# 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

# $PV_{Therm}$-PreCheck – based on MS Excel

# $PV_{Therm}$-PreCheck – input profiles

Hourly weather and load profiles

- Heating
- Cooling
- DHW
- Electricity

# $PV_{Therm}$-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

# $PV_{Therm}$-PreCheck – economics

Hourly weather and load profiles

- Heating
- Cooling
- DHW
- electricity

Components‘ properties & sizes

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

Cost functions

# $PV_{Therm}$-PreCheck – outputs

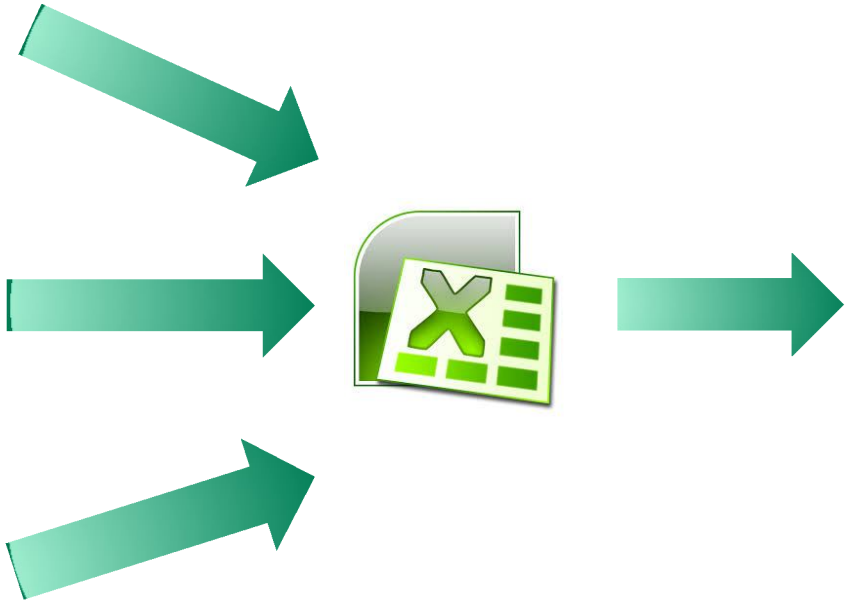
