Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Innosuisse – Swiss Innovation Agency

ACCURATE HYBRID MACHINE LEARNING MODEL FOR LOCAL PV ENERGY YIELD PREDICTION

Prof. Dr. H. Heck, PD Dr. E. Schüpbach, Prof. U. Muntwyler

Bern University of Applied Sciences BFH

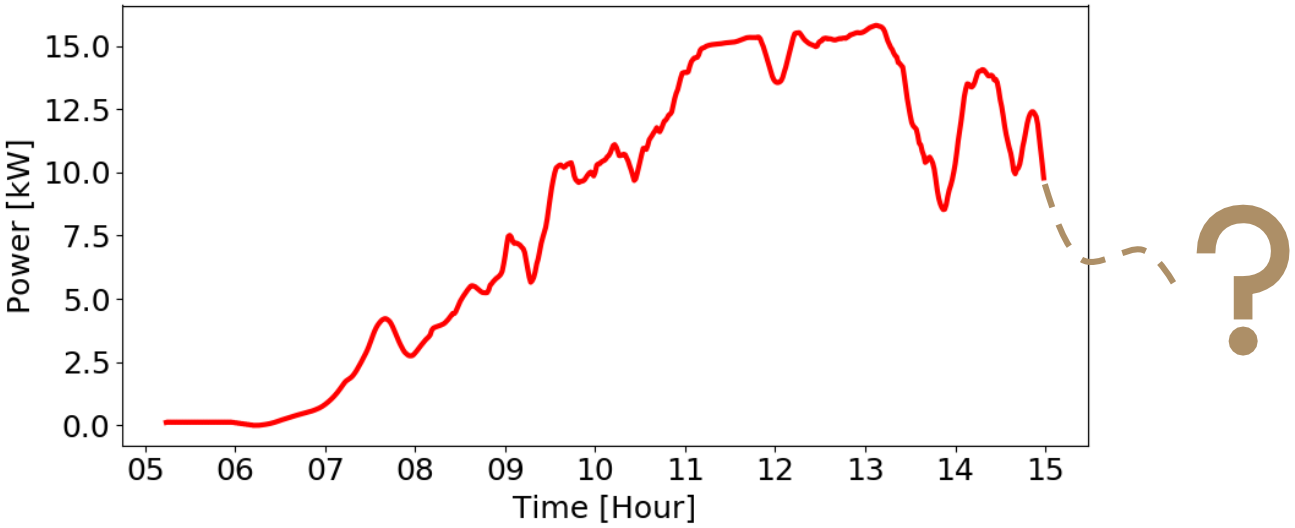
Burgdorf, Switzerland

2020 SCCER-FURIES Annual Conference

28 October 2020, Virtual

Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

PV Energy Yield Predictions – Why?



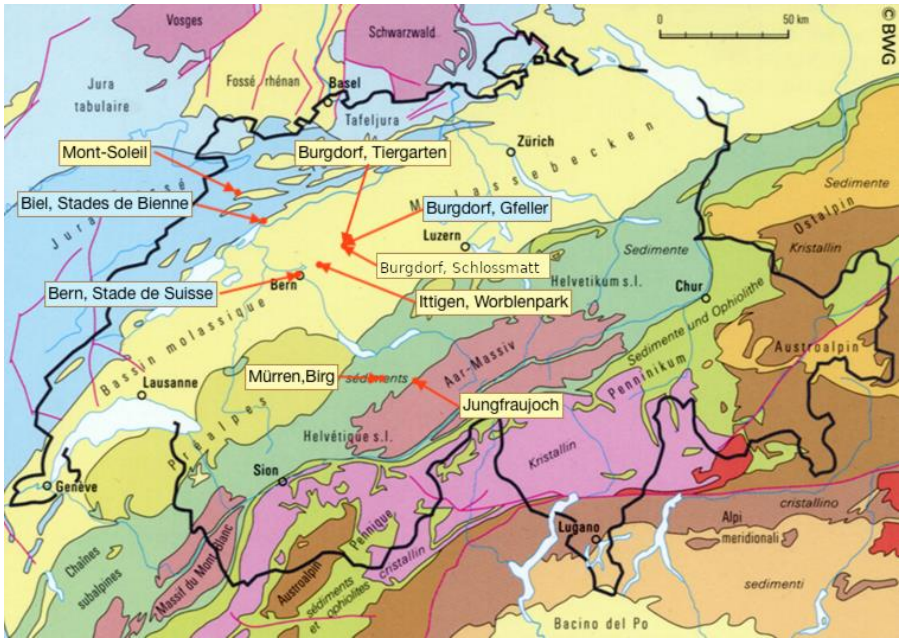
Aim: Enhance own production / consumption (esp. in winter)

