Institute of Technology in Architecture
Faculty of Architecture / ETH Zurich

Wastewater heat recovery

The heart of low exergy systems

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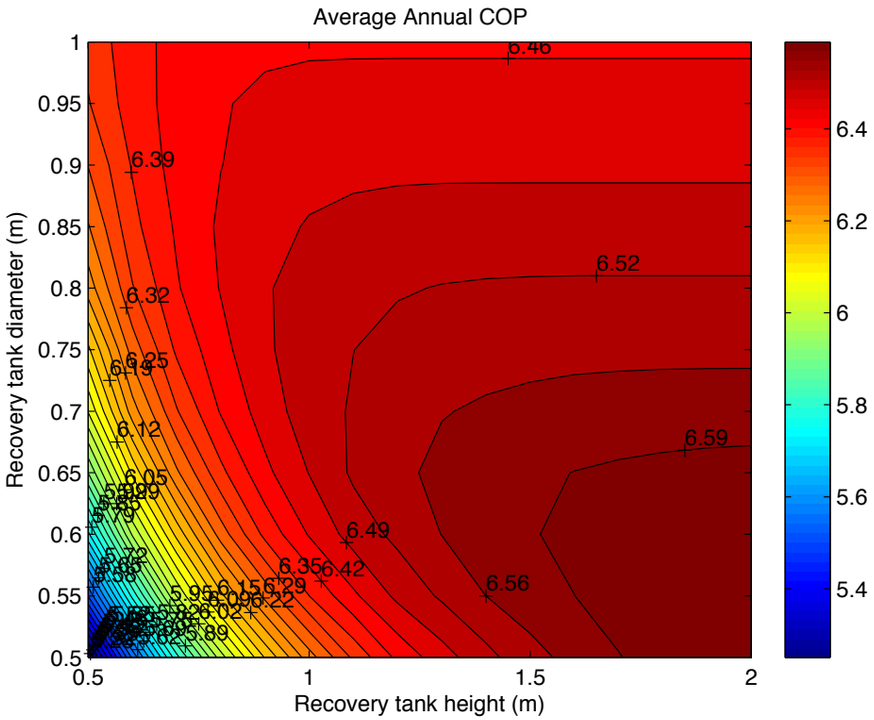


Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Hot water role in building performance

