

# **A Spatial Domestic Energy Framework for Sub-City Areas: A Case Study from the United Kingdom 2016**

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## **Abstract**

This research focuses on spatial domestic energy modelling of sub-city areas in the United Kingdom using Newcastle upon Tyne as a case study. The model estimates the energy end-use at single dwelling level and in three aggregate scales: district, neighbourhood and community.

The model uses two aggregation approaches, one using an approximated prototype-cluster of similar dwellings at district scale and the other using a novel, detailed modelling of building and its micro-cohesive energy structures in neighbourhoods and communities. The results of a property type based model are also introduced. Besides estimating the energy consumption, the property type model could play an interesting role in developing strategies for energy efficiency at various scales.

The validation strategy is used to compare the modelled gas and electricity values in three representative districts against the 2009 DECC values in two aggregate hierarchical areas for electricity and gas, the DECC Medium Layer Super Output Area (MLSOA) and the Lower Layer Super Output Area (LLSOA). A collection of test samples of property type were devised and compared with statistics in the National Energy Efficiency Data set framework (NEED).

The spatially enabled energy model and rich thematic database enables integrated mapping practices, like updating authoritative data with secondary data sets to possibly reduce their production costs. A spatially enabled database also provides the precise spatial extent of the energy consumption in sub-city areas and enables a query procedure that allows identifying building aggregated areas that have spatial expression patterns most similar to a given parameter within the building energy profile.

Although all sources of uncertainties affect the confidence in the domestic energy model estimation, this research only considers the sources that can be subject to quantitative characterisation. The key uncertainties in the energy model are identified in a three dimensional taxonomy originally used in the medical field. The dimensions

identify sources, issues and nature of the uncertainties. The final objective is to extend traditional sensitivity analysis in order to decompose the uncertainty of inputs and uncertainty in the pathway as uncertainty flows through the model to inform data gathering and information collection activities.