

## Article

# Identifying the Potential for Climate Compatible Development Efforts and the Missing Links

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**Abstract:** Those examining climate compatible development and triple-win policy efforts that simultaneously negotiate sustainable development, climate change mitigation, and climate change adaptation considerations are on the cutting edge of exploring why and how policymakers address complex social problems that require balancing considerations about multiple, interrelated policy issues. Enhancing understanding of factors underlying the emergence of these efforts can help strengthen incentives for action, address implementation challenges, and anticipate inequities. This paper uses survey responses from 287 cities and logistic regression analyses to explore conditions and policy actions associated with potential climate compatible development efforts when economic development, sustainability, climate change mitigation, and climate change adaptation considerations overlap. It finds evidence that potential climate compatible development efforts were present in 10% of the cities studied. Adaptation was the issue most likely to act as the missing link when each of these other issues influenced city policy actions, and mitigation was the least likely. Contextual factors associated with these efforts included budget stress, leadership from a policy entrepreneur, higher college degree attainment rates, having an environmental department or commission, and the area of the city composed of water versus land. Examining factors associated with these issues acting as missing links revealed contradictions that highlight the necessity of further exploration of processes affecting the pursuit of climate compatible development.

**Keywords:** municipal governance; wicked problems; co-benefits; trade-offs; climate change policy experiments

## 1. Introduction

How communities address climate change policy reflects their distinctive current conditions, challenges, and concerns [1,2]. Attention to considerations about climate change policy integration [3] or mainstreaming [4] in which climate change efforts are explicitly woven into existing policy deliberations reflect the perceived necessity of considering how efforts to address climate change relate to existing policy work e.g., [5–8].

This need for policymakers to understand and address multiple interrelated issues simultaneously is an increasing challenge for those studying and implementing public policy addressing complex social problems generally [9–11]. Climate change policy scholars have been at the forefront of research related to the role of intersections between considerations about multiple issues on policy outcomes [11]. The role of economic growth as a driver of intensifying climate change and of the economic costs of addressing climate change versus failing to respond have been thoroughly discussed in both scholarly and policy deliberations [12]. But the focus within climate change policy on reducing the risks vulnerable communities face [13] as well as on having the resources to overcome and manage threats [14] have meant that there is also a need to understand the interplay of development efforts

and addressing climate change policy with even greater nuance [15]. Interactions between climate change mitigation and adaptation themselves add another layer to this complexity as efforts to address one can result in co-benefits that positively reinforce efforts related to the other [16,17] or trade-offs that negatively affect efforts related to the other [16,18]. These discussions in the literature have primarily focused on Least Developed Countries due to concerns about the vulnerability of residents as well as the current and future impact of climate change on realizing established development goals in these contexts [19–21]. However, considerations about how addressing climate change mitigation and adaptation intersects with economic development efforts is inevitably a key component of understanding climate change policy in more developed contexts as well [12,22].

Discussions related to the intersection of mitigation, adaptation, and development efforts have featured an assortment of terminology, but perhaps the most developed models focus on climate compatible development [15] that seeks triple-win strategies generating positive feedbacks and minimizing tradeoffs between mitigation, adaptation, and sustainable development [15,19,23]. Policymakers and donors alike have quickly embraced the rhetoric surrounding climate compatible development and triple-wins [20,21,24]. At the same time, critical examinations of these efforts are also emerging that are assessing contextual conditions affecting their emergence [25], their actual impacts [20,24], their long-term viability [26], and their implications for social justice concerns [21,27]. Enhancing our understanding of the political economy underlying these efforts can shed light on ways to strengthen incentives for action, overcome implementation challenges, and anticipate inequities associated with them [21,25].

