Climate change and municipal finance: ordinary innovations for just urban transitions

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Abstract
As cities worldwide increasingly adopt commitments toward climate justice, questions remain about the ways city governments will be able to fund more just climate efforts. While the use of novel debt financing schemes has been examined in the literature for their justice implications, scholars have rarely interrogated how the more mundane tools and practices of municipal finance can be applied to enable more just urban transitions. Here, we use the U.S. as a case study to analyze the impacts of climate change and climate action on municipal budgets and examine how cities are adapting their financial tools and practices to advance climate action and climate justice efforts. We employ a mixed-methods research design that combines 34 expert interviews with a systematic content analysis of municipal budgets from 15 U.S. cities of different sizes. We find that both climate change and climate action can contribute to cities' fiscal vulnerability by imposing additional expenditures and/or reducing municipal revenues. While most cities lack transparency about their investments in climate action and climate justice, some city governments are implementing *ordinary innovations* that embed climate and justice criteria into budgetary practices and funding tools. These ordinary innovations reveal that cities are beginning to reimagine municipal in the service of more just climate futures.

Keywords
Climate finance, just urban transitions, municipal finance, climate action, climate justice, climate politics

Introduction

Widely acknowledged as important sites of climate action for over two decades (Angelo and Wachsmuth, 2020; Bulkeley, 2021), cities are now rising as core sites in the global struggle for climate justice (Bulkeley, 2021; Diezmartínez and Short Gianotti, 2022), which can be understood as the mobilization of racial, economic, and social justice through climate action (Bulkeley et al., 2013). However, as thousands of cities move to implement more just climate efforts, questions loom large about whether and how city governments will be able to cover the costs of the societal and infrastructure transformations required to equitably respond to climate change (Knuth, 2023; Long, 2021).

Funding constraints have been a prevalent barrier to urban climate action – the policies and programs aimed at mitigating and adapting to climate change (Fünfgeld et al., 2023; Hughes, 2017; Shi et al., 2015). City governments often lack funding to operationalize climate policies, hire staff devoted to these initiatives, or sustain these programs in the long-term, and climate action is often abandoned to prioritize other needs (Fünfgeld et al., 2023; Hughes, 2017; Ryan, 2015). In the face of these constraints, cities in the Global North have turned to debt financing to deliver climate action and related infrastructure projects (Cousins and Hill, 2021; Cox, 2022; Hadfield and Coenen, 2022; Hadfield and Cook, 2019; O'Brien et al., 2019; O'Brien and Pike, 2019; Robin, 2022), and international institutions like the World Bank are exporting these financial experiments globally (Bigger and Webber, 2021; Knuth, 2023; Silver, 2023). Scholars have shown that these emerging financial solutions, including green bonds and carbon markets, are exacerbating existing inequities in cities by intensifying both the environmental and financial risks borne by marginalized communities and narrowing the possibilities for more radical changes in municipal finance (Bigger and Millington, 2020; Christophers, 2018; Hadfield and Coenen, 2022; Long, 2021). Public spending, however, also has the potential to aggravate social and environmental vulnerabilities, as city governments are incentivized to make budgetary decisions that increase revenues, reduce expenditures, and enhance cities' debt affordability and creditworthiness, often at the expense of climate action and climate justice (Diezmartínez and Short Gianotti, 2024). Municipal finance, including both funding and debt financing, can thus serve to deepen cities' histories of uneven development and racialized climate vulnerabilities (Hadfield and Coenen, 2022; Rice et al., 2023).

In the U.S., this reality contrasts with cities' growing attention to climate action and climate justice. Over the last decade, justice concerns have played an increasingly important role in climate mitigation and adaptation planning (Caggiano et al., 2023; Cannon et al., 2023; Diezmartínez and Short Gianotti, 2022), and new initiatives such as Justice40, the Inflation Reduction Act, and the Climate Funders Justice Pledge are further pushing cities to invest in climate justice and devote resources to marginalized communities (Diezmartínez and Short Gianotti, 2024). This calls into question whether and how cities' may adapt their existing financial practices to achieve these climate justice efforts, and how municipal finance itself could be *reimagined* to advance, rather than hinder, more equitable transitions toward low-carbon and resilient urban societies – what some call "just urban transitions" (Hughes and Hoffmann, 2020).

In this paper, we use the U.S. as a case study to examine how cities are adapting municipal finance in response to climate change and the increasing pursuit of climate and justice goals. We explore how municipal budgets are being affected by the impacts of climate change and the implementation of cities' climate programs, and investigate whether and how climate and justice criteria are being embedded into fiscal practices and tools. We employ a mixed-methods approach that combines insights from thirty-four expert interviews with an in-depth systematic content

analysis of municipal budgets from fifteen cities across the U.S. Our research shows that cities are beginning to reimagine municipal finance by implementing what we call *ordinary innovations* – small yet meaningful changes that repurpose existing policy tools and governing practices in the service of climate action and climate justice. These ordinary innovations reveal municipal finance as a core site of climate and justice politics.

Background

Urban fiscal geographies and climate change

Our research responds to recent calls among urban scholars to develop an "expanded conception of public finance in geography" (August et al., 2022) and give more attention to the "fiscal geographies" of cities (Tapp and Kay, 2019). Fiscal geographies foreground the spatial consequences of the public finance system, including government revenue, expenditure, and borrowing practices (Cirolia, 2020). In the urban context, scholars have focused on the role that fiscal processes (e.g., budget allocations) and instruments (e.g., taxes) play in the reproduction of urban inequalities, capital accumulation, and the making financialized cities (Cirolia, 2020; Tapp and Kay, 2019). This scholarship has found that cities' fiscal practices are spatialized and embedded in the built environment through urban policies and planning tools that enable certain forms of private investments while disincentivizing others, create tax havens, designate zones of urban renewal and improvement, and/or shape property values within and across cities (Aalbers, 2020; August et al., 2022; Cirolia, 2020; O'Brien et al., 2019).

