EASY TOOL FOR EVALUATION OF BENEFITS OF COMBINING PV + HP/CC

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AGENDA

- What does the tool do?

- How does the tool work?

- Results

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PV$_{Therm}$-PreCheck – based on MS Excel

PV$_{Therm}$-PreCheck – input profiles

Hourly weather
and load profiles
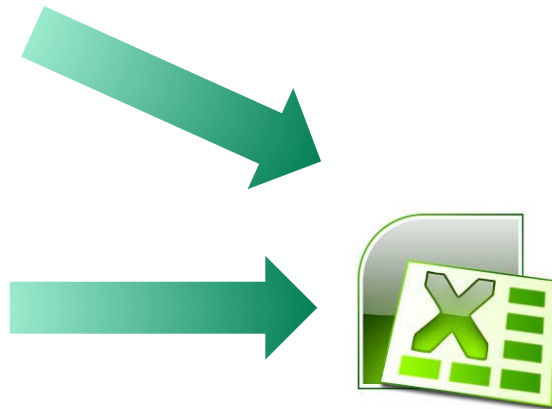
- Heating

- Cooling

- DHW

- electricity

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PV$_{Therm}$-PreCheck – input parameters

Hourly weather and load profiles

- Heating
- Cooling
- DHW
- electricity

Components' properties & sizes

- Thermal storages

- Battery storage

- Efficiency curves of PV/HP/CC

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PV$_{Therm}$-PreCheck – economics

Hourly weather and load profiles

- Heating
- Cooling
- DHW
- electricity

Components' properties & sizes

- Thermal storages
- Battery storage
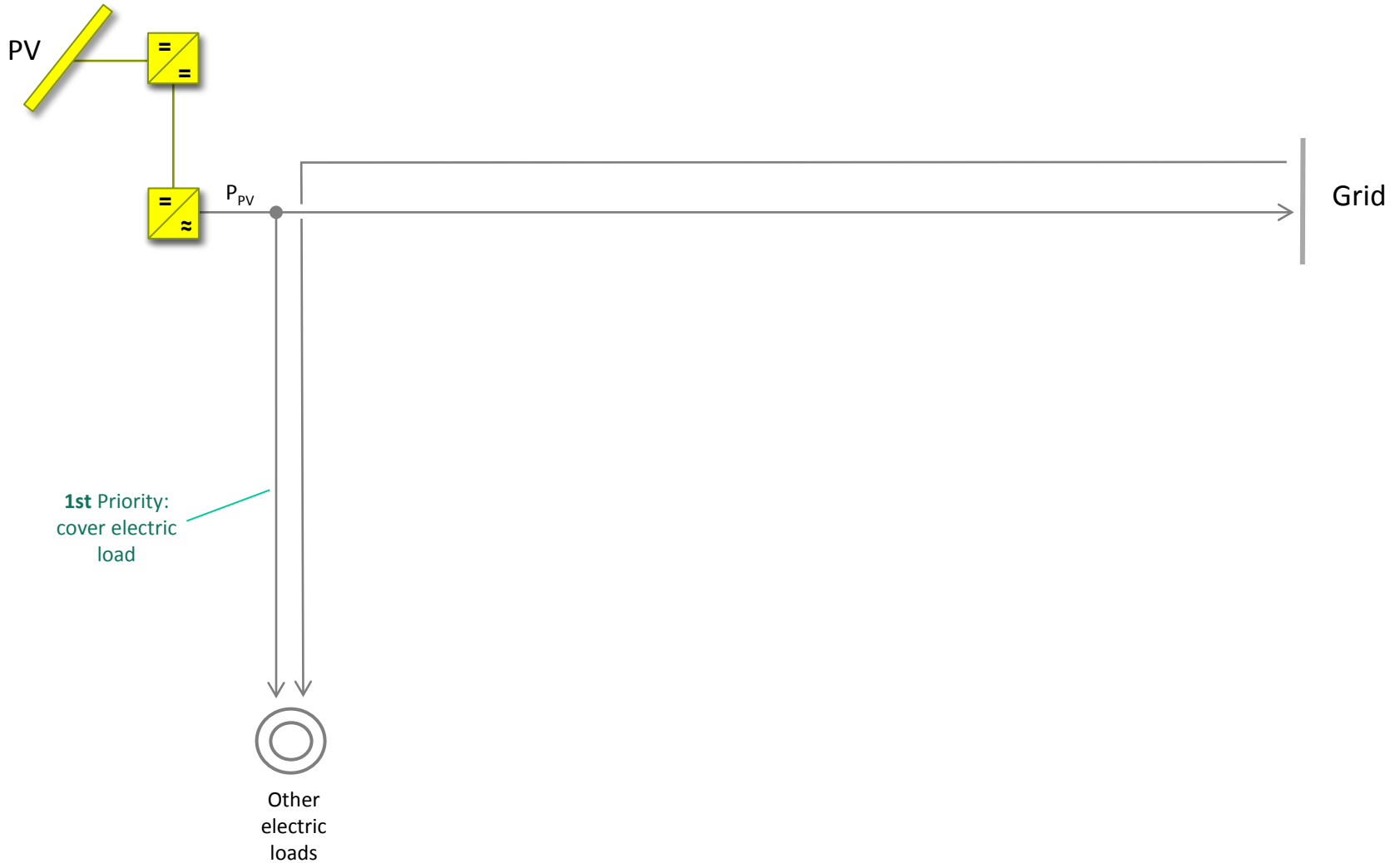- Efficiency curves of HP/CC

Cost functions

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PV$_{Therm}$-PreCheck – outputs

