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Harmonizing Climate Change Mitigation and Adaptation in Transportation and Land-Use Planning in California Cities

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California State University
Transportation Consortium

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REPORT 20-05

HARMONIZING CLIMATE CHANGE MITIGATION AND ADAPTATION IN TRANSPORTATION AND LAND-USE PLANNING IN CALIFORNIA CITIES

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February 2020

10.31979/mti.2020.1856

A publication of

Mineta Transportation Institute

Created by Congress in 1991

College of Business
San José State University
San José, CA 95192-0219

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. 20-05	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Harmonizing Climate Change Mitigation and Adaptation in Transportation and Land-Use Planning in California Cities		5. Report Date February 2020	
		6. Performing Organization Code	
7. Authors Serena E. Alexander, https://orcid.org/0000-0001-8359-5289 Asha Weinstein Agrawal, Ph.D., Ashley M. Hooper, and Michael R. Boswell, Ph.D.		8. Performing Organization Report CA-MTI-1856	
9. Performing Organization Name and Address Mineta Transportation Institute College of Business San José State University San José, CA 95192-0219		10. Work Unit No.	
		11. Contract or Grant No. ZSB12017-SJAUX	
12. Sponsoring Agency Name and Address State of California SB1 2017/2018 Trustees of the California State University Sponsored Programs Administration 401 Golden Shore, 5th Floor Long Beach, CA 90802		13. Type of Report and Period Covered Final Report	
		14. Sponsoring Agency Code	
15. Supplemental Notes 10.31979/mti.2020.1856			
16. Abstract <p>Recent extreme weather events in California—wildfires, drought, and flooding—make abundantly clear the need to plan effective responses to both the causes and the consequences of climate change. A central challenge for climate planning efforts has been identifying transportation and land-use (TLU) strategies that simultaneously reduce greenhouse gas emissions (“mitigation”) and adapt communities so that they will be less affected by the adverse impacts of climate change (“adaptation”). Sets of policies that collectively address both mitigation and adaptation are known as “integrated actions.” This study explores municipal climate planning in California to determine whether cities incorporate integrated actions into their plans, assess the potential drivers of conflict between mitigation and adaptation in municipal plans, and identify ways the State of California can help cities more effectively incorporate integrated actions.</p> <p>The study methods consisted of a detailed analysis of climate planning documents from 23 California cities with particularly long histories of climate planning, plus interviews with 25 local, regional, and state officials who work on municipal climate planning.</p> <p>The authors found that some cities did adopt packages of integrated actions, and, promisingly, two cities with recently updated climate plans explicitly focused on the need for integrated actions. However, most cities addressed climate mitigation and adaptation in separate efforts, potentially reducing synergies between the two types of action and even creating conflicts. Since the first generation of climate action plans focused primarily on mitigation of greenhouse gases (GHGs), adaptation strategies have not yet been effectively or fully combined into mitigation plans in many cities. Also, a cross-comparison of plan content and interview data suggests that cities often had sets of policies that could potentially create conflicts—mitigation policies that would undermine adaptation capacity, and vice versa. In addition, where a city did adopt integrated actions, these efforts are typically not labeled as such, nor do the policies appear within the same policy document.</p> <p>The study findings suggest promising steps that both municipal and state governments can take to support integrated TLU actions at the local level. For example, cities can proactively link the content in climate mitigation and adaptation plans—a process that will require building the capacity for cross-collaboration between the various departments in charge of developing, implementing, and monitoring climate-related plans. As for the state government, it can provide funding specifically for planning and implementing integrated actions, offer technical support to help municipalities adopt programs and projects that produce integrated mitigation and adaptation benefits, and fund research in the area of integrated actions.</p>			
17. Key Words Climate action planning, transportation, land-use, greenhouse gas emissions, community resilience	18. Distribution Statement No restrictions. This document is available to the public through The National Technical Information Service, Springfield, VA 22161		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 66	22. Price

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ACKNOWLEDGMENTS

The authors thank the following people for their important contributions to this project:

- Research assistants Alverina E. Weinardy and Kally Yeung
- The experts interviewed for the project

The authors also thank Editing Press, for editorial services, as well as MTI staff, including Executive Director Karen Philbrick, Ph.D.; Deputy Executive Director Hilary Nixon, Ph.D.; Research Support Assistant Joseph Mercado; and Executive Administrative Assistant Jill Carter.

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EXECUTIVE SUMMARY

Recent extreme weather events in California—wildfires, drought, and flooding—make abundantly clear the need to plan effective responses to both the causes and consequences of climate change. Comprehensive planning for climate change ideally involves a two-pronged approach of mitigation and adaptation: identify strategies to both reduce greenhouse gas emissions (“mitigation”) and adapt communities so that they will be less affected by the adverse impacts of climate change (“adaptation”).

A central challenge for climate planning efforts has been identifying transportation and land-use (TLU) strategies that simultaneously achieve both objectives: so-called “integrated climate actions.” This study looks at municipal climate action planning (CAP) and integrated actions as they relate to TLU strategies in order to explore three research questions:

1. In what ways do California cities incorporate integrated actions into their plans?
2. What are potential drivers of conflict between mitigation and adaptation in municipal plans?
3. What actions can the State of California take to help cities more effectively incorporate integrated actions?

The value of integrated actions has recently become widely acknowledged; current research and California state policy both emphasize the importance of integrating mitigation and adaptation in order to develop cost-effective strategies to combat climate change and protect vulnerable communities. For example, California’s Climate Investments budget for fiscal year 2018–19 specifically calls for funding of projects with “integrated climate action” potential, which are mitigation actions that bring resilience/adaptation benefits. Also, California’s Cap-and-Trade Expenditure Plan includes programs that integrate mitigation and adaptation, such as a “Transformative Climate Communities” program that supports local integrated climate action.¹

Transportation is a particularly important sector in examining the potential for integrated actions because transportation is both a major driver of climate change and vulnerable to its impacts. In California, 41 percent of total emissions are attributed to the transportation sector, marking the sector the largest contributor to GHGs in the State.² On the other hand, transportation infrastructure and operations are vulnerable to climate change impacts. For example, rising sea levels can impact the number or severity of floods damaging infrastructure, heat waves can impair the integrity of road pavements, and wildfires exacerbated by climate change can interrupt road, rail, and air traffic.

Despite the theoretical benefits of integrated actions, planners have found them difficult to develop in practice for a variety of reasons. Both local and state governments have often addressed mitigation and adaptation in separate plans led by different agencies or departments, making coordination an elusive goal. Major conflicts can result between mitigation and adaptation strategies, as can counterproductive climate planning outcomes.

Without a clear, coordinated effort to combine adaptation and mitigation goals into a holistic vision, mitigation strategies can potentially undermine adaptation goals and vice versa. For example, encouraging high densities in urban areas can reduce VMT and thus mitigate transportation greenhouse gas emissions. However, densely built environments in areas prone to catastrophic climate impacts put large populations at risk from these impacts. Also, denser urban communities with less open space may face higher flooding risks or may be more likely to suffer from an urban heat island effect. Similarly, widening roads to increase the capacity of evacuation routes is an adaptation strategy that runs counter to VMT reduction goals. This report can help planners, policymakers and other professionals avoid conflicts and develop and/or implement effective integrated actions by examining challenges and opportunities of planning for climate mitigation and adaptation.

Study Methods

The authors explored the study research questions about municipal climate planning and integrated actions by assessing climate planning efforts in 23 California cities known to have been leaders in climate planning for at least a decade. Each of the 23 cities had produced a CAP by 2009.

For all 23 cities, the authors collected publicly available plans and documents relevant to the climate planning in the TLU sector: municipal climate action plans (CAPs), climate adaptation plans, hazard mitigation plans, community resilience plans, sea level rise road maps and action plans, and general plans. The plans were analyzed using a coding process broken into five themes: (i) mitigation efforts, (ii) adaptation efforts, (iii) potential conflicts between planning efforts, (iv) potential for integrated actions, and (v) common themes across plan programs/policies.

In addition to the plan analysis, the authors interviewed 25 planners and other professionals at the city, regional, and state levels to better understand the challenges and opportunities involved in integrated actions for the TLU sector.

