Mainstreaming Decarbonization in the Capital Improvement Plan

Informing Seattle's Effort to Align Emissions Reduction Goals and Public Infrastructure Investments

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Abstract

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This thesis explores the potential of Seattle's Capital Improvement Plan (CIP) to act as a roadmap for local decarbonization investments; mainly following the foundation set by Jan Whittington and Catherine Lynch on the World Bank's Climate-Informed Capital Investment Planning Guidebook (2015). The paper develops actionable recommendations for city officials to inform their efforts towards enhanced alignment of capital investments and climate objectives, based on analysis of the policy-enabling factors working around the city's CIP process. These pages analyze the institutional, economic, and technical factors that frame Seattle's infrastructure investment decision-making processes and how those investments are, or are not, aligned with local climate policy goals; mainly focusing on the years following the 2020 enactment of the city's Green New Deal.

To my GIZ and WRI mentors: examples of passion, professionalism, and grace.

To all UDP and Evans faculty and staff, thank you for three years of learning.

To my parents, for I wouldn't be who I am without them.

To Paola, who stands by me through it all.

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Introduction

Global climate gaps

The global challenge of mitigating climate change is outstanding. Scientific consensus points out the urgent need for deep and sustained emissions reductions if we are to avert the worst consequences of the climate crisis (Lwasa et al. 2022). For decades, global emissions have continued to rise, increasing the urgency for action. It's now acknowledged that if the world is to fulfill the ambitious goal of limiting global warming to 1.5ºC by the end of this century, global emissions need to be cut by half around the year 2030, and decisively drop to zero around 2050. The drastic need for change was further highlighted by the COVID-19 pandemic. By 2020, the scale of GHG mitigation needed to stay on a 1.5º-consistent trajectory was equivalent to at least a decade of steady pandemic-level (~7% per year) global emissions reductions (Evans 2020). Instead, 2021 saw global CO2 projected emissions rise back to pre-pandemic levels; further complicating the global challenge of systemic decarbonization. Not all is lost though. Even without accounting for the economic benefits of avoiding climate damages, most of current academic literature points to global economic and social benefits that exceed the mitigation costs of limiting warming to 2ºC (IPCC 2023). More ambitious benchmarks require higher up-front investments but can also increase the related co-benefits and reduce costs in the long term. By themselves, the economic benefits of air quality improvements related to mitigation action can match the associated mitigation costs, potentially being larger (Lwasa et al. 2022). The climate practitioners of today can rely upon a wealth of evidence to support the benefits of global mitigation action.

Recent achievements of the global climate response also show the roots of a path forward. The most recent wave of emissions-reduction policies being implemented at the national level has put the world on a 2.6ºC trajectory, down from a 4ºC projected future ten years ago (UNEP 2022). Cooperation between countries has improved, framed by the Paris Agreement framework. For the first time since the UN Framework Convention on Climate Change (UNFCCC) entered into force in 1994, virtually all countries have reached an agreement with temperature goals, topical workstreams on most issues of interest, and a mechanism to ratchet ambition

periodically through technical stocktaking and transparent reporting. Beyond the formal UN climate process, subnational governments and private actors can also rely on several high-profile alliances and fora to drive action. In sum, climate action at every level of government has never been in higher demand.

Even with increasingly promising climate policy scaffoldings, there are gaps in the ambition, transparency, and the ability to implement climate plans and targets at all levels of government. Over the last seven years since the signing ceremony of the Paris Agreement, climate scholarship has repeatedly pointed out coherence, feasibility, and transparency gaps between international climate pledges and their implementation on the ground (Pauw and Klein 2020). Across regions and governance contexts, ambitious political commitments are not translating into emissions reductions of the magnitude needed to combat the climate crisis. At the urban scale, these challenges are evident in the dissonance between municipal GHG emissions reduction targets and the investments in carbon-intensive infrastructure made by city governments. This thesis stems from the assertion that it is crucial to develop actionable evaluations of the gaps and challenges hindering ambitious mitigation pledges.

Urban infrastructure and climate mitigation

The 21st century will see an unprecedented rise in the proportion of humans living in urban settings, as well as the growth of the urban share of global emissions. Over half of the world's population lives in cities, and by 2030 this share is expected to increase to about 70% (Lwasa et al. 2022). Meanwhile, cities are responsible for around 70% of global greenhouse gases being released into the atmosphere (UNEP 2017, IPCC 2022). The growth in urbanization and inertia of our urban built environments will only make that figure rise in the coming decades. Inherently, urban areas concentrate GHG sources because of the size and nature of their economies, the magnitude of their populations, and the energy and GHG embodied in their built environments. Luckily, mitigation actions that address these drivers can make significant dents in global emissions trends. The latest compilation of global mitigation scenarios shows that urban mitigation strategies could reduce emissions by 90% by 2050 (Lwasa et al. 2022). These estimates

call attention to the need for attention to urban infrastructure, emissions trends, and the potential for action.

The evolution of urban infrastructure systems has a multitude of climate implications. For one, it sets the stage for non-infrastructural energy and material demands of its built environments. The density, form, and extent of urban development have a long-lasting influence on GHG emissions, particularly in the transportation and building sectors. In addition, the construction and use of urban infrastructure itself can demand large amounts of embodied energy and emissions. This multifaceted role of infrastructure-related emissions drivers can be exemplified by highway expansions (Thacker et al. 2019), which simultaneously perpetuate car-centric urban forms (with their subsequent energy consumption and emission intensity implications), and demand resource-intensive construction, operation, and demolition actions themselves.

At a global level, infrastructure spending needs are expected to double in 2030, relative to 2015 (CCFLA 2015). Estimates also show that current urban climate finance flows (broadly defined, not infrastructure-specific) are insufficient to implement the level of emissions reductions needed in urban settings (CPI, WB, and CCFLA 2021). Established cities, such as Seattle, need to address the GHG emissions of their building stock, encourage modal shifts, electrify energy supplies, and infill and densify urban areas (Lwasa et al. 2022). Given the complex and long-lasting consequences of perpetuating carbon-intensive infrastructure systems, it is critical to align urban infrastructure investments with climate mitigation ambitions at all scales, including the municipality.

Seattle as a case study for climate mainstreaming

Since at least the 1990s, the city of Seattle has included emissions reductions as a specific line of government discourse and strategy. Particularly since the turn of the millennium, as the international discourse on cities as climate-solution beacons solidified, Seattle's climate politics have translated global discourses into its policy space. Back in 2006, the city's first Climate Action Plan: *Meeting the Kyoto Challenge* exemplified the discursive relevance of climate mitigation in the strategic agendas of city hall. Early in the 2010s, the 2013-updated action plan integrated

themes of racial equity and social justice; and was followed by a multitude of executive climate orders and strategies (from 2018 to 2021) with similar objectives. The most recent iteration of strategic climate ambition by Seattle elected leaders is the Green New Deal framework, operationalized between 2020-2022. This local version of the popular agenda focused on climate neutrality, incorporating a lens of just transition and investment in historically marginalized communities.

No amount of optimism can counter the fact that Seattle's emissions trajectory is not in line with its ambitious goals. Despite increasingly ambitious mitigation targets for several gases, Seattle's GHG inventory has only recorded a slight decline in emissions since its baseline year of 2008 (Seattle OSE 2022). The moving goalposts of carbon neutrality only make the challenge more relevant. By suggesting an ambitious increase of the city's 2030 GHG reduction target from 58% to 100%, Seattle's Green New Deal committed the government to accelerate the rate of emissions reductions more than 20-fold (Seattle OSE 2021). Gifted with hydroelectric dams in the vicinity, the city's low-carbon electricity consumption does not present a major decarbonization challenge. It is the transportation sector, coupled with the city's buildings and industrial activity, that make up more than 98% of the city's challenge of full decarbonization (Seattle OSE 2022). The first package of Green New Deal investments, announced in 2022, shies short of the ambitious 2030 target: it only includes $2.3 Million targeted for city-led phase-out of fossil fuels, limited in scope to city-owned buildings, and not until 2035 (Barnes 2022).

Despite clear limitations in terms of its budget, legal mandates, and national agenda-setting power, the city's history has chosen not to wait for national or international environmental action to catch up to its ambitions. To lay the groundwork for the systemic transformations needed to mitigate the effects of the climate crisis, Seattle's climate-forward city government could be well informed by research into current mismatches between codified climate commitments and the infrastructure investments being planned and implemented. Placed in the complex policymaking environment of the city, this thesis' exploration of the political economy of climate investments hopes to inspire discourse that goes beyond the usual narrative impasses of lacking political will, public sector inefficacy, or entrenched economic interests responsible for blocking progress in climate action worldwide.

Research objectives

This thesis revolves around the potential of municipal capital investment plans to contribute to ambitious city decarbonization goals; mainly following the steps of Jan Whittington and Catherine Lynch for the World Bank's Climate-Informed Capital Investment Planning Guidebook (2015). The purpose of this project is to develop actionable recommendations for Seattle government officials to inform their efforts towards enhanced alignment of capital investments and climate objectives. I present here a nuanced understanding of the entrenched policy-enabling factors working around the city's capital improvement planning process. These pages analyze the institutional, ideological, economic, and technical factors that frame Seattle's infrastructure investment decision-making processes and how those investments are, or are not, aligned with local climate policy goals; mainly focusing on the years following the 2020 enactment of the city's Green New Deal. To do so, I answer the following research questions:

- How aligned is the capital improvement planning process to the city's emissions reduction goals?
- What role are institutional, ideological, economic, and technical factors playing in the alignment and/or mismatch of climate priorities and capital planning?
- Are there remaining opportunities for mainstreaming of climate criteria throughout infrastructure investment planning within the City of Seattle government?