➥ **higher and more stable profit for owners of PV installations**

Gain: Contributes to grid stability

Data Driven Approach for Machine Learning

1. Data



Source: BWG (Bundesamt für Wasser und Geologie)

AC-power

- 6 Swiss PV plants (3 urban, 3 alpine)
- 4 years (6/2016-6/2020)

Weather forecasts

- 6 months (1/2020-6/2020) (MeteoSuisse and Meteoblue)
- Global Horizontal Irradiation (GHI)
- Temperature, wind, humidity, pressure

2. Method

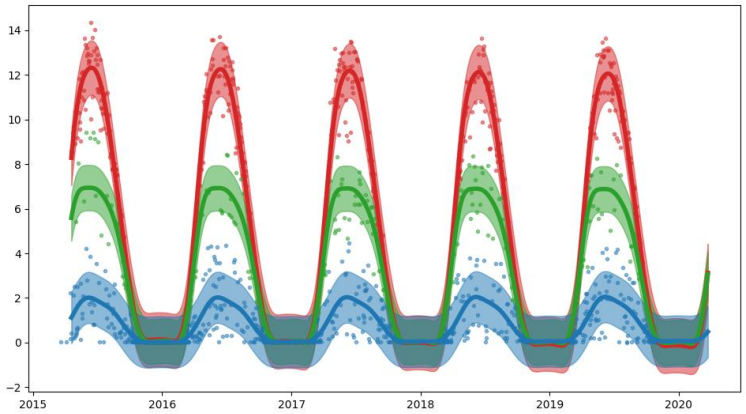
Step 1: Gauss Process model → basic behaviour of the PV plant

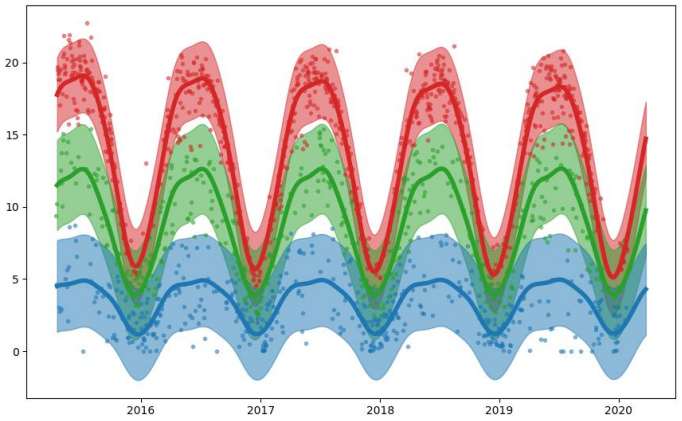
Step 2: Neural Network → adapts Gauss process according to weather condition

Input: Gauss Process model output and weather forecasts

Schematics of Method (2-Step Approach)