Summary of Findings

City planners and city planning documents predominantly emphasize mitigation strategies rather than adaptation efforts related to transportation and land-use. Since the first generation of climate action plans focused primarily on mitigation of GHGs, adaptation strategies have not yet been effectively or fully combined into mitigation plans in many cities.

Although desirable, integrated actions are the exception, not the norm. Some cities are incorporating integrated actions; however, this is often not done explicitly, within the same policy, or within the transportation sector. Promisingly, two cities with recently updated climate action plans explicitly focused on the need for integrated actions. For example, the City of Santa Monica's 2019 *Climate Action and Adaptation Plan* emphasizes and illustrates the mitigation benefits of adaptation actions.

The following are the strategies for integrated actions that most commonly appear in city policies and programs:

- Encouraging high-density, transit-oriented development in urban cores, while simultaneously incorporating measures for a robust urban forest and/or open-space program;
- Encouraging high-density, transit-oriented development in urban cores, while simultaneously incorporating measures to ensure passive, sustainable building design;
- Improving and expanding active transportation infrastructure (i.e., pedestrian and bicycle modes), while simultaneously incorporating measures to plant trees in medians and preserve open space for cooling and/or stormwater management; and
- Improving and expanding alternative transportation infrastructure (i.e., public transit), while simultaneously incorporating measures to add shelters at transit hubs to protect users from weather events (e.g., increased rain or heat).

Most cities addressed climate mitigation and adaptation in separate efforts, potentially reducing synergies between the two types of actions and even creating conflicts. The review of planning documents revealed that cities use a variety of planning documents for TLU climate planning. Although all cities have a general plan and a climate action plan (primarily focusing on mitigation of GHGs), six cities have a separate resilience plan (including broad resilience plans and shoreline or sea level resilience documents), and fifteen cities have a separate hazard mitigation plan. San Diego is the only city in our sample that has a combined climate mitigation and adaptation plan.

The review of municipal-level plans uncovered numerous potential transportation-related conflicts, such as:

- Encouraging higher-density development, without taking measures to mitigate potentially exacerbated urban heat island effects;
- Encouraging higher-density development, without taking commensurate measures for flood protection;
- Changing land-use patterns that might limit mobility for vulnerable populations (e.g., decreasing parking availability), without clearly establishing plans for evacuation in the case of disaster;
- Promoting expansion of electric vehicle charging infrastructure, without accounting for stress to energy grids in the case of extreme weather events; and
- Promoting the expansion of electric vehicle charging infrastructure, without fully examining potential equity issues related to limited grid infrastructure and access to EVs.

A cross-comparison of climate-related plan content and interview data reveals that cities have typically used their general plan or directions provided by metropolitan planning organizations (MPO) to avoid some of these conflicts. For example, cities have used priority development areas identified by MPOs to minimize or avoid high-density development in areas prone to flooding or other climate hazards. Nevertheless, relying solely on general plans or MPO guidelines is likely insufficient to avoid all potential conflicts between mitigation and adaptation. For example, in areas where the demand for development and investment in transportation infrastructure is high, conflicts between the needs and requirements of mitigation and adaptation are still possible. These conflicts are more likely to happen where the entire city or region is considered to be at risk of climate hazards, and/or when uncertainties about the magnitude or distribution of impacts are high. In other words, pressures created by a high demand for development and transportation investments may outweigh climate risks—if those risks are perceived to be hard to avoid or difficult to predict.

Implications for State and Municipal Policy Makers

A cross-comparison of all data collected in this study reveals several key implications for state and municipal policy makers.

To ensure successful development and implementation of integrated actions, the State should:

- *Stress the importance of “integrated actions” to tackle transportation emissions while simultaneously enhancing California’s resilience to adverse climate change impacts.* Options include offering funding for development and implementation of policy measures and programmatic interventions at local and regional levels that effectively integrate mitigation and adaptation, providing technical support for programs and projects that produce integrated mitigation and adaptation benefits, and supporting research in the area of integrated actions.
- *Help determine and enact appropriate climate action at various levels of government (state, regional, and municipal).* Although local action is key to the success of California’s climate action, certain strategies are more appropriate for other levels of government to develop and/or implement. For example, adaptation strategies for threats like flooding and fire are more effectively addressed at the regional rather than the local level. Also, mitigation strategies such as stringent fuel efficiency standards and provision of shared electric vehicle charging stations can be more effectively or equitably addressed at the state level.
- *Boldly and directly address transportation in state-level regulations to meet both climate mitigation and adaptation goals and take the burden off of municipalities.* Examples of policies to consider are mandating electrification of some heavy-duty vehicles, similar to the State’s “Zero Emission Buses” requirements; enacting tighter smog regulations; and providing a definitive timeline for when internal combustion engines will no longer be able to be purchased and/or used. When developing these climate policies, the State should prioritize mitigation actions with adaptation

co-benefits or vice versa. For example, plug-in electric vehicles not only reduce transportation emissions, but they can also serve as a resource during disasters (if energy stored in their batteries can power energy response systems, such as traffic lights or disaster communication equipment).³ These state-level actions will empower cities to take integrated actions and remove the burden of having to enact strict local policies.

- *Build a stronger collaboration between the state, city, and regional planning officials and a feedback mechanism for identifying and closing policy, technical, and communications gaps.* Although the State currently provides substantial technical support for local climate action, the study findings suggest that municipal planners may not be fully aware of all the resources available or may not find these guidelines helpful or relevant.

To ensure successful development and implementation of integrated actions, municipalities should:

- *Better link climate mitigation- and adaptation-related plans.* It is key to link various types of municipal climate-related plans, including general plans, climate action plans, and community resilience plans, to avoid potentially counterproductive outcomes and to harness the benefits of integrated actions. For example, a city's general plan could directly refer to the climate action plan when appropriate, and vice versa.
- *Ensure effective cross-collaboration between various departments in charge of developing, implementing, and monitoring municipal climate-related plans.* For example, when there is substantial overlap between different types of plans, such as hazard mitigation plans and community resilience plans, it is important to ensure that entities responsible for implementation are effectively collaborating with each other.

Finally, the study identified a set of salient TLU opportunities for municipalities to build adaptive capacity while also mitigating GHGs and reducing VMT:

- Expanding and improving alternative transportation infrastructure and facilities, while simultaneously improving capacity to withstand flooding conditions.
- Expanding and improving alternative transportation infrastructure and facilities, while simultaneously planting vegetation to offset heat effects and provide cooling effects for alternative transit users.
- Encouraging high-density, transit-oriented development, while simultaneously improving proximal transportation infrastructure to withstand disaster events and/or allow for evacuations.
- Promoting the adoption of EV technology and EV infrastructure across the community, while also promoting green energy use and opportunities for using EVs as battery storage to bolster the energy grid.

- Pairing water and wastewater infrastructure improvements with transportation and land-use planning. One example is pairing road improvements that expand bicycle paths with improvements to water drainage conditions, such as by planting trees and other vegetation near road infrastructure to capture stormwater.
- Encouraging density near transit without significantly modifying land surfaces to avoid exacerbating urban heat island effects. Examples include repurposing vacant or underutilized buildings near transit for affordable housing and encouraging the development of accessory dwelling units in urban areas.

I. INTRODUCTION

IMPORTANCE, RELEVANCE, AND OBJECTIVES OF THE STUDY

Recent extreme weather events in California—wildfires, drought, and flooding—make abundantly clear the need to plan effective responses to the causes and consequences of climate change. At the municipal level, comprehensive planning for climate change ideally involves a two-pronged approach of mitigation and adaptation: identify strategies to both reduce greenhouse gas emissions (“mitigation”) and adapt communities so that they will be less affected by the adverse impacts of climate change (“adaptation”). A central challenge in these planning efforts has been identifying transportation and land-use (TLU) strategies that achieve both objectives at once, so-called “integrated climate actions.”

The value of integrated actions has recently become widely acknowledged; current research⁴ and California state policy both emphasize the importance of integrating mitigation and adaptation in order to develop cost-effective strategies to combat climate change and protect vulnerable communities. California’s Climate Investments budget for fiscal year 2018–19 specifically calls for funding for projects with “integrated climate action” potential, which are mitigation actions that bring resilience/adaptation benefits.⁵ As an example, California’s Cap-and-Trade Expenditure Plan includes programs that integrate mitigation and adaptation, such as a “Transformative Climate Communities” program that supports local integrated climate action.⁶ Similarly, the Intergovernmental Panel on Climate Change has long highlighted the significance of “no regrets” strategies (i.e., actions that generate sufficient co-benefits to offset the implementation cost).⁷ Also, virtually all state-level climate action plans claim to have environmental, economic, and societal co-benefits, excluding the benefits of mitigated climate change.⁸ Theoretically, integrated actions are appealing because of their potential to create “no regrets” outcomes.

