Measured versus calculated energy use in Sweden

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Main conclusions

Measured EP in Sweden, normalized with respect to climate and behavior

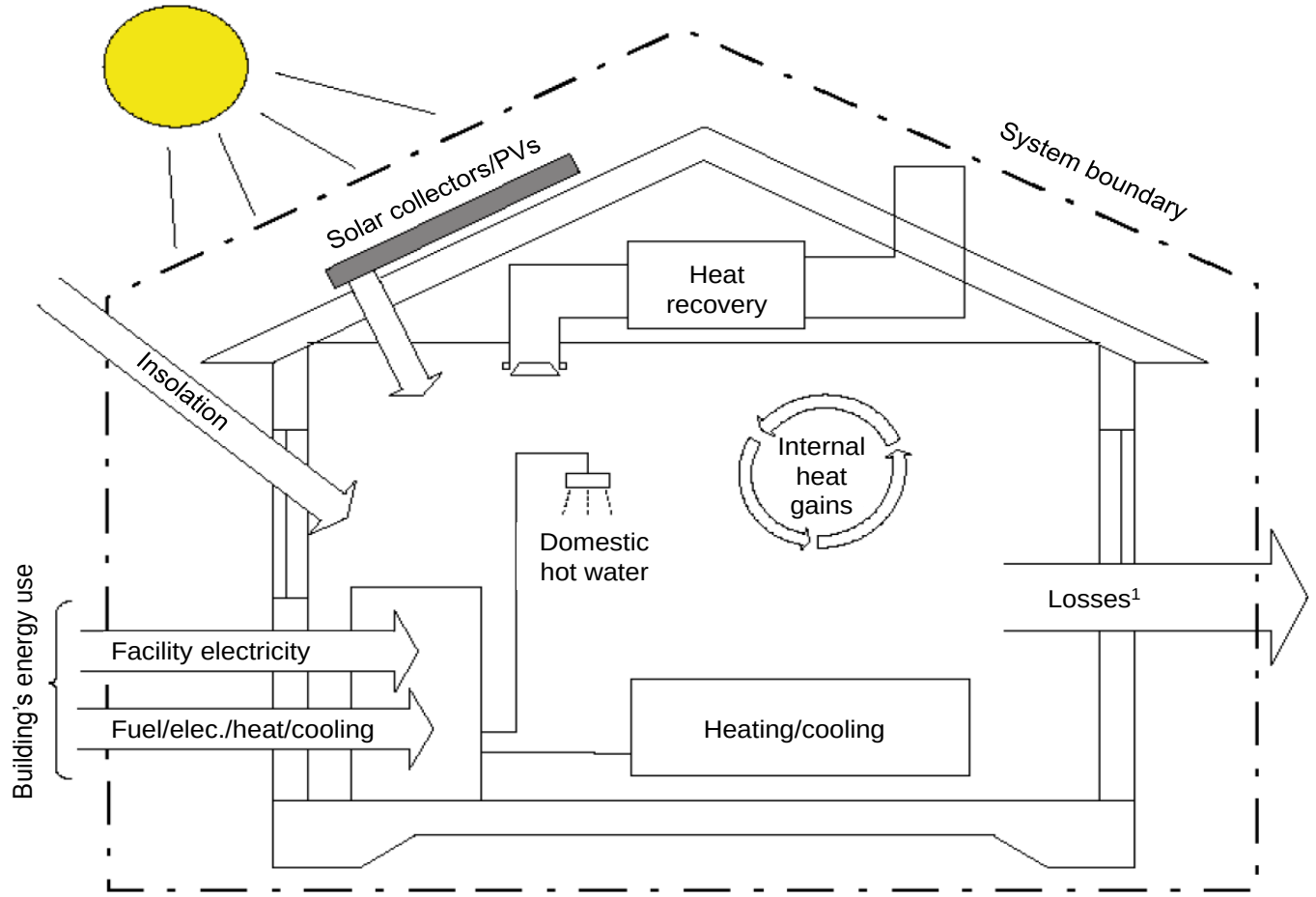
- Energy use by *occupant's behavior* explain a large part of the difference between calculated and measured energy use
- *Normal use* is not standardized and therefore not accounted for in the EPC
- Few buildings have energy meters that *separate energy use* for heating from energy use which should not be included in the EPC
- Bad compliance of the number of EPCs reported for new buildings is caused by *lack of follow-up actions*. There are no court cases of home owners lacking an EPC

