Tracking Municipal Climate Action Plan Progress in the State of California

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ABSTRACT

Climate change represents the most significant financial and ecological threat of a generation. The reduction of greenhouse gas emissions in major cities is an effective way to combat and limit warming. Increasingly, Climate Action Plans (CAPs) represent a means for local governments to address climate change by voluntarily adopting emission reduction targets. I evaluated California cities with adopted climate action plans to determine what actions they have taken to update their progress post-adoption, and assessed how certain financial and political factors associate with the progress updates. Of 161 cities analyzed, a majority have taken some steps to update their progress. I found a statistically significant relationship between the political ideology of city residents, per capita municipal expenditure, and whether a city had provided updates on its climate action plan progress. Future investigation of the relationship between these factors on CAP implementation is needed, with particular emphasis on efficacy of aforementioned CAPs in realizing emission reductions.

KEYWORDS

climate change, municipal policy, greenhouse gas, emissions inventory, climate policy

INTRODUCTION

Climate change represents one of the most significant and pressing threats facing the world today. Limiting warming to 1.5 or even 2.0 degrees C this century will require coordinated international effort to realize swift and significant reductions in greenhouse gas (GHG) emissions (Masson-Delmotte et al. 2021). With over half of the global population residing in urban areas, human activities in cities account for a significant portion of the world's greenhouse gas emissions each year. Current estimates attribute approximately two thirds of global energy use and 70% of global CO2 emissions to cities (UN Habitat 2011). Energy used to power residential, commercial, and industrial building and transportation are the greatest emitting sectors within cities (Wei et al. 2021). Cities are also particularly vulnerable to the impacts of climate change. For example, as urbanization replaces natural land cover with low-reflective, heat retentive, and impervious surfaces such as pavement, cities are at risk of heat waves and urban flooding exacerbated by extreme weather events driven by climate change (Sailor 2014; Pallathadka et al. 2020). Given their contributions, and vulnerability, to climate change, city governments are uniquely motivated to exercise direct regulatory authority to address climate change at the local level. For these reasons, and several others, cities are increasingly acknowledged as having a critical role to play in countering climate change (Bedsworth and Hanak 2013; Rosner 2019; Agrawal et al. 2008).

In the United States, where climate policy and action at the federal level has at times been dependent on the current presidential administration, climate action plans, or CAPs, have emerged as a means through which local governments can address climate change regardless of presidential administration changes (Tang et al. 2013). Climate action plans are comprehensive strategies outlining specific actions a city will take to reduce greenhouse gas emissions to a specific level. Based on greenhouse gas emission inventories, which quantify and identify sources of GHG emissions within a specific geographic area, CAPs focus on cost effective activities with the highest emissions reduction potential (Climate Action Plans n.d.). To date, more than half of the states, as well as over 600 local governments, in the United States have developed CAPs that include GHG inventories and reduction targets (U.S. State Climate Action Plans 2021; Markolf et al. 2020).

Local governments can exercise regulatory authority over many GHG emitting activities, giving them the ability to take action to significantly reduce emissions (Shirazi et al. 2017). In the

state of California, CAPs have become the one of the most common forms of municipal climate change planning tools and their development and adoption is highly encouraged to help the state meet its climate goals (Hotchkiss et al. 2020, Local Government Actions n.d.). The California Air Resources Board (CARB) has developed resources such as the "Local Government Toolkit" and the "Local Government Operations Protocol for Greenhouse Gas Assessments" for the purpose of guiding cities in developing their climate action plans CARB recommends that cities adopt emission reduction targets of 15% below 1990 levels by 2020, 40% below 1990 levels by 2030, and 80% below 1990 levels by 2050 to help the state achieve its climate goals (Local Government Actions n.d.).

While the development and adoption of a city climate action plan is highly encouraged and incentivized by the state of California, it remains a purely voluntary action. Several studies have explored what factors influence voluntary CAP adoption and emission target setting, pointing towards city size, political ideology of residents, fiscal health and institutional capacity as associated elements (Hui et al. 2019; Lubell et al. 2009). But questions remain regarding the progress being made on these CAPs as well as to what extent cities have been successful in realizing their emission reduction goals. Establishing and applying a system to monitor progress is a vital part of CAP development and implementation and allows cities to adjust their strategies based on emission trajectories. The Local Governments for Sustainability (ICELI) network defines effective monitoring as the tracking process (implementing agreed upon actions) and outcomes (achieving desired targets) (Tuts et al. 2015). 2020 marked the passage of the near-term GHG emission reduction target set by many city climate action plans in California, presenting the opportunity to evaluate how cities with climate action plans have tracked and shared updates on their progress since adoption. This study evaluates California cities with adopted CAPs to determine what actions have been taken to update their progress in implementing plans and reducing emissions, identifies which cities have indicated they have met their preliminary goals, and explores factors that may be associated with update behavior.

