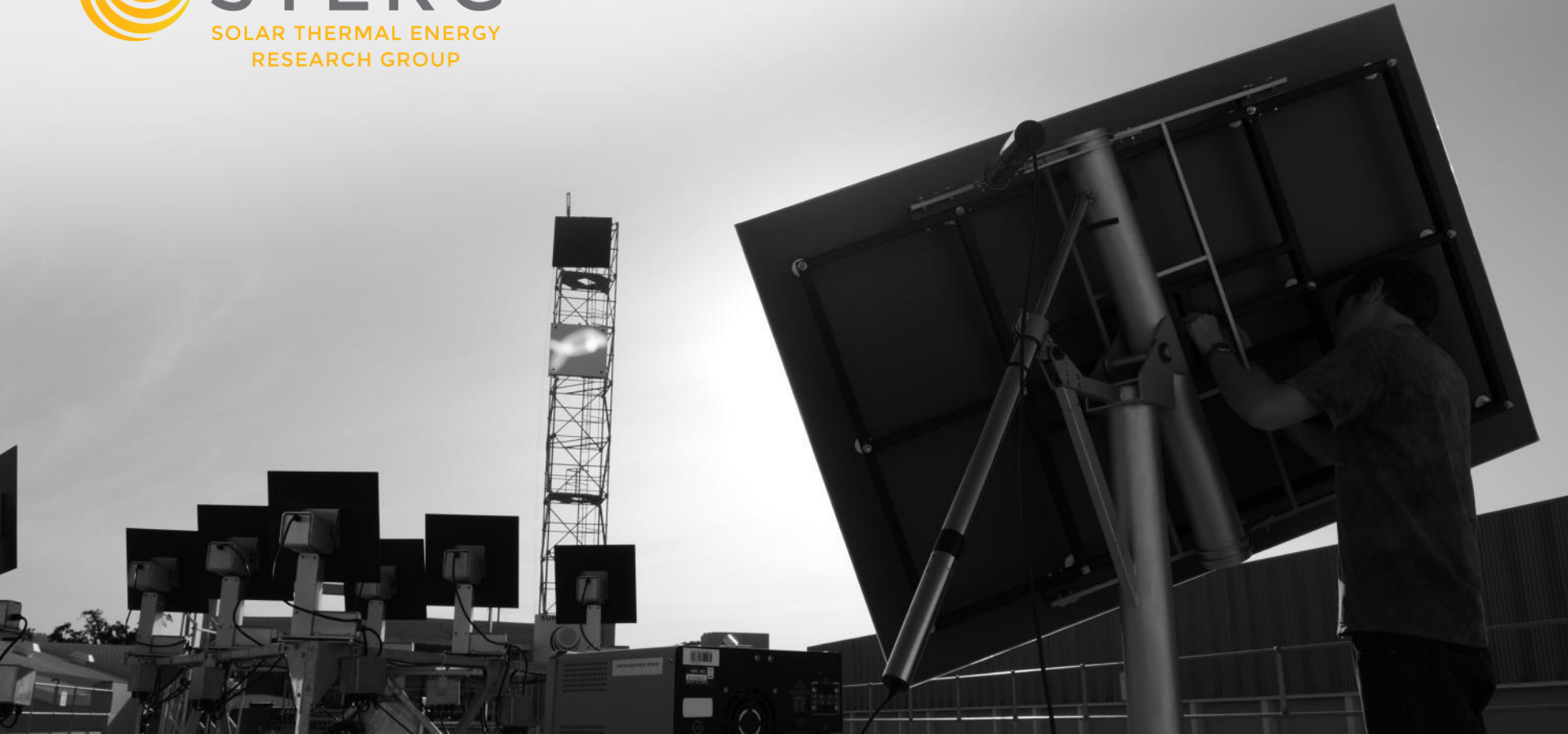




STERG

SOLAR THERMAL ENERGY
RESEARCH GROUP



Modeling of Solar Process Heat Systems in an Open Source Simulation Environment

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Excel-Tool “SolGain”



Justification and Aims of the Thesis

- Existing tools are complex and costly
- Calculation Tool in Excel using VBA
- Free to use, open code
- User friendly and straightforward, self explanatory handling
- Clear tabulated, graphical and precise enough results

Excel-Tool “SolGain”



User Input

- Weather data (G_d , G_b , T_a) hourly average for one year
- Location data (latitude, space limitations)
- Process data (T_{in} , T_{out} , \dot{M} , \dot{Q} , *Load Profile*)

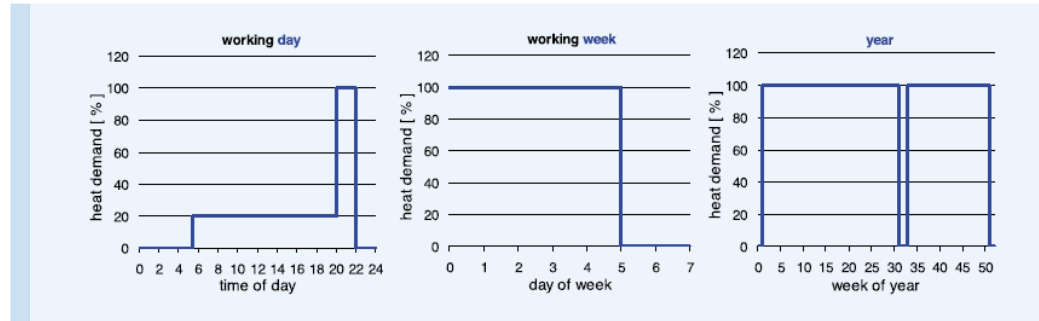


Fig. 6: Example for the discontinuous load profile of the hot water demand for cleaning of production equipment in a smaller company (two shifts)

