

Space heating and domestic hot water predictions

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Public seminar on Energy Flexible Buildings

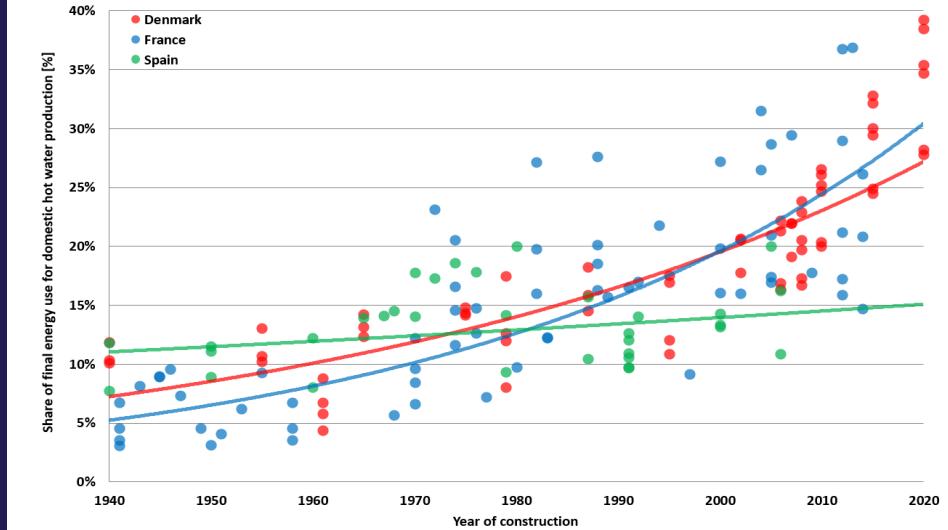
April 4, 2019



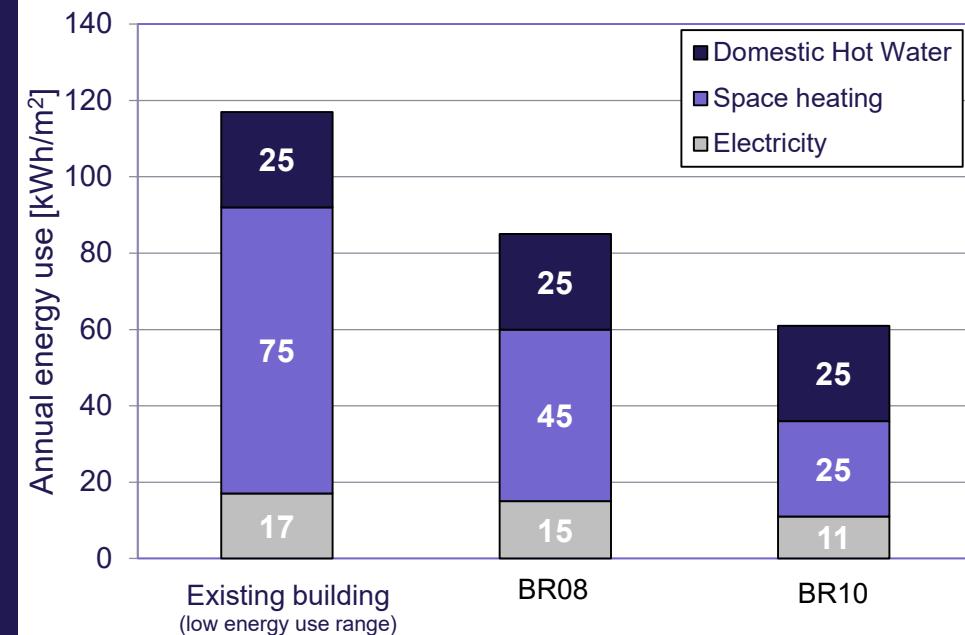
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Why Domestic Hot Water?

- ⦿ 64% of Danish building stock is connected to district heating - 1 connection point
- ⦿ Most research on heat demand modulation investigates solely space heating demand, because:
 - ⦿ DHW is strongly related to occupants (number, age, socio-economic background)
 - ⦿ Lack of detailed understanding of DHW usage (temp, flow)
 - ⦿ Changing users' routines
- ⦿ Increased magnitude of DHW demand