! To improve the EPC scheme, and quality of energy use calculation, further work is needed in the area of *standardizing input data*, *calculation procedures* and *reporting*

Background and introduction

- Performance based energy use demands in the building code 2006
  - Calculated, sent to municipality with the building permit application
- Energy Performance Certificates (EPC) introduced in 2006
  - Measured energy use (12 m within 24 m after commissioning)
  - Corrected to *normal use* during a *reference year*
- Correction to reference year by using the energy index
- No standardized methodology to account for normal use

System boundary for energy use in SE

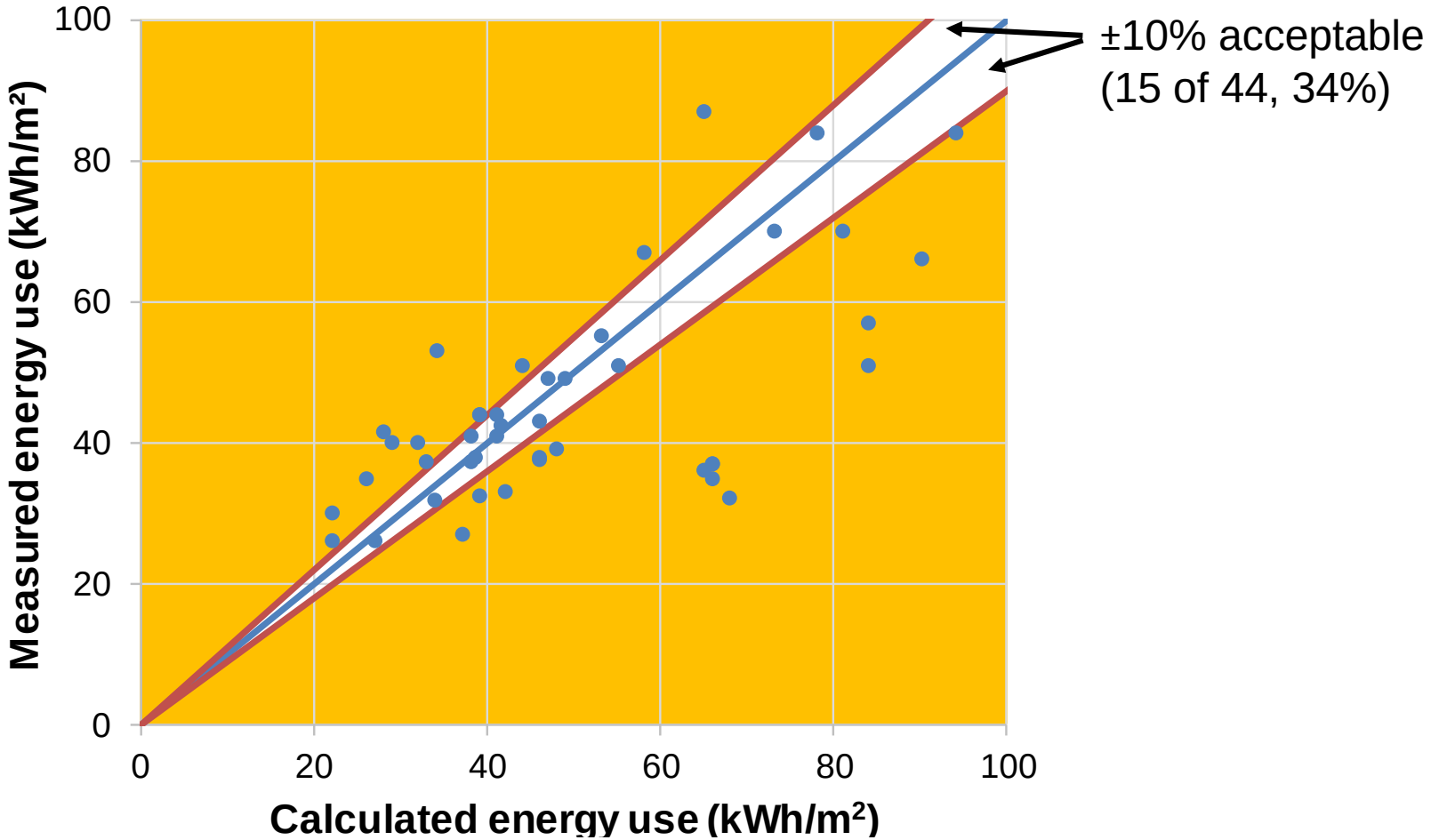


[1]Transmission losses, air leakage, ventilation losses and such

Methods

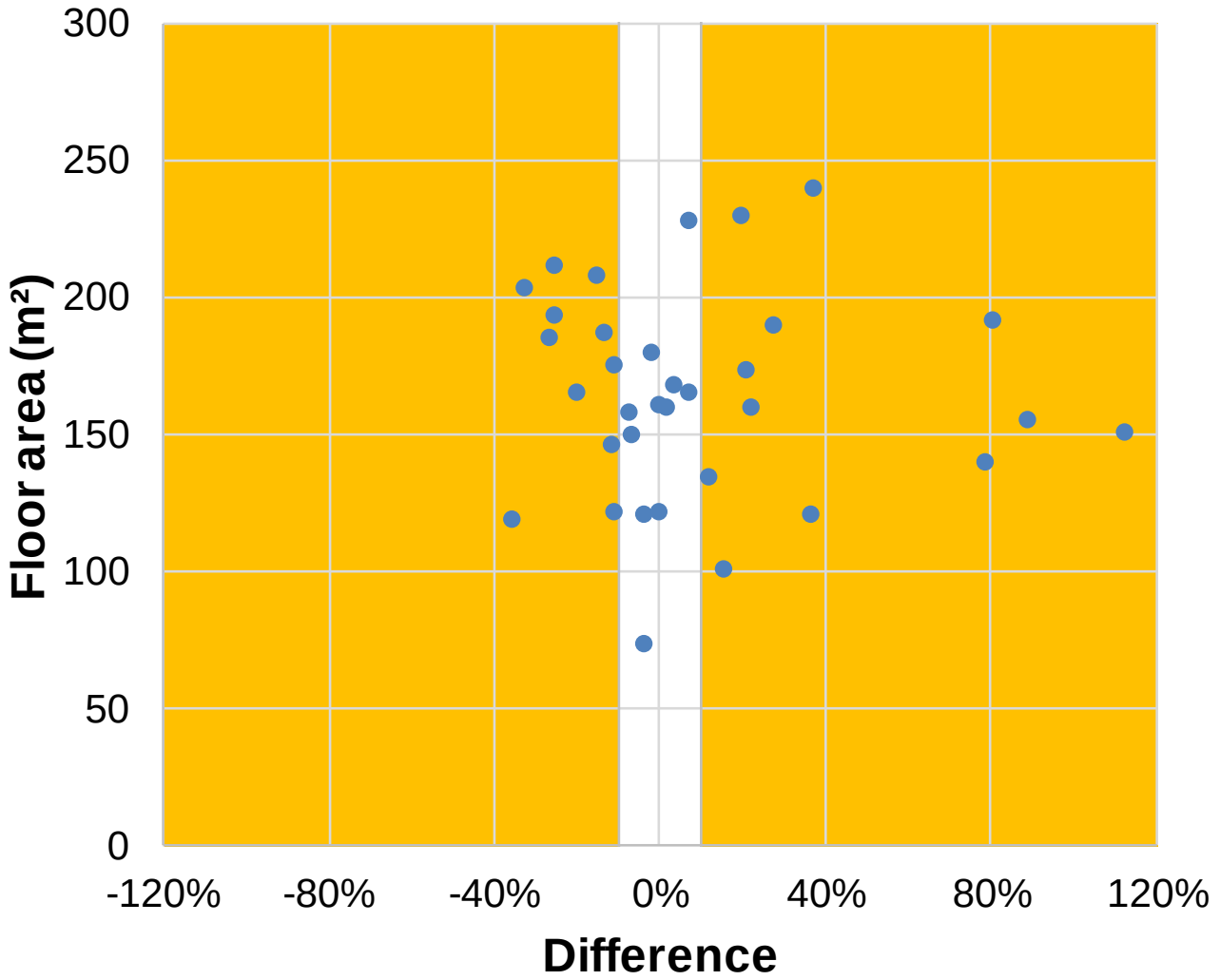
- Interviews with energy experts and energy and climate advisors
- Analysis of 44 single family houses from 2009 and onward with calculated and measured energy use
- Detailed study of 6 houses, data in building permit vs. EPC
- Analysis of 1 753 EPCs from 2006 and onward in the metropolitan Gothenburg area
  - 1 028 multi-family buildings and 725 single family houses
- Parametric study of the energy use in a single family house