Hourly weather and load profiles

- Heating
- Cooling
- DHW
- electricity

Components' properties & sizes

- Thermal storages
- Battery storage
- Efficiency curves of PV/HP/CC
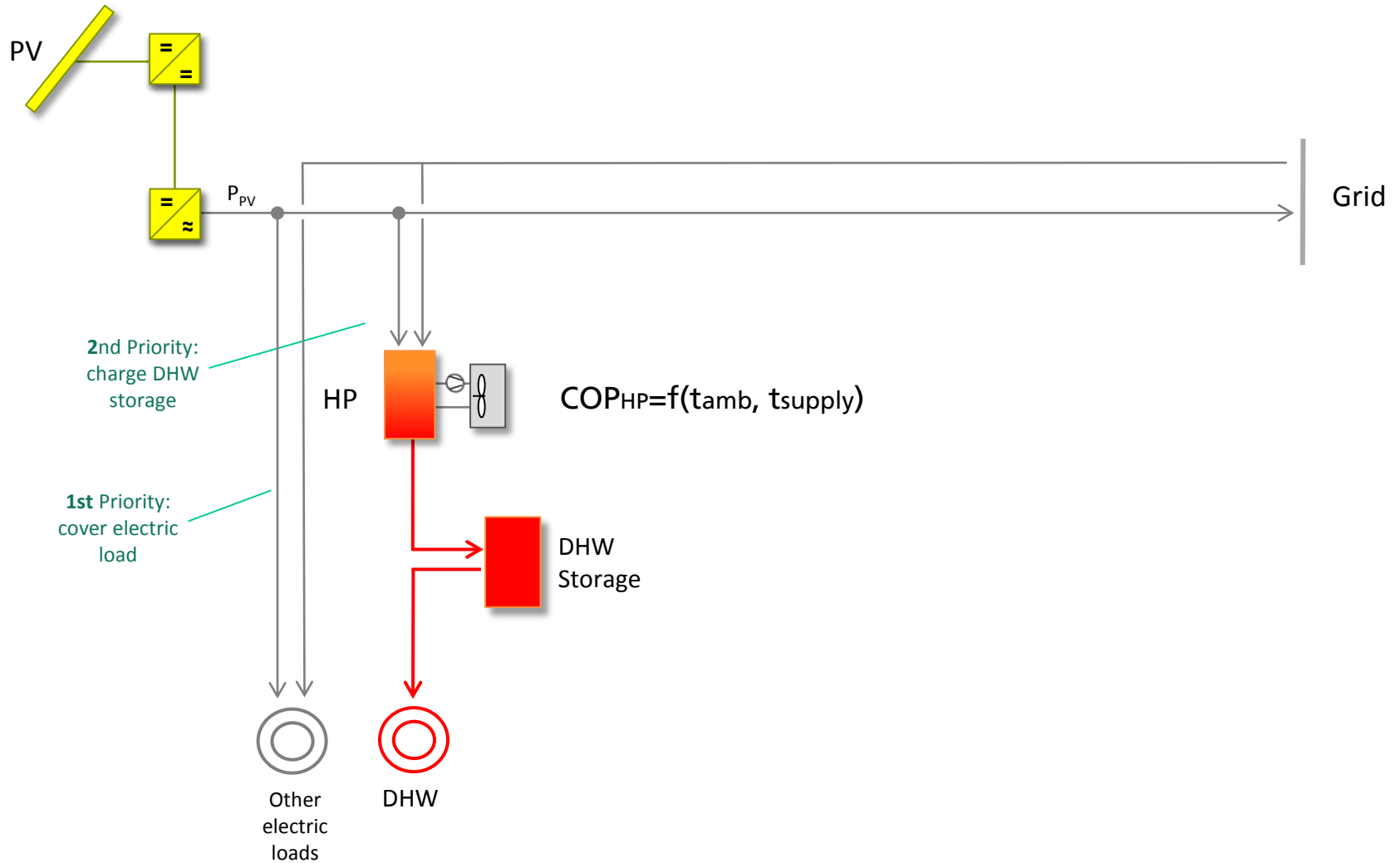
Cost functions

Energetic evaluation

Economic evaluation

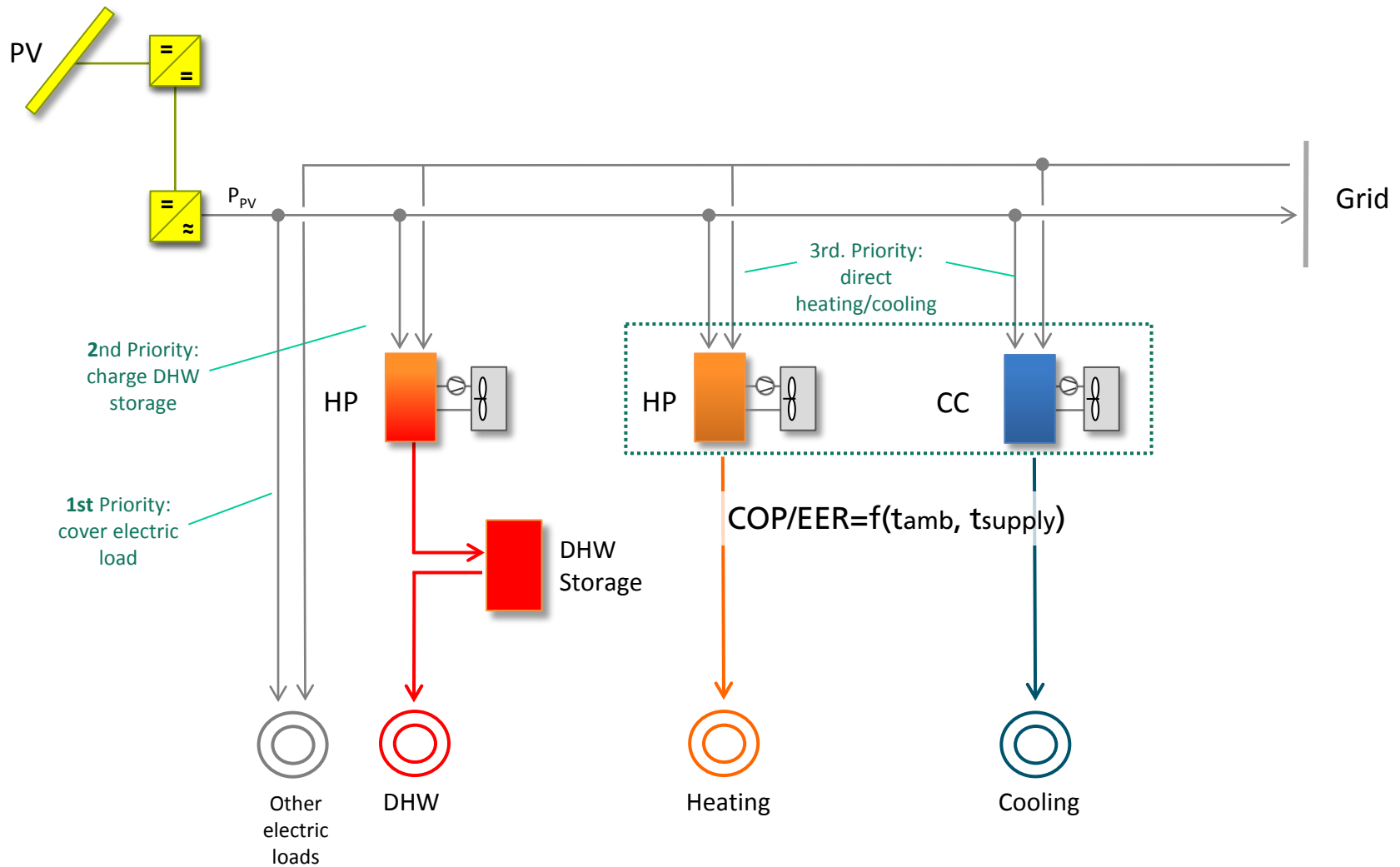# PV$_{Therm}$-PreCheck – System scheme and operation logic

