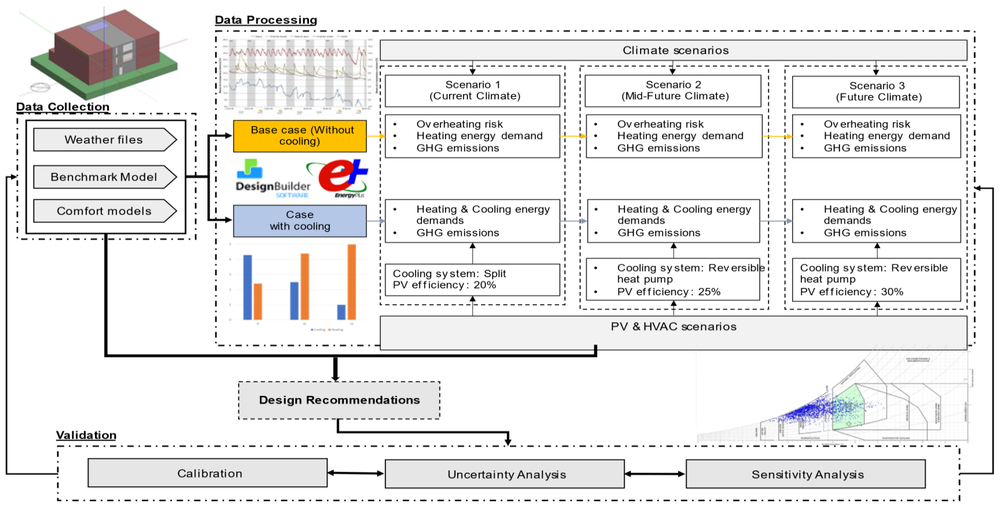
Impact of Climate Change on Heating and Cooling Energy Demands and Overheating Risks for Nearly Zero-Energy Dwellings

Authors: Soufiane AMMAR

E-mail: SOUFIANE.AMMAR@UM6P.MA

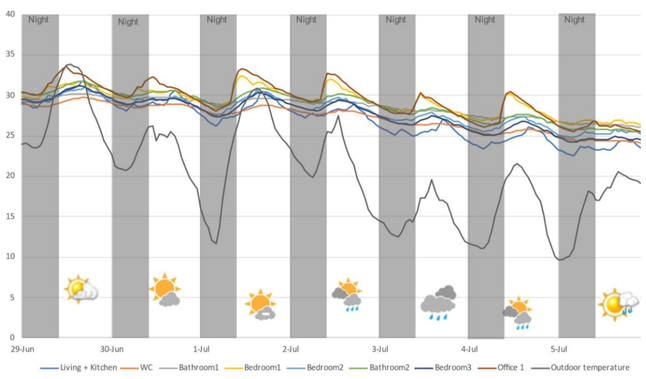
Address: Sustainable Building Design Lab
Quartier Polytech 1
Allee de la Decouverte 9
4000 Liege, Belgium
www.sbd.ulg.ac.be
Tel: +32 43.66.91.55
Fax: +32 43.66.29.09

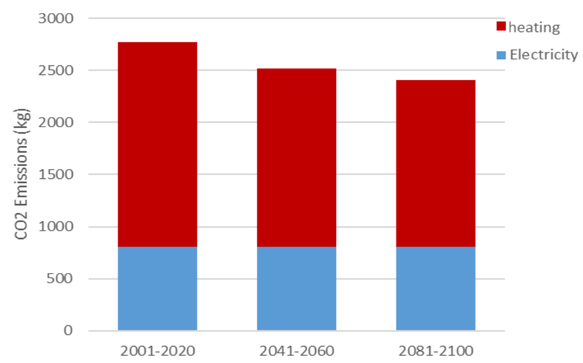
Building energy simulations are performed using climate projections for the 2041-2060 and 2081-2100 periods. The overheating risks are assessed under mid-future (2041-2060) and future (2081-2100) climate conditions. The results quantify the expected decrease in the heating and the increase in the cooling loads due to the future warmer temperatures. Finally, the greenhouse gas emissions for the present and forecasted future energy demand of heating and cooling are determined.