The following pages present a brief review of scholarship on the urban dimensions of the climate crisis. Scoping literature on the governance of urban climate action and infrastructure planning, I elaborate on the potential for a political economy analysis of lessons in the provision of lower carbon infrastructure systems. Revisiting my research objectives, I then operationalize a qualitative case study approach based on policy document reviews and semi-structured interviews with City of Seattle decision-makers. Based on this information, I present forward-looking suggestions for the City of Seattle to enhance climate and capital policy coherence.

While there is an important body of climate literature on urban infrastructure interventions, there are still knowledge gaps regarding how these mitigation options can be integrated into planning processes; as well as the governance models that support decision-making for climate action (Lwasa et al. 2022). My work aims to address these voids, as well as the

scholarly need for assessments of the policy dynamics of emissions reductions on the ground, and the "socio-technical-institutional systems that could allow for progress" (Castán Broto and Westman 2020; Bernstein and Hoffmann 2018).

Literature Review

Notes on Urban Climate Action

In parallel to the implementation gaps in global mitigation action, locally-led emissions reduction initiatives have fallen short of their transformative potential. For the past decade, a wave of urban pragmatism has dominated scholarship on the subject and has sought to reimagine the "subnational" as a meaningful category in the international climate regime (Castán Broto and Westman 2020). This hopeful view of non-national action is supported by several reviews of local climate policy progress, and quantifications of the mitigation potentials available to subnational actors. Most recently, Hultman et al. (2020) estimated that existing city commitments, when joined with state and business action, could single-handedly reduce US emissions 25% below 2005 levels by 2030 – supporting increased national action and international momentum. Cities have also earned the reputation of climate solution labs, with some scholars arguing that subnational climate experiments are key to the global challenge of decarbonization via normalization, capacity building, and coalition building (Bernstein and Hoffmann 2018). Nevertheless, these theorized potentials of ambitious city commitments have so far been undermined by the realities of achieving urban climate action.

Local climate plans are at the forefront of the challenges of acting on climate. By 2010, for example, US city climate plans present great narrative diversity, but little policy innovation or actionable items (like timetables, roles, or specific mitigation measures); most documents have been prepared as clear signals of local political commitments to climate policy, but lack participation of planners or planning commissions (Bassett and Shandas 2010). The nature of local climate plans, particularly of their strategic choices to mainstream climate considerations across economic sectors and government agencies, has also been subject to scrutiny. For instance, it has been recognized that a key issue for plan effectiveness is the diffusion of its goals into parallel frameworks and policies. By themselves, standalone dedicated climate plans have not been successful in leading to coherent sectoral climate policy implementation (Reckien et al. 2019); suggesting the potential of "dual-track" combinations of a multi-sectoral climate planning exercise and a dedicated executive climate strategy, or standalone plans complemented by a

subsequent mainstreaming of goals and issues. It is necessary to acknowledge that ambitious climate targets are more likely to translate to action if they are backed by robust institutional machinery for policy development and implementation (Dubash et al. 2021). This "extended reach" of climate policy beyond dedicated climate plans has been widely accepted (Woodruff and Stults 2016) and calls for the study of governance instruments and processes beyond environment and climate agencies. Arguably, analyzing government actions like infrastructure decision-making or capital investment plans can enhance the understanding of how cities can achieve emissions reductions across their economies.

If urban climate action scholarship is to inform effective local policymaking, it also needs to address the growing need for context-specific, nuanced, and cautious analysis of the barriers preventing government action. Wolfram et al. (2019) rightly point out that city action is not naively independent from broader policy-influencing conditions, or likely to be a silver bullet against inaction at other levels, but incorporates "strong dependencies on the political ecology and economy of cities". The limited faculties and capacities of municipal governments is a broadly recognized challenge. The effective implementation and evaluation of city climate action plans, for one, can require new types of inventories and data on GHG stocks and flows (Bassett and Shandas 2010) that cities might not have readily available. If implemented successfully, local governments must then grasp the potential trajectories for scaling up (or across, horizontally) successful policy experiments (van der Heijden 2019). Thus becomes evident the emerging reconnaissance of climate change governance studies as more than analytical pathway optimization exercises (Rayner 2010), and a field in need of understanding the institutions and processes driving low-carbon urban transformations (Wolfram, Frantzeskaki, and Maschmeyer 2016; Dubash et al. 2021; Castán Broto and Westman 2020; Bernstein and Hoffmann 2018).

Investing in low-carbon urban infrastructure

The interest in studying the municipal provision of low-carbon infrastructure is born from the realization that subnational governments are responsible for most of the public investment in both resilience and emissions reduction initiatives. A recent landmark review of public

expenditures among 30 OECD countries found that since 2016, subnational governments can be attributed 64% of overall public investment targeting environmental and climate action (CPI, WB, and CCFLA 2021). These expenditure shares could be read as a nod of validation to the majority of climate finance scholars, who warn about the shift of power towards private market actors (potentially challenging the efficacy of climate finance) and advocate for a strong return to public climate finance provision under ambitious spending programs (Bracking and Leffel 2021). In addition, the study of fund divestment structures has pointed to decentralized, polycentric structures as enabling mechanisms for funds to reach capable local stakeholders leading flexible and adaptive local investment policies (Agbemabiese et al. 2018). In light of this context, this thesis suggests that Seattle's $7.4 Billion 2023 budget ($1.52 B of which is expected to go into capital improvement) merits inquiring if it could be better aligned with the city's climate ambitions.

Understanding how infrastructure is funded, financed, and governed is integral to explaining its effect on urban development. In essence, the complex socio-technical systems of urban infrastructure dictate urban trajectories by "locking-in" future patterns of behavior and development (Thacker et al. 2019). Thus, the importance of raising the profile of infrastructure provision solutions. O'Brien et al. (2021), for example, recognize that the long-term and capital-intensive nature of infrastructure assets has made infrastructure provision a recurrent challenge for national and local governments. If this challenge is to open the door for redirecting existing finance flows to climate-conscious solutions, practitioners must recognize that the composition of cost-effective low-carbon infrastructure solutions is highly context-dependent, and often requires new enabling governance arrangements (Sudmant et al. 2017).

Exploring the provision mechanisms of low-carbon infrastructures is thus vital to inform broader trajectories toward decarbonized urban built environments. Scholarship has thoroughly evaluated why proactive infrastructure spending should be a cornerstone of government action toward ambitious climate targets. Siegmeier et al (2018) argue that the context of stringent climate mitigation demands mitigation to be an explicit objective of public infrastructure spending, on account that it can shed light on low-cost mitigation options, acknowledge the far-future impacts of existing infrastructures, and correct high-carbon demands that other fiscal

mitigation instruments like carbon prices might not influence. The potential for negative impacts has also been acknowledged. Infrastructure can have profoundly harmful social and environmental impacts within and beyond the lifetime of assets – while also being essential to minimize the impact of human activities on the environment (Thacker et al. 2019).

In some climate-forward cities similar to Seattle, this complexity has been initially faced with a narrow emphasis on the energy sector. The city of Vantaa, Finland, mirrors Seattle's intentions to reach climate neutrality by 2030. So far, the most promising path towards early decarbonization in Vantaa has been decarbonizing its electricity generation. Most of the additional measures needed for carbon neutrality are perceived to rest outside the city's jurisdiction and to depend on private or national actors for implementation (Laine, Heinonen, and Junnila 2020). Expanding the climate role of urban infrastructure beyond the proven potentials of the energy sector calls for a more nuanced understanding of the specific practices and processes in place for the provision of infrastructure systems and assets.

Among the most relevant processes for infrastructure provision in cities similar to Seattle is capital expenditure (aka capital investment, or capital improvement) planning. This thesis will revolve around the potential of municipal capital investment plans to contribute to ambitious city decarbonization goals; mainly following the steps of Jan Whittington and Catherine Lynch for the World Bank's Climate-Informed Capital Investment Planning Guidebook. Whittington and Lynch's work (2015) is among the clearest identifications of the capital investment plan as a tool for climate-informed infrastructure decision-making. Starting with an evaluation of current municipal approaches to mitigation spending, they note that traditional capital planning processes have resulted in investments unaligned with low-carbon pathways. Their work then builds on low-carbon urban infrastructure literature by identifying 4 levers for enhancing the mitigation power of capital investment planning: (1) expanding the time horizon of the capital investment plan, (2) forecasting aggregated carbon from proposed projects, (3) generating low-carbon alternatives to conventional projects, and (4) including climate criteria along the planning process. The authors ultimately suggest minor modifications to commonly used capital planning practices that can "appeal to the pragmatics" of local infrastructure decision-making and open up the potential for leveraging capital budgets for city-led climate ambitions. This rich procedural

framework could be enrichened by the recognition that disrupting carbon lock-in is fundamentally a political activity – given the norms, institutions, capacities, and coalitions that support our current carbon-intensive systems (Bernstein and Hoffmann 2018). The next few pages will elaborate on the value of incorporating a political economy analysis perspective to the framework by Whittington and Lynch and operationalize a research mechanism targeted to inform the infrastructure investment decision-making within the City of Seattle.

