Think Globally, Act Locally:
Adoption of Climate Action Plans in California

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Abstract

California has been a global leader in reducing greenhouse gas (GHG) emissions. The state has set an ambitious goal of reducing GHG to 1990 levels by 2020, and 80% below 1990 levels by 2050. The statewide goal cannot be accomplished without the support of local stakeholders. We analyzed over 150 city climate action plans (CAPs) in California and examined their reduction goals. We hypothesized five sets of factors that can explain whether a jurisdiction adopts a plan or not, and what kind of target it sets. We find that size of the city, political ideology, institutional capacity are related to a higher chance of adopting a climate action plan, while political ideology and environmental vulnerability explain the extent of aspiration of targets. We also find evidence of policy diffusion where neighbors are more likely to adopt plans. Our findings identify gaps in the CAPs within the state and address what lessons can be learned from the Californian experience of local climate policy adoption and goal-setting.

1. Introduction

Worldwide, cities and counties are increasingly becoming a locus of activity and concern regarding the onset of climate change. Concern stems from the potential vulnerability that many municipal areas, and the growing urban populations they support, may have to the effects of climate change. This environmentally-conscious activity arises in cities and counties seeking to mitigate their greenhouse gas emissions and adapt to the local challenges that climate change may bring; in particular, such efforts take center stage in communities where higher forms of government leadership are lacking on these fronts. Indeed, national and international efforts to tackle climate change such as the Paris Climate Agreement and Sustainable Development Goals increasingly recognize the critical role of local policy[1].

In the U.S., where federal leadership on climate change over time has been uncertain, Climate Action Plans (CAPs) have become one particularly prevalent, voluntary way in which cities and counties have sought to formalize their local objectives and strategies to address climate change (Tang et al., 2013)[2]. The California Institute for Local Government (ILG) describes the plans as "comprehensive roadmaps that outline the specific activities that an agency will undertake to reduce greenhouse gas emissions."[3] CAPs' adoption in the U.S. began to accelerate from the mid-1990's onwards, partly in response to more widespread recognition of the challenge of climate change, and partly fueled by institutional support such as Environmental Protection Agency (EPA) grants and the Cities for Climate Protection (CCP) campaign led by the International Council on Local Environmental Initiatives (ICLEI) (Wheeler, 2008). Since then,

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[1] See the 2030 Agenda for Sustainable Development (https://sustainabledevelopment.un.org/post2015/transformingourworld) and the COP21 Paris Agreement (https://unfccc.int/sites/default/files/english_paris_agreement.pdf)

[2] See Center for Climate and Energy Solutions: https://www.c2es.org/document/climate-action-plans/

[3] See California Institute for Local Government: http://www.ca-ilg.org/climate-action-plans

CAPs have been adopted in 34 out of 50 states in the U.S.[4], with hundreds of plans adopted at the city or county level (Tang et al., 2013: 46).

Given the particularly strong support for the CAPs policy from within the state, the California case is a valuable opportunity to analyze how local climate policy dynamics operate in this type of supportive environment. Will the factors driving local climate policy adoption and aspiration differ from those identified in other, less climate-forward states, or at the nation-wide scale? Homsy and Warner (2015) find evidence that 'a supportive state policy environment correlates to a higher environmental policy adoption score among local municipalities' (61), while Sharp et al. (2011) do not find evidence that cities in California are more likely to join ICLEI than cities in other states, despite California's supportive policy environment. This study presents a detailed view of the local climate policy dynamics at play under an extremely supportive state policy regime.

1.1 California Climate Action Plans

California has long taken on a leadership role in the U.S. and has been at the forefront of more stringent policies to mitigate and adapt to climate change, including as a leader in the adoption of CAPs. California's landmark AB-32 legislation, the California Global Warming Solutions Act of 2006, set ambitious state-wide targets to reduce greenhouse gas (GHG) emissions to 1990 levels by 2020, and 80% below 1990 levels by 2050. California adopted its own state-level CAP to support the AB-32 legislation, and has encouraged the development of municipal CAPs through technical and financial assistance and incentives[5]. CAPs are comprehensive tools for local

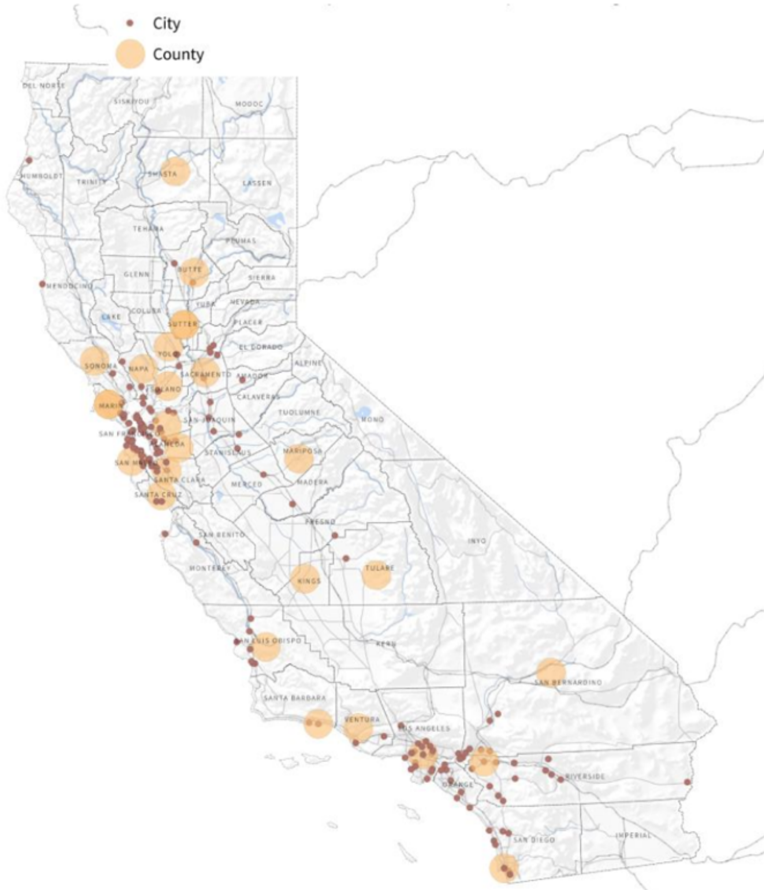
[4] See Center for Climate and Energy Solutions: https://www.c2es.org/document/climate-action-plans/
[5] See California Institute for Local Government: http://www.ca-ilg.org/climate-action-plans

California governments that outline the necessary steps to reduce GHG emissions. Partnering with other California state agencies, California Air Resources Board (CARB) has created a "Local Government Toolkit" to guide CAP planning.[6] CARB encourages local governments to set reduction targets "that is consistent with, or exceeds, the trajectory created by statewide goals". In addition, we observed that multiple jurisdictions hired the same consulting firms to draft their plans. As a result, while the content and length of the CAPs vary, they focus primarily on the theme of mitigation rather than adaptation.[7]

This study assembles an original dataset of CAPs adopted across the state of California, identifying a total of 160 CAPs out of 482 municipalities in California[8] - an adoption rate of 33%. CAPs are now one of the most prevalent climate change planning tools in California, over and above other planning documents such as General Plan Policies, Sustainability Plans and GHG Reduction Plans[9]. We focus this analysis on CAPs as they represent the most widely adopted local climate change planning tool in California[10]. Nevertheless, their rate of adoption is slowing, and geographically they are clustered in the wealthier coastal parts of the state (see Figure 1). As California continues to influence the climate policy of other states, greater analysis and understanding of the Californian context is likely to be of value as others move forward in their own climate change mitigation and adaptation efforts.

