Measurement- and Simulation-Based Analysis of Solar Heat and Electricity Supply Concepts for Buildings

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Agenda

- Project »SolSys«
- Analyzed buildings and measurement results
- Simulation study

SolSys: Consortium

Fraunhofer ISE

Technische Universität Braunschweig

IGS

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SolSys: Motivation

- From approx. 2020 onwards EPBD requires nearly zero energy buildings

  => Holistic supply of heat and power

Today:

- Lack of energetically characterisation of such combined systems
- Competence and workflow in planning and installation of combined heat and electricity systems not (yet) available
- …

SolSys: Ovarall goals

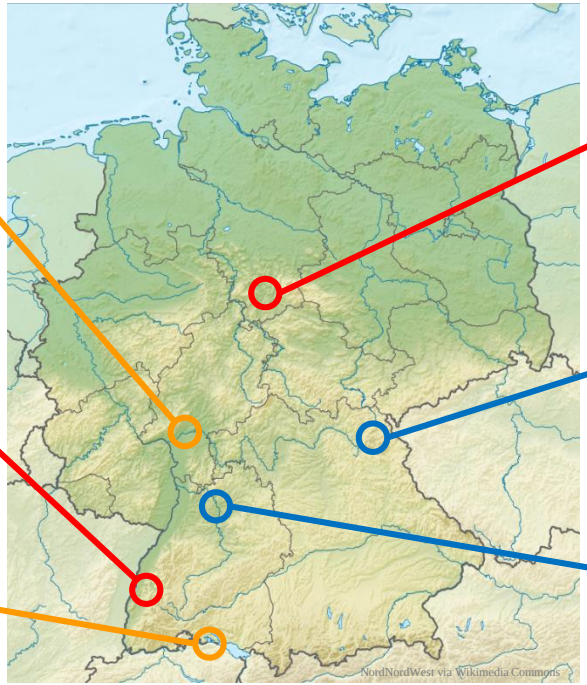
- Development of methodologies for holistic evaluation for combined heat and power systems
- Establishment standardised system concepts
  - Reduce effort in planning and installation
  - Analyse constraints in planning and installation businesses
  - Elaboration of cost effective solutions
- Increase distribution and market penetration of combined heat and power systems for residential buildings

Measurement: Analysed Buildings

Frankfurt

Freiburg .Br.

Konstanz



Katlenburg

Döhlau

Heilbronn

Measurement: analysed buildings

Building	A_N m²	System technology
Döhlau (Hof)	290	ST (40 m² / 28 kW_p), PV (4,8 kW_p) $HP_{a/w}$, TES (1 m³ / 10 m³), EES (10 kWh), split logs stove
Heilbronn-Neckargartach	284	ST (15 m²/ 10,5 kW_p), PV (9,4 kW_p), $HP_{a/w}$, TES (4,7 m³), split logs stove (15 kW)
Umkirch (Freiburg i.Br.)	194	ST (20 m²/ 14 kW_p), PV (5,0 kW_p), TES (1,1 m³), EES (3,7 kWh), split logs stove (13 kW)
Katlenburg (Göttingen)	433	ST (29 m²/ 20,3 kW_p), PV (9,95 kW_p), $HP_{a/w}$, TES (6 m³), EES (6.2 kWh)
Konstanz	2 x 570	PV (59,2 kW_p), $WP_{s/w}$, TES (2 x 2 m³), EES (30 kWh)
Frankfurt a. M.	2.407	ALW (85 m²), PV (99 kW_p), $HP_{s/w}$, TES (98 m³ ice), EES (60 kWh)