Role of political economy analysis in advancing low-carbon urban infrastructure scholarship

Context-specific analysis of the policy environment around urban emissions reductions and its political economy factors has been widely identified as a gap in current urban climate governance and low-carbon infrastructure literature. Systematic literature reviews on urban climate governance have evidenced that a key missing piece is the assessment of "everyday climate governance on the ground", moving beyond generic recommendations to context and place-specific recommendations about fostering change on the ground (Castán Broto and Westman 2020). In addition, understanding the dynamics of mundane, departmental climate action requires a new emphasis on both detailed fieldwork and an understanding of the political economies through which climate change action is being conducted (Bulkeley and Betsill 2013). The relative position of urban governance literature among other fields has also been critically analyzed, finding it essential to create a stronger connection between knowledge of urban climate governance and the theoretical frameworks that are central to urban studies, governance studies, international relations, and other related fields (van der Heijden 2019). Overall, it is clear that the contentious provision of capital improvements, among other city climate efforts, could be well informed by political economy analysis and other inquiries into the policy enabling factors around low-carbon infrastructure.

Among the vast potentials of political economy analysis, it can open opportunities to counteract the prominent focus on the optimization of contextless urban decarbonization pathways. Real decarbonization action depends not only on the implications of cost-optimized

modelling pathways but also on the social, technical, economic and political systems that underpin our societies (Bernstein and Hoffmann 2018). In the same way, the lack of a single best route to low-carbon, climate-resilient, or climate-just cities, makes it imperative to gain a better understanding of the various pathways to effective urban climate governance (van der Heijden 2019). These climate governance pathways are critically determined by the political economy contextual factors a government operates around, given that they circumscribe the process through which climate goals and implementation actions are articulated and contested (Edenhofer et al. 2014). Concurrently, the study of the institutions that mediate interests and barriers to climate policy implementation is in its infancy compared to the very targets and plans they issue (Dubash et al. 2021). Thus, a research approach informed by political economy analysis, with an eye for institutions and contention, can reveal the nuances of how implementation challenges can triumph over narratives of sub-optimal pathways, or the narrative impasses of ´lack of capacity' and ´weak political will´ (Worker and Palmer 2021). Beyond specific challenges, a lens of political economy can provide insight into the relationship between city climate efforts, the global climate fight, and broader challenges of decarbonization (Bernstein and Hoffmann 2018).

Methods & Plan of Inquiry

The research conducted for this thesis consisted of a qualitative approach to the following research questions:

- How aligned are the capital improvement planning process and city emissions reduction goals?
- What role are institutional, ideological, economic, and technical factors playing in the alignment and/or mismatch of climate priorities and capital planning?
- Are there remaining opportunities for mainstreaming of climate criteria throughout infrastructure investment planning within the City of Seattle government?

This chapter elaborates on my use of an evaluative case study design, a semi-structured interview instrument, and qualitative data analysis techniques to develop actionable recommendations for Seattle government officials to inform their efforts towards enhanced alignment of the capital improvement plan and the city's climate objectives.

Case Study Design

In practical terms, case studies are generally defined by the investigation of real-life processes, activities, or phenomena with a comprehensive research strategy. Scholarship on these designs has pointed to its strong qualitative emphasis, in particular its "intensive, holistic descriptions" and "heavy reliance on inductive reasoning in handling multiple data sources" (Merriam and Merriam 1998). Elaborating on its scopes and subjects, the case study has also been distinguished from other research designs by force of its treatment of the phenomenon's context. This articulation of the context-phenomenon duality was best expressed by Yin (1994), who highlights that "case studies investigate a phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident". These very lines could have been written for the relationship between formal capital investment planning processes and their broader policy influences. It follows that a Seattle-specific case study could be appropriate for the complex interplay between infrastructure decision-making and the econo-socio-political environment it unfolds in.

The motive-based classification of case study types also informed the design of this research approach. This distinction was suggested by Stake (1995), who acknowledges the overlap between types, but highlights the important methodological implications of reflecting on researcher motives. Stake identifies *intrinsic* cases, where cases are studied for the inherent interest in its phenomenon and context; *instrumental* ones, in which the case is chosen to understand wider phenomena; and *collective* studies, where several cases are investigated to improve the understanding of commonalities and differences. In these terms, this thesis narrowed its scope from intrinsic and instrumental motivations: I aimed to understand Seattle's capital investment planning to suggest improvements, and to simultaneously understand broader trends, barriers, and opportunities of infrastructure decision-making for urban climate action.

The role of theory was another careful consideration in the design of this inductive approach. While placing concerns of feasibility and pragmatism above all else, the methods selected for this thesis bow to the constructivist grounded theory of Charmaz (2006). This choice led to a "theory-generator case study" (Simons 2009) in which theoretical insights are considered a-posteriori, being constructed from the data itself. While I did not pursue a naïve attempt at constructing a general theory of climate mainstreaming in capital investment planning, the final recommendations of this thesis do borrow from an internal, limited, theory of this case. In more practical program evaluation terms, these internal theoretical findings could be interpreted as the building blocks for a case-specific theory of change. The constructivist research angle allowed treating capital planning like the socio-political process it is, expanding the traditional view of it as a mere optimization problem. In addition, it allowed for findings that focused on how individuals (city staff and policymakers) experienced the phenomena around capital investment and emissions reduction planning.

This case study also prioritized a lens of evaluation that aimed at contributing to informed policymaking and debate. Following Simons (2009), the practical implications of evaluations' inherent political dimension and resource allocation implications are threefold: evaluation case studies of public programs should (1) discern the value of the program being evaluated, (2) be responsive to multiple stakeholders, and (3) include and balance all interests fairly. These three

imperatives sum up the need to shift power away from the evaluator as the sole judge of what is worthwhile. This spirit of responsive evaluation further solidified my focus on policymakers and city officials, opening the door for periodic reevaluations of my research approach that considered the views and responses of interviewees.

Document Review and Interviewee sampling

The bulk of my data collection consisted of policy document review and semi-structured interviews with Seattle policymakers and city government staff. The main population of interest for the interviews was policymakers and local government officials involved in the process of capital investment planning. In addition, some of the interviewees managed other strategic instruments for climate action. Before conducting the interviews, I conducted an extensive review of the city's Capital Planning Policies, Climate Action Plans, and other relevant policy documents for capital improvement and climate action.

For the purposes of the interviews, I relied on a sequential sampling approach leveraging elements of convenience, homogeneity, and discriminate sampling. When starting to consider study participants, Glaser and Strauss (2010) suggest beginning with a few participants (around 5) who have the process of interest in common. In this case, these consisted of actors directly involved in capital improvement planning. In a subsequent stage of discriminate sampling, only persons that could provide new information or answer emerging questions would potentially be added, becoming increasingly selective. Some government officials were hard to come by in the timeframe available, so this plan considered reaching out to academics and nonprofit experts familiar with Seattle's capital planning and climate policy processes.

The issue of final sample size is a point of contention among grounded theory proponents. Because grounded theory insights emerge from the data, there is no reliable way of determining sample dimensions beforehand (Simons 2009). Proceeding with interviews until conceptual saturation is reached is also a challenge, given that each new respondent has something unique to contribute, and "it is usually the researcher who becomes saturated" (Josselson and Lieblich, 2003 in Simons 2009). In light of this complexity and following the rules of thumb by Guest et al.

(2006), I tried to schedule interview appointments with at least 10 people within city government to represent the breadth and depth of the capital planning process without becoming overwhelmed. When it came to scheduling the interviews, the limited capacity of government officials made reaching 10 conversations impossible; exemplifying either the time-constrained environment they operate in, and/or the importance of political capital behind any evaluation that intends to make use of city staffers' most important resource: time.

Interview Execution

After a review of relevant public policy documents, a semi-structured interview protocol was developed to guide every encounter with the sampled actors. In addition to basic delivery instructions and the required informed consent disclosures, the protocol included 6 questions for a 45-60min conversation. Following the political economy analysis structure proposed by Worker and Palmer (2021), the questions touch on each interviewee's perception of the institutional, ideological, economic, and technical factors that frame Seattle's capital planning process. This instrument provided some degree of control over the line of questioning while allowing for flexibility in the case interviewees suggested an unusual but valuable line of reasoning.

Keeping Seidman (2006) and Charmaz (Charmaz 2006) in mind, I centered the open-ended nature of semi-structured interviews during the data collection process, in order to avoid replicating biases and mischaracterizing the interviewees' responses while analyzing data. In addition, a research journal was kept to record impressions, reactions, and other significant events during the scheduling of interviews and the data collection period.

Data Analysis

The final stages of data collection ran in parallel to the first round of analysis. Following the guidance of Miles, Huberman and Saldaña (2020), I used In-Vivo coding for my first round of data analysis, recognizing my status as a beginner qualitative researcher, and trying to center the

language of the policy documents and the experiences of my interviewees. In-Vivo codes strongly rely on the source's use of language and provide a valuable starting point that preserves participants' perceptions of their views and actions. Charmaz (2006), a strong proponent of In-Vivo coding, suggests three kinds of codes that prove to be useful: 1) Widely known general terms that condense significant meanings, 2) A source's innovative phrase that captures experience, and 3) Insider shorthands that reflect group perspectives. These three categories provided a basis to identify first-round codes that cemented an iterative analysis process.

After In-Vivo codes were identified in all interview and document notes, I proceeded with a more focused, selective cycle of coding. In this second phase, the most significant or frequent codes for each interview question were used to sort, synthesize, integrate, and organize insights into the city's capital investment planning process. The focus was getting to a higher level of analysis and abstraction that could lead to well-grounded suggestions for change. As outputs of this conceptual coding phase, I compiled analytical memos on several issues of interest, as well as a theory of change for emissions reductions' mainstreaming in Seattle's capital investment planning. These analytical memos form the basis for case study insights and recommendations contained in the last chapters of this thesis.

