

## Popular Science Summary

Global warming is mainly caused by greenhouse gas emissions. The building sector is responsible for a significant share of energy use and greenhouse gas emissions. Most of the existing buildings in Europe were built before 2001 and the vast majority will remain in place after 2050 when EU aims to achieve climate neutrality. Thus, renovation of the European building stock is needed to reduce operational energy and, therefore, emissions.

Nowadays, the most common way to carry out the building renovation is to create building energy models for existing conditions of building blocks then test several approaches (such as adding insulation in walls) to reduce operational energy. Generating building energy models is difficult. In some cases, it would take more than two weeks to do a detailed inspection of one building to build the energy model. This study aims to reduce effort of creating building energy model.

This thesis project investigates a methodology for semi-automatically generating building energy models at the urban scale. The energy models can be created based on open-access databases, which are OpenStreetMap, BETSI database, and Energy Performance Certifications database. OpenStreetMap is an open-access map database, and it contains building footprints. BETSI database is based on building statistics for Sweden, and it includes detailed construction information and thermal properties. Energy Performance Certifications database contains general construction information for specific buildings such as heated floor area, floor numbers, and energy performance of buildings.

The developed methodology can derive the building footprint data from the OpenStreetMap database. 3D building models were created with geometry data from Energy Performance Certificates and BETSI databases. Thermal properties can be determined from the BETSI database to create building energy models. The global warming potential of building operational energy was calculated by the climate impacts of heating and electricity use. The methodology was illustrated in several case-studies building blocks from different geographical locations in Sweden and construction periods.

Results on the case studies show that it is possible to semi-automatically generate building energy models that predict the energy performance without any input data from a user. The accuracy compared to measurements of space heating from the energy performance certificates was between 3% and 21%. However, more data is required to calibrate the building energy model for higher accuracy. This can be done by, for example, adjusting the simulation input data to fit the actual monthly energy use or by other input data from the user, such as the window-to-wall ratio.