



Climate action in urban mobility: personal and political transformations

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RESEARCH

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ABSTRACT

Although many municipalities have climate action plans with targets and goals, effective climate action still faces significant implementation gaps. Implementation can falter due to barriers for the deployment of low-carbon solutions, as well as the lack of *cultural, systemic, and psychological support* for such solutions. Cultural drivers and perceptions shape citizens' behaviors and can perpetuate carbon-intensive lifestyles. This paper focuses on measures in climate action planning in the Metro Vancouver region of Canada regarding transportation, which remains the largest single source of greenhouse gas emissions and has a low chance of reaching its emissions-reductions targets. Shifting towards greater sustainability will entail a challenge of transformative change, involving shifts in systems, behaviors, worldviews, and cultures. In implementation, the full complexity of the climate action challenge becomes most evident. A scoping review of climate action documentation and semi-structured interviews are used to examine (1) barriers to effective implementation, (2) socio-cultural perceptions and approaches to public engagement and (3) novel areas for transformational action. The study found a need to reweight the focus of climate action, which is predominantly set on techno-managerial efforts, also to include communication, narratives and broader systems change, which are the key barriers to low-carbon urban mobility.

PRACTICE RELEVANCE

Transportation remains a significant source of greenhouse gases and air pollutants in urban areas. To effectively shrink emissions, novel approaches are needed that go beyond technical fixes and view climate action as a challenge of transformative change. This study identifies the dominance of (1) *practical*, techno-managerial solutions, yet notes an inadequate focus brought to (2) the *political* restructuring of systems and developmental trajectories pertaining to mobility and (3) the *personal* aspects of social perceptions and culture. Recommendations are made about how to better account for the deeper human dimensions that present persistent barriers to climate action in transportation by reweighting the focus to include the personal and political spheres of transformation.

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Support for policy and action now exists at global, national, and municipal scales to collectively address the causes of climate change and advocate for the acceleration of climate action (Rogelj *et al.* 2016). The Intergovernmental Panel on Climate Change (IPCC) reports that ‘limiting warming to 1.5°C above pre-industrial levels would require transformative systemic change’ (IPCC 2018: 315), and every Conference of the Parties (COP) finds greater intergovernmental commitment to such climate action. Cities are major sources of carbon emissions with almost half of the world’s population living in urban areas. These urban regions are at risk of becoming vulnerable if action to support climate change mitigation and adaptation is not addressed (Dawson 2007; Hallegatte & Corfee-Morlot 2011; Heidrich *et al.* 2013). The IPCC’s Sixth Assessment Report (AR6) suggests that:

the global trend of urbanization also offers a critical opportunity in the near-term, to advance climate resilient development.

(IPCC 2022: 33)

Many urban municipalities have now introduced climate action plans (CAPs) in line with the Paris Agreement (Rogelj *et al.* 2016) to outline specific activities, measures, and policies that a municipality (*i.e.* a local government, agency, institution *etc.*) is encouraged/expecting to undertake to reduce its greenhouse gas (GHG) emissions and address climate change impacts (Deetjen *et al.* 2018; Stone *et al.* 2012). The potential in cities can be seen with local governments’ declarations of ‘climate emergency’ to accelerate climate action that has filled in for the international stalemate (Davidson *et al.* 2020; Hölscher & Frantzeskaki 2021). In Canada, all major political parties in the 2021 federal election recognized the apparent importance of climate action to Canadians, suggesting broad public support for climate action. Furthermore, many low-carbon urban solutions do exist (Bassett & Shandas 2010; Deetjen *et al.* 2018; Moreno *et al.* 2021).

However, effective climate action is challenged by implementation gaps: gaps between applied research and policy action, or between what is written in CAPs and what is carried out in practice (Pimpalkhute 2021). Often what is technologically feasible does not align with current policies nor with what is perceived, valued, and taken up by the public into behavior change, which can stall or limit the gains made towards reaching emissions reductions targets (Kythreotis & Jonas 2012; Romero-Lankao *et al.* 2018; Steg 2018). CAPs that provide a strategy for emissions reductions targets and draw on technological innovations also need to account for the political and social context of perceptions, values, and uptake into lifestyle changes to be effectively realized. This speaks directly to the need for greater connectivity between technology and society, and for a disposition towards a more synthetic approach (Campbell 2018). This paper reflects on the approach taken in CAPs and implementation, specifically in transportation, in search of ameliorating implementation challenges and greater acceleration of climate action.

Existing municipal CAPs include various interventions to support low-carbon futures, yet the uptake of these solutions can falter for several reasons, such as the cultural and contextual support (Bassett & Shandas 2010; Deetjen *et al.* 2018). Cultural drivers can perpetuate carbon-intensive infrastructure and economies, and can shape the behaviors and actions of citizens as well as hinder the scaling of low-carbon technologies (Romero-Lankao *et al.* 2018). In Canada, while a suite of policies exists for low-carbon transportation, citizen trust in provincial and national governments regarding these policies is low, presenting a threat of public opposition (Kitt *et al.* 2021). Contextual factors can complicate this further, with overlapping legislative and regulatory powers across different levels of government which may not be in alignment.

Locally, in Vancouver, despite investments into sustainable transportation, which situate it as among the best in Canada and the US (Bliss 2016), privately owned, conventionally fueled (petrol or diesel) vehicles used primarily by single occupants still dominate in the transportation sector (Sohi 2021). This is largely an outcome of a broader car-oriented system, which shape not only behaviors but also the developmental trajectories of the urban landscape (Sovacool & Axsen 2018). In 2022, across the Metro Vancouver region, there are 1.5 million cars and trucks in operation, emitting more

than 4.7 million tonnes of GHG emissions (Metro Vancouver 2021a, 2021b). Urban transportation remains the single largest source of GHG emissions in the region (Metro Vancouver 2021b). The City of Vancouver's (2020) Climate Emergency Action Plan (CEAP) has made commitments to reduce carbon emissions to 50% of 2007 levels by 2030, and to be carbon neutral by 2050, with a specific goal of lowering the current 39% of emissions from fossil-fuel vehicles. The targets include: 90% of people to live in an easy walking or biking commute of daily needs, two-thirds of trips being carried out by active transportation and transit, and 50% of the kilometers driven to be by zero-emissions vehicles (ZEVs). These targets and commitments conform with a regional plan (TransLink 2022) for the metropolitan area of Vancouver (consisting of 23 smaller municipalities) and provincial plans (BC Provincial Government 2021) which are also aiming to accelerate climate action targets.

Reaching these targets must work against both the auto-oriented built environment as well as a car-dependent culture. When referring to car dependence, the term 'culture' has two meanings. First, referring to the things that individuals do (*i.e.* individual travel behavior that occurs in relation to habit, practice, routine, or tradition), which are influenced by material factors, such as overall car infrastructure (Mattioli et al. 2020). Second, the things that individuals express and believe about their own activities and how they engage with wider social structures through political or commercial decisions (Mattioli et al. 2020). In other words, a car-dependent culture cannot be fully understood separate from broader systems and practices, in a gestalt that has been referred to as *automobility* (Böhm et al. 2006; Sheller & Urry 2006; Shove et al. 2015; Sovacool & Axsen 2018). Automobility is defined as:

a complex, self-reinforcing socio-material system that is strongly intertwined with technology, culture, norms, and practices in most modern countries.