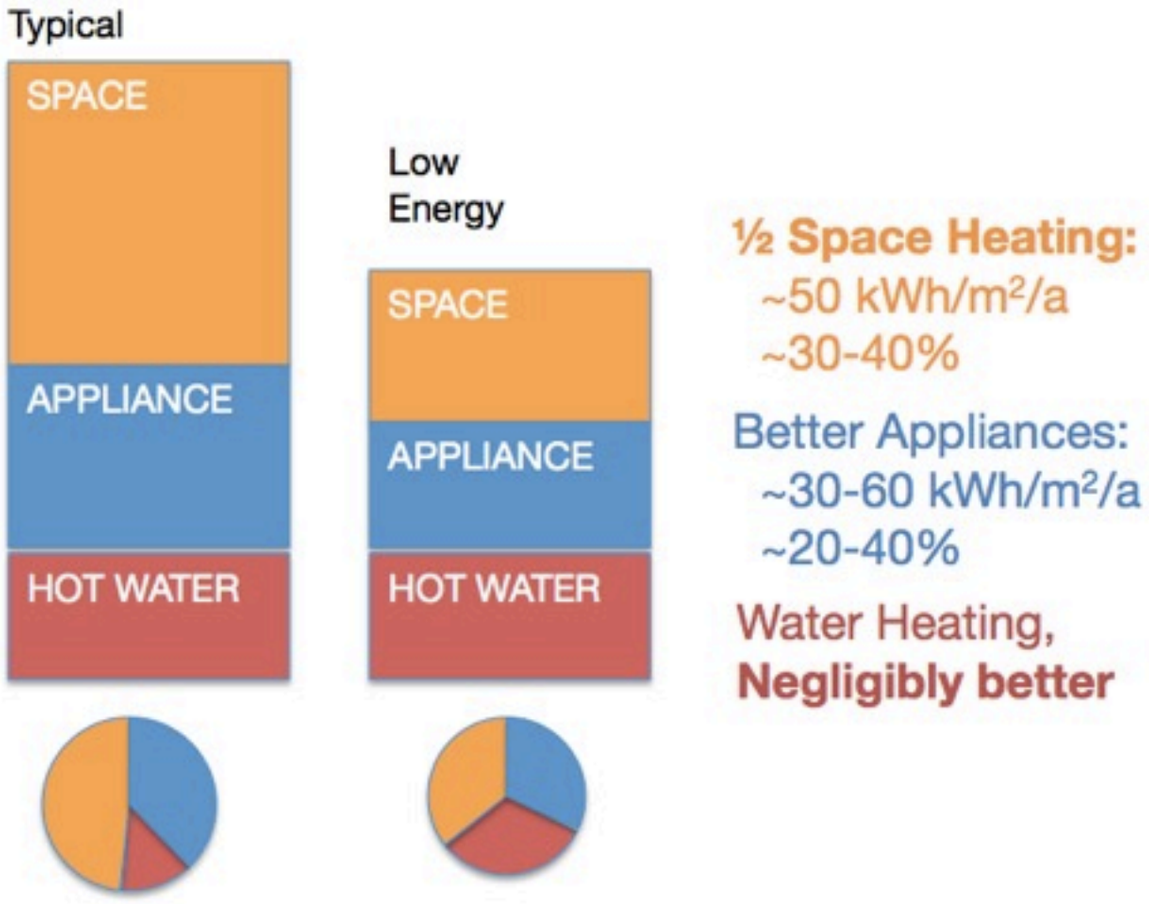
Space Heating:
~100 kWh/m²/a
~40-50%

Appliances:
~40-80 kWh/m²/a
~20-40%

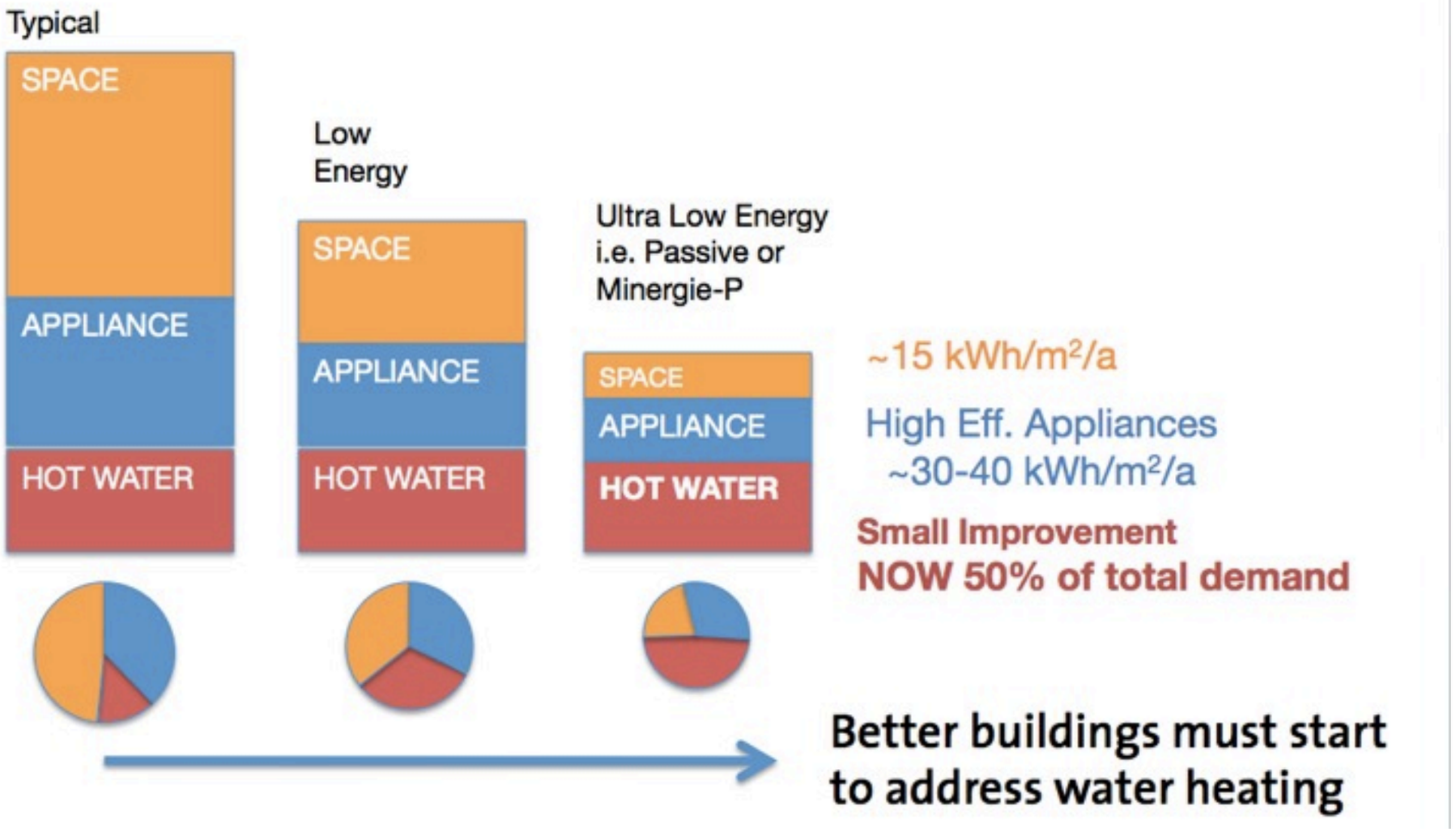
Water Heating:
~20-40 kWh/m²/a
~10-20%

- Typical building
- Space heating dominates the demand
- Water heating only 10-20%

