Swiss energy system assessment- Learnings and outlook

Swiss Symposium Thermal Energy Storage
- Exchanging and networking on Thermal Energy Storage

Lucerne, 22 January 2021

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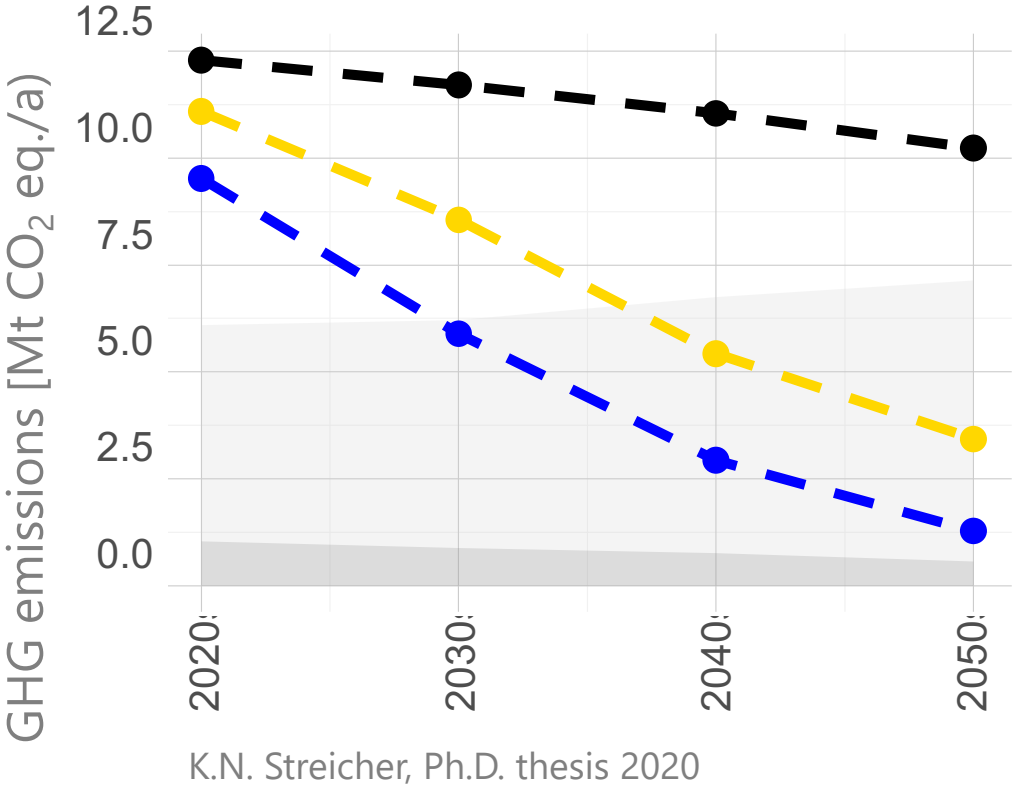
Content

- Retrofitting the building stock
- Large TES
- Small TES and batteries
- Conclusions

Retrofitting the building stock (incl. HP)