In this paper, I draw on a unique dataset of survey responses from 287 cities to explore what policy actions and contextual conditions are associated with the nascent emergence of potential climate change compatible development efforts. Instances where considerations about mitigation, adaptation, sustainability, and economic development cluster together can provide insight into what policy activities and conditions are more likely to feature discussions related to climate compatible development and triple-wins. I first present descriptive data resulting from these surveys showing that instances where considerations about these four issues overlap are fairly uncommon, occurring in just 29 (10%) of the cities studied, but that on average, these 29 cities each had three policy actions where this occurred. I also examine “missing links”—instances where only one of the issues does not influence a policy action, finding that climate change mitigation acted the least often as a missing link while climate change adaptation acted as a missing link the most often. Next, I present a pair of logistic regression models inspired by Ellis et al.’s [25] list of drivers and challenges for climate compatible development. The first is a binary logistic regression model that tests the association between these variables and whether (1) or not (0) a city had a potential climate compatible development effort. The second is a multinomial logistic regression model that tests the association between these variables and the issues of economic development, sustainability, or climate change predominately acting as missing links in the city. In the discussion section, I describe the implications of the results of this study.

## 2. Materials and Methods

### 2.1. Survey

#### 2.1.1. Study Population

This analysis relies on survey responses drawn from mid-sized cities throughout the Great Lakes region of the US—here defined as the eight states sharing coastline with the North American Great Lakes: Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin. This research population was specifically selected to investigate the relationships between efforts to address climate change and development concerns. Cities in general are an ideal setting for quantitative analysis regarding climate change policy both because there are so many of them and because they have emerged as particularly productive arenas for generating experimental policies addressing climate change [28–30]. Furthermore, it is also well established that cities’ efforts to address

climate change are shaped by their concerns about dealing with their own internal goals or perceived threats [1,31,32]. Cities in the Great Lakes region are associated with the US' "Rust Belt"—an area that has been forced to re-orient its economy and identity in light of dramatic losses in manufacturing employment related to global economic changes over the last several decades [33]. This history of combating the impacts of global processes, as well as the region's experience with complex policy deliberations and implementation around protecting the Great Lakes make it a particularly compelling region for exploring the intersection of economic development, sustainability, and climate change efforts [34,35]. The study population included all cities in these eight states with a population between 5000 and 500,000 for which I could find a viable email address to contact. I removed eight cities from this list that I had personal experience working with on developing climate change policy so that my previous efforts would not bias the overall results. This selection process resulted in a final list of 822 cities in the study population.

### 2.1.2. Survey Contents and Implementation

In order to prevent response bias as much as possible, in my email solicitations to potential respondents, I did not mention any of the issues or policy actions that the survey addressed. Instead, I described that the survey assessed whether "certain issues and policies are being addressed (or not)" and "work around certain issues and policies that may or may not be taking place in [city name]." The survey featured a list of sixteen policy actions that these cities might be pursuing. This list was adapted from existing lists of potential policy actions related to climate change in cities like UN-HABITAT's [36] to suit the study population based on my previous climate change decision-support work with cities in this region. Respondents were asked whether their city had undertaken or been involved in each of these sixteen policy actions and could then answer whether or not considerations about economic development, sustainability, climate change mitigation, or climate change adaptation influenced these actions. The respondents were city staff members who responded on behalf of their city with city council clerks being the position that I specifically targeted. I selected clerks as the respondents because they are individuals tasked with attending and keeping objective records related to city policy deliberations [8,11,35,37]. Therefore, while they are informed about policy debates taking place around issues, they should be relatively dispassionate observers with less of a political or departmental agenda than others with such knowledge [8,11,35,37]. Because of these observations, clerks have insight into deliberations taking place around policy actions in their city [8,11,35,37]. Clerks' insight into these deliberations is suited to an exploration of climate change policy development because climate change is a nascent and fluid area of policy action that is largely informal for most cities in North America [38,39]. Understanding ongoing deliberations is also particularly appropriate for investigating climate compatible development, which centers on policymakers' weighing considerations about multiple issues at once [15,19,23].