Hourly weather and load profiles

- Heating
- Cooling
- DHW
- electricity

Components‘ properties & sizes

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

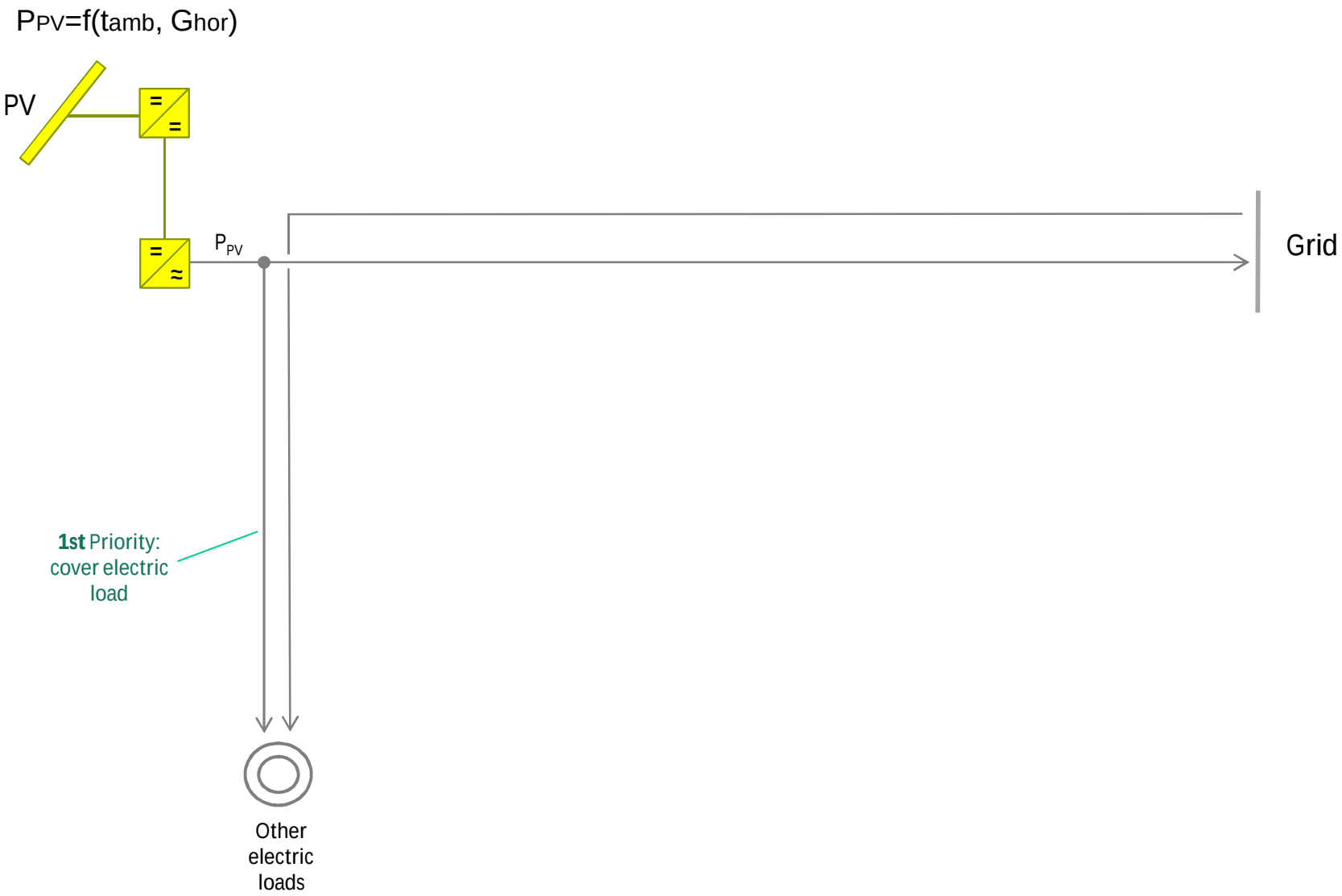
Cost functions



Energetic evaluation

Economic evaluation

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



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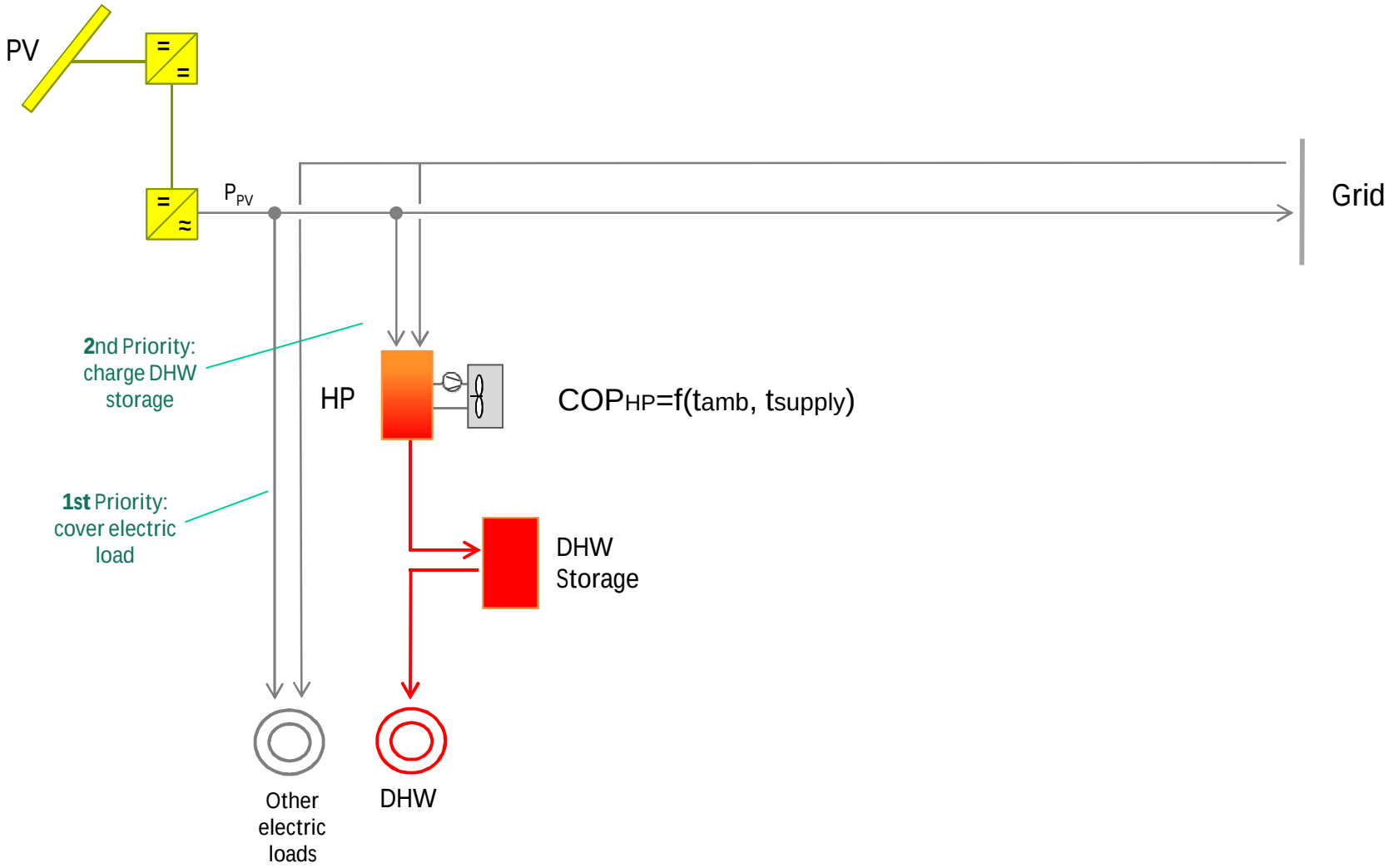

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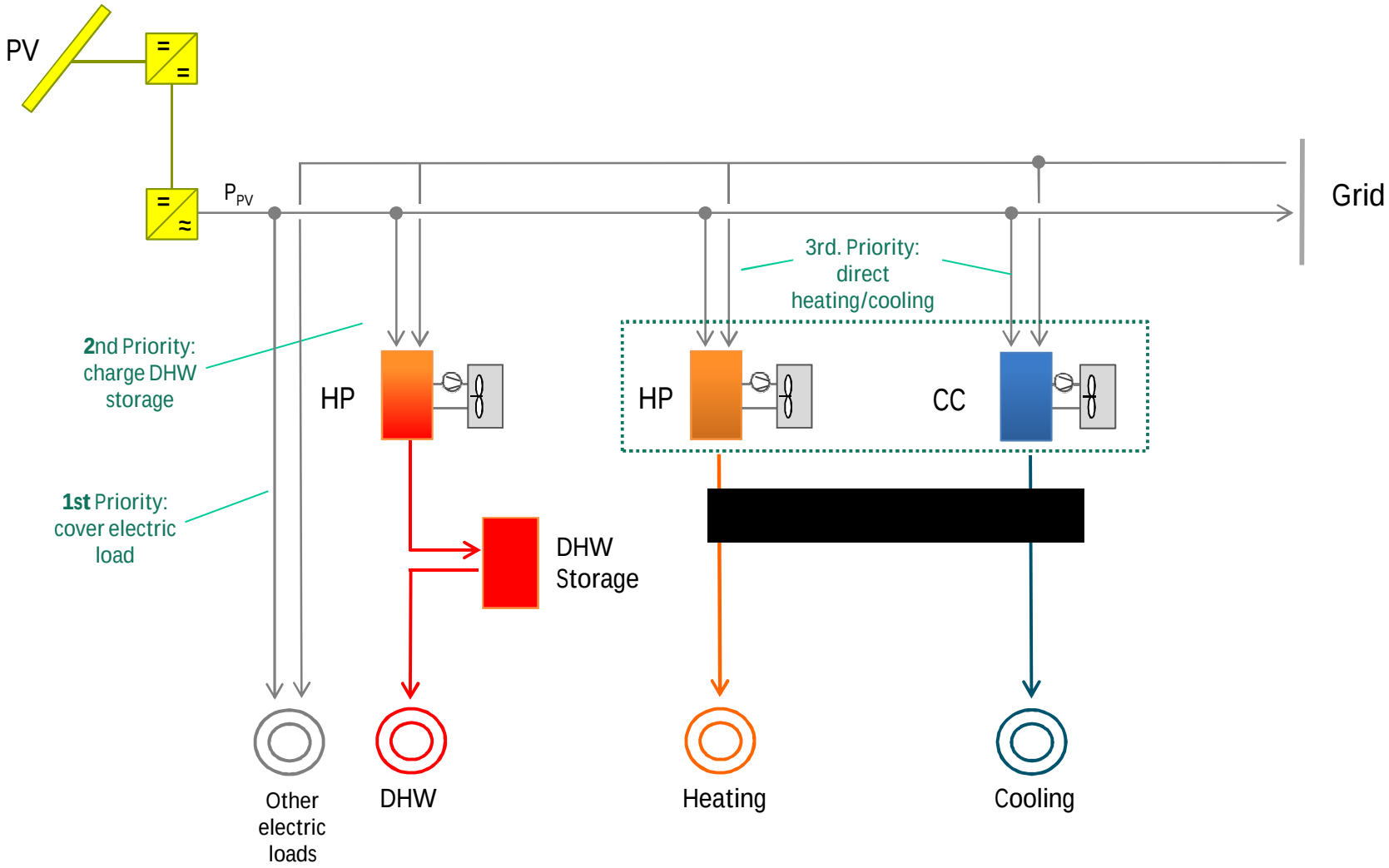