Urban climate action is largely dependent on municipal funding and debt financing tools. Although municipal revenue sources vary across U.S. states, cities' direct spending usually comes from local revenues collected from taxes, fees, and other charges, as well as grants from state and federal governments, the private sector, or philanthropy (Diezmartínez and Short Gianotti, 2024). Debt financing involves the use of municipal bonds and loans, which are often ultimately repaid through cities' revenues (Diezmartínez and Short Gianotti, 2024). Any given city in the U.S., however, has limited options to pay for climate action due restrictions in their revenue generating powers and capacities to raise capital (Diezmartínez and Short Gianotti, 2024). Outside the U.S., cities' ability to use debt financing is also often restricted (Negreiros et al., 2021). Overall, this means that any particular city is often left with a limited menu of revenue sources and fiscal policies to respond to climate change and implement climate action.

Recent scholarship has shown that fiscal policies can exacerbate climate vulnerabilities and constrain climate action in cities. For instance, land-based fiscal policies incentivize cities to grow their revenues through the expansion of urban development, often in areas that are vulnerable to flooding, wildfires, and other climate impacts (Shi et al., 2023; Shi and Varuzzo, 2020; Taylor and Aalbers, 2022; Woodruff et al., 2021), thereby creating new geographies of risks (Shi and Bouma, 2023). In cities where municipal revenues depend heavily on carbon-intensive or resource-dependent industries (e.g., real estate development, tourism), municipal governments are likely protect and enable such activities, even if they exacerbate present and future climate vulnerabilities or drive gentrification (Gray, 2021; Taylor and Aalbers, 2022). Moreover, cities' dependence on credit ratings and perceptions of fiscal health limits their ability to pursue climate justice efforts by prioritizing climate actions that are perceived as profitable, constraining when and for how long cities are able to fund climate programs, and shifting some power away from city governments and residents to determine what climate interventions are worthy of investment, where, and for whom (Diezmartínez and Short Gianotti, 2024). Overall, these dynamics often translate into, at best, insufficient funding for climate action, and at worst, financial decisions that neither climate

sound nor just (Shi et al., 2023; Shi and Varuzzo, 2020; Taylor and Aalbers, 2022; Diezmartínez and Short Gianotti, 2024).

While this scholarship has established that municipal finance is intimately connected to urban climate vulnerabilities and climate efforts, most studies have only explored the unilateral impact of cities' financial decisions on climate policies and programs. Here, we expand on this literature by investigating how the increasing pursuit of climate action and climate justice is reflected in and may impact cities' fiscal policies and reshape municipal finance itself. Our mixed-methods study highlights the dynamic interrelationships between climate action and municipal finance and positions climate action not only as a subject of municipal finance, but as a driving force that can destabilize and reshape existing financial practices in cities.

Municipal budgets as entry points to climate politics

Municipal budgets are planning documents in which cities estimate revenues and allocate expenditures across government operations, departments, and capital projects for a given fiscal year. The resources allocated in municipal budgets remain one of the primary means through which city governments provide basic goods and services, advance community priorities, and redistribute social wealth between populations and across space (Tapp and Kay, 2019). Nevertheless, municipal budgets have remained forgotten sites of urban climate politics. The logics and impacts of cities' budgetary choices are usually opaque and municipal finance has been increasingly dominated by post-political and technocratic processes that frame budget allocations as "objective" and reserve decisions on public monies to those with the "right" expertise and qualifications (Cox, 2023; Knuth, 2023). However, at the core of municipal finance are ethical and political choices about *who* and *what* is worthy of investment (Knuth, 2023). Municipal budgets, and their underlying fiscal policies, are "infused with social and political life" (Cirolia, 2020).

Lacking uniform standards across the U.S., the content of municipal budgets varies widely across cities. However, these documents often include quantitative data on revenues and expenditures, as well as narratives describing cities' priorities and budget allocation processes. Municipal budgets therefore allow us to account for both the quantitative distribution of urban financial resources and the "qualitative redirection" of municipal finance across cities and through time (August et al., 2022).

In this paper, we use municipal budgets as an entry point to explore how climate action and climate justice concerns are being embedded in municipal financial decisions. This provides a unique lens to explore "how cities are grappling with their changing fiscal and political environments" (Hughes, 2017) in the face of climate change.

Methods

We use a mixed-methods approach that combines expert interviews with a systematic content analysis of municipal budgets from fifteen cities in the U.S. to (i) assess the impacts of climate change and climate action in municipal budgets, and (ii) examine whether and how climate action and climate justice concerns are being integrated into cities;' budgetary tools and practices.

Expert interviews

We conducted a systematic analysis of 34 expert interviews focused on urban climate finance, climate action, and climate justice in the U.S. Interviewees included professionals with experience in city governments, private consulting, non-profits, urban climate networks, academic institutions, research centers, think thanks, financial institutions, and federal grant programs. We

used a semi-structured interview approach and covered the following themes across all interviews: (i) patterns and trends in the funding, debt financing, and hybrid tools cities are using to pay for climate action; (ii) challenges and innovations in paying for climate action; (iii) the ways climate finance and fiscal policies shape the implementation of climate action in cities; and (iv) the ways climate finance shapes efforts to pursue justice-oriented climate policies. Our sample of experts included interviewees with experiences from a wide range of cities of all sizes and geographies across the U.S., reflecting cities with different social, economic, demographic, and political characteristics, as well as varying climate vulnerabilities and levels of engagement with climate action. All interviews were transcribed and coded using an iterative qualitative process that combined deductive and inductive coding. The interviews were approved by the [Blinded University] Institutional Review Board (Exempt Research 4886X).

A full description of the methods for recruitment, sampling, interview design, and data analysis is provided in the Supplementary Material.

Content analysis of municipal budgets

We conducted a systematic content analysis of the municipal budgets from fifteen U.S. cities of all sizes for the last five fiscal years (FY). This includes municipal budgets adopted both before (FY 2019 - FY 2020) and after (FY 2021 - FY 2023) the start of the COVID-19 pandemic. We included both operating and capital budgets.