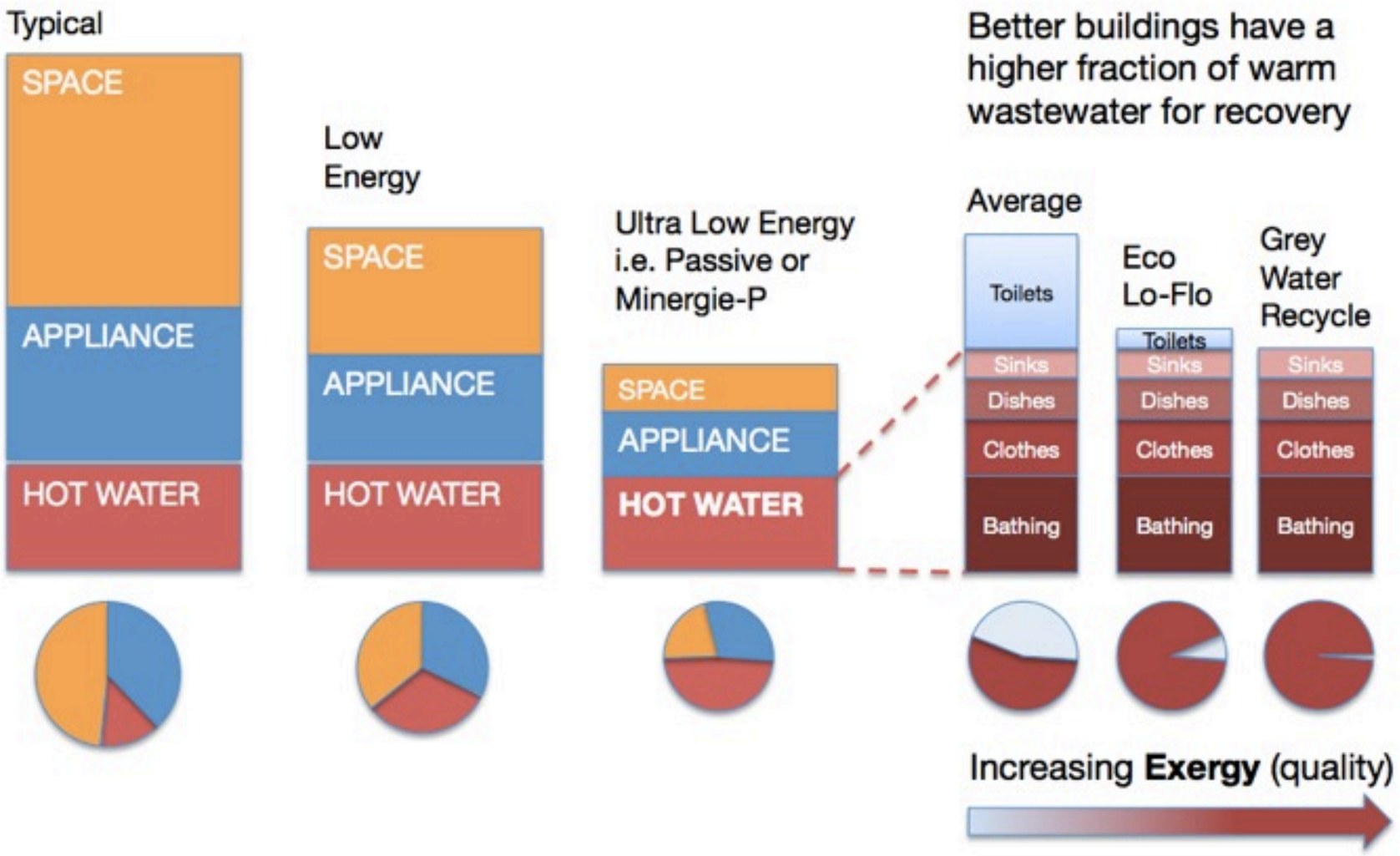
Hot water role in building performance



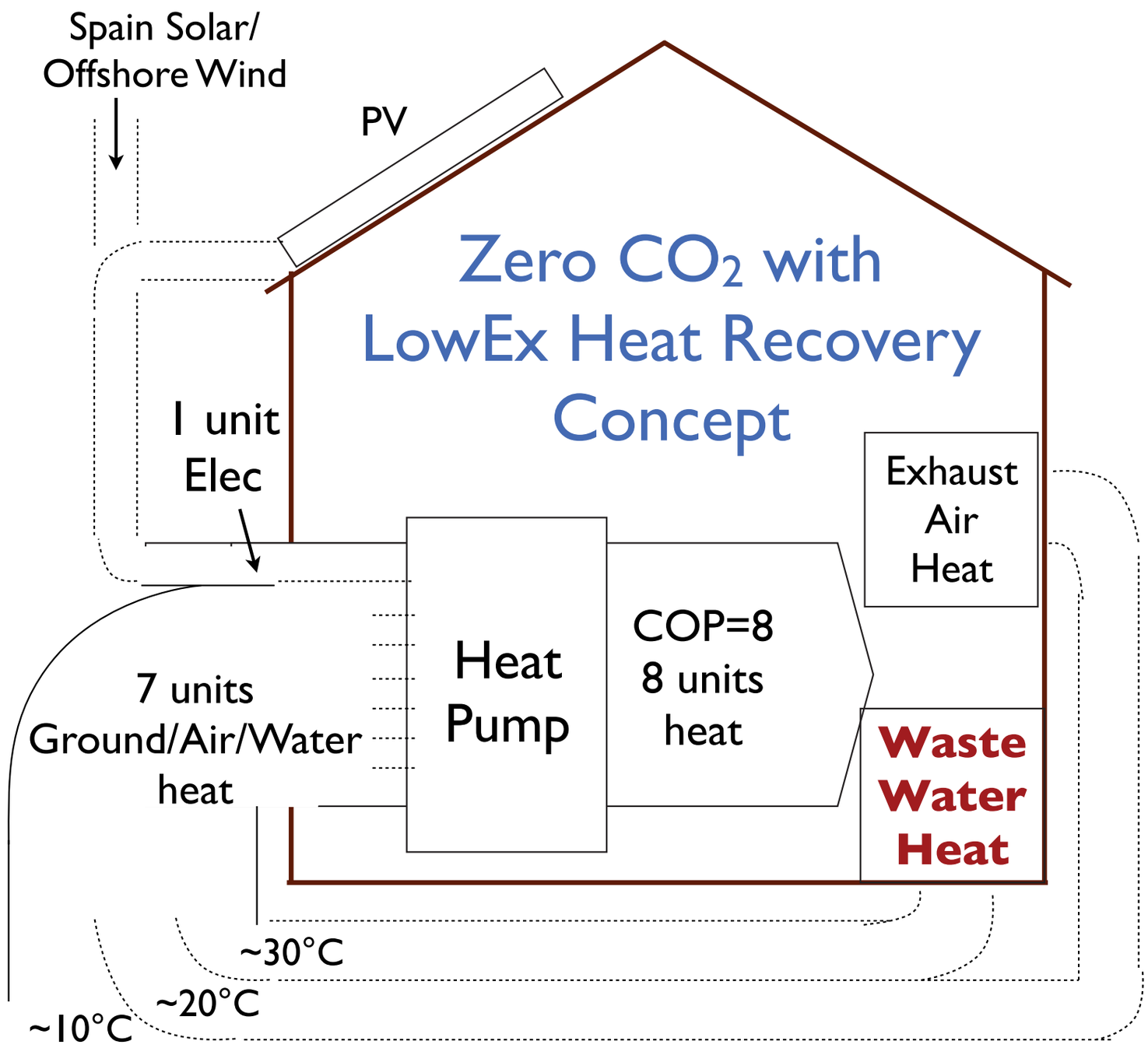
Hot water role in building performance



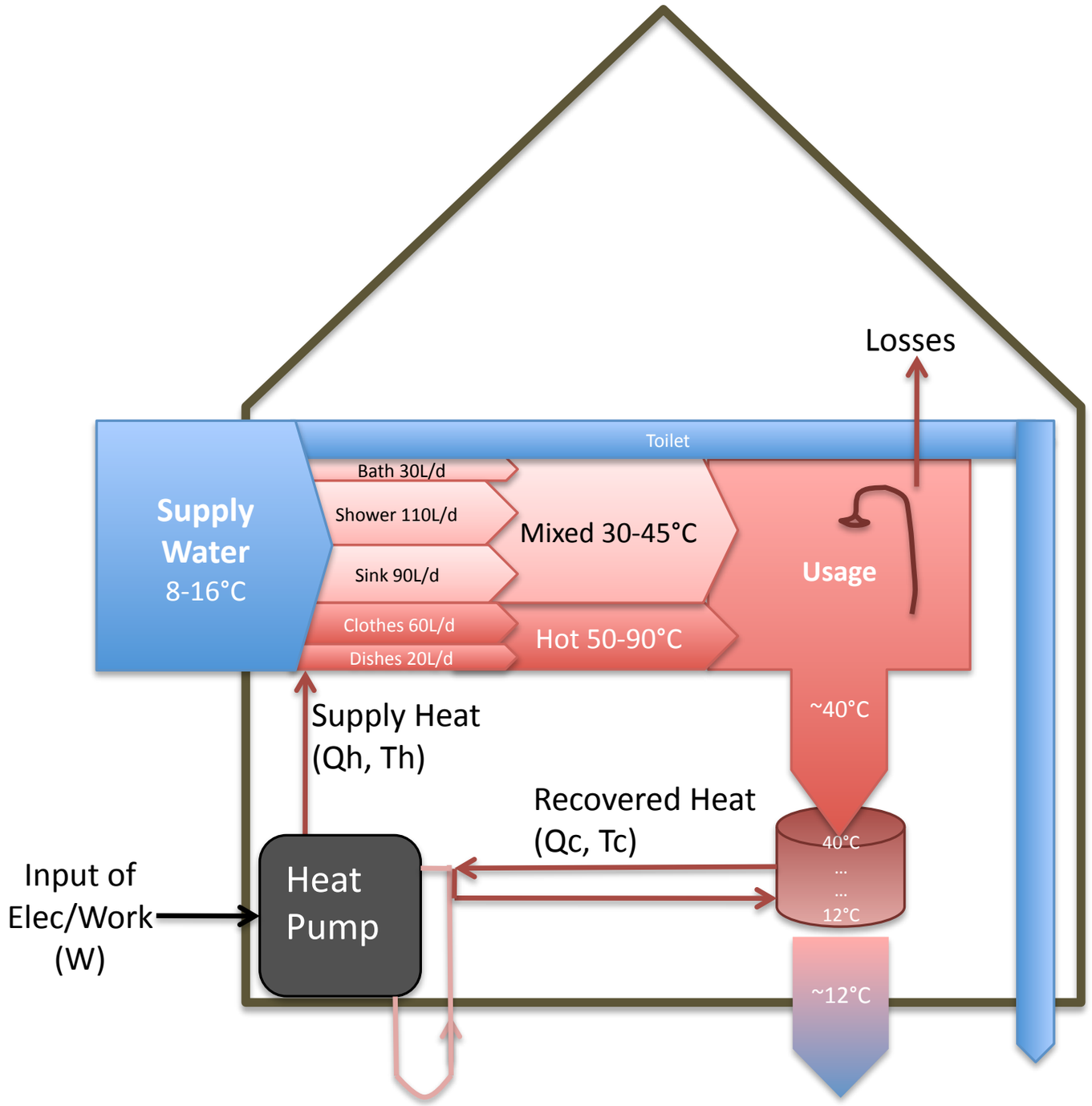
Hot water exergy in building wastewater



Create a new concept to maximize performance



