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Solar Cooling Simulation for Planning and Optimization

Polysun Simulation Software

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Objective

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- Introduction
- Planning Methodology:
  - System dimensioning → *Power* levels
  - Efficiency & Financials → *Energy* consumption
- Examples:
  - Solar Cooling with PV-System
  - Solar Cooling with Heat Assisted Chillers
- Building model
- Conclusion

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Introduction I

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Vela Solaris

- Founded in December 2006 as a Spin-Off from the Technical University Rapperswil
- 10 People in Winterthur, Switzerland. World-wide Online-Marketing activities and partner network
- Activities in innovation and research projects

vela solaris

SPF Solartechnik Prüfung Forschung

NERCRE

- Chinese National Engineering Research Center for Renewable Energy, Beijing (Founded in 1992)
- Alliance to Sunpu (China/World) and Sunda (EU)
- Solar thermal and PV expertise
- Research and commercial
- Polysun distribution partner since 2007

NERCRE 国家新能源工程技术研究中心

sunp 桑普

SUNDA

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Introduction II

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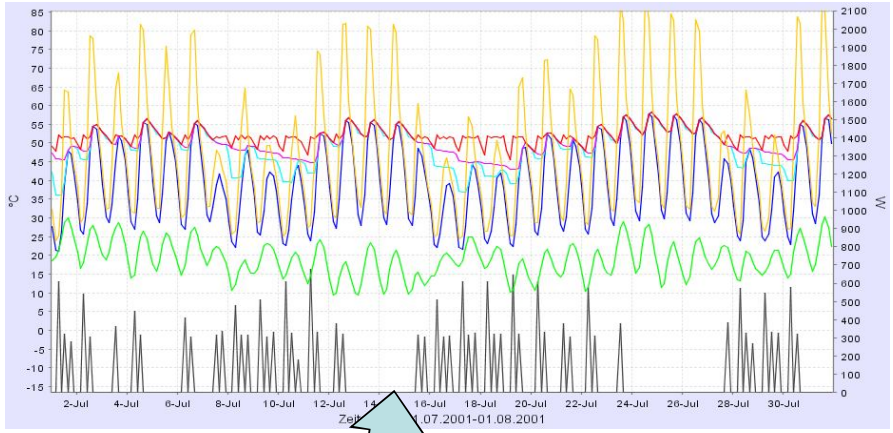
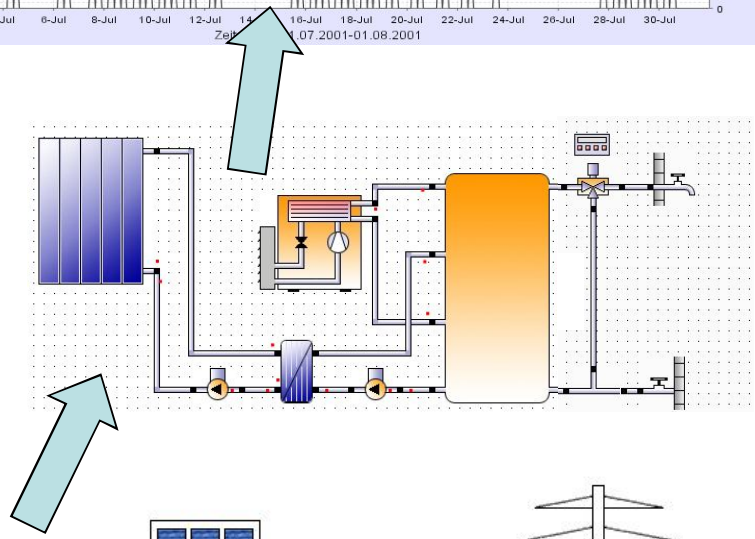
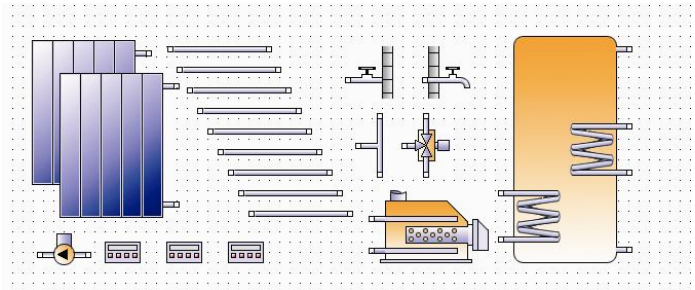
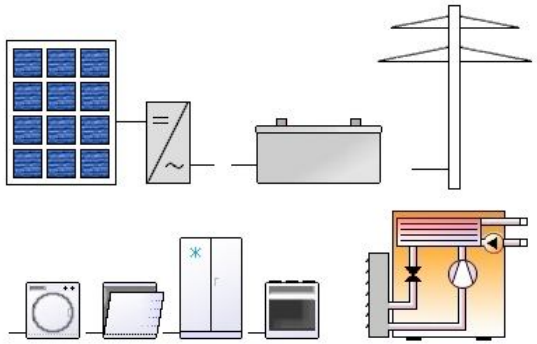
Planning Tool Polysun