We purposefully sampled cities that are known or expected to be implementing climate action and climate justice efforts on the ground and are thus more likely to include climate-related expenditures and narratives in their municipal budgets. Focusing on these "positive" cases provides an early opportunity to learn from the experiences of municipal leaders and examine emerging innovations in an outcome of interest (i.e., municipal budgets embedding climate action and justice) (Hughes, 2020). To select the study cities, we created a database of U.S. cities with more than 25,000 residents that have joined U.S. Climate Mayors and/or the Global Covenant of Mayors (urban climate networks that welcome membership from cities of multiple sizes). From this database of 289 municipalities, we selected fifteen cities that (i) have adopted a formal climate plan; (ii) whose budgets are publicly available online; and (iii) whose budgets include both quantitative data and qualitative narratives. In recognition of the varying capacities and financial resources of cities from different sizes (Fünfgeld et al., 2023), we used a purposive sampling strategy to select five large cities (300,000+ residents), five mid-size cities (100,000 - 300,000 residents), and five small cities (25,000 - 100,000 residents). Since certain states were overrepresented in our database, we selected cities with attention to geography and diversity of socio-economic demographics. Finally, to triangulate and expand the scope of our analysis, we included both cities that were directly represented (4 cities) and not represented (11 cities) by the geographic location and/or expertise of the interviewees.

The cities in our budget analysis (Table 1) represent different types of diversity. Eight cities have been engaged in climate action for more than two decades, while seven cities adopted their first climate plan in or after 2010. These cities also have a wide range of population sizes, median household incomes, poverty rates, and diversity.

We coded municipal budgets using an iterative process that combined deductive and inductive coding (Bernard et al., 2016; Creswell, 2002). Our coding was first based on identifying themes gathered from the expert interviews. This included narratives of municipal budget constraints and climate- and justice- centered budget allocation and funding tools (qualitative data), as well as total budgets and explicit climate-related expenditures reported by cities

(quantitative data analyzed qualitatively). We then re-coded the budgets using emergent themes revealed during the first stage of analysis. As we adapted the coding protocol, we conducted iterative rounds of focused coding to ensure consistency in our analysis across cities. The final coding protocol included the following main themes: (i) total budget and climate expenditures, (ii) narratives related to climate change and climate action, (iii) narratives related to climate action and COVID-19, (iv) budget allocation strategies including climate and/or justice criteria, and (v) climate funding tools. The final coding protocol can be found in the Supplementary Material. We used NVivo 12 Pro software for all coding.

City	City network membership*	Year of adoption of first climate plan	Year of most recent climate plan	Population**	Median Household Income**	Poverty rates**	Percentage of population that identifies as White alone **,***
Chicago, Illinois	USCM, GCM	2008	2022	2,665,039	$ 65,781	17.1%	33.1%
San Diego, California	USCM, GCM	2005	2022	1,381,162	$ 89,457	11.6%	42.0%
Dallas, Texas	USCM	2020	-	1,299,544	$ 58,231	17.7%	28.6%
Denver, Colorado	USCM, GCM	2015	2018	713,252	$ 78,177	11.6%	54.0%
Portland, Oregon	USCM, GCM	1993	2022	635,067	$ 78,476	12.6%	68.8%
St. Petersburg, Florida	GCM	2019	-	261,256	$ 64,375	12.4%	63.9%
Providence, Rhode Island	USCM, GCM	2019	-	189,563	$ 55,787	21.5%	34.1%
Springfield, Massachusetts	USCM	2017	-	154,064	$ 43,308	26.3%	28.9%
Columbia, Missouri	USCM, GCM	2019	-	128,555	$ 57,463	19.9%	73.3%
Boulder, Colorado	USCM, GCM	2006	2021	105,485	$ 74,902	20.9%	78.3%
Asheville, North Carolina	USCM	2009	2023	93,776	$ 58,193	12.4%	77.5%
Portland, Maine	USCM	2007	2020	68,424	$ 66,109	12.7%	81.7%
Burnsville, Minnesota	USCM	2009	2020	63,963	$ 79,059	6.9%	65.3%
Annapolis, Maryland	USCM	2010	-	40,648	$ 92,026	9.2%	54.4%
Ithaca, New York	USCM, GCM	2006	-	32,870	$ 40,973	34.5%	64.1%

* USCM = U.S. Climate Mayors; GCM = Global Covenant of Mayors; ** 2022 estimates from the U.S. Census Bureau; *** This excludes residents who identify as White and Hispanic or Latino.

Table 1. Sample of cities included in systematic content analysis of municipal budgets

We use this content analysis to confirm and triangulate the insights provided by experts regarding the impacts of climate change and climate action on municipal budgets, cities' budgetary constraints for climate action, and cities' emerging efforts to integrate climate and justice criteria into budgetary tools and practices. The content analysis also expanded the insights from experts by identifying the different ways municipal finance is changing in response to climate action and justice efforts across different types of cities. Finally, the content analysis complements our expert interviews by gathering quantitative data on total budgets and climate-related expenditures across cities of different sizes.

Results

Budgetary burdens and fiscal health

Our analysis revealed that, as cities are adapting to a climate-changed world, municipal budgets are increasingly burdened by both the impacts of climate change and cities' growing need to implement climate mitigation and adaptation efforts.