Create a new concept to maximize performance



Previous work

- FEKA System
  - Only for large scale systems
  - Mixing destroys exergy

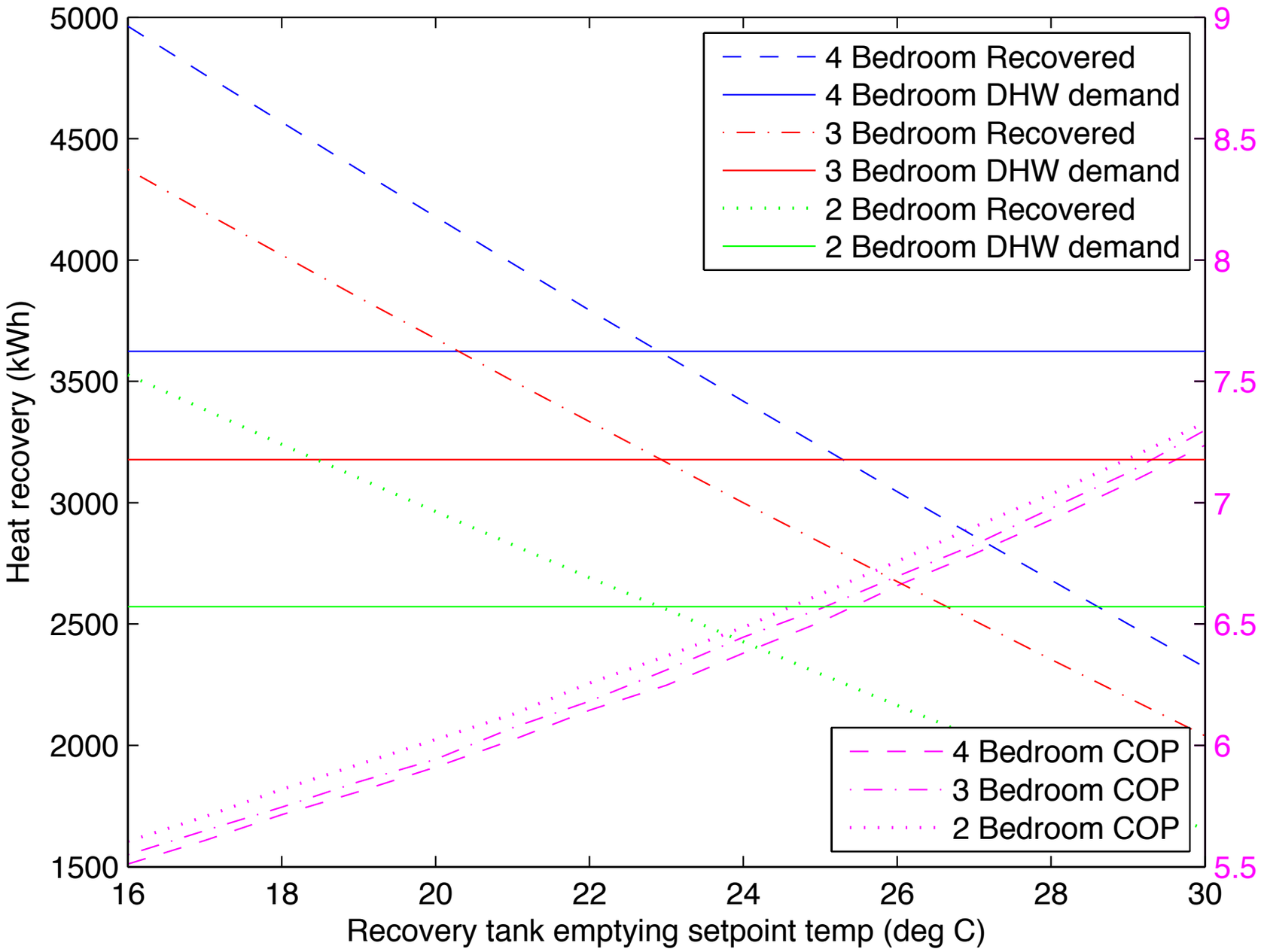
- Heat from sewer
  - SwissEnergy project
  - Again mixed flow at lower temperature

