SOLAR DATA COLLECTOR

System integration

Early fault detection

All-in-one platform

MONITORING PLATFORM

Even a single faulty PV module can substantially affect the whole string of modules and if not treated, cause more damage to the system and other components.

Content

Why monitoring

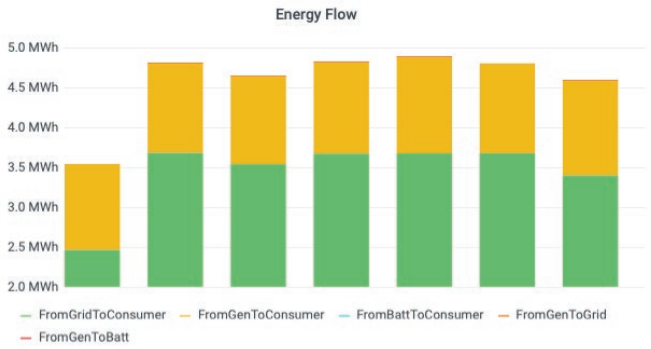
The complexity and the most capital needed for a photovoltaic plant is concentrated at the beginning of its lifetime. From then onwards, it is mostly just gaining revenue from the electricity produced. The varying price of the electricity can be a factor on the revenue, as well as the business model chosen. Support frameworks for utility scale projects are moving towards the premium based model (more info on the different models in my other article), which means that system operators sell the electricity on the market and receive a bonus premium on top of the market price.

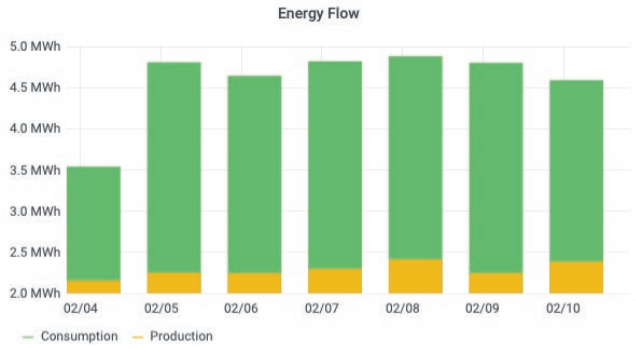
Leaving the business model and market fluctuations aside for a moment, the other risk is the efficiency and performance of the system during its lifetime, or to be more precise the deviation of performance from the optimal value. Many factors can affect the power yield of the system during its lifetime, some of them include: soiling of the modules, module degradation (photovoltaic modules loose efficiency over time and produce less electricity), inverter efficiency, system components' faults. Even a single faulty PV module can substantially affect the whole string of modules and if not treated, cause more damage to the system and other components.

Damjan Postolovski,
CTO

Weekly overview

The weekly overview graphs are showing several important metrics summarized on a daily basis for each day of the week. This tool can be used to identify patterns in the energy flow, such as the difference between workdays and weekend days.
By finding the patterns, the habits or energy flows can be adjusted to improve self sufficiency or other important metric.



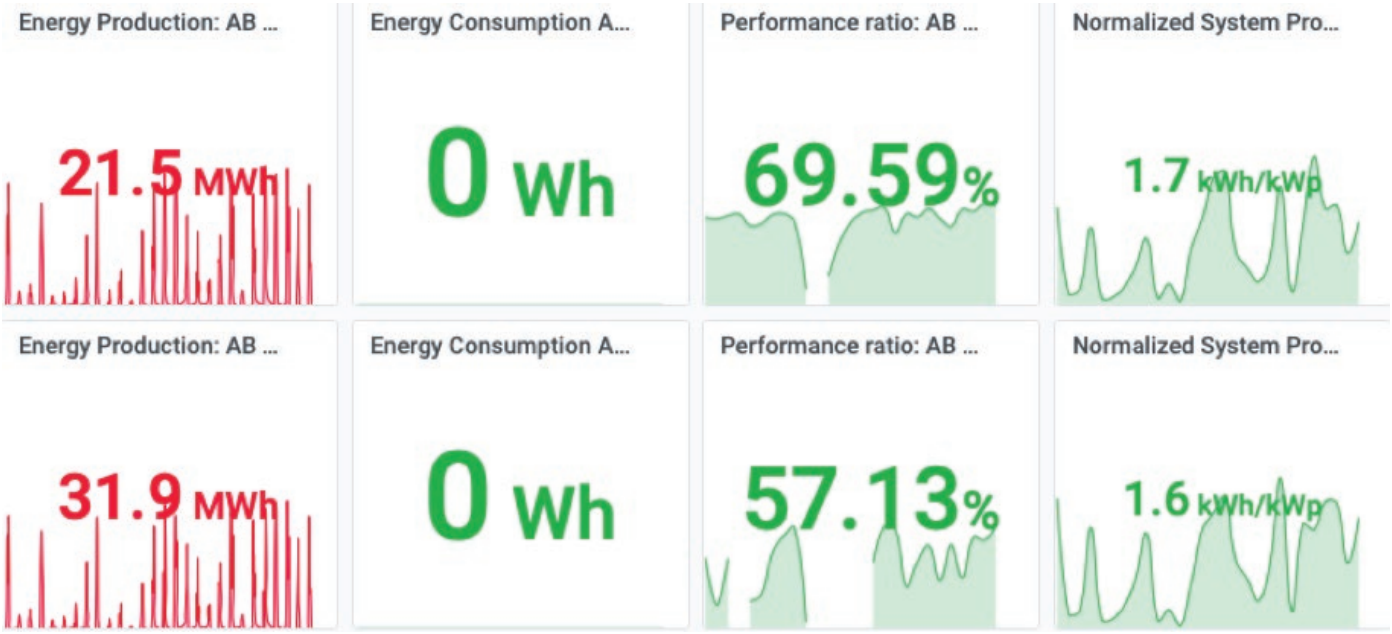


Fun fact:

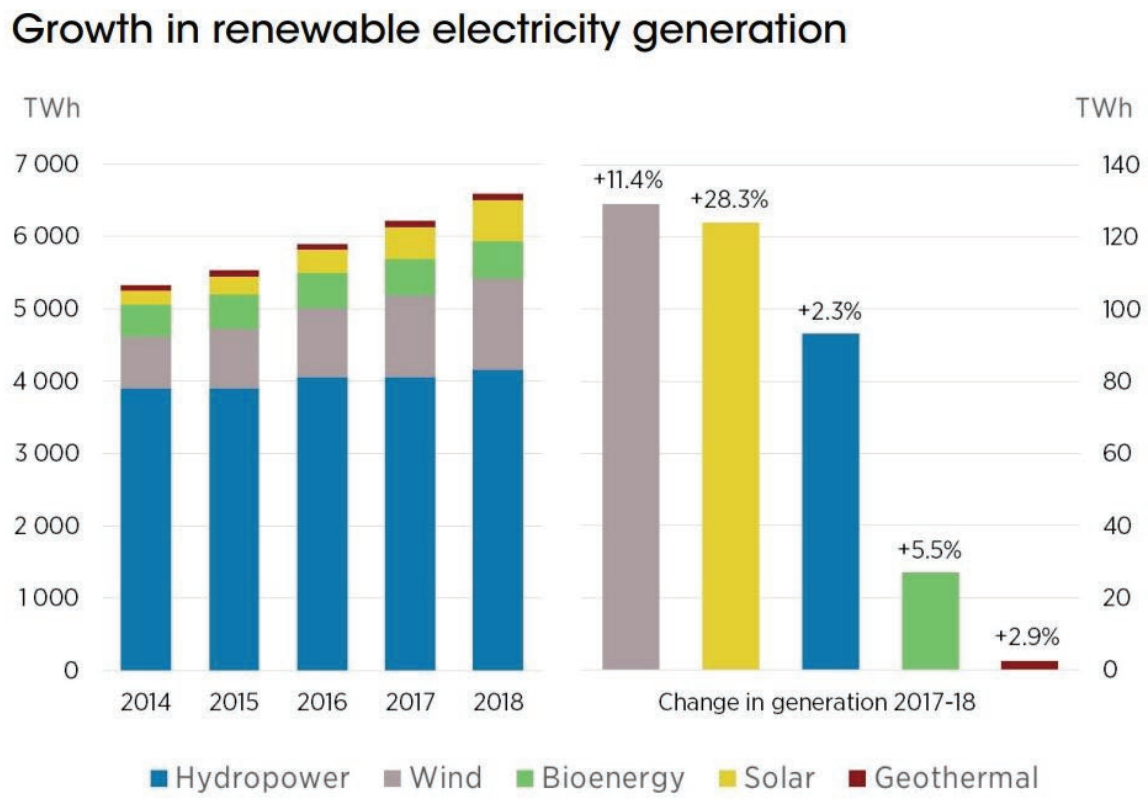
By adjusting the consumption habits and some automation control of heating and cooling devices, a client increased the self-sufficiency of the system from 16% to 27%.

System comparison

This tool allows owners or operators of several PV plants to compare important metrics for each of them. This gives an overview of the operation of the plants, and is a great tool to provide insight about the specific metrics for each plant. For example, one can conclude that Plant 1 is better performing than Plant 2, for a given time-period, which can be selected by the user. The user can also select the plants that he/she would like to compare.



Fun fact:



Weather parameters

The weather dashboard allows for a high level overview of the weather parameters for each location. The heatmaps of global horizontal irradiation and air temperature allow for easy spotting of sunny or cloudy days, hot or cold days. Temperature and irradiation are the most important factors that influence energy yield.

Simulated vs actual energy output

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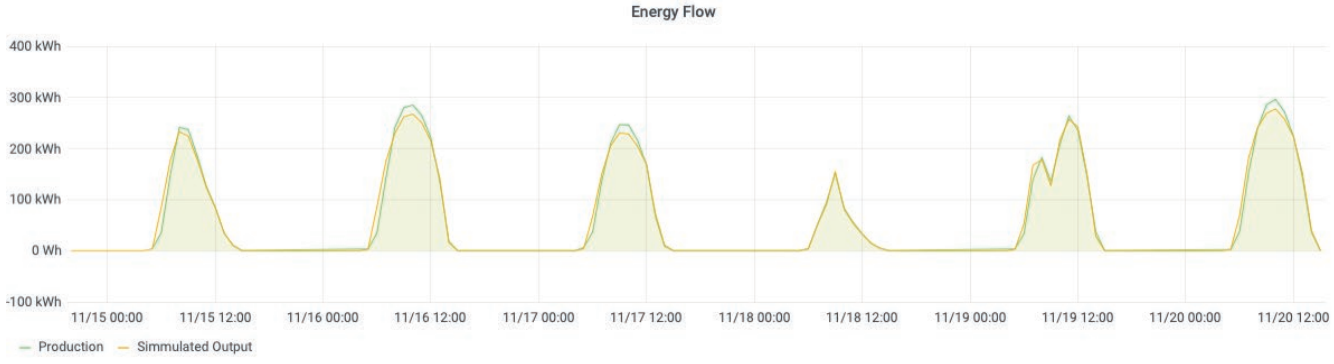
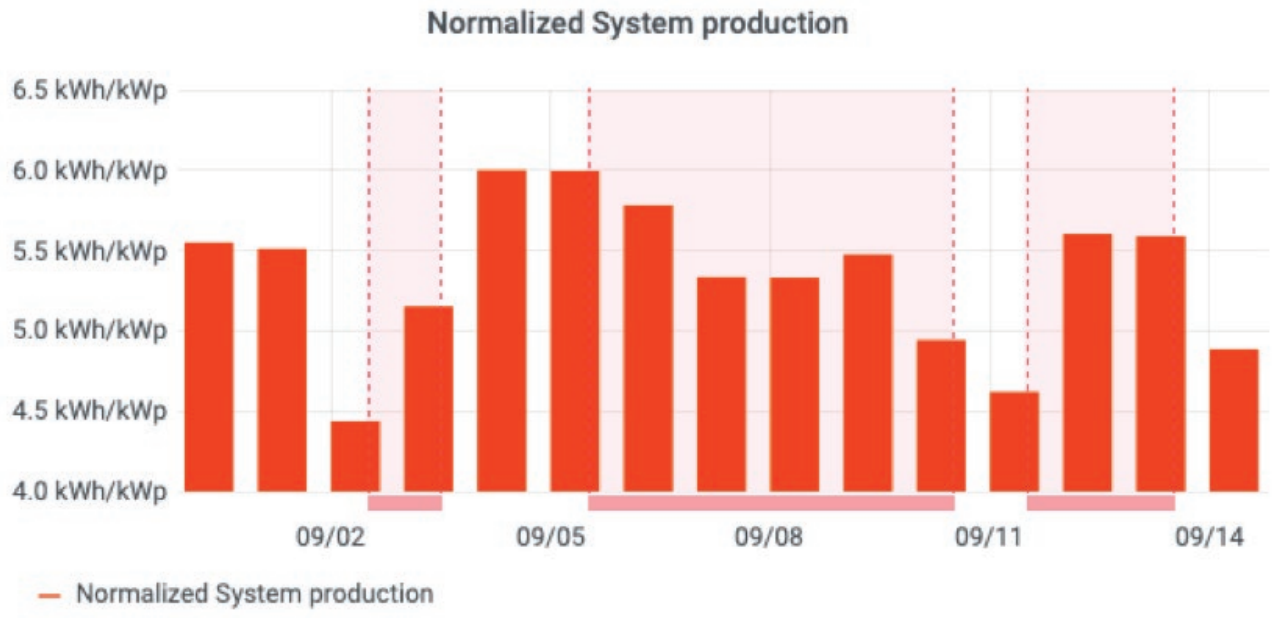