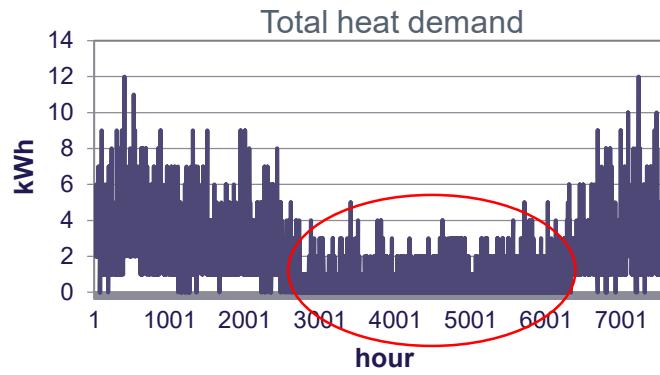


Source: Pomianowski et. al (2019); To be published

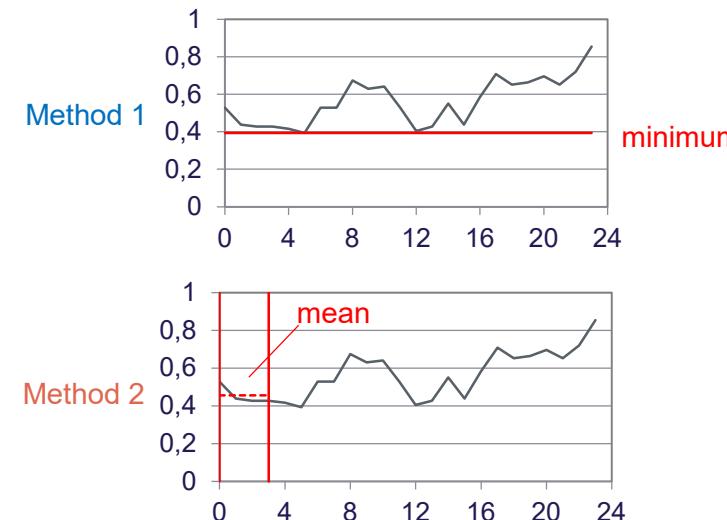


Activity 1: Simple method to estimate DHW demand

INPUT

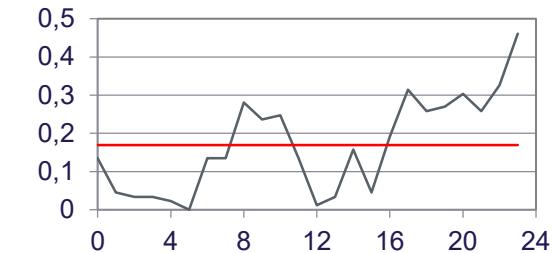


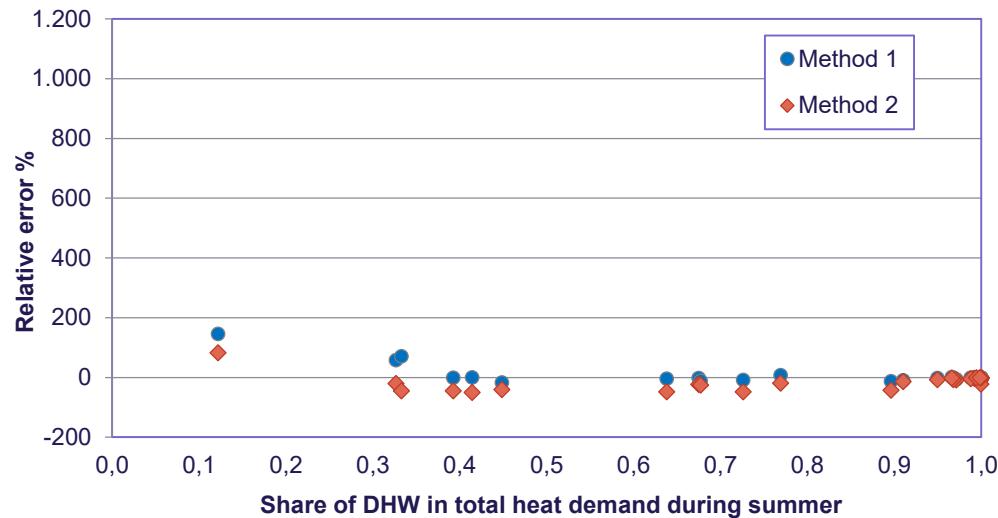
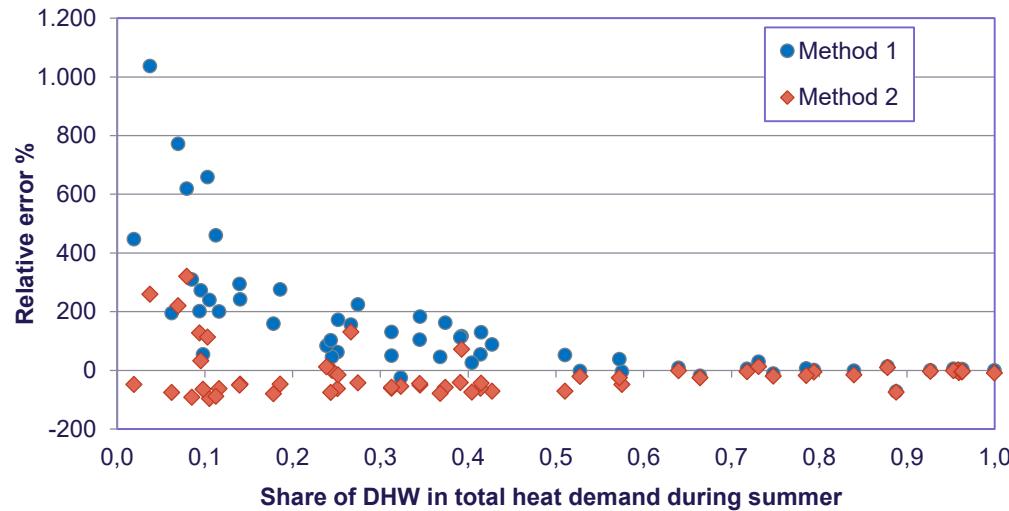
ENGINE