Modeling methods

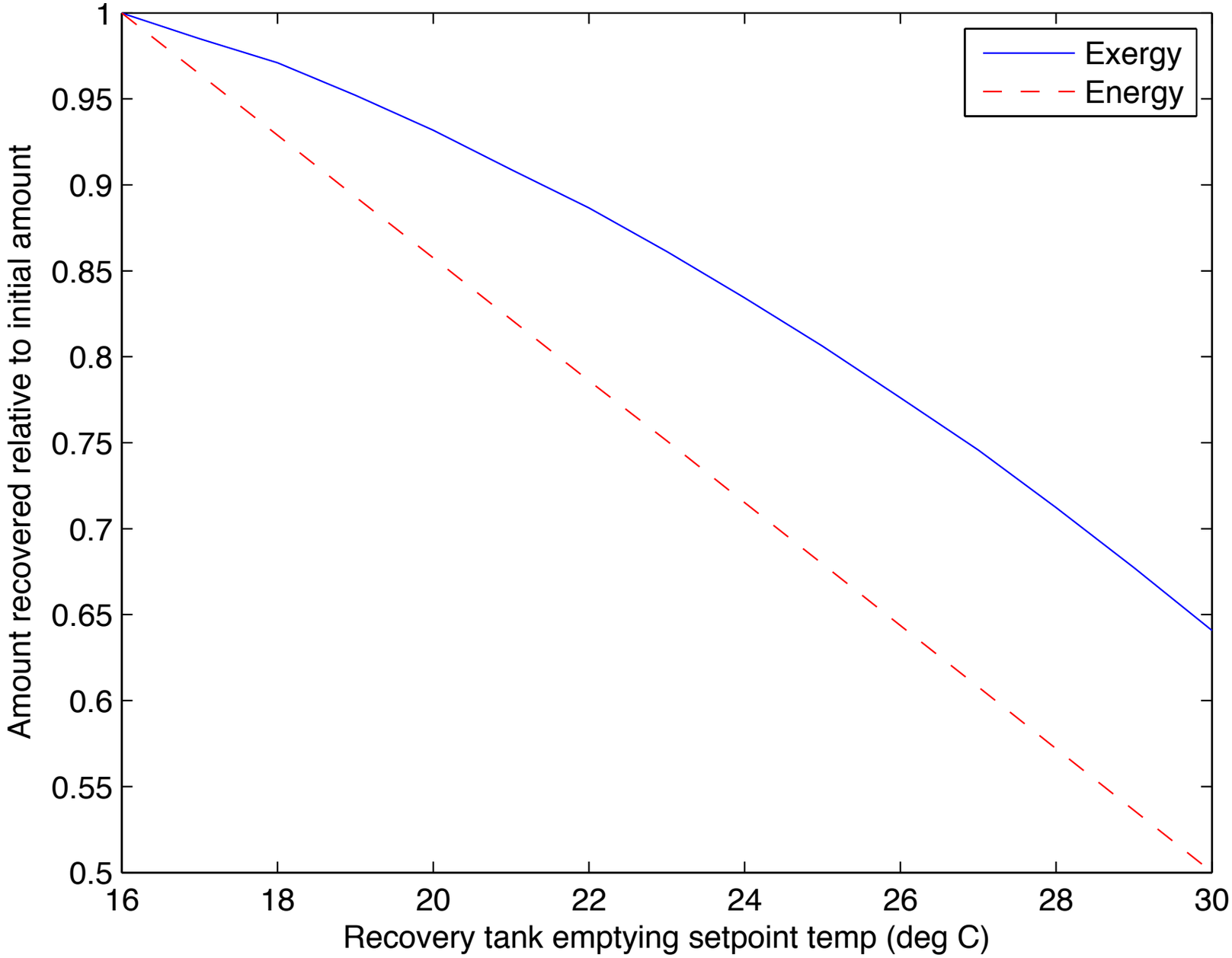
- Data from statistics for hot water usage
  - Shower, Bath, Clothes, Dishes, Sinks
  - Initial data on a 6-minute time interval for the near, most recent analysis data is per event
- Input into tank and heat exchange of energy and exergy modeled
- Initial research looked only at the recovery tank model

- Final analysis incorporated a heat pump system
  - Two potential operations considered
    - 1 – Tank connected to all sources providing heat to the heat pump NON dependent on heat pump demand
    - 2 – Tank connected to just WC sources and provides EXACTLY the DHW demand for the WC.

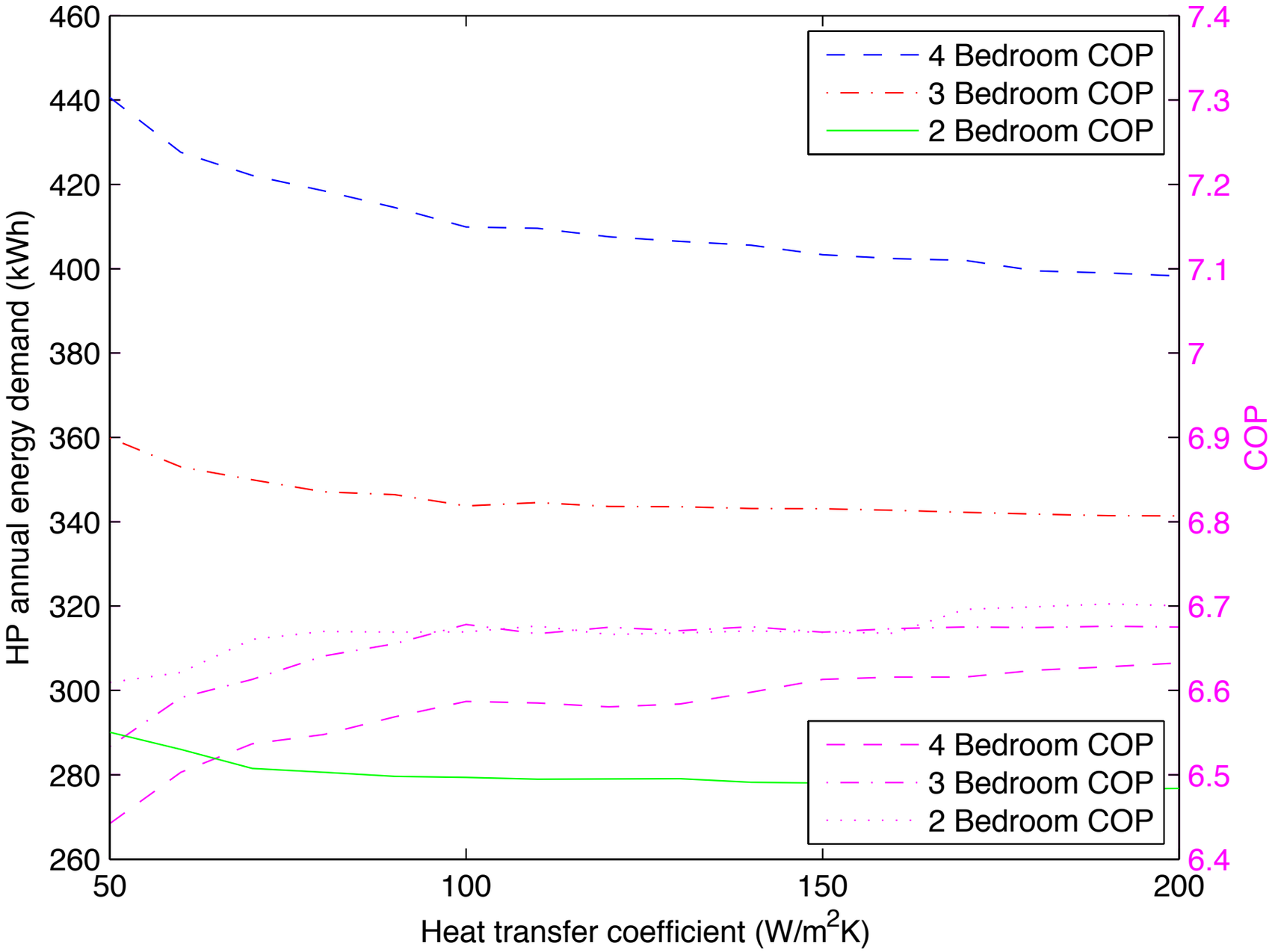
Results 1: Large non-dependent system with varying tank emptying temperature



