



Marieke Rynoson

PhD-student at SOLVE & Dalarna University

Doctoral Programme in Energy Systems in the Built Environment



Main Supervisor
Chris Bales



Co-Supervisor
Jingshun (Vicky) Shen



Co-Supervisor
Joakim Munkhammar



Doctoral Programme in Energy Systems in the Built Environments

Energy as a resource in buildings is seen from a life-cycle perspective in the design of energy system solutions that are sustainable in the long term.

In the subject, emphasis is on energy technology installations located in the built environment, which includes solar energy installations.

*Image: Borlänge Nya Campus,
Archus arkitekter*

Ongoing research topic

Modeling of (BI)PV

Verification of IDA ICE 5 PV simulation & comparison to industry standard PV design tools

- Industry standard tools (eg PVsyst, PVsol, Polysun) do not cover building-PV interaction well
- With measured data from RISE module temperature and power output)
- Initial results promising

Research question:

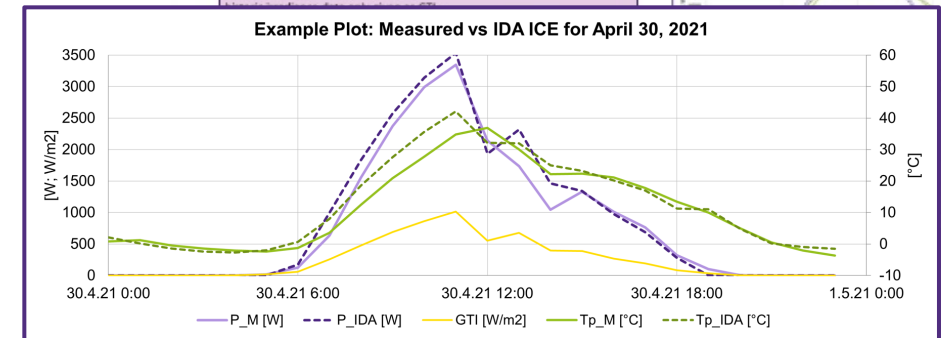
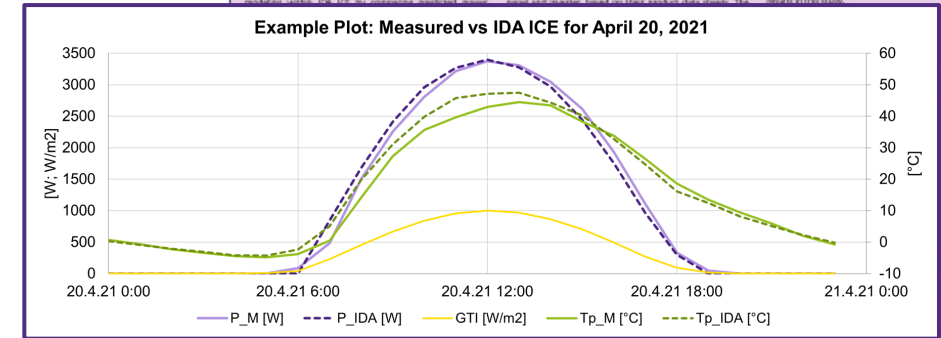
Can IDA ICE accurately replicate the performance of real-world PV installations across a diverse range of system configurations in Sweden?

PV MODELING IN IDA ICE (5.0 BETA) PERFORMANCE ANALYSIS BASED ON MEASURED DATA IN HIGH LATITUDES



Andreas Ryman, Christer Ryman, Stefan Thorsen
Department of Energy, School of Information and Engineering, Falun, SE-791 88
*Corresponding author: ryan.phd@du.se, +46 23 77 86 47

ABSTRACT
In recent years, the widespread adoption of photovoltaic (PV) installations across various sectors has created a growing demand for accurate PV design tools. In this regard, the latest version of IDA Indoor Climate and Energy (IDA ICE 5 beta) emerges as a candidate, offering advanced PV modeling capabilities. This study evaluates the accuracy of PV modeling within IDA ICE 5 by comparing simulated results with measured weather and radiation data. As the measured radiation data is only available as total radiation on a tilted plane, it was decomposed into direct and diffuse components on the horizontal plane using a modified version of the model by Eppes et al. Additional input parameters are the geometry of the PV array, and the characteristics of PV modules and inverters based on their module data sheets. The calculated power output is compared to the measured power output and analyzed through ASHRAE 14-2014 guidelines for performance evaluation. It was found that the software gives an accurate prediction of both panel temperature and PV power production. A study on shading effects is an open problem to improve the generality of the results in this study.



	C	B	A
Requirement (ASHRAE 14-2014)	± 10	30	30
Panel Temperature	MBE [%]	CV	RMSE [%]
A	0.4	16.6	
B	-0.0	26.3	
C	-0.0	25.5	
Requirement (ASHRAE 14-2014)	± 10	30	

ACKNOWLEDGEMENT
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Image: Stuguns nya kyrka;
Ellenor Ågevall, Vision.se

Ongoing research topic

PV & Churches

Research question:

“How do **PV panels** change the **perceived heritage value** – economic, environmental, social – of a church as a specific type of heritage building?”

Method: Qualitative interview study with t.ex. Antiquarians

Planned research topic

Modeling of (BI)PV

Modeling of colored PV

- Based on measured data

Preliminary research question:

How do different types of PV coloring technologies perform at different tilt angles and how can this be implemented in PV design softwares?

*Image: RISE (Borås) with
Kromatix PV panels*



Planned research topic

Perception of BIPV

BIPV is not just integrated into a building, it is also integrated into people's visual environment and daily life.

Which types of (BI)PV are deemed the most desirable?

Preliminary research question:

Which design strategies can be employed to **enhance public acceptance** and appreciation of PV installations in the urban environment?

Image: Architektur trifft Klimaschutz: Solar Decathlon zeigt Städte der Zukunft - blickfeld - Die CampusZeitung für Wuppertal (blickfeld-wuppertal.de)