Figure 1. Geographic Distribution of Climate Action Plans

[6] Toolkit can be found here: https://www.arb.ca.gov/cc/localaction/localgovstrat.htm
[7] It is important to highlight that CAPs are just one type of official target dealing with GHG emissions. There are other planning documents, local ordinances that jurisdictions have adopted to address GHG emissions. See, for example, http://opr.ca.gov/docs/California_Jurisdictions_Addressing_Climate_Change_PDF.pdf
[8] See League of California Cities, as at 1 July 2011: http://www.cacities.org/Resources/Learn-About-Cities
[9] See California Governor's Office of Planning and Research: http://opr.ca.gov/docs/California_Jurisdictions_Addressing_Climate_Change_PDF.pdf
[10] Ibid.



Despite their popularity, open questions remain over what factors explain the patterns of CAP adoption in California, and what factors influence their aspirations as goal-setting documents. A number of studies have analyzed the factors influencing climate policy adoption across the U.S. (Gerber, 2013; Hughes et al., 2018; Krause, 2012b; Lubell et al., 2009; Sharp et al., 2011; Zahran et al., 2008), with a small number focusing specifically on municipal CAPs (Wheeler, 2008; Krause, 2012a; Tang et al., 2013; Bassett and Shandas, 2010). However, generally these studies do not take the further step of analyzing the relationship between why communities may initially adopt a policy and the ultimate content of that policy.

This study tests a number of hypotheses to explore why cities initially adopt CAPs and what factors influence their targets. In the following section, we discuss five sets of factors that can explain whether a jurisdiction adopts a plan or not, and what kind of target it sets: community social capital, political ideology, institutional capacity, environmental vulnerability, and policy diffusion. We find that size of the city, political ideology, and institutional capacity are related to a higher chance of adopting a climate action plan, whereas political ideology and environmental vulnerability explain the extent of aspiration of targets. We also find evidence of policy diffusion where neighbors are more likely to adopt plans. Our findings help to identify gaps within the state of California where vulnerable communities are lacking their own CAPs, and how the factors influencing the adoption and aspirations of local climate policy in California may differ (or not) from other state contexts. Our finding will be of value to policy-makers in the state as well as others monitoring developments in this climate policy-forward region.

2. Theoretical framework: Who adopts a Climate Action Plan?

Several studies have explored the question of why local and state governments may adopt policies to produce the non-local good of climate change mitigation. Broadly speaking, the policy decision-making analysis has focused around five explanatory categories: (i) community social capital, (ii) institutional capacity, (iii) political ideology, (iv) environmental vulnerability, and (v) networks and diffusion.

Berry and Berry (1999) make an important contribution to the literature in distinguishing between 'internal' motivators for policy innovation (such as local ideology, vulnerability, wealth, and capacity, etc.), and 'diffusion' models whereby policy is adopted as a result of ideas being shared between networks and neighbors. Subsequent work in these fields has concluded that a mixture of both internal and diffusion factors plays a role in policy adoption (Bassett and Shandas, 2010: 437; Homsy and Warner, 2015), with internal factors potentially playing a more decisive role among ‘policy entrepreneurs’ and early adopters, and diffusion factors playing a greater role as a policy becomes a more established status quo.

While these five explanatory categories are broadly recognized, previous findings in each category have varied in their magnitude, and even sometimes in their direction. In addition, the majority of such work is still focused on state-level policy (Chandler, 2009; Matisoff, 2008; Huang et al. 2007) despite the ongoing 'Devolution Revolution' (Godwin and Schroedel, 2000: 761) in the U.S. that highlights local policy-making and innovation, particularly in relation to climate and environment. There is also a dearth of literature about how these same factors may subsequently influence the *content* of any policy adopted – particularly in the case of policy such as CAPs, which are highly tailored to their local environment and yet cumulatively are expected to reflect the vision of state-level policy.

2.1 Community Social Capital

In his seminal work, Putnam (1993) coins the term ‘social capital’ to refer to features of social organizations, such as networks, institutions, norms and trust that facilitate action and cooperation for mutual benefit. The theoretical concept is abstract and is often measured empirically by a diverse set of socio-demographic characteristics. The literature has identified some characteristics that are associated with higher likelihood to adopt more vigorous climate mitigation and adaptation strategies. Qualitative studies such as Marsden et al. (2010) and Hunt

& Watkiss (2011) find that it is large and prosperous cities (London, New York, L.A., etc.), particularly in the developed world, that have the most comprehensive and technically advanced climate plans. This is perhaps not surprising as these global cities can draw on a well of wealthy citizens with higher levels of education. Post-WWII, the increase in economic affluence led to an intergenerational shift from materialist to post-materialistic values among many Western societies (Inglehart 1981; 1997). The new generations furnish ideologues and core support for many of the environmental movements. Florida (2002) highlights, in the book 'Rise of the Creative class', that areas with high diversity will increasingly attract creative and highly-educated people, who generate economic growth. This clustering of creative human capital creates increasingly populous, educated, diverse and wealthy areas that value, among other things, protection of the environment.

Numerous previous studies have identified a positive correlation between local climate policy adoption and population size, education level, and income level (Lubell et al., 2009; Sharp et al., 2011; Zahran et al., 2008). In addition, there is contradictory evidence that home ownership may be positively or negatively correlated with climate policy adoption (Fischel, 2001; Homsy and Warner, 2015), due to hypothesized greater attachment and investment in a place. One factor that has not been widely addressed in the literature is whether the racial diversity of an area may be correlated with climate policy adoption. However, in line with Florida's theory that highly diverse areas attract an environmentally-progressive creative class, we predict that more racially diverse areas will also be more likely to adopt a CAP and set more aspirational targets.

In this study, we group the characteristics of racial diversity, income level, education level, home ownership, employment rate, and population size under the heading of 'community social capital' and make the following two hypotheses:

H1a: Jurisdictions with greater community social capital are more likely to adopt a Climate Action Plan.

H1b: Jurisdictions with greater community social capital are more likely to set more ambitious CO2 emissions reduction targets in their Climate Action Plan.

2.2 Institutional Capacity

Several quantitative and qualitative studies find that communities with the greatest capacity, in terms of financial, institutional, and knowledge-based resources, are most likely to adopt climate change mitigation policy. Wheeler (2008) and Bassett & Shandas (2010) find that fiscal and capacity constraints are most commonly self-reported by policy-makers as impediments to policy adoption, even where the policy-makers themselves view the issue as a 'moral imperative' (Wheeler, 2008: 484). Quantitative evidence appears to corroborate these findings. Ryan (2015) argues that government capacity factors are necessary but insufficient drivers for climate policy implementation. Krause (2012a) finds that institutional capacity (in terms of staff capacity) and fiscal constraints are the two factors with the most predictive power in explaining variation in a constructed Municipal Climate Protection Index based on survey responses from U.S. cities. Both Krause and Sippel & Jenssen (2009) draw on policy-makers' own perceptions of the key enablers and constraints in adopting climate policy, with a lack of financial resource the most commonly cited constraint according to Sippel & Jenssen. In a survey released in 2016, cities in the Cities Climate Leadership Group also reported internal governmental capacity and financial resources as two key constraints in achieving climate action[11]. While self-reported data may be open to bias, other quantitative studies draw on objective measures of wealth and capacity with similar findings (Huang et al., 2007; Bromley-Trujillo et al., 2016). Hence, we hypothesize that:

H2a: Jurisdictions with greater institutional capacity are more likely to adopt a Climate Action Plan.

H2b: Jurisdictions with greater institutional capacity are more likely to set more ambitious CO2 emissions reduction targets in their Climate Action Plan.