Measurement: analysed buildings

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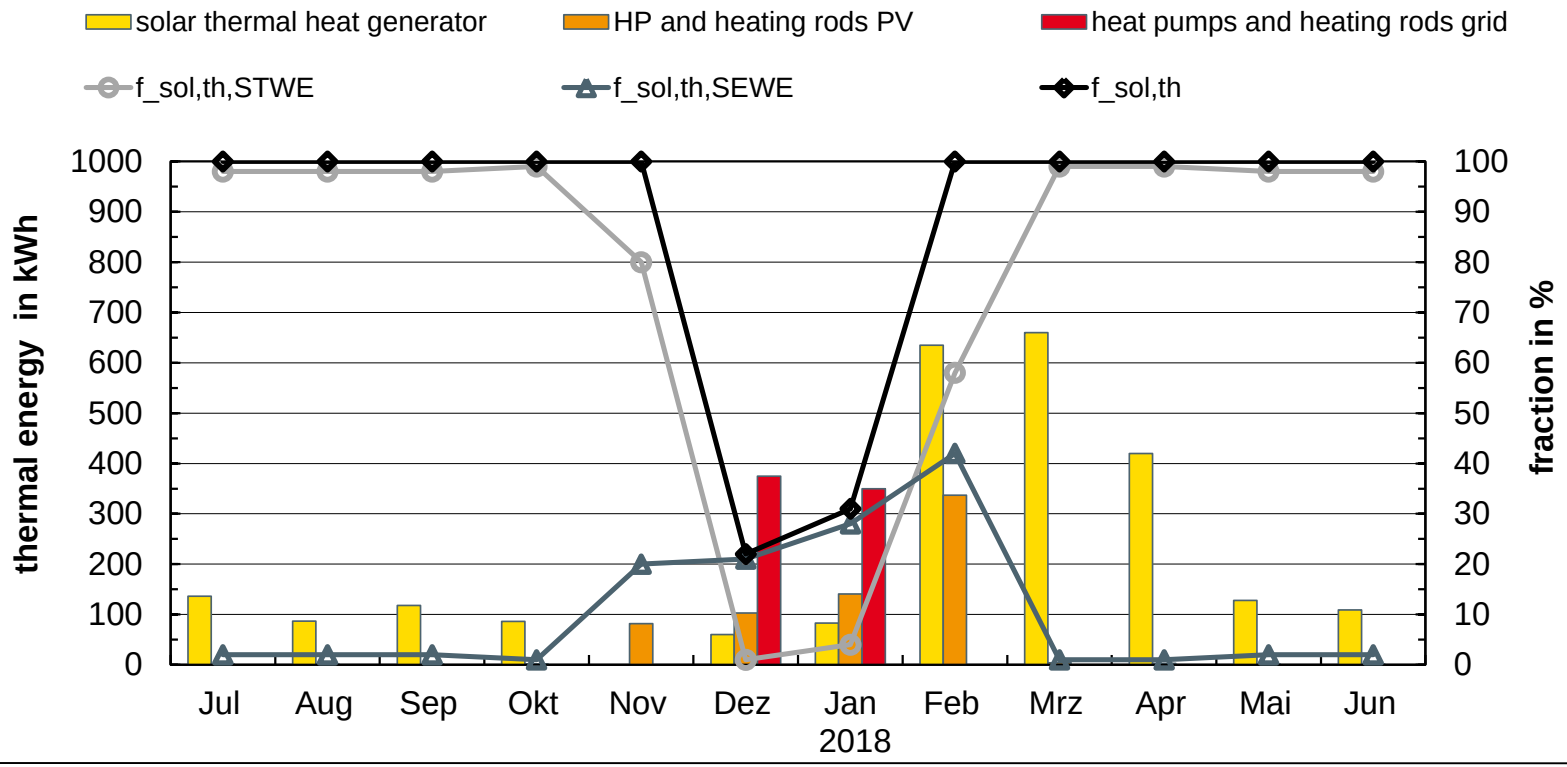