(Sovacool & Axsen 2018: 731)

Strategies and actions to reduce vehicle emissions face a multifaceted challenge of decentering automobility, involving cultural identity, social practices, path dependencies, energy, and road infrastructures, *etc.* (Haarstad et al. 2022; Sheller & Urry 2016; Sovacool & Axsen 2018). Understanding these cultural underpinnings of car dependence, and the associated entrenched nature of automobility, demonstrates how climate action for urban mobility requires transformative change, not just a technical fix. Nevertheless, the focus of climate action predominantly emphasizes *practical change*, such as net-zero technology and infrastructure as well as policy instruments and techno-managerial incentives to nudge behaviors towards net-zero options. Less focus is placed on *personal change*, such as shifts in social perceptions, mindsets, and values, and *political change*, such as shifts in the systems and structures that shape the overall developmental trajectory of society (O'Brien 2018).

This paper argues for the need to reweight that balance. The focus is on the personal and political spheres of transformation. A careful examination of the role of cultures and social contexts in implementing urban CAPs may help to better connect low-carbon technology with the cultural and societal uptake of it and to identify key leverage points for accelerating climate action. The paper reviews and analyzes a range of mechanisms being used for climate action in transportation, specifically for personal mobility. Using a transdisciplinary framework and framed as a challenge of transformative change, it seeks to understand the key barriers and novel opportunities for climate action implementation in transportation in Vancouver.

The paper is structured as follows. Section 2 provides background information. Section 3 describes the analytical framework and methods. Section 4 reports the results regarding climate action for mobility. Sections 5 and 6 examine these findings specifically regarding the personal and political dimensions and identify certain underrepresented yet high-potential leverage points in support of urban climate action for mobility.

2. BACKGROUND

Transport emissions are influenced by a range of factors, only some of which relate to technical efficiency, carbon content of fuel, and travel behavior (Yang et al. 2009), with lifestyles and other socio-cultural factors also being important. For example, the *values, social norms, and habits* that

guide expenditure patterns and lifestyle preferences; *citizen's trust* in governmental climate policies (Kitt et al. 2021); *geographic preferences* for where to live, with low-density suburban neighborhoods tending toward multiple car ownership and produce 'car captivity' (De Vos et al. 2021); *social changes* such as an ageing population with decreases in active transport (i.e. walking and cycling) and greater uptake of car use (Shergold et al. 2015); as well as *demographic changes* with millennials (those born in the 1980s and 1990s) owning fewer vehicles than previous generations, yet poised to increase car ownership in the coming decade (Klein & Smart 2017). Researchers have challenged policymakers and the business community to reconsider the dominant focus on technical solutions for transport (Brand et al. 2019), pointing away from the notion of a 'silver bullet' and towards an integrated suite of solutions to this multifaceted issue (Yang et al. 2009).

This paper joins in that challenge, focusing on a case study of urban mobility in Metro Vancouver in Canada. CAPs in the City of Vancouver and Metro Vancouver (together now referred to as Vancouver) use travel demand management (TDM) initiatives to reduce the number of cars by providing more sustainable alternatives, drawing on a range of push and pull mechanisms to support *behavior change* (Eriksson et al. 2010; Meyer 1999). 'Push' measures such as increased parking costs or road-user charges have been implemented to discourage car use (Steg & Vlek 1997), and 'pull' measures have been introduced to encourage alternative low carbon transport modes, such as improvements to public transport (i.e. frequency, comfort, no price increases, etc.), the promotion of car-sharing, workplace facilities for cyclists, and tax rebates for low-emission vehicles (Gärling et al. 2002). Understanding perceptions and behavioral responses to TDM initiatives is important to encourage meaningful changes to reduce unsustainable travel (Eriksson et al. 2010).

Other strategies focus on *systems change*, viewing the broader context in which choices are made, such as addressing transportation as a land-use issue, designing walkable communities, accounting for equity and climate justice, and working towards a broad, reliable transit system. This includes incorporating a land-use planning frame in consideration of urban mobility and drawing on research into the design of 15-minute cities (Moreno et al. 2021). Within CAPs, there are also considerations for how to support *socio-cultural change*, such as via a focus on public engagement, public participation, and messaging (Solecki et al. 2021).

Despite increases in transit ridership and development of walkable neighborhoods situating Vancouver as an exemplar for North America, vehicle transportation in the region remains the largest single source of carbon emissions and is also the fastest growing (Metro Vancouver 2021b). Vehicle growth rates outstrip population growth rates (Boston 2021). Despite a growing proportion of these cars being considered 'low-emitting' or 'clean' vehicles (which encompasses hybrid vehicles, plug-in hybrid vehicles, hydrogen vehicles, and electric vehicles—EVs), these vehicle types are not a complete solution to meet emission reduction targets for several reasons.

First, hybrid vehicles are not always considered more environmentally friendly than fossil-fuel powered cars as there remains limited evidence on how much driving they do fueled on electricity versus conventional fuel in real-world operations, which can result in their GHG emissions often being higher than fossil fuel vehicles (Plötz et al. 2020: 57).

Second, research suggests that simply replacing fossil fuel vehicles with low-emitting vehicles does not meet overall emission reduction targets if the electricity used to fuel these vehicles comes from non-renewable resources (Logan et al. 2022), which, while less relevant in British Columbia (BC) where the vast majority of energy production is hydropower, is an important consideration for other parts of North America.

Third, the overall life cycle analysis of new low-emitting vehicles needs to be accounted for, including the production of the vehicles that will require mined materials, such as lithium, from (often) unstable regions raising many long-term concerns (Deng et al. 2020).

Fourth, as even when consumers are only able to purchase *new* low-emitting vehicles through the Government of Canada's (2022) ZEV mandate set for 2035, a complete turnover in the car fleet from fossil fuel to ZEVs can take 30 years (Boston 2021; Logan et al. 2022). Furthermore, there remains several sustainability challenges with EV batteries as they begin to diminish over time.

Finally, there remains multiple challenges associated with all car types, such as risk of road trauma, urban sprawl, noise pollution, accessibility, unabated congestion, taking away valuable land for road infrastructure (including charging infrastructure), unresolved supply issues, as well as the reality that shifting to low-emitting or ZEVs does not adequately disrupt the unsustainable mindsets and values that have created the conditions for unsustainability (and climate change within that) in the first place. As Haarstad *et al.* (2022: 7) remark:

Breaking with the failures of the past will likely require more radical—and thus potentially riskier—policy actions [...] rather than simply proceeding up the existing automobility curve as electric cars do.

The private passenger car still makes up the technological core of the global automobility regime and also represents the dominant mode of personal mobility in industrialized countries (Hoffmann *et al.* 2017), including Vancouver (Sohi 2021).¹ In part, this is a systems issue. For example, the affordable housing issue takes people further out of the city and thus locked further into vehicle transport, combined with the insufficient public transit options for car-drivers means that people remain caught in systems of high-carbon choices for transportation. City of Vancouver (2020: 14) acknowledges this, seeing its:

role is to change these systems so that zero emissions choices increasingly become the default choice.

TransLink recently released its ‘Transport 2050’ vision that lays out important shifts in public transit provision in the region (TransLink 2019, 2022). Also, certain low-emitting and zero-emissions systems can now better receive explicit, direct policy-support and make use of novel financial mechanisms to provide low-carbon options for citizens (Talebian *et al.* 2020). In addition, increasingly transportation is being considered in connection with broader systems, such as regarding land use. Yet, a relevant aspect of climate action in transportation comes down to values, attitudes, and culture.

The role that subjectivity and culture play is complex and, to date, not well incorporated into these CAPs. Randell (2016: 664) explains a subjective dimension of the transportation issue is:

the automobile-self of the car-driver assemblage, or ‘autoself’ [...] produced within routine, everyday automobile social interaction.