Results: Document Review and Interview Perspectives

This chapter presents qualitative case study results based on policy document reviews and semi-structured interviews with city experts and officials from the Budgeting (CBO) and Sustainability and Environment (OSE) offices, as well as the Green New Deal (GND) Oversight Board. While the delivery of climate action ultimately depends on sectoral mechanisms and policies, this thesis centered on higher-level, economy-wide levers of institutional change. Recognizing the complex policy scaffoldings that support climate and capital planning in Seattle, this thesis focused its efforts on reviewing a limited set of multi-sector policy instruments like climate plans and executive orders, in addition to the most recent Capital Improvement Plan (CIP). Below, the reader can find key insights around:

- The city's climate planning record, focused on its links with capital-intensive sectors and Seattle's capital planning policies
- Key policy-enabling factors that shape the alignment between Seattle's capital and climate planning efforts.
- City staff perspectives of the opportunities for enhanced alignment of capital planning and GHG reduction goals.

Background: Capital Planning and GHG Monitoring

Part of the annual budgeting process, Seattle's Capital Improvement Plan (CIP) anticipates investments over a six-year period and is central to the city's management of capital infrastructure. In addition to identifying the need for future capital investments, it elaborates on candidate mechanisms for funding them. The CIP's relevance rests in part in that the City owns and operates several physical assets, including parks, roads, bridges, offices, libraries, and more. The CIP also includes City infrastructure, encompassing utilities that deliver electricity, manage solid waste, and provide water and wastewater services. Seattle's current CIP, for the 2022-2027 period, proposed $6.8 billion USD of investments over the six year period, with about $1.4 billion for 2022 (City of Seattle 2022).

Seattle has a transparent emissions inventory development practice and reports periodically on its citywide GHG emissions over two categories: core and expanded. Following the national standards put forward by ICLEI's *US Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions*, a community-scale inventory of emissions is published bi-annually to inform the city's climate efforts. Core emissions represent those under significant influence from local government, while expanded emissions encompass all emissions released within the city's boundary and due to the city's energy consumption and waste disposal. According to Seattle's most recent GHG inventory, most of the city's climate policies and programs target reductions in core emissions (City of Seattle 2020a).

Overall, Seattle is making some progress toward its ambitious decarbonization goals, but action needs to accelerate. Even before the drop in GHG emissions due to the COVID-19 pandemic in 2019, Seattle's total accounted emissions were only reduced by 1.36% from 2008 to 2018, despite significant growth in economic activity and population. When accounting for the emissions over which City Government has more influence, or core emissions, this decrease jumps to 5.29% in that same decade. Due to the COVID-19 pandemic, 2020 saw a major reduction (around 20%) in both categories, but emissions are expected to rebound as the economy recovers – since the reduction can be largely attributed to reduced air and road travel during 2020. Emissions per capita, on a brighter note, reduced significantly between 2008 and 2018. Dropping by 24.5% and 16.8% in core and expanded emissions, respectively (City of Seattle 2020a), per capita emissions trends evidence success in driving down the carbon intensity of Seattle's economic output and per-citizen carbon footprint.

Historically, capital-intensive sectors have dominated Seattle's stubborn lack of emissions reductions. In recent years, buildings and transportation have accounted for a big part of the city's overall emissions, consolidating around 57% of city GHGs and close to 1.3 metric tons of CO2eq annually. Methane gas combustion is still the largest contributor to existing building emissions, with 92.3% of the total in 2020, while only accounting for less than half of the building stock's energy use – and neither usage nor emissions trends point to a significant downward trend. In 2020, the higher number of residents working from home and the increased number of cooling degree days actually contributed to a 0.7% increase in gas use and a 6.3% spike in oil

consumption – highlighting the urgent need for investments that free building stocks of fossil fuel dependencies. Puget Sound Energy, main distributor of natural gas in the city, features prominently both as a source of data on gas consumption and agent of change in the inventory's language. On the transportation side, road transportation presents the largest contributor to city GHG emissions since the first inventory was prepared in 1990. Emissions in this sector sustained constant growth from 1990-2008, but have seen modest decreases through 2020 due to fuel economy improvements and a reduction of vehicle miles traveled within city limits (City of Seattle 2020a).

Compared to other cities', Seattle's electricity supply does not present a major decarbonization challenge in the short term. About 90% of the electricity provided by Seattle City Light (SCL), Seattle's publicly owned electric utility, comes from hydroelectric dams, and the remaining emissions from electricity generation are offset via emissions reduction credits from local projects (Seattle OSE 2021). Policy-wise, State Government has led the charge on mandates for clean energy production. The Clean Energy Transformation Act, for instance, sets a 2030 target for GHG neutrality in electric utilities, and a 2045 zero-carbon generation mandate that would require SCL to phase out its 10% of fossil generation. The need for reducing SCL's reliance on offsets will be further motivated by Washington's cap and trade program, the Climate Commitment Act, which sets a precedent for limiting the use of offsets by big emitters in the state (Tempest et al. 2021).

Background: Climate Planning Instruments

Seattle has a history of progressive policy formulation for GHG emissions reductions, complemented by ambitious climate target-setting. As an example, climate policy formulation for the buildings and energy sectors has seen steady progress since at least the year 2000. At the turn of the millennium, Seattle became the first American city to announce a "green building goal" for newly built publicly owned buildings. Later in 2001 and 2005, the city expanded on its commitment by establishing LEED incentives for private facilities and pushing Seattle City Light to become the USA's first carbon-neutral electric utility (City of Seattle, Office of Sustainability &

Environment 2013). As a complement of this early progress toward decarbonization, 2011 saw the city's Major and Council set an ambitious bar for carbon neutrality. Resolution 31312 directed the city to pursue efforts to become carbon neutral by 2050 and produce a climate action plan aimed to reduce GHG emissions and support other local goals in economic growth, social and racial justice, and neighborhood vitality (City of Seattle 2018). The resulting 2013 Climate Action Plan included a suite of short-term actions and long-term sectoral ambitions to reach the 2050 neutrality goal. Being the first plan that put a date on carbon neutrality, the 2011 carbon neutrality pledge and 2013 CAP consist of the most relevant precedents for the post-2020 Green New Deal era of Seattle climate policy.

Responding to global discourse and international ambition is a main trigger for Seattle's enactment of new climate policy. Since at least 2005, the city has catered to national and global spotlights by announcing ambitious GHG reduction goals. In that year, Seattle's Mayor responded to an overwhelming sensation of federal inaction on climate change and established the Mayor's Climate Protection Initiative – aimed to rally other US mayors around the Kyoto Protocol target of reducing national emissions 7% by 2012 (Seattle GRC 2006). According to the city's recollection of the initiative, more than a thousand mayors joined, pledging to 'meet the Kyoto challenge'. As in the 2011-2013 ramp-up of commitments, in 2005 Seattle complemented bold announcements with the development of climate policy instruments. The 2006 Climate Action Plan was one of the first to be published among US cities, and according to its 2013 counterpart, more than 80% of the action items identified back in 2006 were already implemented or in the process of being so (City of Seattle, Office of Sustainability & Environment 2013).

After 2016, the Paris Agreement has shaped the tone of Seattle's climate commitments. After the 2017 withdrawal from the Agreement by the US Federal Government, Seattle "committed to upholding the pollution reduction targets in the agreement" (City of Seattle 2018). Responding to the Trump administration's dismissal of federal commitments, City Council voted for resolution 31757, which reaffirmed Seattle's climate leadership and requested City Hall to explore 1.5º-aligned policies for the city. The resulting 2018 Climate Action Strategy made a point to chastise the Federal Government for its withdrawal, and framed the included actions as a "tipping point in the transition to Seattle's zero emissions future […] designed to move beyond

incremental change and fundamentally reshape our […] systems for a fossil-fuel-free future" (City of Seattle 2018). The 2020 Green New Deal would only amplify these trends, bringing about additional executive orders, strategies, and Council resolutions with increasingly ambitious GHG reduction goals and explicit links to capital needs and investments.

The Green New Deal resolution marked a new era in Seattle's climate priorities, marked by increased urgency and momentum not necessarily bundled with a grasp of feasible progress or persistent implementation challenges. Answering the call of the federal Green New Deal agenda, Seattle's GND opens its preamble by urging the United States Congress to pass the federal Green New Deal – a continuation of the search for a national leadership position the City has historically pursued. Prominently, the GND established a more ambitious decarbonization goal, targeting climate neutrality by 2030 (Seattle City Council 2020): 20 years earlier than Seattle's previous commitment, dissonant in the face of only modest emissions reductions in the past decade, and demanding unparalleled GHG reduction rates. A few months after the resolution by City Council, the Mayor's office responded to the Green New Deal with a sobering executive order that tampered some of its ambitions and operationalized others. Returning to the 2050 goal of carbon neutrality as the city's guiding compass, the executive order also established new coordination mechanisms and constituted an interdisciplinary team tasked to report to the Mayor on yearly GND progress. This dispute over the feasible level of decarbonization ambitions exemplifies the disconnect between target setting and implementation progress that characterizes recent climate policymaking in Seattle. Despite its overambitious aims, the GND resolution opened exciting policy opportunities by explicitly considering the creation of a fund and dedicated revenue sources for Green New Deal action, establishing as Oversight Board formed by community and expert members, and prioritizing the collaboration with the private sector to achieve its goals. These contextual elements frame my thesis' exploration of alignment between decarbonization goals and capital planning practices, encouraging this project to embrace the climate action implementation gap, and highlighting opportunities for better-informed climate and capital planning efforts.