Measured vs. calculated energy use



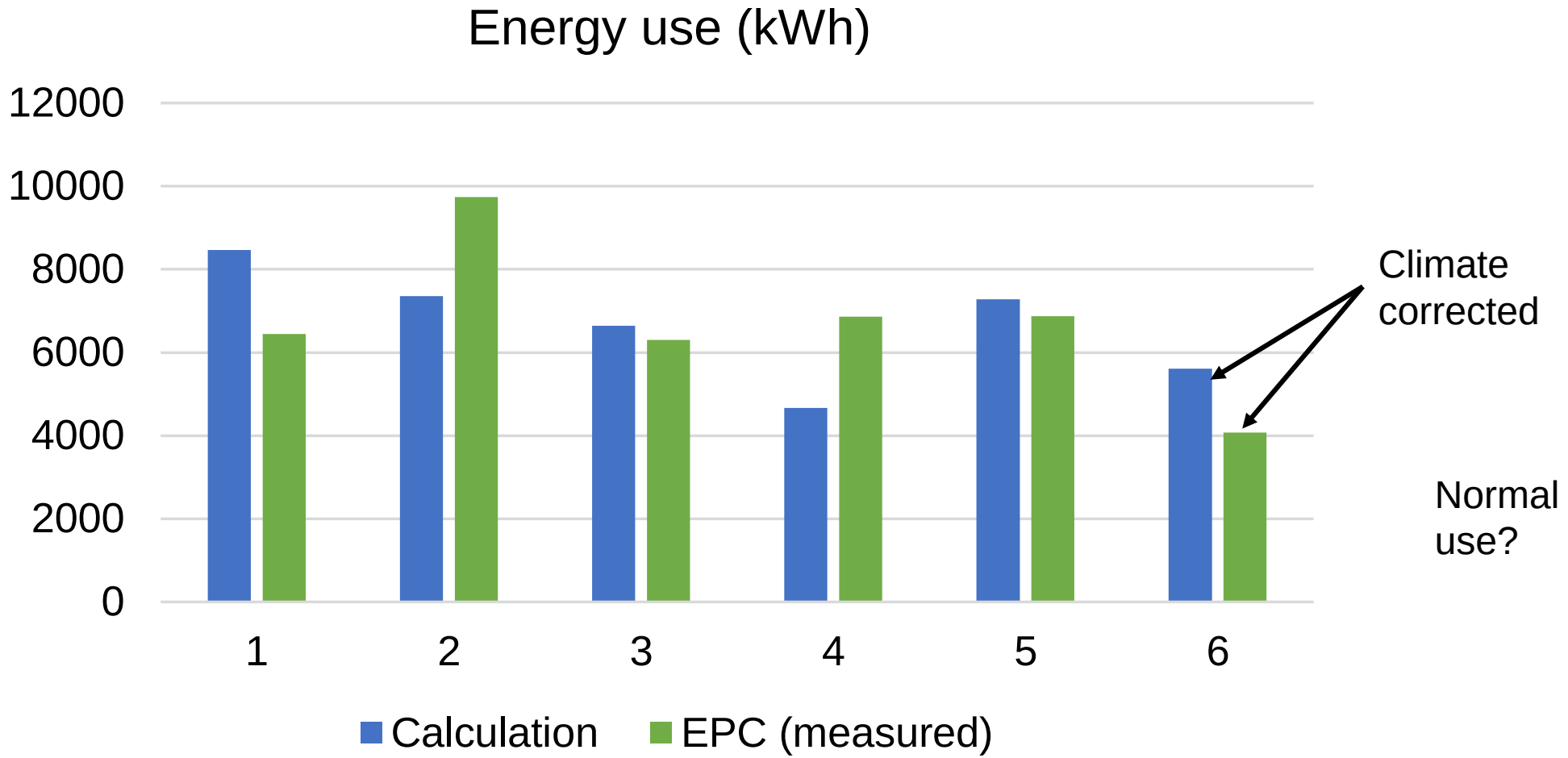
Average difference 25%. Largest difference 113%. Heated floor area measured wrong.