Interviewees highlighted that most cities do not allocate enough resources to climate action, and they often lack predictable funding sources to implement their climate programs. While cities tend to be opportunistic and often take advantage of one-off funding sources, interviewees agreed that climate action requires stable funding sources in the long-term. These dynamics are explicitly recognized in several municipal budgets. For example, in FY 2023, Boulder recognized that the original funding strategies that the city put in place for climate action are "now insufficient to address the scale and accelerating intensity of climate change that we now face". In FY 2021, Portland (Oregon) notes that resources dedicated to climate policy "are not commensurate with the scale of the immediate climate policy, programs, and actions the City needs to take in the face of the climate crisis". This is aggravated by the fact that a significant portion of Portland's budget devoted to climate work is reliant on one-time funding. The city explains that "this hinders [Portland's] ability to move projects forward in a timely way and to thoughtfully resource projects and community partners. Stable funding is foundationally critical to long-range planning and sustainability initiatives to provide equitable service and results in the community". In some cases, cities can also have limited flexibility to increase climate-related expenditures, despite their growing commitments to climate action. For instance, across the five FY, Columbia explicitly mentions that their budget does not dedicate any general source revenues to its Office of Sustainability. Rather, its costs are completely offset by savings generated by sustainability projects, grants, and funding from the utilities. This constraint has not changed, even after the adoption of the city's climate action plan in 2019.

Some municipal budgets explicitly note that expenditures have increased due to the impacts of climate change and the need to implement climate action. In FY 2022 and 2023, both Boulder and Portland (Oregon) dedicated additional resources to wildfire resilience following destructive fire events. In FY 2022, Asheville also allocated increased expenditures to storm responses, as the city continued "to see an increase in significant weather events due to climate change". Overall, several cities included additional investments in flood and stormwater management and/or urban greening to respond to climate change in one or more FY.

Several interviewees explained that insurance premiums are likely to increase in the next decades as a result of climate change, but some are hopeful that these increased expenditures may push cities to recognize the present-value cost of future climate impacts, impose additional pressure to act on climate resilience, and create backlash against climate-silent policies. In the near-term, however, insurance costs are translating into additional burdens for cities. For example, Boulder's municipal budgets report that the city is already experiencing a significant increase in insurance premiums and that "the enhanced disaster risk due to climate change and wildfire impacts are the main drivers of the increased cost of insuring our properties".

At the same time, climate change and climate action are also impacting municipal revenues. For example, in FY 2020, Annapolis reported that "city coffers also suffer" from climate change, as the number of downtown visitors dips during flood events and the city is unable to get associated revenues from parking fees, a loss that was estimated in the hundreds of thousands of dollars. Interviewees also highlighted that municipal revenues are likely to decrease as the impacts of climate change become evident and begin to devalue existing properties or making them

uninsurable, which would greatly impact the fiscal health of cities that heavily rely on property tax revenues. Some interviewees cautioned that by recognizing these climate risks, climate adaptation measures can further contribute to the erosion of municipal revenues. As one interviewee explained, "whether it's coastal flooding area, or whether it's a wildfire-prone area, [all cities] have the same problem that if they tell people not to come or leave, then they lose their property tax bases, and then all the public services that people depend upon to use it". Paradoxically, cities' efforts to mitigate climate change can also reduce municipal revenues in some instances. In FY 2022, Portland (Oregon) explained that existing revenue sources for the Bureau of Transportation are dependent on fossil fuel consumption, and that "as the city implements initiatives to reach its climate action goals, the bureau will see a corresponding reduction in resources necessary to fund these initiatives".

These cases suggest that, as municipal expenditures grow and revenues decrease due to climate change and climate action, cities are likely to increasingly suffer from additional fiscal vulnerability and have even more reduced capacities to direct stable, long-term public spending to climate efforts, thereby fueling cycles of fiscal vulnerability (Fig. 1).

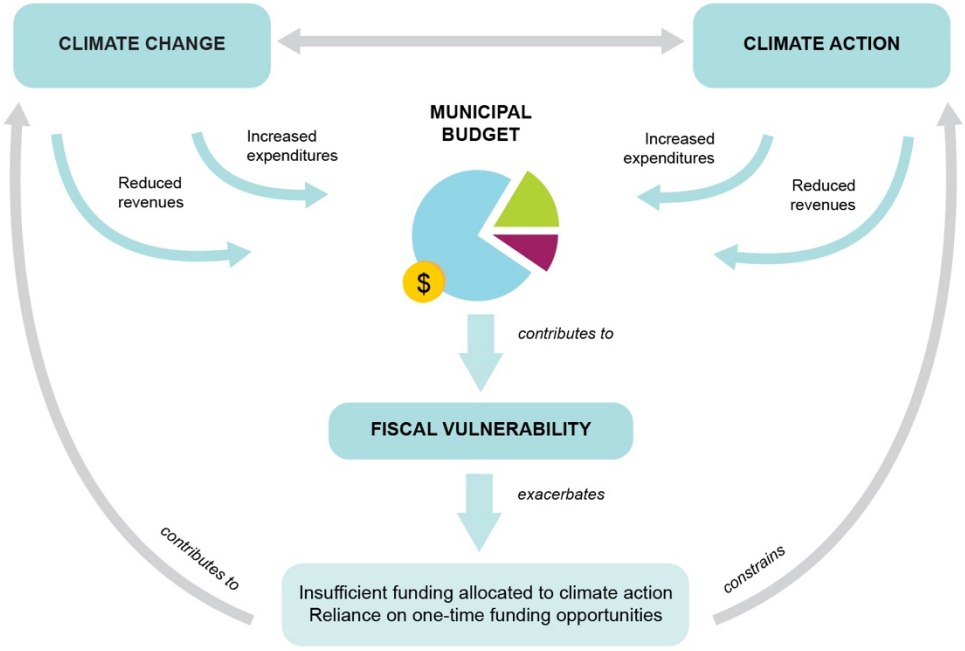

Figure 1. Impacts of climate change and climate action in municipal budgets. Both climate change and the pursuit of climate action contributes to cities' fiscal vulnerability by increasing expenditures and/or reducing municipal revenues. This can exacerbate cities' tendencies to allocate insufficient funding to climate action and to rely on one-time funding opportunities. This further constrains urban climate action and contributes to increased climate risks.