OUTPUT

- ⌚ Average hourly DHW
- ⌚ Average summer day profile





- ⌚ DHW usage prediction related to the ratio of DHW usage to the total heating demand
- ⌚ Reliable for energy efficient houses and apartments
- ⌚ Relative error of $\pm 10\%$
 - ⌚ Single-family houses: $\sigma < 800$
 - ⌚ Apartments $\sigma > 240$
- ⌚ Limitations:
 - ⌚ More complex DHW behaviour
 - ⌚ More complex space heating practices
 - ⌚ Holiday period during summer
 - ⌚ Limited data



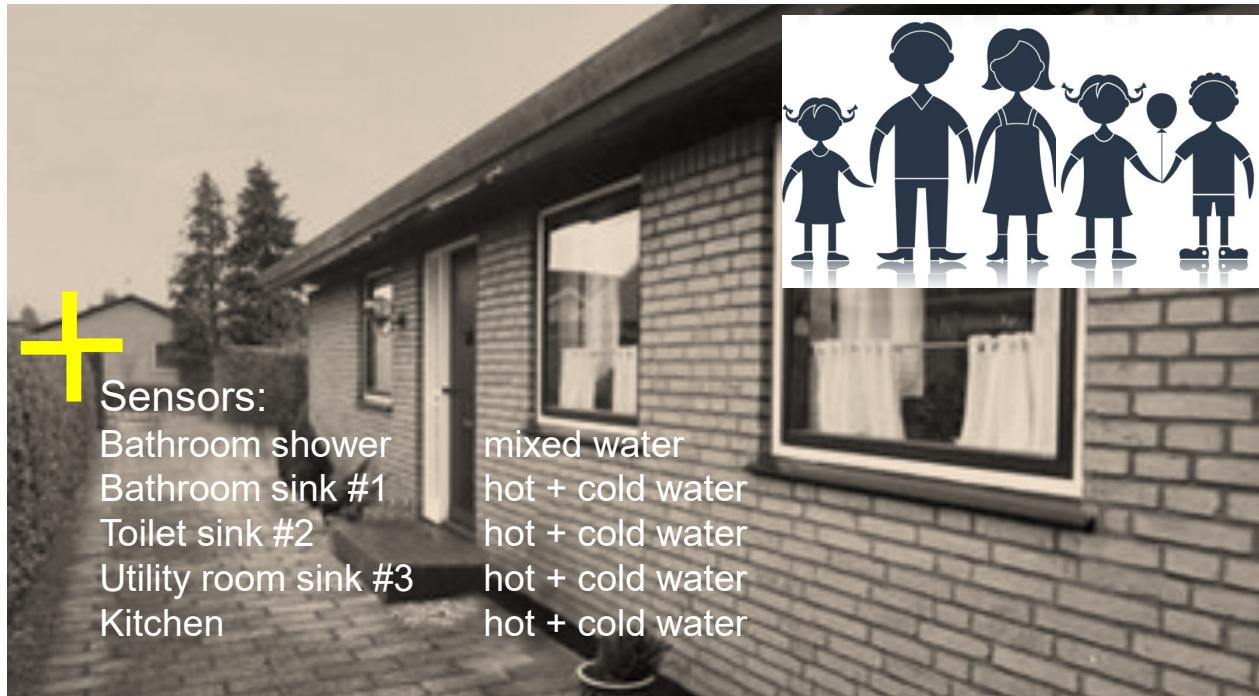
Activity 2:

Measurements at tapping places:

2 case studies



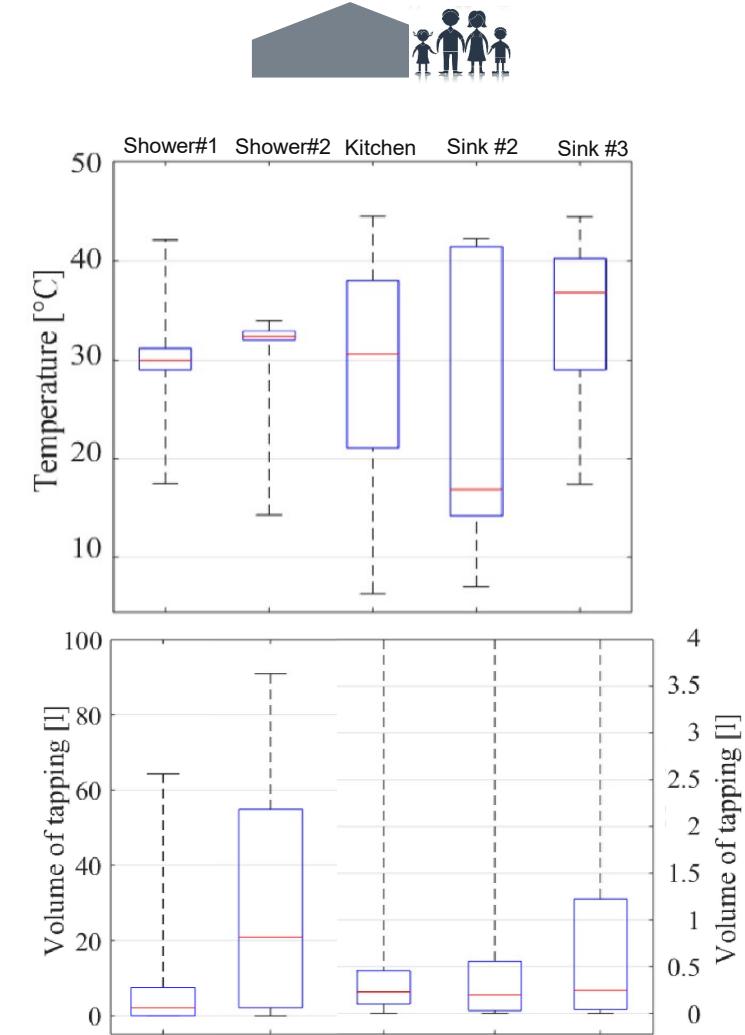
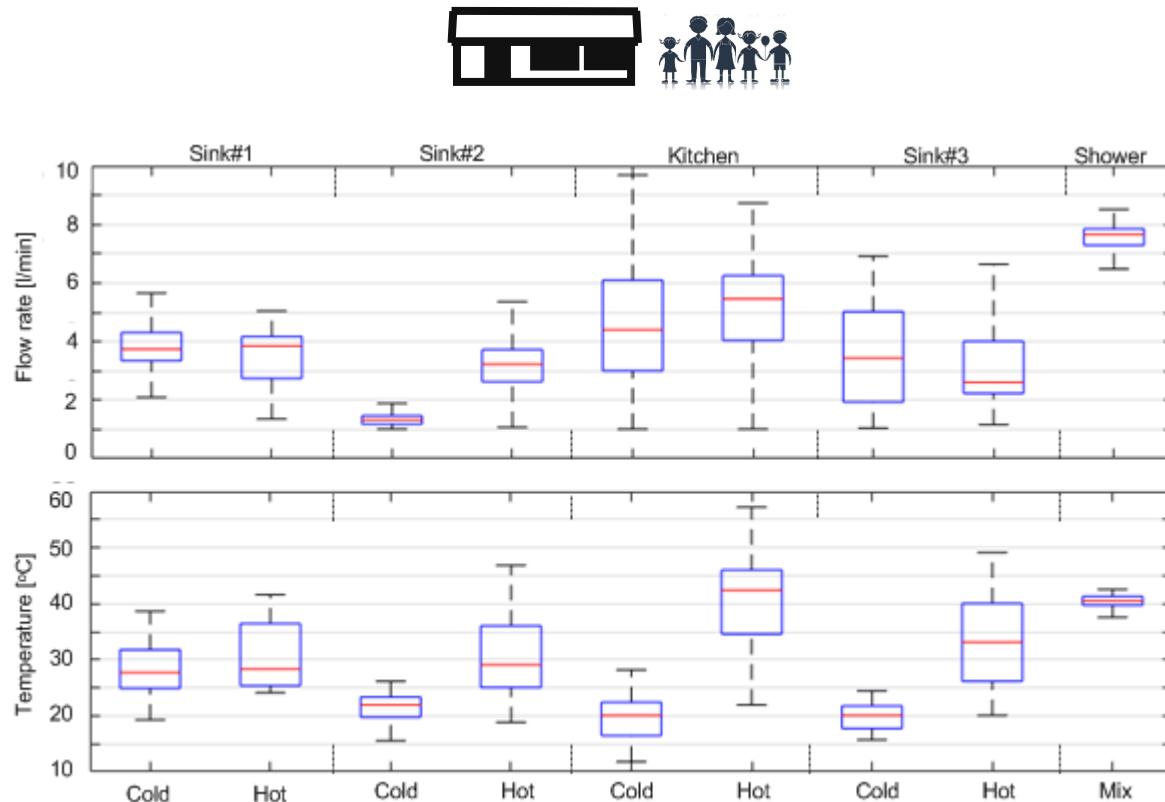
House from 1970's