For these reasons, clerks were the final contact in 725 of the 822 cities. In the 97 cities where the clerk was not available, other staff were contacted such as planners, financial directors, or city managers. Completed responses were collected from 287 cities in the spring and summer of 2015, resulting in a response rate of 35%. Z-test comparisons found no statistically significant differences between the study and response populations based on their populations, median household income, or unemployment rate.

### 2.2. Identifying Potential Climate Compatible Development Efforts and Missing Links

For each of the sixteen policies in each of the 287 responding cities, I first assessed whether or not the city had undertaken the policy effort and said that considerations about economic development, sustainability, climate change mitigation, and climate change adaptation had all influenced it. Because researchers have struggled using formalized means of studying nascent climate change policy efforts in North American cities [38] and because climate change compatible development efforts are grounded in policymakers deliberatively balancing various contextually-based

objectives; I decided to allow respondents to identify which of these objectives had influenced their city government's considerations.

If the respondent identified that a policy action was influenced by considerations about economic development, sustainability, mitigation, and adaptation; I considered that an instance of potential climate compatible development in the city. In order to gain more perspective on the presence of potential climate compatible development in these cities (or not), I also explored instances in which each of these issues acted as "missing links"—when they were the only one of the four issues not influencing a policy action the city was undertaking. For example, if a respondent described that considerations about sustainability, mitigation, and adaptation influenced their city's efforts related to increasing pedestrian transportation; but that economic development did not, then economic development was acting as a missing link for that policy action.

### 2.3. Regression Analysis

In order to explore contextual factors that might be related to the potential for climate compatible development efforts, I also performed two logistic regression analyses. The first was a binary logistic regression that tested the association between independent variables described in the next paragraph and a dependent variable describing whether (1) or not (0) a city had at least one potential climate compatible development effort.

I chose the independent variables used in these models based on inspiration from Ellis et al.'s [25] list of drivers and challenges for climate compatible development and adapted them for the context being studied. Table 1 summarizes Ellis et al.'s list along with explanations of the associated independent variables used in my analysis. Value inflation factor tests performed on the models found no evidence of significant multicollinearity. In their paper, Ellis et al. [25] first describe recognition of the need for adaptation to bolster resilience, foster growth, and reduce poverty. Those living in the Great Lakes region have spent decades in collaborative efforts to clean up their unique freshwater environment while attempting to re-orient their development strategies towards taking advantage of amenities associated with freshwater resources [34]. These efforts have shaped the development of climate change adaptation efforts in the region [40]. Therefore, the first variable included in the model was the city's "water footprint"—the area of the city composed of water versus land. Presumably, in this region, the larger the city's water footprint the more likely it would be to pursue climate compatible development. Ellis et al. [25] also describe a perceived need for energy or resource efficiency. With that in mind, I included a measure of the city's budget surplus versus shortfall 2005–2010. Cities in the US are under substantial pressure to balance their budgets each year; and budget deficits have been associated with more climate change mitigation efforts [11]. Therefore, cities that are experiencing fiscal stress in the form of expenditures recently exceeding revenue might be more likely to connect their climate change efforts with meeting their financial concerns. Next, Ellis et al. [25] describe the desire to take advantage of new economic opportunities as a driver of climate compatible development. Therefore, I included a measure of the city's poverty rate as a higher poverty rate should create more pressure to find new economic development strategies. Based on Ellis et al.'s [25] description of a desire to access aid, I then included the percentage of the city's revenue composed of funds from higher levels of government from 2005–2010 (intergovernmental funds), with the presumption that higher dependence would be associated with more potential climate compatible development. Ellis et al.'s [25] final driver was strong government leadership. This inspired me to include a binary variable describing whether (1) or not (0) a sustainability or climate change policy entrepreneur were present in the city based on my survey results (more information about the development of this variable can be found in a related study [35]). Studies have demonstrated that the presence of environmental policy entrepreneurs are not only critical in the emergence of climate change policy efforts [41,42], but in making connections between climate change efforts and other issues [1,43].