Policy Coherence: Climate Strategy and the Capital Investment Plan

Alignment on paper between climate priorities and capital planning practices does not always translate to GHG considerations being at the forefront of investment decisions. While according to some interviewees (OSE Staffmember 2023), there is strong alignment between the city's approach to GHG reductions and capital investments, the CIP only includes GHG information on some of its investment projects (City of Seattle 2022). From its adopted text, it is evident that the CIP is not serving as a comprehensive roadmap for decarbonization in its six-year forecasting period. A lack of consistent forecasts for capital improvement projects may be preventing the city from recognizing the extent to which CIP decisions align or conflict with the city's decarbonization targets. The coherence between conflicting GHG reduction targets is also a key point of contention; with core city staff organized around the 2050 decarbonization goal, while the GND's 2030 net-zero target is left floating as an ambitious community goal, with no feasible pathway to achieve it in sight (OSE Staffmember 2023).

Reducing GHG emissions is not a stated criteria for prioritizing CIP projects. Yet, the CIP is driven by a variety of sectoral policies with sustainability considerations for buildings, energy, climate, and land-use planning. Compiled in Resolution 31203, Seattle's Capital Planning Policies aim to balance the goals of building and infrastructure maintenance, alignment with the city's long-range plan, historic preservation, sustainable building benchmarks, and community development. Among these policy drivers for the city's capital spending, it is notable to find the goal of pursuing cost-saving commitments, and pursuing "conservation and sustainability investments" (C. Godden 2010). Both have narrative potential to advocate for further mainstreaming of GHG considerations in the CIP, especially given the cost-saving potential of some low-carbon capital investments. These capital policies also include a consideration to prioritize coordination with other departments and jusrisdictions. And while they define a Project Cost Estimate Review and Validation Process, there is no explicit mention of the long-term costs or benefits associated with unquantified effects of the investment, like GHG reductions. On a closing note, no monitoring or verification mechanisms are defined to measure the progress

toward the Capital Facilities Environmental Goals; these being more akin to a north star and guiding principle than measurable benchmarks of success.

Notwithstanding the distance between capital planning and climate targets, capital-intensive sectors form an important part of the Green New Deal's priorities and vision for decarbonization. For example, the City Council resolution acknowledges that more than a third of Seattle's GHG emissions can be attributed to building's use of energy, including for cooling and heating. In parallel, the resolution highlights that the majority of core emissions have historically been related to road transport; mostly attributable to passenger vehicles, followed by road freight. In direct sequence to these challenges, City Council included GND commitments to limit the construction of new fossil fuel infrastructure in Seattle, equitably invest in building decarbonization and energy efficiency, and an accompanying suite of transportation measures (Seattle City Council 2020). To illustrate the bold ambition of its language, the GND resolved to: make transit free, reliable, and widely accessible, electrify all transit, deprioritize single occupancy vehicles, and facilitate transit-oriented development. In quantitative terms, the GND would arguably demand further capital spending by resolving to support the electrification of all ride share, carshare and freight vehicles by 2025, while expanding active mobility infrastructure and providing alternatives to driving. Most importantly, the resolution acknowledges the opportunity present in mainstreaming climate criteria in capital planning, and considers the possibility of "requiring any proposed infrastructure projects that use city funding to provide an estimate of the upstream and downstream [GHG] emissions associated with the projects" (Seattle City Council 2020).

While the CIP is still no roadmap for decarbonization investments, there are institutional mechanisms that work on policy alignment and GND mainstreaming. After the GND was passed, the 2020 climate executive order directed all city departments to collaborate with the newly created GND Oversight Board to "advance the shared goals of the Green New Deal" (City of Seattle 2020b). Institutional coordination features heavily in the order. A newly created GND City Team convened representatives from several departments and was even mandated to work with the Budget Office to prepare annual Green New Deal Budget memos. Further operationalizing the GND's ambitious goals, the order directed OSE to lead a

collaborative effort to define key quarterly indicators to understand emissions trends and prioritize investments (now hosted in the OneSeattle Climate Portal (City of Seattle 2021b)), mandated the GND City Team to report on a work plan, and established that GND progress should be reported annually to the Mayor's Cabinet (City of Seattle 2020b). As another instance of ad-hoc coordination mandated by the executive, the 2021 climate executive order directed OSE, Seattle City Light, and the Budget Office to jointly draft the Municipal Electrification Strategy by December 2022 – aimed at electrifying all municipal buildings by 2035. This electrification strategy is only an example of how the recent coordination mandates mainly consisted of requesting reports on potential GHG mitigation options, mandating strategic collaboration between departments, and urging the accelerated implementation of already planned action. Prominently, the first two priority sections of this order dealt with resilient zero emission buildings and zero emissions transportation, highlighting the ongoing challenge of decarbonizing these capital-heavy sectors (City of Seattle 2021a).

Policy Environment: Defining Factors of the (mis)Alignment

Funding Streams: Seattle finances its capital projects drawing from a large set of funding sources, and tapping into new or modified revenue streams has been a crucial part of aligning investments to GHG reduction goals. Local revenues like taxes and utility rates, intragovernmental grants and transfers, and funding from the private sector join debt issuance to account for the majority of funding streams for capital investments. According to the CIP, the city's level of capital investment is determined in part by the availability and combination of financial resources(City of Seattle 2022). Interviewees expanded on this topic, repeatedly emphasizing that federal IRA[1] funds would radically change the panorama of available funds, further unlocking the potential for low-carbon capital investments (GNDOB Member 2023; CBO Staffmember 2023). Currently, only 1% of CIP funds come from federal purses (City of Seattle 2022). School and parks levy are other examples of how new revenue sources present

[1] The Inflation Reduction Act, or IRA, passed in august 2022 by the Federal Government will significantly increase the funding opportunities available for state and local governments wanting to implement climate projects and policies.

opportunities for the insertion of climate priorities into capital improvement spending . Notably, the Jump Start progressive revenue tax was heralded by interviewees as a key lever that allowed for ramping up investments in affordable housing and Green New Deal measures(GNDOB Member 2023). IRA should further facilitate this ramp-up of low-carbon and socially just investments. Several interviewees expressed uncertainty in the face of WA Department of Commerce's discussions on channeling IRA funds, stemming from the high level of competition for funds whenever they become available (GNDOB Member 2023; OSE Staffmember 2023).

Agency Mandates: Seattle's complex web of agency mandates around planning capital investments and climate planning leads departments to silo their operations, raising the transaction cost of integrating GHG criteria into department goals and capital projects. Among the staff interviewed, there is no prevailing idea or paradigm on how to improve the alignment between infrastructure investments and emissions reductions. Coherence between investments and GHG goals is widely regarded as a challenge, even when there is an overarching sense of "knowing what needs to be done"(OSE Staffmember 2023). While the expectation is for the capital investment plan to instrumentalize the city's vision of low-carbon development (CBO Staffmember 2023), in practice the GHG information contained in the CIP is an uneven recollection of what each department considers to be the climate benefit of their project (City of Seattle 2022). Furthermore, when developing policy and planning instruments for low-emissions infrastructure, like the Comprehensive Plan's annex on capital assets, or the CIP itself, there are significant overlaps in responsibility or action domain between city agencies. Interviewees expressed that planning timelines and mandated duplication can hinder effective progress (OSE 2013). And while it is unclear if an additional coordination mechanism would be worth its costs, city staff recognize that collaboration could be improved to further the integration of capital planning and GHG reduction policy (OSE Staffmember 2023; GNDOB Member 2023; CBO Staffmember 2023).

Data Gaps: While city-wide GHG accounting is an established practice, there are significant data gaps related to the GHG performance of planned CIP projects, and the aggregate effect of past investments in low-carbon capital projects. This case study exercise did not find evidence of data regarding aggregate amounts of GHG reduction due to investments

made by the city, capital projects' GHG implications, the climate performance of recent CIPs, or estimated investment needs aligned with the city's carbon neutrality goals. As a starting point, one interviewee suggested the potential of including climate data fields within CIP project factsheets, or GHG considerations during the CIP prioritization of projects (OSE Staffmember 2023).

Capacity Constraints: City staff bandwidth and capacity bottlenecks are presented by interviewees as a major challenge for city-led and city-enabled climate action. For example, staff describe bottlenecks when trying to push forward heat pump deployment (OSE Staffmember 2023). While interviewees, particularly from the GND Board, identified that there is willingness and disposition among city staff to push decarbonization priorities forward, alignment efforts are dwarfed in the face of competing priorities and human resource scarcity (GNDOB Member 2023). In a city with the budget and capacity of Seattle, these descriptions of low bandwidth might be pointing to a marginalization of GND priorities – perhaps due in part to perceptions of GND ambitious goal as unfeasible. Certainly, these perceived capacity constraints point to the competitive nature of capital in the city, and potential for working on the legitimacy and prioritization of decarbonization goals within city government.

Stakeholders and Constituencies: When supported by stakeholder participation and constituency mobilization, the city has been successful in integrating GHG priorities into sectoral policies and the work of city departments other than OSE. Even so, interviewees in OSE and the GND Board expressed difficulty (2023) in elevating GHG reductions in the priorities of other departments dealing with multiple crises (e.g. COVID-19, housing affordability, etc.). Critically, there are ongoing efforts aimed at facilitating the mainstreaming of GHG considerations in departments that plan for or manage capital projects. For example, an OSE interviewee (2023) highlighted an ongoing 'Capital Project Toolkit' that would aid project drafters to calculate the GHG baseline for their projects, and potentially come up with low-carbon alternatives to include in the planning process. If the city is to fulfill any of its ambitious decarbonization, policy efforts of this type must be scaled up and replicated. Interviewees highlighted that while climate action has its strong constituency, "most people care about good jobs [before GHG emissions]" (GNDOB Member 2023). From the perspective of the city

government insiders, constituencies need to be rallied continuously to gain more institutional leverage and prominently place climate in other departments' agendas.