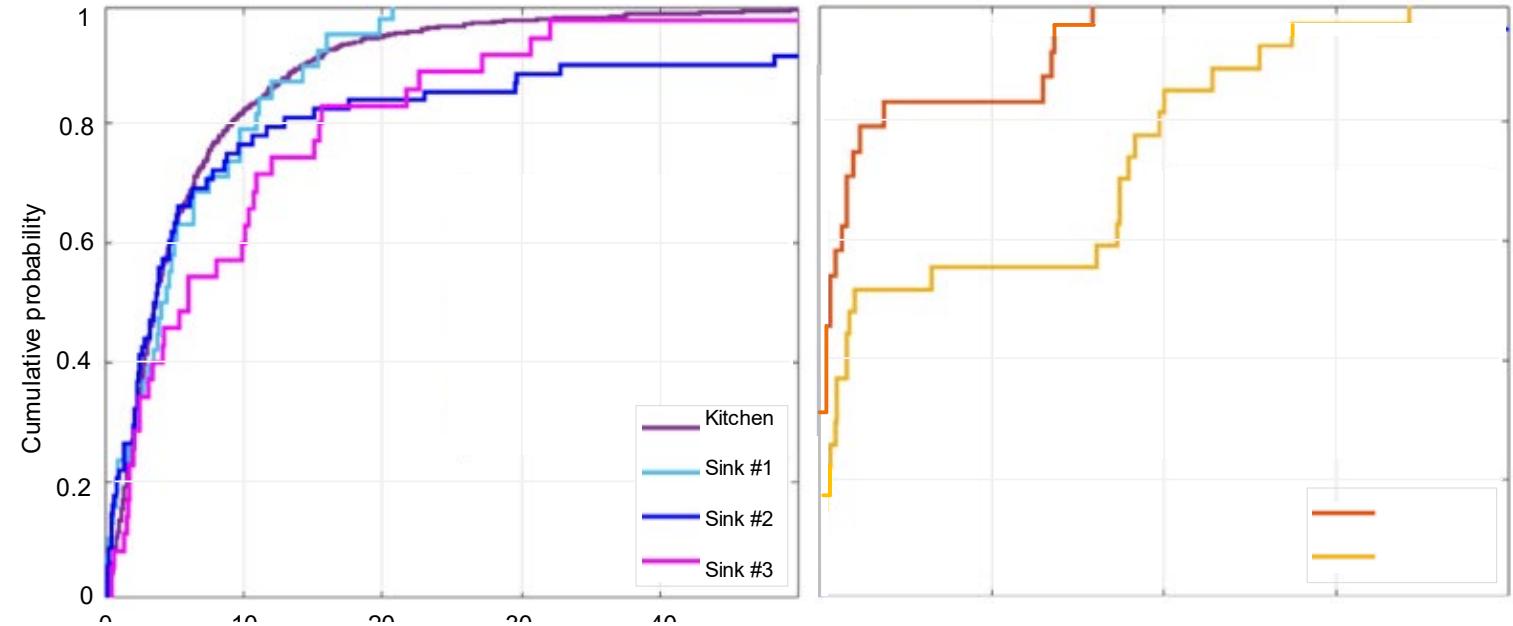
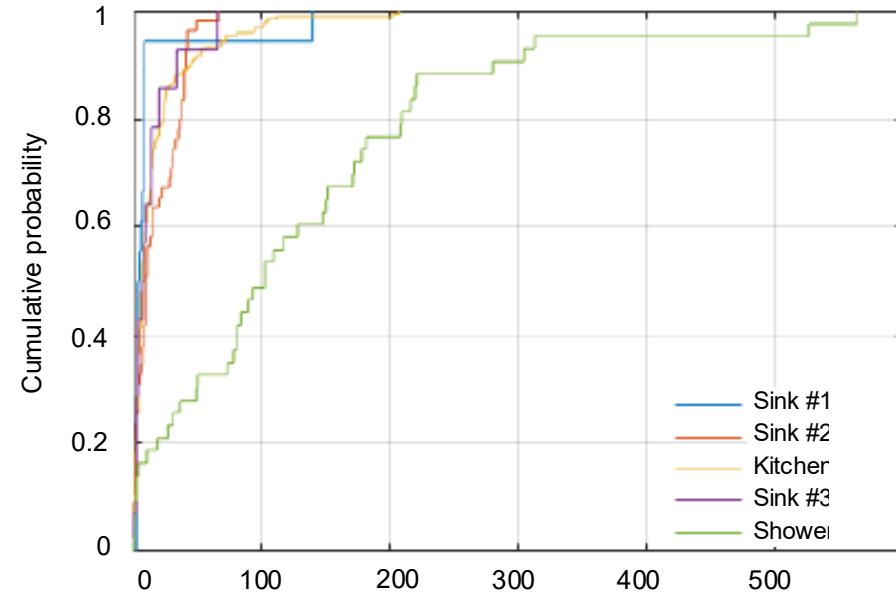
House from 2013 (BR15)



