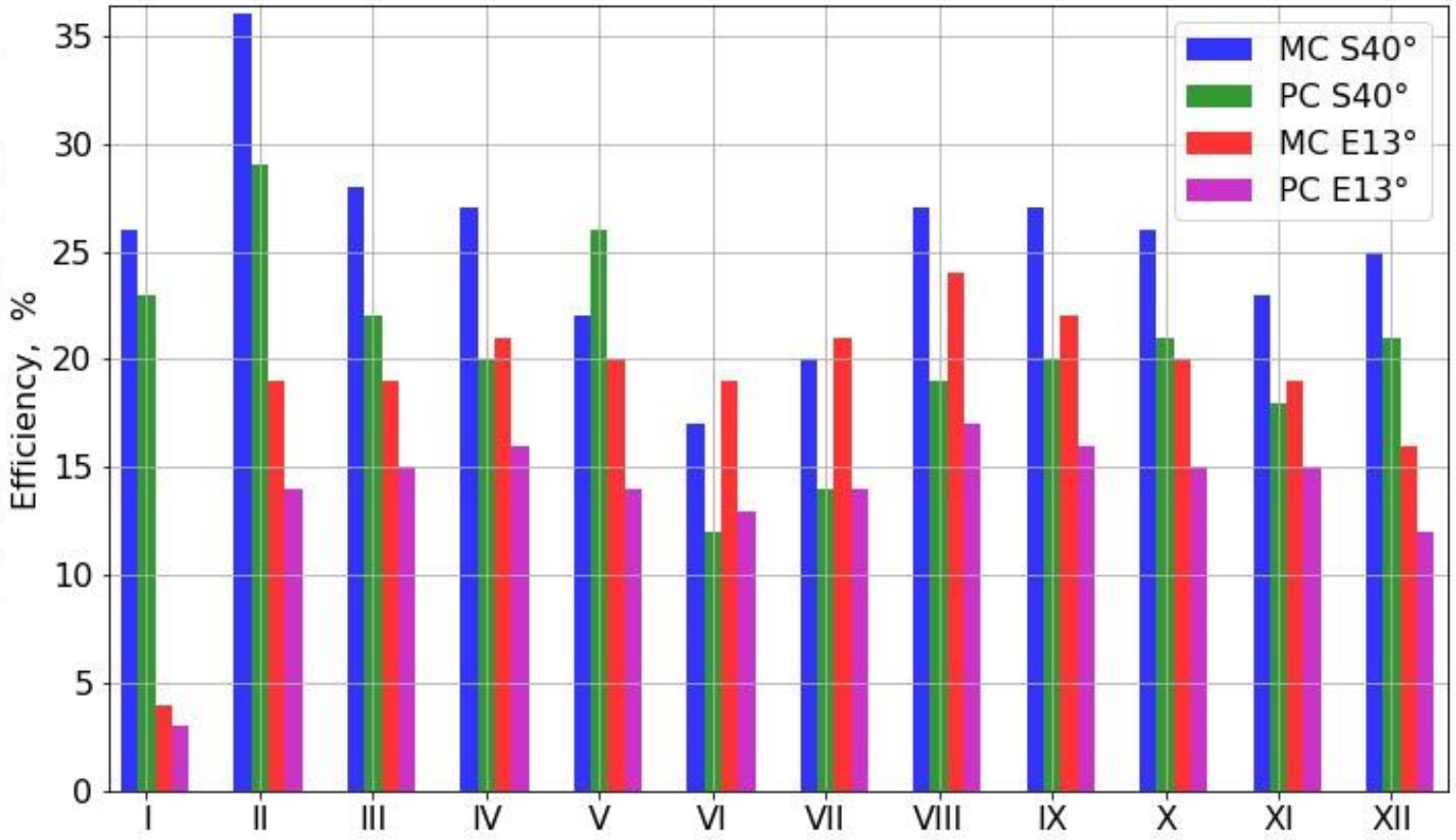
# Solar panel efficiency

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Solar panel efficiency by month

# Conclusions

- The first year of monitoring of various panel types and orientations in Latvian climate indicated that the difference in energy efficiency to “reasonable” variations of orientation is 1 - 8.5%
- MC panels can produce up to 40% more energy than PC panels with identical orientation.
- The actual efficiency indicators for panels correlate well with the values that were determined for standard conditions.

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# Thank you for your attention!

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