Difference vs. floor area



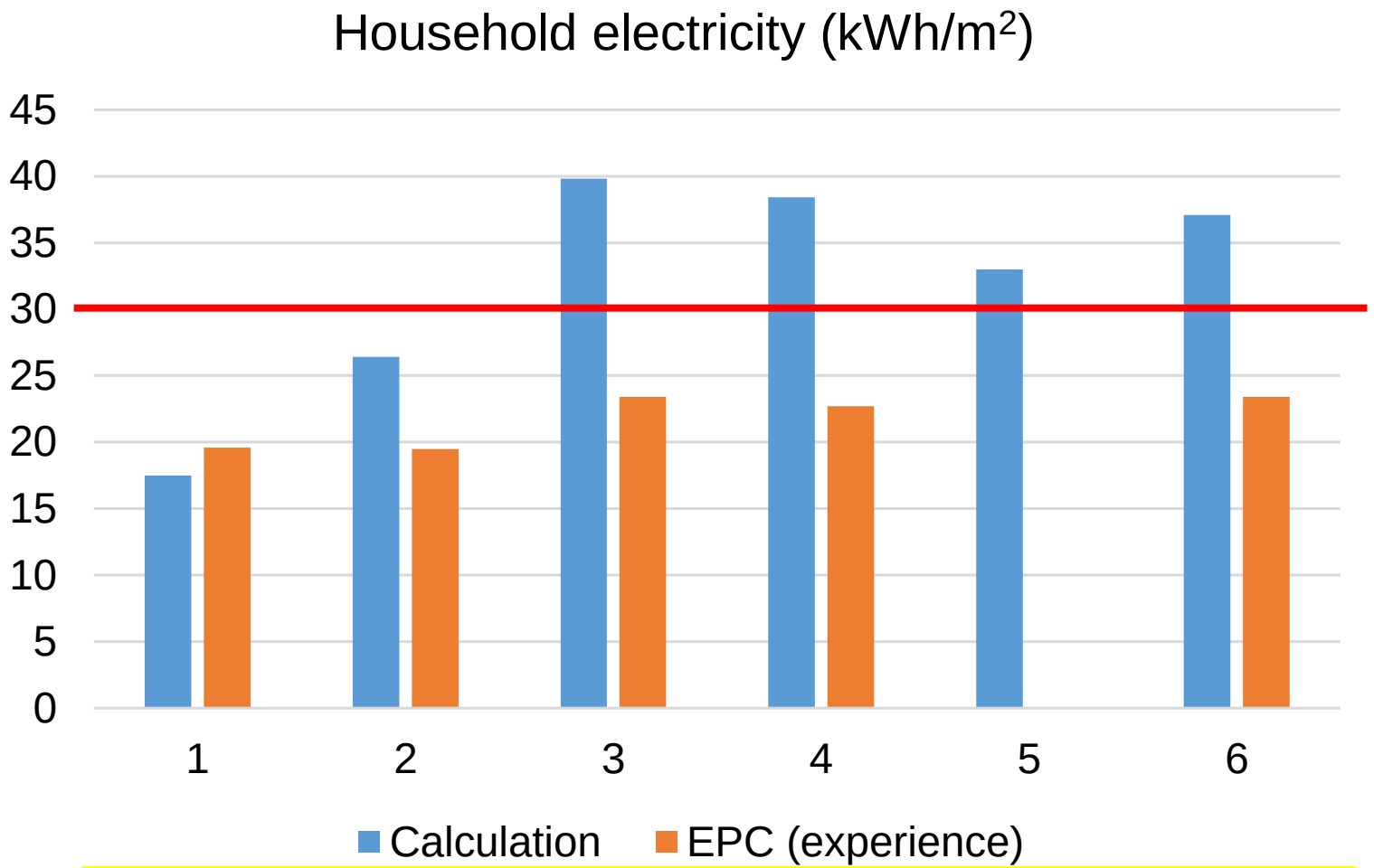
Large buildings have a lower difference in percentage than smaller buildings.