2.3. Political Ideology

In U.S.-based studies, the link between political ideology and enacting climate change mitigation policy is well established. Concentration of self-identified Democrats and ideological liberals in a given area, as shown through elected representatives or interest group membership, is found to be consistently associated with a higher likelihood of adopting climate change policies (Krause, 2012a; Brody et al., 2008; Matisoff, 2008; Huang et al., 2007; Bromley-Trujillo et al., 2016). Rational policy actors, it is argued, have an interest in meeting the demands of groups in their jurisdiction that have the most resources (whether political or economic) and are the most organized in their demands. Policy makers, particularly at the local level, must be able to gain the co-operation of private actors in order to govern effectively (Krause, 2012a). Concerted political pressure on environmental issues is therefore highly likely to influence local government policy.

[11] See C40 Unlocking Climate Action in Megacities: https://www.c40.org/researches/unlocking-climate-action-in-megacities

Even in highly liberal areas, however, climate change mitigation policy can face a public goods problem. The benefits of climate change mitigation are largely diffuse and non-excludable, creating the problem that '[p]ublic opinion with respect to the environment is typically characterized by a high level of support for action but low levels of attention' (Harrison, 2007: 94). Collective action on these issues may be easier to achieve where there is a high degree of shared belief in 'what is natural, fair, and right' (Pendergraft, 1998: 643), which shared political ideology can help to illustrate. Concerted attention, particularly in the form of interest group pressure, can also be more influential than general public support or opposition on a particular issue. This can be seen in the empirical results of Bromley-Trujillo and Poe (2017) and Krause (2012a), who find interest group hypotheses to have strong explanatory power. A number of studies have therefore distinguished between the presence of broad-based liberal or Democratic values among the electorate (as shown through party membership or electoral outcomes) and presence of interest groups such as Sierra Club membership (Bromley-Trujillo & Poe, 2017; Bromley-Trujillo et al., 2016) or prevalence of certain polluting industries (Huang et al., 2007; Matisoff, 2008). In addition, Gerber (2013) demonstrates that ideology may impact the content of climate policies adopted, where areas with a Democratic electorate will be more likely to adopt 'external' climate policies (policies impacting the electorate), while areas with a Democratic elected official but not necessarily a Democratic electorate will be more likely to adopt 'internal' climate policies (policies impacting the internal operations of the local government).

This distinction is significant for our study, as it highlights some examples of how adoption of a policy and its ultimate content may diverge. While broad-based public support may be enough to adopt a CAP, more focused, on-going political pressure and attention from interest groups may cause the ultimate content of the CAP to be more or less ambitious than what would be in line with public expectations. In this study, we focus on a broad test of the role of ideology alongside other internal factors. We use a proxy independent variable of percentage of the local population registered as Democratic Party members to inform the below hypotheses:

H3a: Jurisdictions with a higher percentage of registered Democrats are more likely to adopt a Climate Action Plan.

H3b: Jurisdictions with a higher percentage of registered Democrats are more likely to set more ambitious CO2 emissions reduction targets in their Climate Action Plan.

2.4 Environmental Vulnerability

Environmental vulnerability as a motivator for policy innovation is a lesser explored area of the climate change literature, as, on a rational basis, risk considerations would not impact the likelihood of adopting a climate change mitigation policy. As the diffusion of greenhouse gases is a global phenomenon, local reduction of emissions does not have any causal effect on local risk factors (Krause, 2012a). Nevertheless, climate risk is a prominent form of climate communication with local policy-makers, as it pertains strongly to self-interest. Godwin & Schroedel (2000) find evidence that 'focusing events', such as climate disasters, that generate significant media attention can increase the likelihood of enacting relevant policy. Ormrod (1990) finds evidence that consideration of local conditions is a significant factor when considering whether or not to adopt an innovation. Nevertheless, the empirical evidence for the role of climate change vulnerability in adoption of policy is contradictory. Krause (2012a), for example, does not find robust evidence that climate risk is a significant predictor of climate policy adoption, while Brody et al. (2010) does find a correlation in combination with other variables. Zahran et al. (2008) find evidence that climate-change vulnerability is correlated with cities' decisions to join the Cities for Climate Protection Program, but that socioeconomic-capacity is a more significant factor. Jørgensen and Termansen (2016) find that farmers in Denmark generally acknowledge that climate change is real and have experienced adverse effects, but fail to cognitively link these adverse weather events to climate change, highlighting the complexity of operationalizing vulnerability for climate change action even where it is directly experienced.

Moreover, there is a dearth of literature on how vulnerability may impact the content of policy once adopted. Based on collective action theory, policy is more likely to be made if the local population gains excludable benefits (Olson, 1971). Given that climate change mitigation is a largely non-excludable benefit, lessening vulnerability to climate change impacts could be one excludable benefit that increases the likelihood that populations adopt a CAP – and which we could reasonably expect to be subsequently reflected in the aspirational content of the CAP. Based on the foregoing, we make the following hypotheses:

H4a: Jurisdictions that are more vulnerable to climate change are more likely to adopt a Climate Action Plan.

H4b: Jurisdictions that are more vulnerable to climate change are more likely to set more ambitious CO2 emissions reduction targets in their Climate Action Plan.

2.5 Policy networks and diffusion

Finally, networks and diffusion present perhaps the most contradictory evidence of any of the theories covered here. Importantly, many different kinds of networks may be active in the process of policy diffusion: horizontal (neighbor to neighbor); vertical (state to local government); and professional (via associations, institutions, consultants, etc.). Each type of network diffusion can imply different types of incentives and benefits that may shape the decision to adopt a policy and what form its content will take.

Marsden et al. and Hunt and Watkiss (2011), for example, suggest that influential cities or counties with an international presence, such as San Francisco or Los Angeles in California, can be instrumental in establishing norms that other communities seek to emulate. Basset and Shandas (2010) argue that 'policy entrepreneurs, networks, and consultants seem paramount in climate action planning, although geographic proximity is no longer important' (p.437). In particular, membership of professional networks such as ICLEI (Local Governments for Sustainability) has been well-documented as being valuable in unlocking financial, informational, and other resources for local governments (Betsill and Bulkeley, 2004, 2007), although Krause (2012b) finds only a weak positive impact of ICLEI membership on actual climate policy adoption. Hsu et al. (2017), building on the work of Andonova et al. (2009), identify three prevalent pathways through which horizontal or vertical policy diffusion may occur: information sharing, capacity building, and rule setting.

As we focus on just one state, California, where the state government has set a clear precedent with the state-wide CAP, meaningful hypotheses about vertical policy diffusion cannot be made in this study. A multi-state analysis would be a valuable next step in this regard. With regards to horizontal policy diffusion, Marsden et al. (2010) suggest that city-to-city policy transfer can be explained by patterns of human interactions. Peer knowledge exchange enables public servants to cut through a surplus of information available on climate change, and may lead to networks of communities adopting similar approaches. In addition, neighbors are likely to have similar contexts in terms of physical environment, socio-demographics, and other factors. This may encourage diffusion of policies that are seen to be successful in neighboring contexts.

However, evidence for this phenomenon is mixed. At the state level, several studies find that it is not necessarily physical proximity but similarity of context which determines diffusion of an innovation (Ormrod, 1990; Matisoff, 2008; Bromley-Trujillo et al., 2016), while others find the opposite (Berry & Berry, 1990; Grupp & Richards, 1975). At the local level, though, Brody et al. (2008) show that shared landscape characteristics between neighbors are a good predictor of policy adoption in the case of joining the Cities for Climate Protection Campaign, but Godwin & Schroedel (2000) find some weak evidence for this hypothesis.