BACKGROUND

Policy context: California's climate action history

The State of California has long been recognized as a global leader in environmental and climate policy (Mazmanian et al. 2020). Since at least the 1960's, California's aggressive stance on preserving environmental health has been, in large part, driven by the demand and support of its citizens. California's contemporary climate policy revolves around the greenhouse gas emission reduction targets established by three major pieces of legislation: Assembly Bill 32 (AB32), Senate Bill 32 (SB32), and Executive Order B-55-18. The California Air Resources Board, established in 1967, is the lead state agency for climate change programs in California—including those that reduce greenhouse gas emissions—and continues to set the standard for effective climate policy nationally and globally, fostering one of the most broad and flexible policy landscapes. One of the most notable actions taken by the State in recent decades was the passage of the Global Warming Solution Act of 2006, or AB32. This watershed legislation required by law a sharp reduction in the State's greenhouse gas emissions to 1990 levels by 2020, making California the first state in the nation to mandate greenhouse gas emission reductions across all industries (Boswell and Jacobsen 2019). AB32 required that the California Air Resources Board develop a Scoping Plan to outline policy, planning, regulatory, and market strategies the State would utilize in order to meet its GHG emission reduction target, to be updated every five years (Núñez 2006). The first Scoping Plan was approved in December of 2008, with subsequent updates completed in 2013 and 2017, and a third currently in progress as of Spring 2022. In recognition of the key role local governments and private organizations should play in reaching the State's emission reduction goals, one of the early action items identified and approved by CARB was the development of "guidance and protocols for businesses and governments to facilitate GHG emissions reductions" (Boswell and Jacobsen 2019; Núñez 2006).

Significantly, California met its 2020 emissions reduction target four years early in 2016. Following this early success, Senate Bill 32 (SB 32) was passed the same year. SB 32 expands and strengthens the statewide limit on greenhouse gas emissions, requiring emissions be reduced to 40% below 1990 levels no later than 2030 (Pavley and Garcia 2016). This was followed two years later by an executive order, EO B-55-18, which sets a statewide target of carbon neutrality by the

year 2045. CARB has since recommended that cities adopt their own emission reduction targets of 15% below 1990 levels by 2020, 40% below 1990 levels by 2030, and 80% below 1990 levels by 2050 to be in line with the State's reduction targets established by these pieces of legislation. Despite impressive early success, a recent report has concluded that California is currently not on track to meet its 2030 emissions target (Busch and Orvis 2020). Based on statewide emissions data from 2017, meeting the 2030 goal would necessitate an emissions reduction rate of 13 million metric tons of CO_2 equivalent annually– nearly doubling the rate of reduction over the past decade.

CAP adoption and target setting

There is substantial literature that considers why sub-national bodies, like state, county, and municipal governments choose to adopt policy that addresses climate change. There are currently two explanatory models for policy innovation and adoption: one which considers "internal" drivers, and one which looks to the "diffusion" of policy regionally (Berry and Berry 2018). Internal drivers of policy innovation include political, economic, and social characteristics of the policy "innovator". Studies exploring decision making around climate change mitigation policy have largely been centered around five of these "drivers": community social capital, political ideology, air quality, and policy networks (Hui et al. 2019). While a majority of these studies have been focused on policy at the state-level, there are a number of studies which have considered similar drivers behind sustainability and climate change mitigation policy at the city level. Two studies, Hui et al. (2019) and Lubell et al. (2009), examine the factors associated with climate policy adoption in California cities. Lubell et al. finds sustainable policy adoption in California's Central Valley is associated with greater fiscal health of the city and a higher socioeconomic status among residents. Further, Hui et al. establishes a city's population size, political ideology, and "institutional capacity"– represented by total government expenditure, as factors related to a higher likelihood of climate action plan adoption.

Another driver for city CAP adoption may be the incentive to streamline projects under the California Environmental Quality Act (CEQA). CEQA requires state and local agencies to evaluate any potential environmental impacts of a planned project, and to implement mitigation efforts when necessary and feasible. In 2007 the CEQA guidelines were amended to include

greenhouse gas emissions and their impact on climate change as subjects covered by CEQA analysis (OPR 2008). Rather than perform such analysis on an individual-project basis, which can be cost and time prohibitive, CEQA allows for project analysis to be based off of a programmatic scale analysis of the environmental impacts of GHG emissions. A qualified climate action plan may serve as such a programmatic scale GHG emission impact analysis. For example, a city may develop and adopt a CAP that satisfies CEQA criteria and any subsequent project that is consistent with the CAP may be found to have a "less than significant" impact under CEQA, significantly streamlining the evaluation process (Shirazi et al. 2017). Both standalone CAPs and those included as part of a city's General Plan may be used in this fashion.

A principal part of developing and adopting a climate action plan is setting an effective and feasible greenhouse gas emissions reduction target. In California, where CARB has provided recommendations and guidance surrounding emissions goals, the near-term targets of local CAPs are generally 15% below "current" levels (typically established as between 2005 to 2008) by 2020, reflecting the State's near-term emissions target. Cities that adopted climate action plans or equivalent GHG emissions reduction plans preceding the passage of AB32 in 2006 may have set near-term targets prior to 2020. While studies considering the factors related to target-setting behaviors are scant, at least one has identified higher percentage of voters registered as Democrat and certain types of air quality to be predictors of more ambitious target setting as well as long-term target setting in California's municipal climate action plan (Hui et al. 2019).