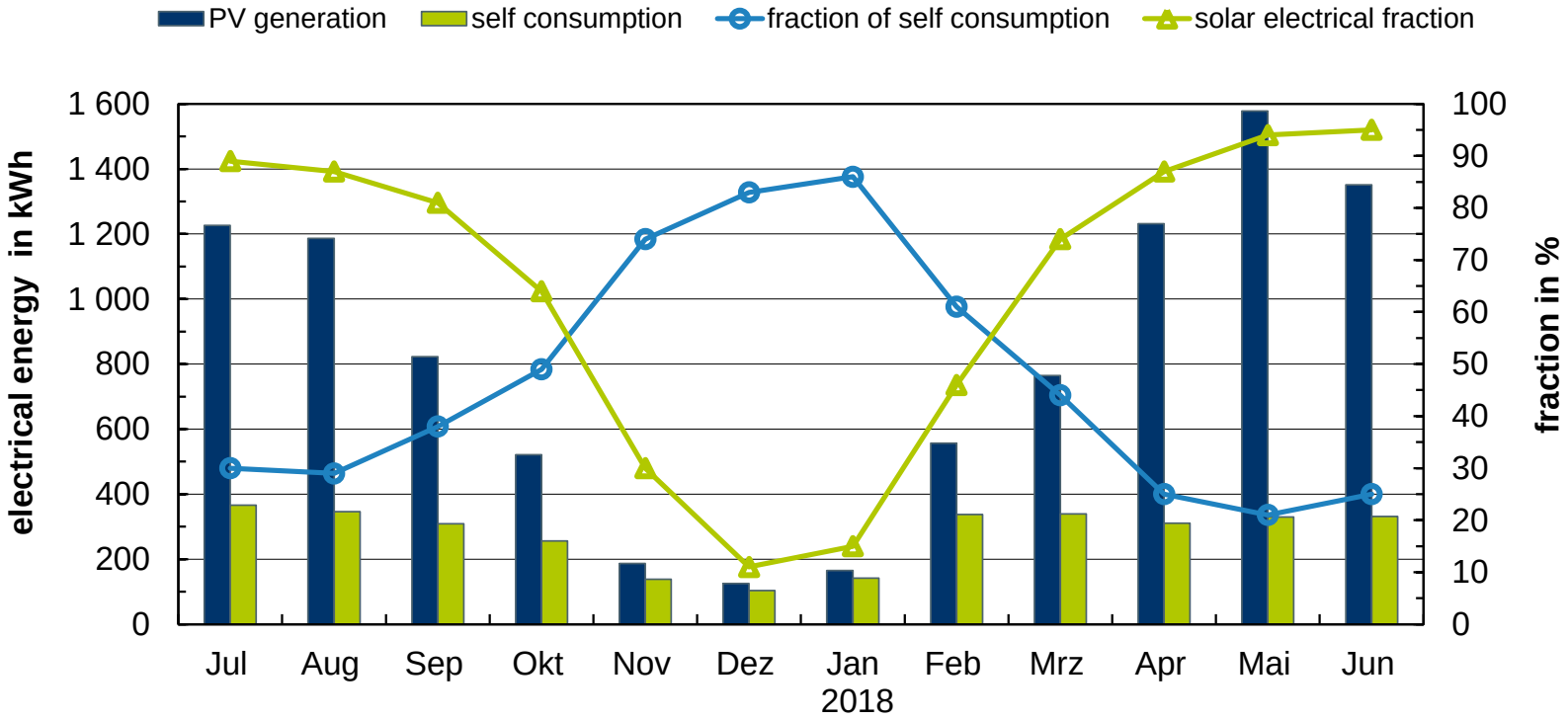
Measurement: solar energy and solar fraction



