



Modelling the Impact of climate change on the electricity grid and the energy performance of buildings in Belgium

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ABSTRACT

Addressing the impacts of short-term (recurrent heat waves) and long-term (global warming) of climate change on the indoor environmental and energy performance of buildings by technological solutions for energy generation, storage, distributions and demand reduction, and behavioral adaptation to heat/cold-related risks in Walloon cities.

KEYWORDS

Climate change, Building energy use, Global warming, Energy demand, Electricity grid, Walloon region

PROBLEM STATEMENT

Global warming has drawn great attention in recent years because of its large impact on many aspects of the environment and human activities in buildings. Recently in the summer of 2018, Belgium had a run of almost 51 consecutive days with temperatures above 25°C and outdoor air temperature of 38.8°C was recorded on the 27th of July. Energy consumption and thermal comfort in buildings are heavily affected by weather conditions.

OBJECTIVES

- Quantifying and upscaling the impact of climate change in terms of overheating risks on the building stock in Wallonia.
- Evaluating and Assessing the appropriate HVAC technologies that could limit the overheating risks in the selected building stock.
- Providing the needed information to electricity grid operators on the impact of climate change on electrical loads to balance with the power production.

AUDIENCE

Building engineers, policymakers, scientists, health services, architects, and energy companies.

RESEARCH QUESTIONS

- What are the potential impacts of climate change on heating, ventilation and cooling energy demands?
- What are the impacts of climate changes on the electrical loads to balance with power production?
- How appropriate HVAC technologies could limit the overheating in new and renovated buildings?

ORIGINALITY

- The developed model divides the building into several zones instead of one single zone in the previous studies.
- In most of the previous studies, indoor temperature is assumed to be constant all along the year, which is not the case in the present study.

METHODOLOGY

A bottom-up approach of the Belgian residential building stock was carried out. A tree structure is created by only taking into account the constructed and the demolished buildings between 2012 and 2030. The model is then calibrated to generate realistic electricity demand profiles representative of the situation in Belgium.