Transportation is a particularly important sector for examining the potential for integrated actions and the practical implications of implementing them. The relationships between transportation and climate change are multidimensional, with transportation being both a driver of climate change and also vulnerable to its impacts. Accounting for an estimated 29 percent of emissions in the United States, transportation is the largest contributor to greenhouse gas emissions,⁹ and by extension, climate change. In California, 41 percent of total emissions are attributed to the transportation sector, marking it the largest contributor to GHGs in the State.¹⁰ On the other hand, transportation infrastructure and operations are vulnerable to climate change impacts.¹¹ For example, rising sea levels can impact the number or severity of floods damaging infrastructure. Heat waves can impair the integrity of road pavements, deform rail tracks, and contribute to thermal expansion of bridges. Wildfires, floods, and severe weather conditions exacerbated by climate change can interrupt road, rail, and air traffic or disrupt transportation operations significantly.

To mitigate transportation-related GHGs, both supply- and demand-oriented interventions are necessary. Some major demand-oriented strategies include implementing carbon taxes and fees for transportation industries; promoting cap-and-trade carbon markets; enacting carbon taxes and fees for industry; applying congestion pricing or cordon pricing; raising parking prices and reducing or eliminating parking minimums; improving infrastructure

to encourage active and public transit modes; and/or instilling traffic bans that set an allowable limit of vehicles in specific urban areas or corridors. For example, carbon taxes can be levied in the form of an emissions tax commensurate to the quantity an entity produces and/or a tax on carbon-intensive goods or services, such as gasoline. Another example is cap-and-trade, which stresses the importance of emission reduction targets (by setting a cap or limit on GHGs and allowing the market to determine a price on GHGs), unlike a carbon tax, which emphasizes the cost of GHGs.¹²

There are also many transport supply improvements that can help reduce GHGs. For example, policies and programs can be developed to encourage or require lower energy intensity for vehicles by using lighter materials or more fuel-efficient engines as well as by lowering carbon intensity for fuels by using alternatives such as natural gas, biofuels, electricity or hydrogen. Another major intervention that can impact both supply and demand of transport involves changes to the land use through densification and agglomeration of activities. Common strategies for this category include transit-oriented development to reduce vehicle miles traveled (VMT) and the development of efficient logistics zone or freight distribution clusters to reduce GHGs from freight. Additionally, when people are closer to jobs, services, and amenities, investing in non-motorized transportation infrastructure, such as bike paths, sidewalks, and cross-walks as well as small motorized “last mile” solutions (e.g. e-bikes and e-scooters) can enhance mobility for all and reduce GHGs.

Adaptation strategies to bolster capacity to withstand climate change impacts involve the planning, design, construction, operation, or maintenance of the transportation infrastructure as well as the delivery of transportation services. The core of adaptation planning for transportation involves three major components: (1) assessing the vulnerability of populations and infrastructure to future climate impacts; (2) developing adaptation strategies such as the adoption of design and engineering standards to alleviate risks to vulnerable populations and infrastructure; and (3) incorporating vulnerability assessment and adaptation strategies into transportation investment decisions and disaster preparedness for various transportation modes.

Despite the theoretical benefits of integrated actions, planners have found them hard to develop in practice for a variety of reasons. Both local and state governments have often addressed mitigation and adaptation in separate plans, and sometimes these plans have been found to be conflict with one another. Also, different agencies or departments have taken the responsibility of developing and implementing mitigation and adaptation strategies with various levels of coordination with others. The result can be major conflicts between mitigation and adaptation strategies: mitigation strategies do not necessarily produce adaptation co-benefits and vice versa. Instead, mitigation and adaptation strategies developed separately can have counterproductive outcomes for climate planning. For example, encouraging high densities in urban areas can reduce VMT and thus mitigate transportation greenhouse gas emissions. However, densely-built environments in areas prone to catastrophic climate impacts can put larger populations at risk of these impacts. Also, denser urban communities with less open space may face higher flooding risks or be more likely to suffer from an urban heat island effect.¹³ Similarly, road widening to increase the capacity of evacuation routes can be considered an adaptation strategy that runs counter to VMT reduction goals. In sum, without a clear, coordinated effort to combine

adaptation and mitigation goals into a holistic vision, mitigation strategies can potentially undermine adaptation goals and vice versa.

Whereas California aims at achieving mitigation and adaptation goals concurrently, no systematic study of TLU policy in the U.S. has identified potential conflict areas, strategies to reduce or eliminate these conflicts, or—most importantly—strategies to integrate mitigation and adaptation strategies. Other than funding a few programs that emphasize integrated action, the State of California does not currently offer a comprehensive guide to help municipalities achieve integrated action and avoid conflicts in TLU planning.

There are several published studies that evaluate multiple plans from U.S. cities focusing on either reduction of GHG emissions or adaptation to the negative impacts of climate change, though not both. Wheeler analyzed the first generation of state and municipal CAPs in the United States to examine GHG emissions reduction goals, the breadth of measures or strategies proposed, and implementation issues.¹⁴ Another study by Boswell, Greave and Seale valuated CAPs from 30 U.S. cities and their associated GHG emissions inventories to understand how inventories influence proposed policies and programs.¹⁵ Also, Bassett and Shandas analyzed municipal CAP processes and documents to understand drivers and obstacles for local action and the popularity of particular types of strategies.¹⁶ Related to adaptation, Woodruff and Stults analyzed 44 local adaptation plans in the U.S. to evaluate plan quality variations across these communities.¹⁷ Also, Woodruff et al. compared 10 resilience plans to 44 adaptation plans from U.S. cities to examine major differences between these two types of plans and assess whether resilience plans can effectively prepare cities for climate change.¹⁸

As a significant contributor to climate change and a likely victim of its adverse impacts, transportation is a key element in mitigation of GHG emissions and adaptation to climate change. The report explores the question of how California can maximize the opportunities for local governments to adopt transportation and land-use (TLU) programs and policies that reduce greenhouse gas (GHG) emissions from the transportation sector while simultaneously enhancing community resiliency vis-à-vis climate change impacts through adaptation measures. Despite the proliferation of research on CAP evaluation in the past decade, no study has focused specifically on integrated actions nor the relationship between mitigation and adaptation related to TLU. This research is designed to fill these gaps in understanding by exploring three research questions:

1. In what ways do cities incorporate integrated actions into their plans?
2. What are potential drivers of conflict between mitigation and adaptation in municipal plans?
3. What actions can the State of California take to help cities more effectively incorporate integrated actions?

To meet these objectives, the authors identified 23 California cities that had developed a Climate Action Plan (CAP) by 2009. For those cities, the authors collected and analyzed the content of municipal CAPs and other relevant plans and documents from 2009 to the

present. The plan analysis focused on mitigation and adaptation actions that were related to the transportation and land-use (TLU) sector. Lastly, the authors interviewed planners and other professionals from cities, other local or regional entities, and the State to better understand the challenges and opportunities involved in TLU mitigation and adaptation efforts broadly, and integrated actions specifically.

This report is organized as follows. Chapter II provides an overview of climate action planning efforts in California, and Chapter III presents the study methods. Chapter IV describes various types of plans used for climate planning in California as well as common climate policies included in these plans. Chapter V offers a detailed examination of ways cities incorporate integrated actions into their plans, also discussing the potential for conflicts between mitigation and adaptation as well as state actions that can help cities better implement integrated actions. In Chapter VI, the authors highlight the opportunities and challenges of integrated actions relevant to the TLU sector and offer recommendations for cities and the State. Lastly, Chapter VII discusses limitations of the study and offers directions for future research.