Normalized system production

This metric allows for comparing different PV plants and days, extracting the influence of the PV plant size. Basically, the data are normalized with relation to the PV plant size.
For each kWp of capacity, the plant is generating a specific energy yield which is given in this graph. For example, if the graph shows a 5.5 kWh/kWp, that means that 5.5 kWh energy is being produced for each kWp of capacity. If the plant size is 10 kWp, it will produce 55 kWh in total for the given day.

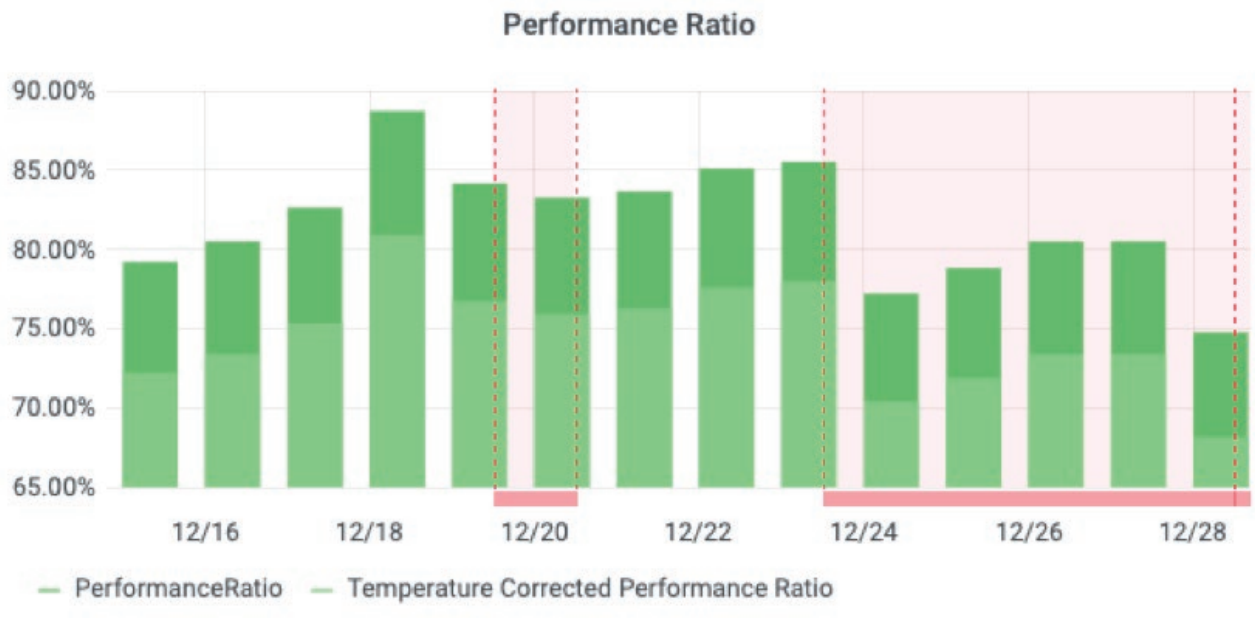


Performance ratio

Performance ratio (or shortly PR) is one of the widely accepted metrics in the photovoltaic industry that empirically states the efficiency of a given system. This metric can be used in all phases of the lifetime of a system, from a pre-feasibility study to continuous operation, which makes it suitable for use in the contract terms with the construction company that is responsible for building and putting the plant into operation.

Specifically, the performance ratio is the ratio of the actual and theoretically possible energy outputs. It is largely independent of the orientation of a PV plant and the incident solar irradiation on the PV plant. For this reason, the performance ratio can be used to compare PV plants supplying the grid at different locations all over the world.