- Draw your system with Components from Database
- World-wide Weather data included (Meteonorm®)
- Simulate with a variable time step (Δt ~ seconds, if necessary)
- Software license 3300 EUR
- Runs on Win & Mac
- Simplified version on www.polysunonline.com









swiss made software

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Polysun user friendliness

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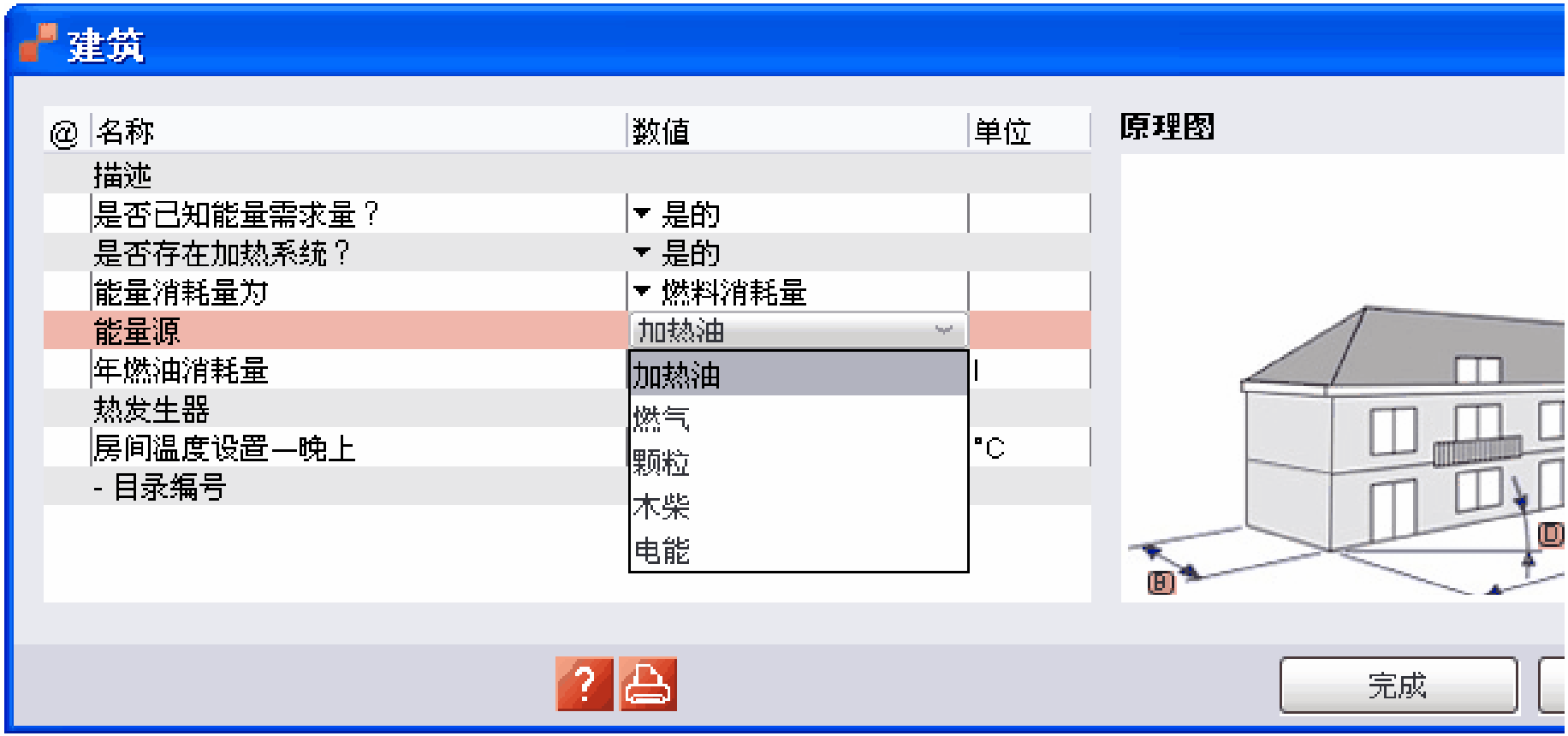
- 15 languages including Chinese

- Wizard
- Templates
- Stable numerics



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Planning Methodology

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- System dimensioning → **Choice of the machine**
  - Traditional dimensioning methodology: make the system big enough for the hardest time in the year
  - Make sure the *Power* levels match
- Further optimization → **Control strategy**
  - Efficiency: Minimize energy consumption over the year
  - Self-consumption: Production and consumption have to match during the day
  - Financial: Consider variable energy prices

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Solar Cooling with Sorption Chiller