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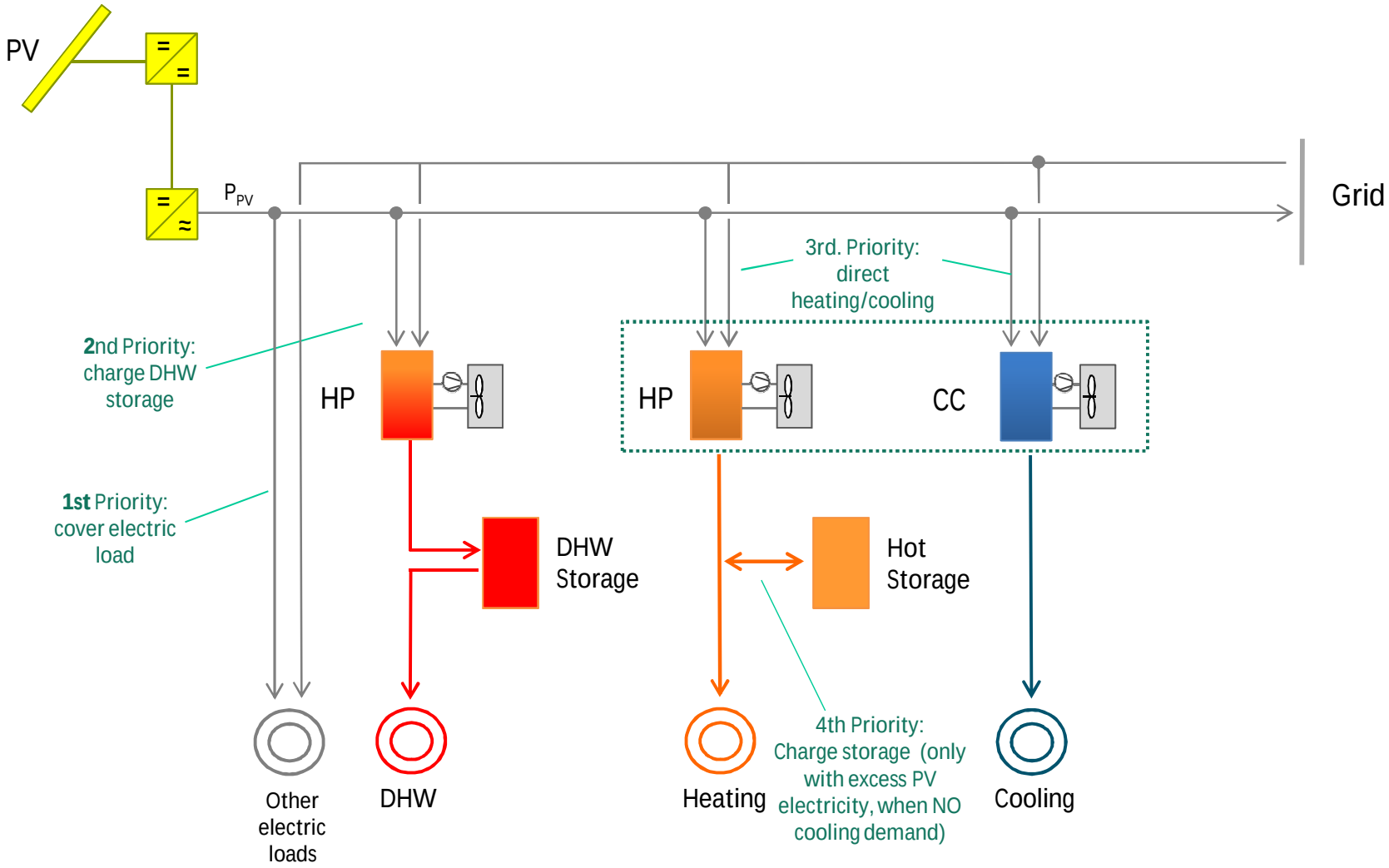