P$_{PV}$=f(t$_{amb}$, G$_{hor}$)

PV

=/=

=/≈

P$_{PV}$

Grid

1st Priority: cover electric load

Other electric loads

PV$_{Therm}$-PreCheck – System scheme and operation logic

PV

Grid

P_{PV}

2nd Priority: charge DHW storage

HP

$COP_{HP} = f(t_{amb}, t_{supply})$

1st Priority: cover electric load
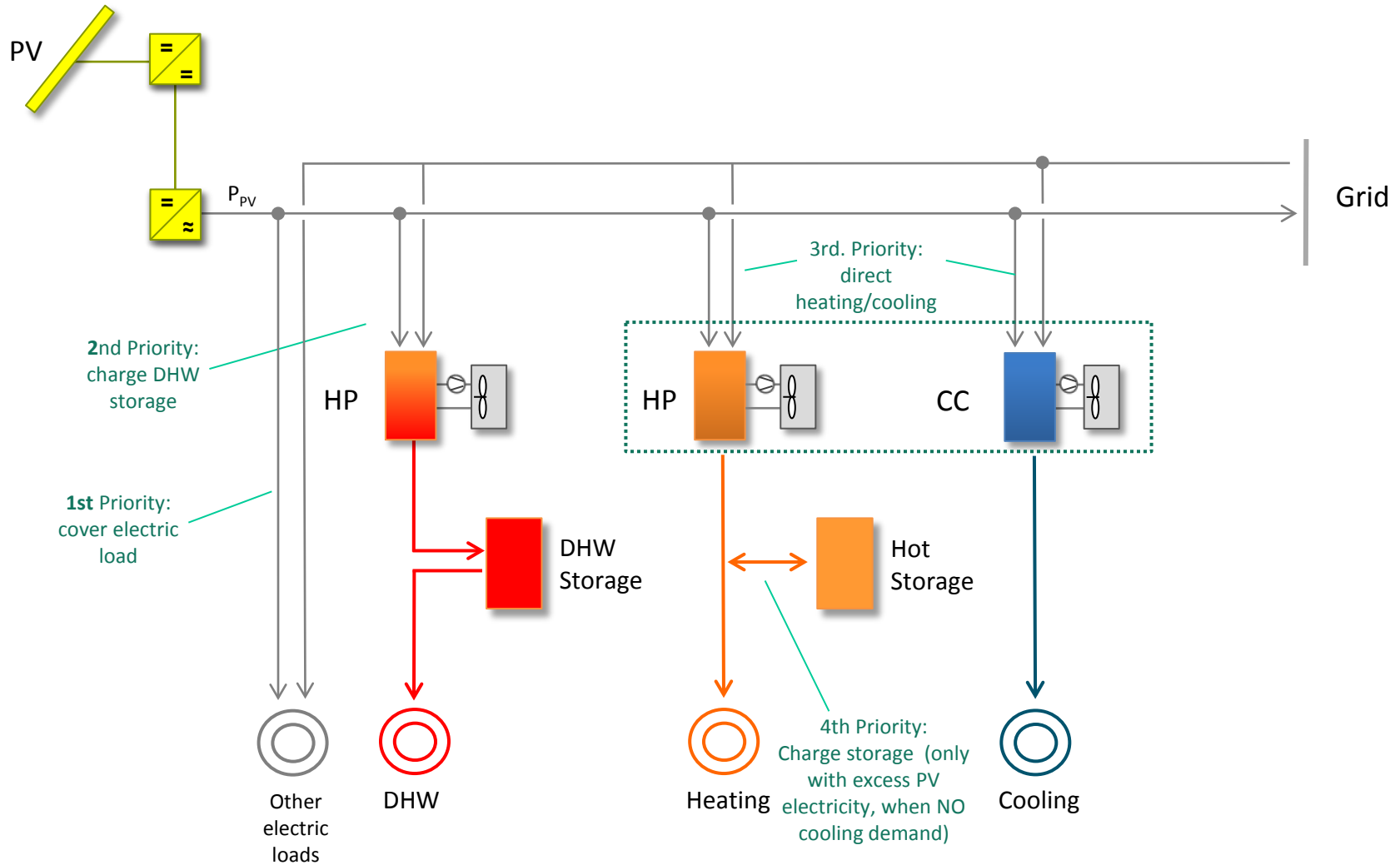
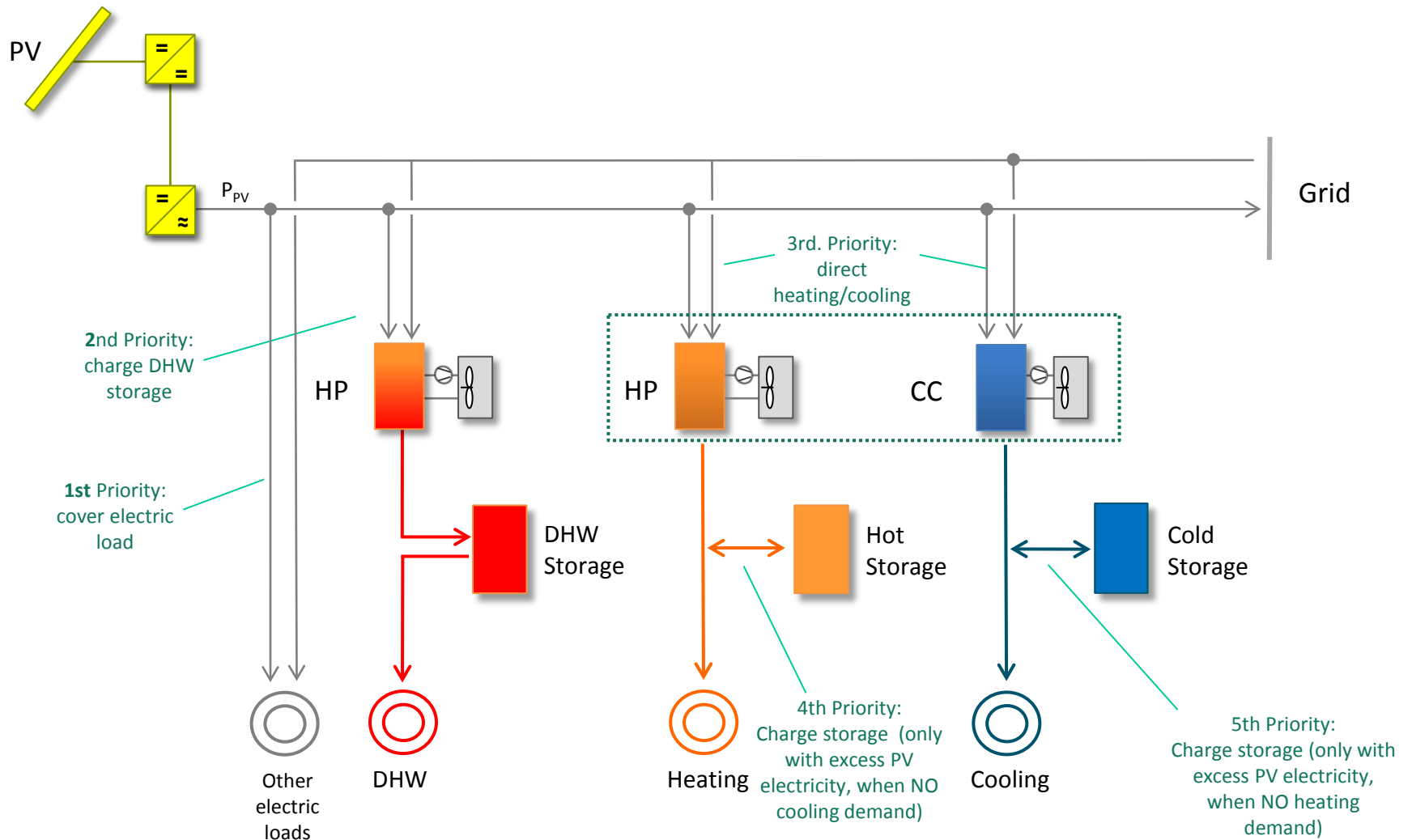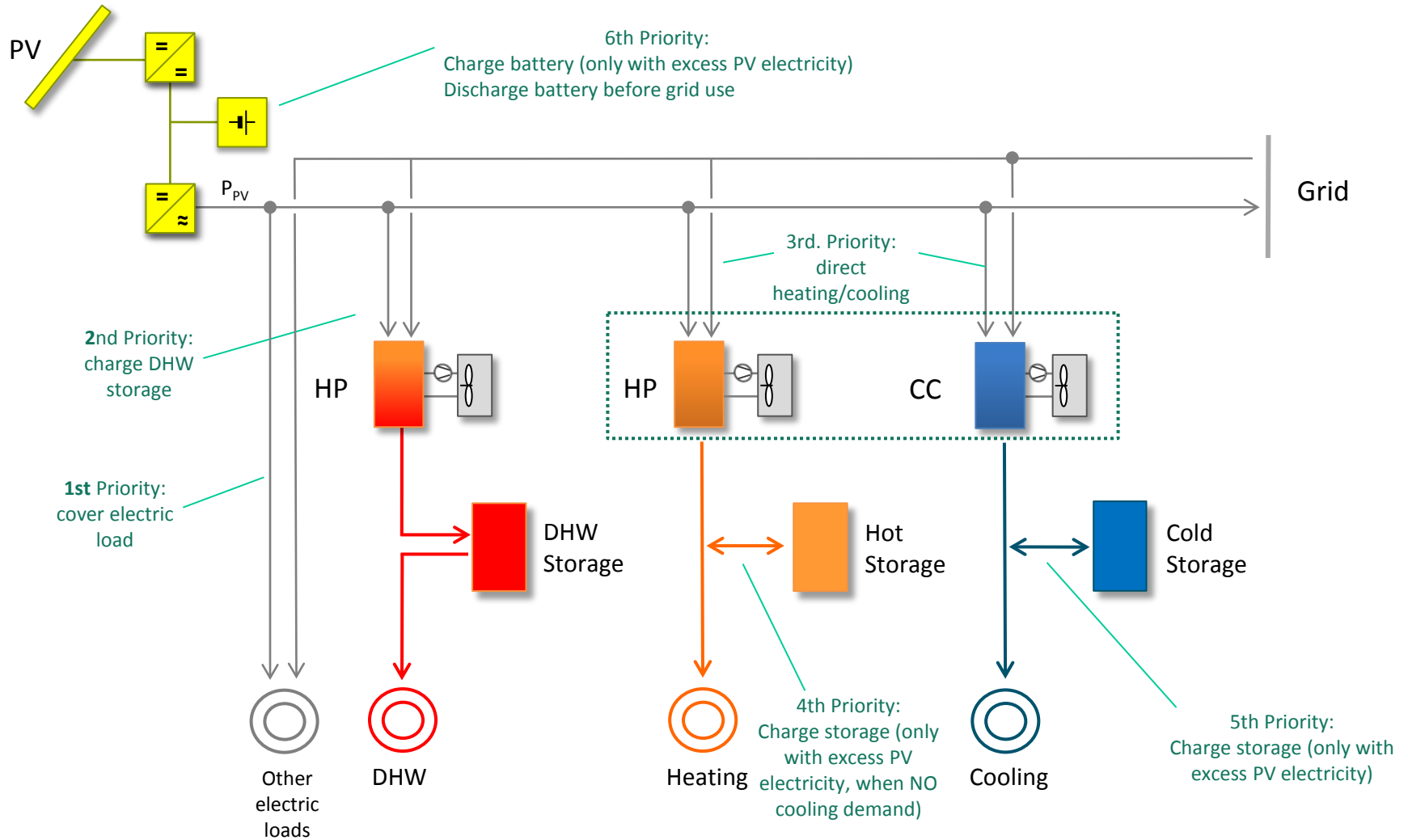DHW Storage