II. CLIMATE ACTION PLANNING IN CALIFORNIA

This chapter provides a broad overview of steps and actions taken by the State of California to address the causes and consequences of climate change. Understanding state-level climate planning is important because these actions have influenced municipal-level climate planning, which is the major focus of this report. On the other hand, local action is critical for the success of state-level climate planning. Hence, the purpose of this chapter is two-fold: (1) to discuss the role of local climate planning in meeting California's GHG emissions reduction targets, and (2) to examine mechanisms through which state-level action has influenced climate planning at the lower levels of government.

CALIFORNIA'S GREENHOUSE GAS EMISSIONS REDUCTION TARGETS AND THE IMPORTANCE OF LOCAL ACTION

Recognizing the risks climate change poses to California's economy, environment, and communities, the State has set both short-term and long-term goals to reduce GHGs. Assembly Bill 32, The California Global Warming Solutions Act of 2006, required the State to reduce GHG emissions approximately 15 percent below the business-as-usual scenario by 2020 to meet its short-term goal. The 2020 GHG emissions reduction target is based on feasibility, but the ambitious 2050 target is designed to meet the scientific requirements of alleviating adverse climate change impacts. Although California is on track to meet its 2020 emissions target, the State's long-term goal of reducing emissions 80 percent below 1990 levels by 2050 necessitates a higher level of commitment from the state and local level governments.

Since local governments have significant impact and authority over activities that contribute to GHG emissions, their participation is critical for meeting California's emission reduction targets. For example, local planning and permitting processes, ordinances, community outreach and engagement activities, and municipal operations can all serve as tools for the implementation of GHG emissions reduction strategies. Also, local governments have authority to control land use within their jurisdictions. Although California Air Resources Board (CARB) is directed as the lead agency to implement AB 32, many of the strategies recommended by California's Climate Change Scoping Plan (and its subsequent updates) rely on local and regional entities.

Since transportation is the largest contributor to total GHG emissions in California, the State has developed several key laws, regulations, and executive orders to tackle transportation emissions. The most relevant to local actions is the Sustainable Communities and Climate Protection Act of 2008, also known as Senate Bill (SB) 375. SB 375 requires metropolitan planning organizations (MPOs) to meet GHG emissions reductions targets by a combination of transportation and land-use as well as housing planning efforts. Although the bill sets out planning requirements for MPOs, local jurisdictions are in charge of adopting and implementing strategies to reduce emissions from the transportation and land-use sector.

According to CARB's 2018 SB 375 Progress Report, California is unfortunately not on track to meet the GHG reduction target set for 2020, as per capita VMT and per capita CO₂ emissions are increasing.¹⁹ The report ascertains that transportation emissions continue

to rise in California despite fuel efficiency improvements and reductions in the carbon content of fuel. Also, transportation spending planned by mode remained consistent in the State's four largest regions, and the portion of people solo driving to work either went up or remained the same in most regions. The report concludes that without significant changes to the ways "communities and transportation systems are planned, funded and built," California will not reach its mandated emission targets for 2030 and beyond.²⁰

In 2018, CARB adopted more ambitious SB 375 targets to enhance progress towards the 2017 Scoping Plan Update goal of reducing 19 percent of per capita GHG emissions below 2005 levels by 2035 from passenger vehicles. Nevertheless, additional state and local efforts are necessary to meet the overall transportation emissions reduction goals set for 2035 (a mid-term target). Although the 2017 Scoping Plan Update stresses the importance of local actions to meet the State's emissions mitigation goals, it only includes nonbinding recommendations and technical information to empower cities to take climate action. It is ultimately up to local jurisdictions to develop and implement transportation and land-use strategies to reduce GHG emissions.

Although the State's requirements have created an impetus for many local jurisdictions to take action, many local governments have not reacted to state-level regulation,²¹ while others have aimed to go beyond GHG emissions reduction goals set by the State. Some cities have developed innovative strategies to reduce GHG emissions from different sectors of the economy and have used a variety of tools—ranging from municipal operation improvements to general plan updates and the adoption of sustainable codes and standards—to achieve sectoral emission reduction targets.

Although local jurisdictions have long been involved in the mitigation of GHG emissions in California, planning for adaptation to the adverse impacts of climate change is a more recent endeavor in many cases. This stronger emphasis on adaptation can be an outcome of several trends. First, in recent years, there has been a growing realization that California communities will experience climate change impacts (such as wildfires, sea level rise, droughts, and heat waves) despite the implementation of GHG emission reduction strategies. Second, local governments now have access to better data about climate change and its impacts on California due to proliferation of research in this area. For example, the web-based tool Cal-Adapt offers interactive climate data visualizations illustrating projected sea level rise and other climate impacts.²² Lastly, state-level actions led by the California Natural Resources Agency emphasize the importance of coordinating state-level initiatives with local and regional adaptation efforts.

A CONTINUUM OF CLIMATE ACTION PLANNING IN CALIFORNIA

As explained in the previous section, the State of California identifies local governments and regional entities as essential partners in achieving the statewide GHG emission reduction targets. Key ways the State has influenced local climate action include laws and regulations, funding programs, technical support, outreach, education, and research.

Laws and Regulations

California law encourages but does not mandate that California cities engage in either climate mitigation or adaptation planning. As explained earlier, AB 32 and SB 375, the two major laws that address greenhouse gas emissions in California, do not mandate that cities develop and implement local CAPs. Nevertheless, cities have a strong incentive to adopt a CAP in order to streamline the environmental review process of projects within their jurisdiction, because the California Environmental Quality Act (CEQA) requires cities to include an analysis of greenhouse gas emissions in their general plan updates. Local CAPs can be used to satisfy the CEQA requirements for general plan updates (as long as certain criteria are met), thereby helping cities save time and resources during the environmental review process of future projects.

SB 375 works through several discrete mechanisms. Most importantly, it establishes a collaborative process between metropolitan planning organizations (MPOs) and the CARB to set regional GHG emissions reduction targets and requires each MPO to develop a “Sustainable Communities Strategy” (SCS) in the regional transportation plan to meet those targets. Consequently, all transportation funding allocation decisions should be consistent with the SCS. If the SCS is inadequate in meeting the regional targets, an “Alternative Planning Strategy” (APS) should be proposed. CEQA streamlining incentives apply to projects that are consistent with the SCS or APS. Nevertheless, neither SCS nor APS supersedes local- or regional-level plans and policies such as general plans. In other words, a city’s plans or local policies do not have to be consistent with either SCS or APS.²³

Other notable California climate policies include:

- Assembly Bill 1493 (2002): State law setting GHG emission standards for passenger vehicles;
- Assembly Bill 2514 (2010): State law requiring the State’s three investor-owned utilities (Southern California Edison or “SCE,” Pacific Gas & Electric or “PG&E,” and San Diego Gas & Electric or “SDG&E”) to build minimum levels of grid-scale energy storage infrastructure;
- Senate Bill 535 (2012): Legislation directing a quarter of the State’s cap-and-trade revenues to benefit disadvantaged communities;
- Senate Bill 743 (2013): Legislation changing the focus of transportation impact analysis in CEQA from measuring impacts to drivers to reducing VMT;
- Assembly Bill 1482 (2015); Senate Bill 246 (2015); Senate Bill 379 (2015); Assembly Bill 2800 (2016): State laws calling for developing (and updating) a climate adaptation strategy, establishing an “Integrated Climate Adaptation and Resilience Program”²⁴ to coordinate regional and local efforts with state climate adaptation strategies, requiring local governments to add adaptation and resiliency strategies in general plans, and requiring state agencies to consider climate change for new infrastructure planning, respectively;

- Senate Bill 32 (2016): Legislation requiring the statewide greenhouse gas emissions to be reduced by 40 percent below the 1990 level by 2030;
- Senate Bill 1383 (2016): Legislation setting a reduction target for short-lived GHGs, such as methane;
- Senate Bill 379 (2016): Legislation requiring local governments to include climate adaptation and resiliency strategies in the safety elements of their general plans;
- Senate Bill 1000 (2016): Legislation requiring local governments to include an environmental justice element in their general plans;
- Senate Bill 1 (2017): Transportation funding legislation increasing the state's gasoline tax to raise funds for transportation projects that involve efficiency improvements and emission reductions;
- Assembly Bill 617 (2017): Air quality legislation to protect vulnerable communities by increasing air monitoring requirements and penalties for polluters exceeding their limits;
- Assembly Bill 398 (2017): State law extending California's cap-and-trade program to 2030;
- Senate Bill 100 (2018) and Senate Bill 350 (2015): Energy legislation setting renewable energy targets for 2030 and 2045 and encouraging greater electric utility investment in EV charging infrastructure;
- Assembly Bill 2911 (2018): State law making various changes to fire safety planning efforts.²⁵

Funding

Cities in California are eligible for several grant programs funded through the State's cap-and-trade allowance revenues. For example, cities have received funding to expand their transit services; implement low-carbon transit operations, such as electric buses; and conserve agricultural land to combat sprawl. A portion of these funds are set aside or prioritized for low-income and disadvantaged communities.