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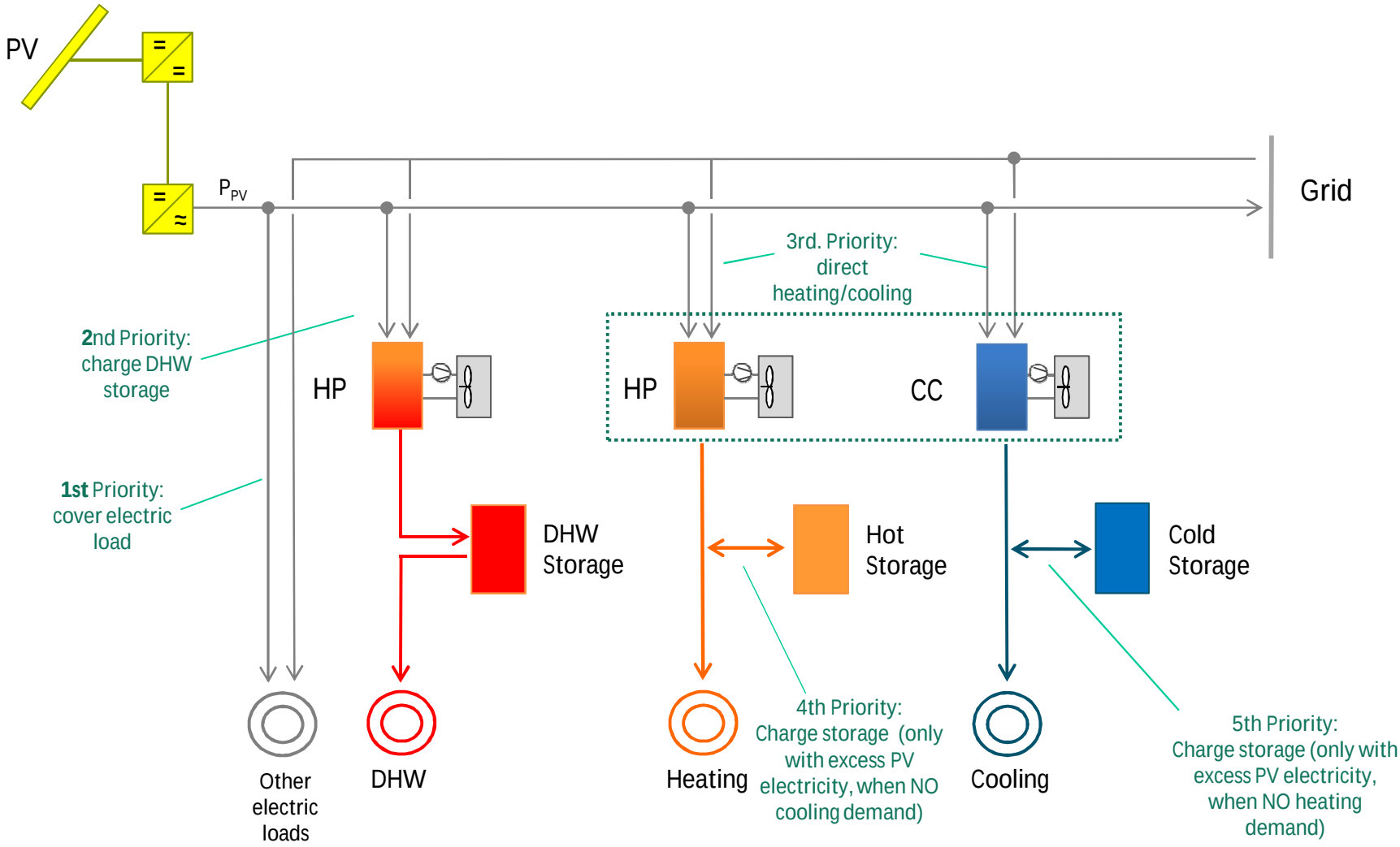

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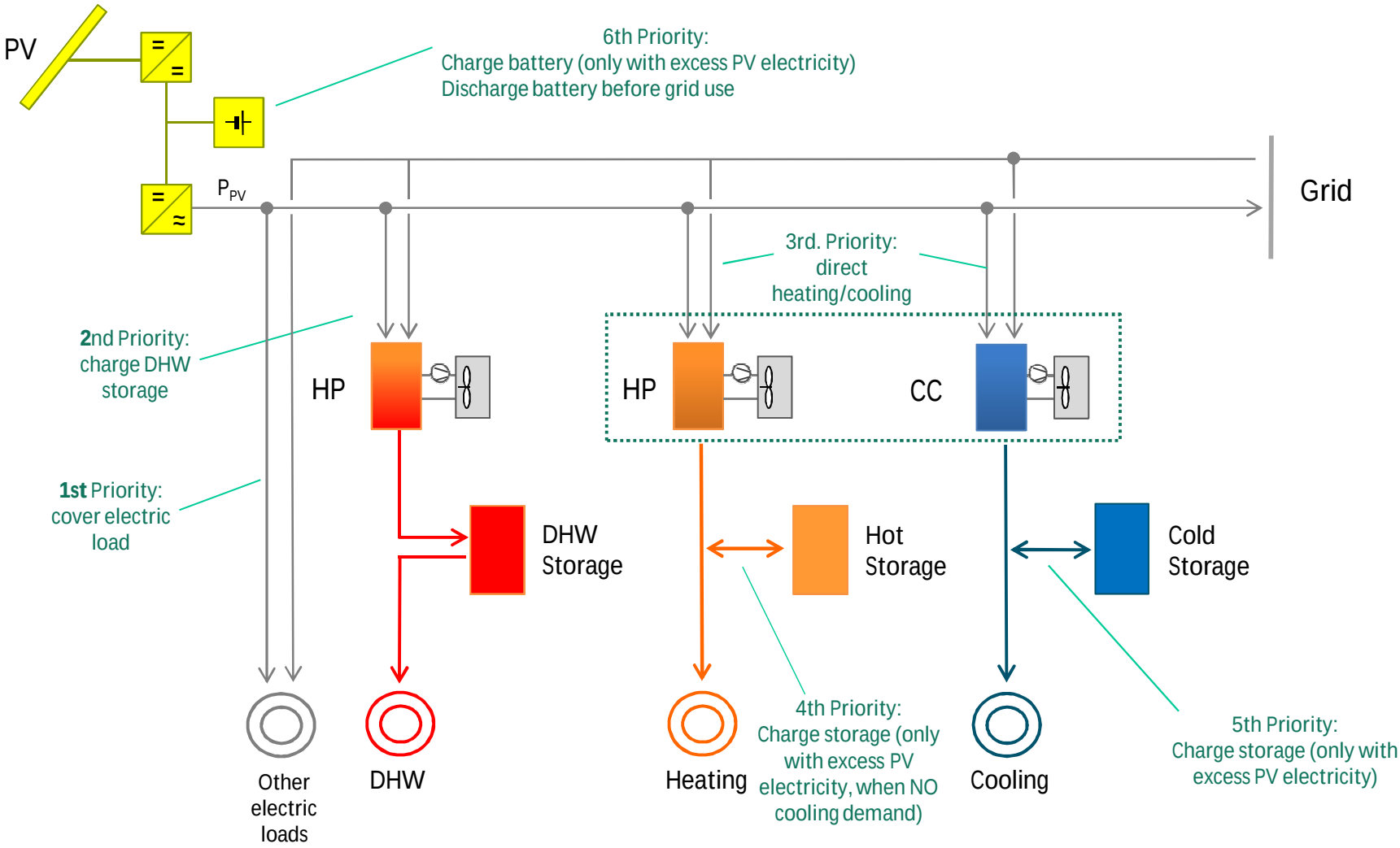