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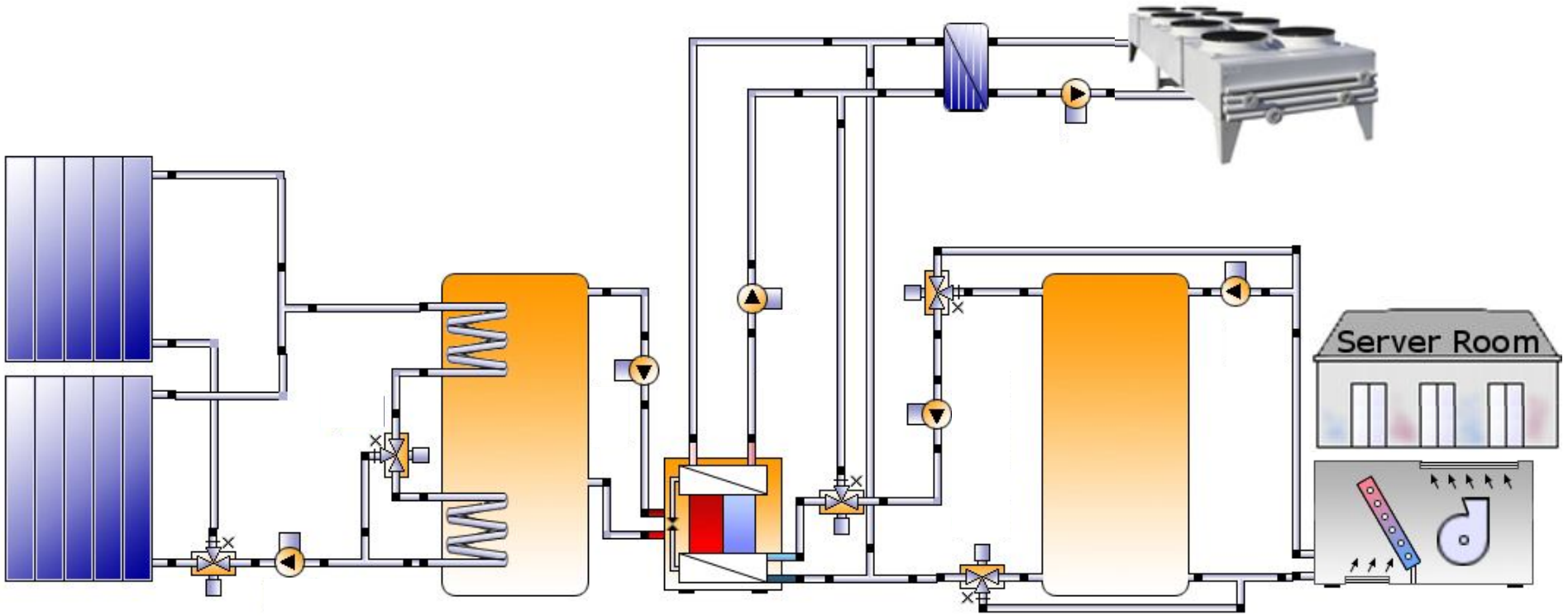
- Server room cooling application
- Storage Tank on the hot side *and on the cool side*



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Solar Cooling with Sorption Chiller

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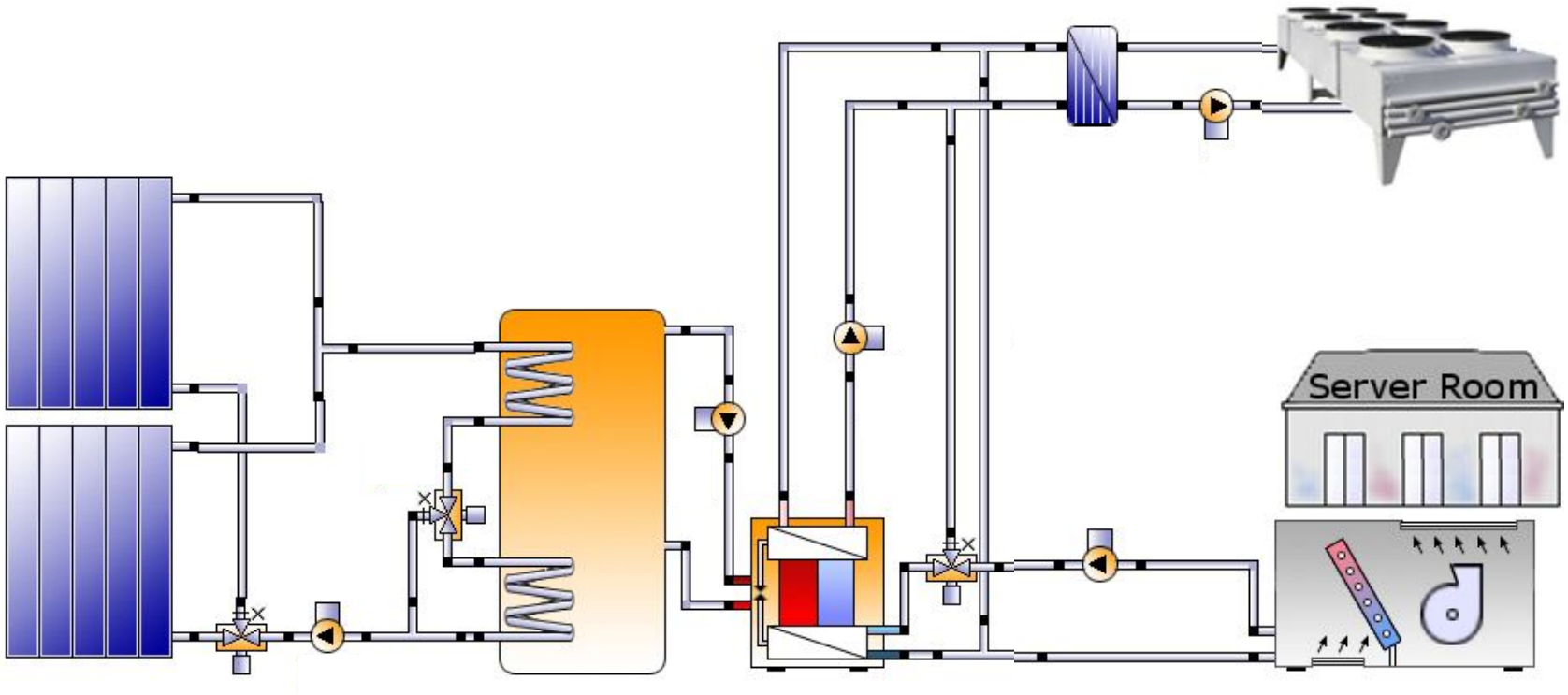
- Alternative System design:
  Storage tank only on the hot side…



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Server Room Cooling: Validation