Monitoring progress: GHG emissions inventory

The ICLEI- Local Government for Sustainability USA (ICLEI) has developed a 5-step cycle framework for climate mitigation. This cycle begins with an inventory of emissions, followed by target setting, climate action plan development, plan implementation, and finally monitoring and reporting on progress. Milestones 1, 2, and 5 rely on quantifying emissions by performing an emissions inventory. An emissions inventory is a quantification, by source, of air pollutants discharged in a defined geographic area (like a city or county) within a specified time period (typically one year) (Managing Air Quality n.d.). There are currently three distinct emission inventory approaches: production based emissions inventory (PBEI), consumption based emissions inventory (CBEI), and "activity based" emissions inventory (ABEI). The CBEI method

considers the life-cycle GHG emissions of goods and services utilized within a jurisdictional area, typically focusing on household and municipal government consumption. The first, PBEI, is concerned primarily with the producer of emissions and considers emitting activities within the subject jurisdiction and associate emission factors (Walter et al. 2017). An emission factor is a value which relates an emitting activity with a quantity of emissions released, allowing for a simple methodological approach where emissions are calculated as the product of emitting activity (AD) and emissions factors (EF): $Emissions = AD \bullet EF$ (Basic Information n.d.). The California statewide inventory conducted yearly by CARB follows a PBEI approach in line with the 2006 Intergovernmental Panel on Climate Change (IPCC) guidelines (Current California GHG n.d.; SANDAG 2018). However, as of 2017 CARB recommends local governments refer to ICLEI's widely-followed *U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions* (U.S. Community Protocol), an ABEI approach, to conduct local-level inventories (SANDAG 2018). The U.S. Community Protocol requires communities to account for emissions from five basic sources: electricity, natural gas, transportation, water (including wastewater), and solid waste. Increasingly utilized by communities in California, the ABEI method is a hybrid of the production and consumption based methods. The combination of PBEI and CBEI provides a more comprehensive account of emissions within a community, and makes it easier to track the impact of local policy and household emissions (Wheeler et al. 2018). Greenhouse gas emissions data is typically reported as metric tons of carbon dioxide equivalent, or $MTCO_2e$. Carbon dioxide equivalent is a metric that measures all greenhouse gas emissions in terms of their global warming potential, converting them to a standardized one unit mass of carbon dioxide (Pollution Prevention 2014) Regularly monitoring emissions allows a city to track the progress towards emission reduction targets, evaluate the efficacy of reduction strategies, and appropriately adjust strategies and targets as needed.

METHODS

Data collection

I constructed a comprehensive dataset to assess the state of climate action plans of California cities. I began by compiling a list of municipalities within the state of California which have climate action plans (CAP) using data from the California Climate Action Portal Map (CAP-Map). The CAP-Map is an open data tool developed by the California Air Resources Board in collaboration with UC Davis which provides users with the climate action planning details of jurisdictions across the state of California. I reviewed the imported data from the CAP-Map for accuracy, removing cities for which I could not confirm the adoption of a CAP. For example, the CAP-Map may indicate that a city has a CAP by citing a draft of a CAP when the city had not actually adopted a CAP. This independent confirmation of CAP adoption status involved visiting each city's website and occasionally reaching out to city staff via e-mail or telephone. For each city I listed the county jurisdiction and a link to the city's first climate action plan.

I then expanded the dataset to include data on population, fiscal capacity, and political ideology for each city. Population data for each city was taken from the 2020 census and made available on the United States Census Bureau (USCB) website. The fiscal capacity of each city is represented by total government expenditure, normalized for population. Total expenditure by city for the 2020 fiscal year was provided by the California State Controller's Office. Political ideology of city residents is expressed by the percentage of voters registered as Democrats. Voter registration data was sourced from the California Secretary of State's July 2021 Report of Registration. This report included total registered voters and a breakdown by registered political party (Republican, Democrat, American Independent, Green) in each city.

Data analysis

I reviewed the climate action plan for each city, recording the year in which the CAP was adopted as well as the year by which the city intended to reduce emissions to the target level (the "target year"). I then visited the website of each city to determine whether any action had been taken by the city to update their progress since the adoption of their initial climate action plan. For the purposes of this study I define an "update" as any of the following actions: the provision of

progress reports or a description of implemented actions or projects, the completion of greenhouse gas emission inventories post CAP adoption, or the adoption or development of an updated CAP . The binary variable "Updated" indicates whether a city has taken steps to update their progress on their climate action plan (1=yes; 0=no). Of the subset of cities that I determined had provided updates on their CAP, I indicated which update action(s) were taken using the binary variables "Progress Report", "GHG Inventory", and "Updated CAP" (1=yes; 0=no). Finally, if I was able to determine that the city had successfully met the greenhouse gas emissions reduction goal specified in their CAP, I indicated as such via the binary variable "Goal Reached" (1=yes; 0=no).

