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CALL FOR PAPERS: special issue

Net-Zero Retrofit of the Building Stock

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Deadline for abstracts: 28 October 2024 noon (GMT)

How might the building stock transition towards Net Zero? How big a change is achievable? At what cost? And what are the theoretical and practical factors that determine both the overall potential as well as the transition process?

Although these questions might lend themselves to a large-scale, aggregate perspective (considering issues like total capital cost, long-term targets for the deployment of low-zero carbon technologies, national and local energy efficiency policies, etc); any changes will be enacted on individual buildings. This special issue will explore these topics, from both a top-down (national, urban or local stock level) standpoint, but also a bottom-up (building level) point of view. Abstracts (in the first instance) are invited that explore these issues whether from a qualitative perspective (e.g. the potential impact of different retrofit policies as well and any barriers to successful uptake) or a quantitative perspective (e.g. the impact of different approaches to deploying retrofit measures at scale).

We are well positioned to understand the challenge of a transition towards Net Zero. The available data on the make-up and performance of the stock is orders of magnitude beyond what existed a few decades ago; both in terms of detail and scale (Batty 2016). While large-scale analyses have historically tended to rely on simple archetype models and aggregate data, the increasing availability of detailed data on the building stock along with modelled & empirical energy data, means that we are shifting towards the ability to do much more detailed and complex analyses at a disaggregate scale (Steadman *et al.* 2020; Rodríguez *et al.* 2017).

Nonetheless, considerable unknowns remain. This includes gaps in the data (*e.g.* identifying hard to treat homes, where retrofit measures may be theoretically suitable, but unviable in reality due to practical factors not captured in the large-scale data), identifying the types of measures most suited to the overall stock, as well as the most appropriate approach to finance the transition and/or encourage building users. This special issue aims to focus on improving our understanding of these unknowns.

Background and context

Globally, the operation of buildings account for almost a third of total energy consumption, and a quarter of anthropic carbon emissions. As part of the wider transition towards Net Zero, major improvements in building performance will be required across the stock. Crucially, since the majority of buildings that will exist in 2050 already exist today, major improvements are necessary across the current stock.

To make such a transition successfully will require long-term sustained changes across a variety of areas; including improvements to the building fabric, the technologies that heat & cool buildings, occupancy behaviour, as well as external factors like the decarbonisation of the energy supply or changes in the utilities distribution infrastructure. Reflecting the timescales needed to limit the impact of climate change, the scale and speed of the challenge is unprecedented. Ambitious targets for the deployment of heat pumps are under consideration for Europe (European Commission 2023).

In recent years, an increasing number of countries and cities across the world have instituted emissions reduction targets, varying in the levels of detail and governance (New Climate Institute *et al.* 2023). However, even where targets are in place, the transition is just as important as the final state of the stock. Naturally, decisions about how building improvements are deployed will impact on the ongoing emissions reduction (CCC 2020). However, even if targets for specific years are met, the transition process itself can impact significantly on the overall economic viability as well as the cumulative emissions and operational costs (OBR 2021; Lowe & Oreszczyn 2020).

What are the pros and cons of prioritising certain measures over others (*e.g.* cheaper or easier retrofits like cavity wall insulation or loft insulation; versus more expensive but potentially larger impact measures like solid wall insulation), or improving certain buildings before others (*e.g.* retrofitting fuel-poor homes first; compared with prioritising homes expected to have the largest reduction potential)? At the large scale, these questions surrounding building selection will define the annual and cumulative performance of the coming decades. At a smaller scale they will also influence things like local employment (*e.g.* whether the skills & infrastructure exist) and define the energy profiles and fuel bills of the individual building occupants.

The impetus for building retrofits often includes policies that provide standards and guidance, energy performance assessments, as well as direct & indirect financial incentives. Policies also vary in terms of how ambitious their goals are, as well as how the impact of retrofits are measured, and more generally how compliance is tracked and enforced. These variations reflect differences in "political structures, social milieu, economic and environmental factors, and existing building stocks" (Zhang *et al.* 2021), as well as the available infrastructure to implement potential policies. Furthermore, the suitability of a given approach will vary considerably from sector-to-sector. The Tokyo cap-and-trade programme (TCTP) for example, was successful for reducing emissions in very large buildings, but may not be suitable for residential or small non-domestic properties. Elsewhere, policies that may be suitable for one sector of the housing market, may be less suitable for another, owing to differences in factors like building occupation and the owners' ability (and willingness) to pay.