Personal vehicles provide status to their owners and can represent their careers, identity, autonomy *etc.*, such that modern societies can become locked-in to automobility (Haarstad *et al.* 2022; Shove *et al.* 2015; Sovacool & Axsen 2018; Urry & Grieco 2016). Automobility produces a ‘car-dependent’ socio-technical transport system involving the automotive industry, car and road infrastructure, the political economy of urban sprawl, and cultures of car consumption (Mattioli *et al.* 2020). Braun & Randell (2022) argue that automobility—both as a car-driver assemblage as well as a socio-technical system—has become so pervasive in urban Western lives it could be considered a ‘hyperobject’; so implicitly and extensively distributed in space and time that it can evade perception and understanding, let alone action (Morton 2013). Processes to engage this psycho-social dimension of climate action in transportation include public engagement to support citizen’s buy-in and trust of policies, communications strategies to ensure alignment with values and social perceptions of the population, and other forms of public education and consultation, yet often are insufficient in meeting the full complexity that exists around this issue (Hochachka 2020; Hulme 2009; Kitt *et al.* 2021; Murphy *et al.* 2016).

As an example, Vancouver’s Climate Emergency Parking Program (CEPP) proposed overnight parking pricing, in part as a TDM push tactic to nudge behaviors away from vehicles and toward other mobility modes, as well as to finance other ‘big moves’ in the CEAP. The CEPP was studied and designed over a two-year period. However, it was voted down when put forward for a final vote in Vancouver City Council in October 2021. Informal analysis suggested this was not due

to objective evidence against this policy but rather social perceptions about disproportionate, inequitable impacts on different members of society, or the political ramifications of how this policy would be perceived by voters, which is congruent with an earlier study on Vancouver's parking policy approach (Thumm & Perl 2020), and in line with TDM push measures not being as well perceived as pull measures (Eriksson et al. 2006). The lessons to be learned in the failure of the CEPP go beyond just practical, techno-managerial aspects, and extend to include personal and political issues of equity, culture, social perceptions, and values.

A key place to connect with the social side of this issue is in public engagement. Public engagement in climate action, however, can tend to carry an *autocratic assumption* that public attitudes and behaviors need to be changed or to follow a '*deficit model*' approach whereby the public engagement problem is framed around either lack of knowledge, capacity, or motivation (Chilvers & Pallett 2018). Owens and Driffill (2008: 4412) point out that 'such 'information deficit' models have been criticized on theoretical and pragmatic grounds, pointing to the:

need to take account of the physical, social, cultural and institutional contexts that shape and constrain people's choices.

With other controversial policies scheduled to be implemented in Vancouver's CEAP, such as for transport pricing, there is a need to better understand these implementation challenges when it comes to public engagement.

The chance of Vancouver meeting its reduction targets from *transportation* is ranked 'low' (City of Vancouver 2021). It is both timely and relevant to consider these implementation challenges in a novel manner. It is becoming clear that proceeding with only a techno-managerial approach will not suffice to reduce emissions (Romero-Lankao et al. 2018). Scholars have pointed out that challenges in implementation arise from disconnects between: (1) what is technologically and practically feasible in terms of behavior change, (2) what is within the political mandate for systems change and (3) what is perceived, valued, and taken up by the public into a cultural or social change, which in turn stall or limit the gains made towards reducing emissions (Kythreotis et al. 2019; Romero-Lankao et al. 2018; Steg 2018). In other words, climate action in transportation is not only a technical problem, rather it is an *adaptive challenge of transformative change* (O'Brien & Selboe 2015). O'Brien (2018) explains when climate action is viewed as a challenge of transformative change across practical, political, and personal dimensions, it may have a greater possibility of reaching emissions reduction targets.

What is less well understood are the specific ways that climate action implementation falters or even fails in a given CAP. CAPs with roadmaps and pathways for decarbonization are crucially important, yet technical plans can miss the extensive social complexity involved in implementation (O'Brien 2018). Here, the present paper considers climate action for transportation in Vancouver in a way that is more commensurate with this complexity, framed as challenge of transformative change.

3. ANALYTICAL FRAMEWORK AND METHODS

The Three Spheres of Transformation were selected as an analytical framework that could include and account for transformative change processes that are considered important in lowering emissions curves to meet climate action targets (Figure 1) (O'Brien 2018; O'Brien & Sygna 2013). The practical sphere involves the techno-managerial efforts, such as incentives, rebates, taxes, rules, and regulations, aimed at shifting habits and behaviors, such as:

the introduction of new technologies, changes in management practices, cost-benefit based climate policies, information driven or rational choice models of behaviour change, and footprint measurements.

(Revez et al. 2022: 5)

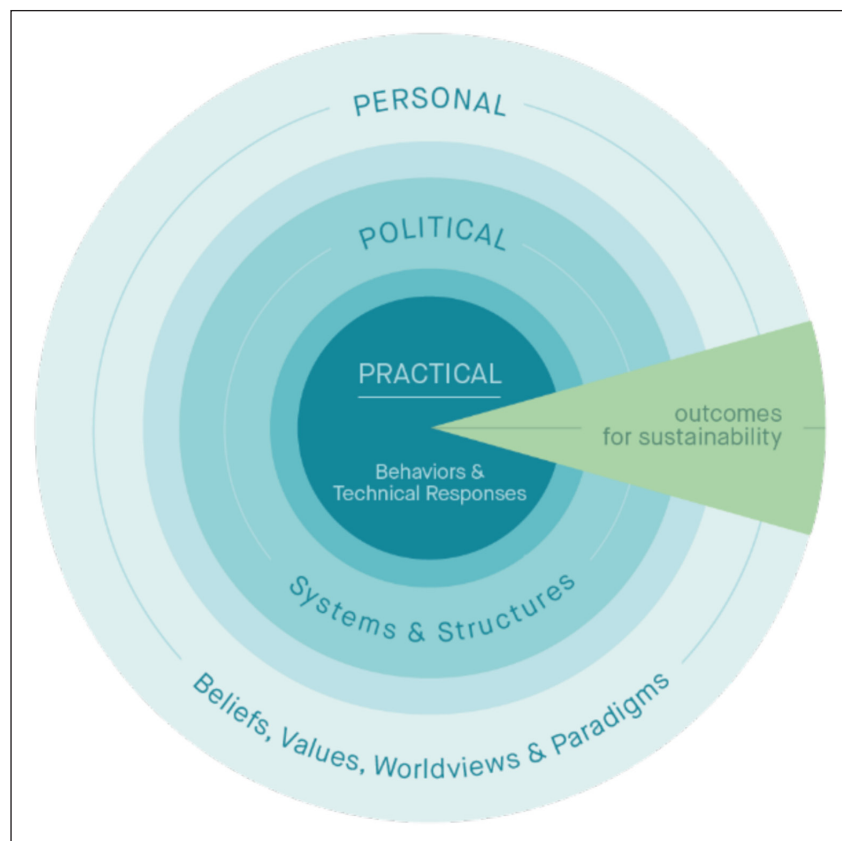


Figure 1: Three Spheres of Transformation change involved in driving down emissions from transport. When integrated or coordinated together, these support outcomes for sustainability.

Sources: O'Brien (2018); O'Brien & Sygna (2013); Revez et al. (2022).

The political sphere involves the systems and structures of the broader developmental trajectory for a region, including how decisions come to be made in a community and the systems that bring those structural decisions into urban forms. This:

involves the political, economic, legal and social systems and structures that define the range of possibilities and constraints framing societal and environmental transformations.