I then evaluated the relationship between city characteristics of population, political ideology, and per capita expenditure and whether a city had updated its CAP progress. I ran a logistic regression with the dependent variable whether a city has updated their progress (1=yes; 0=no), and regressed on the three sets of independent variables: population, political ideology, and per capita expenditure.

RESULTS

Data Collection

After independently reviewing and verifying the data retrieved from the CAP-Map the final count of cities with an adopted climate action plan was 161. These cities were mostly located in coastal areas and especially concentrated around the San Francisco Bay Area and Los Angeles, with few located along the Central Valley region (Figure 1). The majority of climate action plan adoption occurred in the decade following the passage of the Global Warming Solution Act of 2006 (AB32), with adoptions peaking in 2012 (Figure 2).

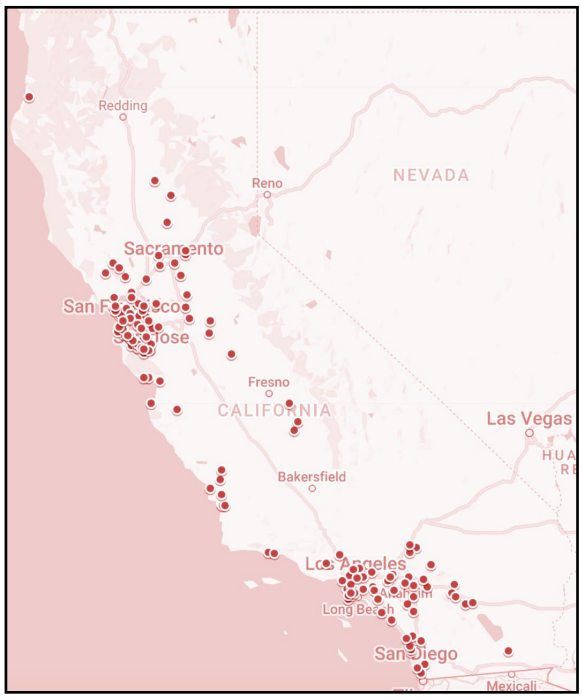

Figure 1. Map of California cities with adopted CAPs.

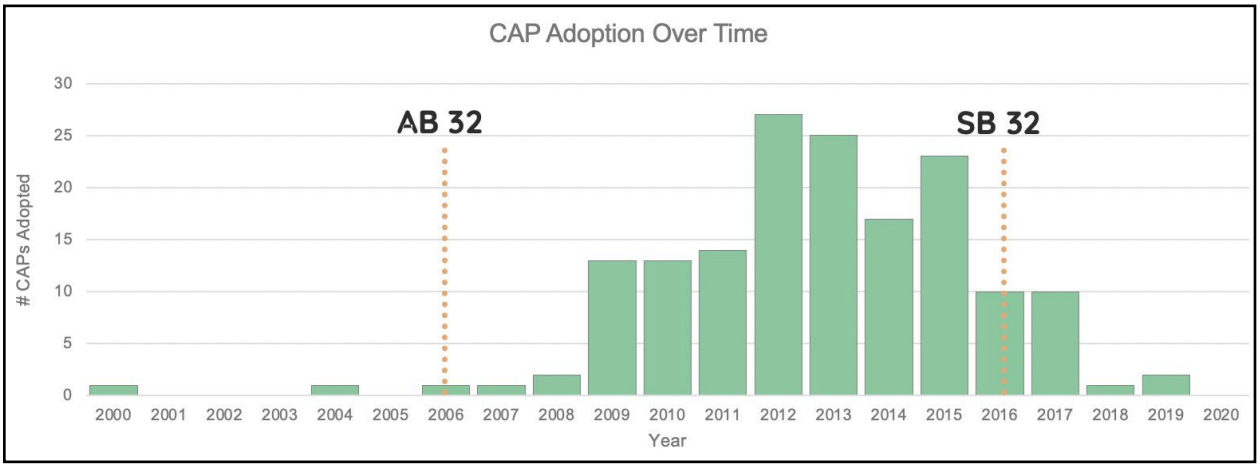

Figure 2. Frequency distribution of city CAP adoption in California over time.

Data analysis

Reviewing the website and materials provided by each city government, I determined that 95 of the total 161 cities, or 59%, have updated their CAP progress in some form, while 66 cities had not performed any form of update (Figure 3). Of the 95 cities that had taken action to update

their CAP implementation progress, 60 had provided some form of progress report, and 86 had performed an emissions inventory since the adoption of their preliminary CAP (Figures 4, 5). A total of 64 cities had since adopted updated versions of their CAP , or were currently working to update the CAP (Figure 6). 83% of cities that had updated their progress had performed at least two update actions, with 39% performing all three actions. Lastly, of the 95 cities that had updated their CAP progress, I was able to determine that 50 cities have definitively declared success in meeting the greenhouse gas emission reduction targets outlined in their initial CAPs.