Other electric loads

DHW

PV$_{Therm}$-PreCheck – System scheme and operation logic

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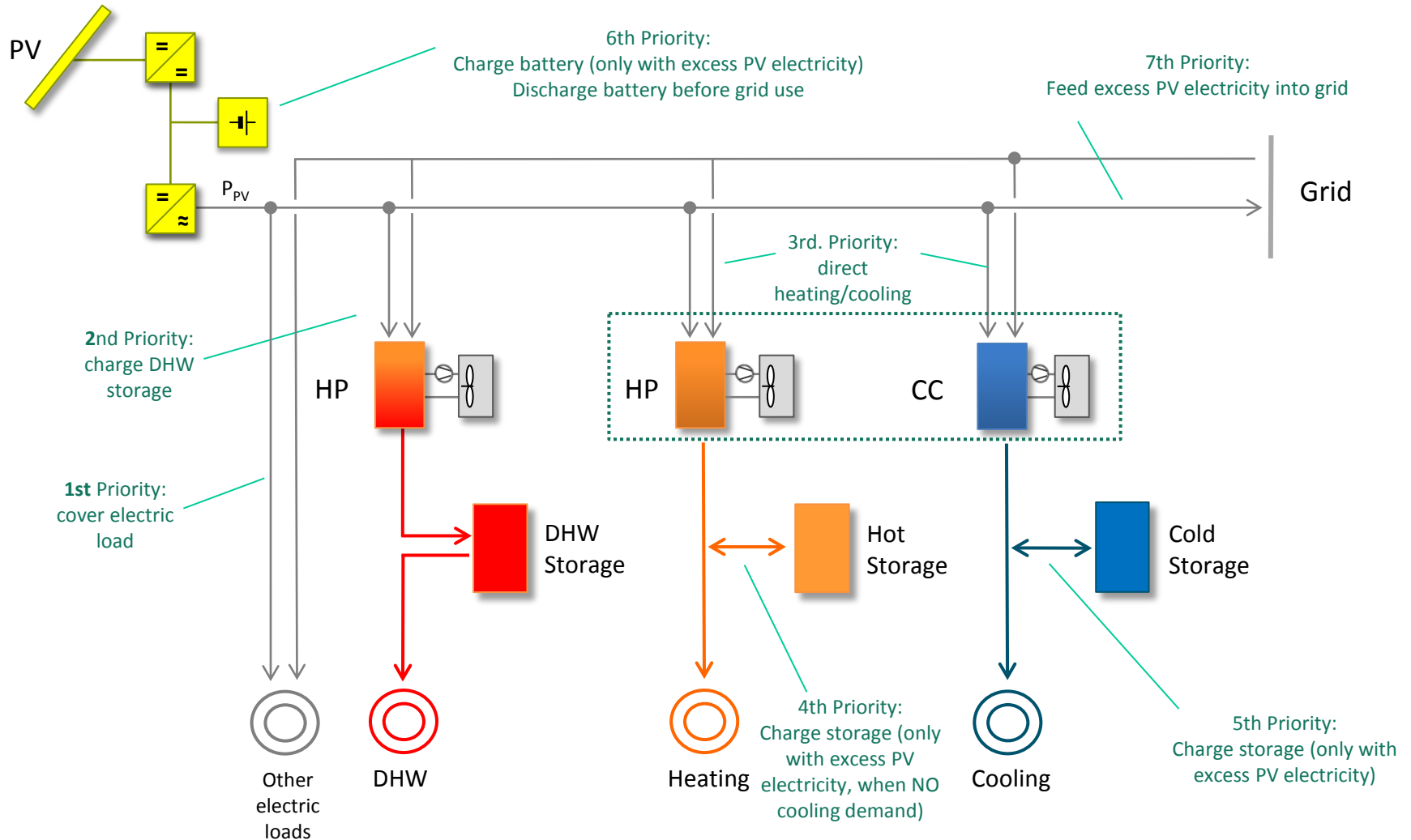
PV$_{Therm}$-PreCheck – System scheme and operation logic

PV$_{Therm}$-PreCheck – System scheme and operation logic

PV

6th Priority:
Charge battery (only with excess PV electricity)
Discharge battery before grid use

Grid

P$_{PV}$

3rd. Priority:
direct
heating/cooling

2nd Priority:
charge DHW
storage

HP

HP

CC

1st Priority:
cover electric
load

DHW
Storage

Hot
Storage

Cold
Storage

Other
electric
loads

DHW

Heating

4th Priority:
Charge storage (only
with excess PV
electricity, when NO
cooling demand)

Cooling

5th Priority:
Charge storage (only with
excess PV electricity)

# PV_Therm-PreCheck – System scheme and operation logic

Examplary results

- Single family house (140m²) in Potsdam, Germany

- Measured electric loads (3700kWh)

- Simulated thermal loads (2400kWh DHW, 7500kWh heating, 1000kWh cooling)