PRELIMINARY RESULTS

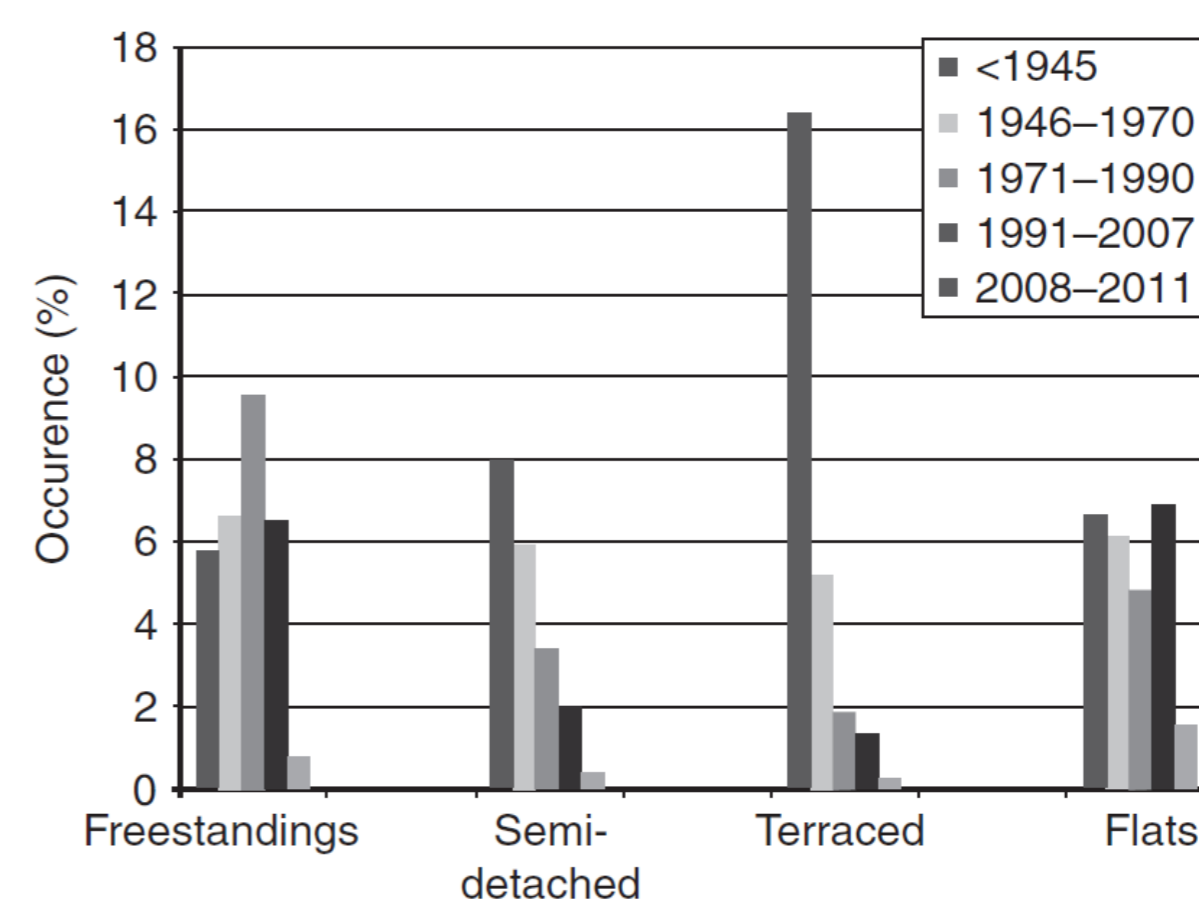


Figure 1: Distribution of the Belgian dwelling types in the different construction periods

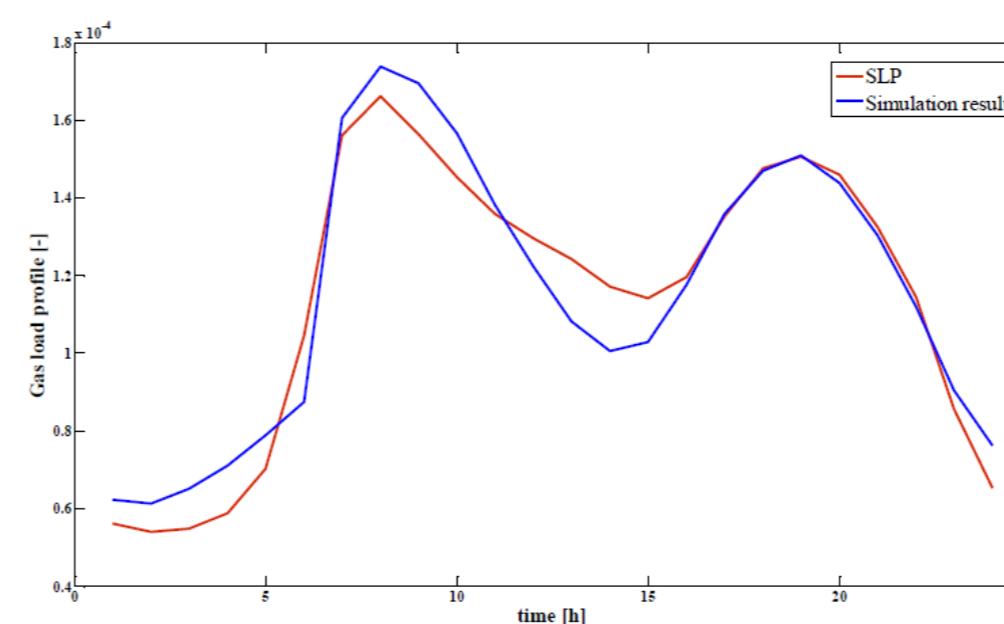


Figure 2: Gas load profile - comparison between simulation results and synthetic load profile for an average day

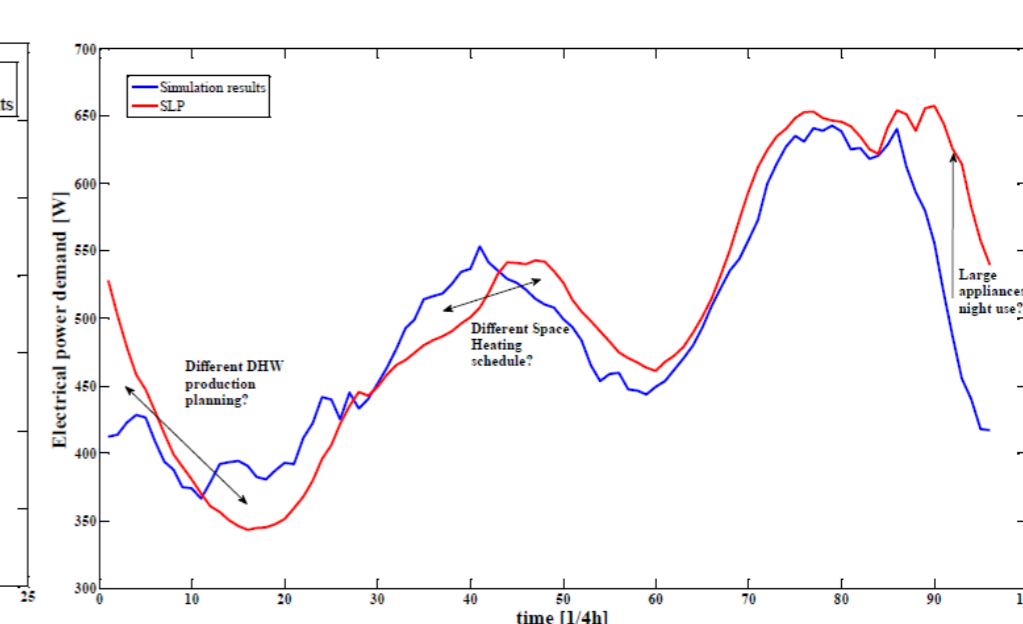


Figure 3: Average day consumption of an average dwelling - comparison between synthetic load profile and simulation results