Measurement: PV self consumption



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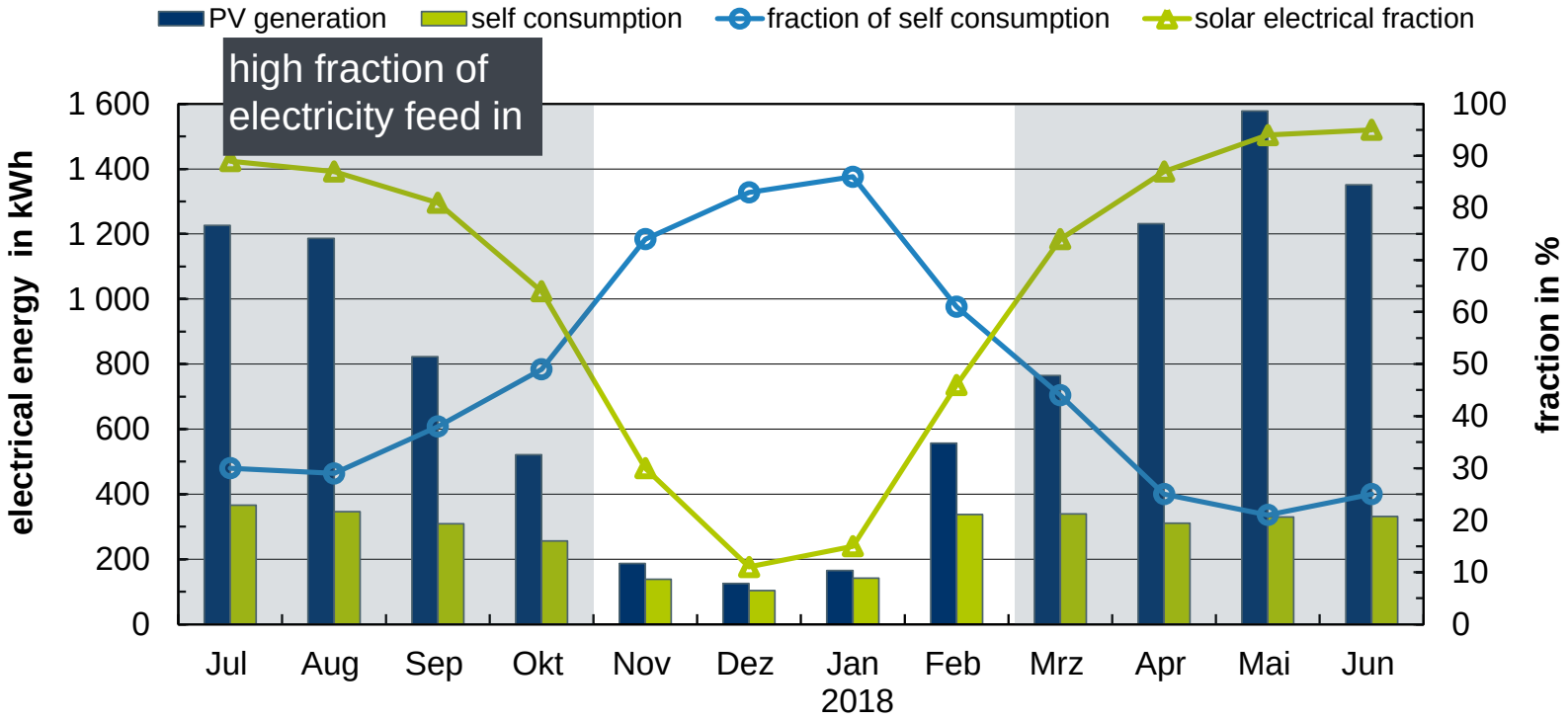