Illegibility of climate spending

Despite the relationships between climate action, climate impacts, and cities' fiscal health, we found that only five of the fifteen cities we analyzed explicitly reported climate expenditures in their municipal budgets (Table 2). Only two of these cities reported these expenditures for all five FY. San Diego is the only city in our budget analysis that reported expenditures specifically related to climate action, while other cities bundled climate-related expenditures with broader environmental and public health investments. For large cities, climate-related expenditures

oscillated between 0.2% and 13.9% of the cities' budget per FY. For mid-size cities, these numbers varied from 0.5% to 8.6%. No small cities in our budget analysis explicitly reported climate-related expenses.

City	Expenditure area	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
San Diego, California	"Implementation of the Climate Action Plan (CAP)", which includes investments across city departments that support the five strategic areas of the CAP, both directly and indirectly.	$181.22 (4.1%)	$453.28 (9.1%)	$9.91 (0.2%)	$523.03 (10.4%)	$475.78 (9.4%)
Columbia, Missouri	"Health and Environment Financial Use", which includes funding for the Office of Sustainability	$19.34 (3.6%)	$20.06 (3.6%)	$20.21 (3.8%)	$25.33 (4.8%)	$24.79 (4.7%)
St. Petersburg, Florida	"Sustainability & Resiliency Strategic Investment and Funding Priority", which includes projects that advance the city's energy efficiency, clean energy, and greenhouse gas reduction goals.	-	$6.94 (0.9%)	$3.48 (0.5%)	$6.10 (0.8%)	$5.49 (0.7%)
Boulder, Colorado	"Environmentally Sustainable Goal Area", which includes progress towards Boulder's climate and energy goals	-	-	-	-	$51.63 (8.6%)
Dallas, Texas	"Environment & Sustainability Strategic Priority", which includes being a global leader focused on climate change and environmental justice.	-	-	-	$645.53 (13.7%)	$628.00 (13.9%)

Table 2. Reported expenditures in climate action or climate-related expenditure areas in constant 2022 MMUSD and as percentage of the total budget per FY.

For most cities, it was not possible to track how much money is being allocated to address climate change. Without explicit reporting, we identified multiple barriers to pinpoint what expenditures should count as climate action within any given city. While in most cases it is possible to track expenditures from departments related to environmental work (e.g., Sustainability), the scope and degree to which these departments contribute to climate action varies across cities according to their organization and jurisdictional powers. In some cities, climate-related staff are not located within independent departments and their expenditures are "hidden" within the budgets of larger offices (e.g., Mayor's Office), making it harder to extract specific data related to climate expenditures. Many climate efforts may also occur in departments outside of environmental sectors or without any explicit "climate" labelling. Moreover, cities' individual reporting is not consistent across time. As Table 2 shows, even cities that are currently reporting climate-related expenditures may not have historical data available to track changes across time. We found that budgetary reporting standards are constantly evolving and tend to change with new administrations, often impacting how legible climate spending is for a particular city.

Embedding climate and justice criteria into budgetary practices

Urban climate action will require more than additional money – it will require a reimagining of municipal finance in the service of climate action and climate justice. When asked about emerging innovations in municipal finance, an interviewee working at a climate network asserted that "the next big thing for cities" is to figure out how to align budgetary decisions with climate change. Several interviewees working in municipal governments explained that they have been working to change how their cities "make their budgets" by ensuring climate and/or justice criteria are part of decision-making processes early on. For example, some interviewees are pushing to incorporate climate criteria into capital planning and procurement practices in their municipalities so that any additional money needed to fulfil a climate goal is included in budgetary requests. They explained that this ensures that departments are asking for "the correct amount of funding" beforehand, rather than requesting additional funding for climate-related elements as an afterthought later in the

process. A municipal official described this strategy as "essentially just flipping the order in which the conversations happen". Other interviewees described this as "integrated thinking" or the "un-siloing" of climate work within municipal finance. As one interviewee put it, the next frontier in urban climate finance is "when it becomes mainstream […] when this is not climate finance anymore. It's just finance".

Our analysis of municipal budgets confirmed that some cities are beginning to explicitly embed climate and justice criteria into budgetary decisions. We identified three strategies that cities are using for this purpose. First, a few cities in our budget analysis are explicitly articulating climate action as part of their fiscal health and duty to maintain "fiscal responsibility" or "fiscal sustainability" (i.e., the ability to maintain a balanced budget in the long-term). For instance, in FY 2021, St. Petersburg incorporated the goals and actions of the city's Sustainability Action Plan into their fiscal policies to achieve "long-term fiscal sustainability through proper planning and prioritization processes". Since FY 2022, Denver also defines fiscal sustainability as "integrating social equity and inclusion, public health, climate change and other environmental impacts, and innovation into the budgeting and decision-making processes". Similarly, from FY 2021 onwards, Portland (Oregon) has articulated that, as part of their fiscal responsibility, "fiscal resiliency, climate action, equity, and the needs of our most vulnerable populations will be the focus of every budget decision". This explicit integration of climate action into cities' fiscal health is significant, as several interviewees highlighted that cities tend to be "fiscally conservative" and are unwilling to risk big climate investments partially because of their duties to maintain fiscal prudence (see also Diezmartínez and Short Gianotti, 2024).

Second, nine of the fifteen cities in our budget analysis articulated climate action as a *budget priority area* for at least one FY (Table 3). Cities tend to frame budget priority areas as "strategic priorities" or "critical expenditures" and use them to "align" budget resources with existing planning documents, goals, or initiatives. In some cases, budget priority areas are used to direct resources to specific climate actions (e.g., San Diego), while other cities use them to signal the relevance of environmental and/or climate efforts more broadly (e.g., Boulder). Budget priority areas help municipal governments decide where money should be spent, and as seen during the COVID-19 pandemic, where expenditures should not be cut. However, it is unclear whether and how budget priority areas are systematically used in practice to allocate resources across departments and capital projects. As shown in Table 2, both San Diego and St. Petersburg experienced a steep decline in their climate spending in FY 2021 (the first budget adopted after the start of the COVID-19 pandemic), despite their explicit recognition of climate efforts as a budget priority area. Table 3 also shows that budget priority areas related to climate action are transient in nature and can either change their scope over time, as seen in Columbia, or even disappear after a few years, as seen in Asheville and Burnsville.