- Reversible, 0-100% controllable HP, additional DHW-HP

- 200l DHW storage

- Direct self consumption / heating / cooling
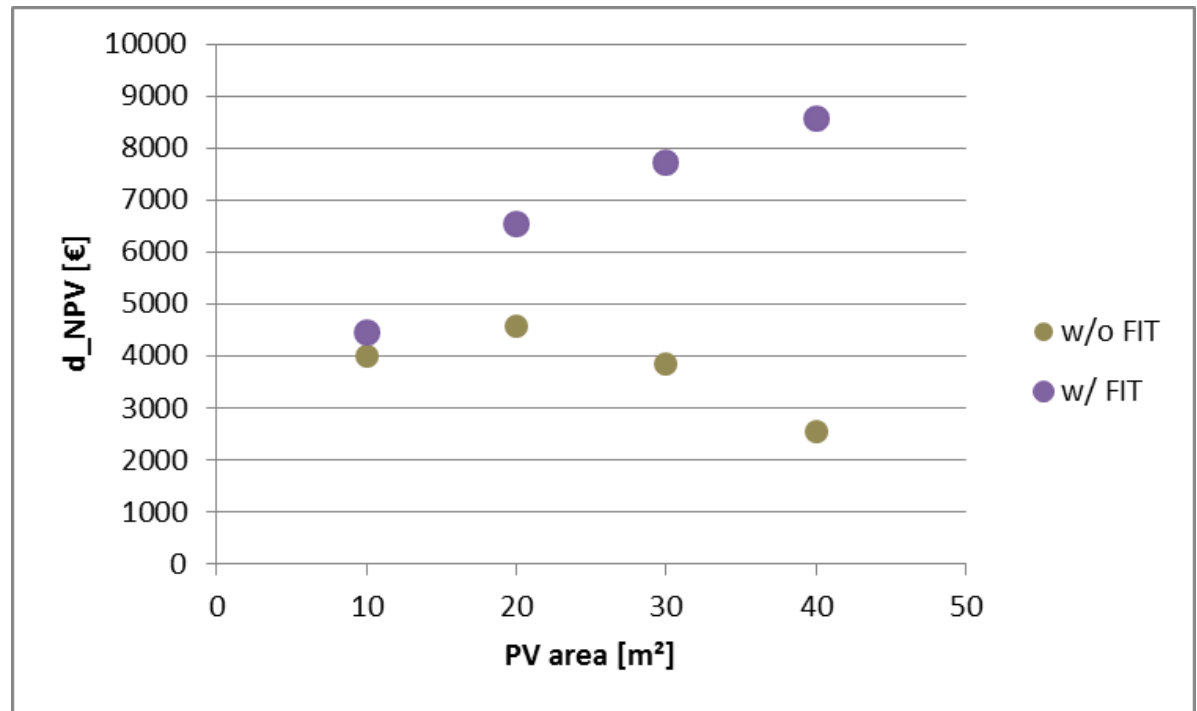
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Results – SFH Germany: Solar fraction

- Single family house (140m²) in Potsdam, Germany

- Measured electric loads, simulated thermal loads

- Direct self consumption / heating / cooling
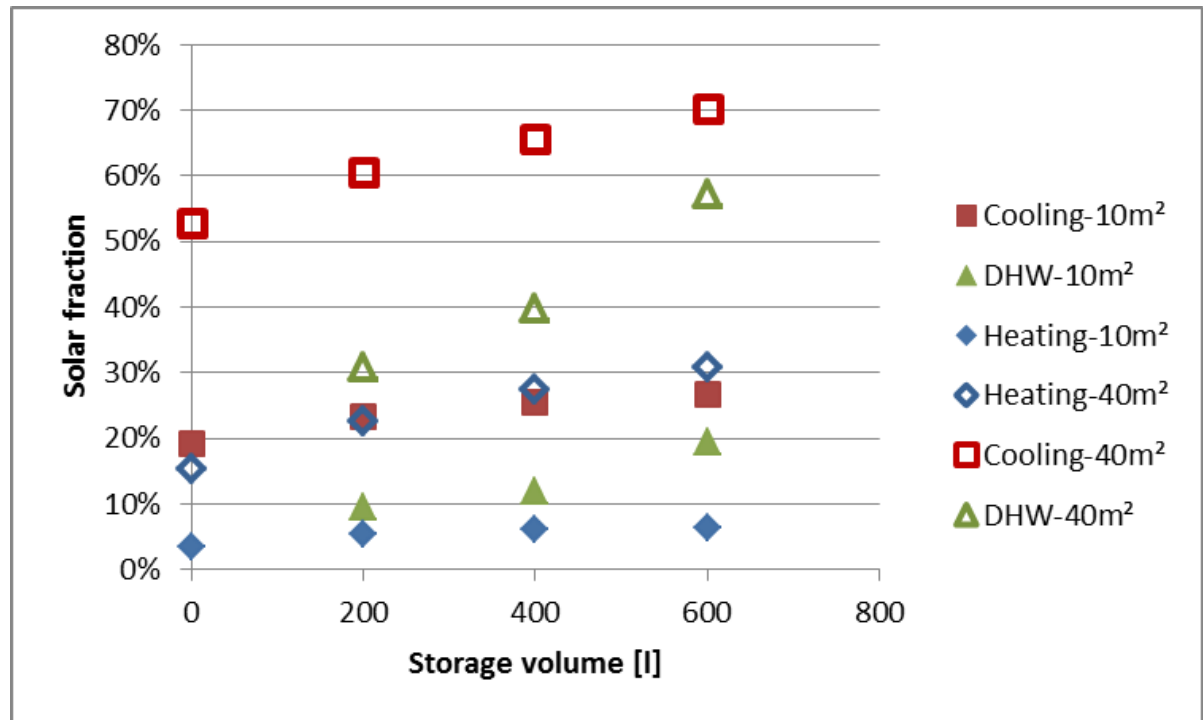
- 200l DHW storage
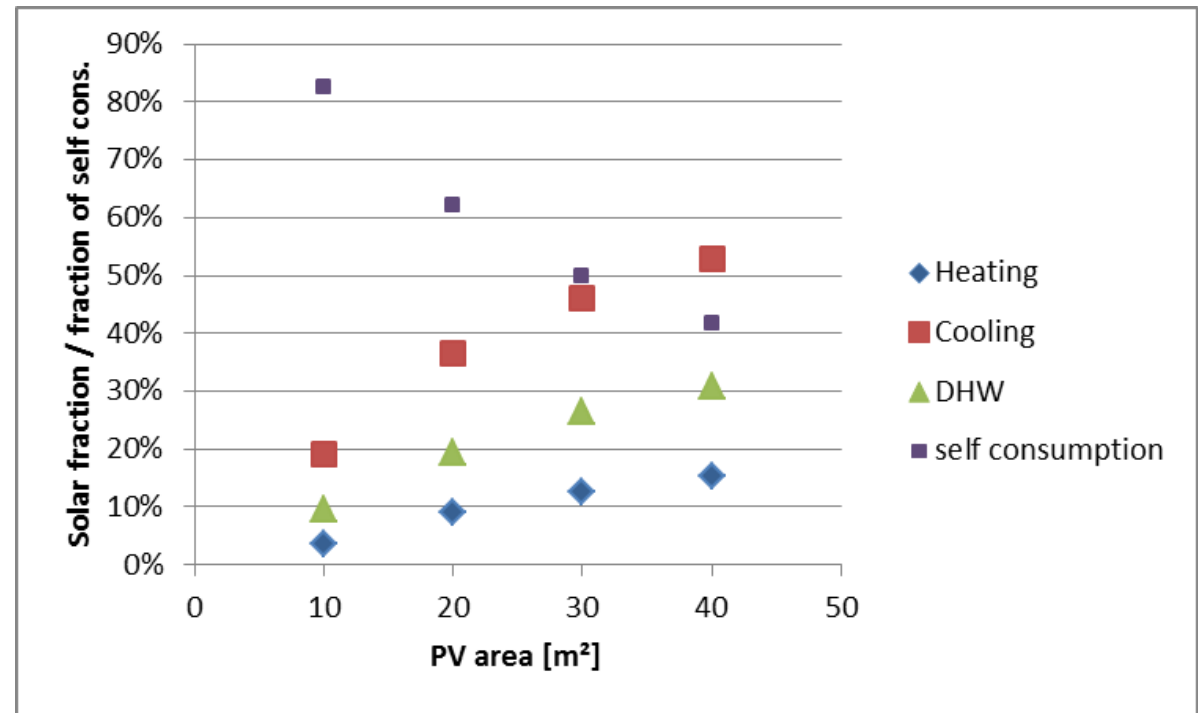
Results – SFH Germany