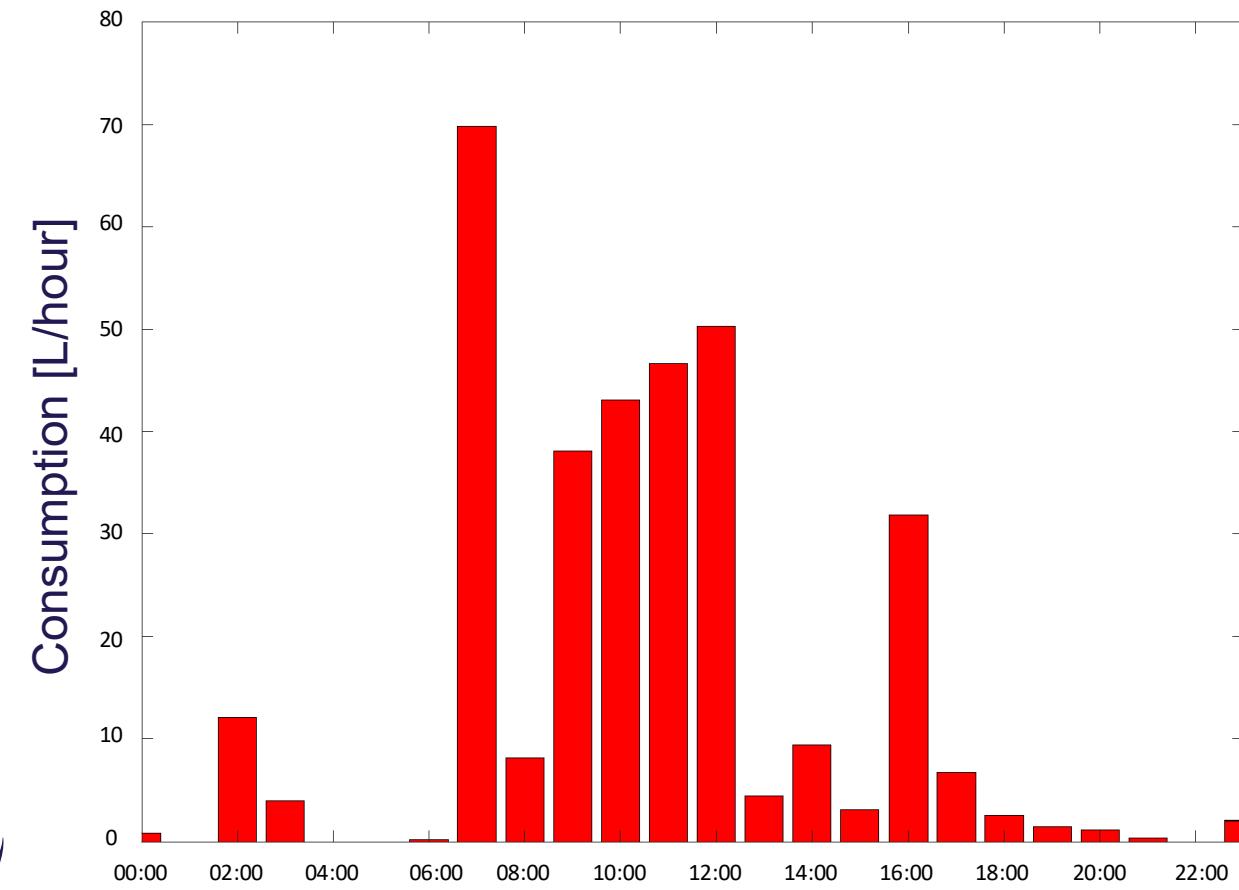
