



# Probabilistic modelling of building stock properties for urban mining

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## Abstract

The construction industry is one of the biggest contributors to greenhouse gas emissions and unsustainable waste. A circular economy of the existing building stock can contribute to minimising mining of finite resources and reducing the construction industry's waste. However, stakeholders often list lack of information about the existing building stock as a barrier against implementing a circular economy in the construction industry. This study provides a framework for construction industry stakeholders to combine publicly available data sources to obtain probability-based information about the building stock. The study analyses existing building data at city level using Bayesian Networks, a probabilistic modelling approach that accounts for the missing data consistently in contrast to other methods. The framework can be extended to incorporate first principle, data-based and empirical models from disciplines such as structural engineering, architecture, and industrial ecology to facilitate a circular economy.

**Keywords:** circular economy; probabilistic modelling; existing building stock; residential buildings.

## 1 Introduction

The built environment stock and construction industry are among the biggest contributors to global greenhouse gas emissions, energy consumption, and unsustainable waste. This can partly be attributed to the production of building materials and components, construction, and demolition. In fact, in Europe, one third of all waste stems from construction and demolition activities [1].

A circular economy of the existing building stock can contribute to minimising mining of finite resources and reducing the construction industry's waste. Citywide circular economy approaches aim at implementing this approach at the local level. This makes it easier to set up a framework for a circular economy when working together with relevant actors, but also reduces the need for transport that can counteract the economic and

environmental benefits of reusing and recycling. However, stakeholders often list a lack of information about the existing building stock as a barrier against implementing a circular economy in the construction industry [2].

There are attempts to collate information about existing buildings from several European countries including footprint, height, building type, and age [3]. However, not only are there many missing entries for these attributes, but also, countries such as Norway were not included and important information like the main construction material is missing. Moreover, there is no suggestion on the part of the researchers on how to deal with data scarcity.

Probabilistic modelling is one way to effectively capture information on the building stock to facilitate circularity, allowing us to deal with an increased level of uncertainty due to either random