Detailed study of 6 houses



Differences for all buildings. Errors in both calculations and EPCs.

Household electricity (electric heating)



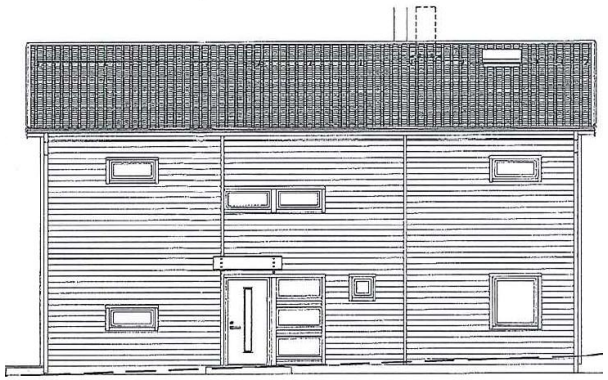
According to Sveby:
30 kWh/m²

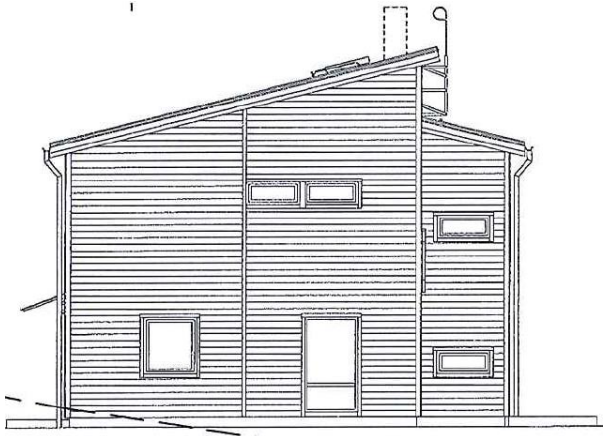
Large variation between the buildings, calculations and EPCs.

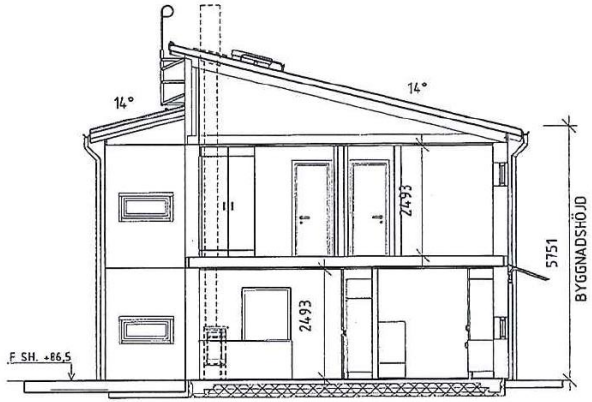
Parametric study

- Single family house (built in 2012)
- Light-weight wooden construction
- Ground source heat pump
- Exhaust air to water heat exchanger
- Indoor temperature 20°C, 21°C and 22°C