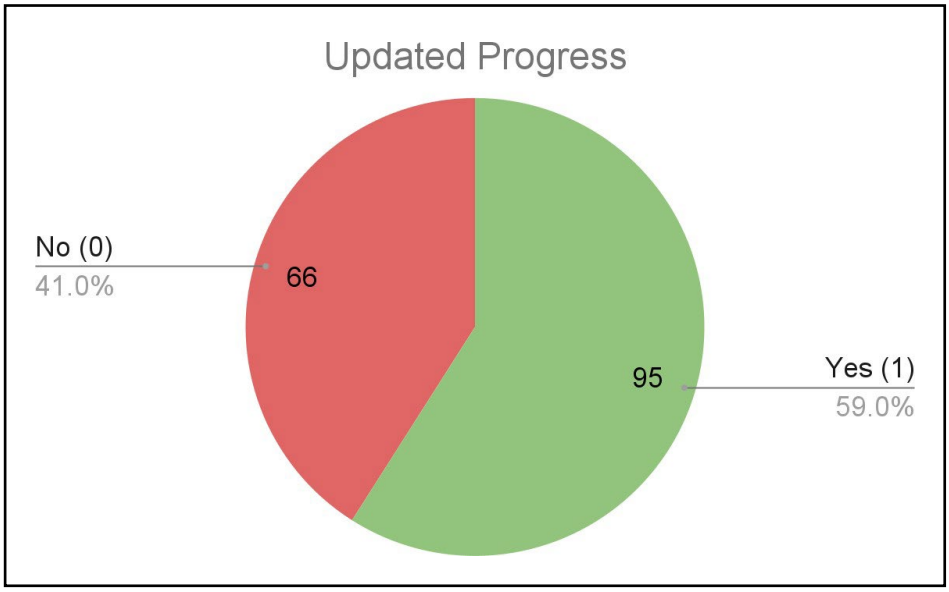

Figure 3. Percentage of 161 cities that have and have not updated their progress.

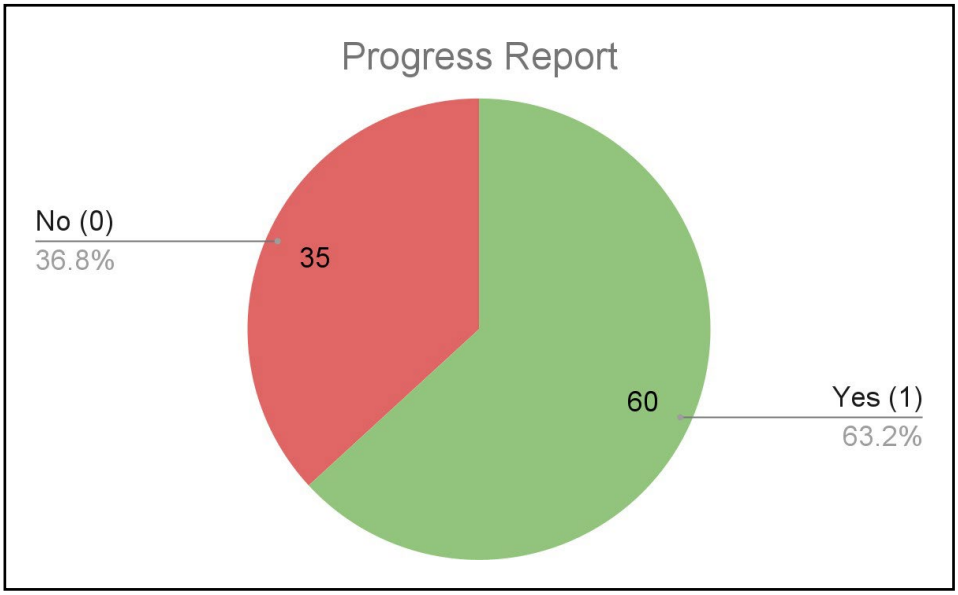

Figure 4. Cities that have and have not provided progress reports.

