# CITIESTWINS – A digital framework to merge durability data, maintenance models and energy retrofitting decisions

**Summary**

This project aims to create a modelling framework for cities that supports the maintenance of the buildings' envelope (roofs, façades, and window frames) to meet occupants' needs while further ensuring that a city meets its building-related carbon emission reduction target for 2035 and beyond.

This exploratory project complements existing efforts to manage Lisbon and other Portuguese cities via Digital Twin (DT) technology and adds a unique new dimension by adding urban building maintenance needs in concert with energy efficiency concerns. This addition is key since most building owners will only update the façade if there are compelling maintenance and safety issues.

The proposed framework is developed for a case study as a proof of concept (Figure 1). This pilot study is an unfamiliar house with three storeys, with thermal and humidity sensors in different rooms (with different solar orientations). The case study has individual energy data available over 10 years with the following characteristics: i) in the first years, electricity supplied by the company, water heating panels and without air conditioning; ii) after 4 years, addition of air conditioning; iii) after 7 years, addition of 6 solar panels for electricity production; iv) after 8 years, to counter skyrocketing electricity prices, the owners decided to add five more solar panels to reach increased energy independence. This case study allows calibrating the energy performance model proposed, evaluating the impact of positive measures of carbon neutrality, namely through the simulation of the rooftop photovoltaics in the energy demand and real costs over the years (in a pre- and post-war phase).

A digital twin is created to model dynamically the house changing conditions (Figure 2) by: i) visualising real-time thermal and humidity states for each room; ii) optimising maintenance schedules through predictive analytics based on long-term performance data; and iii) evaluating energy efficiency improvements, such as retrofitting strategies, via detailed cost–benefit analyses.

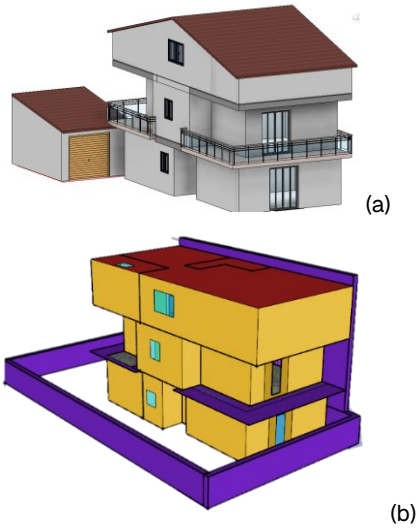


*Figure 1. Case study analysed (a) and BEM model (b).*

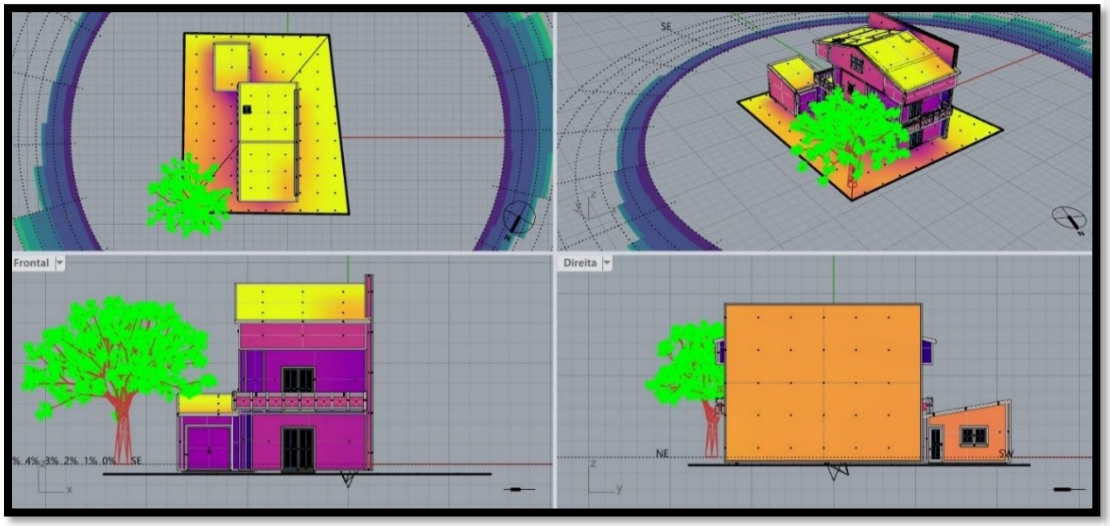


*Figure 2. Energy modelling of the case study.*

**Project Reference**

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**Leading Institution**

IST-ID – Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento (Portugal)

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49 786.07€

**CERIS**

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**Project website**

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