Achieving Effective Climate Action in Cities by Understanding Behavioural Systems

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Summary

Cities are under pressure to deliver against net zero targets within the next couple of decades. To reduce emissions at the pace and scale required, urban policy-makers will need to make greater use of systems thinking and behavioural science. We explore the value of emerging tools which integrate these approaches.

Cities globally are under pressure to meet national and local net zero emissions targets within the next couple of decades. Cities account for 75% of global carbon emissions despite covering only 3% of the world's land mass [1]. Without drastic changes to activity, urban emissions could increase as populations continue to grow, with increasing demand for housing, goods and services [2]. The long lifetime of major city infrastructure also poses the risk of high emissions patterns becoming 'locked in' [2]. At the same time, cities are hubs of innovation and have the potential to provide low-carbon ways of living. In high-income countries, per-capita emissions tend to be lower in urban areas than rural areas, partly due to the nature of industries but also to the efficiency of denser city living [3]. As a result, city governments are under high expectations to be the 'front line' of delivering against national and international climate targets.

The burden of climate responsibility on city governments is not distributed or felt equally across different global contexts. Low and middle-income countries in the Global South are relatively more vulnerable to adverse climate outcomes such as extreme weather events, causing risks to infrastructure and health, while countries in the Global North have higher per capita and excess emissions [4]. These can be mainly attributed to energy use in buildings (24-95%), followed by transportation (7-56%), and waste disposal (0-63%) [5]. As a consequence of global disparities, much climate mitigation research and practice has focused on transforming cities in the Global North. However, such work also points to the wide variation in emissions profiles across cities and highlights that climate solutions in the Global North will not be global solutions. All cities will need to develop and implement strategies that address their unique context.

Leaders in over 700 cities around the world have pledged to reach net zero carbon emissions [5]. However, these are voluntary commitments which have been criticised as meaningless unless accompanied by a strategy for action and implementation plan. There are a wide range of networks and initiatives to support cities in these steps: prominent examples include the C40 cities network of almost 100 mayors, as well as the EU-funded projects INHERIT, Net Zero Cities, REFLOW, and CLEVER Cities. Recent findings from C40

indicate 54 cities, including Lisbon, Milan, Vancouver, and Montréal, have in place viable strategies to meet the Paris Agreement of limiting global warming to 1.5°C [5]. Nevertheless, it is unclear whether efforts will be enough to rise to net zero. Climate experts point out that achieving net-zero is far more challenging than lesser 'low-carbon city' ambitions [2]. Some people hoped the major disruptions of Covid-19 could lead to a moment of change for sustainability in cities, but apart from small reductions in transport, most activity and emissions have returned to normal, and there are concerns recovery spending could undermine sustainability efforts. This illustrates how existing patterns of urban activity can be resistant to change, meaning net-zero cities will need to drastically alter existing physical and social systems.

Understanding Cities as Complex Systems

Anyone working in urban policy or research will recognise that cities are complex systems of many intricate moving parts, which can often come into conflict. For example, the main sectors responsible for urban emissions – buildings, transport, and waste – are highly interdependent. Infrastructure and services supporting these sectors are also highly interconnected in regional and national networks. This means that major alterations to the fabric of cities are likely to face pragmatic difficulties from multiple angles, and the potential effects of intervening may be hard to fully anticipate.

Systems thinking is an approach to intervening in complex systems to produce the desired outcomes. It refers to a set of skills for understanding systems in terms of their underlying structure, which often includes mapping or modelling their interrelated parts. It has been used, for example, to model physical flows of waste management and test how they would be affected by different policy options in cities such as New York, Delhi, Dhaka and Kisumu [6]. Systems thinking also involves considering the role of multiple different people or stakeholders in an issue, who might otherwise be overlooked. For example, schoolchildren have been key to UK air quality campaigns about urban transport; tradespeople are highlighted as key players in getting home-owners to adopt energy-efficient technologies; farmers' sensitivity to water catchment areas can impact urban water security.

However, use of systems thinking can be at odds with processes of decision-making in cities, which are typically characterised by departmental siloes and fragmented urban planning.

