



A Two-step Clustering Framework for Locally Tailored Design of Decarbonizing Residential Heating

Benefits to local authorities, policy makers, urban planners

“Integrated analysis of data across diverse dimensions will enable more effective implementation of energy technologies in cities”

-Ruchi Choudhary, Data-centric Engineering Program, Alan Turing Institute

Summary

We present a two-step clustering framework of high-dimensional data involving socio-demographic, physical, and economic features of districts across London. The framework takes the advantage of the aligned design of statistical geographical boundaries and different characteristics of various clustering algorithms to provide enlightening hidden patterns and policy implications at multiple resolutions both numerically and geographically without including the target variable and geographical information in the modelling process.

As a result, we identify distinct groups of local authorities that share patterns of heating consumption. The relationship among variables may vary in both qualitative and quantitative aspects in different clusters. It is of great help to

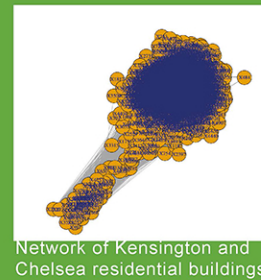
perform cluster analysis that includes all approachable information and to look into the differentiated characters among generated clusters before designing or executing their policies.

We have also performed network analysis to further categorised residential built environment based on their energy efficiency properties. Depends the understanding of building for future improvement on building energy efficiency.

Acknowledgements: This project is in partnership with Centre for Smart Infrastructure & Construction and Data-centric Engineering Program at the Alan Turing Institute.

Key Findings

- It is not enough for urban planners and policy makers to consider the targeted areas as a whole. The relationship among variables may vary in both qualitative and quantitative aspects in different clusters.



Network of Kensington and Chelsea residential buildings

- We generated 8 LSOA clusters that have decomposed the full density of domestic gas consumption into eight different sub-densities with each has its own characteristics without including the gas consumption information in the model.

• The combined characters across 22 dimensions in each cluster provides unique energy efficiency related policy indications.

- The Local Authorities that lies in the same cluster (or sub-cluster), especially the ones that are locally adjacent, may pursuit closer collaborations.

Impact and Value

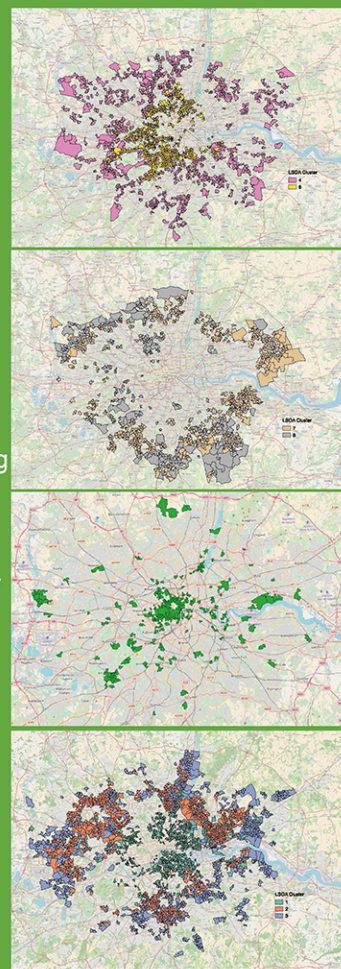
- Master-planning tools to support locally tailored implementation of energy policies in UK cities.
- These will help us understand why certain energy policies are more or less successful than others, geographically, socially, and physically.
- It will also enable sustainable infrastructure planning that is aligned with UK's carbon targets and is, at the same time, locally robust.

Long-term Vision

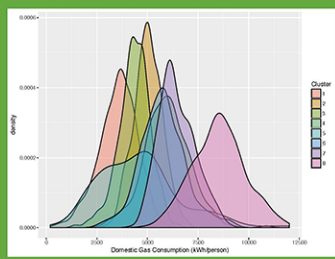
In the long-term, we aim to develop an integrated standard procedure that combines state-of-the-art statistical models to help local governments/planners to understand the targeted area at various resolutions and in a more comprehensive view.

Next Steps

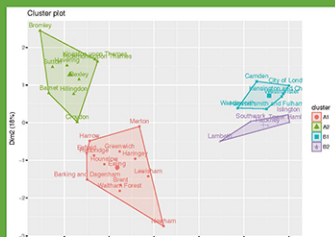
- Further develop the framework to incorporate situations when the accessibility of data is limited
- Comparing the energy consumption patterns among cities/areas at different scale with the proposed methods
- Combining information at both macro and micro level in the modelling to provide evidences more robust and comprehensive evidences



LSOA cluster spatial distributions



Cluster densities of domestic gas consumption in GLA



Dendrogram of the LAD clusters



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