**Table 1.** Summary of Drivers, Challenges, and Associated Independent Variables.

Ellis et al. [25] Drivers and Challenges	Associated Variable <sup>1</sup>
Driver: A recognized need to adapt to climate change in order to bolster resilience, achieve growth and reduce poverty	Water Footprint: Comparison of area of city composed of water versus land (2010 Census)
Driver: A need for energy security and natural resource efficiency	Budget: Ratio of city revenue versus expenditures for years 2005–2010 (City Budgets)
Driver: A desire to capitalize on new economic opportunities	Poverty Rate: Poverty rate in the city (2005–2010 American Community Survey estimates)
Driver: A desire to access climate finance and aid	Intergovernmental Funds: % of city revenue composed of intergovernmental funds 2005–2010 (City Budgets)
Driver: Strong government leadership	Entrepreneur: A policy entrepreneur associated with sustainability or climate change (survey)
Challenge: Costs associated with change	Debt Burden: % of city expenditures composed of existing debt payments 2005–2010 (City Budgets)
Challenge: Interest groups opposed to change	Political Conditions: % of vote Barack Obama received versus Mitt Romney in the city in the 2012 election (Secretary of State databases)
Challenge: A lack of awareness or trusted information	Bachelor's Attainment: 4-year college degree attainment rate of city population (2005–2010 American Community Survey)
Challenge: Short-termism	Real Estate Sector: Percentage of population employed in real estate sector (2005–2010 American Community Survey)
Challenge: A lack of state capacity to respond to and implement strategies	Council-Manager: Binary—does city have a city-manager form of government (1) or not (0) (City websites)
Challenge: Institutional Constraints	Environmental Department: Binary—does city have a department or commission dedicated for environmental work (City websites)

<sup>1</sup> Variable sources shown in parentheses.

Ellis et al. [25] also include six challenges to the emergence of climate compatible efforts: costs, opposed interest groups, a lack of awareness or trusted information, short-termism, lack of capacity to respond to and implement strategies, and institutional constraints. For costs, I included a measure of the city's debt burden—how much of its expenditures were devoted to servicing existing debts 2005–2010. Cities in the US compared to others throughout the world have a relatively large amount of freedom to take on debt to finance their investments; however, because they face pressure to balance their budgets year to year, having to pay off existing debts can constrain taking on new policy initiatives. Therefore, I hypothesized that the higher the city's existing debt burden, the less likely it was to perceive that it had the flexibility in its budget to take on potential new costs related to innovative efforts related to climate compatible development. For opposition, I included a variable describing the percentage of the vote Mitt Romney (R) received versus Barack Obama (D) in the 2012 presidential election in precincts in each city. Climate change remains a divisive issue in the US, and political party support remains a strong predictor of potential opposition to developing climate change-related policies [41,44]. For awareness and trusted information, I included a measure of the bachelor's attainment rate in the city. Presumably the percentage of city residents that had attained at least a four-year college degree should be positively related to greater levels of awareness and trust in information about climate change in the city population that would provide a base of support for city politicians and city staff to have opportunities to engage with scientific research and feel more comfortable forging connections between policy efforts and science [41]. For short-term outlooks limiting long term planning, I included the percentage of the population employed in the real estate sector in the city. I hypothesized that a greater number of residents employed in this sector might lead

to considerations about city development having longer time horizons. To address the capacity to respond to and implement strategies, I included a binary variable describing whether (1) or not (0) the city had a Council-manager form of government. Council-manager forms of government are a popular local government reform strategy in the US that are believed to make government more efficient and have been associated with cities taking on climate change and sustainability efforts [45]. Therefore, I hypothesized that this form of government would be associated with climate compatible development efforts. Finally, to represent existing ability to overcome institutional constraints, I included a binary variable describing whether (1) or not (0) the city had a department or commission (groups that meet with city council legislators) that were specifically tasked with addressing environmental issues or sustainability. Such a focused area for discussion of environmental efforts would presumably be associated with more climate compatible development efforts because they could help assess and coordinate activities. In addition to these variables, I also included the population of the city (based on the 2010 Census) and the state each of the cities were in to account for variation based on the size of the city and the influence of state-level government.

