

EPI application for solar farms under frequent curtailment and reactive power injection

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Introduction

For solar farms, dynamic active power curtailment (DAPC) and dynamic reactive power injection (DRPI) into the grid are two operating conditions that can be requested unexpectedly by the grid operator to maintain the electrical stability of the grid.

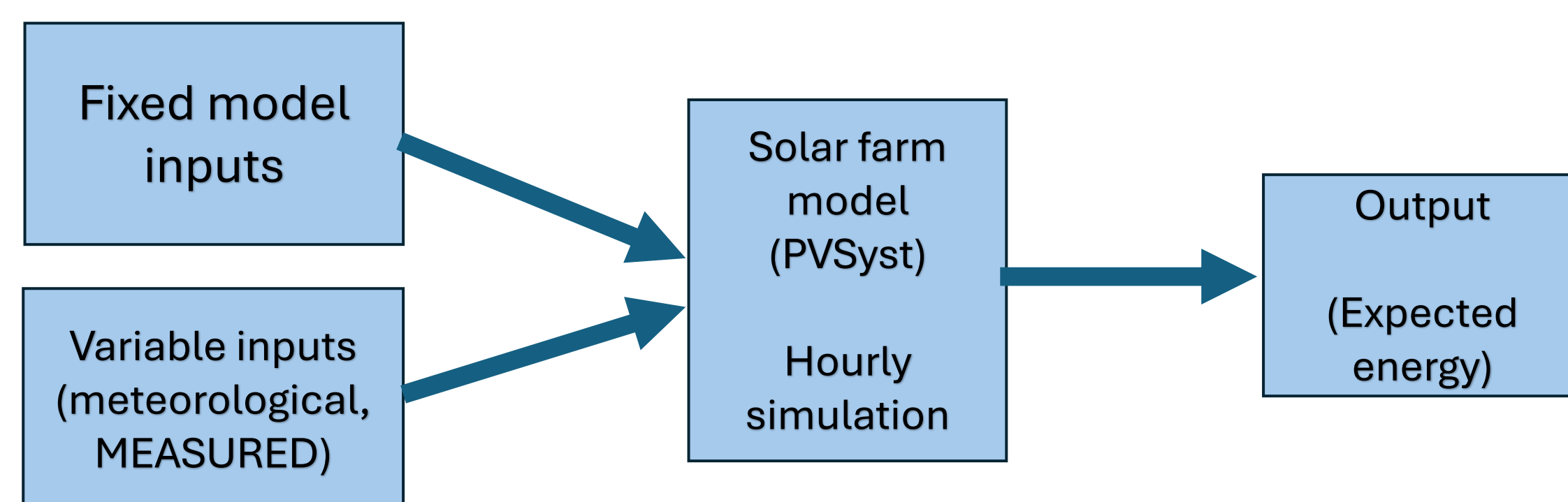
Due to its unpredictability, these operating conditions are commonly underestimated in the simulation model used for establishing the performance ratio (PR) and Energy Performance Index (EPI) goals.

When calculating the actual PR of the farm, this difference between the scenario that was simulated and the actual operational conditions of the farm, with regards to APC and RPI, forces the discard of prolonged periods of time (when DAPC or DRPI are occurring) in order to make the simulation and the real operation comparable.