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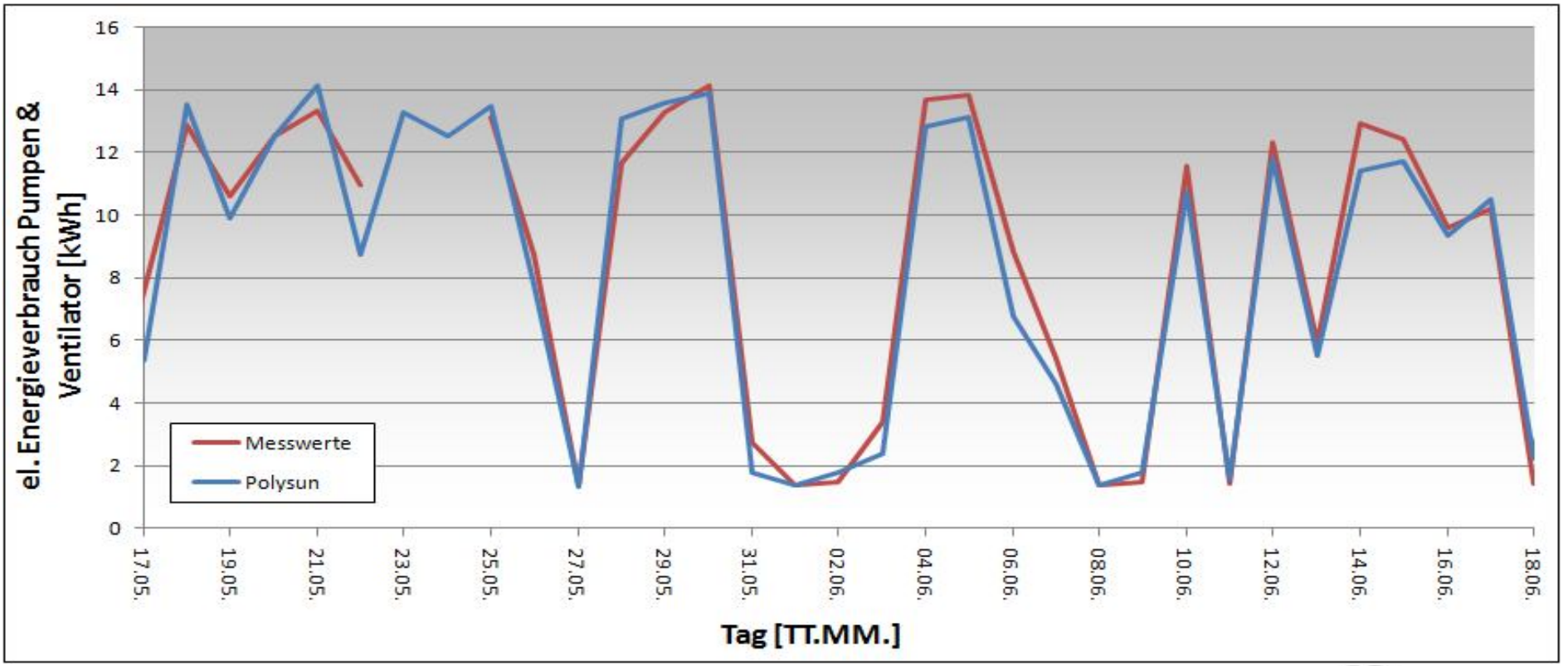
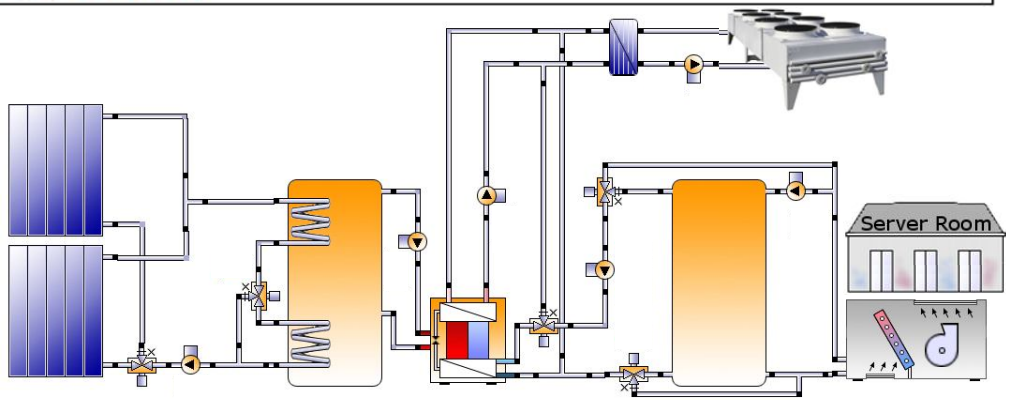


Sortech
ACS 08



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Solar Cooling with Sorption Chiller