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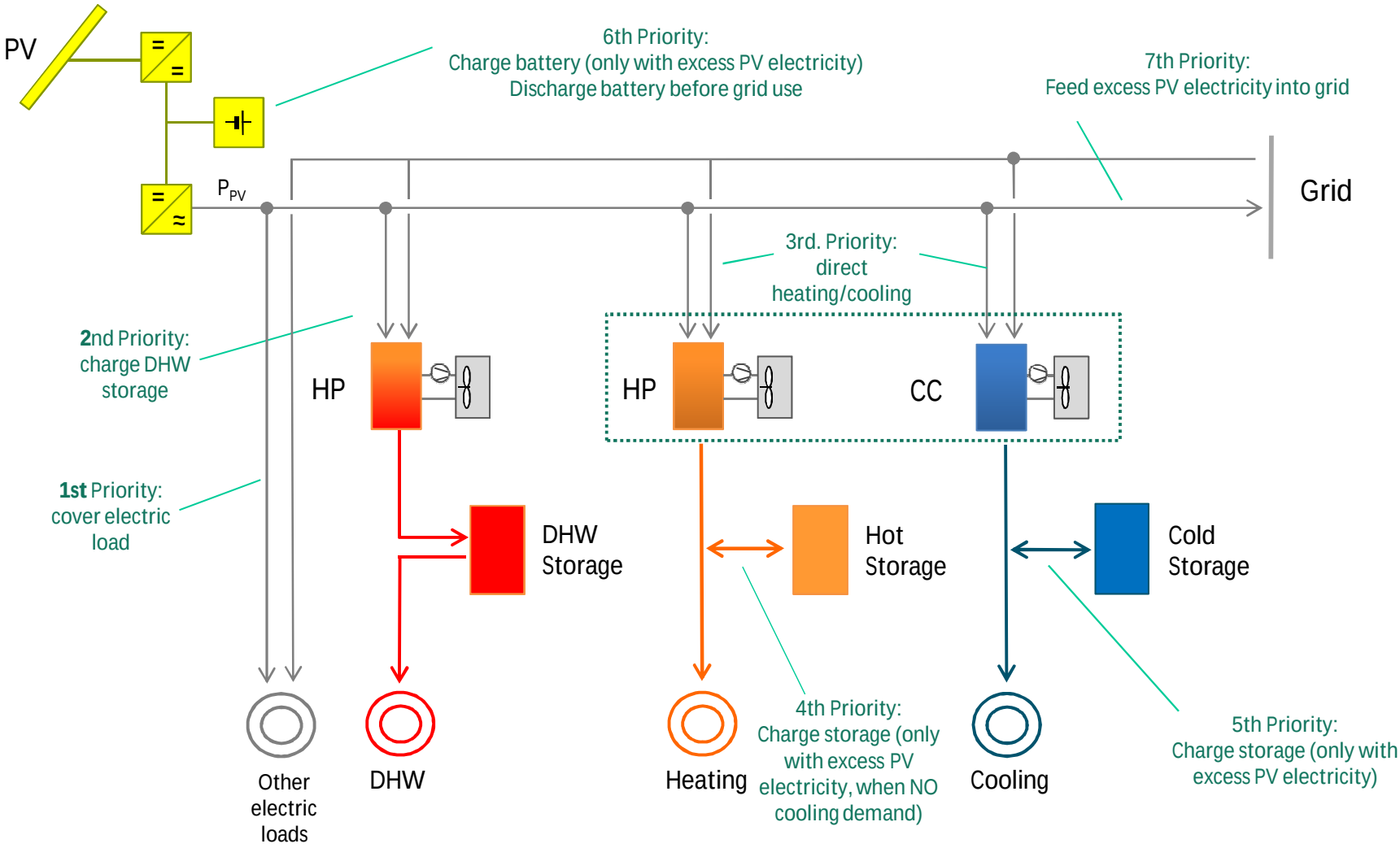
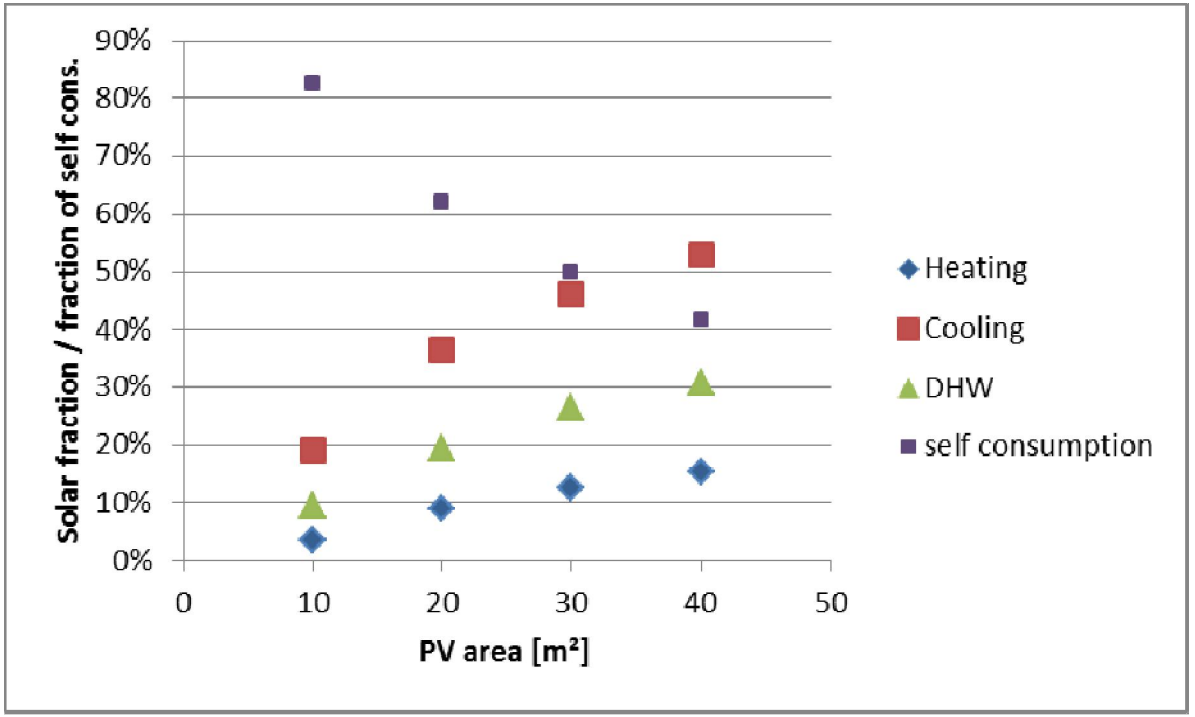