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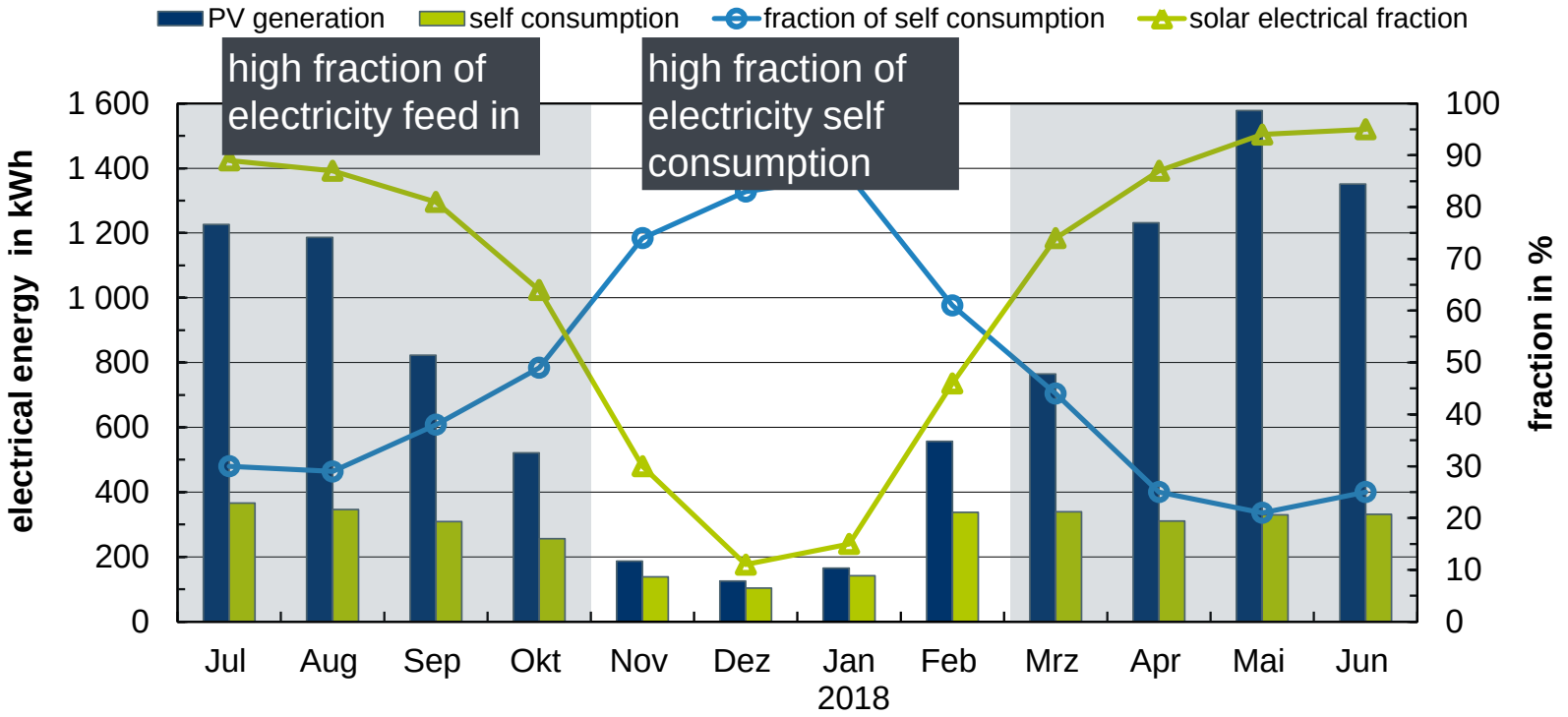
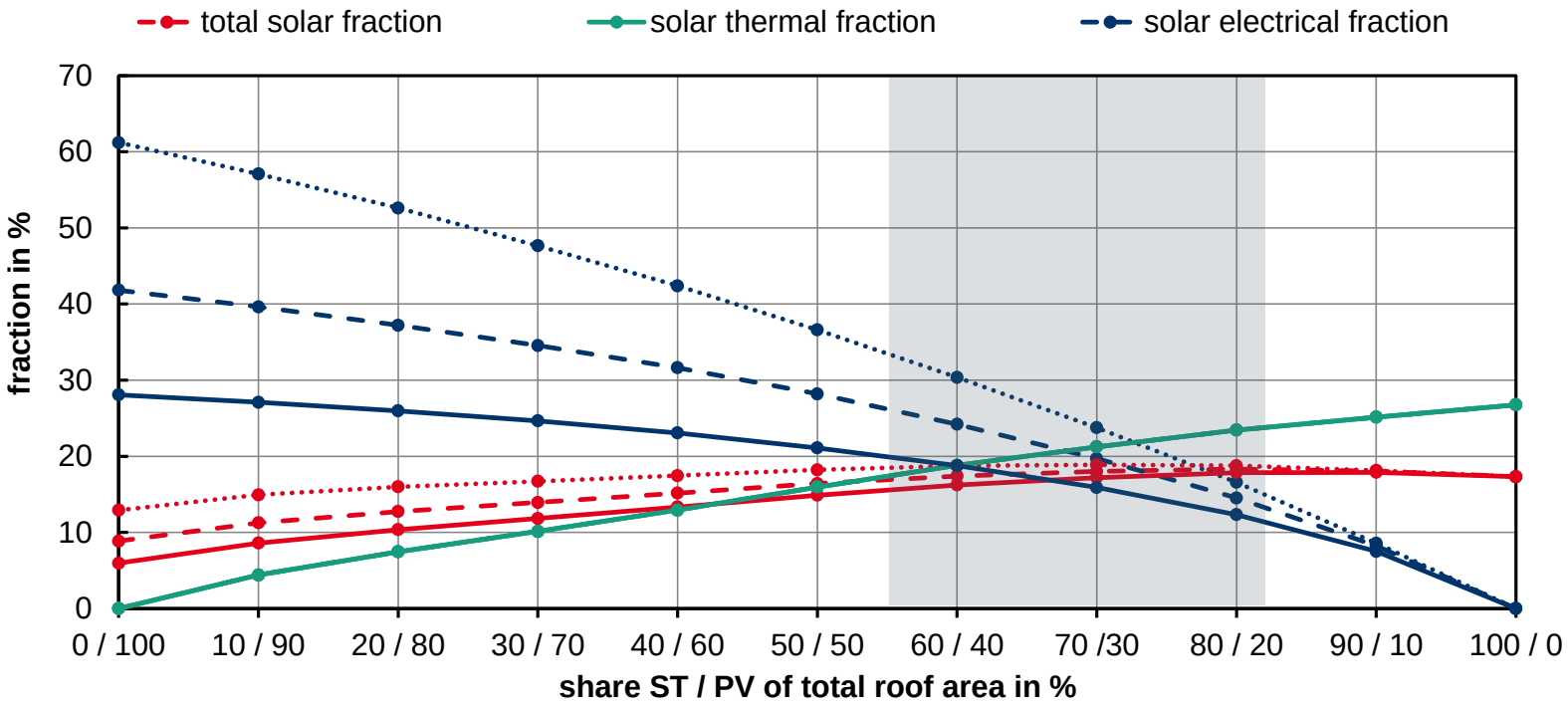