The weather corrected performance ratio mitigates the effect of the temperature on the performance ratio. It is a metric proposed by NREL (National Renewable Energy Laboratory)



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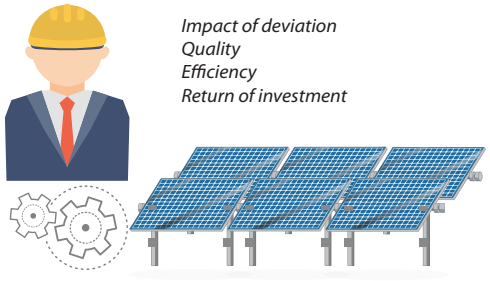
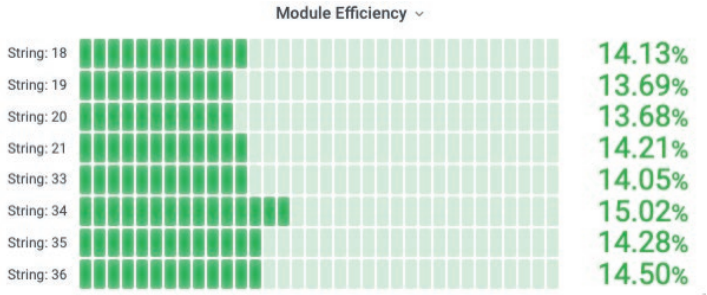
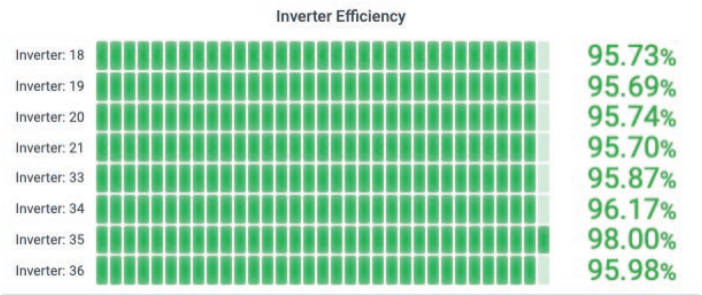


Inverter and module efficiencies overview

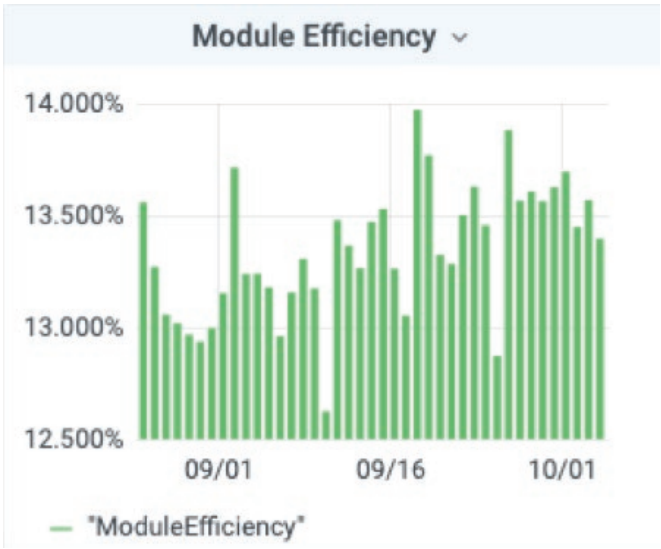
The efficiencies for each string and inverter are being shown in this graph. This is a useful tool for locating a faultry string of modules, or a faulty inverter.

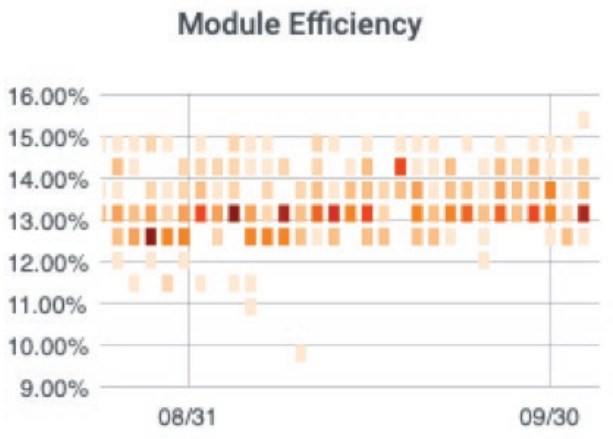




Module efficiency per string

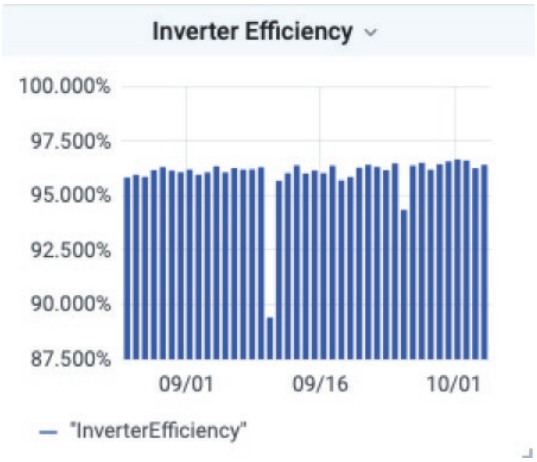
This graph is a detailed view of the module efficiency for a selected string. The left bar chart shows the average daily efficiency, and the right 'heatmap like' graph, shows a histogram of the efficiencies for each hour of the day. The Y axis is the efficiency in %, and the X axis are the days. The Z axis (the heat of the collor), is the range where the