# Examplary results

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

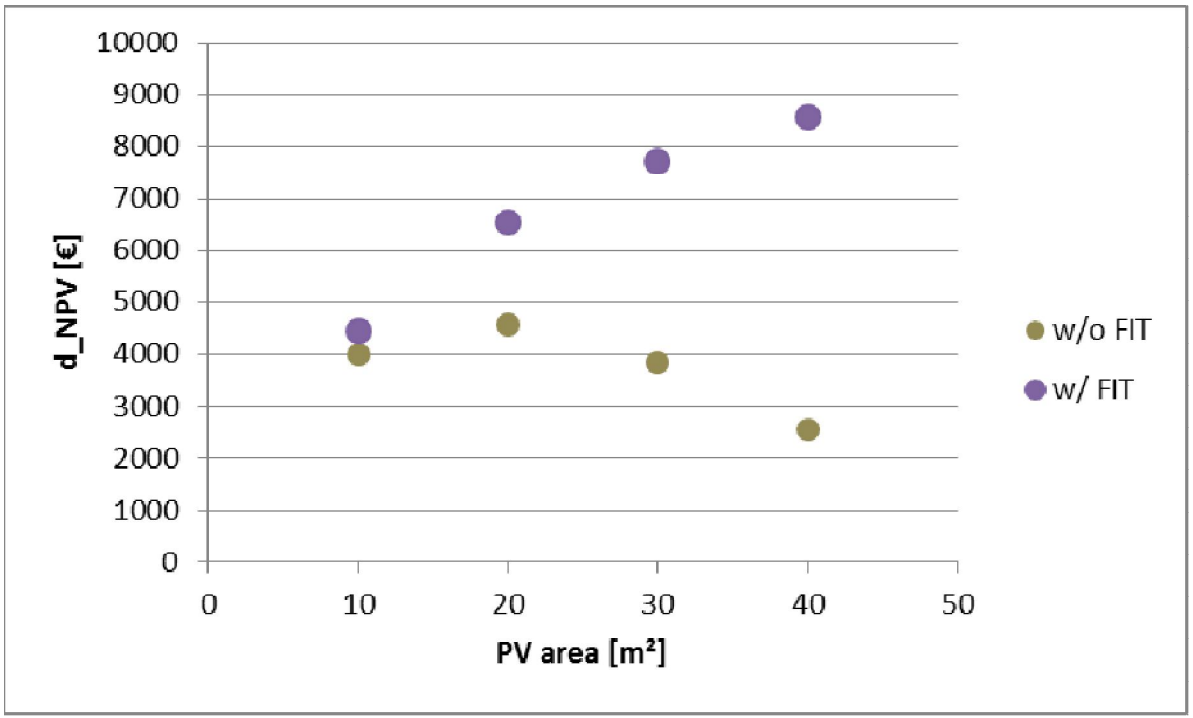
# Results – SFH Germany: Solar fraction

- Single family house (140m²) in Potsdam, Germany
- Measured electric loads, simulated thermal loads
- Direct self consumption / heating / cooling
- 200l DHW storage