With this theoretical debate in mind, we explore the theory of policy diffusion further with the below hypotheses:

H5a: Jurisdictions are more likely to adopt a Climate Action Plan if their neighbors have.
H5b: The targets of a given Climate Action Plan will be similar to those of its neighbors.

3. Data and Methodology

We built a comprehensive dataset to test our hypotheses. We began with the CAP records collected by the Institute of Governmental Studies at the University of California, Berkeley[12]. The collection includes over 160 county and city CAPs. For our analyses, we focus primarily on the city CAPs. We developed a database with the metadata for the CAPs, including information on name of jurisdiction, year of adoption, authors of the plan etc.

We read the plans and hand-coded the greenhouse gas emission reduction targets that had been set in each case, noting the baseline emissions and targeted annual reduction (as a percentage of baseline emissions and in mtCO_2e). In addition, we assigned a Long-Range Planning score (LRP) from 0 – 3 to each plan based on how many targets each plan had set. An LRP of 0 meant that the plan set no greenhouse gas reduction targets. An LRP of 1 meant that the plan set one greenhouse gas reduction target (usually a percentage reduction to achieve by 2020, the first milestone in California's statewide emissions reduction targets). An LRP of 2 meant that the plan set two greenhouse gas reduction targets (typically a percentage reduction to achieve by 2020 and another by 2030-2035), and an LRP of 3 meant that the plan set three greenhouse gas reduction targets, in-line with California's statewide plan milestones at 2020, 2030, and 2050.

We then merged that dataset with the California city and municipal Census records obtained from the National Historical Geographical Information System (NHGIS) website[13]. The Census demographic records came from the 2016 American Community Survey. To correspond to our theorized category of community social capital, we collected socio-demographic data including race, household income, education, employment rate, home ownership, and population size.

[12] https://igs.berkeley.edu/library/california-local-government-documents (Accessed September 30, 2017)
[13] https://data2.nhgis.org/main (Accessed September 30, 2017)

We then expanded our dataset with records from the City Consolidated Statement published by the California State of Controller's office[14]. The records listed the revenues, expenditures and fund balances of cities in 2016. The information is used to measure institutional capacity. To measure political ideology of our cities, we obtained the 2016 Report of Voter Registration from the California Secretary of State[15]. The dataset contains the partisan registration by city before the general election in 2016.

Lastly, to measure our cities' environmental vulnerabilities, we obtained data from the version 3.0 of the California Communities Environmental Health Screening Tool (CalEnviroScreen 3.0), which incorporates environmental, health, and socioeconomic information[16]. The CalEnviroScreen 3.0 is created by the Office of Environmental Health Hazard Assessment, on behalf of the California Environmental Protection Agency. The environmental hazard records are available at the Census tract level. We aggregated Census tract level records to city level. Table 1 provides a summary of the dependent and independent variables used in this study.

To model the likelihood to adopt a CAP, we ran a logistic regression with the dependent variable whether a city has adopted a CAP (1 if yes; 0 otherwise). We regressed on our four sets of independent variables, namely, community social capital, institutional capacity, political ideology and environmental vulnerability. To model what factors explained their stated reduction target by 2020 (which ranges from 4.5% to 36%), we ran an ordinary least square regression on

[14] https://bythenumbers.sco.ca.gov/City-Other-Data/City-Consolidated-Statement/e4s3-uwib/data (Accessed May 30, 2018)
[15] https://www.sos.ca.gov/elections/report-registration/ (Accessed September 30, 2017)
[16] https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30 (Accessed May 30, 2018)

the reduction target percentage. To model the extent of aspiration of the long-range planning goals (which ranges from 0 to 3), we ran an ordinal logistic regression on the LRP scores assigned. Lastly, we turned to the spatial error and spatial lag model to examine if policy diffusion occurred.

Table 1: Description and Sources of Variables

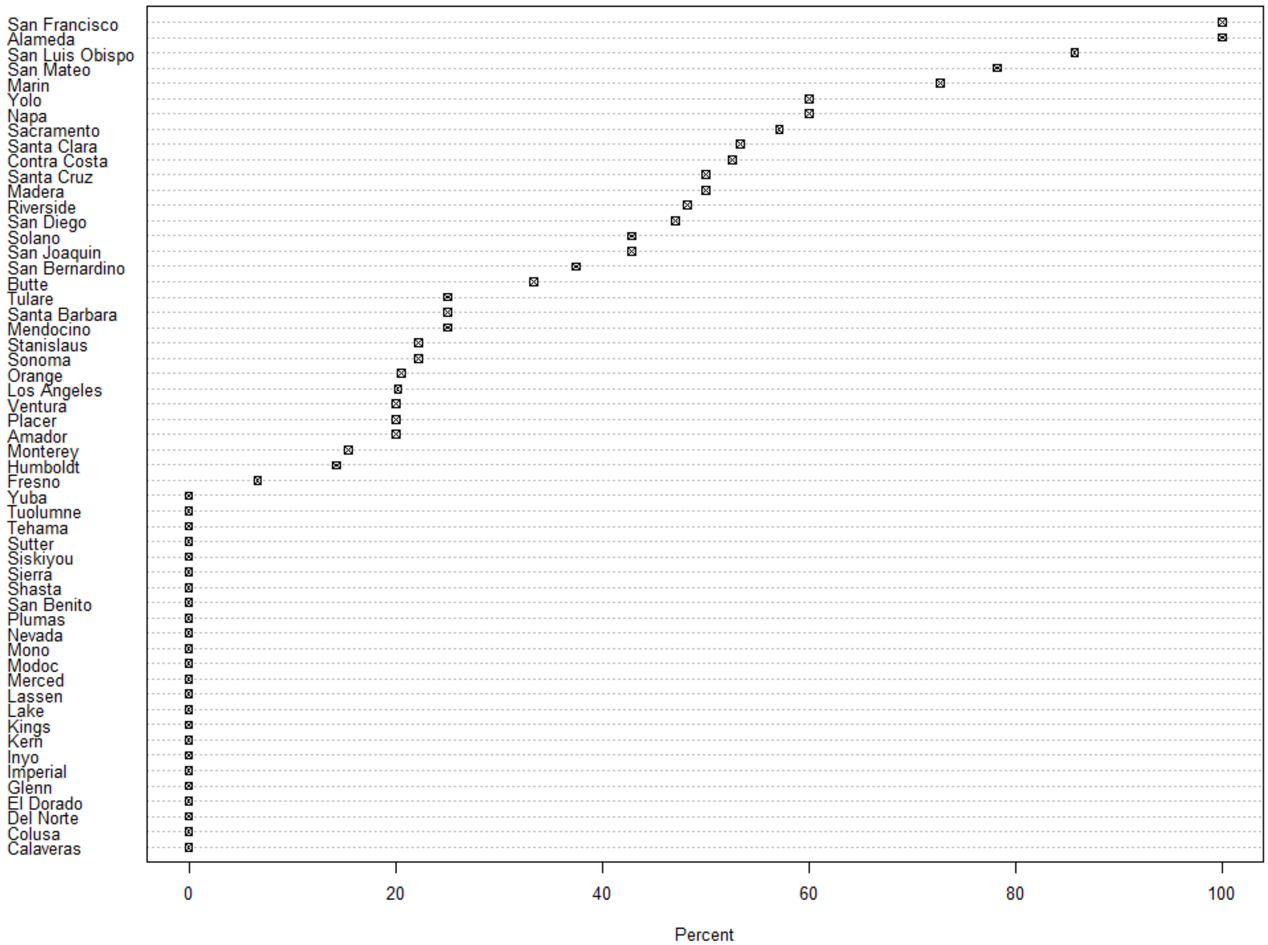
Category	Empirical Variables	Variable description	Source
Dependent variables	CAP	1 if a city has CAP; 0 otherwise	Institute of Governmental Studies CAP collection
	Stated emission reduction target	Specific GHG reduction target by 2020	Hand-coding from CAPs
	Long-range planning score	0 if no GHG target 1=GHG target set at 2020 2=GHG targets set beyond 2020 3=GHG targets set for 2020-2050	Hand-coding from CAPs
Community social capital	Various demographic measures		2016 American Community Survey
Institutional capacity	Total government expenditure	Proxy for size of government	2016 City Consolidated Statements
Political Ideology	Percentage of registered Democrats	Partisanship measure	2016 Report of Registration
Environmental Vulnerability	CalEnviroScreen 3.0 score	Index constructed of 12 pollution indicators and 8 population indicators to calculate a pollution burden score	CalEnviroScreen 3.0
	Ozone concentration in air	Air quality measure	
	Particulate matter 2.5 concentration in air	Air quality measure	
	Diesel particulate matter	Air quality measure	
	Traffic network density	Proxy for pollution from traffic	
Networks and diffusion	Latitude and longitude coordinates		