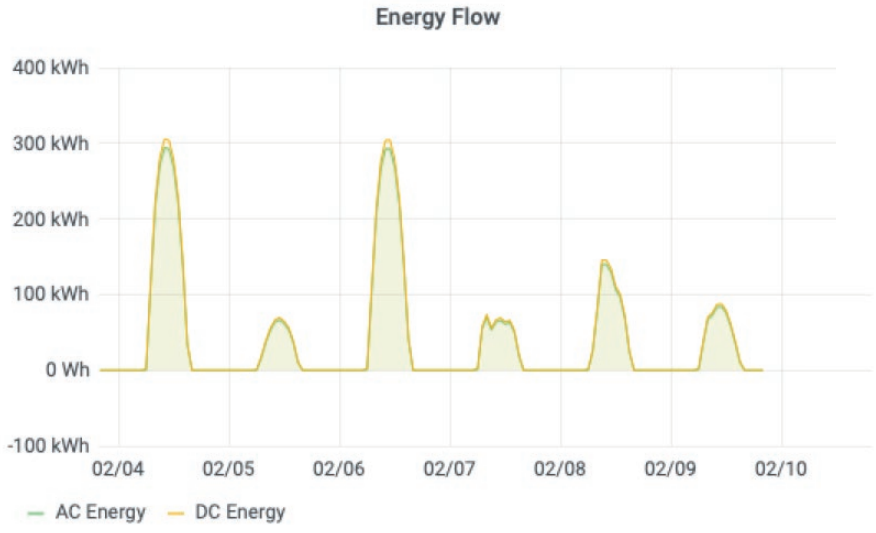
Inverter efficiency per each inverter

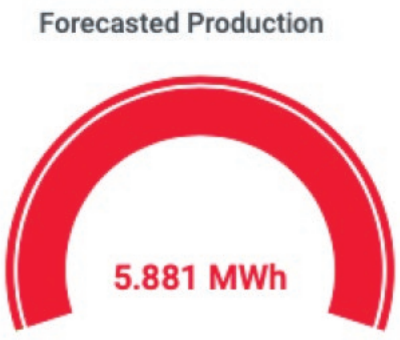
The inverter efficiency graph shows the DC/AC conversion efficiency for each inverter. The total average and the daily averages are being shown on these graphs. It can be used to detect days where an inverter has operated less than the nominal value, which can be a sign of a defect or a malfunction.

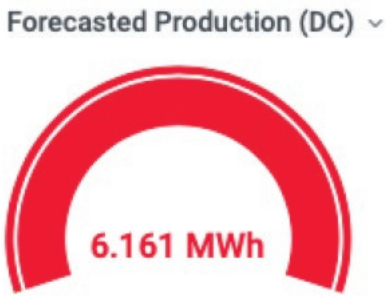


Energy forecasting (7 days ahead)

The energy forecasting function predicts how much energy will be produced by the plant in the next 7 days, on an hourly basis. The forecasted production is calculated on the DC and AC level. The forecast is being performed by using weather forecasts and the technical specification of the plant, as entered by the user.

