Developing a data-driven tool for building energy retrofit planning

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Abstract

As only less than one percent of the existing housing stock is replaced annually, retrofitting existing buildings has become the most effective
approach to meet energy efficiency targets in this sector. Recently, researchers have highlighted the advantages of data-driven tools over traditional physics-based parametric simulations for retrofit planning. As a result, this research aims to develop a novel web-based data-driven tool with advanced capabilities, including predicting residential buildings' energy consumption and CO_2 emissions, evaluating the impact of various retrofitting measures, considering the effects of renewable energy solutions on energy performance and environmental outcomes, and estimating retrofit costs based on real-time market data. Accordingly, the research has developed a novel dataset using automation of dynamic thermal simulation process in DesignBuilder simulation tool for different types of buildings and different buildings' features.

Furthermore, the model is trained using XGBoost machine learning algorithm and user interface of the tool has been developed in the Streamlit framework. Moreover, the hyperparameters of the machine learning model were tuned using a genetic algorithm. The developed data-driven tool offers a reliable, time-efficient alternative to simulation models, providing accurate cost and impact assessments. It is user-friendly for non-professionals and home-owners without requiring simulation expertise and allows professionals to evaluate retrofit costs and prioritise options for detailed simulation analysis and therefore, enhances decision-making

Keywords

Retrofitting, Data-Driven tool