Source: S. Heß, A. Oliva: *SO-PRO – Solar Process Heat*

Optional Inputs

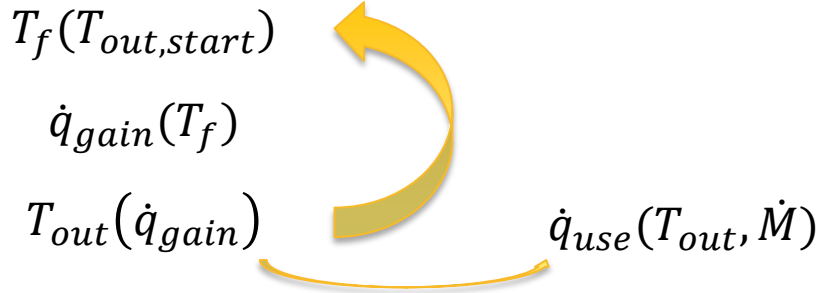
- Collector Data
- Calculation Parameters

Excel-Tool “SolGain”



Calculation Steps

- Determine the sun position, angles, G_{bt} and G_{dt}
- Calculate IAM's (Incident Angle Modifiers) $K_b(\theta_t, \theta_l)$, K_d
- Calculate T_{out} , \dot{q}_{gain} and \dot{q}_{use}



Further Steps

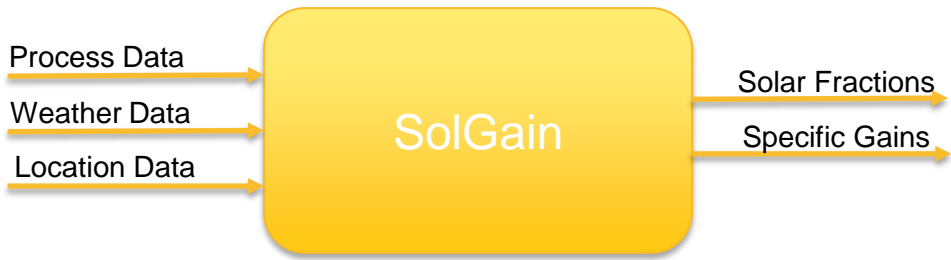
- Calculate system losses
- Include a heat storage
- Model integration points

Excel-Tool “SolGain”



Overview

- Flow picture of the tool



- Example for a userform



Data Entry

Location	Latitude	Hemisphere
Durban	29,88 °	S

If the Tilt or the Orientation is Fixed then it is enough to fill in the Smallest Tilt/Orientation AM field.

The Tilt angle is 0° for a horizontal plate and 90° for a vertical plate.

Tilt	Smallest Tilt	Biggest Tilt
Fixed	30 °	

The Orientation angle is 0° for a plate facing the equator at an angle of 90°. It is negativ for plates facing east and positive for plates facing west.

Orientation	Orientation AM	Orientation PM
Fixed	0 °	

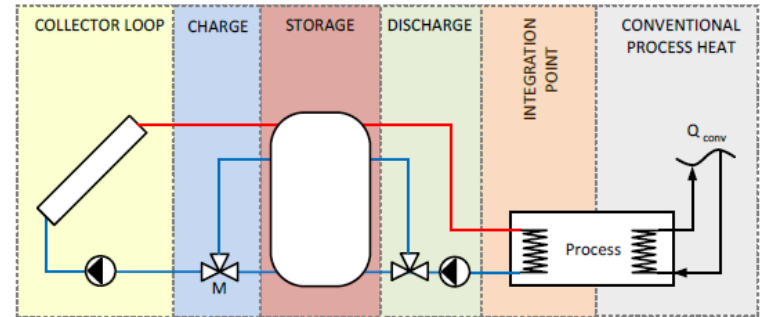
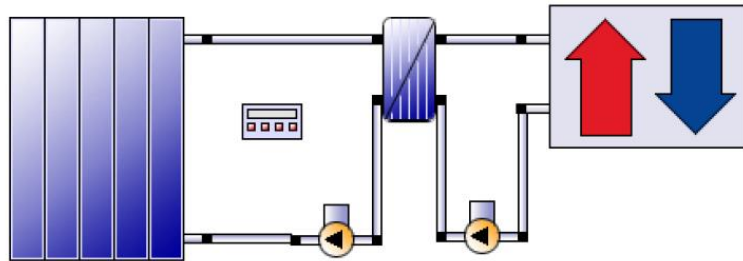
Continue

Excel-Tool “SolGain”



Evaluation

- Compare results to other simulation tools (Polysun, TRNSYS, T*Sol)
- Start with simple systems
- Test the limits



Source: Muster B., Hassine, I. B., Helmke A., Hess S., Krumpenbacher P., Schmitt B., Schnitzer H. (2015). *Integration Guideline - Guideline for solar planners, energy consultants and process engineers.*

Thank you

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