To explore associations between these independent variables and particular issues acting as missing links in potential climate compatible development, I also used them in a multinomial logistic regression model. The dependent variable of this model described whether the city falls into one of four categories: there were no missing links, economic development primarily acted as the missing link, sustainability primarily acted as the missing link, or climate change mitigation or adaptation primarily acted as the missing link. To develop this variable, I first assessed what issues acted as the missing link most frequently in each city. I ignored 11 cities in which two or more issues were tied for the most frequent missing link and combined climate change mitigation and adaptation into a single category, climate change, because there were so few cities (8) where mitigation was the primary missing link. This resulted in 208 cities with no missing links, economic development primarily acting as the missing links in 17, sustainability in 19, and climate change in 32. The model compared cities in which economic development, sustainability, or climate change primarily acted as the missing link versus those cities with no missing links (i.e., “no missing links” is the reference, or baseline, category for this analysis).

### 3. Results

#### 3.1. Policy Actions, Potential Climate Compatible Development, and Missing Links

Table 2 provides a summary of the sixteen policy actions addressed in the survey, along with the number of cities in which that policy action either was influenced by considerations about economic development, sustainability, mitigation, and adaptation (representing a potential climate compatible development effort) or had one of these issues as a missing link. In all, 29 cities (10% of those surveyed) had at least one policy action that represented a potential climate compatible development effort, 29 (10%) had an instance where economic development was a missing link, 34 (12%) had an instance of sustainability as a missing link, 19 (7%) had an instance of mitigation as a missing link, and 35 (12%) had an instance of adaptation as a missing link.

**Table 2.** Summary of Policy Actions and Instances of Potential Climate Compatible Development Efforts and Missing Links by Issue.

Policy Actions <sup>1</sup>	Potential	Missing Links			
	Climate Compatible Development	Econ. Develop.	Sustain.	Mitig.	Adapt.
Measures to increase pedestrian transportation	13	4	17	4	12
Enhanced parks	10	5	4	6	3
Enhanced public transportation options	9	1	5	1	7
Promoted reuse of brownfields	7	3	7	4	3

Table 2. Cont.

Policy Actions <sup>1</sup>	Potential	Missing Links			
	Climate Compatible Development	Econ. Develop.	Sustain.	Mitig.	Adapt.
Altered wastewater management	6	4	6	1	9
Increased tree canopy	6	5	4	2	4
Reduced energy use	6	9	5	1	8
Developed alternative energy on buildings	5	2	4	1	5
Made changes to fleet vehicles	5	2	4	0	4
Altered stormwater management	5	9	4	2	9
Increased building efficiency	4	11	5	5	8
Developed alternative energy	3	0	3	4	4
Altered emergency management strategy	3	2	5	2	3
Altered building codes	3	3	3	0	1
Promoted greater development density	3	2	2	0	2
Developed water recycling or reuse	2	0	1	0	1
Total	90	62	79	33	83

<sup>1</sup> Policy actions in order of most to least number of instances of potential climate compatible development efforts.

Policy actions that had the most instances of potential climate compatible development were measures to increase pedestrian transportation (13), enhanced parks (10), and enhanced public transportation options. In general, instances of acting as the missing link were more common for climate change adaptation (83) and sustainability (79) than for economic development (62) and climate change mitigation (33). The policy action for which economic development acted most frequently as the missing link was increased building efficiency (11) while the policy action for which climate change mitigation acted most frequently as the missing link was altered wastewater management (6). Measures to increase pedestrian transportation was the policy action for which both sustainability (17) and climate change adaptation (12) acted most frequently as missing links.

### 3.2. Logistic Regression Analyses

#### 3.2.1. Potential Climate Compatible Development Efforts

Table 3 summarizes the results of the logistic regression assessing the associations between the independent variables described in Section 2.3 and the binary dependent variable describing whether (1) or not (0) the city was undertaking at least one policy action that potentially represented a climate compatible development effort. This model had an R-squared of 0.444.

