About the role of SHIP in industrial hybrid energy systems

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Ambient temperature dependent heat plays a significant role

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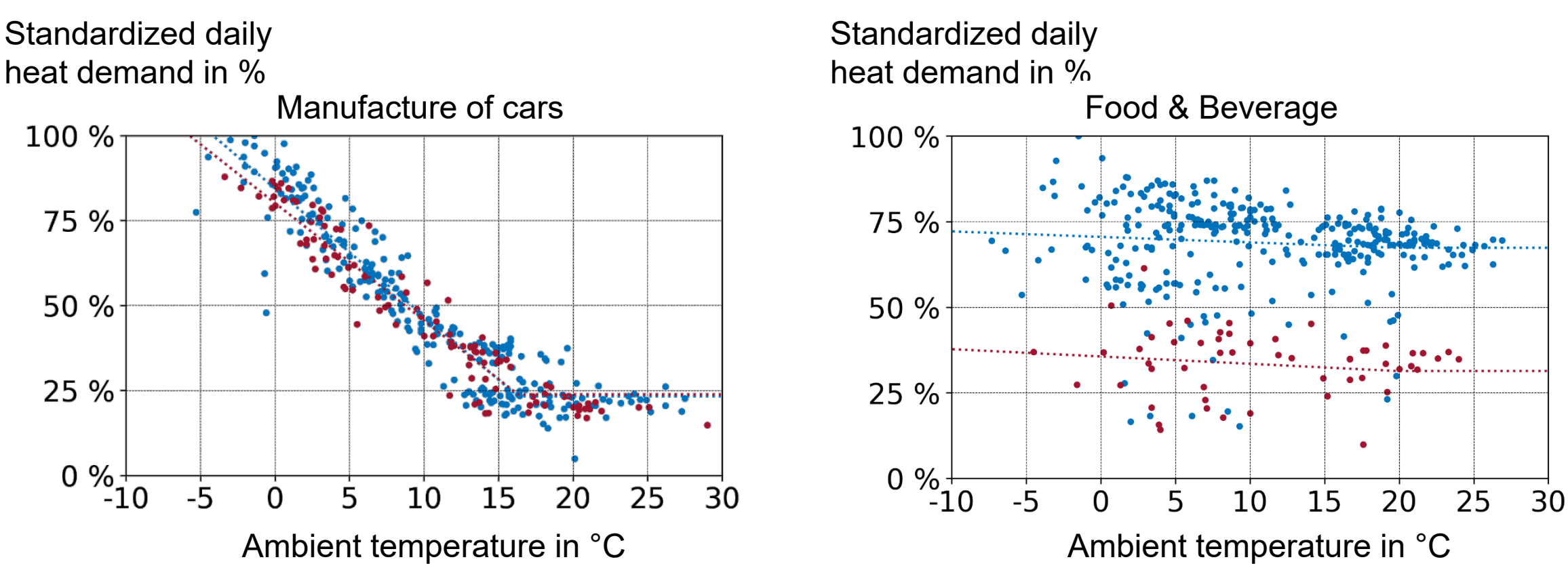
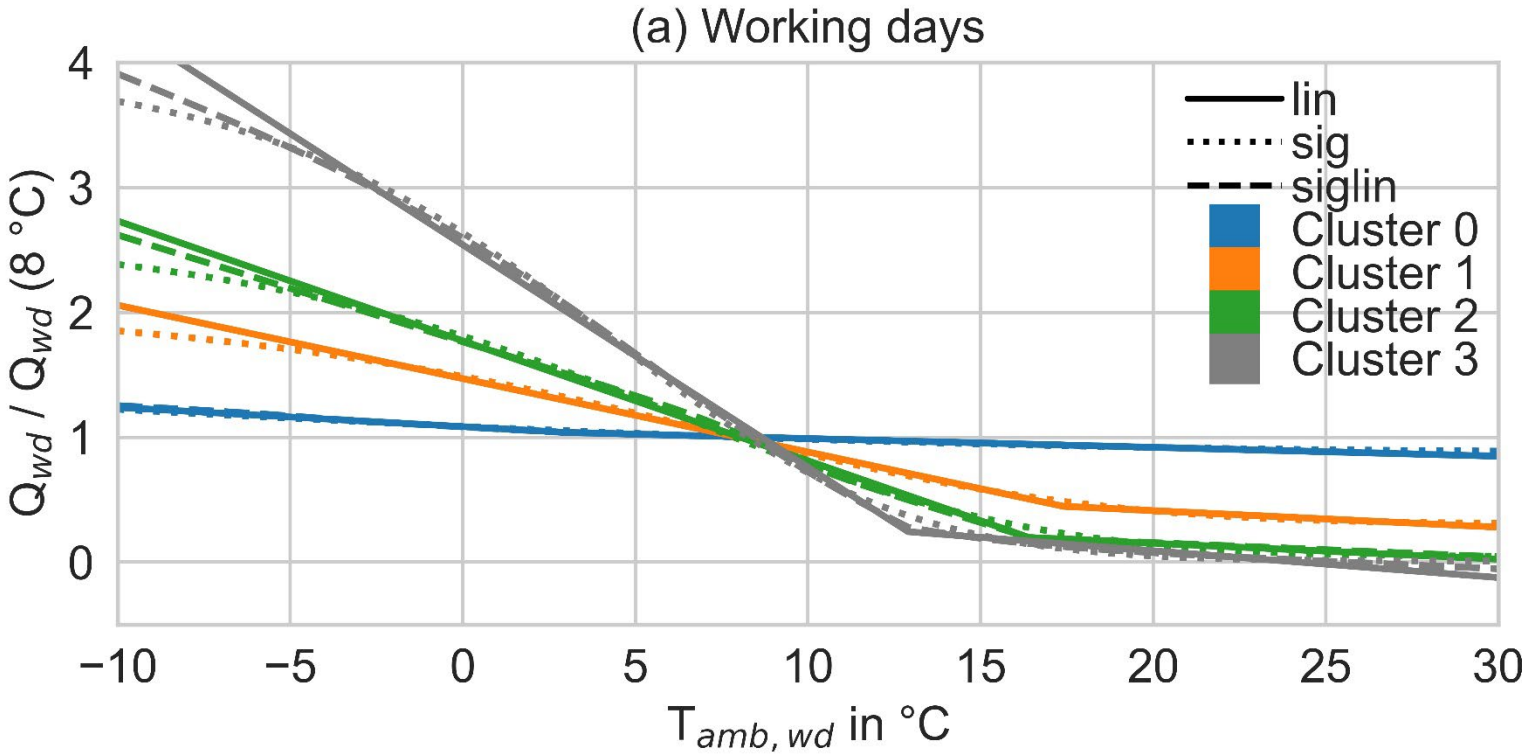
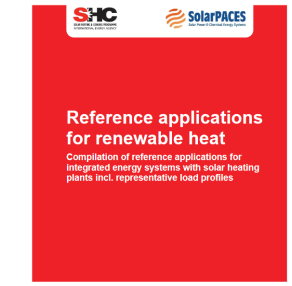
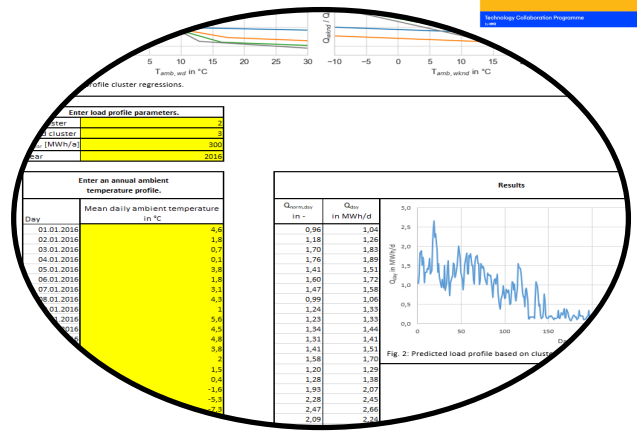