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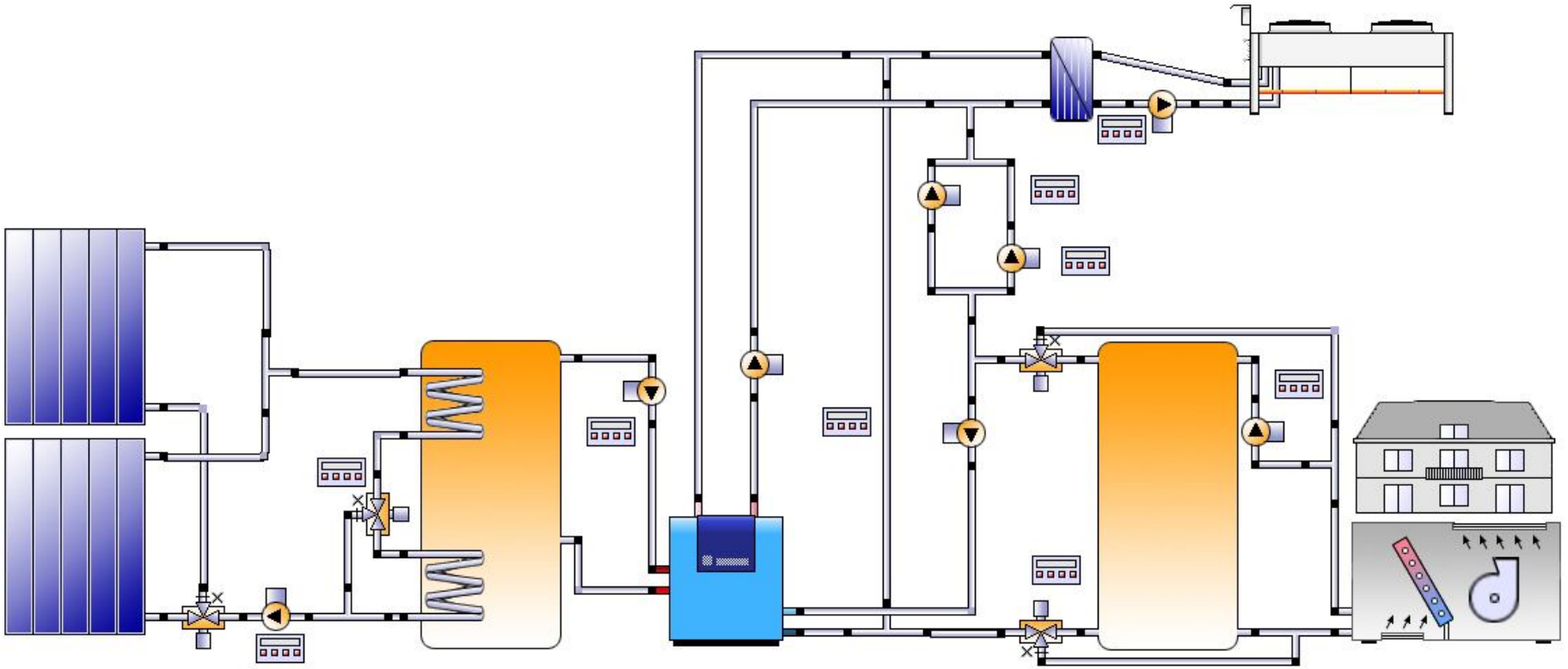
- Database with Chiller Components
  from Companies (Sortech, Climeatewell, Yazaki, …)



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Cooling and heating with PV & Compression Chiller

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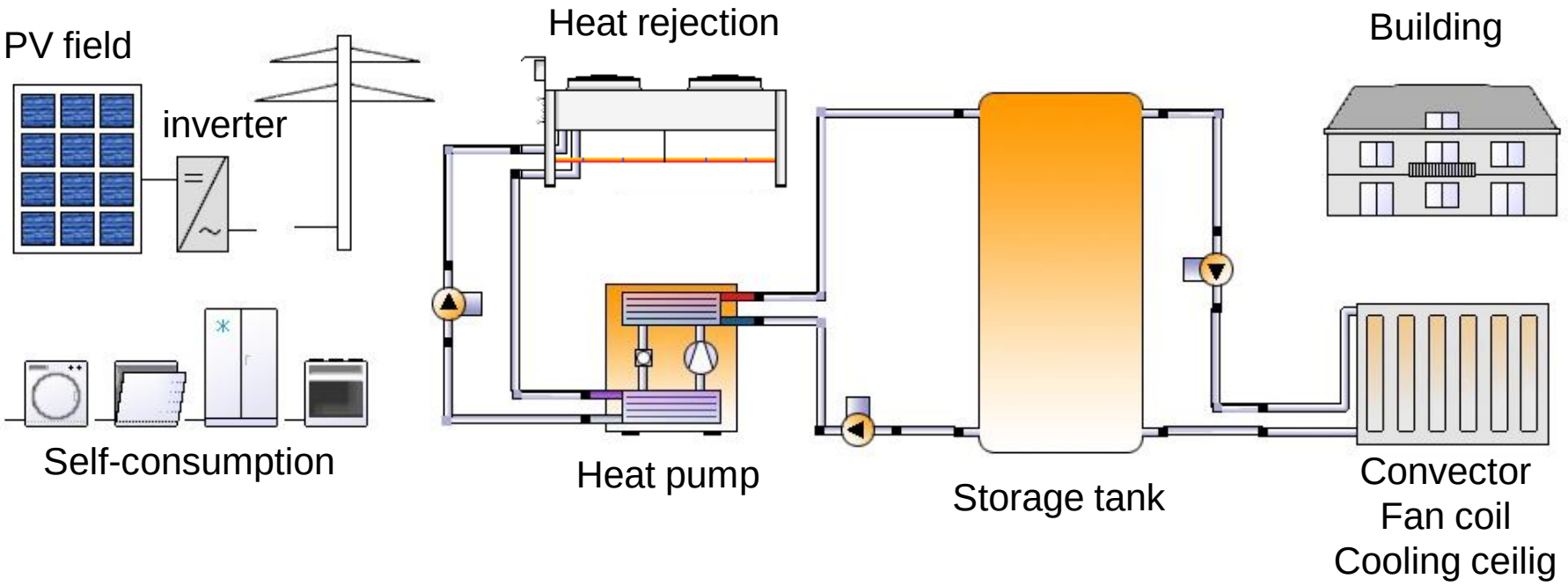

