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In-situ quantification of the thermal performance of residential buildings for formulating renovation strategies

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Background

Theoretical energy use

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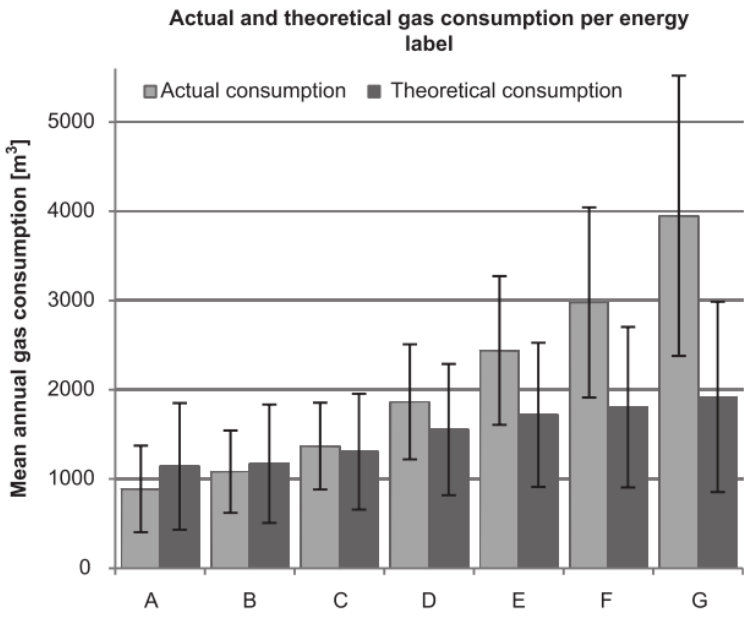
Actual energy use

(e.g. Bosch, 2011; Entrop, Brouwers, & Reinders, 2010; Majcen, Itard, & Visscher, 2013; Struck et al., 2014)

→ The performance gap



(Majcen, Itard, & Visscher, 2013)

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Introduction

Thermally characterize (individual) buildings

- Space heating: 2/3 of the energy demand of dwellings (Eurostat, 2016)
- Energy transition
  - Connections to district heating
  - Heat pumps

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Aim

Determine the actual thermal performance of an energetically renovated case study building.

- By performing a co-heating test (Bauwens & Roels, 2014)
- In terms of the total heat loss coefficient (HLC)

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Aim

Determine the actual thermal performance of an energetically renovated case study building.

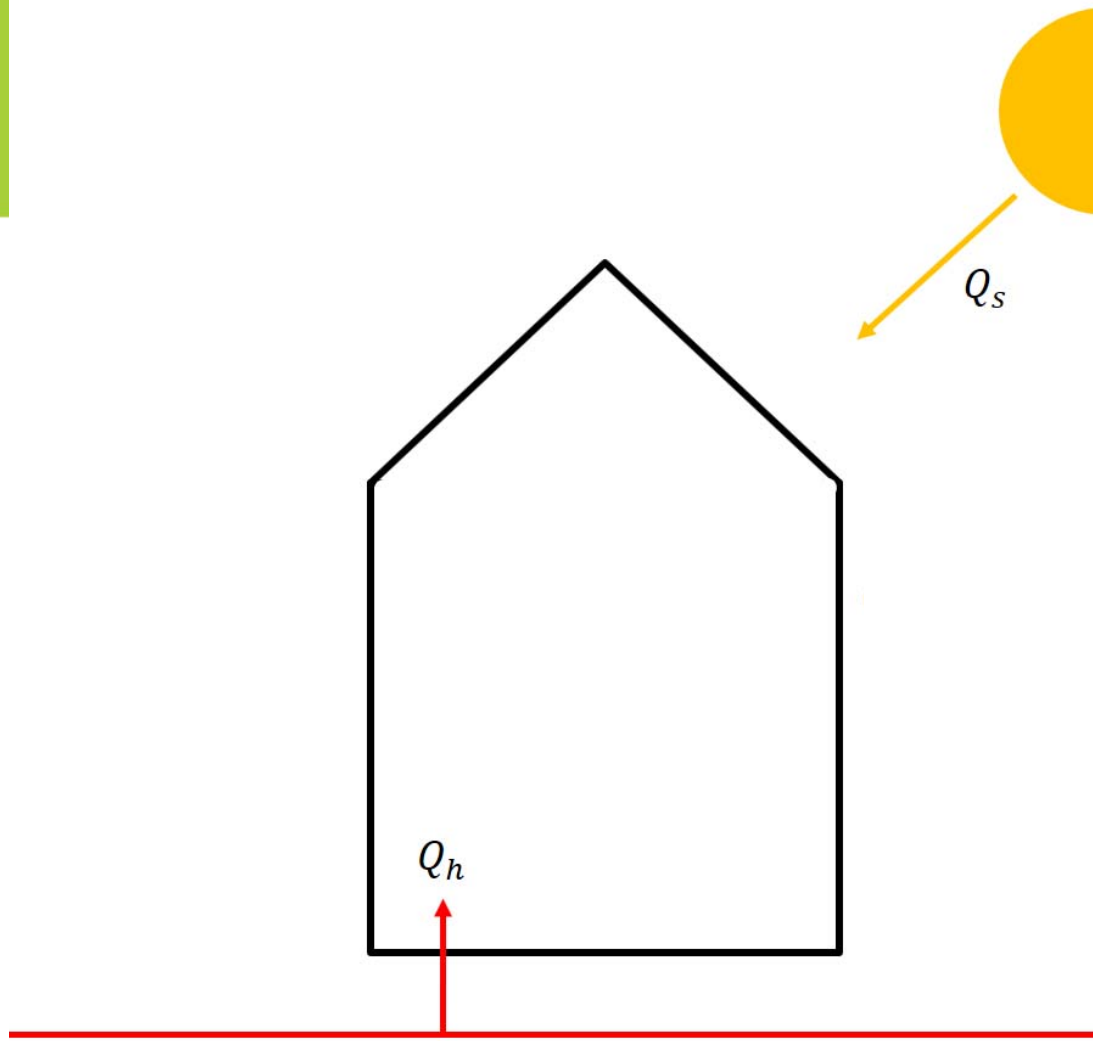
1. Assess the thermal quality of the case object for the owner;
2. Contribute to the discussion of what the HLC must include.