(Revez et al. 2022: 5)

The personal sphere includes social acceptance and legitimacy, accounts for cultural norms and values, and how mindsets or awareness shape one's choices and perceptions. The personal sphere:

involves issues of identity, sense of self and, therefore, holds a strong representational influence in the way problems are framed, questions are asked, controversies are silenced, and solutions are prioritised.

Revez et al. (2022: 5)

While these spheres are conceptually separated, change processes involve all three spheres simultaneously; transformations in the practical sphere represent outcomes of the political and personal spheres, just as the personal sphere influences the types of structures, systems, and techno-managerial responses that are considered and prioritized.

Other conceptual frameworks that were contestants in this selection include Shove et al.'s (2012) social practice theory and Geels' (2010, 2011) multilevel perspective, both of which seek to understand how change occurs in society. However, the three spheres capture the complexity of change and transformation across key dimensions of society specifically regarding climate change, public engagement, and GHG emissions reductions (O'Brien 2015, 2018; Revez et al. 2022) in a manner that was helpful to the focus of this article. This framework was referred to in IPCC's Impacts, Adaptation and Vulnerability (IPCC 2014: 27), as part of the range of approaches to managing the risks of climate change. O'Brien (2018: 55) describes it as a heuristic or 'process-ontology' to account for and integrate different theories and actions involved in deliberate transformation.

The framework has been used by Revez *et al.* (2022) in a scoping review of emerging concepts of public engagement in low carbon transitions in Ireland, resulting in novel cross-sectoral and cross-disciplinary insights. The three spheres were used to understand the gaps and potentials for climate action in Vancouver on transportation, drawing on Revez *et al.*'s approach.

The framework of the Three Spheres of Transformation regarding climate action is tested through this exploratory study. The intent is to identify areas for more thorough applied research. The qualitative case study design sought in-depth insight from highly experienced key informants on emissions reductions in transportation in Vancouver. Research methods included (1) a scoping review of sample documents pertaining to climate action for mobility and (2) semi-structured interviews.

The scoping review was carried out as a type of rapid appraisal, mapping fields of strategy or action to examine the extent, range, and nature of activities planned or underway, and to identify gaps in the existing climate action documentation (Arksey & O'Malley 2005). It included a sample of CAPs and other plans relating to transportation for Metro Vancouver and City of Vancouver from 2010 to 2022 (see **Table S1** in the supplemental data online). These were selected because they comprise the main documentation produced by municipal and regional governments regarding climate action in Vancouver across the 12 most recent years. Using the three spheres heuristic, the efforts, targets, or actions planned or taken to support climate action for mobility in Vancouver were analyzed.

The semi-structured interviews included key informants selected from the public sector, non-profit sector, as well as from academia, through a purposive sample, selecting for a participant's current role and depth of experience on the topic. Participants had between six and 20 years' experience working in this area of climate action and transportation, and included government staff and elected officials as well as important thought-leaders in the private, non-profit, and practitioner-academic sectors; some had contributed to IPCC assessment reports. A sample of 12 informants were interviewed, which for a homogenous group of actors is considered sufficient (Guest *et al.* 2006) and at which point the data collection was saturated (*i.e.* new information produced little or no substantially novel additions or changes in coding). Interviews were recorded and transcribed.

The sample of documents and the interview transcripts were coded for common themes in NVivo. A structured codebook was developed through this process (see **Table S2** in the supplemental data online). This analysis provided an understanding of the broad patterns in terms of where climate action is focused, where implementation gaps or disconnects arise, and what opportunities or novel potentials may exist.

Generalizability and transferability of a single case study is often conventionally contested, yet Flyvbjerg (2006: 228) argues that that is based on a misunderstanding of case studies, saying that indeed:

one can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods

if done carefully. Here, the analysis drew on Bengtsson and Hertting's (2014: 725) 'two-step logic' to identify surface features that are unique to contexts, from deeper mechanisms, that are portable across contexts.

4. RESULTS

4.1 THREE SPHERES OF TRANSFORMATIONAL ACTIONS

The CAPs pertaining to transportation in Vancouver were found to largely focus on the practical sphere of change, however greater inclusion of the political sphere and personal sphere increased across year brackets (Figure 2). Examples from each sphere are provided in **Table S3** in the supplemental data online.

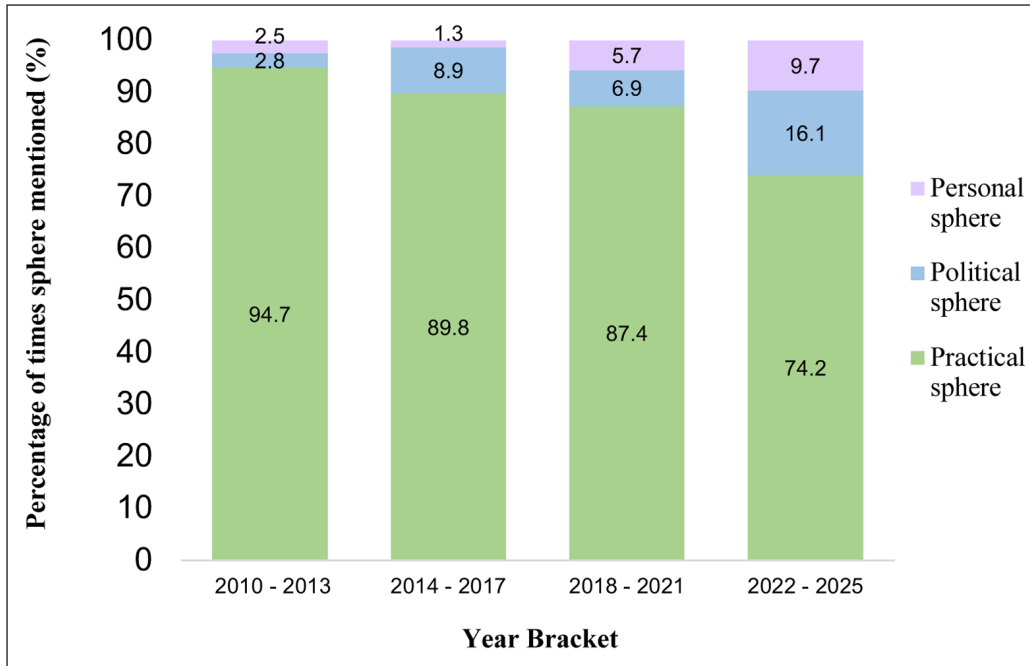


Figure 2: Distribution of climate action and transportation documents using the Three Spheres of Transformation scale in increments of four years from 2010 to 2022.

4.2 EXPLORING KEY BARRIERS IN THE PERSONAL AND POLITICAL SPHERE

Respondents noted the ‘sheer number of barriers’ (respondent, public sector, 2022) to climate action in mobility (Figure 3). This finding is first a confirmation that the study is in fact dealing with a system, and as such, this array of barriers across what is a broad transport system are not themselves surprising. A more surprising finding in these data is that, of the top six barriers, while the practical sphere consisted of 23% of responses, 59% pertained to the socio-cultural and personal aspects of climate action for mobility—or the personal sphere. The political sphere was 18%, referring to the broader developmental trajectory, such as the political coordination and jurisdictional agency to support large-scale, systemic change. These findings underlined the importance of these two spheres for climate action.