Pro-environmental urban interventions introduced without thorough consideration of the systemic context can lead to small or even adverse effects. For example, Low-Traffic Neighbourhoods aiming to promote active travel and reduce short car journeys were widely introduced in UK cities during the Covid-19 pandemic, but despite some moderate benefits for walking and cycling, many were discontinued in a context of strong local resistance and concerns over accessibility. These were reversible interventions, but larger infrastructural changes can have potential for more severe unintended consequences. For example, the Trans Java Expressway development in Indonesia aimed to spur interregional connectivity and economic growth in a 'green way' but has increased the vulnerability of cities located along the coastline to flooding and land subsidence [7]. Considering that one hundred unintended consequences were identified for UK housing energy efficiency policies alone [8], it is vitally important that local policy-makers are enabled to assess climate solutions more systemically.

Bringing systems thinking into city policy-making is itself a major challenge. Reasons can include lack of time, skills, and resources to use systems tools such as systems mapping, simulation models, and digital 'twins' of cities, which can require specialised expertise. Some international research programmes are aiming to address this gap by partnering policy-makers with systems researchers. An example is the Complex Urban Systems for Sustainability and Health (CUSSH) project [9], partnered with cities in Europe, China and Kenya, which has helped to apply systems thinking to issues including green space use in London, waste management in Kenya, and the process itself of academic-city engagement on climate action. Other projects have focused on bringing together scientists and public stakeholders in deliberative climate assemblies, which have had success in cities such as Washington, Kawasaki, Paris, Bogotá, and many more. However, each of these

approaches involves high investments of resources, demanding more mainstream ways to increase systems thinking capability among urban decision-makers.

The Role of Human Behaviour Change in Urban Sustainability

It is clear that net zero cities will require coordinated, systemic action supported by local policy. However, when it comes to how climate action might be achieved, 'behaviour change' and 'systems change' are often framed as two different alternatives. 'Behaviour change' is often assumed to mean approaches which target individual consumer actions, whereas 'systems change' is often as short-hand for intervening in technological, built-environment and regulatory contexts [10]. Behavioural and social scientists have pointed out that this dichotomy is inaccurate and unhelpful. Instead, policy-makers should consider people's multiple roles beyond that of a consumer, and target a wide range of actions including support for and participation in diverse climate measures.

Trying to promote pro-environmental action by individual citizens without considering the wider systems in which they act can lead policy initiatives to backfire. For example, recycling programmes in many US cities previously relied on China as a buyer of recyclables, but since 2018 China has restricted its imports. This meant costs to recycle could not be covered domestically, leading to reduced curbside services and diminishing faith in the system, which is likely to further reduce recycling rates in US cities' [11]. Another example is the UK's Green Deal, which aimed to encourage installation of home energy efficiency measures by providing financial incentives, but ultimately saw little uptake because the intervention failed to address barriers for tenants, building controllers, installers, banks and landlords [12].

Likewise, attempts to create urban environments conducive to sustainable living can fail when there is insufficient consideration of people's actual behaviour. In Austria a 'solarCity' was developed featuring energy-efficient building design, solar panels, district heating, and public transportation connection to the close by city of Linz. Evaluations showed that 80% of residents still commuted by car, because of the somewhat remote

location, and many had difficulties using the heating and ventilation system which resulted in inefficient practices such as leaving windows open when ventilation was on [13].

Climate activist Greta Thunberg said: "*[…] I know we need a system change rather than individual change. But you cannot have one without the other*.". This message is becoming unavoidable as cities look for ways to facilitate the use of low-carbon technologies. In particular, the roll-out of electric vehicles – both privately owned and municipal vehicle fleets – has been mainly treated as a technical issue concerning design features and the provision of charging infrastructure. Now, greater attention is being paid to aspects like convenience of charging, drivers' 'range anxiety' concerns, and how the quietness of EVs could be a safety hazard to pedestrians. A similar shift is happening around understanding the uptake of home retrofit technologies like solar panels and heat pumps, with initiatives like pump:chic aiming to help overcome people's reservations over costs and aesthetics. The UK committee on climate change has estimated that 62% of emissions reductions to meet the national net zero target will rely on behavioural changes, the others coming from low-carbon technologies and fuels [14]. In reality, these also represent changes to human activity, since technologies and fuels are things used by people – in other words, 100% of reductions necessitate people behaving differently.