Limited City Prerogatives: While local executive action has emerged as the main engine for action, the Mayor's Office increasingly recognizes that City Government has limited scope for action on standards, fiscal policy, and other legislative powers. The inclusion of advocacy to the state legislature as part of Seattle's suite of climate strategies presents sophistication in the type of actions pursued by City Hall (Seattle City Council 2020). Seattle's 2021 climate executive order, for example, directs city departments to advocate at the state legislature for additional climate funding authority. In this call, the city even considers studying sales tax rebates as funding mechanisms for climate projects – suggesting the possibility of bypassing the need for State funds by using municipal fiscal space for climate action (City of Seattle 2021a).

Discussion

Contextualizing Seattle's Challenges

Seattle's tension between operationalizing ambitious decarbonization targets while further raising ambition mimic the dynamics of the global climate action implementation gap. As discussed in the introduction, nations have made collective discursive progress by pledging GHG reductions that would bring the world closer to the 2ºC goal of the Paris Agreement, if fully implemented – while in reality, the aggregate of currently planned investments would blow past that target . In parallel, Seattle presents a cycle of ever-increasing climate ambition while under-delivering on the investment shifts needed to pull emissions trends in line with its targets. This parallel might be underpinned by the emergence of "the subnational" as a meaningful category in the international climate regime, described by (Castán Broto and Westman 2020). Arguably, Seattle has reached the global climate spotlight by replicating the disjointed approach to climate pledge implementation prevalent in national governments: pledging ambitious targets, while sub-emphasizing the systemic transformations needed to achieve them. Both at city hall and during UN Climate Weeks, ambitious declarations seem to be disconnected from the spending mechanisms necessary to fulfill their pledged GHG reductions. Given this fundamental gap, the city would do well to soberly acknowledge the governance changes necessary to deliver on its climate goals.

The city's climate planning efforts have seen great evolution since their 2000's start, but there is still a need for course-correction if the city is to operationalize its ambitions. Seattle's still relies heavily on its stand-alone climate plans and executive actions, but has shown several signs of policy innovation (coordination mechanisms, advocacy to state legislature) and concrete actionable items (timetables, departmental roles, reporting requirements) that were not present in the average local climate plan of the past decade (Bassett and Shandas 2010). Even so, it is clear that most of the reviewed documents have been prepared as signals of local political commitments to climate action, but lack influence over long-established processes like capital planning or city budgeting. From this standpoint, leadership in Seattle should emphasize that ambitious climate targets are more likely to translate to action if they are backed by robust

institutional machinery for policy development and implementation (Dubash et al. 2021), and act accordingly. In the context of urgent transitions toward decarbonization, GHG reductions need to be an explicit objective of public infrastructure spending, echoing the potentials (elaborated by Siegmeier et al 2018) for shedding light on low-cost mitigation options, acknowledging the far-future impacts of existing infrastructures, and correcting high-carbon demands that existing policy instruments do not influence.

Opportunities for Enhanced Alignment

Centering discourse around the co-benefits of emissions reductions could unlock institutional alignment opportunities and buy-in from decisionmakers that plan for investments in capital improvements. Some of the ambitious GND targets for the city will require high up-front investments, but have the potential to offset their fiscal burden by providing health, environmental, and economic benefits in the long-term. In parallel to this discursive lens, a re-evaluation of priorities and the introduction of procedural adjustments could break departmental silos and further mainstream decarbonization goals and issues into sectoral investments and policy decisions: a "dual-track" approach (Reckien et al. 2019) to local climate action. A concrete example of these opportunity-focused procedural adjustments could be to codify capital decarbonization mandates for city departments other than CBO and OSE. Framed by the ample evidence of the social cost-effectiveness of most low-carbon investments (Lwasa et al. 2022), executive action could be taken to mandate further mainstreaming of decarbonization as a whole-of-government ambition (e.g. requiring climate annexes in departmental workplans). Over time, this horizontal integration of GHG reductions as a government priority across sectors and agencies will enable the aggregation of decarbonization progress, and facilitate a culture of continuous performance evaluation, learning, and improvement that spills over to the Capital Improvement planning process. Codifying decarbonization mandates in all local government offices' responsibilities would serve the dual purpose of making department leaders accountable for GHG emissions reductions within their control and serve as an impulse to decarbonize the pipeline of capital projects from their roots in government department's budgets and plans.

Minor procedural tweaks to the CIP process could be useful for Seattle to proactively plan for decarbonization investments. In the context of globally rising infrastructure spending needs and the collective need to scale up urban climate finance flows (CPI, WB, and CCFLA 2021), Seattle would do well to treat all capital choices as instrumental to its decarbonization ambitions. Using the fiscal leverage of the CIP process, city departments could be pushed toward ad-hoc reflections on their role in the city-wide roadmap to decarbonized capital facilities and infrastructure. In concrete terms, the Mayor's Office could work with City Council to update resolution 31203 on the city's capital planning policies, codifying the responsibility of reporting on decarbonization progress as part of the CIP cycle. This new requirement for CBO and project-responsible departments could build on the lessons of the city's multidisciplinary GND team annual reports to the Mayor's Office, and draw from the wealth of sectoral expertise developed while preparing Seattle's Community Emissions Inventory. While the specifics of the mandate would need to be consulted with stakeholders, CBO staff, and other constituencies; this thousand-feet-view of the aggregated GHG performance of *adopted* CIP projects would be an unprecedented guide for future efforts to include quantitative GHG information in *proposed* capital projects, or other initiatives to further integrate climate criteria in the capital planning process.

The above CIP-first approach to mainstreaming GHG criteria to capital investments could be complemented by a top-down estimation of GND investment needs. Since the GND includes transformative sectoral goals that break with the current reality of buildings, transportation, and other urban systems in the city, it would be useful to approximate the investments needed to fulfill its goals – even if only at an order-of-magnitude precision. This approximation would serve as baseline argument for City Hall to tap into regional and national funding streams, and rally city government around the transformative need for disrupting the stubborn status-quo of carbon-intensive systems in the city. The output of that estimation exercise could also guide how CBO references decarbonization investment progress to 1.5ºC-cligned or GND-aligned magnitudes of investment, pushing the city to establish a more effective roadmap for decarbonization according to sources of funding and finance over time.

A new emphasis on strategic low-carbon investment would not erase the examples of sectoral policy wins, but rather complement them and build on their lessons to scale up GHG emissions reduction efforts. The successful green-buildings policies and city progress in decarbonizing electricity supply need to be followed-up by coherent spending of municipal funds. Given the initial success in shrinking emissions intensities in the city, leadership must firmly grasp the potential trajectories for scaling up (or across, horizontally) their successful policy experiments (van der Heijden 2019). Seattle must complement their ambitious rulemaking with strategic spending and a robust arrangement for monitoring the GHG performance of its investments. The following section elaborates on a potential framework to bank on Seattle's climate policy progress, follow up successful policy development with targeted investments, and leverage the above-mentioned opportunities to enhance the alignment of decarbonization targets and capital investment planning.

Framework for Mainstreaming Decarbonization in the CIP

In thinking of the immediate next steps for Seattle's CIP process, the city could make use of a built-out framework by Whittington and Lynch (2015) aimed at leveraging capital budgets for city-led decarbonization investments, and furthered in the development and application of models for subnational climate-smart capital improvement programming by Dr. Whittington and the University of Washington's Urban Infrastructure Lab (2023). Their work suggests minor modifications to commonly used capital planning practices that appeal to the pragmatics of local infrastructure decision-making, suggesting elements easy to adopt in cities with well-established budgeting processes and sophisticated data systems, like Seattle. The following table summarizes three of their four suggested modifications to the CIP process and contextualizes the potential utility of each for the City of Seattle.

TABLE 1: Immediate action framework for mainstreaming decarbonization in the CIP

SUGGESTION BY WHITTINGTON AND LYNCH	CONSIDERATIONS FOR THE CITY OF SEATTLE
Forecasting aggregated carbon from proposed projects **-** Quantifying a city's CIP emissions allows the government to identify which sectors contribute most **TO OVERALL** GHG emissions and thereby strategize how best redirect spending on capital improvements.. **- THE CAPITAL INVESTMENT PLAN IS THE MOST OPPORTUNE PLACE TO APPLY EMISSIONS INVENTORY INFORMATION, IF IT IS TO BE PUT TO USE IN REDUCING EMISSIONS.** -The emissions accounting for infrastructure assets in local government's greenhouse gas inventory can be used as a "conventional" baseline scenario, against which to measure reduction potential from the climate‐informed capital investment planning process.	City leadership could take the framework's advice and transform the CIP into a strategic output for Emissions Inventory insights on necessary decarbonization progress. A forecast of aggregated GHG performance of each adopted CIP could then form a key element of the accountability and progress monitoring opportunities described in the discussion section of this thesis.
Generating low-carbon alternatives to conventional projects **- THE DECARBONIZING POTENTIAL OF ANY CAPITAL INVESTMENT PLAN IS ONLY AS GREAT AS THE SET OF PROJECTS PROPOSED BY LOCAL GOVERNMENT DEPARTMENTS.** **-** When this approach is adopted together with capital investment planning criteria that incentivize low carbon options at the portfolio level, the local government can catalyze a virtuous cycle of low carbon investment, because departments that submit low carbon projects would be more likely to secure funding in the budget.	Seattle could inform their OSE workstream on supporting low-carbon project preparation with Whittington and Lynch's insights. After the toolkit is done and socialized, OSE and city leadership would do well to foster the generation of low-carbon project alternatives with a narrative of co-benefits, highlighting health, development, and economic upsides that are usually unaccounted for.
Including climate criteria along the CIP planning process **-** The goal is not to prioritize low‐carbon projects over other important community investments; rather, the goal is to prioritize low‐carbon alternatives of important community investments. **- ALLOWING CARBON EMISSIONS TO BECOME ONE ADDITIONAL MEASURED AREA OF PERFORMANCE FOR PROPOSED CAPITAL PROJECTS.** **-** The outcome of the process will only result in lower carbon emissions if the criteria specific to climate change are allotted an influential proportion of weight.	A third and key element, it could instrumentalize the vision of the CIP as a roadmap for decarbonization investments. The city would need to carefully weight GHG and the other prioritization criteria, using the potential of CBO's agenda-setting power and fiscal leverage to enhance the CIPs alignment with GND decarbonization targets.