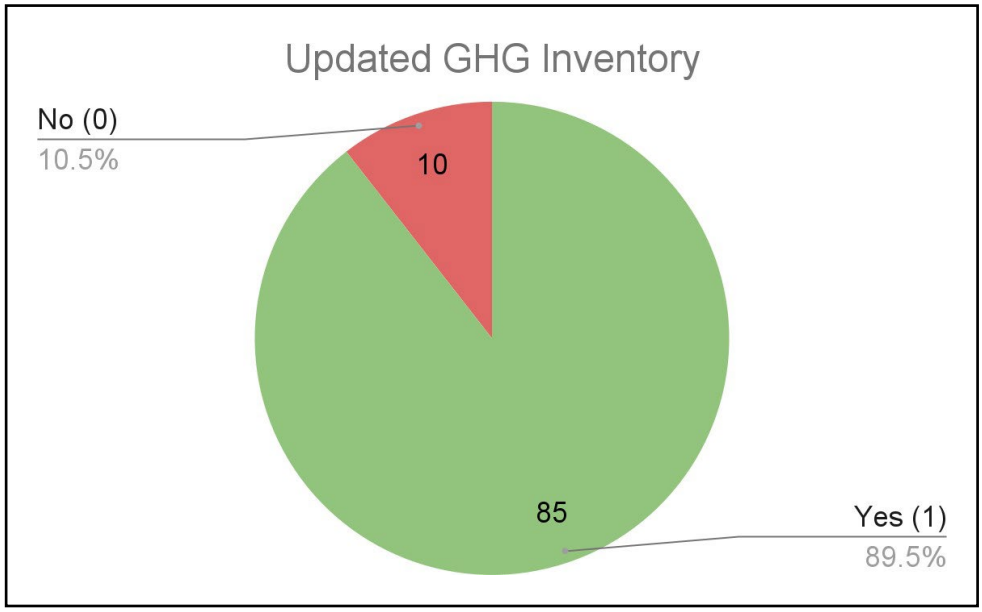

Figure 5. Cities that have and have not performed an updated emissions inventory.

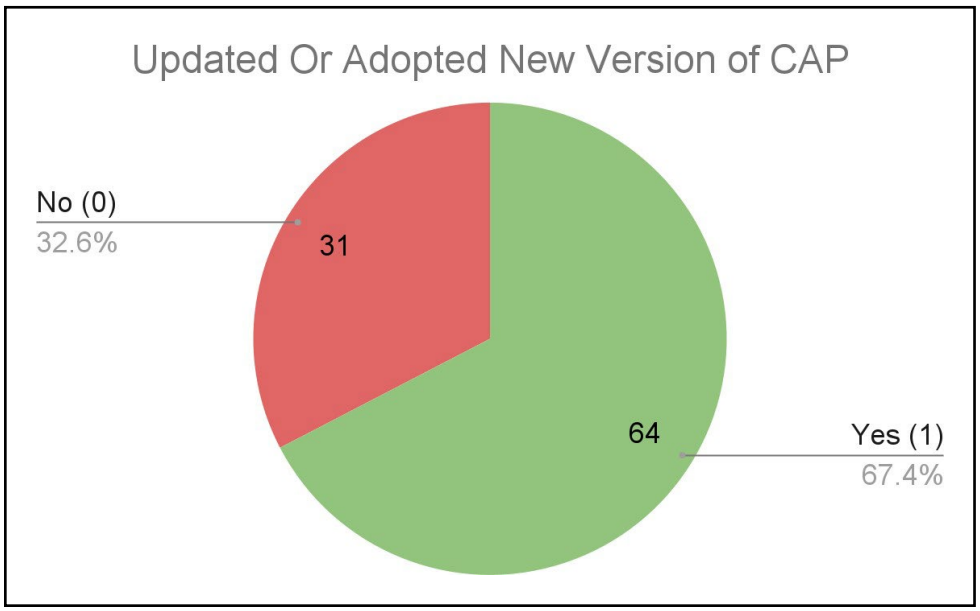

Figure 6. Cities that have and have not adopted updated versions of their CAPs since adoption.

Next I evaluated the results of the logistic regression. Here I found that jurisdictions with greater fiscal capacity and a greater percentage of voters registered as Democrats are more likely to have provided updates on their climate action progress. A jurisdiction's population size, on the other hand, is not associated with a higher likelihood of updating progress. The variable "fiscal capacity", represented by the jurisdiction's per capita expenditure, had a non-normal distribution as seen in Figure 7 below. A log-transformation failed to normalize the distribution, so instead I removed the data points from the "tail" and ran a logistic regression on a normally distributed subsample of the per capita expenditure of 126 cities. The distribution of the subsample can be found below in Figure 8, as well as the results of all three logistic regressions in Table 1.