Every year, the State releases an annual report to the legislature that provides a list of the projects funded through the cap-and-trade auction proceeds. It also describes the status of funded programs as well as expected GHG reductions from project investments. The California Climate Investments 2019 Annual Report dedicated a chapter to funded projects and programs related to "Transportation and Sustainable Communities."²⁶ According to the 2019 Annual Report, the cap-and-trade revenues support various projects and programs related to TLU, such as those promoting "low carbon transportation" (e.g. zero emission truck, bus and car-share pilot projects), "community air protection," and "coastal resilience planning."²⁷ For example, the Affordable Housing and Sustainable Communities Program

(AHSC) provides funding for various types of projects (i.e. transportation, housing, and land preservation) that support infill and compact development as a way to reduce GHGs.²⁸

In addition to the cap-and-trade allowance revenues, local governments can benefit from Local Government Partnerships (LGP) programs that are managed by investor owned utilities (IOUs). Local governments can receive support for retrofitting governmental facilities, promoting various community energy efficiency programs, or undertaking other activities relevant to the California Energy Efficiency Strategic Plan (CEESP).²⁹

Technical Support

California state agencies provide technical support to enable cities to take climate action. Major examples include, but are not limited to:

- “CoolCalifornia.org,”³⁰ an informational website that offers carbon calculators, a “Funding Wizard” identifying grant and loan opportunities, success stories highlighting innovative approaches, and several other resources helping cities develop and implement CAPs;
- “General Plan Guidelines,”³¹ developed by the California Governor’s Office of Planning and Research (OPR), which include information to help cities meet the CEQA greenhouse gas emissions requirements through CAPs and other relevant plans linked to general plans;
- “Climate Action Portal Map,”³² an interactive map and centralized database developed by CARB displaying emission inventories, GHG reduction targets and strategies, and other specific information about local CAPs; and
- “California Climate Investments Technical Assistance Program,”³³ a program administered by the California Strategic Growth Council (CSGC) to support and prepare organizations serving under-resourced communities to apply for state grants.

Outreach, Education, and Research

The State of California recognizes that cities are typically better positioned than states to develop and implement successful outreach and education programs to engage citizens at the local level. However, the State has taken on a few outreach, education, and research efforts, such as:

- Enacting broad public education and outreach campaigns to encourage the development and implementation of key technologies, such as ZEVs;
- Hosting workshops and meetings to receive public input and engage stakeholders in the development process of the 2017 Scoping Plan; and
- Climate change research grants distributed to California universities and research laboratories by the California Strategic Growth Council.

III. STUDY METHODS

This chapter describes phases of the study methods: selecting cities for analysis, identifying and reviewing plans and policies, and expert interviews.

Case Study Selection

The study analyzed 23 California cities that are in more advanced stages of climate action planning. The authors chose these cities for special focus because, as the early actors in climate planning, they are the ones most likely to have thought through and experienced the challenges of integrated action.

The authors identified the 23 case studies for analysis using a publicly available dataset produced by ICLEI-Local Governments for Sustainability, a global network of local governments dedicated to sustainability and climate action. ICLEI offers a systematic framework for climate action planning that involves five major milestones, ranging from preparing a greenhouse gas emissions (GHG) inventory to plan implementation, monitoring, and evaluation.³⁴ From this dataset, the authors selected the 23 municipalities that in 2009 had reached at least the third milestone: developing a CAP. Our analysis of plans focused primarily on the latest versions of CAPs. If the city only updated parts of the CAP or referred to a previous version of the CAP, the authors reviewed both plans carefully. Table 1 shows the list of selected cities that have had a CAP in place since 2009 or earlier.

Table 1. List of Municipalities

City	Population	Region of CA	County
American Canyon	20,359	Northern	Napa
Arcata	18,257	Northern	Humboldt
Berkeley	121,643	Northern	Alameda
Emeryville	12,104	Northern	Alameda
Fremont	237,807	Northern	Alameda
Hayward	159,620	Northern	Alameda
Los Angeles	3,990,456	Southern	Los Angeles
Menlo Park	34,549	Northern	San Mateo
Napa	79,263	Northern	Napa
Novato	55,655	Northern	Marin
Oakland	429,082	Northern	Alameda
Palo Alto	66,666	Northern	Santa Clara
Rohnert Park	43,753	Northern	Sonoma
Saint Helena	6,152	Northern	Napa
San Diego	1,425,976	Southern	San Diego
San Francisco	883,305	Northern	San Francisco
San José	1,030,119	Northern	Santa Clara
San Rafael	58,704	Northern	Marin
Santa Cruz	64,725	Northern	Santa Cruz
Santa Monica	91,411	Southern	Los Angeles
Santa Rosa	177,586	Northern	Sonoma
Windsor	27,849	Northern	Sonoma
Yountville	2,982	Northern	Napa

Source: U.S. Census Bureau.

REVIEW OF PLANNING AND POLICY DOCUMENTS

For each city, the authors analyzed the key documents where one would expect to find mitigation and adaptation planning work related to TLU and climate change.

Planning and Policy Documents Collected

For all 23 cities in California, the authors collected publicly available plans and documents relevant to the project. Specifically, the authors collected and analyzed:

- Municipal climate action plans (CAPs) and any related updates;
- Climate adaptation plans and any other closely related documents, such as local hazard mitigation plans, community resilience plans or strategies, and sea level rise road maps and action plans; and
- General plans.

Although the authors collected a variety of types of plans, such as general plans and bicycle plans, our main focus was on plans directly related to climate change and its impacts. For example, the authors only reviewed aspects of general plans that were related to climate action planning efforts. Similarly, the authors only referred to bicycle plans or pedestrian plans when these plans were explicitly mentioned as a means of CAP implementation.

Content Analysis Process

To analyze the CAPs and their related documents, the authors employed three phases of analysis. In Phase I, the authors first developed a framework that would enable the capture of specific information about TLU strategies along with general information such as GHG emissions targets and baseline emissions levels. To create this framework, the authors drew upon a review of the climate planning literature and a sample of municipal climate action plans. In Phase II, the authors pulled content from planning documents and coded them using the framework developed in Phase I. Subsequently, in Phase III, the authors coded content pulled in the second phase to identify (i) mitigation efforts, (ii) adaptation efforts, (iii) potential conflicts between planning efforts, (iv) potential for integrated actions, and (v) common themes across plan programs/policies.

Phase I

For analysis of both CAPs and general plans, the authors created an analysis framework including the following categories of municipal actions:

- Strategies related to the physical transportation infrastructure, such as bike and pedestrian infrastructure, complete streets, mass transit services, support for electric and autonomous vehicles, car-sharing, anti-car-idling ordinances, and so on.
- Land-use policies, such as transit-oriented development, infill development, accessory dwelling units, urban growth boundaries, open space and farmland preservation, parking reform, urban forests, port policies, and so on.
- Transportation demand management (TDM) and related programs designed to encourage less single-occupancy vehicle driving.
- Cross-cutting issues and regional collaboration, such as implementing regional rail service that expands infrastructure for active and public transit.
- “Other,” a category to capture innovative but uncommon strategies.

The framework for analyzing climate adaptation and related plans added specific components appropriate to adaptation, such as analysis of exposure to climate impacts, population and infrastructure sensitivity, and strategies to enhance adaptive capacity.

After establishing the content of this analytical framework, the authors created a matrix with each of the four primary categories (i.e., strategies related to physical transportation infrastructure, land-use policies, transportation demand management, cross-cutting

issues) and the “other” category. Sub-categories (e.g., “infill development,” “urban growth boundary,” and “port policies”) were added to the matrix under the appropriate primary category heading to facilitate the coding processes in Phases II and III.