Conclusions

This thesis examined Seattle's Capital Investment Plan and its potential to contribute to ambitious city decarbonization goals. Inspired by Jan Whittington and Catherine Lynch's approach outlined in the World Bank's Climate-Informed Capital Investment Planning Guidebook (2015), the project aimed to develop actionable recommendations for Seattle government officials to inform their efforts towards enhancing the alignment of capital investments with climate objectives. This project provided a nuanced understanding of the entrenched policy-enabling factors within Seattle's capital improvement planning process, and analyzed the institutional, ideological, economic, and technical factors that frame the decision-making processes that lead to infrastructure investments in the city.

The methods encompassed various stages, starting with a brief review of scholarship on the urban dimensions of the climate crisis. This literature review explored the governance of urban climate action and infrastructure planning, with a particular focus on the potential for a political economy analysis to uncover lessons in the provision of lower carbon infrastructure systems. As part of a qualitative case study approach, policy document reviews and semi-structured interviews with decision-makers from the City of Seattle were conducted. These methods formed the foundation of the research design, facilitating a deep exploration of the alignment between the capital improvement plan and the city's climate objectives. The case study design allowed for a detailed examination of the specific context and dynamics within Seattle, shedding light on the practical implementation of climate policies and infrastructure planning. The semi-structured interviews, guided by a carefully designed interview instrument, provided a platform for engaging with key stakeholders and decision-makers. The insights and perspectives gathered through these interviews were instrumental in understanding the factors shaping the capital improvement planning process and their relationship with climate objectives. Based on this information, I presented forward-looking suggestions for the City of Seattle to enhance climate and capital policy coherence.

The research conducted in this study holds significant importance in the context of urban climate action. Recent compilations of global mitigation scenarios have demonstrated the immense potential of urban mitigation strategies in reducing emissions by up to 90% by 2050 (Lwasa et al., 2022). Exploring the provision mechanisms of low-carbon infrastructures becomes crucial in informing the trajectory towards decarbonized urban built environments. However, there remains a limited understanding of the governance models and regimes necessary to support multi-level decision-making for effective mitigation and climate action. Transformative climate action requires redefining relationships between various actors, harnessing the knowledge derived from data and models, and deepening our understanding of the urban system to support informed decision-making (IPCC 2023). This research contributes to bridging these knowledge gaps and provides insights into the governance structures and strategies necessary to foster sustainable and climate-resilient urban development. By enhancing our understanding of the policy-enabling factors that influence capital investment planning processes, this research aids in shaping effective urban climate policies and aligning infrastructure investments with ambitious climate objectives.

Another highlight of this approach lies in its incorporation of a political economy lens, which offers a fresh perspective for understanding the policy environment surrounding Seattle's Capital Improvement Plan and its alignment with climate plans and executive orders. By analyzing the political economy of low-carbon investment planning, this research aimed to stimulate discourse that goes beyond the usual narrative impasses of lacking political will, public sector inefficiency, or inescapable entrenched economic interests that hinder progress in climate action worldwide (Worker and Palmer 2021). In doing so, it addresses critical knowledge gaps regarding the integration of mitigation options into planning processes and the governance models needed to support decision-making for effective climate action (Lwasa et al., 2022). The context-specific analysis of the policy environment and its political economy factors in urban emissions reductions aimed to fill a significant gap in the current literature on urban climate governance and low-carbon infrastructure. By shedding light on the interactions between technical, economic, and institutional factors, this research contributes to a deeper understanding of the complexities

surrounding climate investments and offers insights that can inform more effective decarbonization investment plans.

Having said that, it is important to recognize the limitations of this research piece. Given the instrumental nature (Stake 1995) of this case study, external validity remains a challenge to address if its findings were to be used in other cities or contexts. The insights generated by this "theory-generator case study" (Simons 2009) are internal and limited to their context. In addition, the small sample size of 3 city interviewees might risk a lack of responsiveness to stakeholders not within the sample and a fair balance between interests around the CIP (Simons 2009).

Future research projects into local climate or capital planning would do well not to underestimate the political capital necessary to conduct a policy coherence evaluation of this type. While this thesis intended to conduct at least 10 interviews with policymakers and provide a deep dive into policy opportunities for enhanced climate-CIP alignment, the reality of limited staff bandwidth and competing priorities made it impossible to survey a representative sample of government officials from more than three offices. Future explorations into this topic, including any exercises developed to explore my recommendations as viable policy options for Seattle, would need to secure the buy-in of a high-profile decision-maker within the city to facilitate data collection and verification.

While this thesis dealt with whole-of-government instruments, the vast catalog of Seattle's sectoral decarbonization policies demands further analysis of sector-by-sector opportunities for better low-carbon capital planning. Interviewees highlighted a rich wealth of policy work on sustainable buildings, transport electrification, industry standards, and other areas of government action that were not reflected in this document. A future exploration of opportunities for climate mainstreaming in capital projects would need to carefully dissect sectoral and departmental specificities to come up with more granular findings.

Other areas of inquiry that will need to be explored if Seattle is to enhance the CIP as an instrument decarbonization are the issue of vertical integration with State and Federal government, and the question of capacity-building challenges for lower-carbon project

development. This thesis did not address the potential capacity or mandates that may limit Seattle's ambitions. Asking the city government to assess decarbonization funding needs, for example, might surpass the capacity and willingness of city departments to prioritize meta-evaluations of needs, instead of urgent policy and implementation work in climate and other priority policy areas.

References

Agbemabiese, L., P.D. Nyangon, J.-S. Lee, and J. Byrne. 2018. “Enhancing Climate Finance Readiness: A Review of Selected Investment Frameworks as Tools of Multilevel Governance.” SSRN Scholarly Paper. Rochester, NY. doi:10.2139/ssrn.3082542.

Barnes, A. 2022. “Seattle Mayor Signs Green New Deal. Here’s What’s in It.” Text. *The Hill* (blog). September 23, 2022. https://thehill.com/changing-america/sustainability/climate-change/3658078-seattle-mayor-signs-green-new-deal-heres-whats-in-it/.

Bassett, E., and V. Shandas. 2010. “Innovation and Climate Action Planning: Perspectives From Municipal Plans.” *Journal of the American Planning Association* 76 (4): 435–50. doi:10.1080/01944363.2010.509703.

Bernstein, S., and M. Hoffmann. 2018. “The Politics of Decarbonization and the Catalytic Impact of Subnational Climate Experiments.” *Policy Sciences* 51 (2): 189–211. doi:10.1007/s11077-018-9314-8.

Bracking, S., and B. Leffel. 2021. “Climate Finance Governance: Fit for Purpose?” *WIREs Climate Change* 12 (4): e709. doi:10.1002/wcc.709.

Bulkeley, H., and M.M. Betsill. 2013. “Revisiting the Urban Politics of Climate Change.” *Environmental Politics* 22 (1): 136–54. doi:10.1080/09644016.2013.755797.

C. Godden. 2010. *Resolution 31203*. http://clerk.seattle.gov/search/resolutions/31203.

Castán Broto, V., and L.K. Westman. 2020. “Ten Years after Copenhagen: Reimagining Climate Change Governance in Urban Areas.” *WIREs Climate Change* 11 (4). doi:10.1002/wcc.643.

CBO Staffmember. 2023. CBO Interview.

CCFLA. 2015. “THE STATE OF CITY CLIMATE FINANCE 2015.” https://sustainabledevelopment.un.org/content/documents/2201CCFLA-State-of-City-Climate-Finance-2015.pdf.

Charmaz, K. 2006. *Constructing Grounded Theory: A Practice Guide Through Qualitative Analysis*. CA: SAGE.

City of Seattle. 2018. “Seattle Climate Action - 2018 Climate Action Strategy.” http://greenspace.seattle.gov/wp-content/uploads/2018/04/SeaClimateAction_April2018.pdf.

City of Seattle. 2020a. “Community Greenhouse Gas Emissions Inventory.”

City of Seattle. 2020b. “Executive Order 2020-01: Advancing a Green New Deal for Seattle.” https://wayback.archive-it.org/3241/20211218155953/https://durkan.seattle.gov/wp-content/uploads/sites/9/2020/01/Final-Executive-Order-2020-01-Advancing-a-Green-New-Deal-for-Seattle_.pdf.