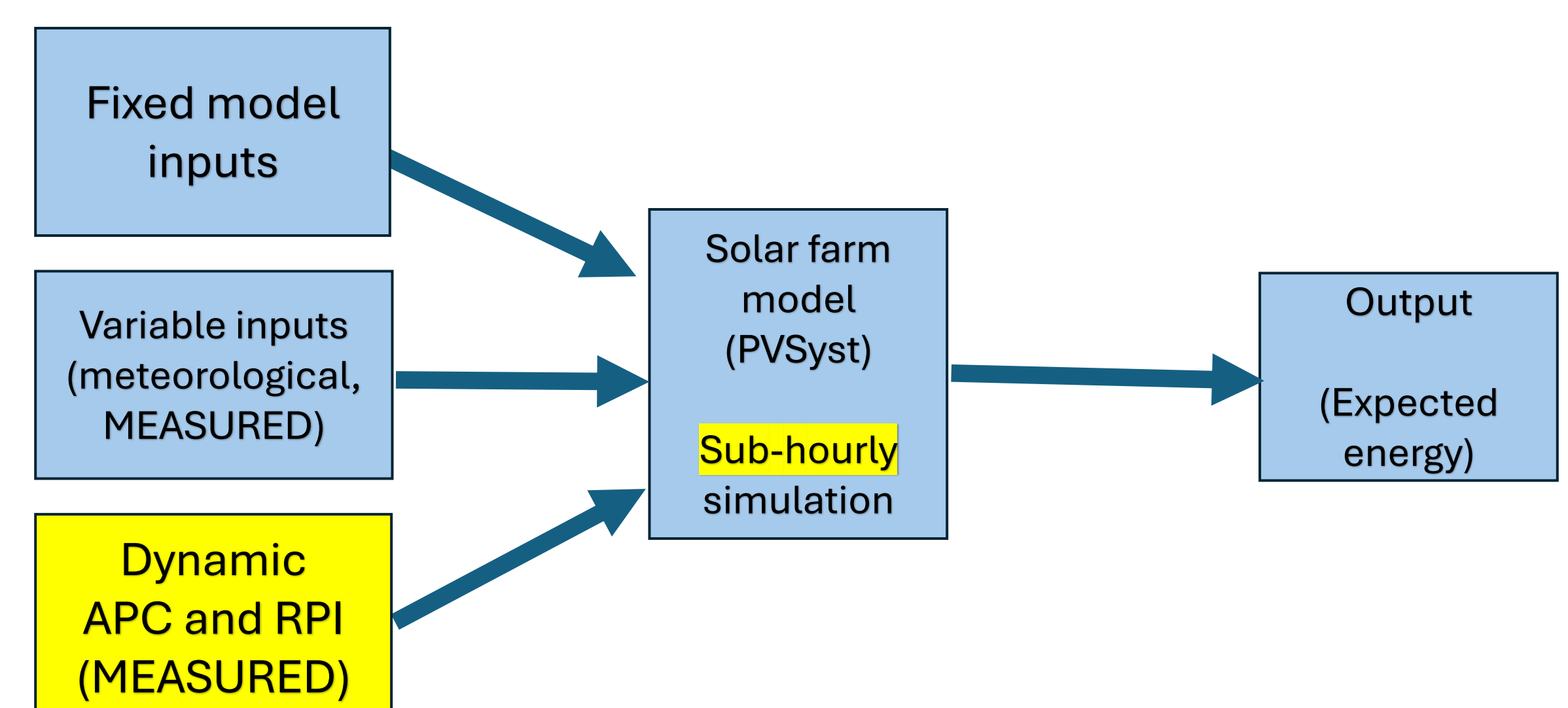
With regards to EPI calculation, the introduction into the simulation model of a dynamic behavior for curtailment and reactive power injection may be challenging, depending on the simulation tool that is being used.

Proposal

Standard EPI: IEC 61724-3: 2016¹



Proposed EPI:



Results

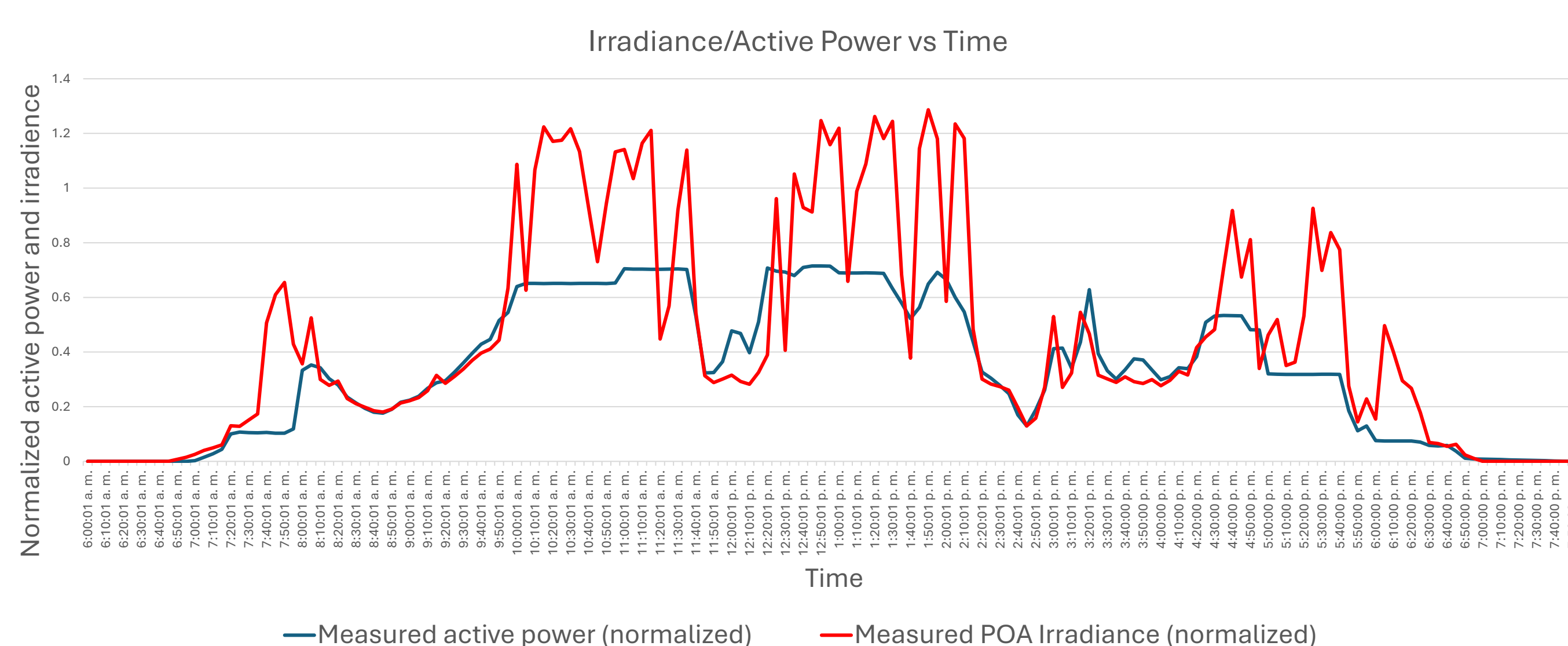


Figure 1: Deep curtailment requested by the grid operator in periods of high irradiance.