Ambient temperature dependent heat plays a significant role

- Ambient temperature dependent heat plays a significant role
- Database of +500 heat load profiles from industries (hourly resolution)
- Cluster algorithm to analyse ambient temperature dependency



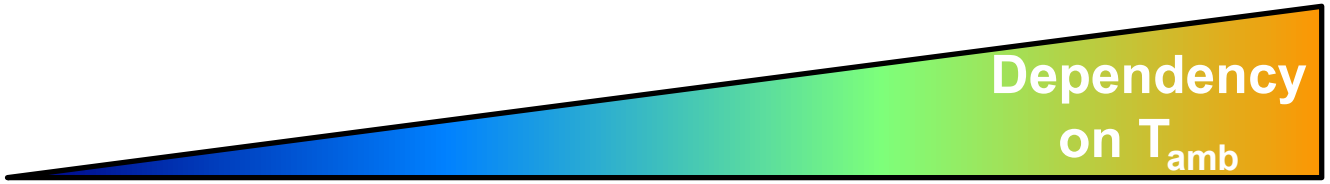


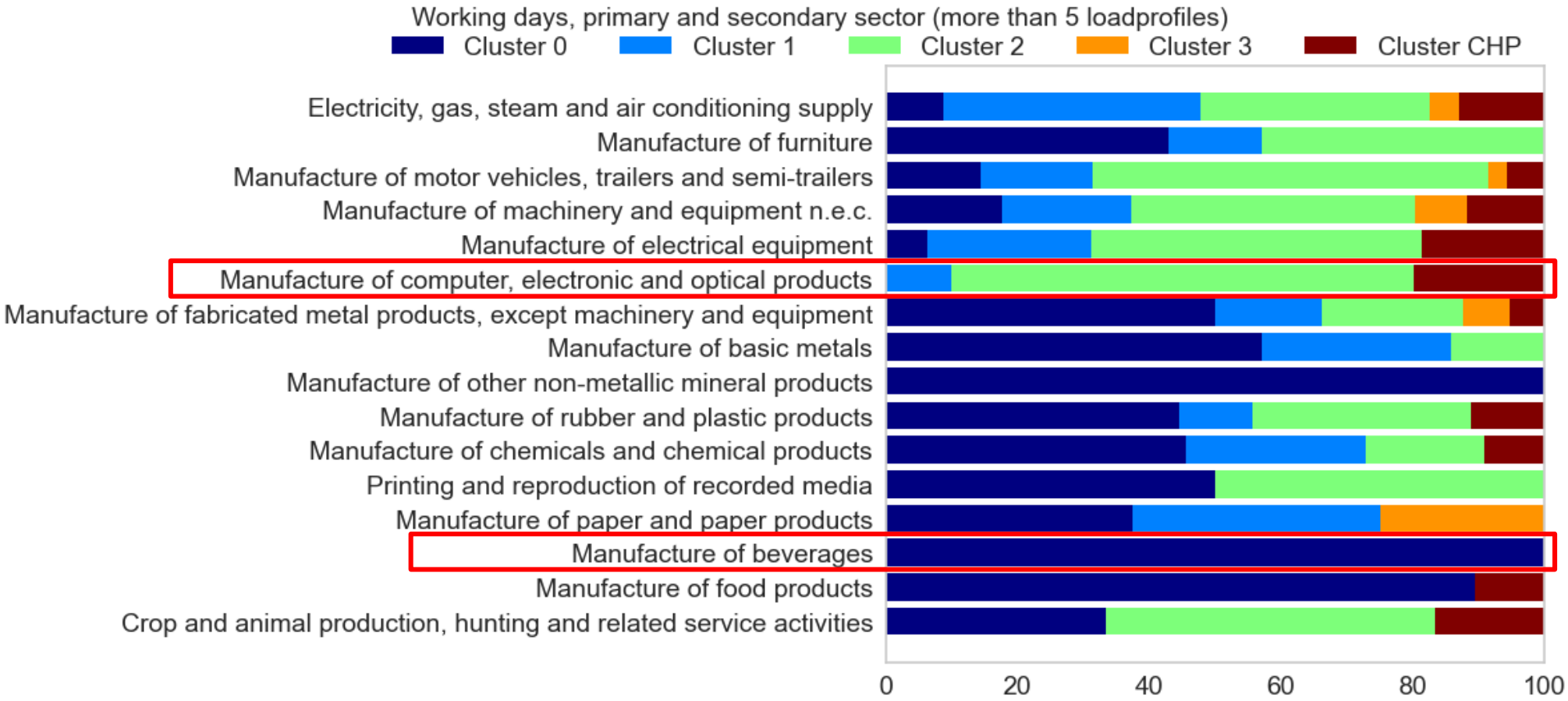


Excel-Tool
https://task64.iea-shc.org

Jesper et al. 2021

Cluster - Industry

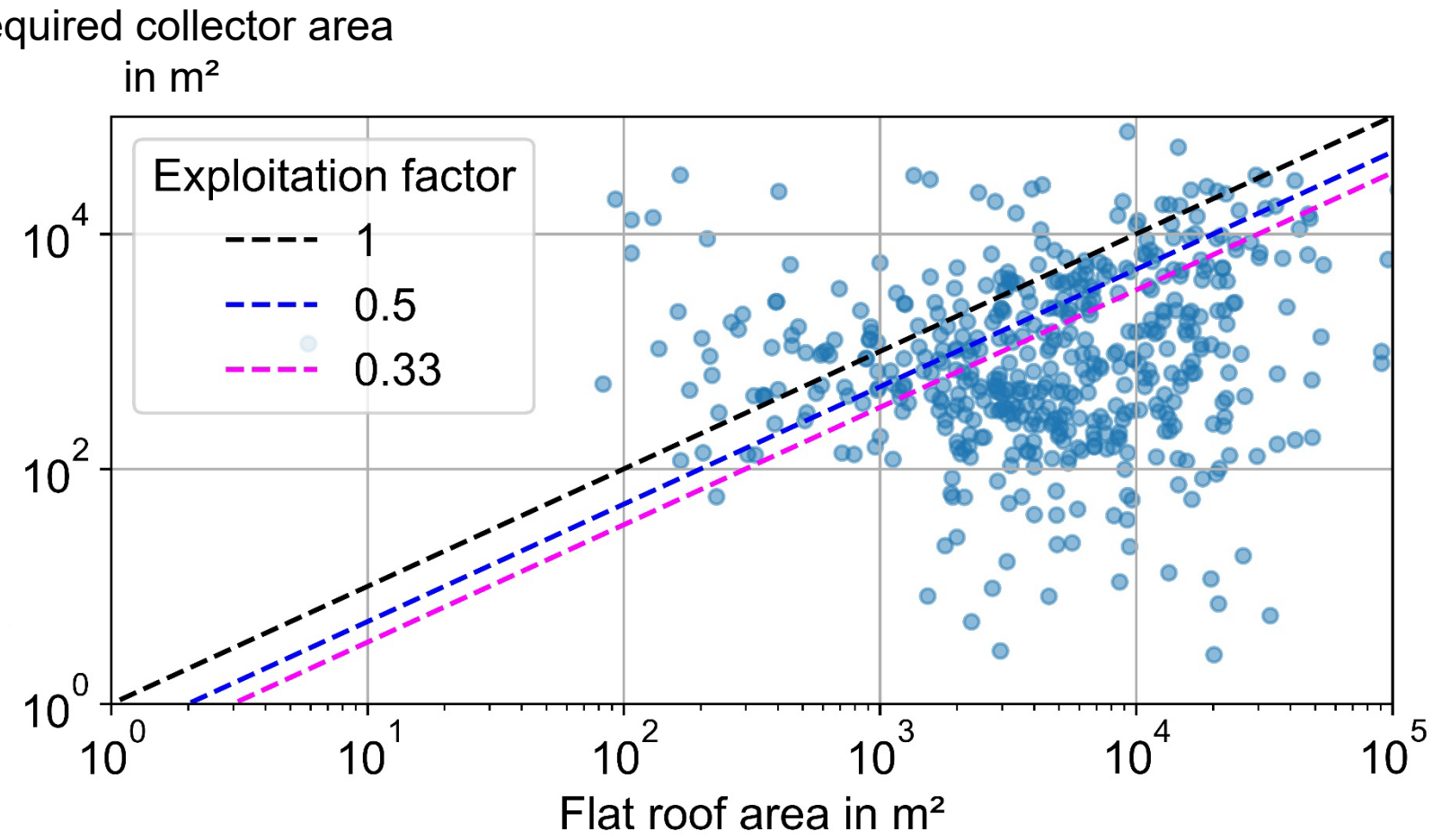




Share of companies in wd-clusters for different sectors in %