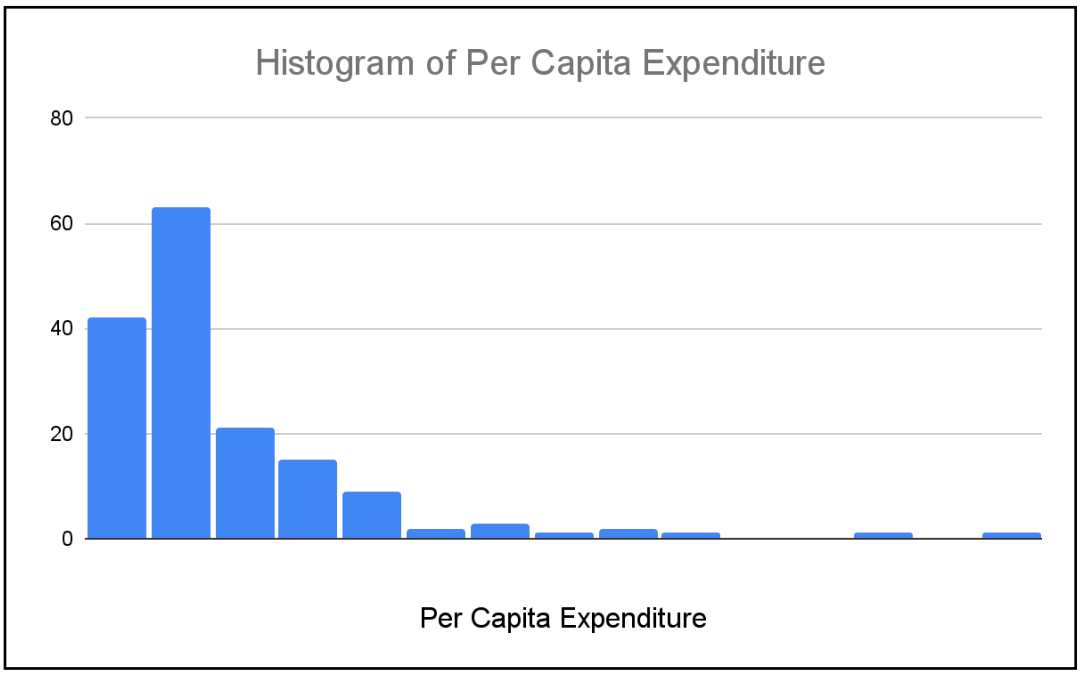

Figure 7. Skewed distribution of per capita expenditure.

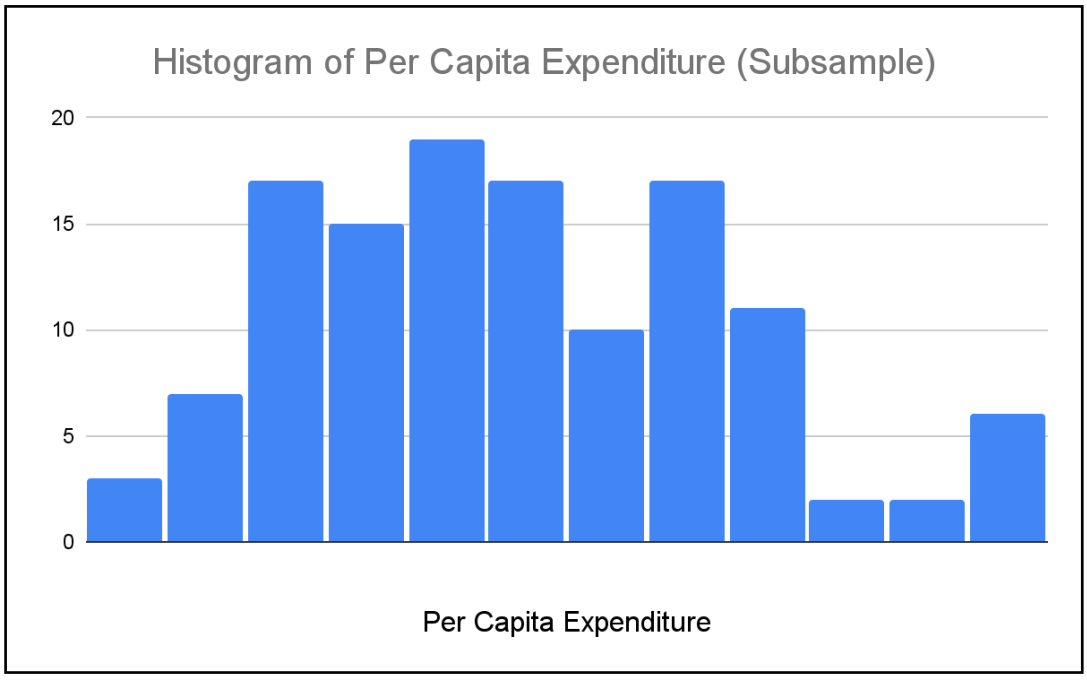

Figure 8. Normal distribution of subsample of per capita expenditure.

Table 1: Logistic Regression Results. A city's fiscal capacity (per capita expenditure) and the political ideology of its residents (% of voters registered as Democrat) were associated with a higher likelihood of performing a CAP progress update.

Regression Results			
	Dependent variable:		
	Update		
	(1)	(2)	(3)
Per Capita Expenditure	0.001**		
	(0.0003)		
Population		0.00000	
		(0.00000)	
% Registered Democrat			0.075***
			(0.017)
Constant	-0.922*	0.120	-3.278***
	(0.547)	(0.216)	(0.825)
Observations	126	161	161
Log Likelihood	-84.000	-106.759	-97.259
Akaike Inf. Crit.	172.001	217.518	198.518
Note:	*p<0.1; **p<0.05; ***p<0.01		

DISCUSSION

While a majority of cities that have adopted climate action plans in the past decades have provided some form of update on their progress, a number of cities appear to have not followed up on the commitments outlined in their CAPs. Moreover, based on available information such as emissions inventories and progress reports, less than one third of cities with CAPs seem to have met their near-term emission reduction targets. Political ideology of city residents and fiscal capacity were associated with a higher chance of updating climate action plan progress. These findings are consistent with existing studies that have established relationships between political ideology and the fiscal health or institutional capacity of local governments with their CAP adoption and target setting behavior. A city's population size is not associated with whether a city updated their progress. The results of this assessment revealed crucial gaps in information

surrounding the current state of climate action plans. Addressing these gaps may inform the efficacy and ongoing implementation of climate action plan and other climate policy at the local level in California, and beyond.