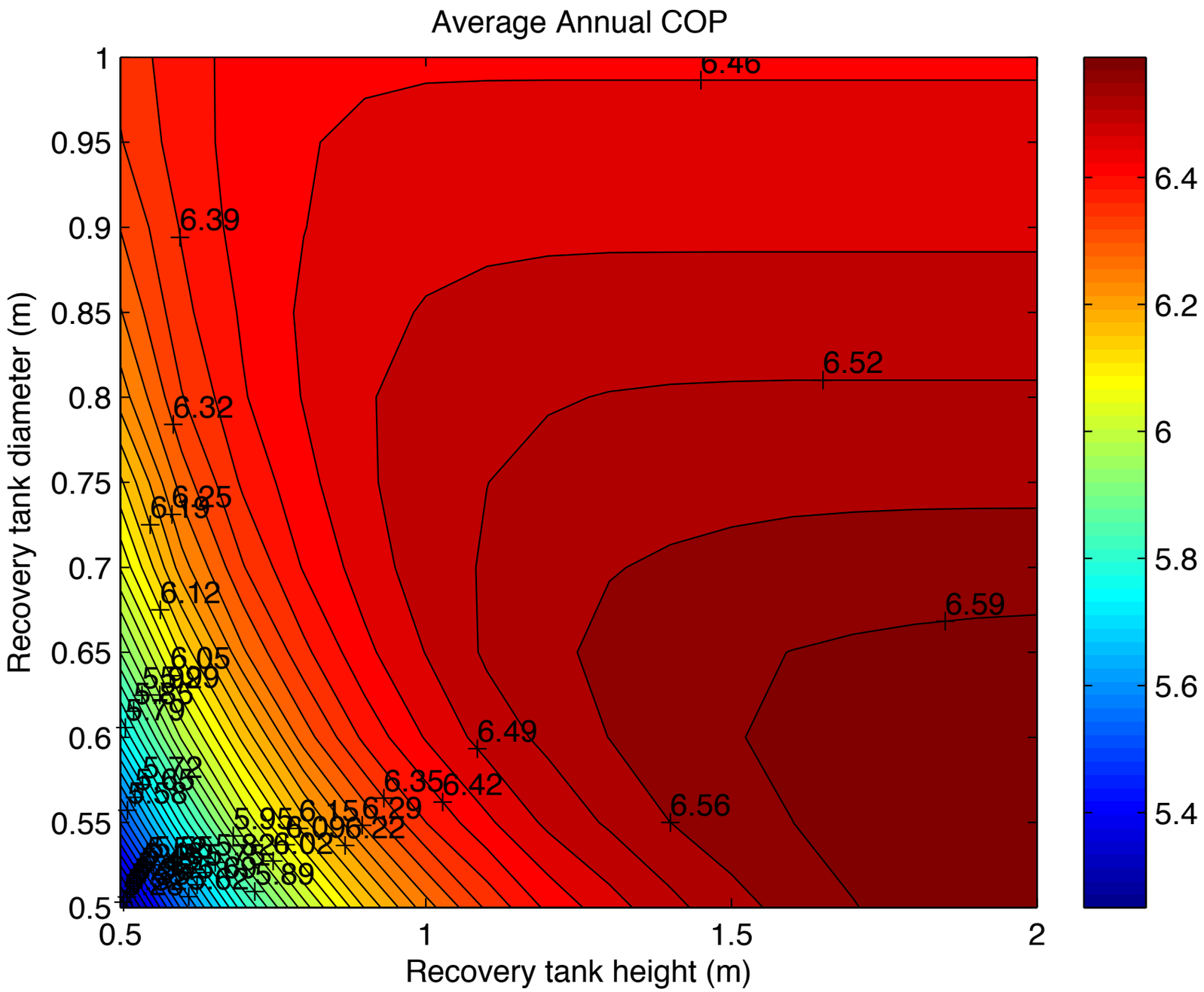
Results 1: Energy and Exergy comparison



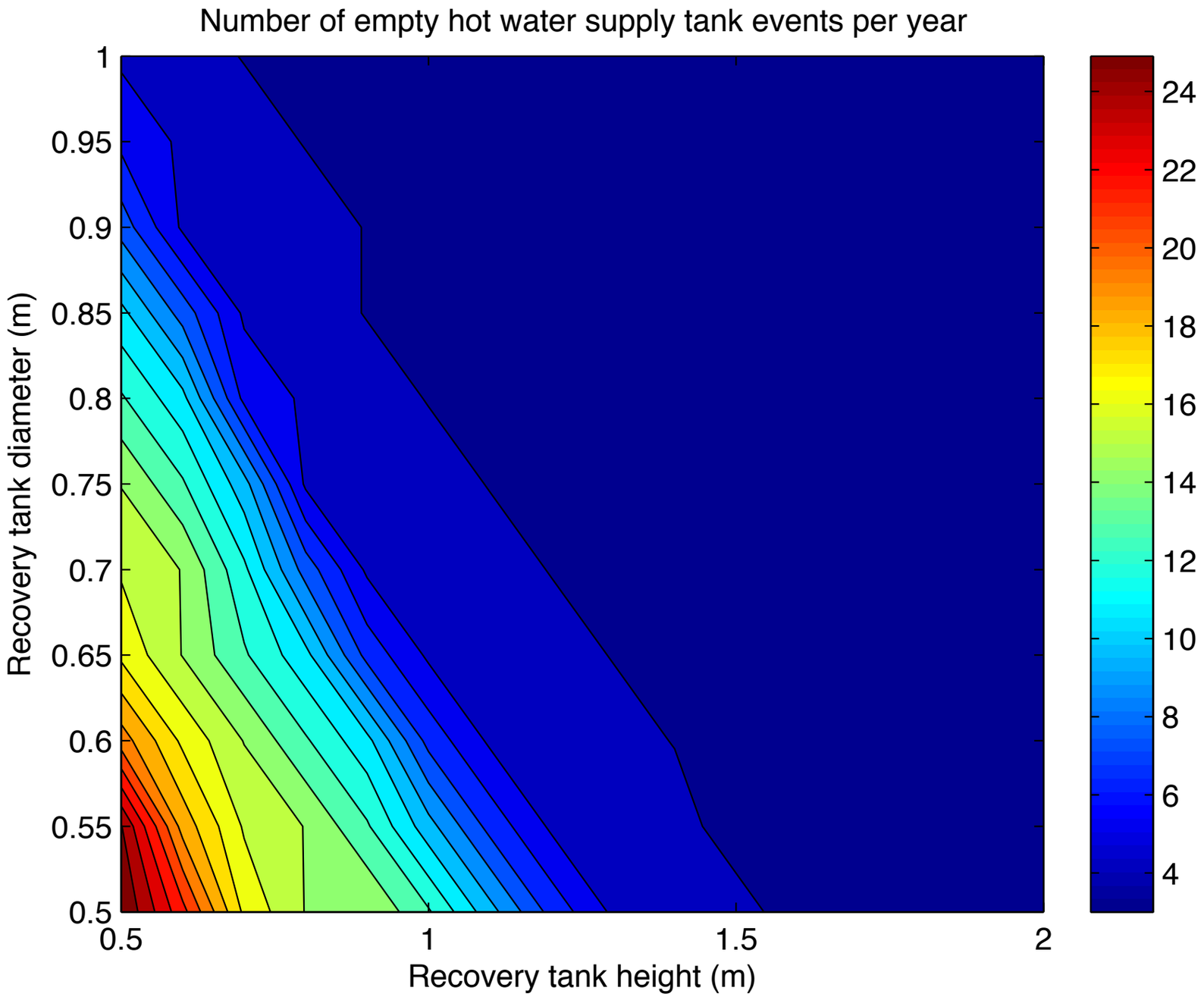
Results 2: DHW supply system performance