Step 1: Gauss Process per hour



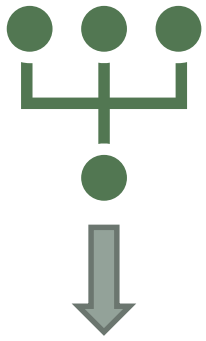


6:00 h

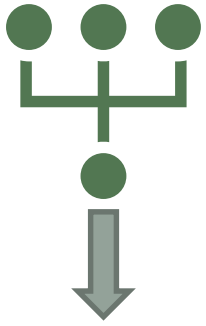
12:00 h

Step 2: Neural Network

Step 2: Neural Network



Weather forecast

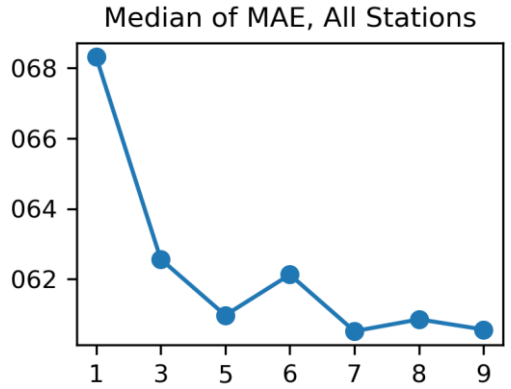


AC power prediction for 6:00

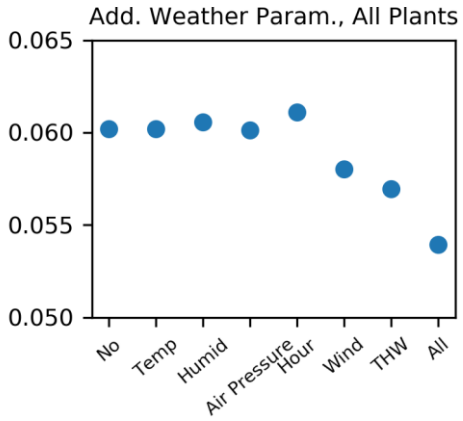
AC power prediction for 12:00

Results - Yield Predictions for 6 Swiss PV Plants

More than one GHI value per prediction



Additional weather parameters



Prediction precision increases > 30% with additional weather parameters

Plant	First Try	Optim.	Diff.	Increase %
Burgdorf Tiergarten	0.0662	0.0486	0.0176	36 %
Mont Soleil	0.0700	0.0513	0.0187	36 %
Worblenpark	0.0666	0.0456	0.0210	46 %
Jungfraujoch	0.0717	0.0535	0.0182	34 %
Birg	0.0807	0.0573	0.0234	41 %
Burgdorf, Schlossm.	0.0617	0.0472	0.0145	31 %

H. Heck, E. Schüpbach, U. Muntwyler, 2020, Proceed. EU PVSEC, 7-11 September 2020, pp. 1796-1801

SCCER – FURIES
Shaping the FUtuRe SwIss Electrical InfraStructure

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Innosuisse – Swiss Innovation Agency

THANK YOU VERY MUCH FOR YOUR ATTENTION!

Contact: horst.heck@bfh.ch

Acknowledgements

This research is part of the activities of the Swiss Centre for Competence in Energy Research on the Future Swiss Electrical Infrastructure (SCCER-FURIES), which is financially supported by the Swiss Innovation Agency (Innosuisse - SCCER program). Co-financing from Bern University of Applied Sciences (BFH) is gratefully acknowledged

Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

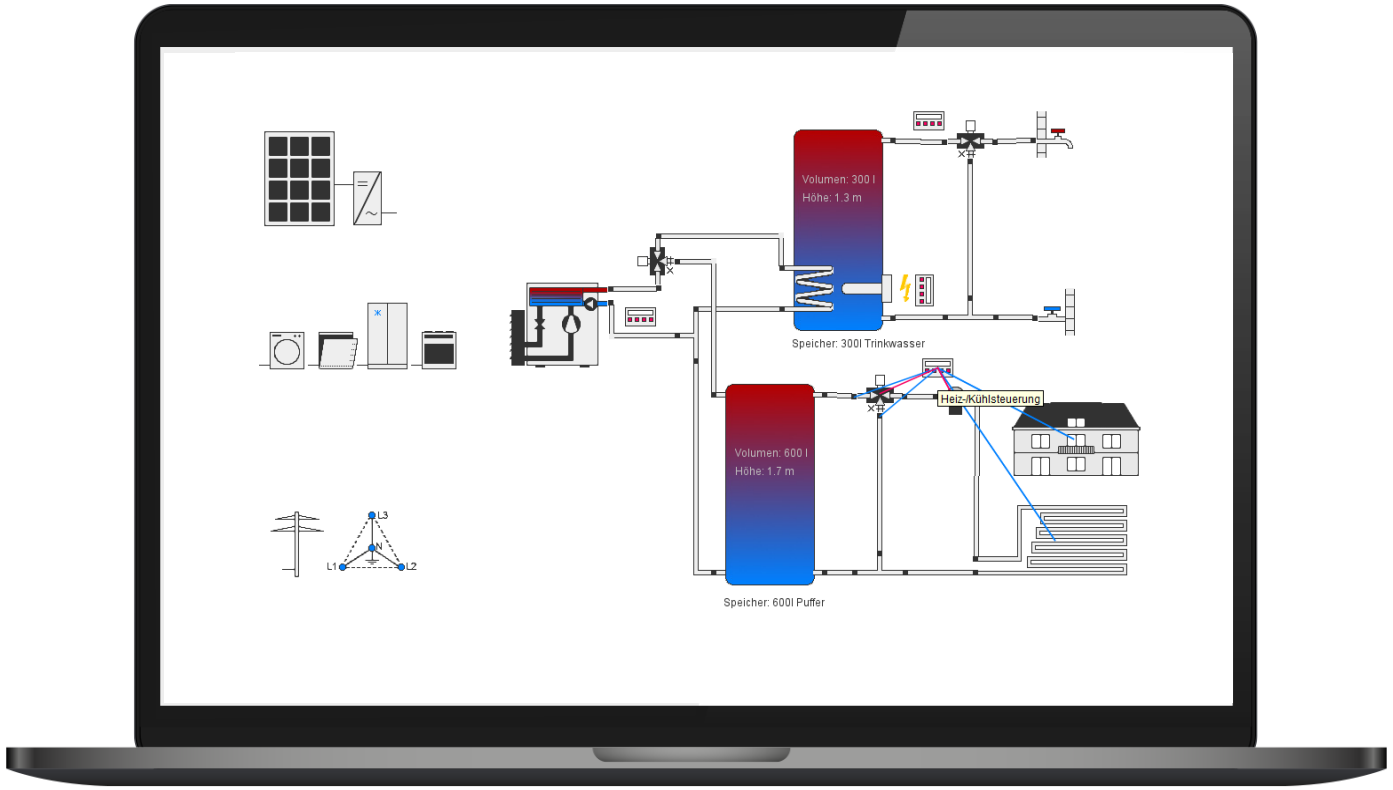
POLYSUN®
BY VELA SOLARIS

WHAT IS THE ADDED VALUE OF SIMULATING ENERGY SYSTEMS?

Angela Krainer, Managing Director Vela Solaris AG, Winterthur
angela.krainer@velasolaris.com

VELA SOLARIS – PORTRAIT

POLYSUN®
BY VELA SOLARIS



Competence Center for energy system simulation

- Spin-off of the Institut für Solartechnik (SPF), HSR Rapperswil (CH) in 2006
- Development and sales of the energy system simulation software Polysun and associated services for commercial use as well as education and R&D
- Dynamic and coupled simulation of all technologies (power, heating/cooling, mobility)

