



Sim4Blocks

UNDERSTANDING THE POTENTIAL ENERGY FLEXIBILITY OF BUILDINGS

As the use of **renewable energy** sources rise, electricity utilities across the EU are increasingly being challenged with electricity supply and demand imbalances. **Demand response** (DR) is one way of managing how and when electricity is used for capacity flexibility. The EU-funded project, Sim4Blocks, recognises how significant DR can be for future smart cities however, to be successful, tools need to be developed that enable DR to be **implemented** easily and inexpensively on a large scale.

Due to a lack of widespread data on the DR potential of buildings in the EU, Sim4Blocks has used classification and clustering models to analyse and judge the DR capabilities of **residential** building stock so that flexible energy services can be applied to blocks of buildings, districts and municipalities.

Both techniques categorise buildings according to their **thermal** or **power characteristics** to pre-assess whether DR services can be implemented.

EUROPEAN BUILDING STOCK

Knowing whether buildings are suitable for DR can be challenging. The European building stock (the structure and composition of each house and its relation to its energy efficiency in the EU) is large and varied making it extremely difficult to build DR systems. More data is needed on buildings' potential exploitable energy flexibility.

Sim4Blocks examined the effectiveness of two approaches, classification and clustering, for pre-assessing buildings on a much larger scale to see which flexible energy services are suitable for different groups of buildings.

PILOT SITE

Wüstenrot in Germany is the testing site for the clustering and classification models due to its large diversification of building types and high-quality data set.





CLASSIFICATION

Classification is usually based on using domain knowledge and expertise to determine which class each building belongs to from a set of predefined classes.

Examples of building classification include:

- Houses built in the 18th, 19th and 20th century – classifying into three categories.
- Some buildings are residential, offices, institutions etc.
- Different years of renovation e.g. prefabricated and brickwork

3D-building models can be generated using the technical data available for the building, providing data on the age, use, number of floors, type, refurbishment year, window surface and insulation for example. Sim4Blocks used this data to determine the heat transmission and demand of each building.

Summary of classification:

- Works well when there are extensive records on the area's building stock
- Important as it helps identify interested private and commercial users for smart meters to shift their electricity demand



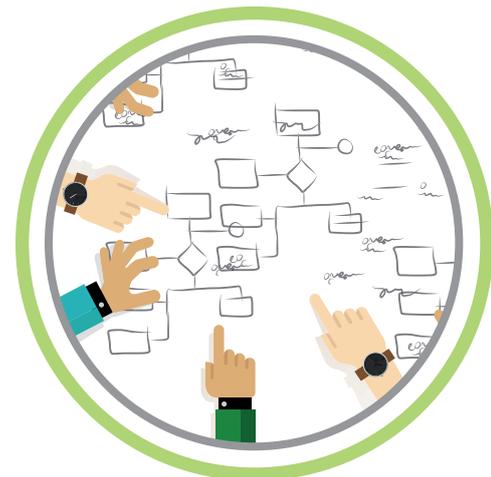
CLUSTERING

A plethora of computer-based algorithms are used to filter data points into groups to identify whether there are any similarities between them. This technique is fairly new as it has not been widely used before for the thermal determination of buildings.

Example of building clustering: A cluster might represent buildings with similar attributes in demographic, economic, geometric and annual heating demand.

Summary:

- Suitable for large data sets
- Suitable when there is little or poor knowledge of building regulations
- Estimates the DR potential of geometrically similar buildings
- One challenge is identifying the most suitable clustering algorithm from a large choice of algorithms



BEYOND SIM4BLOCKS

For Wüstenrot, classification proved to be effective enough due to the large dataset already compiled from various sources.

However, both classification and clustering can obtain useful results. Classification can capture which particular buildings are more appropriate for applying DR measures, whilst clustering can provide an aggregated DR potential of a group of buildings with similar geometric characteristics or with similar energy demands.

In doing this research, Sim4Blocks contributed to understanding tools to help aggregators and electricity companies, and methods that should be used to make estimates of how the EU's building stock can contribute to flexibility, efficient DR frameworks and grid stability.