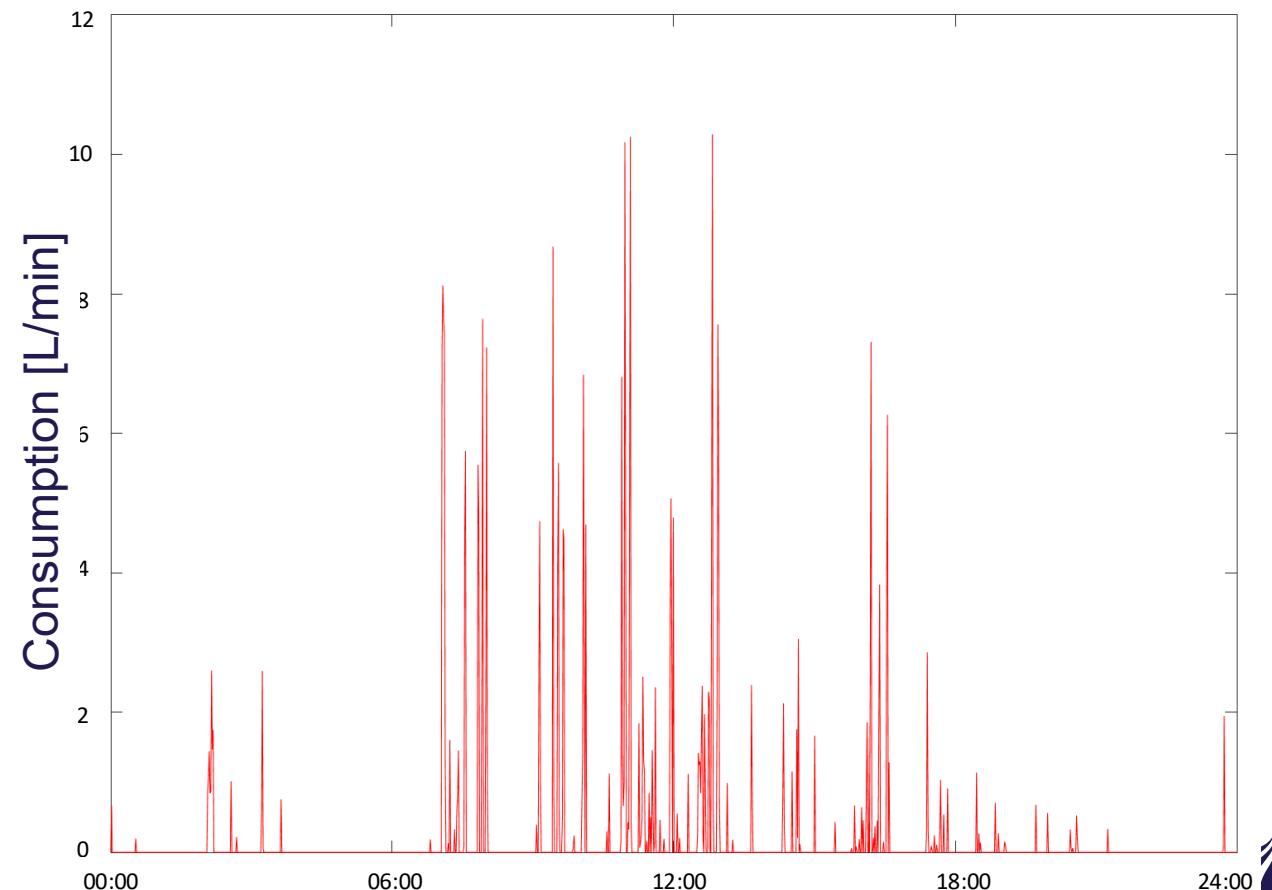
Flow & temperature