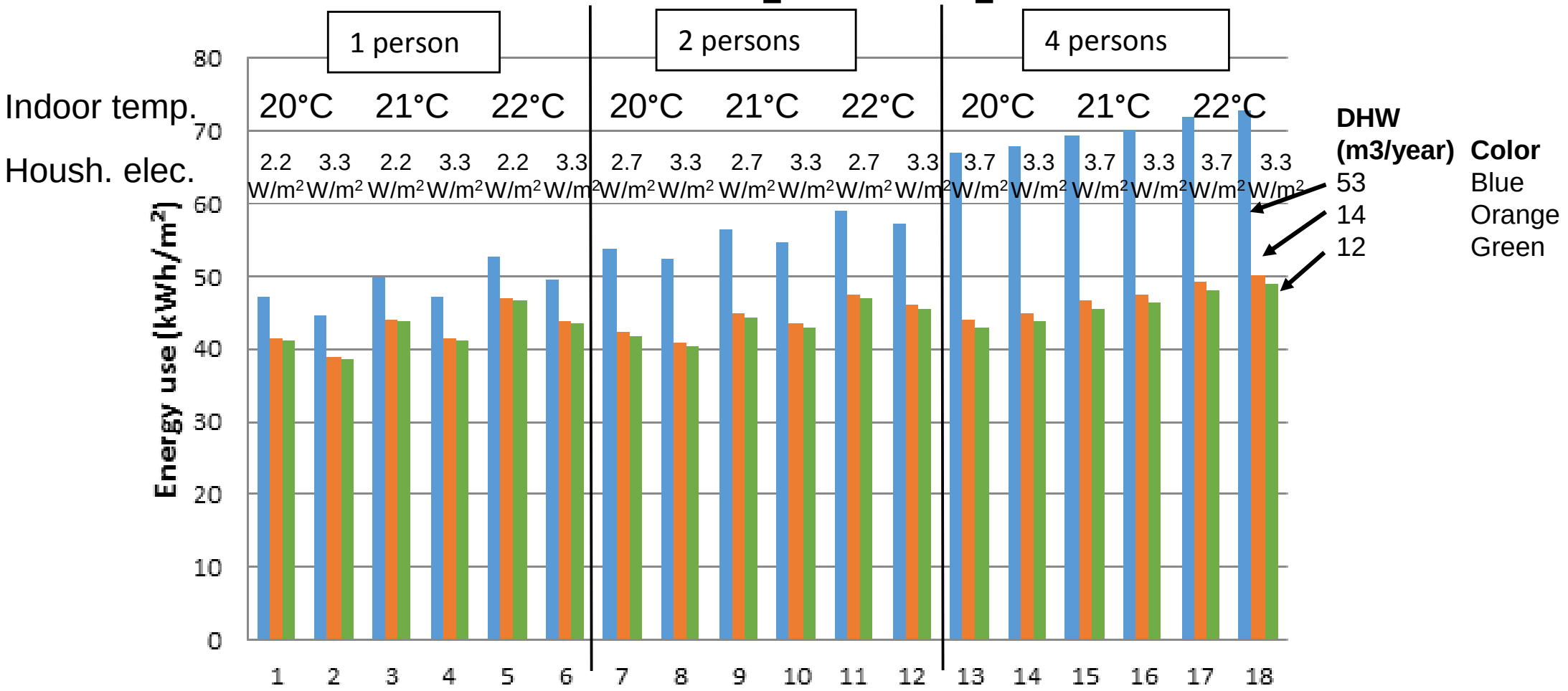
Number of persons	Household electricity	Hot water consumption	
1	3.3 W/m^2 = 5 100 kWh/year	145 l/pers/d = 53 m^3/year/pers	High (blue/left)
2	1.6 W/m^2 + 0.52 W/m^2/pers = 2 500 kWh/year + 800 kWh/year/pers	38.4 l/pers/d = 14 m^3/year/pers	Medium (orange/middle)
4		32.9 l/pers/d = 12 m^3/year/pers	Low (green/right)







Results of 54 occupant profiles



Normal use is not defined. Can be 36% difference for 1 vs. 4 pers.

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