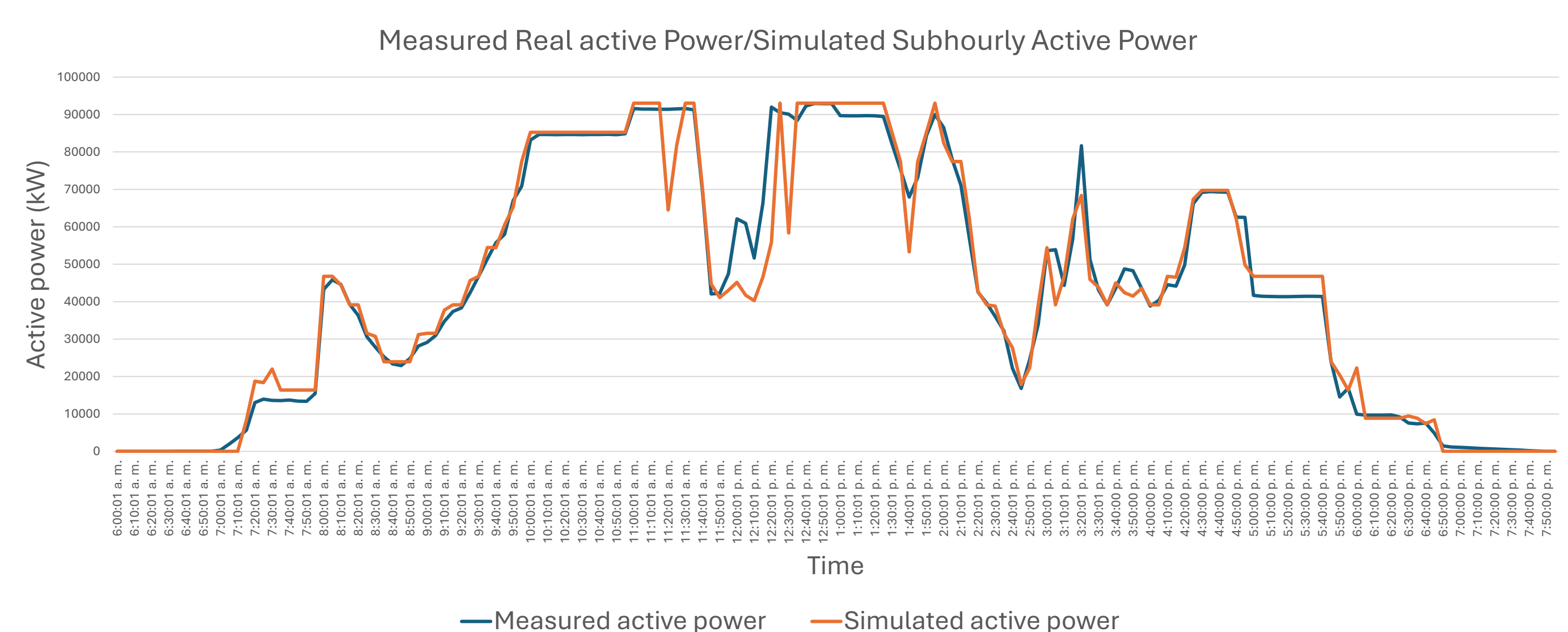


Figure 2: Comparison between the active power measured at POI and the simulation proposed.

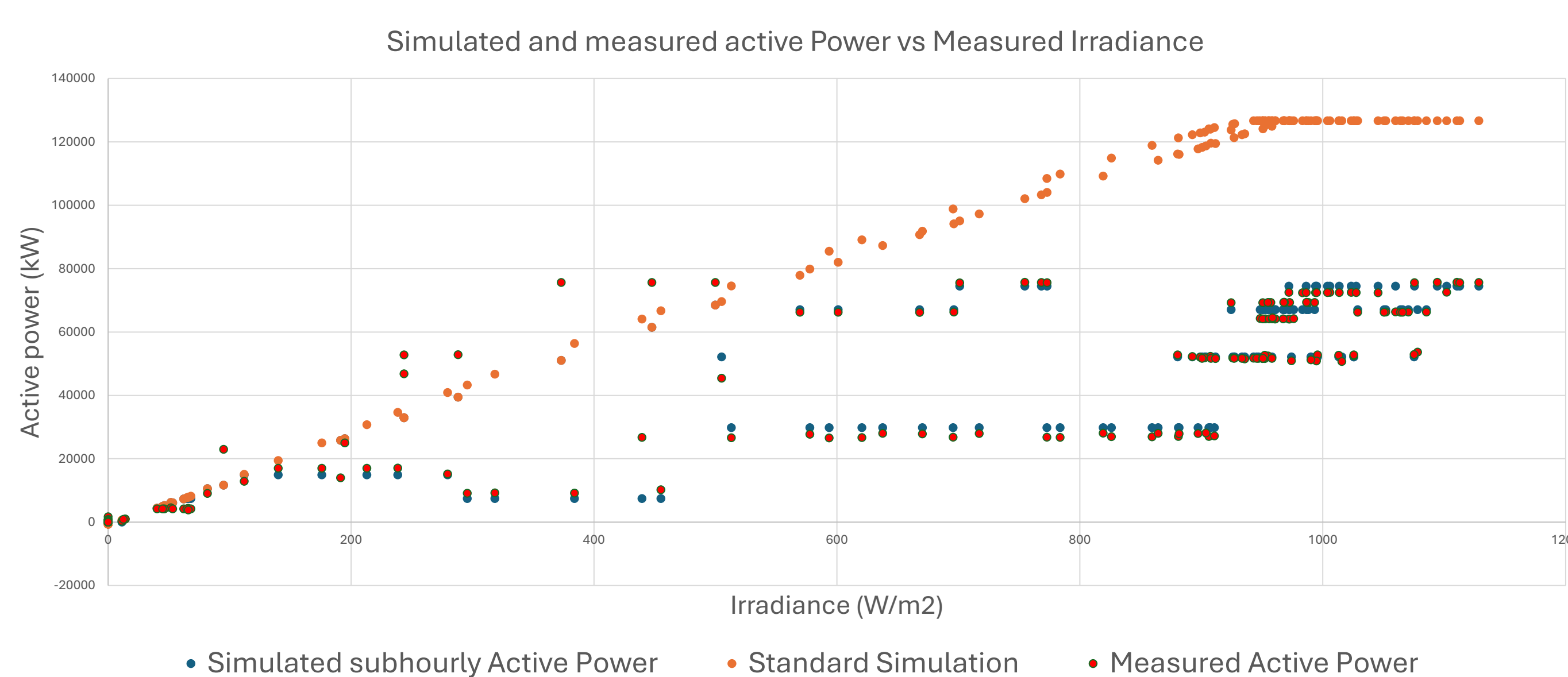


Figure 3: Comparison between the standard EPI calculation, the measured active power and the proposed methodology .