Phase II

Utilizing the coding framework established in Phase I, two research assistants worked collaboratively to review planning documents and identify text relevant to the four categories identified in the initial phase. After finding related text, the research assistants coded the text by copying the text verbatim into the matrix under the appropriate category and sub-category.

Phase III

After the text for each plan had been pulled and categorized using the analysis framework matrix, the authors employed additional rounds of coding to identify mitigation and adaptation efforts, integrated efforts, and potential sources of conflict. First, the authors categorized each planning policy/program as being related to mitigation efforts (e.g., discussing the reduction of GHGs by replacing single-occupancy vehicle trips) or adaptation efforts (e.g., adding shaded trails to provide cooling effects for riders). Second, the authors reviewed across codes for each municipality to identify integrated actions. For example, if a municipality included robust cycling policies to reduce VMT and GHGs in one aspect of the plan, while also incorporating tree canopy along bicycle paths for shade and cooling, these actions would be coded as being exemplary of an integrated action. In a third step, this same review process was applied in identifying possible conflicts between mitigation and adaptation efforts across plans. For example, if a plan encouraged higher-density development but did not provide offsets for the urban heat island effect, this would be considered a possible conflict in adaptation and mitigation efforts.

Finally, the coded plans from all cities were analyzed again in a comprehensive fashion to identify general themes in plan content, such as types of adaptation efforts commonly discussed by cities.

INTERVIEWS

The planning document analysis provided a basis for the third phase of this research: expert interviews. Through the interview phase, the research team ensured that all relevant updated documents were reviewed. This phase also helped the research team validate the findings of the content analysis.

The Interview Protocol

The authors designed a semi-structured interview protocol based on findings from the previous two phases of research. Questions asked city planners and professionals to describe their experience with climate action planning as well as their efforts to coordinate mitigation and adaptation planning in their communities. Other questions asked interviewees to comment on the relative success of their city in mitigating GHG emissions from the TLU

sector, the ways in which plans/policies have bolstered capacity to respond to climate change, and the challenges in establishing adaptation, mitigation, and integrated efforts. Appendix A provides the entire interview protocol.

Selecting the Interviewees

For each city, the authors identified two or three individuals who were likely involved in climate action planning efforts using information provided in the CAPs or in the cities' relevant websites. The authors then contacted all identified individuals to request an interview with them or a recommendation of someone else at the city to interview.

The authors obtained interviews with at least one administrator or planner from each of 15 cities. In some cities, the authors conducted group interviews because the invited interviewee recruited or recommended additional people from other city or county departments or regional entities to participate in the discussion. In total, the authors interviewed 25 individuals representing municipal- or regional-level efforts in California.

In addition, a second, smaller set of interviews with state administrators explored their perceptions about policy actions the State of California is already taking and could take in future to help local governments achieve integrated actions and minimize conflicts between mitigation and adaptation. The authors interviewed three experts representing relevant state departments.

Table 2 presents the names and affiliations of all interviewees.

Interview Administration

All interviews were administered via Zoom Video Communications. For most interviews, two researchers were present. The interviews lasted about one hour each. All interviews were audio-recorded and transcribed by a professional transcription service.

Content Analysis Process

The authors used a combined deductive and inductive process to identify critical themes for analysis and then systematically coded the transcripts for these themes.

Table 2. List of Interviewees

Name	Department or Agency
Garrett T. Wong	Office of Sustainability and the Environment, City of Santa Monica
Timothy Doherty	San Francisco Municipal Transportation Agency, City and County of San Francisco
Rebecca L. Lucky	Sustainability Division, City of Menlo Park
William He	Planning Division, City of American Canyon
Nancy Humphrey	Environmental Services, City of Emeryville
Rachel DiFranco	Sustainability Manager, City of Fremont
Dan Schoenholz	Community Development, City of Fremont
Alyssa Muto	Environment and Mobility Planning, City of San Diego
Joe Tagliaboschi	Public Works, Town of Yountville
Erik Pearson	Environmental Services Manager, City of Hayward
Billi Romain	Office of Energy & Sustainable Development, City of Berkeley
Paul Jensen	Community Development Department, City of San Rafael
Nancy Adams	Transportation and Public Works Department, City of Santa Rosa
Carolyn Glanton	Sonoma County Regional Climate Protection Authority
Jessica Jones	Planning Division, City of Santa Rosa
Amy Nicholson	Planning Division, City of Santa Rosa
Tasha Wright	Energy & Sustainability, City of Santa Rosa
Claire Myers	Energy & Sustainability, City of Santa Rosa
Sylvia Star-Lack	Department of Transportation, City of Palo Alto
Ken Davies	Climate Smart San José, City of San José
Michael Samulon	Sustainability Office, City of Los Angeles
Tracey Frost	Office of Smart Mobility and Climate Change, California Department of Transportation
Laura Tam	San Francisco Bay Area Planning and Urban Research Association
Chris Ganson	California Governor's Office of Planning and Research
Annalisa Schilla	Climate Action & Research Planning, California Air Resources Board

IV. TYPES OF PLANS AND POLICIES

This chapter describes the different types of plans cities typically develop to address the causes and consequences of climate change, explains the different types of planning documents analyzed for this study, and analyzes how cities in California use each type of plan to guide transportation planning and policy.

TYPES OF MUNICIPAL PLANS USED IN CLIMATE PLANNING

Cities can choose to address climate change directly or indirectly through various types of plan documents. The most common types that are relevant to transportation and land-use planning are as follows.

1. *Comprehensive or general plans*: community land-use plans used to guide public and private physical development and investment decisions such as transportation infrastructure projects. In the 20th century, land-use plans evolved from simple zoning and design guidelines into a combination of design, policy, and management strategies to guide urban change and engage the community.³⁵ More recently, cities have updated these comprehensive or general plans to include elements or sections that address climate change.
2. *Hazard mitigation plans*: special-purpose plans that are used to supplement comprehensive plans through more detailed policy and design guidelines to mitigate hazards, such as earthquakes, wildfires, or floods. Hazard mitigation planning accelerated after the passage of the Disaster Mitigation Act (DMA), enacted by Congress in 2000, which required all local governments to adopt a hazard mitigation plan approved by the Federal Emergency Management Agency (FEMA) for eligibility to receive federal disaster funds.³⁶
3. *Climate action plans (CAPs)*: typically, stand-alone strategic plans that include policies and programs to mitigate GHG emissions from various sectors of the economy (e.g. transportation and land-use; energy supply; residential, commercial, and industrial; agriculture, forestry, and waste).³⁷ Local CAPs are based on GHG emissions inventories that show the contribution of various sectors, such as transportation and land-use, to total emissions.³⁸ CAPs may also include adaptation strategies to help communities adapt to the adverse impacts of climate change, such as sea level rise or flooding.³⁹ CAPs became more common in the mid-to-late 1990s after the U.S. Environmental Protection Agency (EPA) offered grants to states to develop GHG emissions inventories and mitigation plans, and local governments increasingly sought ICLEI—Local Governments for Sustainability—membership to reduce GHGs.⁴⁰
4. *Adaptation and resilience plans*: plans to generally help communities better prepare for potential hazards. Adaptation and resilience plans have several differences. Adaptation plans specifically focus on alleviating negative consequences of climate change, and they typically use multiple sources of data to examine climate change impacts and offer a breadth of strategies to address these impacts.⁴¹ Resilience

plans are typically broader or more holistic and more likely to emphasize participatory action.⁴² For example, resilience plans may focus on affordable housing in addition to addressing climate adaptation needs. Nevertheless, resilience plans can also focus on one single type of climate impact, such as sea level rise. In recent years, cities are increasingly using the concept of resilience (rather than adaptation) to frame their climate actions.⁴³ One Hundred Resilient Cities—a program pioneered by the Rockefeller Foundation—has significantly contributed to the popularity of resilience planning.

For this study, the authors analyzed all planning documents of the types described above that had been adopted by the 23 cities in California. As seen in Table 3, all cities have a climate action plan (primarily focusing on mitigation of GHGs), six cities have a separate resilience plan (including broad resilience plans and shoreline or sea level resilience documents), and fifteen cities have a separate hazard mitigation plan. San Diego is the only city in the sample that has a combined climate mitigation and adaptation plan. All cities have a general plan. Although terminology is not consistent across climate action planning documents, there still are two major components: mitigation of GHGs and adaptation to climate change impacts. Therefore, the authors hereafter refer to plans primarily focusing on reductions of GHGs as *climate action plans* and to documents that predominantly focus on alleviating the impacts of climate change, such as hazard mitigation or resilience plans, as *adaptation plans*.