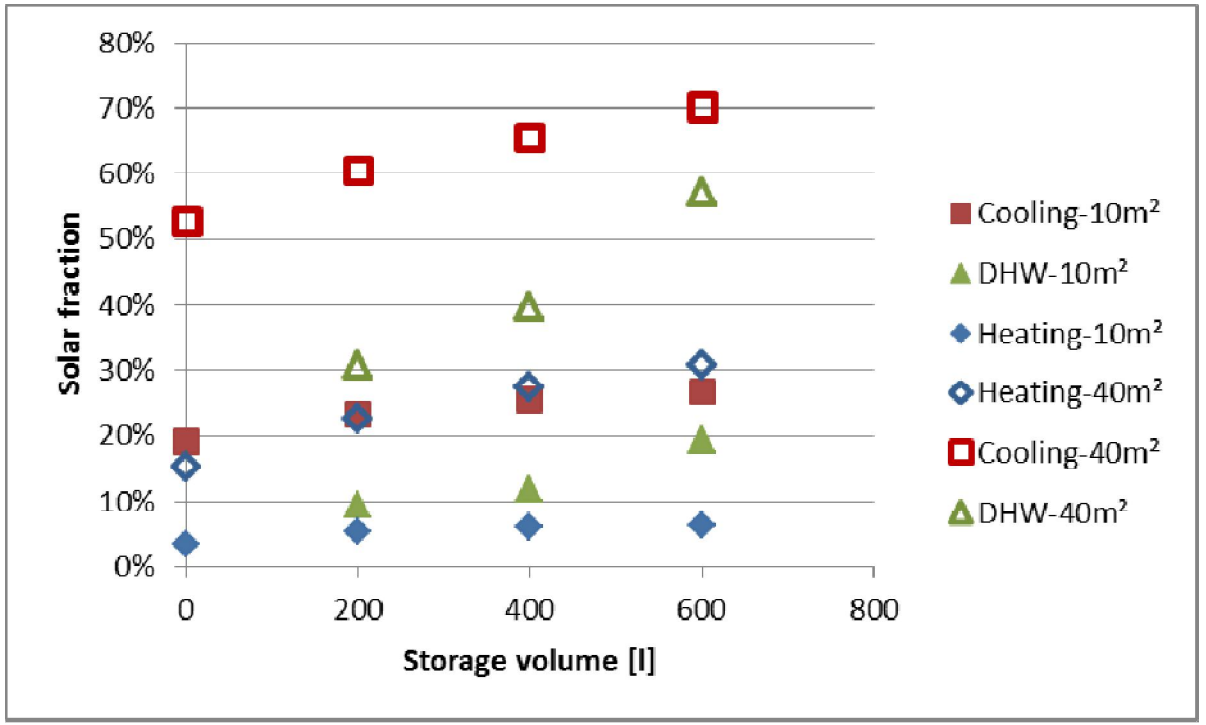
# Results – SFH Germany

- d_NPV = NPV actual configuration – NPV reference configuration
- Feed-in tariff 12ct/kWh
- Electricity cost 25ct/kWh



# SFH Germany – influence of storage volume

- Only one storage size is varied at a time



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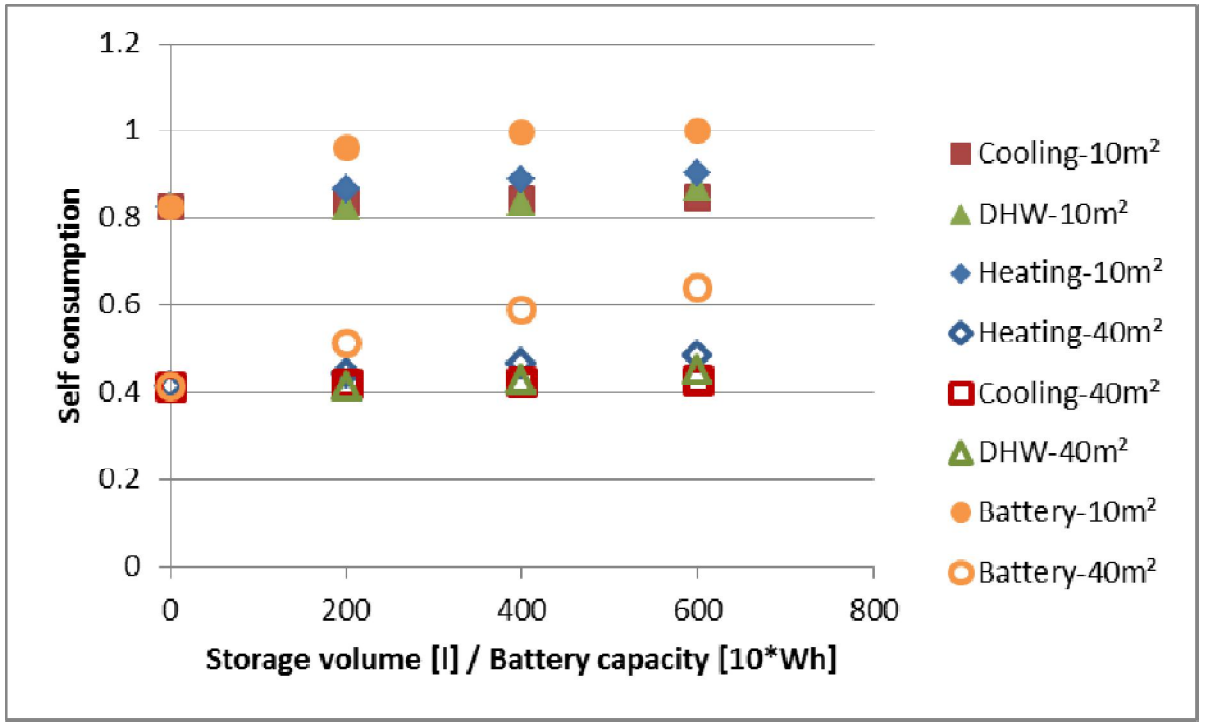

