

## Developing a Multi-Criteria Model for Energy Retrofitting of Heritage Buildings

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### **Developing a Multi-Criteria Model for Energy Retrofitting of Heritage Buildings**

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#### Abstract

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The city of Amsterdam has the ambitious greenhouse emission reduction targets: to achieve a 95% reduction in emissions by 2050 and to phase out natural gas by 2040. Disconnecting the existing building stock from natural gas requires a switch to alternative energy-efficient sources, making optimal use of heat pumps and sustainable heating solutions available locally. The present study aims to identify minimum retrofitting strategies to prepare the historical city centre for lower temperature heat. The vast majority of the buildings in the historic centre of Amsterdam are protected and often poorly insulated, leading to increased energy use and poor thermal environment. Standard retrofitting interventions and the use of new materials may be restricted, requiring new approaches to balancing the need for energy efficiency and the preservation of heritage significance.

Using parametric design tools, the developed multi-criteria model allows to iterate retrofitting scenarios (post-insulation measures, air tightness, windows or equipment upgrades) and identify minimum requirements to make buildings suitable for lower temperature heating. By integrating bottom-up energy modelling and Geographical Information Systems data, the research estimates the effect of the selected retrofit packages on the energy demand of residential stock at the district scale. The study also provides knowledge for the municipality of Amsterdam to guide decisions on the improvement in energy performance and decarbonisation of the historic built environment.