

Future thermal energy demand in the building stock

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Introduction

Problem

- Effect of climate change and building stock transformation on future space heating and cooling demand.

Objective

- Estimate current and future demand for space heating and cooling in the residential (SFHs and MFHs) and non-residential building stock (Offices and Schools);
- Analyse the influence of architectural features on future thermal energy demands → hotspots;
- Estimate the impact of energy retrofit interventions.

Method

The building stock is described by building archetypes. The hourly cooling and heating load is calculated from an energy model based on EN-ISO 52016.

Swiss Meteo's design reference years for RCP 8.5 and RCP 2.6 were chosen to calculate the demand in future years.

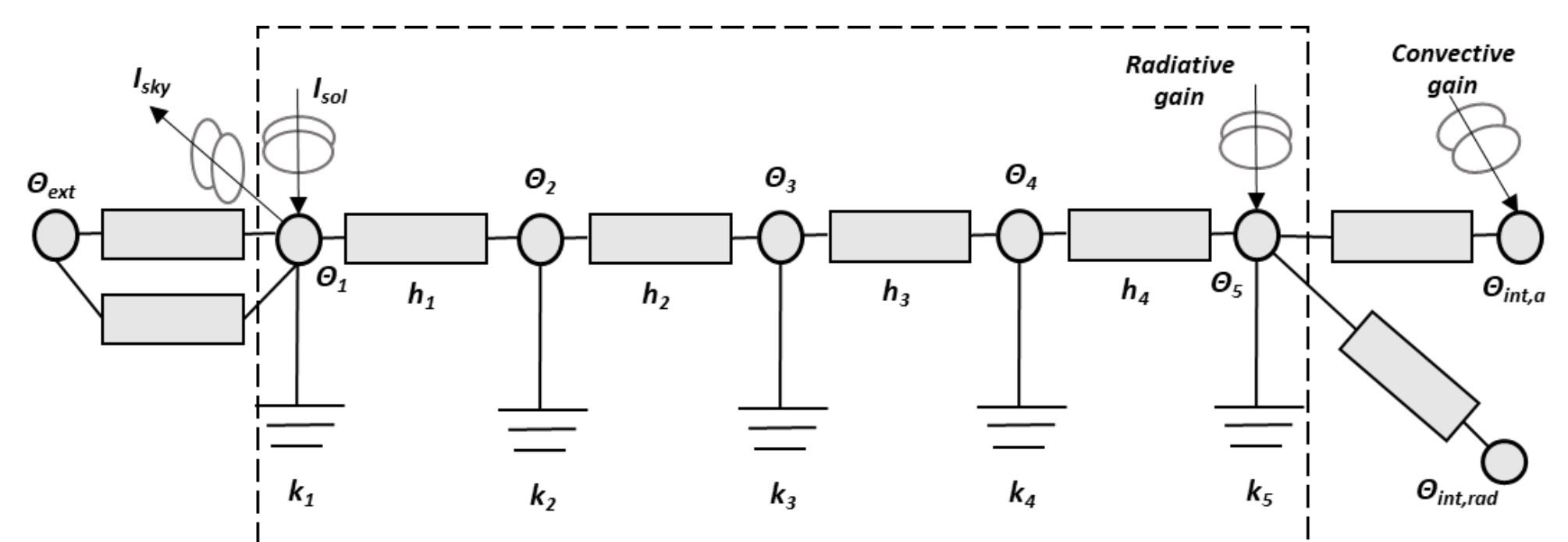


Figure 1: RC model of an opaque element in the EN-ISO 52016

Results

Current status – Offices

| Construction period | Heating demand [kWh/(m ² ·y)] | Cooling demand [kWh/(m ² ·y)] | Window to wall ratio [%] | Envelope U-value [W/(m ² ·K)] | Infiltration air exchange rate [m ³ /(m ² ·h)] |
|---------------------|--|--|--------------------------|--|--|
| <1919 | 120 | 28 | 21 | 1.0 | 1 |
| 1919-45 | 125 | 28 | 28 | 1.1 | 1 |
| 1946-60 | 131 | 29 | 35 | 1.1 | 1 |
| 1961-70 | 97 | 26 | 40 | 1.1 | 0.5 |
| 1971-80 | 91 | 27 | 40 | 1.0 | 0.5 |
| 1981-90 | 65 | 20 | 40 | 0.7 | 0.5 |
| 1991-00 | 63 | 37 | 43 | 0.6 | 0.5 |
| 2001-10 | 50 | 41 | 44 | 0.5 | 0.25 |
| >2010 | 35 | 45 | 37 | 0.4 | 0.125 |

Table 1: Current yearly specific space heating and cooling demand and main characteristics of the building envelope for Office buildings as a function of the construction period.