Finally, we found that six cities in our budget analysis have created *budget allocation tools* to systematically embed climate and/or justice criteria to request, evaluate, and make budgetary decisions (Table 4). In general, these tools set a series of goals, questions, and/or or prioritization scores that (i) help departments integrate climate and/or justice criteria into their policies, programs, and budget requests, (ii) provide a basis for municipal budget officers to assess budget requests and distribute budget allocations, and/or (iii) support the evaluation and tracking of budget allocations against cities' goals. Budget allocation tools tend to incorporate climate criteria into budgetary decisions by setting climate action as a goal, focus area, and/or desired outcome of cities' policies and investments. Justice criteria are most frequently operationalized as series of questions designed to assess whether and how community engagement was used to design policies

and programs (procedural justice), whether and how departments are targeting marginalized communities (recognitional justice), and what are the expected impacts of policies on vulnerable populations (distributional justice). Some budget allocation tools are also pushing city governments to make budgetary decisions based on standardized data, and a few cities have created their own set of metrics to aid in this process (e.g., San Diego's "Climate Equity Index" or Dallas' "Equity Indicators"). Budget allocation tools therefore move beyond budget priority areas by formalizing and systematizing the use of climate and/or justice criteria in budget decision-making processes.

City	Budget priority area(s)	FY	Climate efforts included in budget priority area
Asheville, North Carolina	A Clean & Healthy Environment / Environment	2020 - 2021	Climate resilience, energy, energy efficiency, waste, climate justice, urban greening
Boulder, Colorado	Environmentally sustainable	2023	Climate action (general)
Burnsville, Minnesota	Environment / Adaptability	2019 - 2021	Climate resilience
Columbia, Missouri	Social equity	2019	Clean energy, energy efficiency, climate resiliency
	Infrastructure	2020 - 2022	Transportation, urban greening, energy, waste, climate resiliency
	Climate Action and Adaptation Plan	2023	Climate action (general)
Dallas, Texas	Environment & Sustainability	2021 - 2023	Climate action (general)
Denver, Colorado	Environmentally Resilient	2019 - 2023	Climate action (general)
Portland, Oregon	Climate goals / climate action	2021 - 2023	Climate action (general)
San Diego, California	Implementation of the Climate Action Plan	2019 - 2023	Energy efficiency, water, clean energy, transportation, waste, climate resiliency
St. Petersburg, Florida	Sustainability & Resilience / Environment, Infrastructure, and Resilience	2019 - 2023	Energy, waste, urban greening, transportation

Table 3. Budget priority areas including climate action.

City	Tool	FY	Embedded criteria		Functions explicitly identified in budgetary documents		
			Climate	Justice	Budgetary requests	Budgetary decision-making	Budget evaluation / tracking
Boulder, Colorado	Sustainability, Equity, and Resilience (SER) Framework	2019 - 2023	X	X	X	X	X
Chicago, Illinois	Budget Equity Tool	2022 - 2023	X	X	X		
Dallas, Texas	Budgeting for Equity Tool	2020 - 2023		X	X		
Denver, Colorado	Budget Equity Framework	2020 - 2023		X	X	X	
Portland, Oregon	Budget Equity Tool	2019 - 2023	X	X	X		X
San Diego, California	Priority Score Policy for Capital Planning	2019 - 2023	X	X		X	X

Table 4. Budget allocation tools including climate and/or justice criteria.

Reimagining funding tools

Another emerging innovation that hints towards cities' reimagining of municipal finance is the creation of climate-specific funding tools. Four cities in our budget analysis have created special revenue funds dedicated to climate action (Table 5). These funds collect revenues from fees, taxes, or other charges and earmark them for a specific climate-related department and/or a set of dedicated uses related to climate action.

Some of these funding tools integrate justice criteria by (i) allocating funding for justice centered climate efforts, (ii) directly targeting specific vulnerable populations, and/or (iii) enabling community-driven funding decisions. For example, Boulder's "Climate Tax" requires dedicates funding to "resilience efforts that center equity". San Diego's "Climate Equity Fund" requires funded projects to be located in disadvantaged communities identified through the city's "Climate Equity Index". Similarly, Denver's "Climate Protection Fund" and the "Portland Clean Energy Community Benefits Fund" (PCEF) prioritize programs targeted to vulnerable communities. The PCEF is also significant due to its decision-making structure, which enables a community-driven committee to make expenditure recommendations to the Mayor and City Council. While this is the only funding tool in our budget analysis that enables residents to directly make funding allocations, the PCEF highlights the potential for climate action and climate justice efforts to contribute to the power sharing in municipal finance and the democratization of public spending.

Several interviewees highlighted that, by creating consistent and stable revenue streams, climate-specific funding tools can enable cities "to move and fund projects in ways that other cities just aren't able to do". However, some of these new climate funds are dependent on carbon-intensive activities, such as the use of natural gas utilities and the sale of gasoline. As explained earlier, as climate action progresses, these revenues sources may paradoxically not be stable in the long-term.

While these new climate-specific funding tools are promising, interviewees caveated that these solutions are also not transferable to all cities in the U.S., as municipalities may be subject to different state laws that limit their revenue-raising capacities, and in some contexts, the creation of new taxes and fees can also create significant political blowbacks.