City of Seattle. 2021a. “2021 Climate Executive Order.” https://wayback.archive-it.org/3241/20220101183208/https://durkan.seattle.gov/wp-content/uploads/sites/9/2021/11/2021-09-Climate-EO_2.pdf.

City of Seattle. 2021b. “One Seattle Climate Portal.” 2021. https://experience.arcgis.com/experience/d109ec235c8a44b08675452e64b5e4fe/.

City of Seattle. 2022. “CITY OF SEATTLE 2023-2028 Adopted Capital Improvement Program.”

City of Seattle, Office of Sustainability & Environment. 2013. “Seattle Climate Action Plan.” http://www.seattle.gov/Documents/Departments/Environment/ClimateChange/2013_CAP_20130612.pdf.

CPI, WB, and CCFLA. 2021. “The State of Cities Climate Finance 2021.” https://citiesclimatefinance.org/wp-content/uploads/2021/06/2021-State-of-Cities-Finance-Executive-Summary.pdf.

Dubash, N.K., A.V. Pillai, C. Flachsland, K. Harrison, K. Hochstetler, M. Lockwood, R. MacNeil, et al. 2021. “National Climate Institutions Complement Targets and Policies.” *Science* 374 (6568): 690–93. doi:10.1126/science.abm1157.

Edenhofer, O., R. Pichs-Madruga, Y. Sokona, J.C. Minx, E. Farahani, S. Kadner, K. Seyboth, et al. 2014. “Climate Change 2014: Mitigation of Climate Change: Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.” New York, NY: Cambridge University Press.

Evans, S. 2020. “Analysis: Coronavirus Set to Cause Largest Ever Annual Fall in CO2 Emissions.” Carbon Brief. April 9, 2020. https://www.carbonbrief.org/analysis-coronavirus-set-to-cause-largest-ever-annual-fall-in-co2-emissions/.

Glaser, B.G., and A.L. Strauss. 2010. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. 5. paperback print. New Brunswick: Aldine Transaction.

GNDOB Member. 2023. GNDOB Interview.

Guest, G., A. Bunce, and L. Johnson. 2006. “How Many Interviews Are Enough?: An Experiment with Data Saturation and Variability.” *Field Methods* 18 (1): 59–82. doi:10.1177/1525822X05279903.

Heijden, J. van der. 2019. “Studying Urban Climate Governance: Where to Begin, What to Look for, and How to Make a Meaningful Contribution to Scholarship and Practice.” *Earth System Governance* 1 (January): 100005. doi:10.1016/j.esg.2019.100005.

Hultman, N.E., L. Clarke, C. Frisch, K. Kennedy, H. McJeon, T. Cyrs, P. Hansel, et al. 2020. “Fusing Subnational with National Climate Action Is Central to Decarbonization: The Case of the United States.” *Nature Communications* 11 (1): 5255. doi:10.1038/s41467-020-18903-w.

IPCC. 2023. “SYNTHESIS REPORT OF THE IPCC SIXTH ASSESSMENT REPORT (AR6).” Summary for Policymakers.

Laine, J., J. Heinonen, and S. Junnila. 2020. “Pathways to Carbon-Neutral Cities Prior to a National Policy.” *Sustainability* 12 (6): 2445. doi:10.3390/su12062445.

Lwasa, S., K.C. Seto, X. Bai, H. Blanco, K.R. Gurney, Kılkış, O. Lucon, et al. 2022. "IPCC AR6 WGIII Chapter 8: Urban Systems and Other Settlements." PCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, NY, USA: Cambridge University Press. https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_Chapter08.pdf.

Merriam, S.B., and S.B. Merriam. 1998. *Qualitative Research and Case Study Applications in Education*. 2nd ed. A Joint Publication of the Jossey-Bass Education Series and the Jossey-Bass Higher and Adult Education Series. San Francisco: Jossey-Bass Publishers.

Miles, M., A.M. Huberman, and J. Saldaña. 2020. *Qualitative Data Analysis: A Methods Sourcebook*. 4th Edition. Thousand Oaks, CA: SAGE.

O'Brien, K. 2021. "How Quickly Will Apartment Rents Start Growing Again? | RP Analytics." RP Analytics Blog. January 19, 2021. https://www.realpage.com/analytics/quickly-will-apartment-rents-start-growing/.

OSE. 2013. "Seattle Climate Action Plan." City of Seattle - Office of Sustainability and Environment. https://www.seattle.gov/documents/Departments/Environment/ClimateChange/2013_CAP_20130612.pdf.

OSE Staffmember. 2023. OSE Interview.

Pauw, W.P., and R.J.T. Klein. 2020. "Beyond Ambition: Increasing the Transparency, Coherence and Implementability of Nationally Determined Contributions." *Climate Policy* 20 (4): 405–14. doi:10.1080/14693062.2020.1722607.

Rayner, S. 2010. "How to Eat an Elephant: A Bottom-up Approach to Climate Policy." *Climate Policy* 10 (6): 615–21. doi:10.3763/cpol.2010.0138.

Reckien, D., M. Salvia, F. Pietrapertosa, S.G. Simoes, M. Olazabal, S. De Gregorio Hurtado, D. Geneletti, et al. 2019. "Dedicated versus Mainstreaming Approaches in Local Climate Plans in Europe." *Renewable and Sustainable Energy Reviews* 112 (September): 948–59. doi:10.1016/j.rser.2019.05.014.

Seattle City Council. 2020. "Resolution 31895: A RESOLUTION Relating to a Green New Deal for Seattle." http://seattle.legistar.com/ViewReport.ashx?M=R&N=Text&GID=393&ID=3611579&GUID=ADF51F71-1823-4D7B-B599-9ED04DFD8860&Title=Legislation+Text.

Seattle GRC. 2006. "Seattle, a Climate of Change: Meeting the Kyoto Challenge." Seattle, WA: Mayor Nickels' Green Ribbon Commission On On Climate Protection. https://www.broward.org/Climate/Documents/SeattleaClimateReport.pdf.

Seattle OSE. 2021. "Climate Impact Actions for the Seattle Green New Deal."

Seattle OSE. 2022. "Seattle Community Greenhouse Gas Emissions Inventory 2020." https://www.seattle.gov/documents/Departments/OSE/ClimateDocs/GHG%20Inventory/2020_GHG_Inventory_Oct_2022.pdf.

Seidman, I. 2006. *Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences*. New York: Teachers College Press.

Siegmeier, J., L. Mattauch, M. Franks, D. Klenert, A. Schultes, and O. Edenhofer. 2018. "The Fiscal Benefits of Stringent Climate Change Mitigation: An Overview." *Climate Policy* 18 (3): 352–67. doi:10.1080/14693062.2017.1400943.

Simons, H. 2009. *Case Study Research in Practice*. 1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom: SAGE Publications, Ltd. doi:10.4135/9781446268322.

Stake, R.E. 1995. *The Art of Case Study Research*. Thousand Oaks: Sage Publications.

Sudmant, A.H., A. Gouldson, S. Colenbrander, R. Sullivan, F. McAnulla, and N. Kerr. 2017. "Understanding the Case for Low-Carbon Investment through Bottom-up Assessments of City-Scale Opportunities." *Climate Policy* 17 (3): 299–313. doi:10.1080/14693062.2015.1104498.

Tempest, K., D. Scientist, K. Roedner-Sutter, and K. Belcher. 2021. "WASHINGTON STATE'S CLIMATE COMMITMENT ACT." https://www.cleanprosperouswa.com/wp-content/uploads/2021/09/CaPWA-Policy-Brief-—-Washington-States-Climate-Commitment-Act.pdf.

Thacker, S., D. Adshead, M. Fay, S. Hallegatte, M. Harvey, H. Meller, N. O'Regan, J. Rozenberg, G. Watkins, and J.W. Hall. 2019. "Infrastructure for Sustainable Development." *Nature Sustainability* 2 (4): 324–31. doi:10.1038/s41893-019-0256-8.

UNEP. 2017. "Cities and Climate Change." UNEP - UN Environment Programme. September 26, 2017. http://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change.

UNEP. 2022. "Emissions Gap Report 2022." 2022. https://wedocs.unep.org/bitstream/handle/20.500.11822/40932/EGR2022_ESEN.pdf?sequence=8.

Whittington, J., and C. Lynch. 2015. "Climate-Informed Decisions: The Capital Investment Plan as a Mechanism for Lowering Carbon Emissions." World Bank. doi:10.1596/1813-9450-7381.

Wolfram, M., N. Frantzeskaki, and S. Maschmeyer. 2016. "Cities, Systems and Sustainability: Status and Perspectives of Research on Urban Transformations." *Current Opinion in Environmental Sustainability*, System dynamics and sustainability, 22 (October): 18–25. doi:10.1016/j.cosust.2017.01.014.

Wolfram, M., J. van der Heijden, S. Juhola, and J. Patterson. 2019. "Learning in Urban Climate Governance: Concepts, Key Issues and Challenges." *Journal of Environmental Policy & Planning* 21 (1): 1–15. doi:10.1080/1523908X.2018.1558848.

Woodruff, S.C., and M. Stults. 2016. "Numerous Strategies but Limited Implementation Guidance in US Local Adaptation Plans." *Nature Climate Change* 6 (8): 796–802. doi:10.1038/nclimate3012.

Worker, J., and N. Palmer. 2021. “A Guide to Assessing the Political Economy of Domestic Climate Change Governance.” *World Resources Institute*. doi:10.46830/wriwp.18.00047.

Yin, R.K. 1994. *Case Study Research: Design and Methods*. 2nd ed. Applied Social Research Methods Series, v. 5. Thousand Oaks: Sage Publications.