Table 3. Climate-Specific Plans Reviewed

City	Climate Action Plan	Resilience Plan	Hazard Mitigation Plan
American Canyon	✓		
Arcata	✓	✓	
Berkeley	✓	✓	
Emeryville	✓		✓
Fremont	✓		✓
Hayward	✓	✓	✓
Los Angeles	✓	✓	✓
Menlo Park	✓		
Napa	✓		
Novato	✓		✓
Oakland	✓	✓	✓
Palo Alto	✓		✓
Rohnert Park	✓		✓
Saint Helena	✓		
San Diego	✓*		✓
San Francisco	✓	✓	✓
San José	✓		
San Rafael	✓		✓
Santa Cruz	✓		✓

City	Climate Action Plan	Resilience Plan	Hazard Mitigation Plan
Santa Monica	✓		✓
Santa Rosa	✓		✓
Windsor	✓		✓
Yountville	✓		

Notes: All cities have a general plan. *San Diego has a combined mitigation and adaptation plan.

TYPES OF CLIMATE POLICIES INCLUDED IN MUNICIPAL PLANNING DOCUMENTS

The review of climate-related planning documents revealed a wide variety of transportation-related strategies implemented: changing zoning codes to address GHGs and VMT; expanding or improving alternative and active transportation infrastructure; promoting connected, dense, and accessible land-uses; implementing requirements or incentives for developers; greening city fleets and city infrastructure; assisting businesses and institutions in developing commuter benefits programs; educating the public and improving access to transportation-related information; collaborating with regional transit authorities to expand and improve public transit service; removing barriers to improved bicycle mobility; addressing the jobs–housing mismatch; and implementing financial incentives/disincentives to reduce VMT and GHGs. The following sections provide a more in-depth look at these common approaches. The discussion is organized by plan type.

Climate Action Plans

All CAPs reviewed for this project included a variety of strategies to reduce GHG emissions from the TLU sector. More specifically, CAPs covered strategies related to transportation infrastructure, land-use policies, and transportation demand management. The different strategies identified for addressing climate change, for each city, are presented in Table 4.

Table 4. Content Addressed in Climate Action Plans, by Municipality

City	Date	Transp. Infrastructure/Built Environment									Land-Use Policies										TDM					Total	
		Bicycle	Pedestrian	Complete streets	Mass transit	Electric vehicles	Car-sharing	Low-carbon fuels	Autonomous vehicles	Climate-friendly infrastructure	Other	TOD	Infill development	ADU program	Housing development near activity centers	Housing affordability / jobs–housing balance	Preserve open space & environment	Urban growth boundaries	Parking requirements	Urban forest	Port policies	Other	TDM for employers	Programs to lessen driving	Education and outreach		Other
American Canyon	2012								✓																		1
Arcata	2006	✓	✓		✓						✓	✓		✓				✓			✓		✓	✓	✓	✓	13
Berkeley	2009	✓	✓	✓	✓		✓				✓			✓	✓	✓		✓	✓		✓		✓	✓	✓	✓	17
Emeryville	2016	✓	✓		✓	✓		✓	✓		✓			✓		✓		✓	✓		✓		✓	✓	✓	✓	17
Fremont	2012	✓	✓		✓	✓		✓			✓			✓							✓		✓	✓	✓	✓	13
Hayward	2009	✓	✓	✓	✓				✓		✓			✓	✓			✓			✓		✓	✓		✓	15
Los Angeles	2007; 2019 ^a	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓		✓	21
Menlo Park	2009; 2015 ^a	✓	✓		✓	✓	✓		✓		✓			✓							✓		✓	✓		✓	12
Napa	2012	✓	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓	✓			✓		✓		✓	✓	✓	✓	19
Novato	2009	✓	✓	✓	✓	✓		✓	✓			✓		✓				✓	✓		✓		✓	✓	✓		16
Oakland	2012; 2018 ^a	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	21
Palo Alto	2016	✓				✓	✓		✓		✓	✓		✓	✓			✓					✓	✓	✓	✓	13
Rohnert Park	2007								✓														✓				2
Saint Helena	2009																						✓				1
San Diego	2015	✓	✓	✓					✓		✓			✓	✓			✓					✓			✓	10
San Francisco	2004	✓	✓		✓	✓	✓				✓			✓		✓		✓	✓		✓		✓	✓	✓	✓	16
San José	2018	✓	✓		✓	✓		✓	✓		✓	✓		✓				✓			✓		✓	✓	✓	✓	17
San Rafael	2009; 2019 ^a	✓	✓		✓	✓	✓	✓	✓			✓	✓		✓				✓		✓		✓	✓	✓	✓	18

		Transp. Infrastructure/Built Environment										Land-Use Policies										TDM						
City	Date	Bicycle	Pedestrian	Complete streets	Mass transit	Electric vehicles	Car-sharing	Low-carbon fuels	Autonomous vehicles	Climate-friendly infrastructure	Other	TOD	Infill development	ADU program	Housing development near activity centers	Housing affordability / jobs-housing balance	Preserve open space & environment	Urban growth boundaries	Parking requirements	Urban forest	Port policies	Other	TDM for employers	Programs to lessen driving	Education and outreach	Other	Regional collaboration	Total
Santa Cruz	2012	✓	✓	✓						✓	✓	✓	✓		✓							✓	✓	✓	✓	✓	✓	14
Santa Monica	2013; 2019 ^a	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓			✓		✓			✓		✓	✓				16
Santa Rosa	2012	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓	✓		✓	✓	✓			✓	✓	✓		✓	19
Windsor	2012									✓													✓					2
Yountville	2016	✓	✓	✓	✓	✓	✓				✓									✓		✓	✓	✓	✓	✓	✓	13
		19	18	10	16	14	10	10	0	15	6	16	11	3	15	11	6	2	12	10	3	15	22	18	14	11	15	

^a Multiple plan dates indicate that an initial plan and subsequent updates were reviewed for this project.

As seen in Table 4, the most common strategies related to transportation infrastructure and the built environment are expanding bicycle infrastructure and/or amenities (19 cities), improving pedestrian infrastructure and access (18 cities), improving access, connectivity, and functionality of mass public transit (16 cities), and implementing climate-friendly infrastructure (15 cities), such as roundabouts and energy-efficient street lighting. Other common strategies included encouraging the expansion of electric vehicles (EVs) such as by adding city-wide EV charging stations (14), adding low-carbon/alternative fuel infrastructure (10 cities), and implementing complete-street designs that accommodate multi-modal travel (10 cities).

Less common strategies in the CAPs were built-environment policies to limit car-idling (one city) and “other” strategies (6 cities), such as installing solar panels in parking facilities, encouraging installation of pickup lockers for goods to reduce commercial vehicle use within cities, and/or implementing shared-scooter parking zones to encourage use of lower-emission modes of travel.

The most common land-use policies presented in the CAPs included transit-oriented development (16 cities), zoning for or otherwise encouraging housing development near activity centers (15 cities), implementing parking requirement policies such as unbundling parking from housing (12 cities), promoting infill development (11 cities), and urban forest policies (10 cities).

Less common strategies included policies and programs directed at expanding or preserving open space, agricultural land, and critical environmental areas (6 cities), encouraging accessory dwelling-units (ADUs) (3 cities), establishing climate-friendly port policies (3 cities), and establishing urban growth boundaries (2 cities).

Nearly all of the cities (22) provided transportation demand management (TDM) strategies in their CAPs. The most common strategies discussed options for reducing within-city car trips (e.g., encouraging transit use through education and outreach) and limiting regional workforce single-occupancy vehicle commutes (e.g., encouraging vanpool and carpool options, instituting employer-provided free or subsidized transit passes, telecommuting and home occupations, emergency ride home programs, bicycle storage facilities and showers for employees, and EV charging/purchasing incentives). In addition, most cities (18) provided other programs or incentives to reduce driving trips, such as pricing on-street parking relative to congestion; subsidizing fares for sustainable transit for youth, students, seniors, and underserved groups; or making more city services available online to discourage driving.