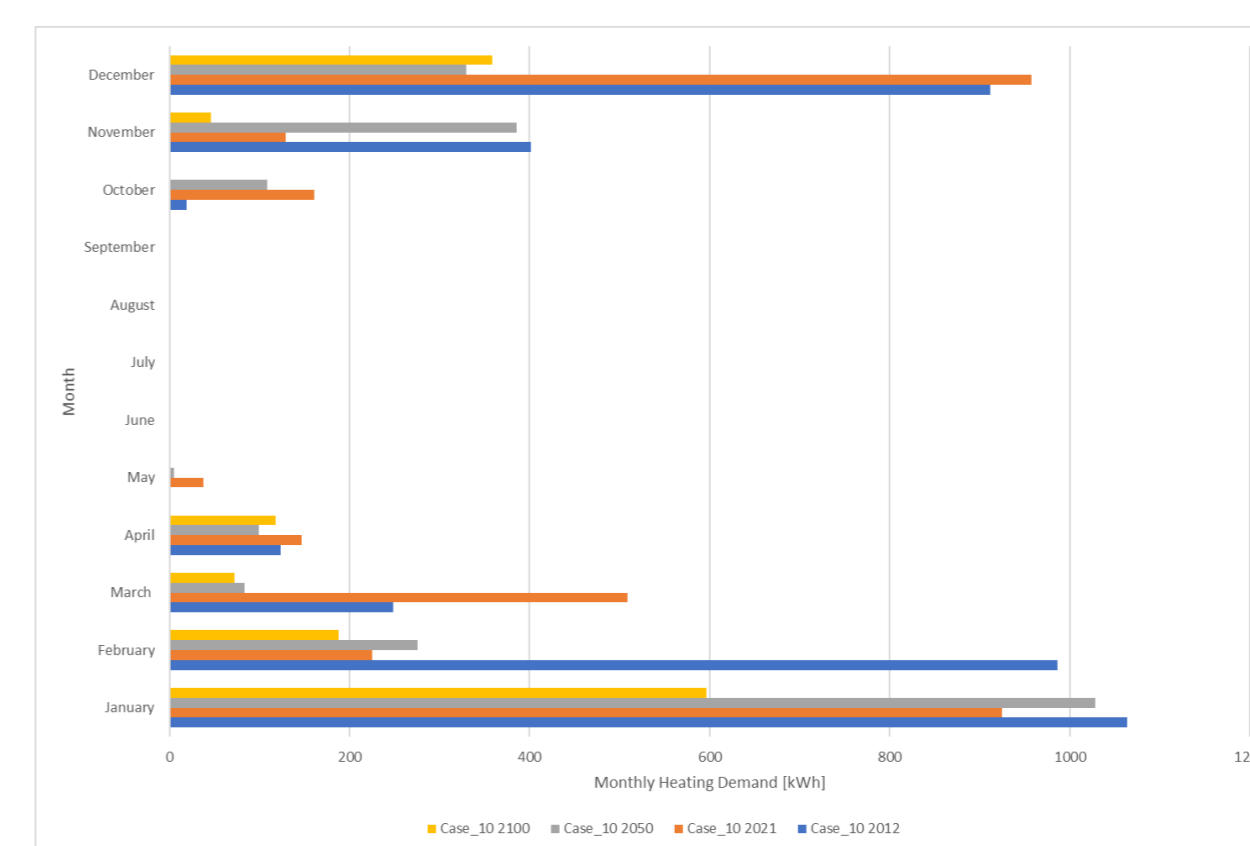


Figure 4: Monthly Heating Demand for an apartment from 2012 to 2100

CONCLUSION

This study aims to assess the evolution of the profiles of final energy consumptions at the national level with the predicted evolution of the climate until the end of the current century. The preliminary results show a significant decrease in the future heating demand in the upcoming years especially between the period 2050-2100.

RESOURCES

- Gendebien, S., Georges, E., Bertagnolio, S., & Lemort, V. (2015). Methodology to characterize a residential building stock using a bottom-up approach: A case study applied to Belgium. *International Journal of Sustainable Energy Planning and Management*, 71-88 Pages. <https://doi.org/10.5278/IJSEPM.2014.4.7>