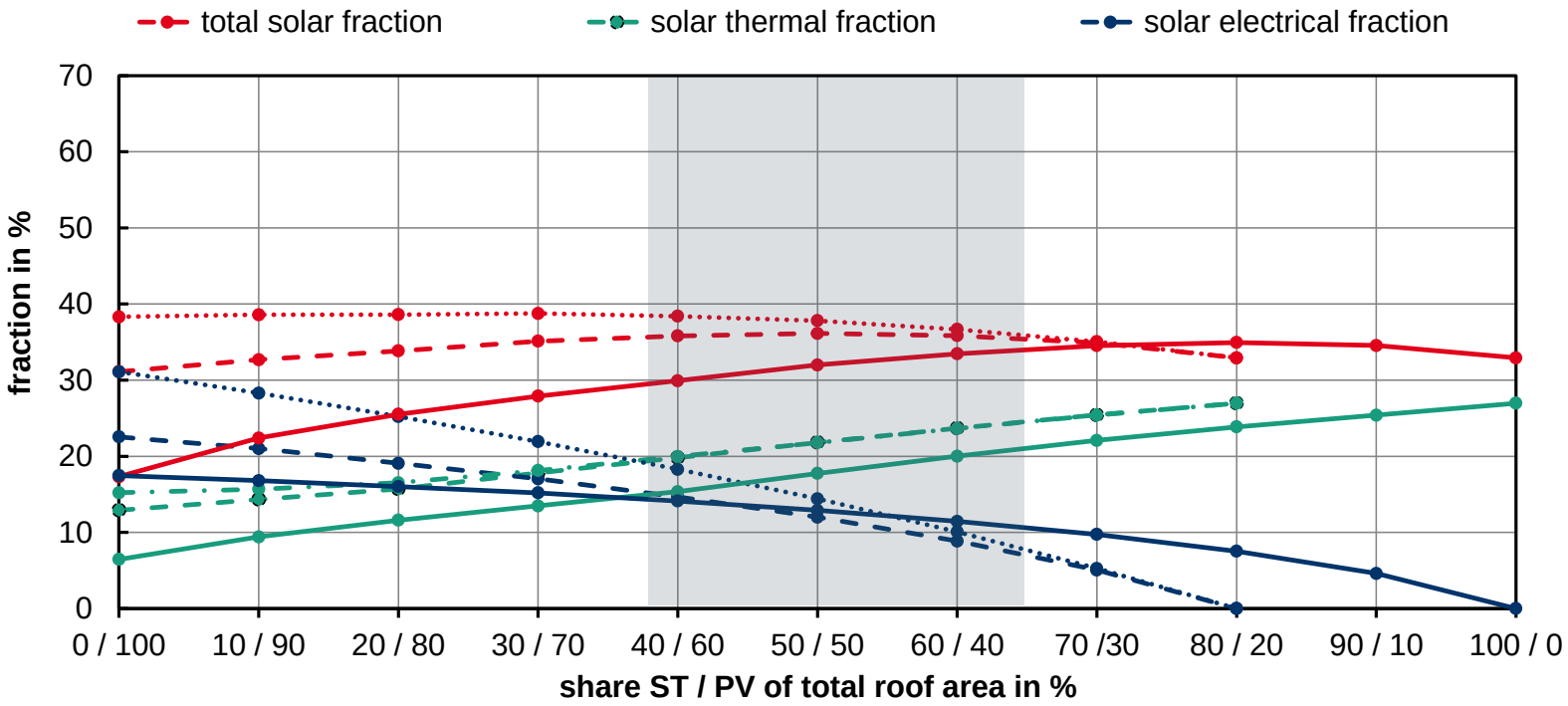
Simulation study: gas boiler

TES	EES
100 L/m²Aperture	0.0 kWh/kWp
	0.5 kWh/kWp
	2.0 kWh/kWp

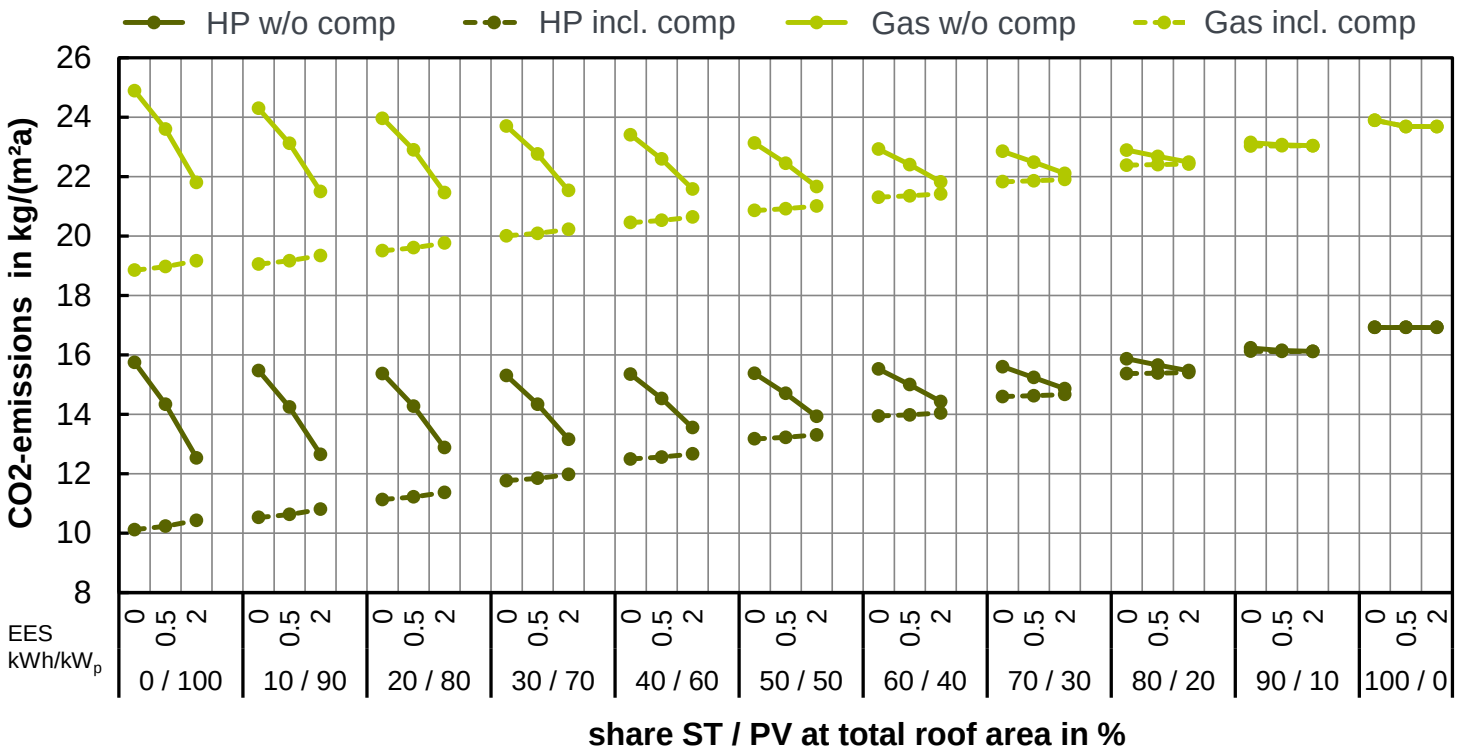


Simulation study: air heat pump

TES	EES
100 L/m²Aperture	0.0 kWh/kWp
	0.5 kWh/kWp
	2.0 kWh/kWp

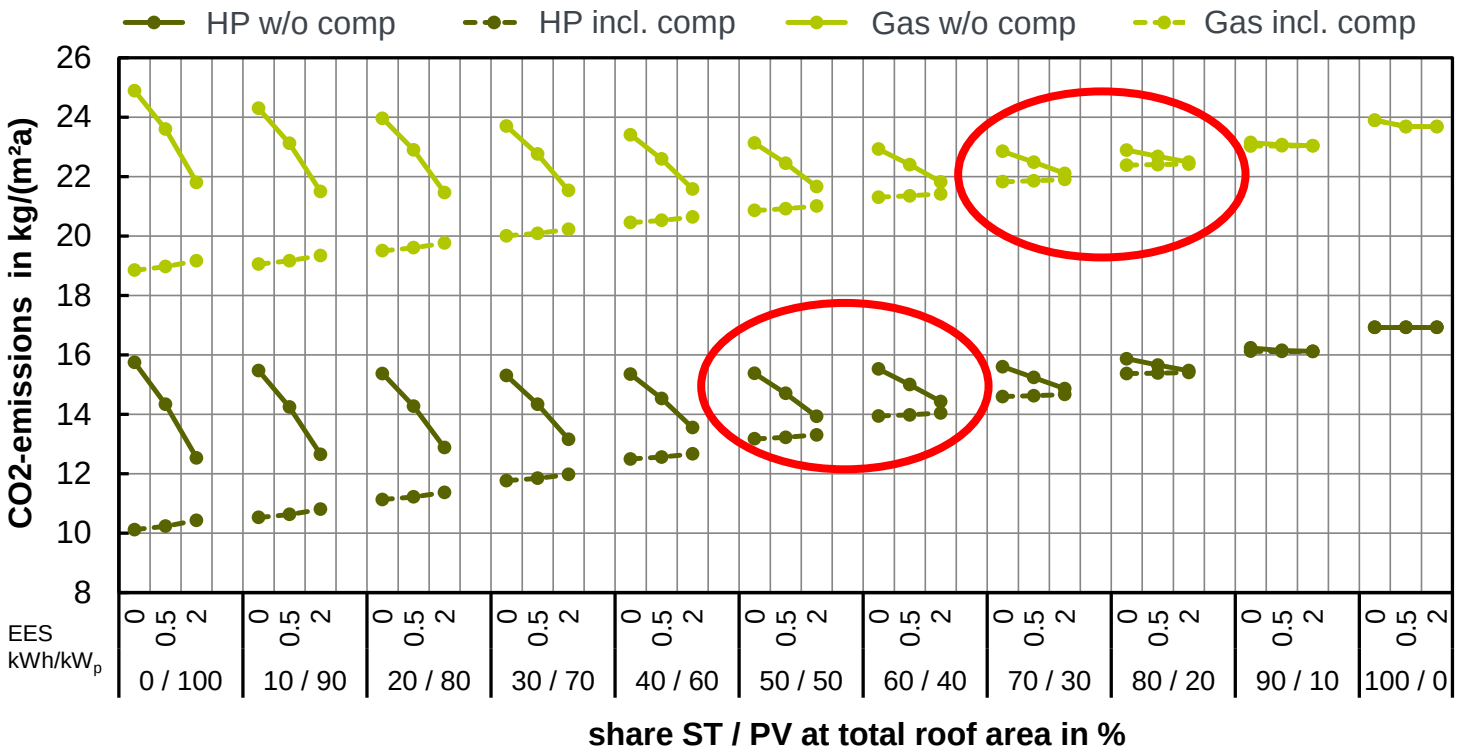


CO_2 emissions analysis



no LCA, only operation

CO_2 emissions analysis



no LCA, only operation

Conclusion

- Wide range of combined heat and power system concepts analysed in measurement campaign, e.g.:
  - »concept heat« (large thermal storage capacities)
  - »concept electricity« (w/o large thermal storage capacities)
  - Systems show very different levels of complexity
- High total solar fractions of combined heat and power demand
- Most ecologically combination of PV, solar thermal and HP

Final conclusion

Combined heat and power supply is in many cases the most cost effective option to generate a large share (> 60 %) of the energy consumed in the building with renewable energy sources available at the building

Thanks to

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- You for your attention

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