City	Funding tool	Year of adoption	Annual revenue estimates	Revenue sources	Permitted uses	Justice criteria		
						Funding supports justice centered efforts	Funding directly targets vulnerable populations	Funding decisions are community-driven
Boulder, Colorado	Energy Impact Offset Fund (EIOF)	2015	$350 thousand	Fees from marihuana license holders who are required to obtain 100% of their electricity use from renewables. In lieu of compliance, license holders may pay into the EIOF.	Local projects that directly reduce and/or offset the marihuana industry's greenhouse gas emissions.			
	Construction and Demolition Deposit Fee	2020	Unknown	Administrative fees required for building demolition permits.	Funding for Boulder's Climate Initiatives Department.			
	Climate Tax	2022	$6.5 million	Taxes from natural gas and electricity bills.	Climate resilience efforts that center equity and work toward systems change, with $1.5 million dedicated to wildfire resilience.	X		

City	Funding tool	Year of adoption	Annual revenue estimates	Revenue sources	Permitted uses	Justice criteria		
						Funding supports justice centered efforts	Funding directly targets vulnerable populations	Funding decisions are community-driven
					The tax includes "bonding authority", enabling Boulder to issue debt that would be repaid with future Climate Tax revenues.			
Denver, Colorado	Climate Protection Fund	2020	$40 million	Local sales and use taxes.	Workforce training for under-resourced individuals, adaptation and resiliency programs that help vulnerable communities, programs and services that provide affordable, clean, safe and reliable transportation choices, upgrading energy efficiency of homes, offices and industry, and investments in renewable energy technology and battery storage.	X	X	
	Green Building Fund	2022	$700 thousand	Fees from commercial buildings that are 25,000 sq. ft. or larger who are required to comply with the Green Building Ordinance. In lieu of compliance, developers or owners can pay a fee and those fees go into the Green Building Fund.	Creation and improvement of green space, green infrastructure, green roofs, and urban forest; solar and energy efficiency projects for low-income households.	X	X	
Portland, Oregon	Community Solar Fund	2013	$8 thousand	Electric utility companies, in the form of a fifteen-year stream of incentive payments based on the energy produced from each solar energy system	Installing new, small-scale solar electric systems on community buildings.	X		

City	Funding tool	Year of adoption	Annual revenue estimates	Revenue sources	Permitted uses	Justice criteria		
						Funding supports justice centered efforts	Funding directly targets vulnerable populations	Funding decisions are community-driven
				Donations from individuals, businesses and organizations who provide voluntary contributions.				
	Portland Clean Energy Community Benefits Fund (PCEF)	2018	$80 – 90 million	Clean Energy Surcharge, a 1% surcharge on retail sales for large retailer businesses.	Grants for community-led projects and programs that reduce greenhouse gas emissions and advance social and economic benefits. Prioritizes communities of color, low-income residents, and other communities on the frontlines of climate change with clean energy funding, green infrastructure projects, and job training programs targeting historically disadvantaged groups, including women, people of color, and the chronically under-employed. Funding decisions are made by the Mayor and City Council based on recommendations of a nine-member committee consisting of community members.	X	X	X
	Parking Climate and Equitable Mobility Transaction Fee	2022	$1.8 million	Parking fees.	Transportation affordability and access programs.	X	X	
San Diego, California	Climate Equity Fund (CEF)	2021	$9.1 million	Gas and electric franchise fees, Transnet (sales tax), and the Gas Tax.	Support underserved communities effectively respond to impacts of climate change.	X	X	

City	Funding tool	Year of adoption	Annual revenue estimates	Revenue sources	Permitted uses	Justice criteria		
						Funding supports justice centered efforts	Funding directly targets vulnerable populations	Funding decisions are community-driven
					CEF projects must have an impact on reducing greenhouse gas emissions, enhancing safety in the public right-of-way, relieving congestion, or achieve other climate equity concerns. CEF projects must be located in a disadvantaged community within an area that scores between 0 and 60 on San Diego's Climate Equity Index.			

Table 5. Climate-specific funding tools.

Discussion and Conclusion

Our research shows that municipal budgets are facing increasing burdens as urban areas transition into climate-changed cities. Despite cities' growing attention to climate action and climate justice, interviewees agreed that climate efforts continue to be underfunded in U.S. cities, and our analysis of municipal budgets show that these funding constraints exist across cities of all sizes. Both climate change and climate action generate new burdens on municipal budgets by increasing cities' expenditures and/or reducing their revenue streams. This, in turn, has the potential to increase cities' fiscal vulnerability and reduce their capacity to (equitably) respond to climate change. Although previous scholars have estimated the *future* fiscal impacts of climate change in U.S. municipalities (Gourevitch et al., 2023; Shi et al., 2023; Shi and Varuzzo, 2020), our findings contribute to emerging evidence (Gilmore et al., 2022; Liao and Kousky, 2022) that some cities are already experiencing climate-induced fiscal stress, hinting at the increasingly important role that municipal finance will play in urban climate politics.

Our analysis also revealed that, even in cities that have been formally engaged in climate action for more than two decades, it is usually not possible to identify and monitor how much money is being spent on climate action. This echoes previous literature that denounces different aspects of municipal finance as opaque or "hostile in many ways to meaningful democratic decision-making" (Knuth, 2023), and further highlights the need to elevate municipal finance in climate politics. Although cities may face many challenges to track their climate spending, the illegibility of climate expenditures in most municipal budgets suggests that budgetary processes, and municipal finance more broadly, have not fully been recognized as part of the realm of climate politics, and cities may not have received sufficient pressure to be accountable of their climate expenditures and investments. This is critical, as the metrics that cities choose to be held accountable to reflect particular logics of cities' priorities, and can ultimately shape the conduct of

municipal governments (Hughes et al., 2020). This lack of transparency and monitoring can further disempower local communities and non-governmental actors to demand climate action from cities (Hughes et al., 2020).

Although we were unable to quantitatively track the distribution of climate spending in most cities in our budget analysis, our research revealed two promising trends in the "qualitative redirection" of municipal finance (August et al., 2022). First, we found that several cities have embedded climate and justice considerations into their municipal budgets by (i) recognizing the role that climate change and climate action play on cities' fiscal health; (ii) explicitly articulating climate action and/or justice as a budget priority area; and/or (iii) by developing budget allocation tools that systematically incorporate climate and/or justice criteria into budgetary decisions. The recognition of climate action as a component of cities' fiscal health and the inclusion of climate and justice criteria into budgetary allocations (Boulder's SER Framework) and capital planning (e.g., San Diego's Priory Score Policy) contrast with cases where the traditional financial logics of municipal finance that have driven cities to limit investment on climate action and capital infrastructure projects to protect their debt-to-revenue ratios and creditworthiness in the eyes of lenders, investors, and credit rating agencies (Gray, 2021; Shi and Varuzzo, 2020, Diezmartínez and Short Gianotti, 2024). Rather than framing climate efforts as a liability for cities' fiscal health, these strategies position climate action and climate justice as fiscally responsible efforts that are worthy of investment and that form part of the core functions of municipal finance.