Table 3. Regression Results: Presence of a Potential Climate Compatible Development Effort.

Variable	Coeff. <sup>1</sup>	SE
Intercept	−7.914 *	4.634
Water Footprint	4.103 ***	1.581
Budget	1.018	4.083
Poverty Rate	0.051	0.033
Intergovernmental Funds	0.023	0.038
Entrepreneur	1.954 **	0.836
Debt Burden	−0.171 **	0.076
Political Conditions	0.008	0.012
Bachelor's Attainment	0.050 **	0.021
Real Estate Sector	0.503	0.338
Council-manager	−0.929	0.670
Environmental Department	1.515 **	0.639
Population	−0.039	0.143

Table 3. Cont.

Variable	Coeff. <sup>1</sup>	SE
Illinois (Reference)		
Indiana	1.403	1.159
Michigan	1.263	0.971
Minnesota	0.367	1.277
New York	1.614	1.136
Ohio	0.212	0.999
Pennsylvania	2.458 *	1.310
Wisconsin	−4.390	24.596

<sup>1</sup> \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Independent variables that had a statistically significant positive association with the presence of a potential climate compatible development effort were the city's water footprint ( $p < 0.01$ ), the presence of a policy entrepreneur ( $p < 0.05$ ), bachelor's attainment rate ( $p < 0.05$ ), and the city having an environmental department or commission ( $p < 0.05$ ). A city's debt burden had a statistically significant negative association with this outcome ( $p < 0.05$ ). In terms of predicted probabilities, the overall probability of the presence of a potential climate compatible development effort was 0.11. If the city's water footprint is 0 (10th percentile of the distribution of cities studied) this probability is 0.09, while if the city's water footprint is 0.13 (90th percentile) this probability is 0.13. The predicted probability is 0.14 when a policy entrepreneur was present, and drops to 0.04 when one isn't present. It is 0.18 when the city's debt burden is 1.04% (10th percentile) and drops to 0.02 when the debt burden is 20.40% (90th percentile). When bachelor's attainment is 12.47% (10th percentile) the predicted probability is 0.07, while it is 0.21 when bachelor's attainment is 49.83% (90th percentile). Finally, the predicted probability is 0.09 when the city does not have an environmental department or commission and it rises to 0.21 when the city does have one.

### 3.2.2. Missing Links

Table 4 summarizes the results of the multinomial logistic regression model assessing associations between the independent variables described in Section 2.3 and comparisons between cities in which economic development, sustainability, or climate change primarily acted as the missing link versus cities with no missing links. This model had an R-squared value of 0.447.

Table 4. Regression Results: Model Predicting Issue Primarily Acting as Missing Link.

Variable	Econ. Develop.		Sustain.		Climate Change	
	Coeff. <sup>1</sup>	SE	Coeff.	SE	Coeff.	SE
Intercept	0.956	5.968	0.353	4.046	−8.351 **	3.638
Water Footprint	3.212	1.983	1.018	2.275	1.032	1.649
Budget	−3.183	5.720	−3.366	3.887	5.368 *	3.037
Poverty Rate	0.066	0.047	−0.021	0.047	0.010	0.036
Intergovernmental Funds	−0.040	0.059	0.008	0.038	−0.082 **	0.042
Entrepreneur	18.137	2590.465	0.506	0.608	0.184	0.480
Debt Burden	−0.056	0.067	0.025	0.048	0.043	0.037
Political Conditions	−0.009	0.016	−0.003	0.013	0.017	0.010
Bachelor's Attainment	0.059 **	0.030	0.012	0.024	0.003	0.020
Real Estate Sector	−0.546	0.827	0.713	0.440	0.079	0.472
Council-manager	−0.794	0.882	0.723	0.766	0.429	0.585
Environmental Department	1.872 **	0.803	0.716	0.783	0.555	0.572
Population	0.167	0.201	0.087	0.152	0.251 *	0.134
Illinois	−0.922	2.072	−0.450	1.463	2.564 *	1.340

Table 4. Cont.