Example:

- Building 9m ×11.2m, 3 floors, low energy building. Location: Rome, Italy
- Cooling in summer (T_{sp}=21°C) and heating in winter (T_{sp}=26°C)
- PV field assumed to cover the entire roof (82m^2)

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Results: PV for heating and cooling

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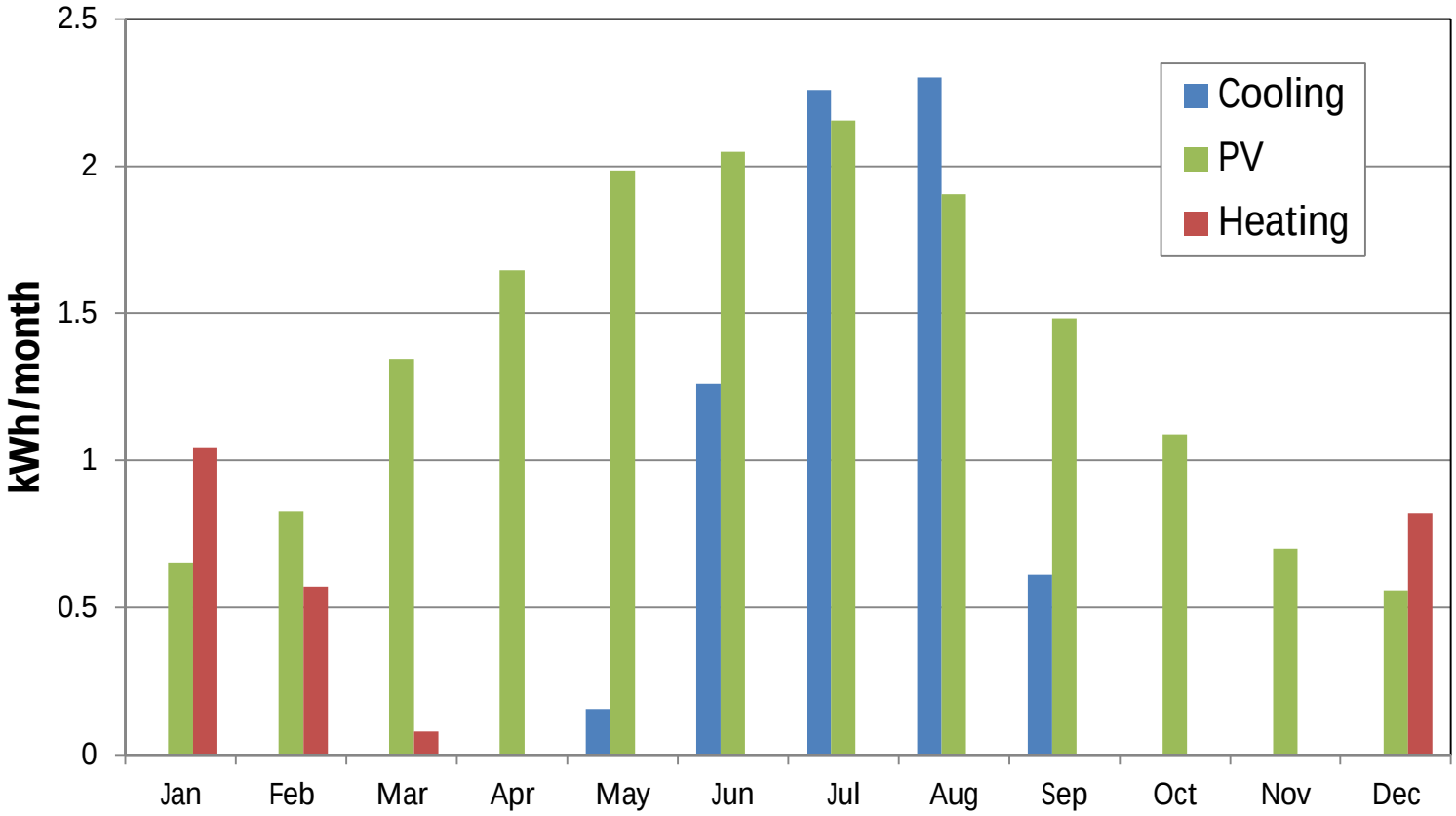

Note:

- Excess PV power expected

  (size of the PV field was chosen to cover the entire roof)

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Results for heating in winter