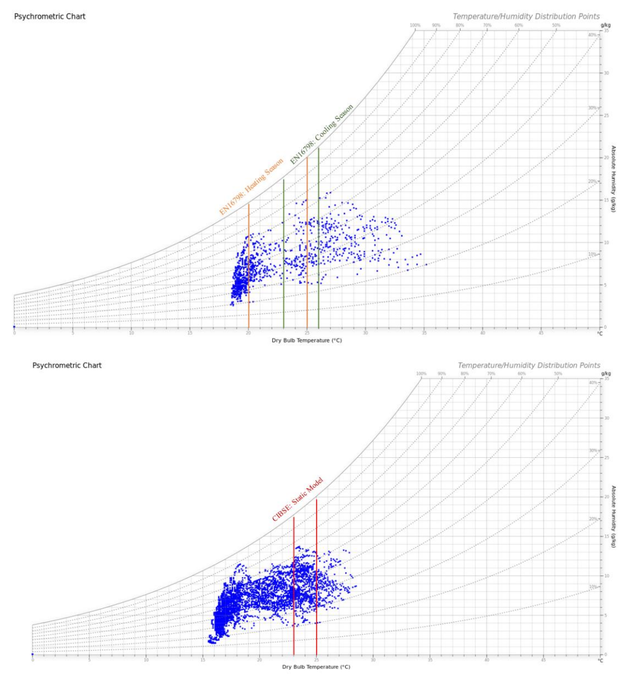


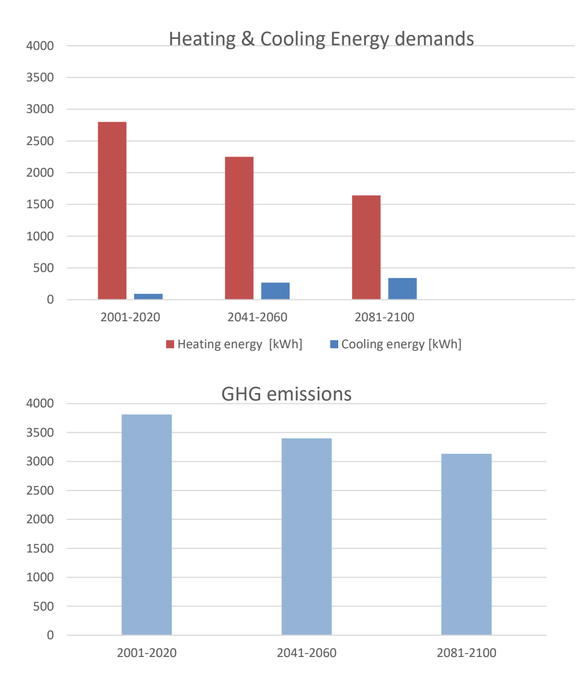
Building performance; energy use intensity; thermal comfort; HVAC; Greenhouse gas emission; future weather data

There is a vicious circle between buildings and climate change, as building energy use affects the climate and leading to climate change, and more energy use will generally be a result of climate change. Furthermore, the energy needs for maintaining a comfortable indoor environment is strongly related to the outdoor environment, and with extreme weather the HVAC systems may consume high energy. Thus, the impact of climate change on the energy consumption and overheating risk must be assessed.









Investigate the response of a nearly zero-energy building (NZEB) to global warming

- Evaluate the thermal performance and overheating risks under future climate scenarios
- Predict the changes in heating and cooling energy demand in the future
- Estimate the total building carbon emissions with the evolution of building systems

- Building engineers, urban planners, architects.
- Cooling industry.
- Policy makers (EPPD).

Under the scope of my joint thesis, I have performed a detailed case study, which could allow stakeholders to make decisions. Simulation results showed that climate change results in a substantial increase in building cooling loads while reducing heating loads. However, the magnitude of change in cooling and heating loads is highly dependent on building climate zones and outdoor climate conditions.

- What is the impact of climate change on the indoor overheating risks of nearly zero-energy buildings?
- What are the potential impacts on heating, and on cooling energy demand?
- What are the GHG emissions in the current and future scenarios?

- Validation of benchmarking studies in Belgium
- Assessing future performance of the building in relation to the climate change

[Attia, 2021] Developing a benchmark model for renovated, nearly zero-energy, terraced dwellings.

[Attia, 2020] Attia S.;Gobin C.; Climate Change Effects on Belgian Households: A Case Study of a Nearly Zero Energy Building. https://doi.org/10.3390/en13205357

[Berardi, 2020] Umberto Berardi, Pouriya Jafarpur. Assessing the impact of climate change on building heating and cooling energy demand in Canada. https://doi.org/10.1016/j.rser.2019.109681

[Hamdy, 2017] Hamdy M.; Carluccia S.; JanHoesb P.; Hensenb J.; The impact of climate change on the overheating risk in dwellings; https://doi.org/10.1016/j.buildenv.2017.06.031

[Wyard, 2020] Wyard C.; Scholzen C.; Doutreloup S.; Hallot E., Fettweis X. Future evolution of the hydroclimatic conditions favouring floods in the south-east of Belgium by 2100 using a regional climate mode. 09 May 2020. https://doi.org/10.1002/joc.6642

[Yang, 2019] Yang, Y.; Nik, V.M. Assessing the impacts of climate change on the German building stock. In Proceedings of the 16th IBPSA Conference, Italy, Rome, 2–4 September 2019; pp. 3563–3570.

SBD LAB
Sustainable Building Design Lab

LIÈGE université