Variable	Econ. Develop.		Sustain.		Climate Change	
	Coeff. <sup>1</sup>	SE	Coeff.	SE	Coeff.	SE
Indiana	0.966	1.725	2.220	1.395	1.539	1.520
Michigan	−0.675	1.791	0.133	1.232	1.178	1.335
Minnesota	−0.477	1.868	−0.899	1.211	0.995	1.297
New York	0.208	1.796	1.451	1.369	−16.567	8763.916
Ohio	−0.142	1.598	−1.010	1.411	1.867	1.248
Pennsylvania	−17.862	0.000	2.536 *	1.365	−16.882	9086.143
Wisconsin (Reference)						

<sup>1</sup> \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Based on the economic development results, the city's bachelor's attainment rate and having an environmental commission or department both had a statistically significant positive association with economic development acting as the primary missing link at the  $p < 0.05$  level. None of the variables assessed had a statistically significant association with sustainability primarily acting as the missing link. However, climate change primarily acting as the missing link in a city was positively associated with the city having a higher budget surplus versus budget deficit ratio and with the city having a higher population (both at the  $p < 0.10$  level). On the other hand, the city having a higher dependence on funds from higher levels of government was negatively associated with climate change primarily acting as the missing link at the  $p < 0.05$  level.

#### 4. Discussion

Understanding policy actions and conditions associated with climate compatible development efforts is an essential area of study not only for addressing climate change successfully in ways that improve peoples' lives [15,19]; but also for exploring how policymakers manage the complex, interrelated policy challenges society faces today more generally [11]. The results of my analysis above help shed light on conditions and policy actions that are more likely to be associated with potential climate compatible development efforts in cities. In general, instances where considerations about economic development, sustainability, climate change mitigation, and climate change adaptation all influenced a policy action were fairly rare in the cities studied. Just 29 (10%) of the 287 cities surveyed had this occur for any of the sixteen policy actions examined. However, 90 instances of potential climate compatible efforts emerged from these 29 cities so these cities averaged three each. These results imply that contexts where these activities currently develop might be quite exceptional [25], but that these efforts can also multiply across policy actions once they become established [11]. There were 257 instances in 78 cities in which there was a "missing link" where only three of the four issues influenced a policy action. Perhaps because climate change mitigation is a more developed and integrated policy issue in cities than adaptation [11,28,46], climate change mitigation was the issue least likely to be the missing link (33 instances, 13% of the total) while adaptation was the issue most likely to be the missing link (83 instances, 32% of the total). Caution is necessary in interpreting how representative these results are of activity taking place in other contexts. This study population was explicitly chosen because the history of the region might encourage climate compatible development to emerge and it is plausible that those working in the most active cities would be the ones most likely to take the time to answer a survey. On the other hand, given that both of these factors may have led to some bias towards more potential climate compatible development instances being reported, it is perhaps even more notable that only 10% of the cities studied had at least one.

The policy actions that most frequently represented potential climate compatible development efforts were: measures to increase pedestrian transportation (13 cities), enhanced parks (10), enhanced public transportation options (9), and promoted reuse of brownfields (7). The relatively high frequency of these efforts related to transportation emphasizes that this sector is a particularly salient policy

area for cities that might offer a critical entry point for working with cities on the pursuit of climate compatible policy initiatives [47]. Finding policy entry points like this one might be particularly important for those interested in promoting climate compatible development if the notion that such policy innovations can spread quickly both across areas of city policymaking within a city [11] and between cities themselves [35] is true. The relatively high frequency of efforts related to enhancing parks and redeveloping brownfield sites also highlights the importance of the land use sector in city efforts related to climate compatible development [8,48]. As is often the case with city climate change policies though, the question remains whether these efforts related to pedestrian transportation, parks, and developing former industrial areas are impactful responses to climate change or are attractive but ultimately relatively superficial interventions [28,49].

