

Modelling Urban Energy Systems

Dr. James Keirstead

Imperial College London

Cities are now home to over half of the world's population. In the coming decades, this figure is expected to grow, particularly in developing nations, as people continue to seek out the economic and social opportunities provided by urban areas. Supporting these populations requires large flows of materials and energy from outside of the city and recent research has shown that approximately 2/3 of global primary energy consumption and 71% of global energy-related CO₂ emissions can be attributed to cities. This creates significant pressure to maximize the efficiency of urban energy systems through better system design and operation. We define urban energy systems as 'the combined processes of acquiring and using energy to satisfy the energy service demands of a given urban area'.

This presentation will provide an overview of the modelling techniques that are used to study urban energy systems, drawing on a recently conducted literature review. The study found that six unique modelling approaches are commonly applied to urban energy systems, ranging from those focused on individual technologies, through to whole system assessments of both technology and policy. A critical assessment of these approaches is offered and common challenges identified, particularly in the area of data collection and standardization. Future opportunities are also discussed, including new computational advances and modelling frameworks. Illustrations from the author's work on urban energy systems modelling are provided throughout. These draw on recent work on urban energy retrofitting in Newcastle, as well as agent-based modelling of urban energy demands in London.

The results suggest an emerging consensus on the need for integrated models, based around an activity-based view of urban energy consumption. While the focus of this presentation will be on urban energy systems, it is hoped that other researchers will find parallels with other areas of urban resource consumption and common areas of interest can be discussed.