- d_NPV = NPV actual configuration – NPV reference configuration
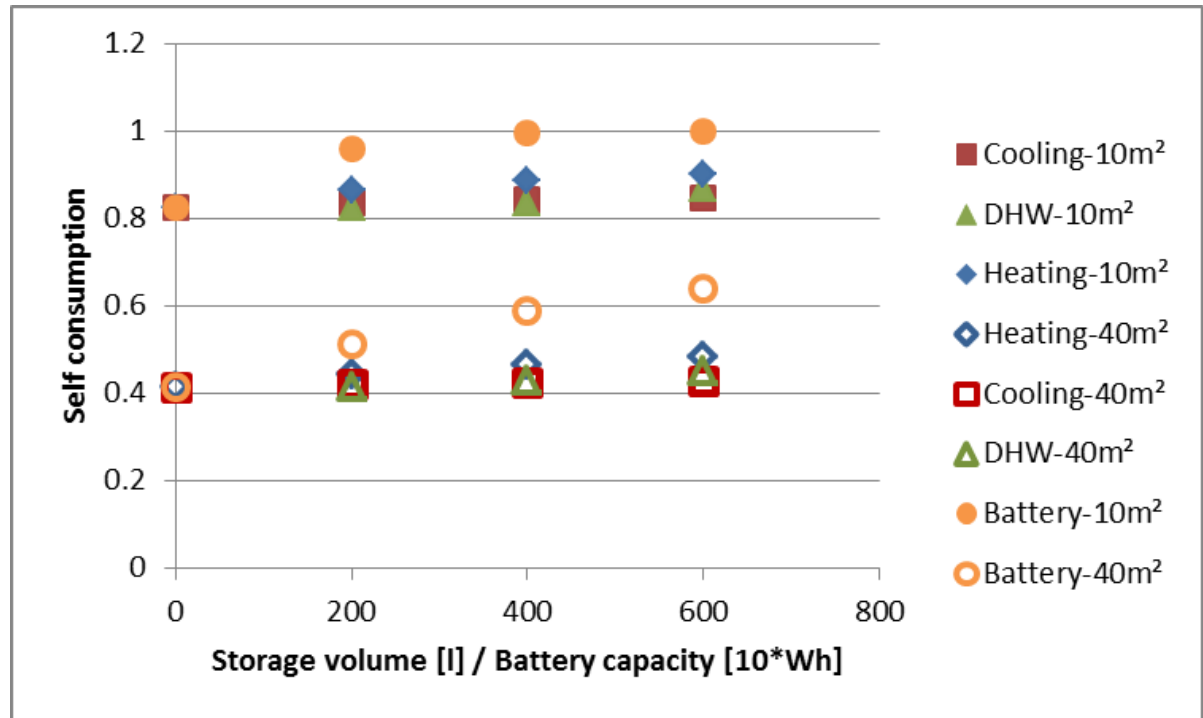
- Feed-in tariff 12ct/kWh

- Electricity cost 25ct/kWh

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SFH Germany – influence of storage volume