Jesper et al. 2021

Available roof area is a limiting factor



Exploitation factor:

$$\frac{\text{Collector area}}{\text{Roof area}}$$

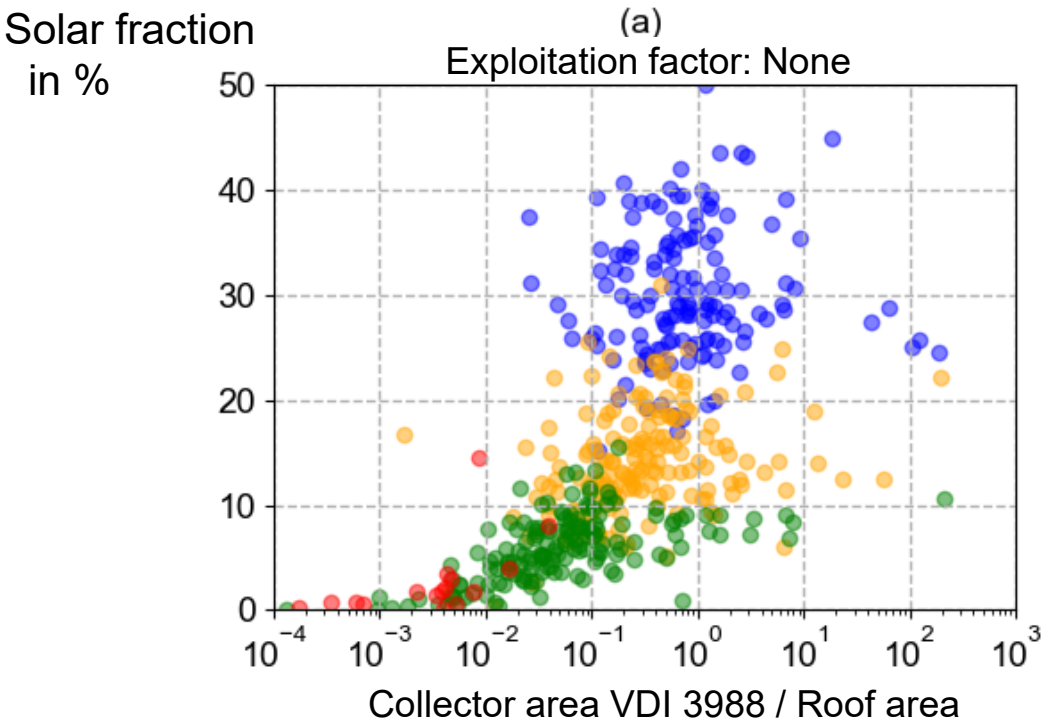
„How efficiently is the roof area utilized?“