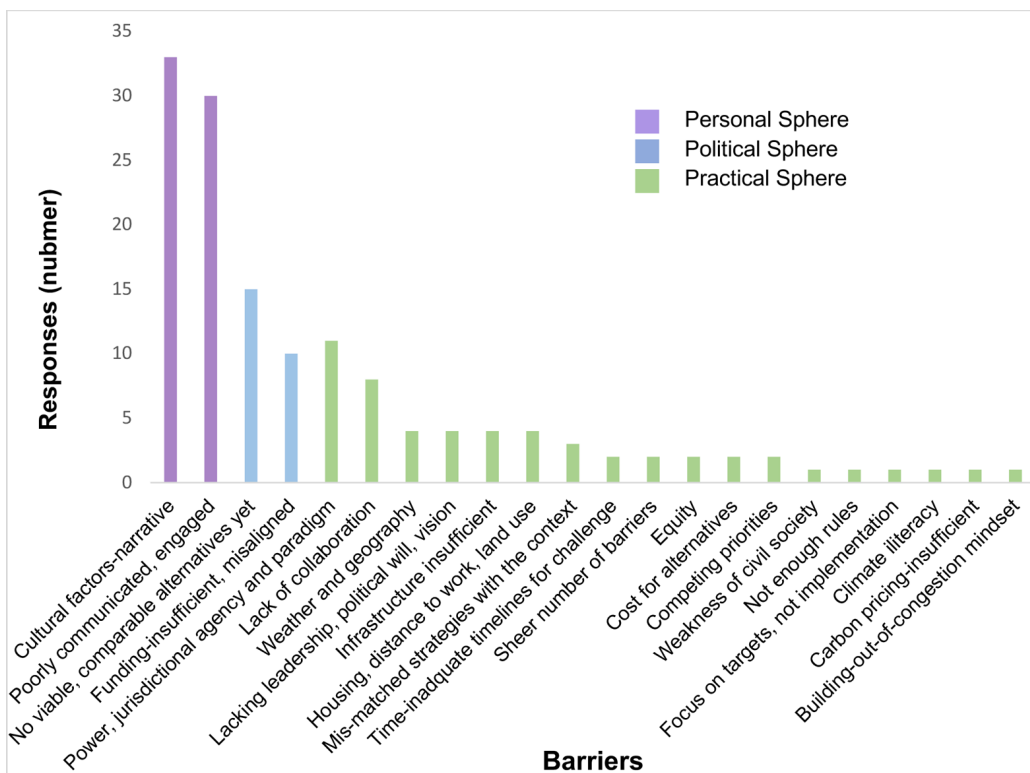


Figure 3: Barriers described by respondents. For the top six barriers, the Personal sphere comprised 59%, the Political sphere was 18% and the Practical sphere 23% of responses.

4.3 SOCIO-CULTURAL BARRIERS: ‘IT’S SUPER PERSONAL FOR PEOPLE’

A key category with the most numerous codes pertained to the difficulty of socio-cultural engagement on climate action in transportation. Yet, decentering the current reliance on private cars is no small undertaking. One respondent remarked:

It’s super personal for people. There’s just so much in our culture around the right to your own private vehicle and a system designed to prioritize that vehicle. That is culturally really hard to challenge [which] we saw loud and clear in the parking permit program.

(respondent, public sector, 2022)

This is simultaneously linked with cultural- and self-identity: ‘we have a kind of obsession with the car’ (respondent, practitioner–academic, 2022), and:

cars are [not just] how people get around, [the car is] an extension of themselves.

(respondent, non-profit, 2022)

However, it also relates to entrenched socio-technical systems that support and sustain private car use. Describing this complex attachment to the car, one respondent explained:

the sociological theory called automobility. This idea of a private car that’s powered by fossil fuel, and the roads and infrastructure and housing types and institutions that lock that system in...and it is cultural here. People don’t want to change the status quo. [Regarding] having a more transit-oriented Vancouver, that would be a huge departure from the status quo [...] it’s transformational.

(respondent, practitioner–academic, 2022)

4.4 TECHNICAL FIXES TO MEET A CHALLENGE OF TRANSFORMATION

Regarding the challenge of disrupting automobility, one respondent noted:

Replacing gas cars with electric vehicles does nothing to change automobility. You’re replacing a fossil fueled power car with electric power, it does nothing to address the other challenges around private car ownership and the institutions and land use planning decisions.

(respondent, practitioner–academic, 2022)

A respondent from the public sector surmised:

I don’t think we can address climate change adequately without crashing that idea [of automobility]; without decentering that.

(respondent, public sector, 2022)

In describing policymakers’ efforts to de-center private automobile ownership in place of transit in certain municipalities of Vancouver, another respondent explained that the narratives that shaped around the issue ultimately derailed the process:

The political opposition led with a populist message. [... In one municipality] they demanded a Skytrain, saying, ‘anything less is treating us like second citizens.’ [In another]: ‘By putting in a high-speed bus, they are taking our parking spaces away and we’re going to lose our community!’ It was a powerful victim narrative [based on] fear and a populist movement, these are all cultural messages [...].

And what do transit authorities and transit activists do? We answer with technological solutions. We show pictures of buses, talk about increases in ridership, scheduling shifts. We rarely talk about people, what transportation means for us or what it delivers.

(respondent, practitioner–academic, 2022)

This points to the misalignment between the dominant focus on the practical sphere in the CAPs for transportation (Figure 2) and the personal sphere which respondents view are where the persistent barriers lie (Figure 3). Other respondents underlined this, saying:

Having all of the right facts, having a very good, sensible and defensible policy, doesn't win that fight; you don't bring facts to a culture war, and that—driving, motordom—is a culture war.

(respondent, public sector, 2022)

A policy maker [...] can come up with technically clear and coherent policies that make sense and that account for the equity concerns that people have, and dress those in a way that is fair, and [include] all those details, [but] that doesn't mean people will believe it's true.

(respondent, public sector, 2022)

4.5 IMPLEMENTATION: NOVEL MOVES AND GLARING GAPS

Despite these above challenges:

Vancouver has done a great job though—it's all relative when you go to other communities—even if Vancouver isn't hitting its goals, it's so far ahead of almost any [city] in North America.

(respondent, non-profit, 2022)

When asked to describe instances where implementation was successful, respondents reflected on how a big part of Vancouver's success related with *how* the 23 municipalities in the region have undertaken climate action: specifically on relationships, sharing, transparency, and trust (Table 1).

Part of the agreement is that the cities are going to *share all of it*. And so what you have happening here in British Columbia is extraordinary, because [City of] Vancouver typically was one of the ones to go first—and they would do something big—and then they would say [to the 22 other municipalities], 'You can have everything from us: you can have our policy design or economic analysis you can have how we got the Council on board and the public on board and whatnot.' [...] Maybe one of them leads and puts the R&D [research and development] into it, so they all don't have to do it. [They] come up with the whole plan. They roll it out, they pilot it, and then they share and then everybody else adopts it, and now it's spread. It's not just Vancouver, [it's also] city of Richmond. [...] So that happened with step code [to reduce emissions from buildings]. 15 municipalities putting in step-code policies, overnight, because they shared with the one who went first.

(respondent, non-profit, 2022)

It's about *relationship* building. But it's not just about buy-in for the policy, part of it is, [but] in order to solve this problem, it can't just be a bunch of experts around a table, we need people with local, lived experience in a community. People are experts about the community that they live in; they're experts about their daily life, what gets in their way and what brings them joy.

(respondent, non-profit, 2022)

It's actually [about] *trusting* people: you're going to get ideas that you don't think of yourself that are in the transformational category.

(respondent, non-profit, 2022)

Many of these responses on effective implementation correspond with the personal sphere (Figure 4), which comprise 48% of the responses on this question and include reflections on the need for engagement that 'meets people where they are at,' mobilizing a social mandate, and developing trust. The political sphere with 26% of responses included such things as the need for planning policy on supply and demand, courageous leadership, and collaboration across levels of government.