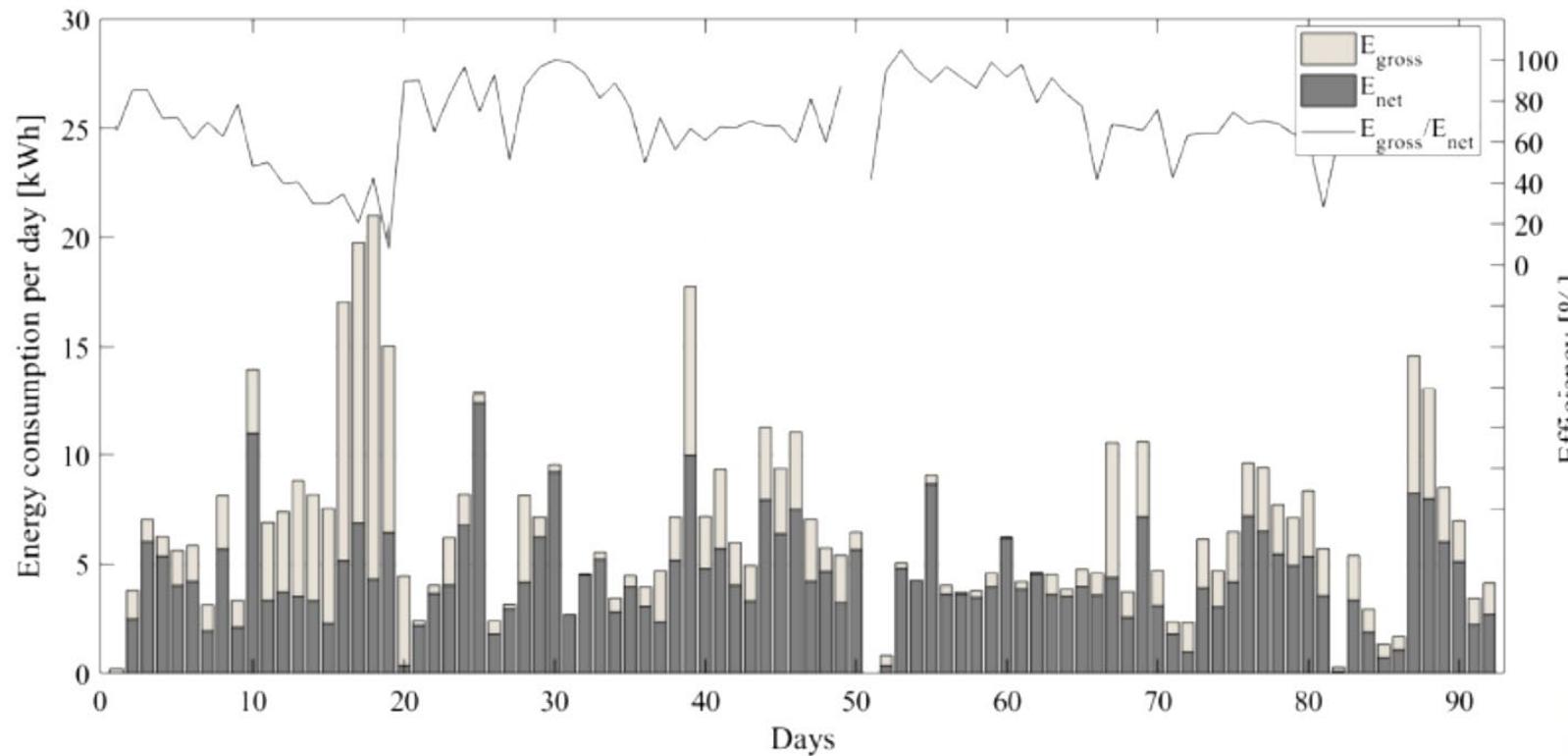
Duration of tappings



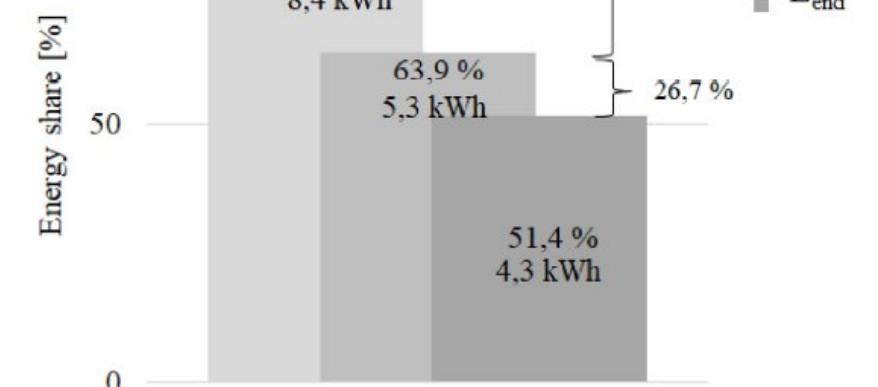
Resolution??



Energy losses



E_{gross} – energy delivered to heat exchanger
 E_{net} – energy delivered by heat exchanger
 E_{end} – energy used at tapping places



Conclusions

- By dismissing DHW in energy flexibility studies, we get only a part of picture (especially in case of energy-efficient buildings)
- The use of a high resolution metering system enables more precise measurements to be recorded.
- The temperature range measured in the household is generally lower than the levels stated in the standard for design of water systems.
- Distance between the tap and the DHW distribution point is important – taps with high temperature close to the distribution point