THE SIMULATION OF ENERGY SYSTEMS BENEFITS THE WHOLE LIFECYCLE

POLYSUN®
BY VELA SOLARIS

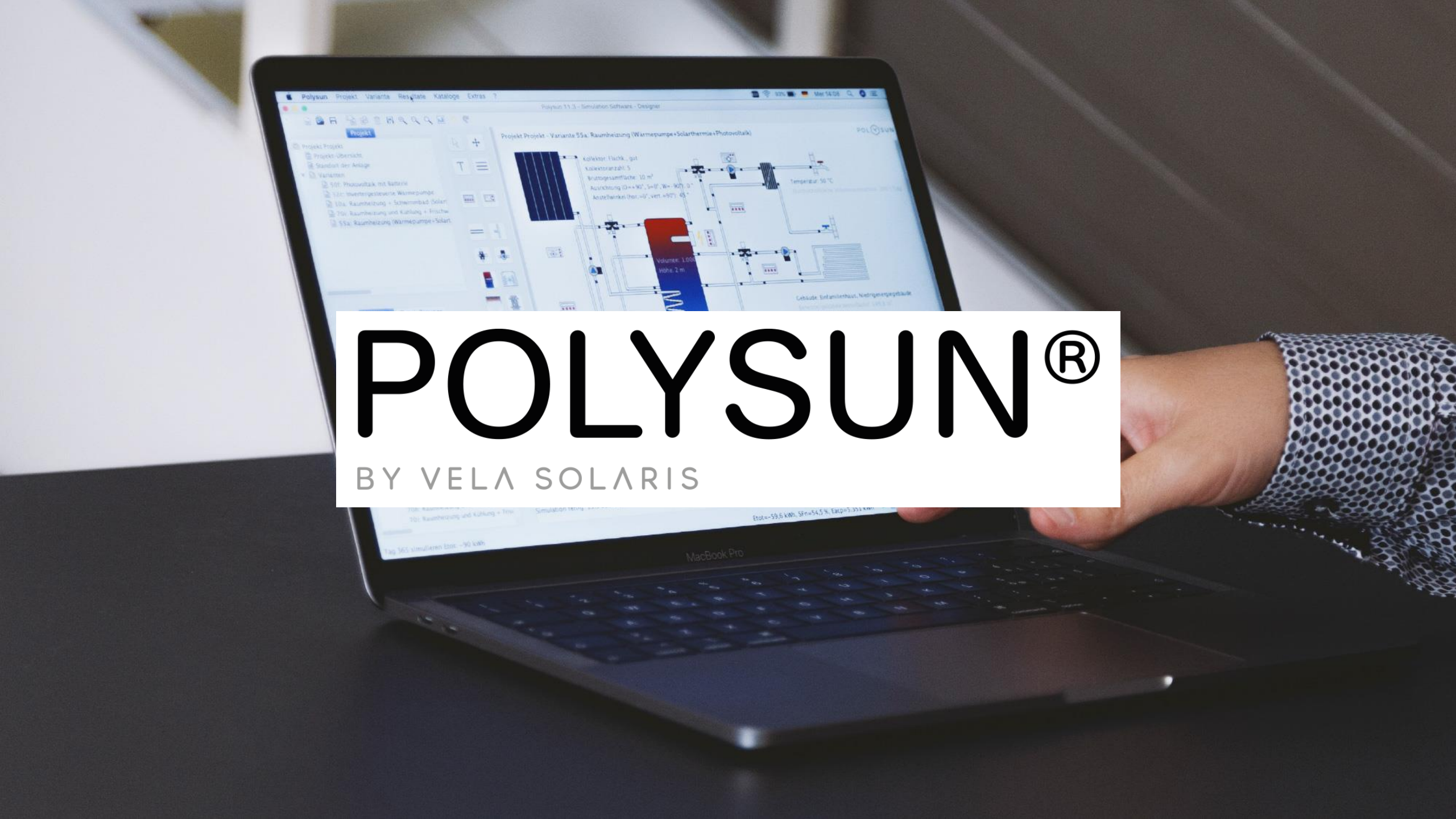
Feasibility	Planning	Construction	Operation
Simulation ist used to **quickly compare different energy systems** with regards to energy-efficiency and profitability and **choose the best option**	Simulation ist used to **optimise defined energy systems** (e.g. number/type/layout of PV-modules) and **adapt to changes in planning at the lowest cost**	Simulation results are used to **perform construction according to plan, and quickly identify performance gaps**	Simulation ist used to **optimise the operation of the energy system**, e.g. with regards to self consumption or real-time power prices

simulation reduces the performance gap in BIM projects

EXPECTED RESULTS OF COLLABORATION WITH BFH / SCCER-FURIES

POLYSUN®
BY VELA SOLARIS

- ✓ Gain insight into the **accuracy of machine learning** models to predict PV energy yield and **compare with physical simulation**.
- ✓ **Improve physical simulation** of Polysun software with regards to PV system losses (e.g. soiling, snow, degradation).
- ✓ Evaluate the business potential to combine long-term simulation of PV yield currently used in Polysun (e.g. **next 30 years) with short-term prediction (next day), to identify perfomance gaps.**


POLYSUN®
BY VELA SOLARIS