Principle Findings and Implications: Accountability and addressing information gaps

With the State of California falling behind on its goal to reduce emissions 40% below 1990 levels by 2030, and ambitious targets like statewide carbon neutrality looming in the near future, local emission reduction efforts, such as climate action plans, will remain a crucial component of moving the State towards these benchmarks. Assessing and understanding the post-adoption behaviors of these cities provides insight into the successes and failures of climate action plans. Available information surrounding progress updates among cities with CAPs is inconsistent and incomplete, presenting a barrier to efficacy evaluation. The voluntary nature of CAPs means there is no mechanism to hold cities accountable to their commitments. As a result, cities are not required to provide evaluation of their progress and cities may vary in how frequently and with which methods they choose to perform such evaluations, if at all. This is evident in the 41% of cities included in this study that had not provided any updated information regarding their CAP progress. Whether the fact that a city has failed to supply progress updates means that the city has not made any progress remains to be seen. Additionally, there is evidence that cities involved in climate action planning review the plans and progress of other cities (Bassett and Shandas 2010). This gap in information, then, can represent an impediment to cities adopting or updating plans. Even amongst cities that have provided updated information in the form of emissions inventories, there may be discrepancies in inventory methods across cities, and from one inventory to another within a single city (Gurney et al. 2021, SANDAG 2018). This inconsistent reporting makes it difficult to provide a clear picture of the status quo of municipal climate action plans in California.

Among the 161 cities assessed in this study, the political ideology of residents was found to be a strong predictor of whether a city had updated their CAP progress. A higher percentage of voters registered as Democrat is associated with a higher likelihood that a city would update their progress, meaning that political ideology drives not only CAP adoption and target setting. Democrats are generally more supportive of climate policy than Republicans (Ehret et al. 2018). This may imply that communities that express a higher degree of support for climate policies, such

as climate action plans, may hold their local governments accountable for following through on climate commitments. Fiscal capacity was also found to be a predictor of updating CAP progress among the cities assessed in this study. Jurisdictions have reported a lack of institutional and financial resources as barriers to realizing local climate action (Salon et al. 2014). While per capita expenditure represents an indirect measure of a city's financial capacity, it is crucial to further understand the relationship between civic expenditures and impact on reporting progress of climate action plans. Other studies have also highlighted increased funding and uniform reporting guidelines as a means to address inconsistent and inaccurate communication of emission data and other local climate policy activity (Sippel 2011). This study represents a first step in identifying potential "problem areas" in local government climate action and emission reduction efforts, particularly monitoring and reporting, and presents an opportunity to address these issues.

Limitations and Future Direction

Some limitations and uncertainties in the execution of this assessment should be addressed. Given that there is not yet a comprehensive and up-to-date database of California cities with CAPs, the cities assessed in this study may not represent a complete count of cities with CAPs. A review of all 482 municipalities in California may provide a more complete picture of local CAP adoption and implementation. While this study considers how certain factors are related to whether a city will update their CAP progress, it does not explore why some cities have failed to do so. Next steps should be identifying and understanding the barriers to updating CAP progress. Further, the city characteristics considered (population, fiscal capacity, and political ideology) in this study provide only a partial evaluation and explanation of the factors associated with CAP update behavior. Certainly other factors that were not considered in this study may reveal to be better predictors of whether a city has, or will, update their progress on their climate action plan. For example, fiscal capacity is a very broad metric and does not necessarily equate to greater resources towards climate action. In the future it would be useful to perform a more detailed evaluation of city budget to determine what funds are being put towards the implementation and monitoring of climate action plans.

Conclusions

Recognizing the important role cities play in addressing and mitigating climate change, it is important to understand where cities are succeeding and where they are facing challenges. While over half of the cities included in this assessment were found to have provided some form of update on their CAP progress, a significant portion had provided no follow-up since adoption. Because climate action plans are purely voluntary, there exists no system to hold cities accountable when they lapse on their promises. Some have suggested legal solutions to make CAP commitments as binding as possible– holding cities accountable to their emissions goals. For example, the city of San Diego's 2015 climate action plan was determined by their city attorney to be a legally enforceable document. It is clear from this study that cities have much room for improvement when it comes to providing timely and consistent assessment of their climate action plan progress. You can't manage what you don't measure, as the adage goes. Going forward, the development of a more complete, accurate, and up-to-date catalog of municipal climate action progress would serve as an invaluable resource.

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