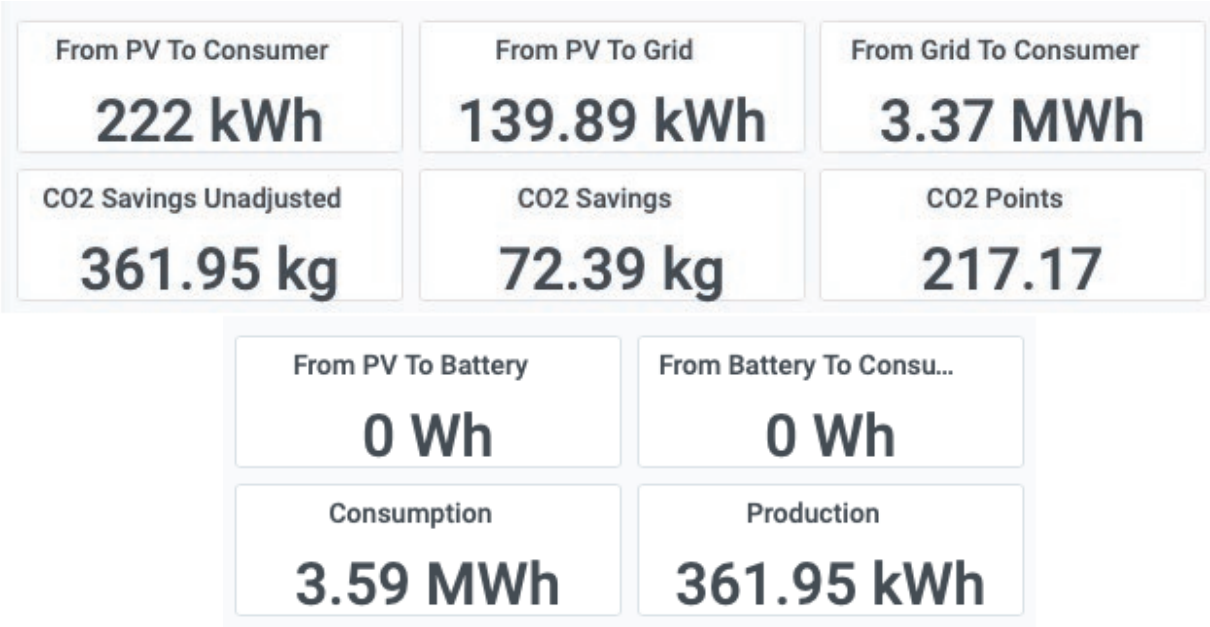






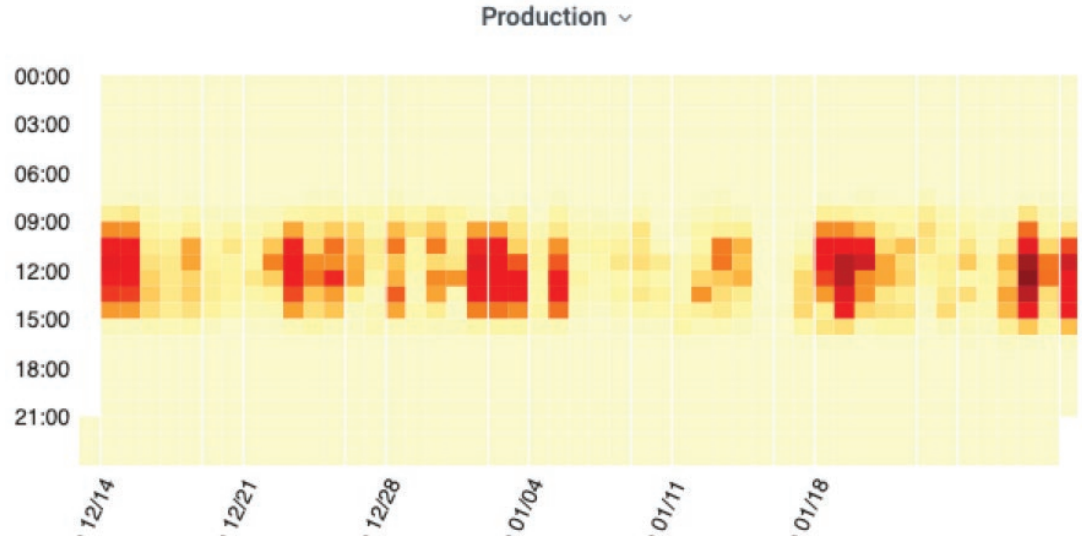
Summary for a customizable period

The inverter efficiency graph shows the DC/AC conversion efficiency for each inverter. The total average and the daily averages are being shown on these graphs. It can be used to detect days where an inverter has operated less than the nominal value, which can be a sign of a defect or a malfunction.



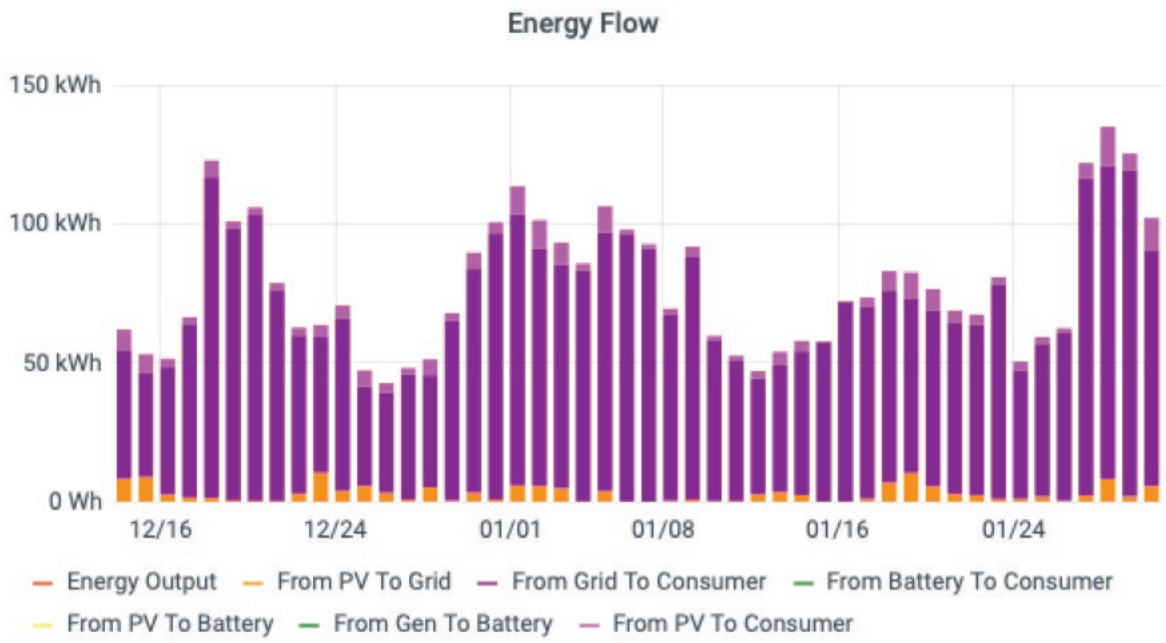
Energy production heatmap

The heatmap of energy production is useful for easy observability of a longer period. The hours with the most energy produced are being shown in a darker color. Each vertical column on the graph is one day, and each horizontal line is an hour of the day. A pixel in the heatmap is the amount of produced electricity in the specific hour and day.



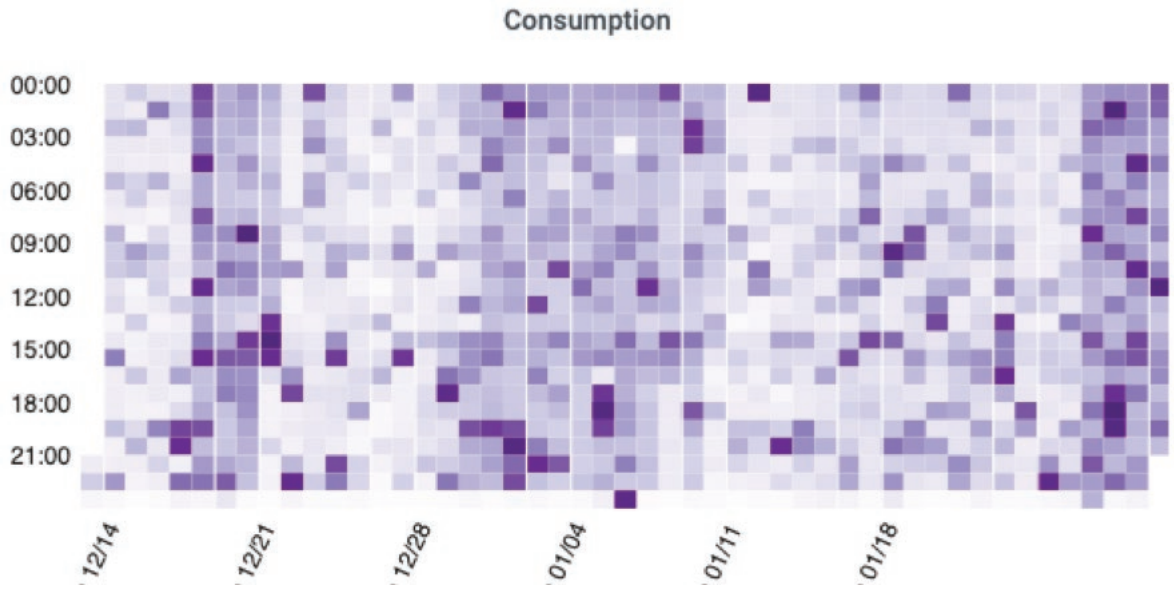
Daily summary of energy flow

The daily summary of energy flow, is showing a sum of all the metrics for each day. This is useful for detection of patterns and comparison of the different energy paths in the system.