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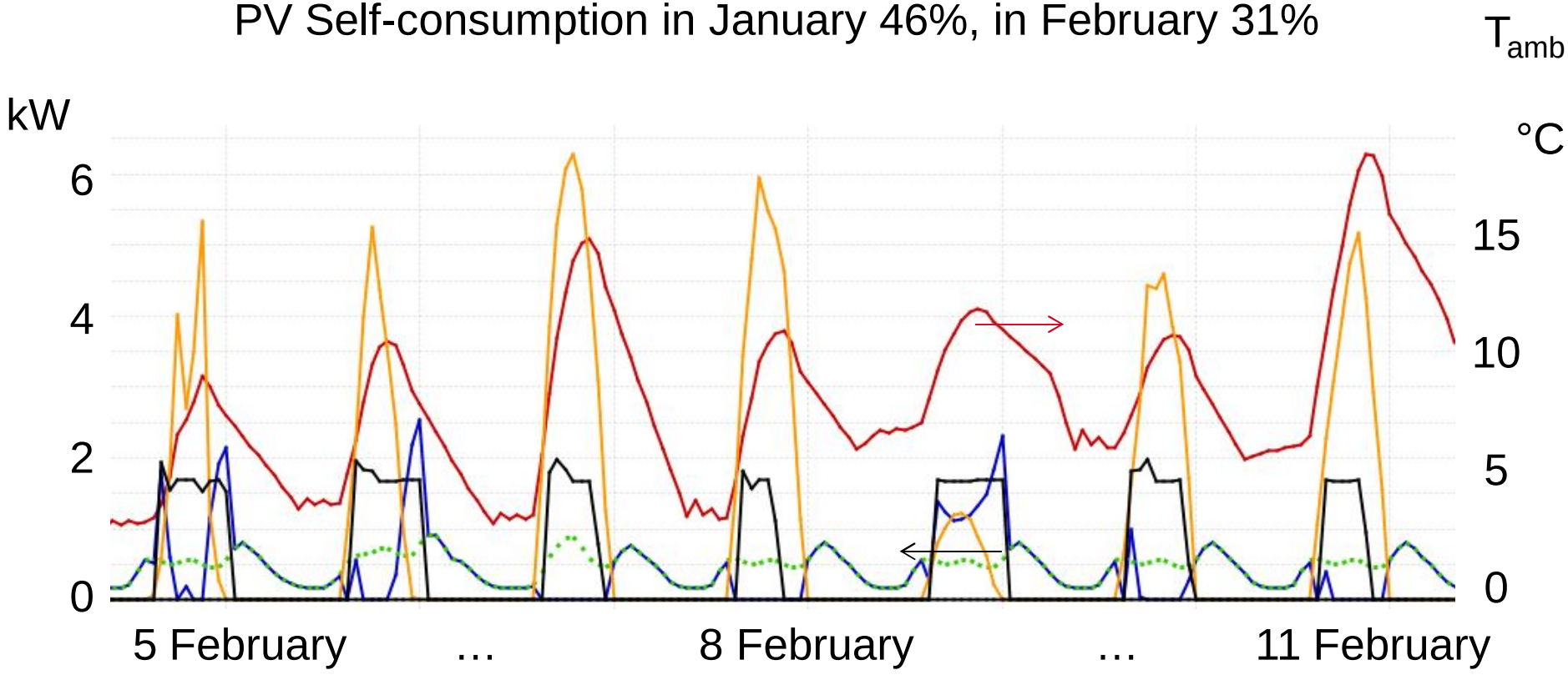
PV Self-consumption in January 46%, in February 31%



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Results for cooling in summer

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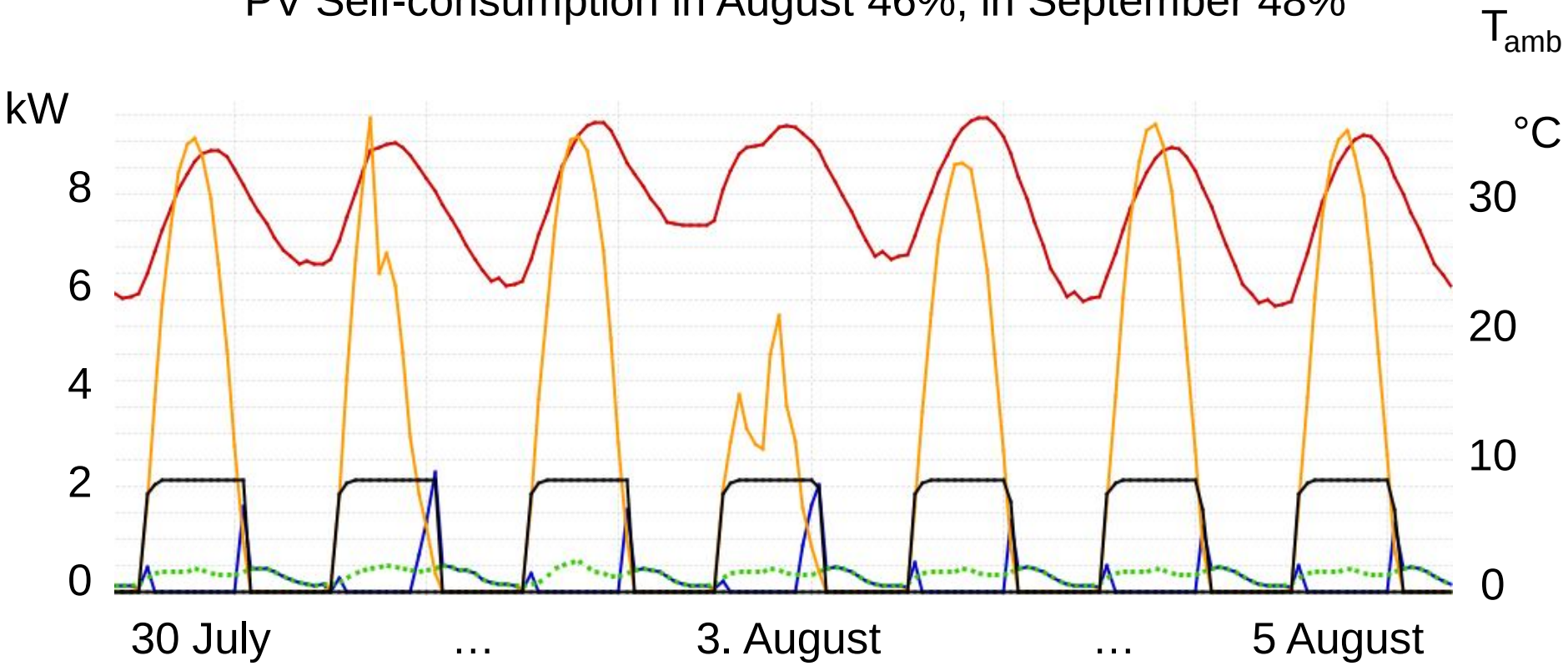
PV Self-consumption in August 46%, in September 48%



