

# **Weighing the Importance of Urban Built Environment Stocks for Sustainability.**

## **A Danish Case Study.**

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Built environment stocks (i.e., buildings and infrastructure) have several important roles in society. They represent an extensive reservoir of secondary raw materials, provide essential services to citizens (e.g., shelter, transportation), and influence the type and quantity of materials flowing throughout the economy.

This thesis aims at weighing the importance of urban built environment stocks for sustainability strategies, using Odense, third city of Denmark, as a case city. First, the amounts of material and energy flowing through the cities were quantified, and results showed that Danish cities have improved in terms of resource consumption and emission generation. However, a lack of detailed understanding of the inner workings of cities hindered further exploration of potential improvement.

Odense's built environment stocks were then characterized in terms of type, quantity, and location of construction materials. In total, 66.7 megatons (or 329 tons per capita) of construction materials are stocked in the city. Spatially refined and detailed results were found to support the development of resource recovery strategies such as urban mining and circular economy.

These results were used to calculate the amount of carbon that would be emitted if Odense was to be built from scratch with current construction materials and technologies. This so-called carbon replacement value amounts to 10.5 megatons of carbon dioxide, corresponding to 13 years of the city's operational emissions. This results highlighted the importance of recovering the materials already stocked in Odense, in order to avoid further carbon emissions linked to the production of new material.

Finally, a qualitative investigation highlighted the importance of built environment stocks for fulfilling human basic needs. But, using the carbon replacement value previously calculated, the building of new urban stock in developing countries would result in considerable carbon emissions if carried out in a similar way than in Odense, thus stressing an urgent need for more carbon- and resource efficiency in the built environment.

Further research on built environment stocks is needed, in particular detailed and spatially refined case studies, in order to understand better the intricate drivers of material stock accumulation, and implications for sustainability strategies.