

CAPACITY UTILIZATION FACTOR VS PERFORMANCE FACTOR



$$CUF = \frac{\textit{Output}(kWh)}{\textit{Capacity}(kW) \cdot 8760h}$$

$$PR = \frac{\textit{AchievedOutput}(kWh)}{\textit{Theoretical output}(kWh)}$$

PR and CUF

- CUF can be understood as real output of the plant compared to theoretical maximum output of the plant
 - Example: DG with 100kW that runs 12 hour per day:

$$CUF_{DG} = \frac{12h \cdot 100kW \cdot 365d}{100kW \cdot 8760h} = \frac{438000kWh}{876000kWh} = 50\%$$

What is CUF?



- PR can be understood as the comparison of plant output compared to the output the plant could have achieved under certain frameconditions.

Example: Solar PV system

$$PR = \frac{\text{Achieved output}(kWh)}{\text{Theoretical output}(kWh)} = \frac{1400 kWh}{1650 kWh} = 84,8\%$$

What is PR?



- PR takes into account:
 - Irradiation
 - Panel temperature
 - Availability of grid
 - Size of the aperture area
 - Nominal power output
 - Temperature correction values

What is the difference?



- CUF does not really fit to solar-PV because of the time domain
 - Solar-PV systems typically do not work at night
 - Solar irradiation changes during the seasons
 - Plant output depends on temperature, too
- PR fits well to the needs of developers, EPCs and project owners
 - PR can be calculated permanently
 - Takes into account the climate conditions
 - Gives a direct feedback on "what was achieved vs. what could have been achieved" – quality control instrument

Why is PR "better" than CUF?

	CUF	PR
Comparison of different plants independent from external factors (climate, irradiation, grid availability, etc.)	No	Yes
Early Warning System	No	Yes
Clear information on real performance of plant	No	Yes
Indicator on effectiveness of cleaning	No	Yes
Indicator on effectiveness of maintenance	No	Yes
Permanent comparison of performance	No	Yes
No additional cost for HW + SW	Yes	No

Benefits for Developers and Investors



CUF

- Grid availability **doesn't** matter
- Solar irradiation **doesn't** matter
- Temperature of panels **doesn't** matter
- Climate conditions **don't** matter

PR

- Grid availability **does** matter
- Solar irradiation **does** matter
- Temperature of panels **does** matter
- Climate conditions **do** matter

Benefits for EPCs

	CUF	PR
Quality control possible by international standards	No	Yes
Monitoring of external factors (grid!) possible	No	Yes
Limit liability only on factors that are in direct control	No	Yes
Sales argument	No	Yes
Option for aftersales services (cleaning, maintenance, etc.)	No	Yes

Benefits for EPCs



- If you go for PR, almost all external factors are taken into account (grid availability, climate, panel efficiency, inverter efficiency, etc.)
- **Result:** You will not longer be liable for factors you can't control or can't influence.

Benefits for EPCs



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