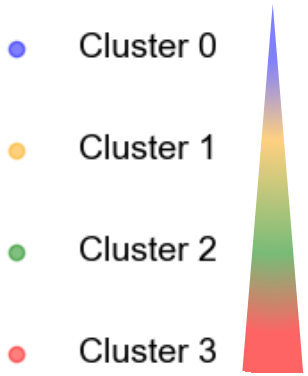
- Exploitation factor 0.33:
  40 % of the companies is limited by its roof area in its solar system design

Parameters:
T_{flow}/T_{return} = 80/60°C
Vacuum tube collectors

Pag et al., 2022

Solar fraction: limited by roof area and load profile





Dependency on Ambient Temperature

Median Solar fraction	Exploitation Factor None
Cluster 0	29.1 %
Cluster 2	5.9 %

[Pag et al., 2022]

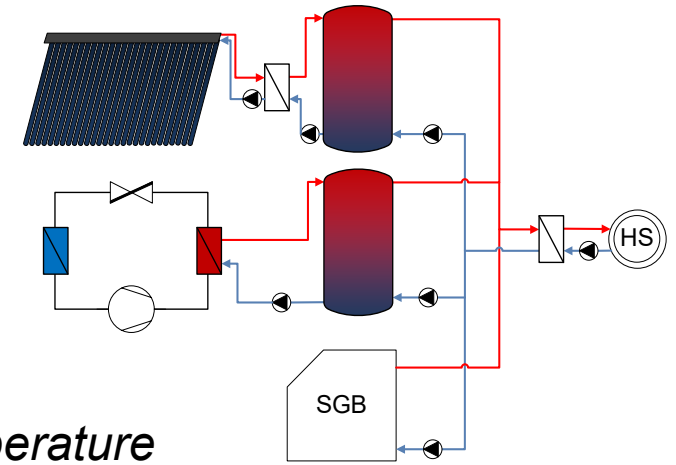
How to combine Solar + HP?

- Sensitivity analysis of technical and economic parameters
- Which parameters are relevant?
- Simplified calculation model

Jesper et al., 2022 (in review: Solar Energy Advances)

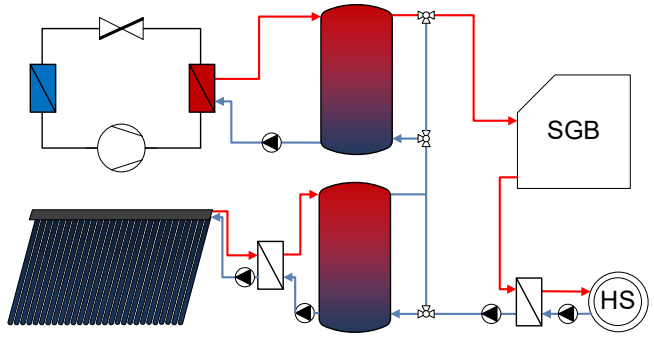
Parallel (P)