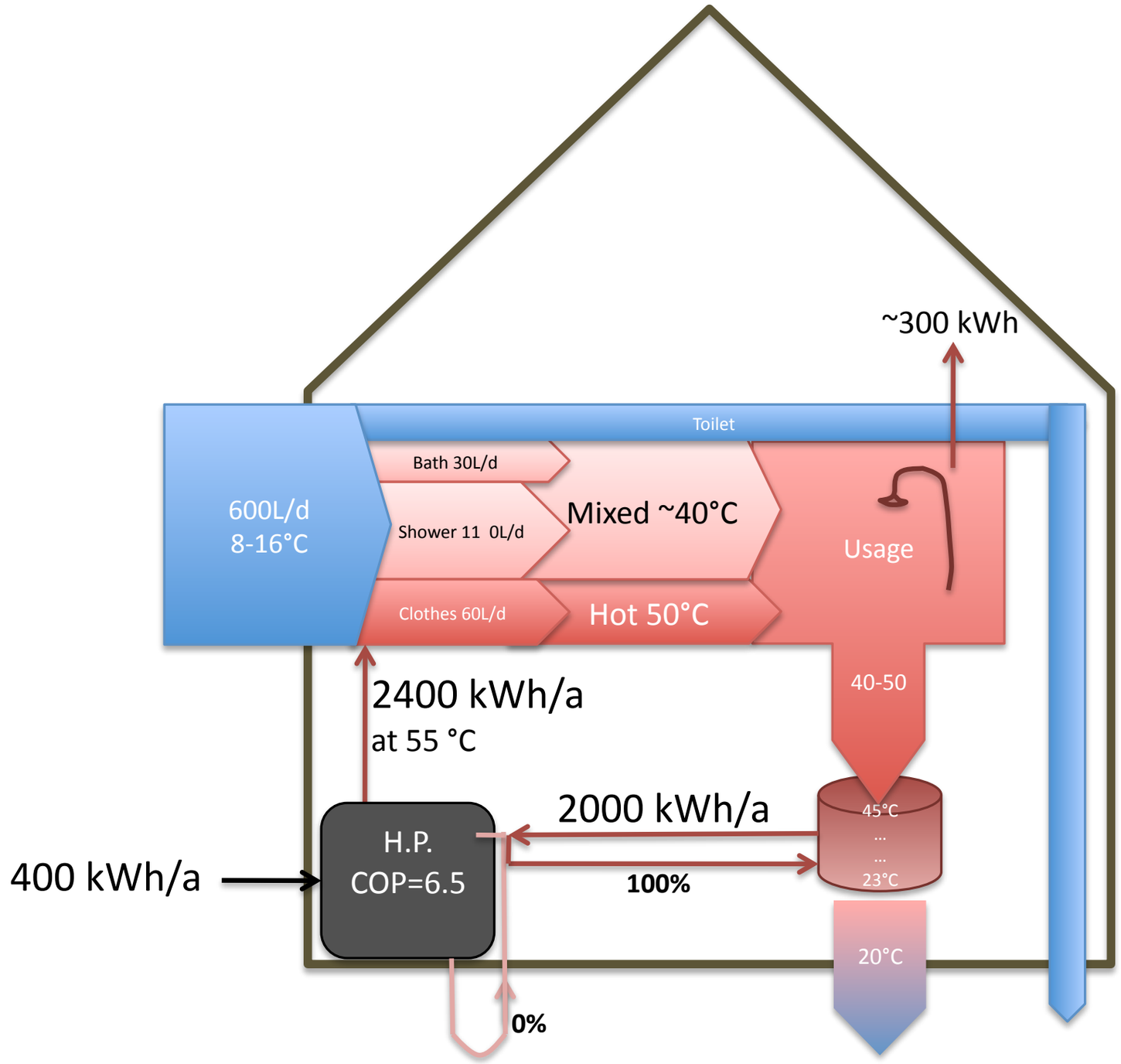
Results 2: Tank size optimization - heat recovery tank COP