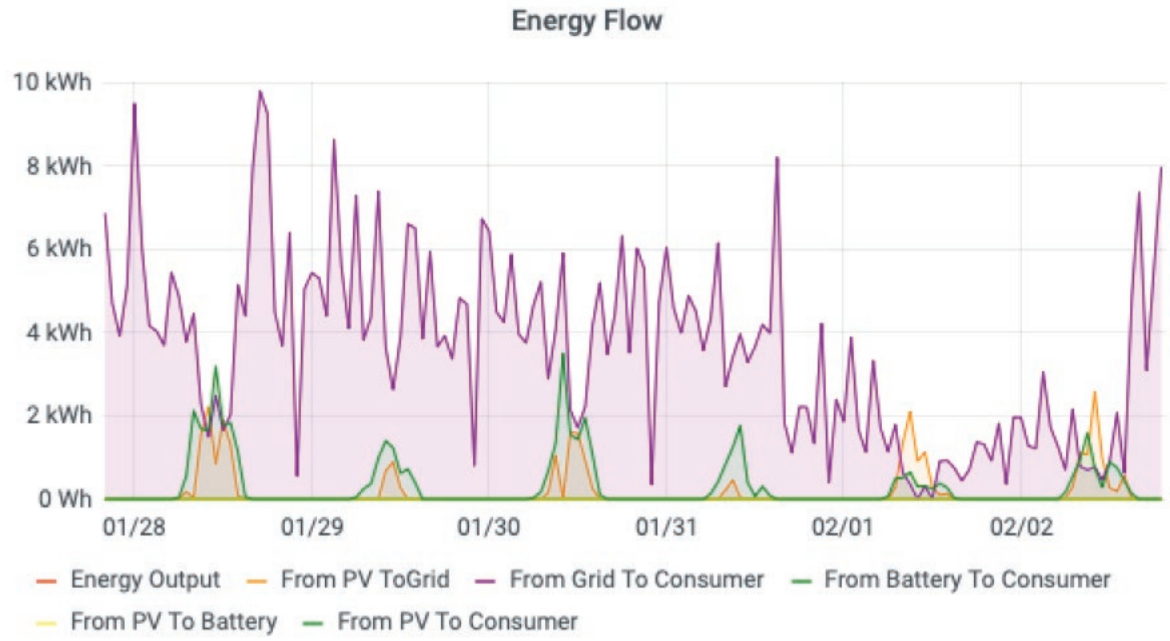
Consumption heatmap

The heatmap of energy consumption is useful for easy observability of a longer period. The hours with the most energy consumed are being shown in a darker color. Each vertical column on the graph is one day, and each horizontal line is an hour of the day. A pixel in the heatmap is the amount of consumed electricity in the specific hour and day



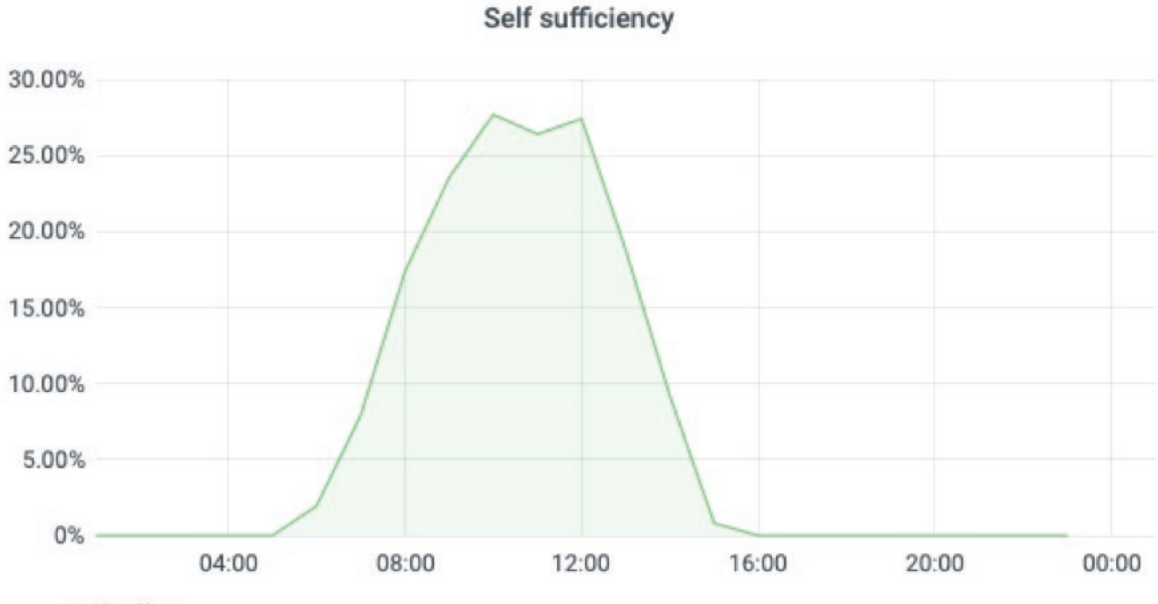
Detailed hourly energy flow

Detailed view of the hourly energy flow in each energy path, as a line chart that can be utilized to view peaks.