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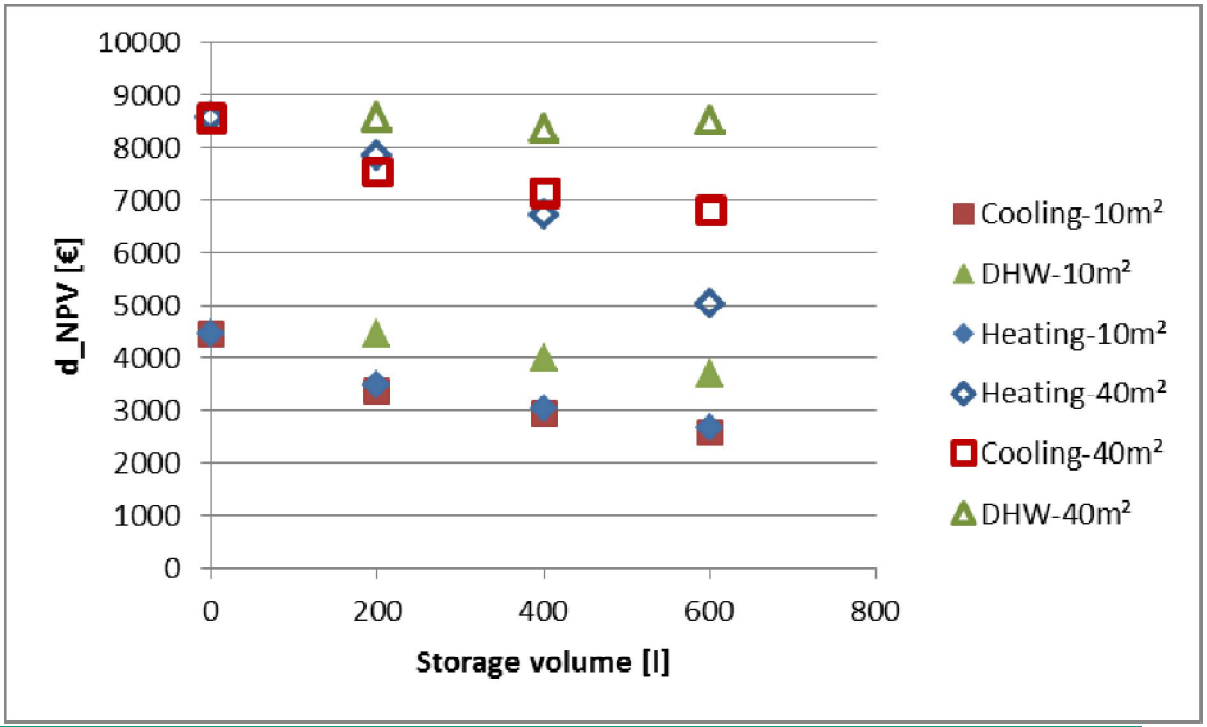
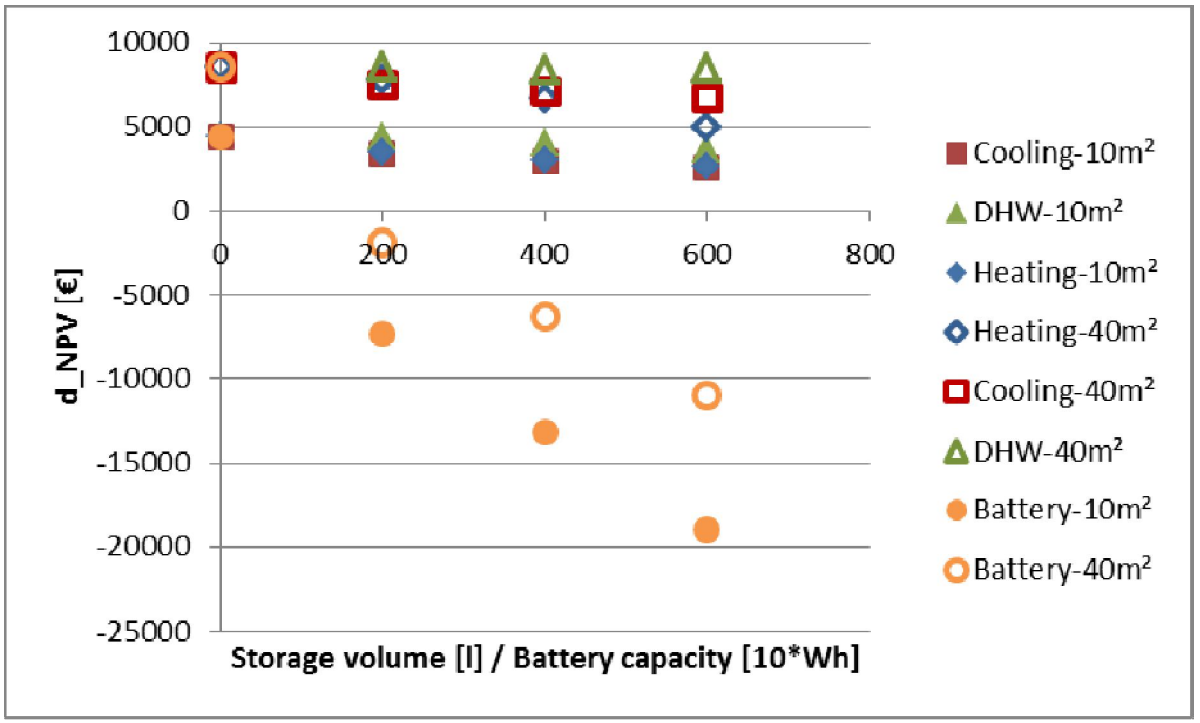



Calculated with 12 ct/kWh FIT

# SFH Germany – influence of storage volume

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




Calculated with 12 ct/kWh FIT

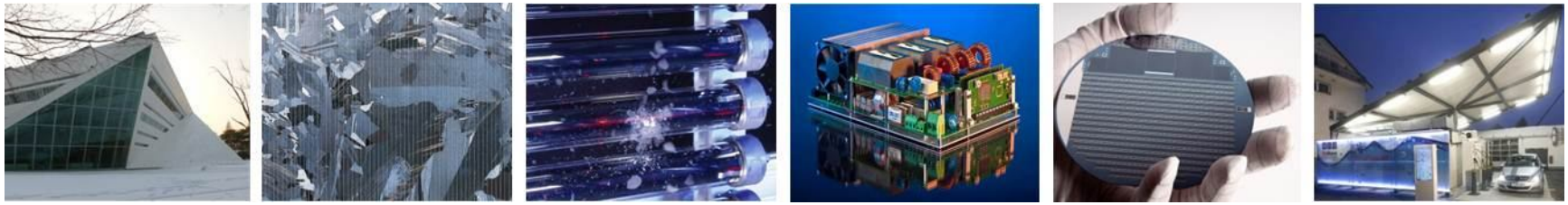
# Conclusions

- 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,
- Application to other sites
- …

# Thank you for your attention!



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