4. Results

Before we discuss the results from the regressions, we begin with some descriptive characteristics of CAPs for context. Altogether we retrieved 160 CAPs at the city level. The length varies substantially from about 9,000 to over 1,000,000 characters, with a mean of about 270,000 characters. The most frequent use of the words in the documents are: emiss(ion), reduction, GHG reduct(ion), energy use. The CAPs mostly discuss mitigation strategies, such as the use of efficient fuel, electric cars, efficient use of water etc., and little on adaptation strategies.

Figure 2 displays the proportion of cities that have adopted a CAP by county. San Francisco is both a city and a county, hence as a county its percentage of adoption is 100%. Surprisingly, all 14 cities in the Alameda County have adopted CAPs. Out of all 58 counties in California, 24 inland counties have not enacted a plan. Most of the plans were compiled and adopted between 2010 and 2015 (Online Appendix Figure A1 depicts the distribution of years in which the adopted plans were issued.)

Figure 2. Rate of Adoption by County



In Figures 3 and 4, we use boxplots to compare some socio-demographic, political and environmental characteristics of jurisdictions that have adopted a CAP versus those that have not. Figure 3 shows that on average, jurisdictions that have adopted CAPs tend to have higher median household income, larger population size, higher concentration of registered Democrats, as well as larger general expenditures. In Figure 4, we compare some environmental vulnerabilities faced by these jurisdictions. Intriguingly, contrary to our expectation, jurisdictions that have adopted CAPs tend to have *lower* concentration of ozone and particulate matter (PM)

2.5. However, these jurisdictions are more likely to experience heavy traffic and diesel particulate matter.

Figure 3. Box Plots of Key Demographic Characteristics by Adoption of Climate Action Plans

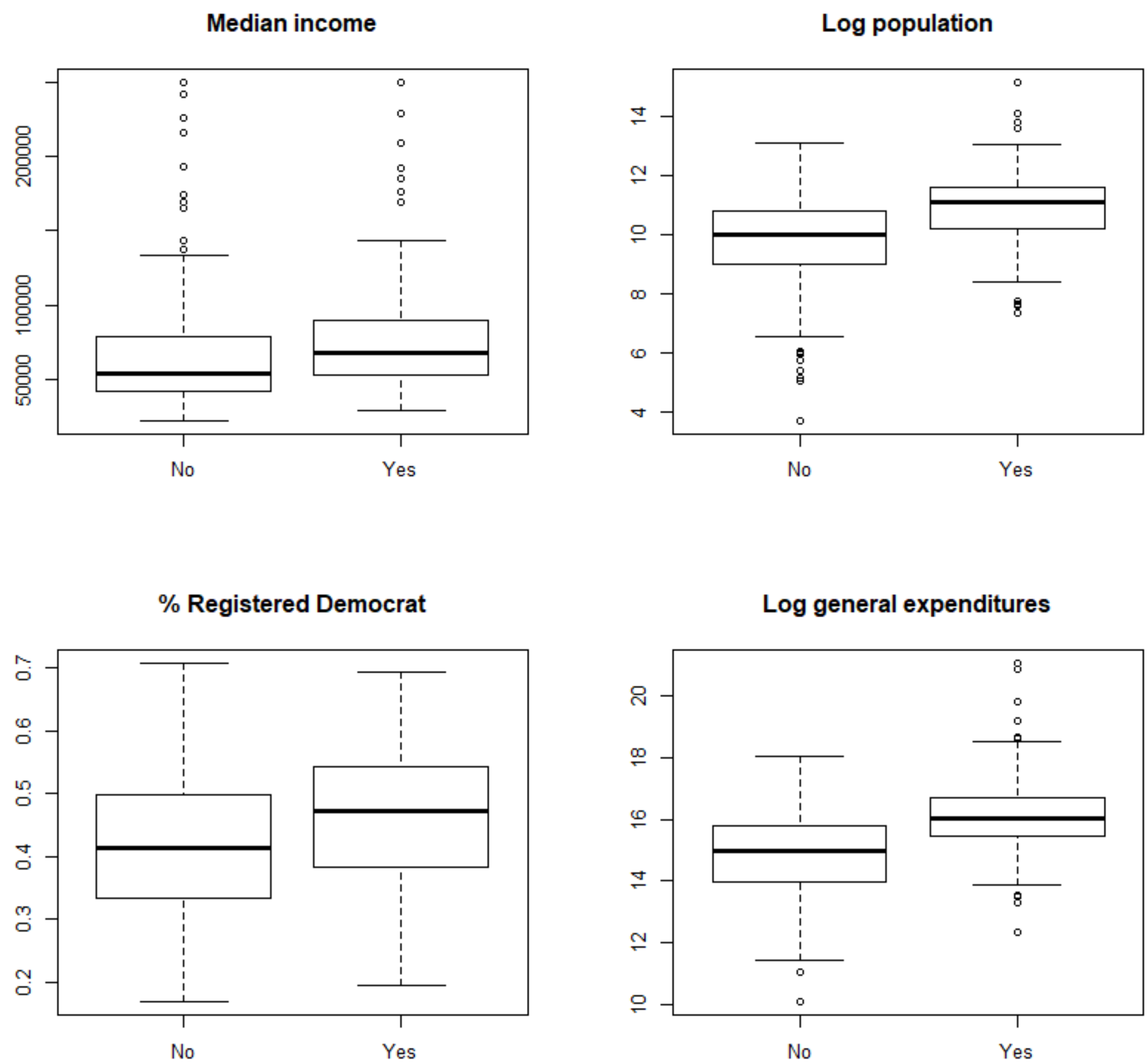
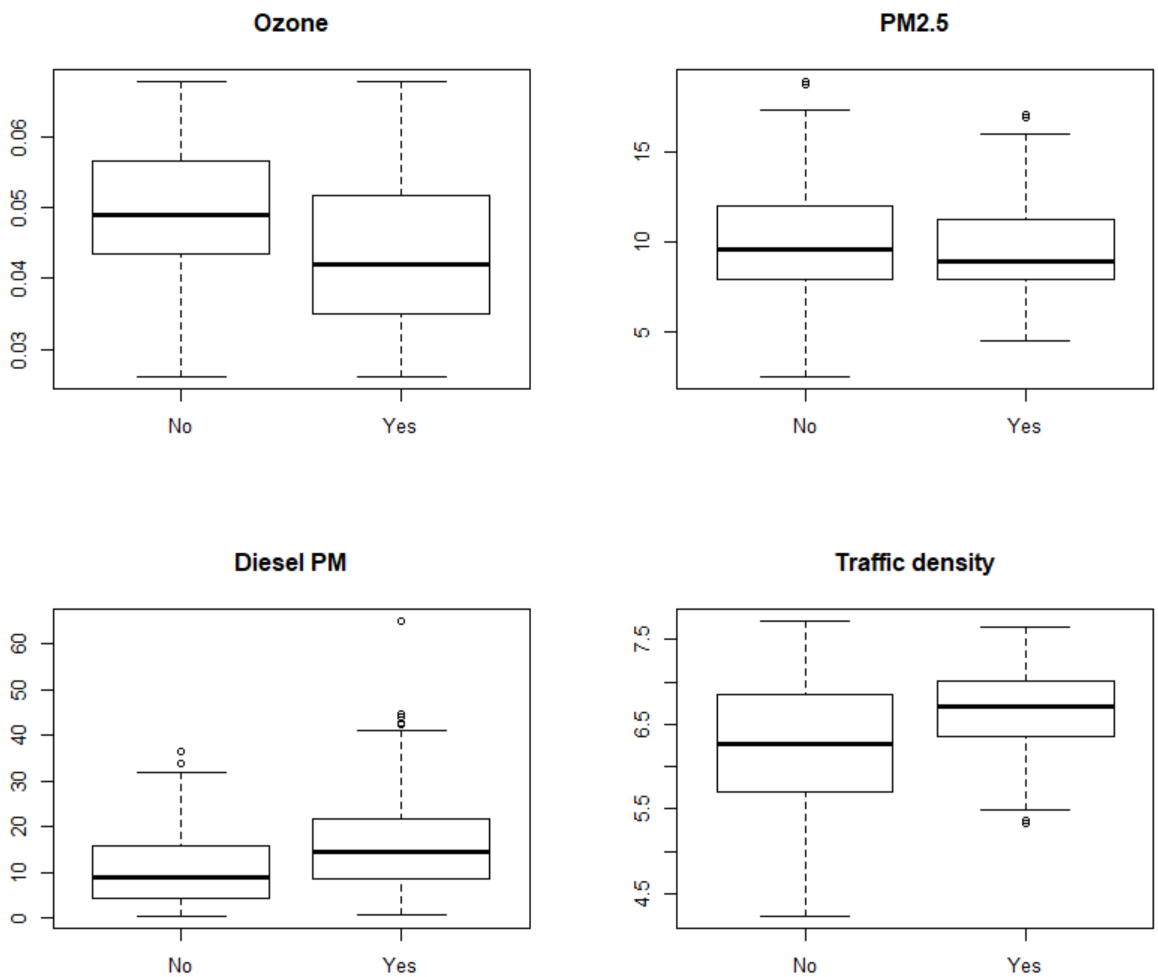