Second, we found that some pioneer cities are creating funding tools that earmark municipal revenues for climate action and climate justice efforts. Although tax- and fee-based funding tools have long been part of the vernacular of municipal finance, the reimagining of these instruments to support climate efforts is also significant, as the lack of long-term, stable funding sources has been a constant barrier to climate action in the U.S. and beyond (Fünfgeld et al., 2023; Hughes, 2017). However, since some of these emerging climate funding tools continue to be reliant on the use of fossil fuels, it is unclear whether cities will be able to provide stable financial resources in the long-term, even with these emerging transformations. In creating new climate funding tools, policymakers should be mindful about how revenues are generated and whether these tools could inadvertently serve to further lock-in cities' fiscal dependence on carbon-intensive activities or, as argued by Shi et al. (2023), land and real estate development.

The advent of climate- and justice-oriented budget allocation processes and funding tools echo insights from several interviewees who claimed that "[…] we don't need to really invent anything new at this point. We just need to do what we do better". Rather than promoting the pursuit of novel debt financing schemes and financialized experimentation in cities (Bigger and Millington, 2020; Christophers, 2018; Knuth, 2023), we argue that the strategies and tools presented here constitute *ordinary innovations.* Ordinary innovations represent small, mundane, but meaningful changes that enable cities to repurpose the practices of municipal finance in the service of climate action and climate justice. This reimagining of municipal finance is, in turn, generating new spaces and opportunities to contest and decide the making of (just) urban climate futures.

Scholarship on urban climate justice has increasingly focused on the need for "transformative action", "systems change", and "transformative innovation" as a means to achieve justice and equity in cities (Amorim-Maia et al., 2022; Hadfield and Coenen, 2022; Hölscher et al., 2019; Long and Rice, 2021; Shi et al., 2016; Shi and Moser, 2021). While emphasizing the need for structural change is an important component of the climate justice movement in both scholarship and practice, a myopic focus on large-scale or radical transformations may overlook

the mundane and quiet acts through which just urban transitions have already begun to unfold on the ground and discount the impacts of such efforts on urban life. Although unjust socioeconomic systems continue to prevail in the U.S., the *ordinary innovations* and *practices* presented here represent more than incremental advancements toward climate justice that could produce material impacts for urban communities and the built environment. These efforts and their consequences are deserving of attention.

Future research could productively build on our analysis of municipal budgets to examine a larger sample of cities within and beyond the U.S. This can serve to test whether the ordinary innovations presented here are being used across different geographies and city typologies and to identify additional ways in which municipal governments may be impacted by climate change and/or embedding climate and justice criteria into their financial practices. Case studies that trace how the cycles of fiscal vulnerability theorized in this paper are unfolding on the ground would be helpful to test the causal relationships between climate-induced expenditure increases and/or revenue decreases, cities' fiscal vulnerability, and cities' levels of funding dedicated to climate action.

Our findings also open new questions about the multi-scalar nature of fiscal geographies. As cities continue to reimagine municipal finance to advance just urban transitions, scholars may examine how these transformations interact with existing state and federal fiscal practices. Since states in the U.S. often set limitations for cities' revenue-generating authorities (Diezmartínez and Short Gianotti, 2024), the adoption of climate- and justice-driven funding tools may be constrained geographically and politically, further contributing to unequal geographies of climate action and climate risks (Shi and Bouma, 2023). Previous studies have shown that the fiscal impacts of local climate disasters are mostly absorbed by state and federal governments (Liao and Kousky, 2022; Miao et al., 2018; Shi et al., 2023). However, these higher levels of government are also expected to suffer public deficits due to climate change (Miao et al., 2018; Parrado et al., 2020), which may revert at least some recovery costs back to municipalities (Shi et al., 2023). The effectiveness and stability of municipal climate and justice-oriented financial solutions may be tested in these circumstances.

While our research focused on U.S. cities as a case study, recent scholarship has shown that municipal finance is a site of climate and justice politics in cities across the world, with consequences at multiple scales. For instance, participatory budgeting in Europe and Latin America is being used to challenge green growth paradigms and to embed justice criteria into climate action (Cabannes, 2021; Falanga et al., 2021; García-Lamarca et al., 2022). In Australia, cities are leveraging municipal finance to facilitate equitable decarbonization outcomes and achieve extra-local renewable energy development despite unsupportive state and federal policies (Hadfield and Cook, 2019). In the Global South, the use of municipal finance for climate action and climate justice efforts is entangled with multi-scalar relationships with other countries and multilateral organizations through global climate finance flows (Bracking and Leffel, 2021; Mohan and Tan-Mullins, 2019; Silver, 2023). This further positions municipal finance as a potential site to examine climate politics not only within a single municipality, but also across city boundaries and at multiple scales. Future research exploring the climate and justice politics of municipal finance should compare cities in different contexts and trace the climate and justice politics of public finance across different governance levels.

In the same way that municipal finance has taken an important role in racial justice movements (Barrett and Safransky, 2024), the emerging ways in which city governments are reimagining municipal finance to implement (just) climate action indicate that municipal finance

will increasingly become an important site of climate and justice politics. Urban scholars, practitioners, and activists interested in advancing just climate action must begin to raise questions of municipal finance – how cities obtain and allocate public funding, for what, and for whom, what values and criteria are prioritized in those allocations, and who is able to contribute to those decisions. Municipal budgets, taxes, fees, and other mundane aspects of municipal finance must be seized as sites of conflict and contestation to create more just urban climate futures.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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