Theory

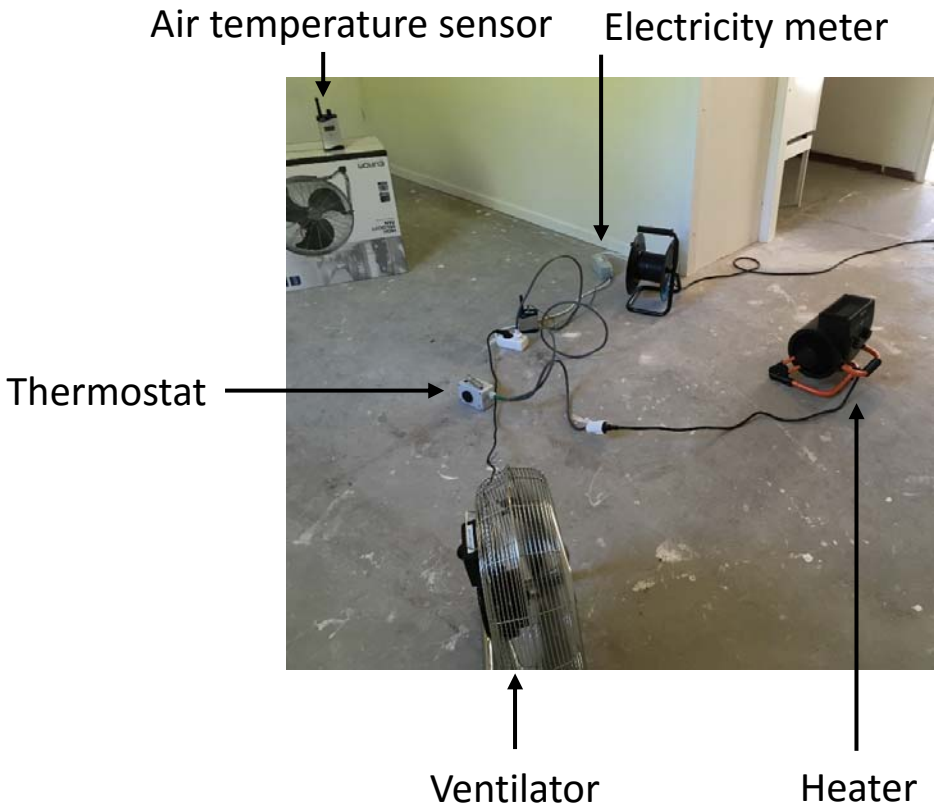
The energy balance:

$$Q_{in} = Q_{out}$$

$$Q_h + Q_s = Q_t + Q_v$$



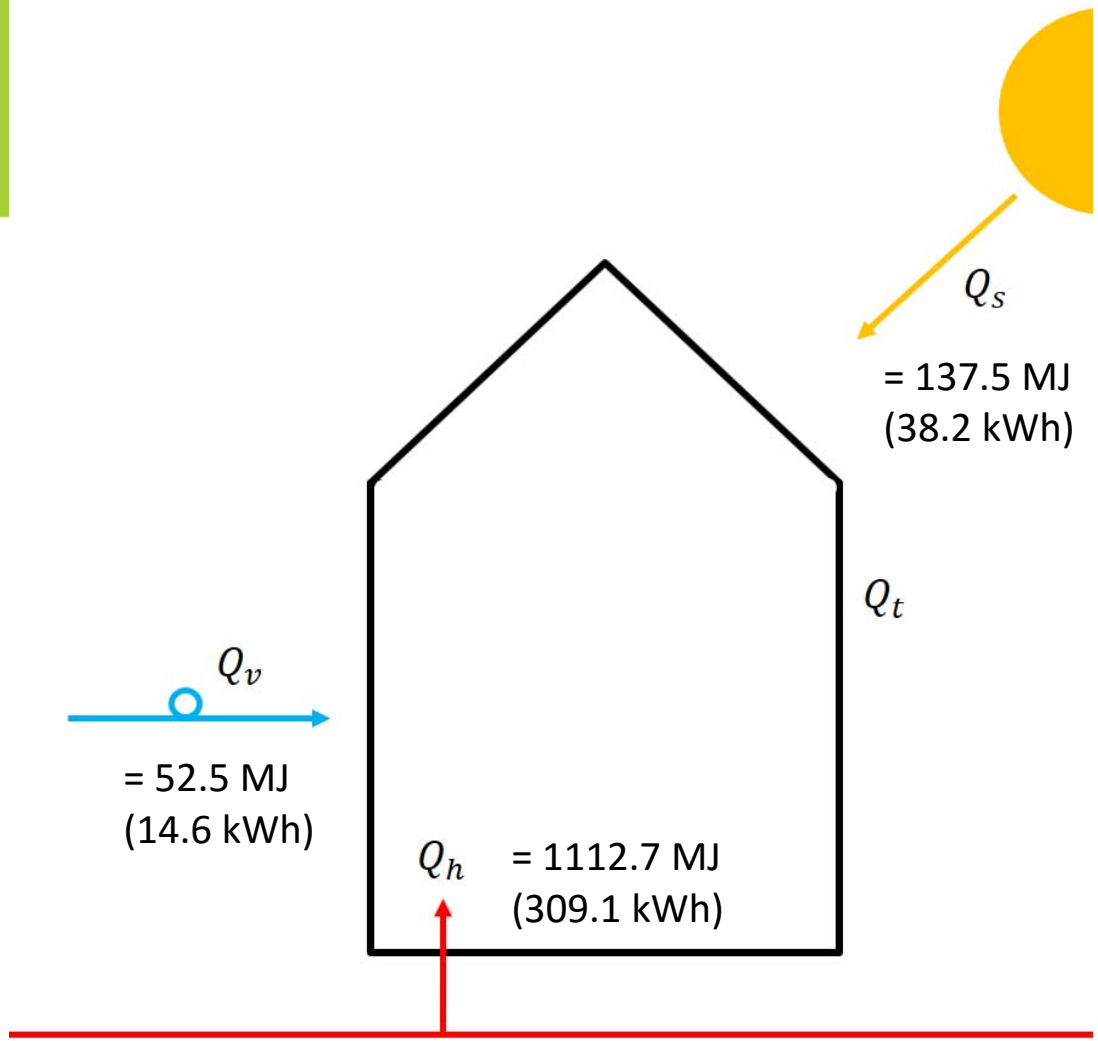
Research method



Results

$$Q_h + Q_s = Q_t + Q_v$$

$$Q_t = Q_h + Q_s - Q_v$$



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Analyses

Heat Loss Coefficient (HLC)

$$Q_h = HLC \times \Delta T$$

	Q_h	$Q_v + Q_t$	Q_t
HLC (W K^{-1})	172.8	192.1	183.3
SD (W K^{-1})	1.78	3.19	3.30
R^2 (-)	0.96	0.91	0.90
HLC (W K^{-1} m^{-2})	1.36	1.51	1.44

Analyses

Author(s)	Country	Year of construction	HLC ($W\ K^{-1}\ m^{-2}$)
Sjögren et al. (2009)	Sweden	1998 – 2003	0.95 – 1.58
Farmer et al. (2016)	United Kingdom	2009	0.73
		2012	1.17 – 1.27

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Conclusions

1. The case object is of good thermal quality (HLC = 1.51 W K^{-1} m^{-2}).

2. The HLC differs significantly depending on which energy flows are considered (>10%).

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Look-out

The co-heating test method may be used to validate the results of energy use prediction models.

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