Integrating Systems Thinking and Behavioural Science

Recent methodological developments make it possible to apply systems thinking to understand the roles of multiple actors and their behaviours in complex environmental problems. One multi-disciplinary method that integrates behavioural science theory and systems thinking is behavioural systems mapping [15,16]. This method maps the relationships between people, their behaviours, and the factors influencing their behaviours (Figure 1). It thus develops systems maps about a given problem in a way that makes the role of human behaviour more visible and explicit. This is intended to make it easier to identify which behaviours to target, and to apply behavioural theories and frameworks which are important for the effectiveness of interventions.

The value of behavioural systems mapping has been demonstrated in decarbonisation policy research. In 2018, the Welsh Government set up an independent advisory group to develop policy recommendations on residential decarbonisation. Welsh housing is amongst least energy efficient in Europe, with domestic energy use around 27% of national consumption, and 25 million homes requiring retrofit to meet net zero by 2050. Together with behavioural scientists, the advisory group mapped interrelated behaviours and factors influencing behaviour of actors including owner-occupiers, landlords, tenants, supply chains, financial institutions, and local and national governments [15]. This process highlighted, for example, the interconnected roles of local authorities, installers and home-owners, and pointed to the value of roles such as retrofit designers (trained professionals currently in short supply) who could help home-owners navigate the process (Figure 2). Of the policy recommendations informed by this process, over 90% were evaluated as specifying a way to increase relevant actors' capability, opportunity and/or motivation to engage in behaviours supporting retrofit, such as accessing finance (home-owners) or committing to carrying out the installation (installers) [15].

Behavioural systems mapping is a relatively new and evolving approach for informing effective action strategies. It is already being applied by academic researchers in the UK and Australia, and by UK government departments, to other environmental issues such as waste disposal (e.g. https://kumu.io/JoHale/waste-in-kisumu) and circularity in the repair of products [17]. However, more collaboration between systems research and behavioural science communities, and engagement of them with policy-makers, will enable behavioural systems mapping to become more useful to and usable by a wide range of decision-makers. This may entail the discussion of practical and theoretical challenges, such as different ways of involving key actors (e.g., through surveys or virtual platforms) or how to use the maps for communication purposes with the wider public. The benefit is that identifying where human behaviour fits into systems of influences signposts entry points for intervening and targeted policies to bring about the type of transformational change that is urgently needed.

Conclusion

Achieving the net zero pledges that hundreds of cities around the world have committed to needs, first, political will and second, methods to increase understanding to enable change. In the past, cities' climate policies have failed to achieve substantial impacts for lacking an integrated systemic behavioural perspective. Behavioural systems mapping is a method that can help to advance understanding of how to change city policies and practices by making the role of human behaviour in urban environmental problems more visible and explicit and bringing together a variety of perspectives to generate a common understanding and solutions. Given the important role of cities in tackling the climate crisis, it vital for researchers and decision-makers to communicate and collaborate as efficiently and effectively as possible to design and implement climate action with impact at scale.

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Figure 1

Typical components of a Behavioural Systems Map

Note. This diagram illustrates the main components that are usually specified in behavioural systems maps. The visual representation of these components and the steps used to create a behavioural systems map can vary depending on purpose, resources and materials or software used to create the map.

Figure 2

Behavioural Systems Map for Retrofitting Homes in Wales

Note. This figure is adapted with permission from [15]. This is a selected, simplified section of a qualitative behavioural systems map for decarbonising homes in Wales owned by owner occupiers. The map was developed through group mapping workshops facilitated by behavioural scientists, in which the Welsh Government's independent advisory group on residential decarbonisation synthesised evidence they had previously reviewed in order to map the system 'as it could be'. The full maps produced can be viewed interactively online at https://kumu.io/JoHale/walesdecarbonisation. Full methods and results of the mapping process are reported in [15]. Actors are shown in large bold text. Behaviours are shown in medium bold text. Influences on behaviour are shown in small italic text. Colour coding is used to show which actors perform which behaviours. Arrows are used to show positive causal links identified among behaviours and influences on behaviour. Black text boxes are used to show potential new services or resources to support decarbonisation.