Figure 4. Box Plots of Key Environment Vulnerabilities by Adoption of Climate Action Plans



Next, we discuss our results from our regression analyses. In Table 2, we used a binary dependent variable of whether a city has adopted a CAP (1=yes, 0=no). In column I, we report regression coefficients and standard errors in parentheses for when we control for community social capital. Here we find that jurisdictions with larger population, higher median household income are more likely to adopt a plan. These areas tend to be high living cost area and hence home ownership is inversely correlated with the propensity to adopt a plan. In column II, we include the percentage of registered Democrats as a covariate in our regression to account for the political ideology of the place. The coefficient is positive and statistically significant at 0.01 level, indicating a strong tie between political ideology of a place and adoption of CAP. In column III, we then include a measure of the size of general government expenditure to account for the place's institutional capacity. The coefficient on this variable, again, is positive and statistically significant at 0.05 level. As we have already controlled for population size in the model, this finding indicates that cities with larger per capita institutional capacity are more likely to adopt a plan. Lastly, in column IV, we expanded the model with measures of environmental vulnerabilities as covariates.[17]We already observed mixed patterns in the boxplots in Figure 5. The logistic regression results show that, unsurprisingly, none of the vulnerability factors drive the adoption of plan.

In Table 3, we examined two other dependent variables. In column V, we used the 2020 greenhouse gas emissions reduction target as our dependent variable. We find that two explanatory factors – namely, percent of registered Democrats and concentration of diesel particulate matter – are statistically significant in predicting the extent of aspiration of the target, at the 0.05 level and 0.001 level respectively. Political ideology and particulate matter concentration also play a key role in predicting whether a city has a higher long-range planning score, which we test in column VI. Intriguingly, ozone concentration and CalScreenScore 3.0, which is a combined index of pollution burden, are *negatively* correlated with a longer-range planning score here. We believe this negative relationship stems from the fact that many cities in

[17] There is a concern that perhaps these variables are highly correlated and multicolinearity may explain why none of the environmental vulnerability coefficients are statistically significant at 0.05 level. We have experimented with various specification of the model and inclusion of variables and yet arrived at the same conclusion. We also tried re-specifying our models *without* the variable, EnviroScreen Score 3.0 and only retained the air pollution indicators (Ozone, PM2.5, Diesel PM) in our models. We arrived at the same conclusion, the EnviroScreen score was not statistically significant at 0.05 level.

the Central Valley experience high air pollution but have not yet engaged in long range planning.[18]

Table 2. Modeling the Likelihood of Adopting a Climate Action Plan

	Specification I	Expanded Specification II	Expanded Specification III	Expanded Specification IV
Intercept	-22.807***	-19.326***	-19.774***	-10.314
	(5.374)	(5.452)	(5.484)	(7.951)
% White	0.022	0.035	0.029	0.034
	(0.021)	(0.022)	(0.022)	(0.024)
% Black	0.063	0.035	0.025	0.035
	(0.036)	(0.037)	(0.037)	(0.041)
% Asian	0.027	0.036	0.030	0.034
	(0.024)	(0.025)	(0.025)	(0.027)
% Hispanic	-0.007	-0.005	-0.007	0.000
	(0.015)	(0.016)	(0.016)	(0.019)
% Less than high school degree	-0.018	-0.050	-0.044	-0.039
	(0.028)	(0.029)	(0.030)	(0.033)
Log(Median household income)	1.951*	1.700*	1.555*	0.463
	(0.758)	(0.789)	(0.778)	(0.976)
% Own home	-0.047***	-0.031*	-0.025	-0.013
	(0.012)	(0.013)	(0.014)	(0.016)
Log (Median rent)	-0.588	-1.360	-1.384	-1.305
	(0.863)	(0.930)	(0.918)	(1.117)
% In labor force	-0.013	-0.029	-0.033	-0.028
	(0.018)	(0.019)	(0.020)	(0.022)
Log (Population)	0.639***	0.795***	0.558***	0.758***
	(0.112)	(0.127)	(0.163)	(0.209)
% Democrat		6.685***	6.376***	5.681**
		(1.421)	(1.425)	(1.781)
Log(General Government Total Expenditures)			0.334*	0.315
			(0.167)	(0.200)
CalEnviroScreen score				-0.030
				(0.025)
Ozone				-12.067
				(18.488)

[18] In addition, based on the recommendation of our journal reviewer, we located a dataset from CAL FIRE which lists the cities for which CAL FIRE has made recommendations on very high fire hazard severity zones. (http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_maps_citylist). We added this variable to our models but it is not statistically significant at 0.05 level. That is, there is no linkage between potential fire hazard and adoption of CAP. The result is shown in Online Appendix Table A1.