Table 1: Contributing factors to the 'how' of successful implementation of climate action plans (CAPs) in transportation were sharing, relationships and trust.

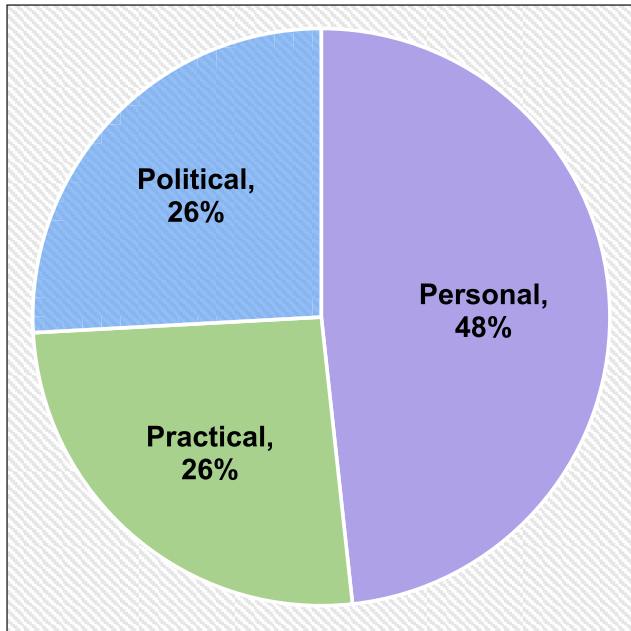


Figure 4: Key components involved in successful implementation.

However, when asked to explore novel moves or underutilized potentials, opportunities in the practical sphere predominated. As one respondent noted:

I'm not naive enough to think that we are going to solve this exclusively with technology. But we are not going to solve it without technology.

(respondent, public sector, 2022)

Examples included e-bikes, sharing modalities, vehicle-to-grid, and mobility pricing; owing to space limitations, these are listed in **Table S4** in the supplemental data online.

The emphasis on the practical sphere to some extent makes good sense: mobility simply has to work practically in the context of people's daily lives. As it stands in Vancouver:

for certain areas of the region, the active transportation network and the transit network are not practical solutions for most people.

(respondent, public sector, 2022)

Such alternatives need to be 'straightforward and efficient,' addressing people's needs for 'speed and convenience' (respondent, non-profit, 2022). One respondent concluded:

We have not created the options. People will make the modal shift, if those options exist!

(respondent, practitioner-academic, 2022)

Respondents articulated the need for transportation:

alternatives to be at least equally efficient, and convenient, which is not currently the case.

(respondent, public sector, 2022)

those buses have to be frequent and reliable; and that's a challenge.

(respondent, private sector, 2022)

This is linked to:

core drivers of behavior or choice [...] the barriers relate to the time and/or cost and the effort involved in more sustainable modes right now [... it is a] longer, more laborious, challenging prospect to take transit than it is to drive.

(respondent, academic, 2022)

Respondents described how this boils down to a pragmatic set of needs, which link with the personal sphere (desires, perceptions, and values):

People make decisions based on some pretty fundamental core things in their life over both their limited amount of time and limited amount of financial resources and the desire to have a good experience of day-to-day life. [...] What's going to be needed to really drive behavior change is not necessarily making the case for taking a green mode of travel because it's a green mode of travel, but because it's faster, cheaper, really enjoyable and comfortable.

(respondent, practitioner–academic, 2022)

However:

you can't transportation-splain them—you've got to accept that they're using the transportation they're using right now, because it's meeting needs that they feel other modes won't meet—so start there and meet them where they're at.

(respondent, public sector, 2022)

In consideration of the political sphere, a question arose about where cities have power to make structural change.

The city pretty much reduced every emission it could directly reduce [from 2008 to 2018] and created the policy framework for the rest. [...] What Vancouver could do and did do, was to build out bike lanes and to vastly increase car sharing and bike sharing. The city was able to do a lot all around transit but not directly to transit.

(respondent, public sector, 2022)

The reality is cities have very little power. It's like this tiny little legislative authority that they have, and an even smaller fiscal capacity with the property tax as the primary revenue source that cities are allowed to utilize. So given all that, the city was able to achieve a lot from a policy standpoint. But on a lot of the biggest levers that you need, like transit, for example, the city is not the only hand [nor biggest hand] on the wheel. [Rather the city is] in the backseat trying to get the attention of the people who are up in the front seat.

(respondent, public sector, 2022)

Future research should consider the role of active travel—such as regarding short trips driven or not made; the (lack of) data relative to reasons why those trips are not walked; and the (lack of) prioritized measures to enable and encourage those trips—all of which would support the decision-making, advocacy, and prioritization of funding (political sphere). Within the scope of where the city does have power, respondents spoke of the need to work in a more integrated manner, linking social and technical work, recognizing knock-on effects, and moving beyond fragmentation (Table 2).

[We are] starting a project, where we're doing some technical work, but also trying to figure out what the public opinion research and public engagement facets of that would be [in a more *integrative* way].

(respondent, public sector, 2022)

These [public transit] projects [...] that are, multi-billion-dollar projects, they pay dividends over time and they have kind of *knock-on effects* that are actually difficult to quantify, or really forecast in building the business case for things like that. And [the knock-on effects] all build on each other. Which is, one of the things that frustrates me a lot with regional public transit planning discussions: it's always sort of like pitting one project against another. When the reality is that they're *stronger together*: it's a two plus two equals five scenario.

(respondent, practitioner–academic, 2022)

People don't separate these things out from one another; if you are concerned about climate change, you're as interested in transportation, as you are in whatever else, right, you just want to kind of get the pieces pulled together. [...] My perspective on why the implementation is so challenging is that it's *really fragmented* for people. [...] How are you going to *start bringing this together*?

(respondent, non-profit, 2022)

Table 2: To support truly sustainable alternatives for mobility, respondents noted the need for further integration.

Vancouver provides a paradigmatic case study on accelerating emissions reductions from transportation, given its place as a forerunner for urban climate action. This study's analysis of CAPs alongside the key informant interviews provided lines of sight into the various components that lead to effective implementation. While transportation infrastructure is a crucial dimension to this problem, this paper has focused primarily on the personal and political dimensions, which are often underemphasized, yet important, in climate action planning in mobility. For example, the commitment to share and collaborate with other cities across the metropolitan region helped to scale effective climate policies more broadly. Also when policymakers sought a more relational approach to public engagement—such as when they went directly to the people in sectors that were hard to reach to gain input and perspectives—their climate interventions were upheld by a stronger social mandate. Below, the paper discusses what components made for transformational actions in Vancouver, where the disconnects and gaps prevail and where novel moves may lie.

5.1 NEED FOR CLIMATE ACTION PLANS COMMENSURATE WITH SOCIAL COMPLEXITY

The value of the practical sphere is unquestionable, and it takes a central place in CAPs regarding transportation. This focus has brought funding and attention to net-zero technological innovations. It has also spurred policymakers to arrive at robust policies in support of behavioral shifts to more sustainable mobility modes. Its limits, however, can become apparent when actions of the practical sphere are carried out in a manner that is not balanced with the other spheres of transformation. As explained in the OECD's (2021: 8) *Transport Strategies for Net-Zero Systems by Design*:

An important limitation for scaling up climate change mitigation is that efforts all too often aim at optimizing individual components within our economic and social systems rather than transforming the systems themselves, which are unsustainable by design.