All heat generators supply the set temperature



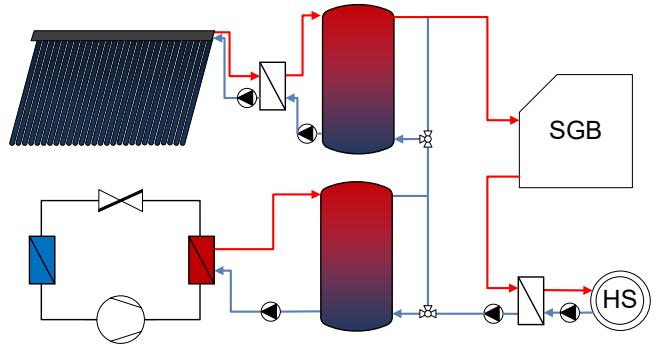
Serial (S1)
Sol → HP→ SGB

Solar pre-heating

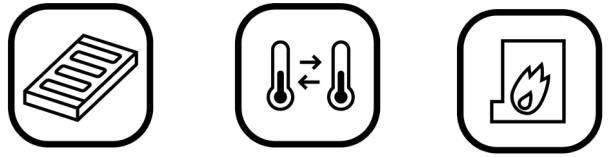


Serial (S2)
HP → Sol→ SGB

HP pre-heating



LCOH of Complete System



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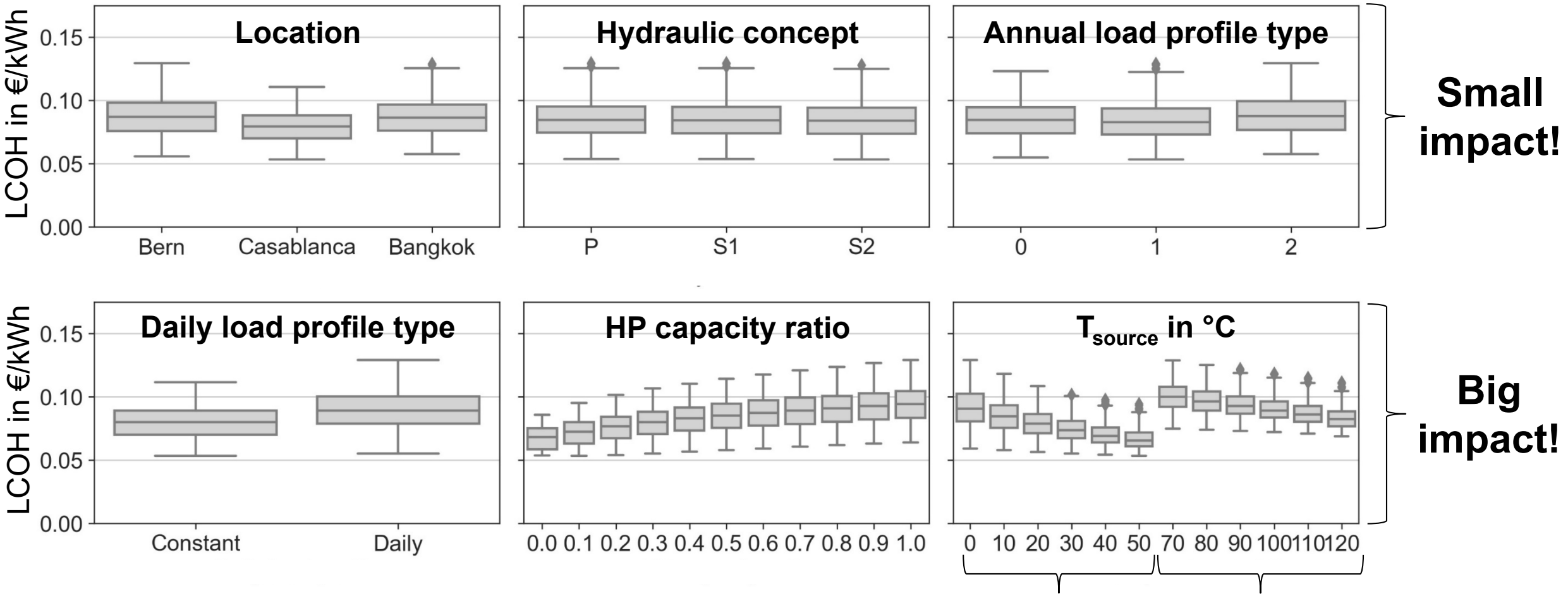
Coll. technology: Only st, Q_{dem} = 10.0 GWh/a, c_{el} = 0.13 €/kWh, c_{ng} = 0.03 €/kWh, i = 6%, no subsidies



Jesper et al., 2022 (in review: Solar Energy Advances)

Conclusions

- Heat load profiles in Industry cannot be assumed to be constant
  - Ambient temperature dependent heat plays a significant role due to processes such as ventilation systems, drying, and space heating
  - Almost all companies with summer heat demand

- Roof area is a limiting factor for the solar system design especially for companies with a high summer heat demand

- New design strategies for solar heating plants are needed to reach higher solar fractions in companies with relevant ambient temperature dependent heat

- Design strategies for Solar + HP systems are (still) missing

Thank you very much!

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