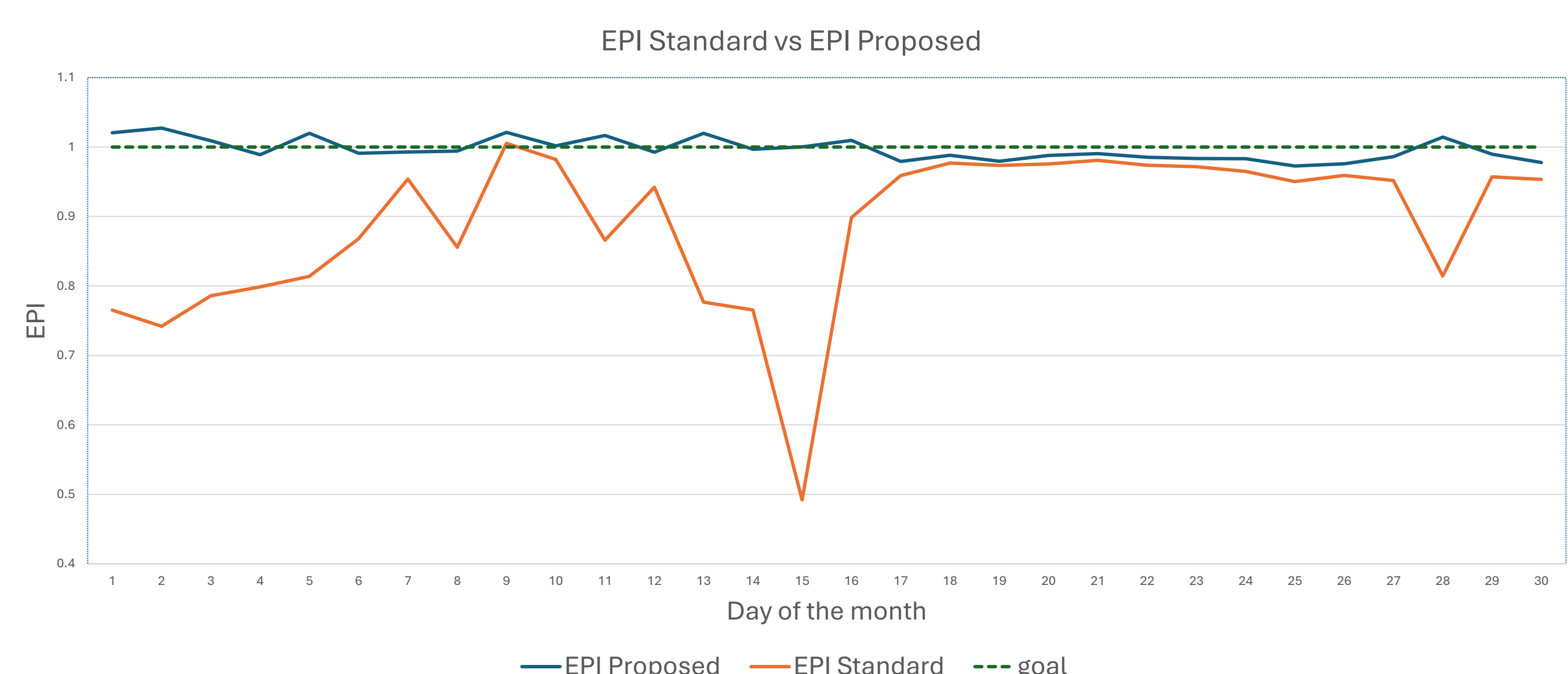


Figure 3: Comparison between the standard EPI calculation and the proposed methodology for a month with high and frequent levels of curtailment.

Conclusions

- 1) The proposed methodology allows the performance evaluation of a solar farm avoiding the discard of prolonged periods of time due to APC and RPI.
- 2) In order to improve the precision of the algorithm, it is necessary to increase the number of curtailment steps, which in turn will increase significantly the simulation time.

Next steps

To include an additional power loss component associated to the module temperature elevation due to the active power curtailment. This temperature depends on the curtailment depth (module efficiency).

References

- 1) International Electrotechnical Commission; IEC Technical Specification 61724-3; 2016.