Future scenarios- Building stock

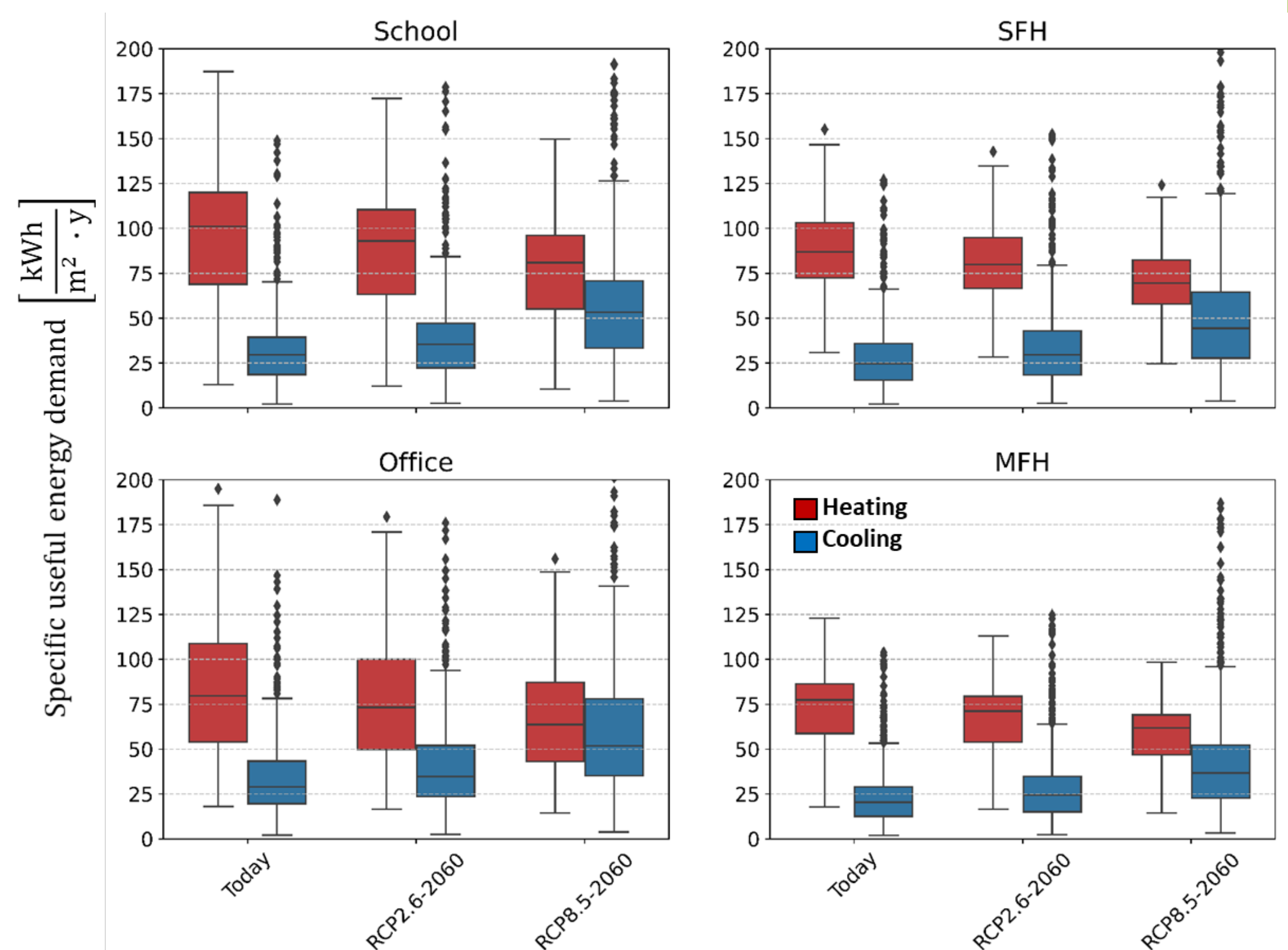


Figure 2: Current and future yearly specific useful demand for space cooling and heating for different building types

Conclusions

- High levels of thermal insulation, window to wall ratio and airtightness lead to higher cooling demand in modern buildings
- Increase of space cooling demand due to climate change
 - RCP 8.5-2060 → +80%
 - Office → +95%

Next steps:

- Scenarios development:
 - Cooling systems adoption
 - Retrofit [..]