Results 2: Tank size optimization - maintaining hot water supply

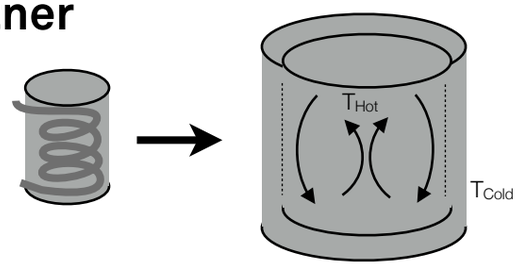


Example Results: 4 Bedroom family supplying WC with a heat pump

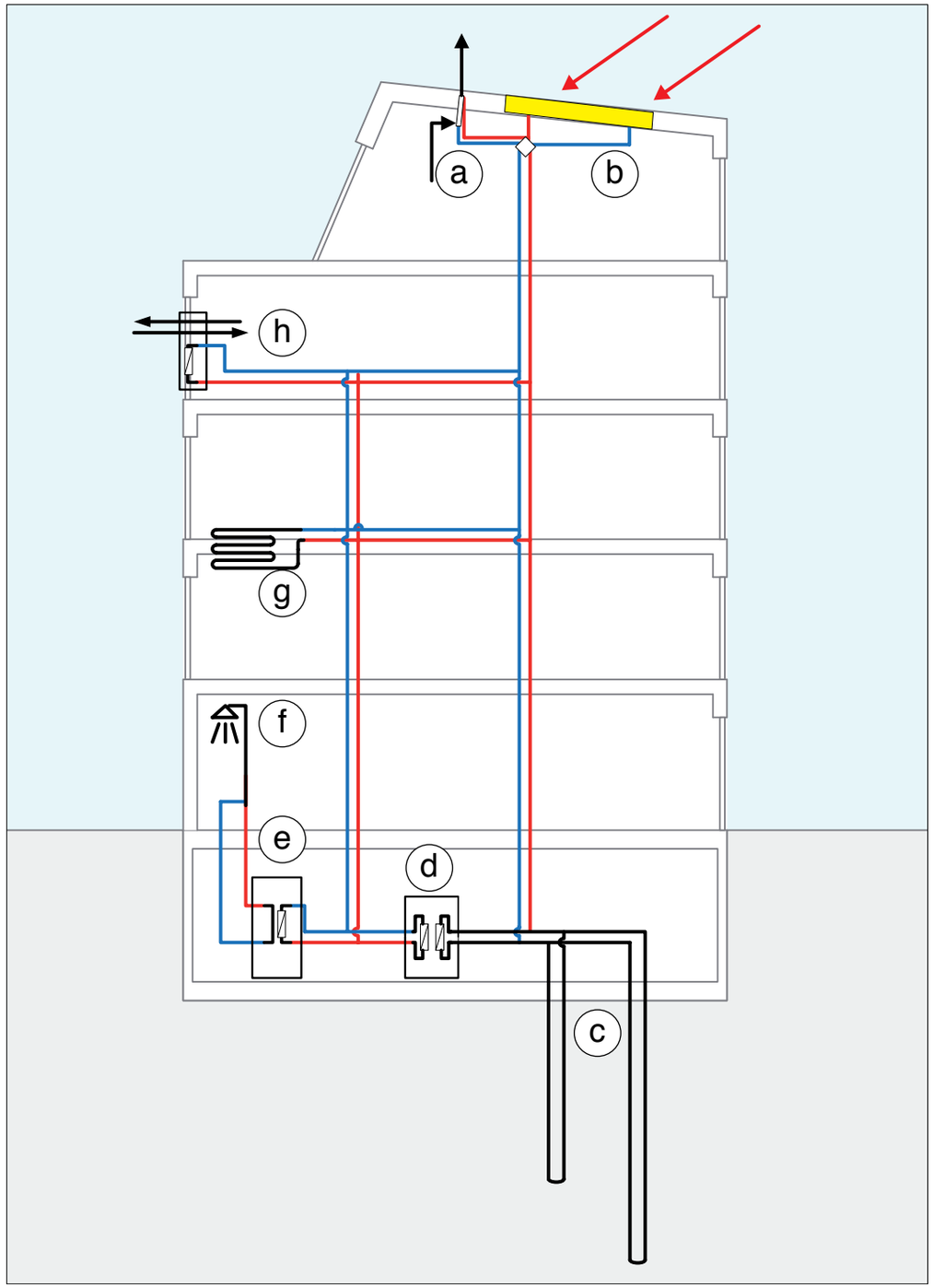


Implementation: Industry partner

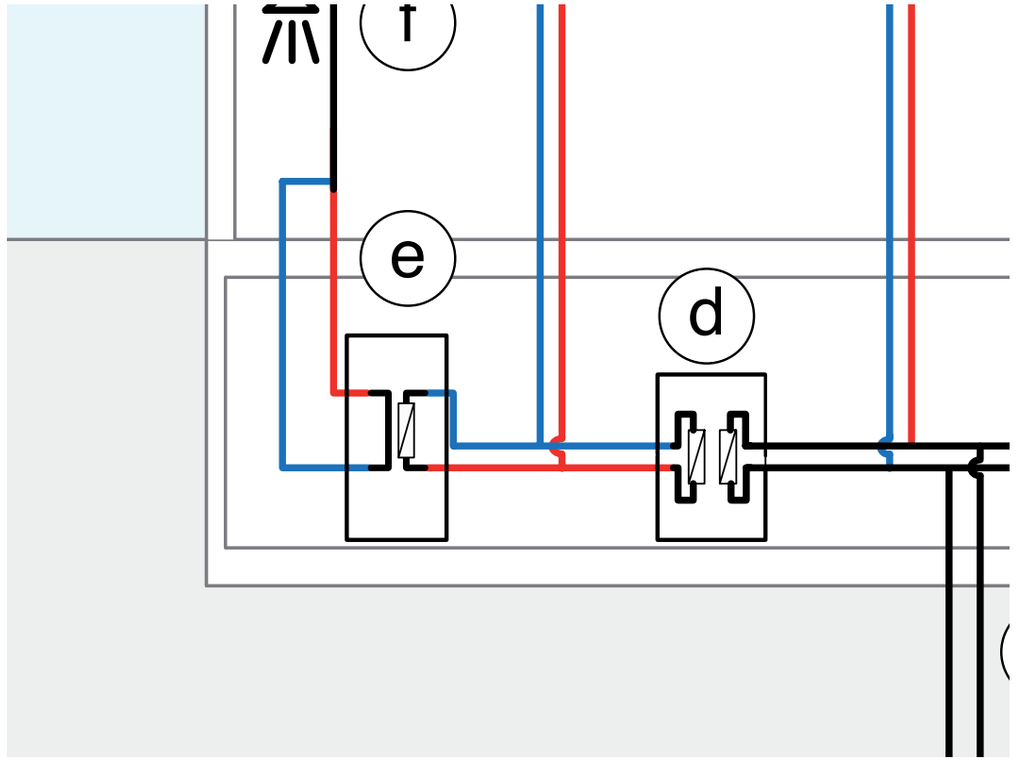
- Successful KTI project started, but lost partner
  - Intial work on tank design considered
- Need to develop real working prototype
- One successful implementation in Ireland



Implementation: Hot Water Concept B35



(a) Exhaust heat recovery
(b) PVT hybrid panels
(c) dual zone boreholes
(d) high COP heat pump
(e) low temp hot water storage



Conclusions

- More Info in Schlussbericht von BfE
- Potential to provide DHW with much lower exergy inputs
  - Typical values of **4000-5000 kWh/a -> 400-500 kWh/a**
  - Product development is still needed - results are theoretical at this point
    - Collaboration on better heat pumps are essential for this project
- Thanks to the BfE for the support!