Particulate Matter 2.5				-0.032
				(0.072)
Diesel Particulate Matter				0.032
				(0.025)
Traffic network density				-0.000
				(0.000)
Log-likelihood	-245.267	-231.063	-228.831	-205.447
BIC	558.604	536.262	537.948	520.375
N	487	482	481	438

***p<0.001; **p<0.01; *p<0.05

Table 3. Modeling Factors that Affect Reduction Target and Long Range Planning Score

	V[19] Extent of reduction target	VI[20] Long range planning score
Intercept	97.633*	
	(38.640)	
% White	0.013	-0.028
	(0.114)	(0.032)
% Black	-0.019	0.028
	(0.168)	(0.051)
% Asian	-0.006	-0.024
	(0.128)	(0.038)
% Hispanic	0.108	0.048
	(0.103)	(0.030)
% Less than high school degree	-0.271	-0.046
	(0.182)	(0.055)
Log(Median household income)	-6.722	1.031***
	(4.910)	(0.305)
% Own home	0.095	-0.024
	(0.079)	(0.019)
Log (Median rent)	0.526	-1.409***
	(6.045)	(0.216)
% In labor force	-0.203	-0.017
	(0.144)	(0.033)
Log (Population)	1.034	0.044
	(0.974)	(0.265)
% Democrat	19.104*	0.818***
	(8.504)	(0.024)

[19] We used ordinary least square regression. Dependent variable ranges from 4.5 to 36%.
[20] We used ordinal logistic regression. Dependent variable takes on value from 0 to 3. Intercept coefficients not shown in the Table.

Log(General Government Total Expenditures)	-1.397	-0.133
	(0.884)	(0.250)
CalEnviroScreen score	-0.147	-0.069*
	(0.121)	(0.029)
Ozone	-64.949	-42.063***
	(89.351)	(0.001)
Particulate Matter 2.5	0.345	0.220*
	(0.392)	(0.099)
Diesel Particulate Matter	0.284***	-0.021
	(0.078)	(0.024)
Traffic network density	-0.002	0.000
	(0.002)	(0.001)
Adjusted R-squared	0.125	
N	118	148

***p<0.001; **p<0.01; *p<0.05

Finally, we tested our hypothesis about policy network diffusion. Since our interest is in whether diffusion occurred, we only present the spatial lag and spatial error results in Table 4 to highlight our quantities of interest.[21] The spatial lag model suggests a direct spatial interaction occurred meaning that neighbors are more likely to adopt CAPs. The spatial error model also indicates statistically significant spatial autocorrelation remains even after controlling for socio-demographic, political and environmental factors. When we turned to reduction targets, however, the spatial relation disappeared. In other words, neighbors are likely to adopt plans together but often with different, localized targets.

Table 4. Modeling Spatial Dependency Among Neighbors

Dependent variable: has plan or not

Spatial lag model			
Rho	0.19	p-value	0.0013
Spatial error model			
Lamda	0.20	p-value	0.0038

[21] We created our neighbor adjacency matrix with k-nearest neighbors, where k was set to 4.

Dependent variable: 2020 target reduction			
Spatial lag model			
Rho	0.044	p-value	0.76
Spatial error model			
Lamda	-0.25	p-value	0.24

5. Discussion & Conclusion

In summary, we find that population size, political ideology, and local government institutional capacity are related to a higher chance of adopting a climate action plan, while political ideology and certain types of environmental vulnerability explain the extent of aspiration of targets. We also find evidence of policy diffusion where neighbors are more likely to adopt plans, but that communities do not necessarily emulate the targets that their neighbors set. These findings are broadly consistent with our hypotheses and existing research. In the following section we question how this information can be leveraged for on-going climate policy in California and beyond.

At the time of writing, California has recently met its 2020 greenhouse gas emissions reduction targets ahead of schedule, and Governor Brown has signed an ambitious new Executive Order, B-55-18, to achieve carbon neutrality by 2045. Arguably, a large part of the progress in the future will be driven by state-level policy aimed at increasing renewable energy in the grid and raising automobile fuel emissions standards. But to fulfill the most ambitious long-term goals, actions taken by local governments will be crucial. Our analysis finds that of the 160 CAPs currently adopted among the 482 municipalities of California, the majority (57%) have only set emissions reductions targets to 2020 (a long-range planning score of 1). While these significant near-term efforts to reduce emissions are crucial (Figueres et al., 2017), this also implies a large-scale effort required in the next few years to update many of the existing plans with revised goals to 2030 and beyond, as well as to formally assess progress against the 2020 targets already set. Furthermore, cities have to redouble their reduction efforts to meet the 2030 state-wide target of 40% below 1990 levels (and which is likely to be increased in the wake of the new goal of carbon neutral by 2045).

An obvious open question that remains is whether CAPs are in fact conducive to achieving greenhouse gas emissions reductions. This is most likely something that will only begin to come to light as the first 2020 target approaches and CAPs go through the process of being evaluated and updated, often for the first time since being adopted. We see the long time-lag between plan creation and evaluation as a critical gap in California's emissions reduction strategy, which can allow targets to fall out of focus for elected local officials operating under shorter electoral and budgetary time-horizons. While the state cannot mandate regular updates, providing further technical and financial resources to review and update the plans every five years could be a valuable improvement.

However, this also brings up a problem of scarce local resources, and the pressure of regular updates may further dissuade poorer communities that lack institutional capacity from adopting CAPs in the first place. The state offers a variety of support such as a "local government toolkit," but due to the voluntary nature of CAPs this is not perhaps as actively targeted and promoted as it could be. Policy organizations beyond the state such as Local Governments for Sustainability (ICLEI) and Cities for Climate Protection (CCP) also provide valuable resources and support for municipalities seeking to implement CAPs; however, municipalities must a priori know how to seek out and tap into these networks proactively and effectively. Municipalities that are already short on institutional resources may be less likely to do this, and could benefit from more targeted state-led guidance or resource support in order to adopt a plan. Our findings reinforce the point that while institutional capacity may not subsequently influence how ambitious the reductions targets set are, it is a first hurdle to overcome in whether a community adopts a CAP or not. As such, a valuable next step may be targeted state-sponsored programs that can more effectively channel knowledge-based resources and funding to the communities that our model predicts will not adopt a CAP otherwise.

Our results also showed that, for California, Democratic ideology is among the most powerful predictors of whether or not a community will adopt a CAP and the extent of aspiration of the targets they set. We see this effect at work in extremely liberal communities such as the cities of Santa Cruz or San Francisco, where the percentage of registered Democrats ranks in the top quartile in our data, they have a long-range planning score of 3 and 2 respectively, and their targets set a more ambitious reduction path than the state-wide targets. While the average target is about 17%, San Francisco and Santa Cruz aimed to reduce emission at 25% and 30% below by 2020, respectively. Conversely, areas with a lower percentage of registered Democrats are less likely to adopt a plan, and if they do, set weaker targets. The issue of partisan division over climate change is a particularly important and difficult one to address in California and the United States more generally. This may be a valuable area for future comparative work to better understand how political ideology interacts with climate policy adoption and aspirations in various state contexts.

Our findings suggest two possible policy routes to attenuate the negative relationship between climate policy and lower percentage of registered Democrats. Firstly, we see significant overlap of lower income areas and areas that have a lower percentage of registered Democrats. Insofar as we have shown that local institutional capacity has a statistically significant effect separate from ideology on adoption of a CAP, the measures suggested above to target funding and knowledge-based support to these areas may help to increase uptake. Indeed, Lubell et al. (2009) find that cities in the more conservative Central Valley region of California are following a similar trajectory of increasing sustainable policy adoption as these cities grow and transition away from traditionally agricultural economies to become more populous, with wealthier and more educated populations. This would suggest that institutional capacity support may help to accelerate these changes. Secondly, given that we find a statistically significant effect of policy diffusion between neighbors, state policy might be most effective when targeting county-level adoption of CAPs where the county as a whole is more Democratic than individual cities within its boundaries. Our data shows that county-level adoption of CAPs in areas such as Alameda County has been effective in promoting or mandating adoption of CAPs by the cities within their boundaries.