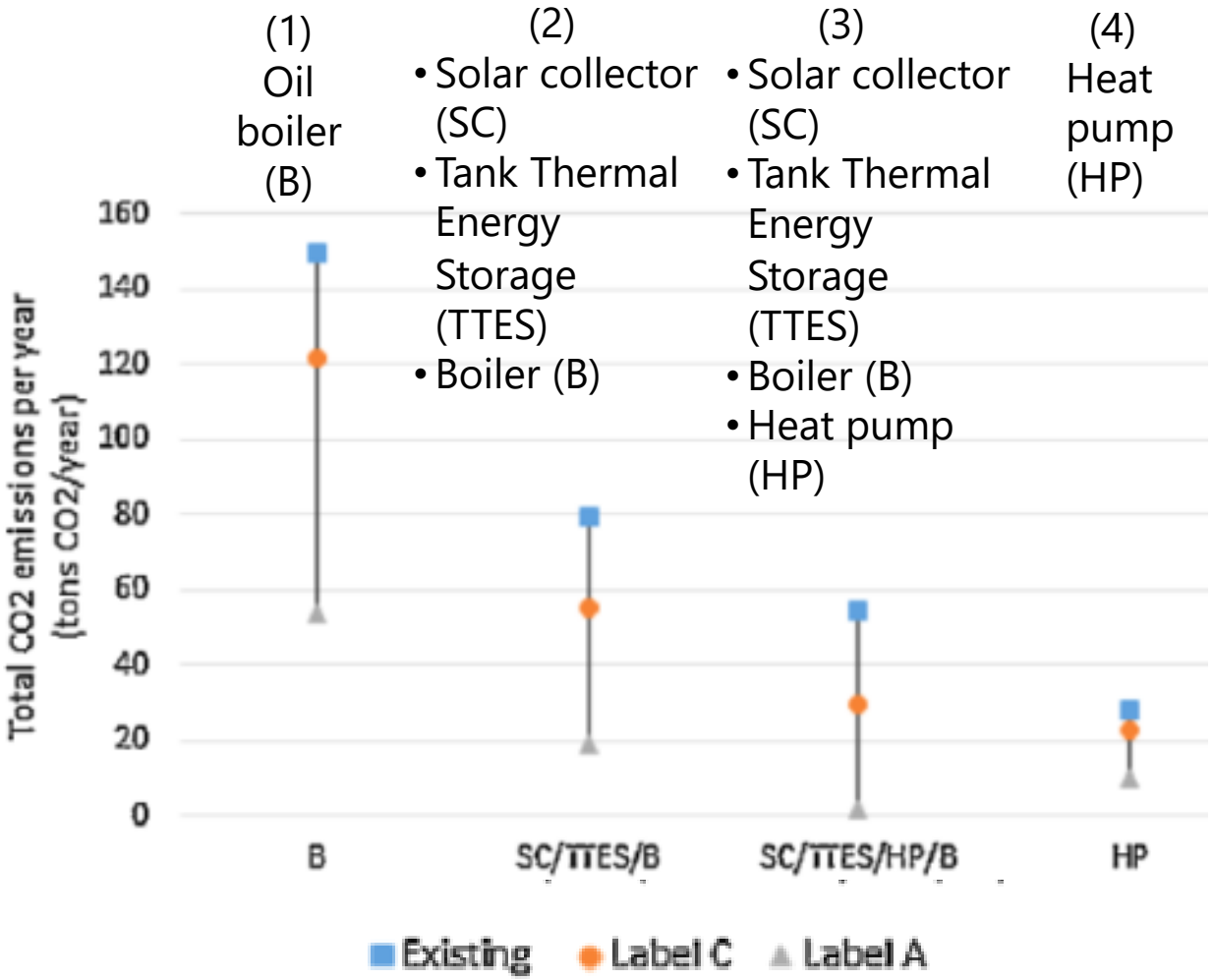
K.N. Streicher, Ph.D. thesis 2020

- Reference (BaU): Completely insufficient
- Minimized emissions (approx. -90% CO_2 in 2050)
- Minimized cost (approx. 70% CO_2 in 2050)
  Good compromise but
  - early retrofit wherever cost optimal (paradigm change)
  - comprehensive and immediate implementation
  - simplifying assumptions (e.g., for ASHP; electric grids)
  - further reduction of emissions needed

- How can thermal storage contribute?

Tank Thermal Energy Storage (TTES) in perspective - Seasonal

- For 50 dwellings



- Major contribution of heat pumps (4)
  - Even as primary measure
  - Lowest cost option
  - But impact on electricity grid
- Configuration (3)
  - **Zero carbon** in combination with Label A
  - Also very significant savings for **Existing** and **Label C**
  - 70% lower peak electricity demand

K. Narula et al., Renewable Energy 161 (2020)

Thermal storage vs. battery storage for SFH with PV and HP - Daily

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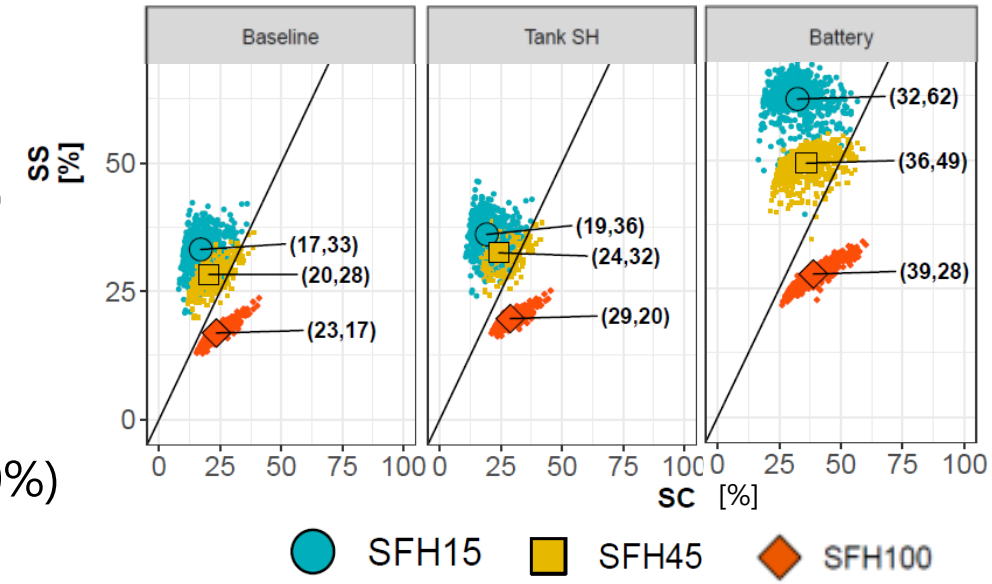
- Battery: 7.5 kWh
- Relatively small TS (equiv. to 1500 l water at ΔT=10 K), i.e. 17.5 kWh
- **Existing** bldg.: 100 kWh/m^2/a (also 15, 45)
- Two-level ToU tariff ($/kWh), with and without capacity tariff ($/kW)

- TS and battery improve SS and SC
  - TS: Limited effectiveness
  - Battery: moderate (but high for efficient bdlgs esp. for SS)

- Peak flow (kW) as indicator for grid friendliness
  - TS decreases Peak flow by 10%
  - Battery increases peak flow without capacity tariff (by ~10%) but decreases peak flow with capacity tariff (by ~10%)



- TS decreases Levelized cost while battery (currently) increases it

A. Pena-Bello et al., in preparation

Conclusions

- TES can play important role for Net zero strategies
  - Which type, which configuration, which size, …?
  - How can cost be brought down to levels of other measures?
- TES reduces impact on electric grid (not necessarily true for battery)
  - Which size dependencies, …?
- TES-small = cost-effective; TES-large = costly
  - What is the right size for sensible ES? Other energy storage options?
- Heat pumps = “Must have” and most cost-effective
  - Which synergies with TES, in particular in thermal grids
- Energy retrofit = Continues to be high priority and prerequisite for Net zero
  - How to accelerate, how to combine with TES (and HP)?
- Potentially more attractive options by other system configurations and in service sector

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