Hoffmann et al. (2017: 392) describe how, in addition to practical sphere innovations:

regime change also requires developing concepts of deliberate discontinuation of socio-technical regimes, *i.e.* a variety of political efforts to bring an end to a well-established, stable and socially embedded regime, including most of its technological, industrial, political, cultural, *etc.* elements.

This present study concurs with these scholars and considers how to include these diverse elements in an integrated manner.

The focus of CAPs illustrated in Figure 2 was found to be misaligned with the barriers to successful implementation as they are described by respondents in Figure 3, and within that disconnect, implementation flags or even fails. In Vancouver, the current likelihood that this region will meet its climate action targets regarding transportation is scored low, in large part due to precisely the policy failure of the CEPP. That tool had a two-part objective: to nudge behaviors away from fossil fuel-powered vehicles, but also to finance other aspects of the CEAP.

While the early uptake of electric vehicles in Vancouver is encouraging, that transition needs to accelerate significantly to meet our 2030 target. The carbon pollution surcharge in the Climate Emergency Parking Program was designed to accelerate the uptake of EVs, and the decision to not implement the Parking Program means that we won't have access to that tool.

(City of Vancouver 2021: 18)

The 2021 Annual Report (City of Vancouver 2021: 18) elaborates that this constitutes a:

significant gap in the CEAP financial framework, due in part to the decision to not implement the Climate Emergency Parking Program [...] currently [has] no replacement revenue source identified.

This is but one policy, however it provides important lessons more broadly. For example, in a survey study of low carbon transportation policies in Canada, research found that overall citizen trust in both provincial and national government to address climate change and pursue low carbon strategies was relatively low, and that greater value similarity (between citizens and leaders) and positive ‘affective’ beliefs about the intentions of their government would in turn lead to greater policy support (Kitt et al. 2021).

Looking across these CAPs (Table 1), perhaps a more significant threat is a paradigmatic one: namely, the tendency of treating climate action in mobility as a technological-managerial fix rather than as a transformative change issue. OECD (2021: 8) calls for policymakers to undergo a mindset shift in viewing this complex problem ‘from parts (e.g. vehicles) to systems functioning (e.g. car-dependency).’ This change in mindset would support bringing the focus of climate action to redesigning systems to be more sustainable. Replacement of fossil fuel cars for EVs does not on its own constitute a transformation of urban mobility as it neglects examination of the wider systemic change required (Revez et al. 2022; Urry & Grieco 2016); these vehicles have significant embodied emissions and their subsidies are regressive, and because they have lower operating costs they tend to be driven more annual-kilometers and so increase traffic problems and non-tailpipe emissions (Litman 2021). Scholars go as far as to suggest that they may even lead to overall policy failure in terms of sustainability and justice (Haarstad et al. 2022).

Respondents in this study described the top two barriers for climate action in transportation as being related to this socio-cultural-systemic complex of ‘automobility,’ which is neither adequately recognized in these CAPs, nor have public engagement processes sufficiently accounted for it. Framed as a technical problem, excellent technical solutions may be brought forward—even defensible policies that have been well-researched—yet they nevertheless can miss their mark when brought to bear in a complex socio-cultural field of competing narratives, contested values, and varying degrees of trust in government.

5.2 THE HUMAN DIMENSIONS OF CLIMATE ACTION IN TRANSPORTATION

The choice to drive a fossil-fuel-powered car for any given trip is not solely a result of individual preferences. As noted by respondents, when it comes to transportation, a simple decision links to many facets of human decision-making, such as pragmatic considerations of cost, safety, time, and competing commitments, as well as psychological factors like social norms, values, negative affect, identity, culture, and equity (Habib et al. 2021). Key informants strongly emphasized the importance of these human dimensions, yet noted how they are frequently missing lenses brought to bear on the mobility climate-action challenge for Vancouver.

Vancouver has commendably focused on improving or replacing (mainly private) combustion engine vehicles for low-emitting or ZEVs, to also account for how to reduce the number of trips taken, the distances travelled, and the allocation of land-use, infrastructure, and design of communities to support alternative and active transportation, all of which is known to support climate action in mobility (Frank et al. 2010a, 2010b). Transportation 2040 goals include commendable targets (such as two-thirds of trips be carried by sustainable modes by 2040 and have a 20% reduction in vehicle-kilometers traveled from 2007 levels) (City of Vancouver 2012), but policy reforms needed to achieve them lag behind. The region is not on track to meet emissions-reductions targets, and respondents specifically noted how, in attempting to nudge these emissions curves down, climate actors and policymakers face an evident tension between competing cultural narratives. While some citizens advocate for greater climate action in transportation with more investment into transit, parking fees, and congestion pricing, other citizens construe such policies as going against people’s freedom and their prevailing cultural norms, as well as raising issues of equity.

Facts alone do not win in a clash of narratives, and respondents underlined the need to rethink approaches to public engagement. In the techno-managerial approach (practical sphere), people are largely treated as objects to be managed, changed, or nudged one way or another, and information is still disseminated in a one-way manner (Leichenko & O’Brien 2019). They are not necessarily engaged as conscious subjects who are empowered to partake in re-designing how

they move through the city. While in Vancouver the notion of one-way ‘behavior change’ is being seen as a colonial and top-down way of conducting climate action and replaced with other terms such as ‘community action,’ what is still needed are the interpersonal skills and forums to engage in a more two-way, relational manner. Transport for All (2021) describes the importance of both infrastructure and equity, forged through meaningful engagement with groups that are currently discriminated, such as disabled people.

Some precedents for this exist in Vancouver. For example, Simon Fraser University’s Center for Dialogue’s Moving in a Liveable Region, carried out in Metro Vancouver since 2012, provides one such template for such generative dialogue with citizens (Moving in a Livable Region n.d.). Forerunners of this type of relational public engagement have been carried out by government in reducing GHG emissions from buildings, e.g. respondents described how Vancouver staff engaged directly with a diversity of tradespeople and general laborers in their communities to hear their views on the Greenest City Plan (GCP) (City of Vancouver 2015) and staff at Vancouver went directly to condominium strata councils to troubleshoot and custom design how to move those buildings off natural gas. In such cases, this relational engagement bore unique insight for policy design, such that respondents recommended it as worth pursuing in emissions reductions from transportation.

5.3 SCOPE OF INFLUENCE—WHAT IS WITHIN REACH?

The glaring gap in CAPs for transportation remains the lack of comparable alternatives. Respondents spoke about how if such alternatives were to exist, people would shift their mobility modes. Key among these alternatives for a city growing at the rate of Vancouver is public transit. Transit in Vancouver is simultaneously commendable, yet also insufficient:

[Public transit] ridership in Vancouver has grown significantly in recent years, and new services such as the Canada Line have been met with instant success. [Yet] transit demand in Vancouver far exceeds capacity. Overcrowded buses routinely pass long line-ups of waiting passengers, and there are trip denials on HandiDART. [...] Service optimization can help somewhat, but significant new investment is needed—and that requires new and improved funding sources.

(City of Vancouver 2012: 31)

This raises a critical question of what is within the scope of influence for a city or a municipality, given the enormity of infrastructure and investment that a viable transit system would require. This is because large policy agreements do not always translate well to city policy (or local actions) as climate change targets have historically been framed as a global issue. The Cities for Climate Protection (CCP) in the US, for example, suggested that climate change is more likely to be reframed as a local issue when policy response can be directly affiliated with issues already on the local agenda, i.e. controlling GHG emissions to improve local air quality (Betsill 2001). Furthermore, Betsill (2001) explains how when local municipalities want to make active changes to address climate change, institutional barriers often make this challenging to transition from political rhetoric to actionable change. While Vancouver has important policy options to reduce GHG emissions, these potential jurisdictional limitations can directly influence the range of practices implemented to reduce emissions. For example, investment into public transportation and expansion remains dependent on planned and funded agreements within the metropolitan Vancouver regional government and senior government (Jaccard et al. 2019).