Previous research has also focused on the role that different framings of climate change and emphasis of co-benefits may have on willingness to act (Maibach et al., 2010; Nisbet, 2009; Zia and Todd, 2010; Sharp et al., 2011). One particularly salient framing, given our findings, may be linking public health outcomes to climate change mitigation actions, as we see that concentration of diesel particulate matter is a statistically significant predictor of CAPs adoption and extent of aspiration of targets set. This may be of use in the more conservative Central Valley region of California, where air pollution is high.

The mixed significance of environmental vulnerability in our analysis highlights the perennial problem that local climate change mitigation actions face: trying to mobilize collective action in order to produce a non-local good. In this sense, it should not be surprising that the saliency of environmental vulnerability is limited to those factors which are more visible and can be more directly linked to greenhouse gas emissions, such as higher concentrations of diesel particulate matter from 'nuisance' pollution such as traffic congestion that citizens are more likely to be directly aware of. On the one hand, this effect is valuable, as currently 41% of Californian greenhouse gas emissions come from transportation[22], and local efforts to reduce reliance on automobiles and their associated emissions (through zoning, creation of bicycle lanes, etc.) will contribute to much-needed reductions. However, for areas at high risk of adverse environmental impacts from climate change that are less immediately visible (such as sea level rise, increased risk of wildfire, flooding, or temperature extremes), these findings can be concerning.

Our review of the content of the CAPs in our analysis finds that climate adaptation measures are generally not considered alongside mitigation measures in these documents. Although the State encourages local jurisdictions to develop adaptation plans through other venues[23], this may be a missed opportunity to conceptually link climate change mitigation efforts to climate change effects and increase the saliency of these efforts for local populations. Previous literature considering the linkage of climate change mitigation and adaptation in policy highlights that when not considered together, these policies may cross-cut one another and undermine

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[22] See California Air Resources Board 2018 Greenhouse Gas Emissions Inventory: https://www.arb.ca.gov/cc/inventory/data/data.htm

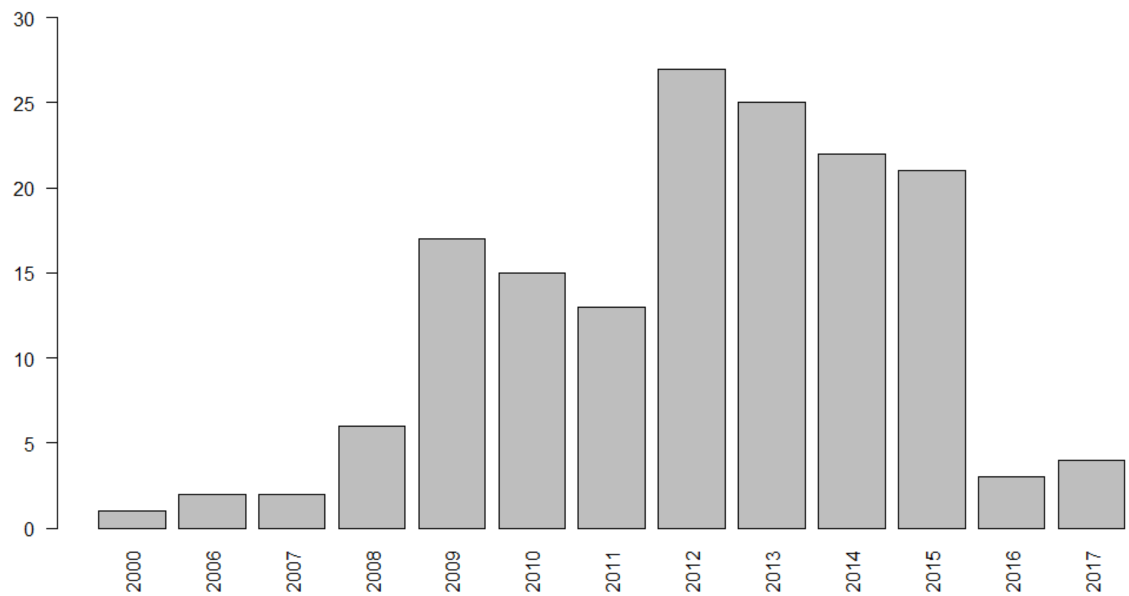
[23] For example, coastal jurisdictions are encouraged to develop separate plans to address the rising sea level problems. http://www.opc.ca.gov/planning-for-sea-level-rise-database/

efficiencies and effectiveness (Kane and Shogren, 2000; Laukkonen et al., 2009). We therefore emphasize this as a potential area for change in practice as communities begin to prepare updates to their plans post-2020.

In conclusion, this paper provides valuable insight into the drivers of local climate policy using an original dataset of the CAPs adopted to date in California. Our analysis identifies some key gaps limiting the expansion of these policies in the state, chief among which are the institutional capacity and ideological hurdles among inland, more conservative cities, and the opportunity for more explicit linking and framing of co-benefits in terms of environmental health and climate adaptation . We hope that future work will expand on this analysis to consider comparative work between states that may shed further light on California's status as an exception or the norm when it comes to local climate policy adoption and aspiration.. Finally, the upcoming target date of 2020 is likely to trigger a wave of CAP updates and reviews of success in achieving emissions reductions thus far. This will provide a valuable opportunity to evaluate the real environmental impact of CAPs, and consider how to increase their effectiveness, ambition, and expand their uptake to a broader range of communities.

Online Appendix

Figure A1. Year of Adoption of CAP



Online Appendix Table A1. Relationship between Potential Fire Hazard and Adoption of CAP

For details, see footnote 18.

	Specification I	Specification II	Specification III	Specification IV
Intercept	-22.809***	-19.312***	-19.771***	-10.212
	(5.377)	(5.446)	(5.482)	(7.956)
% White	0.022	0.035	0.029	0.034
	(0.021)	(0.022)	(0.022)	(0.024)
% Black	0.063	0.036	0.025	0.036
	(0.036)	(0.037)	(0.037)	(0.041)
% Asian	0.026	0.036	0.031	0.034
	(0.024)	(0.025)	(0.025)	(0.027)
% Hispanic	-0.007	-0.005	-0.007	0.000
	(0.015)	(0.016)	(0.016)	(0.019)
% Less than high school degree	-0.019	-0.049	-0.044	-0.038
	(0.028)	(0.029)	(0.030)	(0.034)
Log(Median household income)	1.940*	1.726*	1.567*	0.492
	(0.762)	(0.793)	(0.783)	(0.982)
% Own home	-0.047***	-0.031*	-0.025	-0.013
	(0.012)	(0.013)	(0.014)	(0.016)
Log (Median rent)	-0.572	-1.404	-1.402	-1.360
	(0.871)	(0.942)	(0.929)	(1.134)
% In labor force	-0.013	-0.028	-0.032	-0.028
	(0.018)	(0.020)	(0.020)	(0.022)
Log (Population)	0.642***	0.789***	0.557***	0.754***
	(0.114)	(0.128)	(0.163)	(0.209)
Very high fire hazard warning	-0.034	0.085	0.033	0.092
	(0.247)	(0.259)	(0.261)	(0.291)
% Democrat		6.746***	6.402***	5.684**
		(1.435)	(1.440)	(1.781)
Log(General Government Total Expenditures)			0.333*	0.316
			(0.168)	(0.200)
CalEnviroScreen score				-0.029
				(0.025)
Ozone				-13.731
				(19.222)
Particulate Matter 2.5				-0.031
				(0.072)
Diesel Particulate Matter				0.032
				(0.025)

Traffic network density	-0.000
	(0.000)