- Only one storage size is varied at a time

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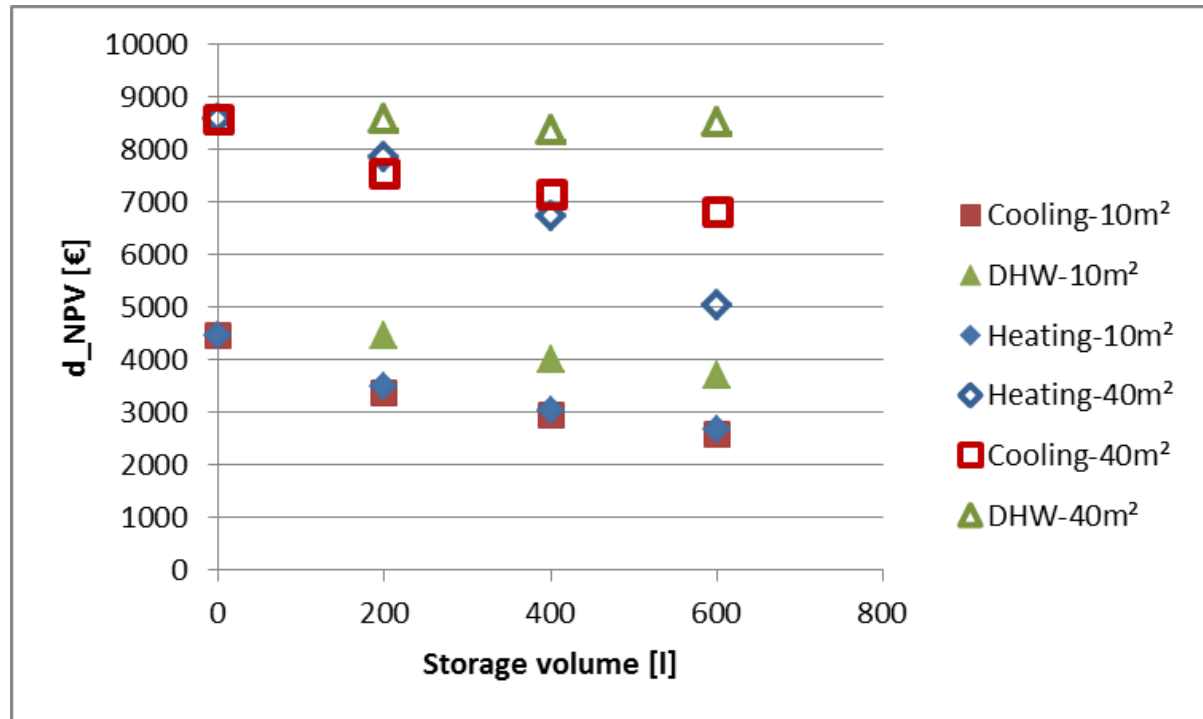# SFH Germany – influence of storage volume

SFH Germany – influence of storage volume
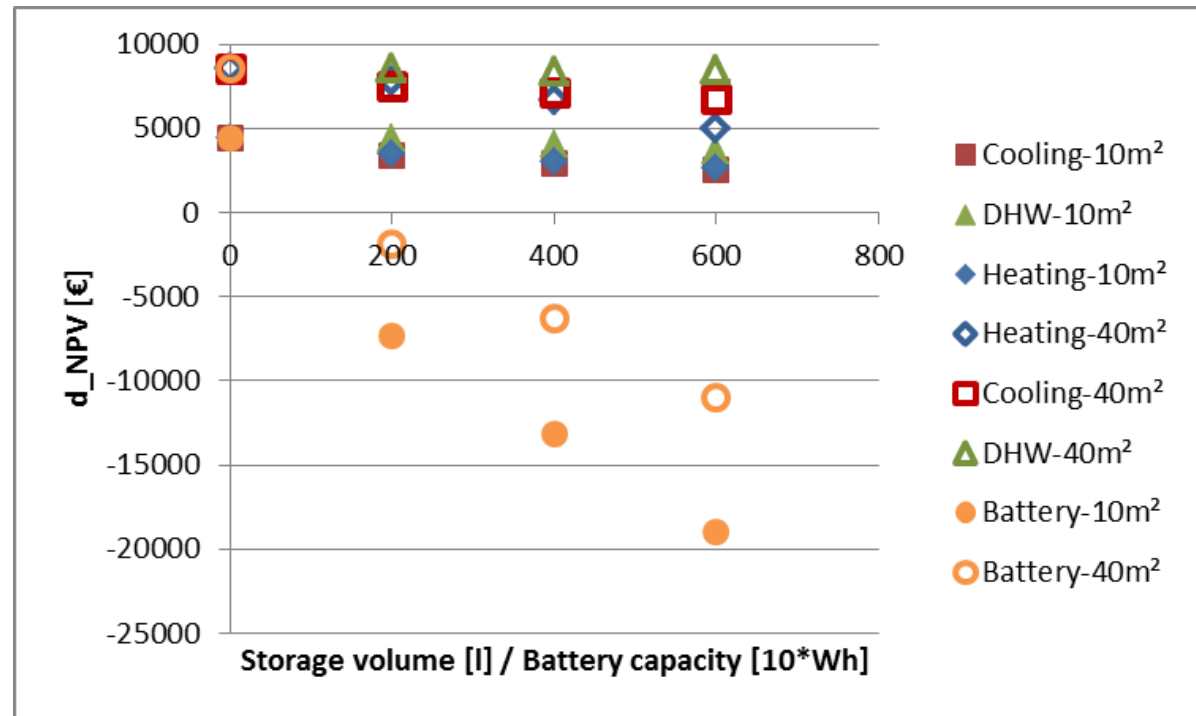
- d_NPV = NPV actual configuration – NPV reference configuration

Calculated with 12
ct/kWh FIT

SFH Germany – influence of storage volume

- d_NPV = NPV actual configuration – NPV reference configuration
- Specific costs of *installed* battery storage 2…3k€

Calculated with 12
ct/kWh FIT

Conclusions

- Simple tool allows quick evaluation of different scenarios (incl. parameter variation)

- Optimum configuration dependent on various factors (loads, climate, costs, …)

- In small applications energy storage is rarely profitable

  - Heating due to bad congruence of solar resource and demand

  - Cooling due to small dT in sensible storage

  - Battery due to high investment costs

Next steps:

- Refinement of models,

- Validation against transient simulation,

- …

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Thank you for your attention!
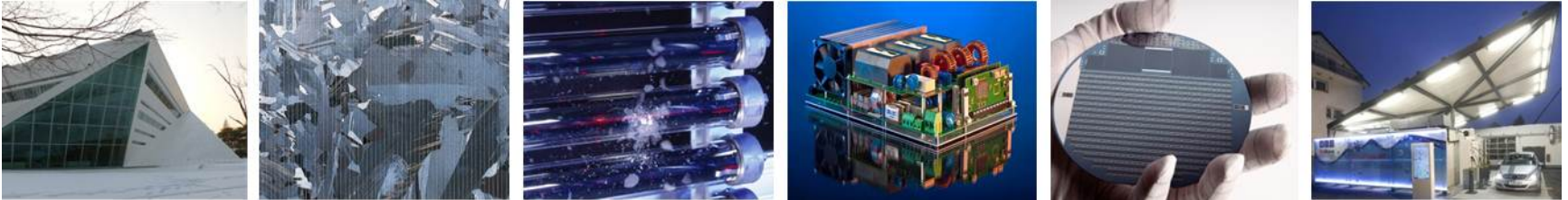
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