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Building model

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Good Defaults

- Important to model passive solar gain properly
- Help for users who do not know the building in early planning stage
- Living area relevant for heating and air-conditioning
- Database of building types + user can edit parameters

Building type (examples)	Overall heat transmission coeff.
Passive house	0.17 W/K/m^2
New building, well insulated	0.24 W/K/m^2
Average residential building 2010	0.34 W/K/m^2
Average residential building 2000	0.50 W/K/m^2
Building not modernized (<1995)	0.80 W/K/m^2

- Building type
- Windw to wall ratio (WWR)
- Solar transmittance of glass
- Air change and infiltration
- Internal loads
- Heat capacity

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Building model

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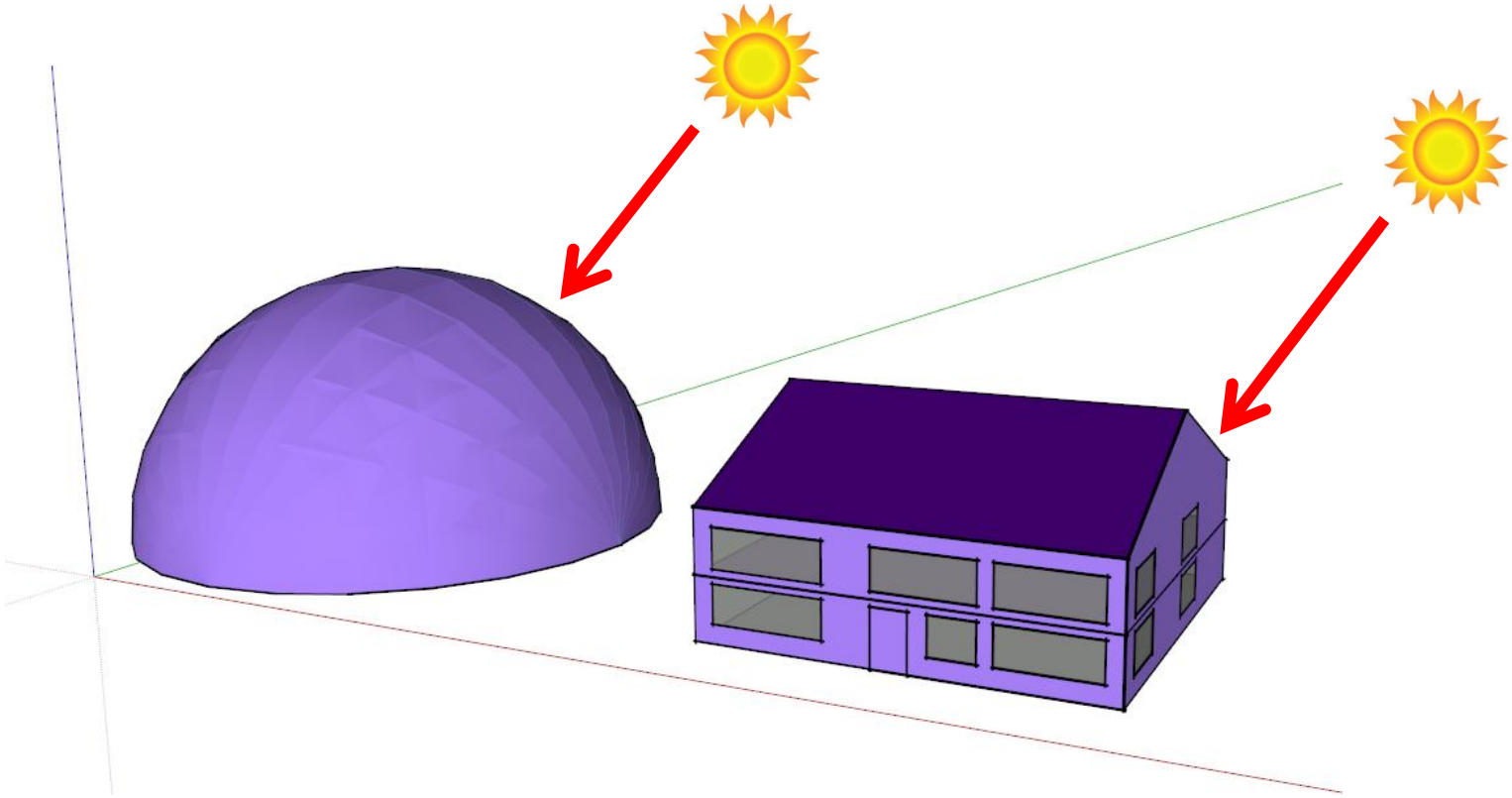
Simple building model

- Passive solar gain with simplified model

Polysun building model

- Solar irradiation on walls and into windows calculated in every time step



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Summary / Conclusion

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- Easy to use planning tool for renewable energy systems
  - Solar thermal
  - Photovoltaic
  - Heat pump
  - Absorption + Adsorption
  - Storage (thermal and el. Batteries)
- Programmable Controllers
- Solar Cooling is available

All in One Tool

- Opportunity for disseminating good solar cooling systems (via automatic update to existing users or online version)
- Contact:
  - Vela Solaris → info@velasolaris.com, www.polysun.com
  - NERCRE → zhujk82@163.com, www.polysun.cn

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