

# GIS-Based Data-Driven Analysis For Urban GHG Emissions In Northern Ireland

Ming Jun Huang\*<sup>a</sup>, Neil Hewitt<sup>a</sup>, Leila Darvishvand<sup>a</sup>, Xingying Zhang<sup>b</sup>, Lu Zhang<sup>b</sup>

<sup>a</sup> Belfast school of architecture and built environment, Ulster University, N. Ireland, UK

<sup>b</sup> National Satellite Meteorological Center, China Meteorological Administration, China

\* [m.huang@ulster.ac.uk](mailto:m.huang@ulster.ac.uk)

In Northern Ireland, green house gas (GHG) emission from buildings takes one third of the total GHG emission. Understanding the distribution and characteristics of the residential building stock is essential for informing housing policy, urban regeneration, and sustainable planning. Northern Ireland, with its diverse urban and rural environments, offers a unique context for studying building typologies and development patterns. This study aims to perform a GIS-based, data-driven analysis of residential buildings across Northern Ireland, focusing on the spatial distribution of property types, construction age bands, property sizes, energy efficiency levels, central heating fuel types, and demographic patterns.

The study integrates multiple datasets, including energy performance data, census records, and building stock data, within a geographic information system (GIS) framework. Datasets were pre-processed to ensure consistency and spatial integration. Data-driven methods, including statistical aggregation and exploratory spatial analysis, were employed to map and quantify the proportions of terraced, semi-detached, detached, and apartment-type properties, as well as the distributions of construction periods, property sizes, energy efficiency levels, and central heating fuel types across different districts. Thematic maps reveal distinct regional patterns, highlighting variations in housing types and historical development trends. Preliminary findings suggest strong spatial clustering of certain property types, construction age bands, and central heating fuel types, offering insights into regional housing characteristics and potential areas for targeted policy interventions, retrofitting initiatives, and sustainable development efforts.