Therefore, to have a meaningful and significant impact, Vancouver will need to continue to press out its scope of influence as far as possible regarding where this level of government has agency. This is largely through techno-managerial inputs of the practical sphere, such as:

the City can support high ridership and improved, cost-effective service by building transit-supportive streets and public spaces, by protecting corridors and sites for future routes and stations, and through transit-supportive land use.

(City of Vancouver 2012: 31)

Taken together, some of these shape the overall urban fabric towards greater sustainability. For example, one respondent noted with excitement that adding more priority bus lanes is under city purview and would be relatively inexpensive; getting the existing number of buses moving faster than vehicle traffic will substantially meet transportation needs and present a more compelling alternative to driving.

Yet even the implementation of bike lanes and other active transportation has historically been considered a controversial topic in which several challenges needed addressing before the public would accept such a road reallocation (Siemiatycki *et al.* 2016). For example, Vancouver's Burrard Street Bridge pilot project, which was first proposed in 1996 and aimed to transfer a lane on Burrard Bridge from cars to bikes, ended in political acrimony; it was raised again in 2009 and saw success. It is widely agreed that a key lesson in the failed 1996 pilot was an overestimation of public support for the bike lane and the public discourse that rose up around it, deeming it a 'war on the car' (Siemiatycki *et al.* 2016). Road allocation proposals might appear easy and within reach from a municipal planning standpoint, but their implementation requires taking stock of the pervasiveness of automobility and the 'the "capture" of the state within the car-dependent transport system' (Mattioli *et al.* 2020: 1). Key among the reasons for the subsequent 2009 bike lane success was the focus on public engagement and communications along with careful framing of the political discourse around available options, improved infrastructure, and an increased everydayness of riding (Siemiatycki *et al.* 2016). This example highlights the challenges faced by cities when projects remain relatively simplistic when, in fact, they require both political and public acceptability.

Considering a single bike lane less than 1 km long underwent such a 13-year process, it is small wonder that municipalities come up against immutable barriers when it comes to transit. As described in the GCP, although targets were commendably met for walking and cycling and reductions in trip length:

the future of transit is less certain. Vancouver's system is well-used and largely at—and in some cases beyond—capacity, with significant latent demand. To reach our longer-term targets, secure long-term funding and support is required from other levels of government.

(City of Vancouver 2015: 24)

City property tax was not designed to finance the scale of build that a transit system comparable, if not competitive, with driving would require. In terms of large-scale investment into a different developmental trajectory, cities need broader provincial or federal financial and political support, which will entail addressing socio-cultural and political-economic dimensions of such systemic change. The federal Government of Canada recently committed to permanent public transit funding of C\$3 billion per year, but not beginning until 2026–27; with most immediate investment still going into private vehicle transportation, such as ZEV charging infrastructure (Government of Canada 2022). This pathway is set to secure greater uptake and prevalence of EVs and low-emitting vehicles, but may end up not tending sufficiently to the 'elephant in the room,' namely a car-centric regime—supported by its infrastructure, funding, and decision-making mechanisms—that does not ultimately lead to sustainability and justice for mobility (Haarstad *et al.* 2022). More adequately financing public transportation would entail altering broader developmental trajectories (political sphere) and confronting the automobility-bias (personal sphere) still present throughout these levels of government.

6. CONCLUSIONS

Vancouver has a strong history of commitment to both mitigation and adaptation policies to reduce their GHG emissions. To meet these targets, it is recommended that policymakers better focus on how these different types of mobility transitions can be implemented from CAPs. For example, encouraging incremental steps such as transitioning to low-emission vehicles will likely result in similar challenges that are already being faced with conventionally fueled petrol and diesel vehicles (*i.e.* a risk of road trauma, urban sprawl, noise and environmental pollution, unabated congestion, health concerns including obesity, heart failure, *etc.*). Policymakers should communicate larger

step changes, such as encouraging low-carbon transit use and active transportation, by attending to the values and narratives that are most resonant with the public as well as securing the political buy-in to support such alternatives.

Like many municipalities, meeting climate-change targets requires a shift from purely techno-economic advantages, which remains a key policy narrative, to consider personal and systemic changes. This case study can help to inform global strategies and actions to the extent that policymakers consider these interlocking spheres in their CAPs for mobility. As such it can be considered a paradigmatic case, and could be drawn upon as a reference point for other regions (Flyvbjerg 2006). For example, this case showed the tendency for CAPs to predominantly include the practical sphere, showing instances where implementation became delayed or even failed due to the imbalance of efforts in the personal and political spheres. This presents a reference point for other cities regarding how policymakers might ensure they are considering each of the three spheres in their policy design. That is, not resting with a well-built policy based on technical detail alone, but also considering the public communicative frames with which it needs to relate and the necessary political engagement strategies that are meaningful and resonant across narratives.

Findings from this exploratory study underline the need to frame the problem as a challenge of transformative change rather than as a technical problem of GHG emissions. The disconnect between actions and efforts in the practical sphere (Figure 2) and the key barriers being primarily in the personal and political spheres (Figure 3) sets up a situation in which certain culturally provocative climate action policies and measures may meet with public opposition and indeed fail. Although there are various novel interventions shared in Appendix 4 in the supplemental data online, each of which on their own can contribute in helpful ways to improved reductions in emissions, the transformational action will be in their integration.

In terms of realizing the possible novel moves, each of these also involves better inclusion of human dimensions of understanding, values, and perceptions (personal sphere) as well as re-designing broader systems and structures to decenter the socio-technical system of automobility (political sphere). In other words, novel moves are most potent when there is synergy between spheres.

This calls for an integrative turn in how climate action is planned and carried out: one that acknowledges that this is a challenge of transformative change, and that includes these three broad domains of change, which when taken together generate more sustainable outcomes.

NOTE

- 1 While this paper focuses on urban personal mobility, it is important to note that half of the land transportation emissions in BC originate from the transport of goods, often with heavy-duty vehicles. As such, in this province (with almost 100% renewable electricity), heavy-duty and freight vehicles represent a daunting policy challenge. The relationship between gross domestic product (GDP) and the number of trucks in BC is clear and suggests that, under the current model, increasing the number of trucks is an inescapable side-effect of economic growth. This is one sector that could benefit from hydrogen technologies. However, under the previous management, TransLink—Metro Vancouver's transportation network—decided to avoid hydrogen buses altogether. The reasons for that decision were never made clear. Government policies could accelerate the transition toward low-carbon hydrogen (Talebian et al. 2020). While this is not within the scope of the present paper, it warrants mention in terms of further research on what the role will be for hydrogen strategies in heavy-duty and freight (and possibly bus transport) in Vancouver over the long-term.

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COMPETING INTERESTS

The authors have no competing interests to declare.

ETHICAL APPROVAL

The study design was approved by the Behavioural Research Ethics Board of the University of British Columbia (H22-00186). All participants agreed to participate through a process of informed consent. Personal identifying information was kept confidential and anonymous, and indirect identification was carefully considered (*i.e.* respondents' sectors are shared in a general sense, but not their specific organizations). Transcripts and a draft of the paper were checked by respondents to verify accuracy and placement of their quotations, which increased the trustworthiness of the findings.

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SUPPLEMENTAL DATA

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