Building improvements aimed at reducing operational emissions also need to be considered in the context of wider factors than solely energy & emissions; such as the risk of increased summer overheating and rising operational costs (potentially linked to increased insulation and heating plant changes respectively (Ortiz *et al.* 2020)), external factors like the ability of the grid to cope with a large-scale electrification of a historically gas-based heating system, as well as more qualitative issues such as preserving architectural culture/heritage (Webb 2017). Within this context, some previously accepted rules of thumb have also been called into question. Is fabric-first always a necessity prior to transition from boilers to heat pumps (Eyre *et al.* 2023)? From a whole life carbon perspective, are there instances where it is preferable to demolish and construct new buildings rather than refurbish them (Schwartz *et al.* 2018)?

Potential Topics

Potential topics could examine topics such as those listed below:

Overall impacts

- Understanding the overall emissions reduction potential, and how this potential varies across the building stock.
- Quantifying the costs associated with a large-scale and long-term roll out of retrofits.
- Research into the impact and implications of embodied carbon on retrofits and the total carbon budget.

Retrofit selection

- Exploring the impacts of building-level changes (building fabric, HVAC or renewables), compared with larger scale measures (like district heating), or external/infrastructure changes (the decarbonisation of the grid).
- Assessing deep versus shallow retrofits, and the phasing of retrofit deployment.
- Assessing the potential impact of wider technological or construction changes.
- Analyses and/or data that quantifies how much of the theoretical potential is achievable in practice (*e.g.* accounting for 'hard-to-treat' buildings, or buildings and urban areas of heritage or cultural value).

Occupancy & behaviour

- Examining the impact of potential changes in behaviour (positive or negative and intentional or unintentional) *e.g.* increased use of air conditioning, work-from-home, or wider societal & cultural changes.
- What impacts arise from more fundamental changes in the way that buildings are operated, *e.g*. an increased use of personal environmental control systems or individual passive or active climate 'safe rooms' during extreme weather instead of the traditional approaches to heating & cooling spaces?

Deployment policy

- Research that explores how large-scale decisions, that might be taken by local policy, and small-scale decisions, that might be taken by individual building owners, impact on the transition process.
- The potential role that local and national policy can play to ensure the necessary improvements to the stock are made (*i.e.* should the approach be the carrot or the stick, or some mix of the two). The need for additional support (*e.g.* knowledge-sharing, providing approved suppliers or solutions, or approving works, as well as advisory/ consumer protection processes).
- The suitability of different mechanisms *e.g.* funding improvement measures, public certification schemes or minimum efficiency standards.

Skills and tools

- Research that examines if the infrastructure and skills are in place to deliver such large-scale and long-term improvements to the stock at sufficient quality.
- Research into the tools and policy instruments to assess and track the transition process (*e.g.* the gap between the modelled/predicted and actual performance of our building stock).

Many of these topics are interconnected. As such, we also welcome studies that explore the uncertainties raised by these connections. For example: the chosen measures will impact on the costs and embodied carbon; a large uptake in specific retrofits will likely affect their price;

some desired improvements may be limited by external factors (policy, public opinion or the available skills and supply infrastructure); etc. Furthermore, while some improvement decisions can be made at the scale of individual buildings, others (such as district heating) must be applied across multiple buildings and occupants. Other decisions are inherently time-sensitive, in terms of carbon the benefits of building scale renewables. For instance, the carbon intensity of the grid electricity is expected to fall in the future.

Timeline

Deadline for abstract submission	**28 Oct 2024 (noon GMT)**	
Full papers due	31 Jan 2025	NB: authors can submit sooner if they wish
Reviewers' comments to authors	07 Apr 2025	
Revised papers due	19 May 2025	
Publication of the special issue	July 2025	NB: papers are published as soon as they are accepted

Briefing note for contributors

We welcome contributions from the research community in both the Global North and Global South as well as the building industry including engineers, architects, researchers, building code officials, and software developers.
You are invited to submit an abstract for this special issue. Please send a **500 word (maximum) abstract** to editor **Richard Lorch** richard@rlorch.net **by 28 October 2024 (noon GMT). Your submission must include these 3 items:**

1. the author's and all co-author's names, institutional & departmental affiliations and contact details, email addresses
2. the question(s) or topic(s) in this Call for Papers that the abstract and intended paper address
3. the abstract (500 words maximum) defining the research question(s), scope, methods and results

Abstracts will be reviewed by the editors to ensure a varied, yet integrated selection of papers around the topic. Authors of accepted abstracts will be invited to submit **a full paper (6000-7500 words)**, which undergoes a double-blind review process.

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Questions?

The Editors are happy to discuss ideas with potential authors. Please contact: **Richard Lorch** richard@rlorch.net, **Daniel Godoy-Shimizu** d.godoy-shimizu@ucl.ac.uk and **Philip Steadman** j.p.steadman@ucl.ac.uk

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