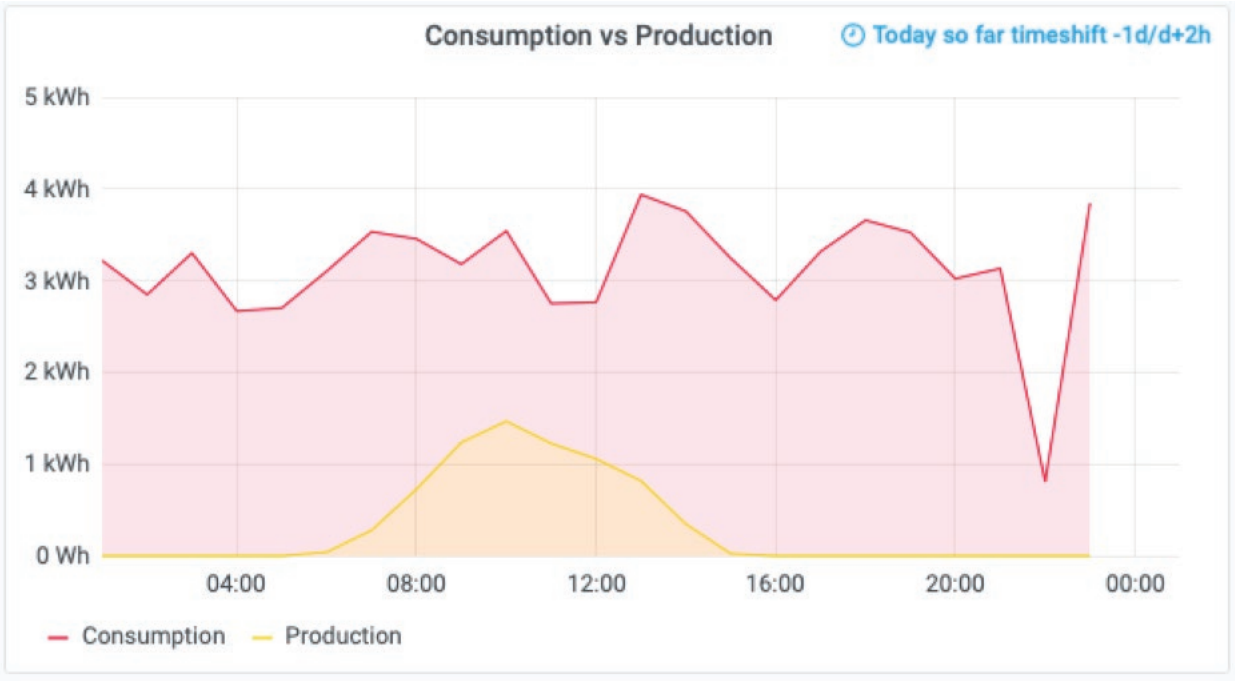
Daily self-sufficiency on hourly basis

Self-sufficiency refers to how much of the consumed energy came from the photovoltaic system. It is a ration between self-consumed produced energy of the system and the total consumed energy. It is an important metric in the case where the energy consumption is higher than the actual production of the system (or when the consumption curve does not match the production curve).



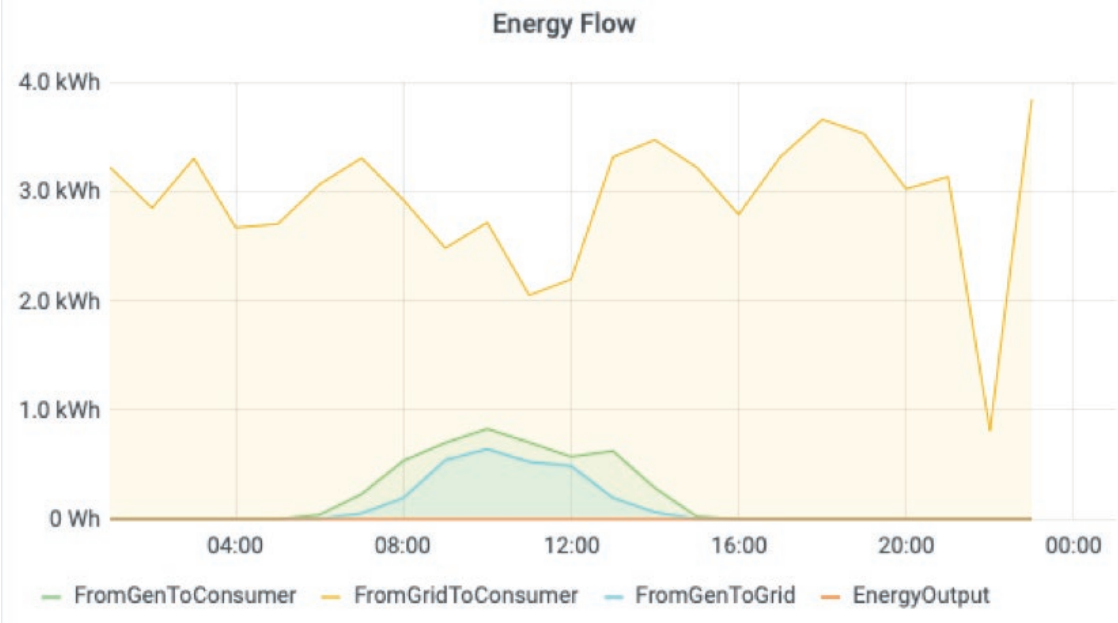
Daily production and consumption curves on hourly basis

Averaged energy consumption and production curves for each hour of the day, averaged within a given period, customizable by the user. It can be used to detect a daily pattern in the consumption or production of energy.



Daily energy flows on hourly basis

Averaged flow curves for each hour of the day, averaged within a given period, customizable by the user. It can be used to detect a daily pattern in the flow of energy.



Next:

Designing photovoltaic plants with Solar Data Collector and benefits of using our software.

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