Still, the rarity of potential climate compatible development efforts invited analysis of the conditions that are actually associated with their presence. Ellis et al.'s [25] list of drivers and challenges for climate compatible development inspired a binary logistic regression model that explained just over 44% of the observed variance in whether (1) or not (0) the cities studied had a least one policy action that did so. A second analysis using these independent variables in a multinomial logistic regression also explained over 44% of the observed variance in comparisons between cities with no missing links and cities that fell into one of three categories: where economic development, sustainability, or climate change primarily acted as the missing link.

The potential for climate compatible development efforts was associated with the city having: water constitute a greater portion of its area, an environmental policy entrepreneur present, a lower debt burden, and an environmental department or committee. While this provides evidence that these are political economic factors that are associated with all of these issues overlapping with one another [8], the results pertaining to economic development acting as the primary missing link complicates this interpretation. A higher bachelor's attainment rate and the city having an environmental department or committee were both positively associated with economic development acting as the primary missing link compared to cities where there were no missing links. Furthermore, a similar association was not observed for environmental policy entrepreneurs because there was no actual variation in the variable—an environmental policy entrepreneur was present in every city where economic development was the primary missing link. This provides some evidence that while these conditions might be associated with the city addressing environmental policy concerns, they don't necessarily ensure that such efforts won't be isolated from the city's efforts to address other policy concerns. This finding lends empirical support to the supposition that dedicating environmental work to particular departments or individuals may result in siloing where environmental efforts become isolated from other activities [7]. In particular, while policy entrepreneurs can be essential for forging connections between issues [50–52], they strategically limit these efforts to advantageous situations [35,37] and so could potentially reinforce siloing if they perceive that as being in their interest. Issue siloing can block insights into how to realize potential co-benefits or reduce potential trade-offs associated with pursuing related policy goals [8,16,18] as well as limit interactions with politicians and staff that could enhance the quality of environmental policy efforts [53–55]. Relatedly, the finding that climate change acting as the primary missing link was negatively associated with higher dependence on intergovernmental funding seems to provide further evidence that the Obama administration's efforts to tie together climate change interventions and economic development could encourage overlaps between these issues [8]. However, reliance on funding from higher levels of government might actually reduce the overall quality of climate change policy efforts [53], so such funding-based incentives might not ultimately improve policy outcomes related to climate change [53].

In general, both the significance of environmental policy efforts being isolated (or not) from efforts related to other issues as well as the development of strategies for avoiding any resulting negative impacts are important questions for future research [7,56]. These issues are central to understanding not only the emergence and cultivation of climate compatible development, but the actual importance of such efforts as well. Future research will also need to unpack the feedbacks likely taking place as

past policy efforts to address these interrelated issues influence future efforts [10]. For example, while the debt burden variable was included as an indicator of an existing need for efficiency as a driver, it is also possible that the causality works in the opposite direction and those cities more capable of forging connections between development and other policy concerns end up having a lower debt burden.

This study was an initial exploratory attempt to quantitatively examine the emergence of potential climate compatible development or triple-wins. The development of overlaps between policy issues is a complex political process that evolves over time as challenges and conditions change [8,10,11]. This complexity only increases when weighing the multiplying interconnections between economic development, sustainability, mitigation, and adaptation considerations that give rise to climate compatible development or triple-wins. Furthermore, differences in perceptions about climate compatible development itself are another layer that needs further exploration. This particular analysis allowed cities to self-identify their own notion of climate compatible development because they could self-identify which policy considerations were relevant to their actions. While I've argued that this analysis strategy is useful for identifying nascent potential efforts; the further development of a theory of climate compatible development and triples-wins as well as successfully realizing these goals on a wide scale will require understanding implementation and developing practical common standards for impact assessment. Unpacking the factors that underlie the emergence, development, and ultimate impact on policy outcomes of these complex efforts will require dedication and nuance from policy researchers for years to come.

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