Education and outreach policies to address TDM goals were also common in CAPs (14 cities). Examples include creating education campaigns to discourage idling at intersections, encouraging shoppers to “walk to shop” and providing discounts for participants, and implementing community-based campaigns encouraging residents to take public transit.

Eleven cities included other policies and programs that did not fit into any of the categories in the framework. These included encouraging responsible and local alternative fuels (e.g., biofuels made from recycled oil) and identifying an internal EV champion to work with private and public sectors in the expansion of EV use and infrastructure.

Finally, 15 cities address the need for regional collaboration in their CAPs. The majority of these cities identified the need to work with regional transit authorities and other cities in improving regional transit circulation through coordination, incentives, and infrastructure expansion. Other collaborative efforts addressed in CAPs included advocating for low-carbon fuel at regional levels and actively participating in county and regional transportation planning working groups.

Adaptation Plans

A review of the 16 adaptation plans reveals that despite different locations within the State, most cities recognize that they face threats from flooding (14) and earthquakes (15), with the latter potentially resulting in liquefaction, tsunamis, tidal inundation, and/or landslides (Table 5). Twelve cities recognize drought as a threat, and ten recognize danger from wildland–urban interface fires. Threats recognized by far fewer cities include terrorism, civil unrest, and heat waves.

Table 5. Summary of Risks Identified in Adaptation Plans

City	Earthquake	Flooding and/or Tidal inundation	Mudslides/landslides	Drought	Urban–wildland interface fires	Liquefaction	Tsunami	Dam/levy failure	Sea level rise	Hazardous materials release	Extreme/adverse weather	Heat waves/ Extreme heat	Urban conflagration/Fire	Terrorism/Biological threats	Civil unrest/Economic inequality	Erosion/Overtopping	Saltwater intrusion
Arcata	✓	✓					✓		✓							✓	✓
Berkeley	✓		✓	✓	✓	✓	✓		✓	✓		✓		✓			
Emeryville	✓	✓								✓			✓	✓	✓		
Fremont	✓	✓	✓	✓		✓	✓		✓			✓	✓				
Hayward	✓		✓	✓	✓	✓	✓		✓	✓							
Los Angeles	✓	✓	✓	✓	✓		✓	✓	✓		✓						
Novato	✓	✓	✓		✓												
Oakland	✓	✓		✓	✓	✓			✓						✓		
Palo Alto	✓	✓	✓	✓	✓			✓			✓						
Rohnert Park	✓	✓	✓	✓	✓	✓		✓		✓							
San Francisco	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓			
San Rafael		✓		✓				✓	✓		✓	✓	✓				
Santa Cruz	✓	✓	✓	✓		✓	✓	✓								✓	
Santa Monica	✓	✓	✓		✓		✓				✓						
Santa Rosa	✓	✓	✓	✓	✓	✓		✓		✓							
Windsor	✓	✓	✓	✓	✓	✓		✓			✓	✓					
TOTAL	15	14	12	12	10	9	8	8	7	6	6	5	4	3	2	2	1

Notes: Seven of the selected cities did not have adaptation plans to review. Table 5 includes hazard mitigation plans and resiliency plans that incorporated adaptation strategies.

In addition to outlining risks, adaptation plans often identify population groups and infrastructure that are the most vulnerable. Vulnerable population groups identified by the plans typically include lower-income, elderly, unhoused, young, mobility-impaired, and/or linguistically isolated residents. Adaptation plans have also noted specific types of infrastructure (e.g. bridges and highways, water treatment facilities, and utilities) deemed to be most at risk. For example, Berkeley's plan mentions that fires may impede road infrastructure and inhibit the capacity of first responders to extinguish fires.

Yet despite clearly identifying the numerous causes of disaster, as well as the people and infrastructure affected, the plans contain few truly adaptive actions to prepare. For example, the risks most amenable to adaptive actions (e.g., protecting residents from heat waves and urban heat island effects) is identified as a problem for the most vulnerable populations, but it is not typically addressed in associated plans to promote resiliency. Instead, the plans tend to emphasize building capacity for response to a disaster (e.g., disaster preparedness education, continued monitoring of resources) and ameliorating effects of disaster impacts (e.g., retrofitting structures). With the exception of raising seawalls, there is limited discussion of *adaptive* changes in infrastructure design and management such as modifying the composition of road surfaces to prevent deformation in high temperatures, using ecosystem-based approaches to protect transportation infrastructure from floods, investing in systems to warn of impending flooding on transportation infrastructure, implementing 'defensible spaces' to buffer roads and structures from fire damage, and using zoning codes and ordinances to prevent new construction and transit infrastructure in high fire risk zones.

General Plans

The general plan content reviewed included strategies related to transportation infrastructure, land-use policies, and transportation demand management. The most common types of policies within these sectors are illustrated for each city in in Table 6 below.

Table 6. Content Addressed in General Plans by City

City	Date	Transp. Infrastructure/Built Environment									Land-Use Policies									TDM					Total		
		Bicycle	Pedestrian	Complete streets	Mass transit	Electric vehicles	Car-sharing	Low-carbon fuels	Autonomous vehicles	Climate-friendly infrastructure	Other	TOD	Infill development	ADU program	Housing development near activity centers	Housing affordability / jobs-housing balance	Preserve open space & environment	Urban growth boundaries	Parking requirements	Urban forest	Port policies	Other	TDM for employers	Programs to lesson driving		Education and outreach	Other
American Canyon	2012	✓	✓						✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓						12
Arcata	2006	✓	✓		✓					✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓		✓	✓	15
Berkeley	2009	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓		✓	19
Emeryville	2016	✓	✓	✓	✓				✓	✓		✓		✓				✓			✓		✓			✓	13
Fremont	2012	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	23
Hayward	2009	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	21
Los Angeles	2007; 2019 ^a	✓	✓	✓	✓			✓		✓	✓		✓	✓	✓	✓		✓			✓		✓		✓	✓	16
Menlo Park	2009; 2015 ^a	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓		✓	✓	17
Napa	2012	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	19
Novato	2009	✓	✓		✓		✓			✓	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓		✓	16
Oakland	2012; 2018 ^a	✓	✓		✓					✓	✓	✓	✓	✓	✓	✓		✓			✓	✓		✓	✓	✓	16
Palo Alto	2016	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	22
Rohnert Park	2007	✓	✓		✓				✓	✓		✓		✓	✓	✓	✓				✓		✓	✓		✓	14
Saint Helena	2009	✓	✓		✓					✓		✓		✓	✓	✓	✓	✓	✓		✓					✓	12
San Diego	2015	✓	✓		✓		✓			✓	✓		✓	✓	✓	✓	✓	✓			✓	✓			✓	✓	17
San Francisco	2004	✓	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	19
San José	2018	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	21

		Transp. Infrastructure/Built Environment										Land-Use Policies										TDM						
City	Date	Bicycle	Pedestrian	Complete streets	Mass transit	Electric vehicles	Car-sharing	Low-carbon fuels	Autonomous vehicles	Climate-friendl infrastructure	Other	TOD	Infill development	ADU program	Housing development near activity centers	Housing affordability / jobs-housing balance	Preserve open space & environment	Urban growth boundaries	Parking requirements	Urban forest	Port policies	Other	TDM for employers	Programs to lesson driving	Education and outreach	Other	Regional collaboration	Total
San Rafael	2009; 2019 ^a	✓	✓		✓	✓	✓	✓			✓	✓			✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	17
Santa Cruz	2012	✓	✓		✓					✓	✓	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓		✓	17
Santa Monica	2013; 2019 ^a	✓	✓	✓	✓		✓				✓	✓	✓		✓	✓	✓		✓	✓		✓	✓	✓	✓		✓	17
Santa Rosa	2012	✓	✓		✓					✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	18
Windsor	2012	✓	✓	✓	✓				✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	20
Yountville	2016	✓	✓		✓						✓			✓	✓	✓	✓	✓	✓	✓		✓			✓		✓	14
		22	22	9	22	6	8	7	3	10	23	17	17	11	23	22	22	15	20	14	11	22	16	11	18	2	22	

^a Multiple plan dates indicate that an initial plan and subsequent updates were reviewed for this project.

As seen in Table 8, the most common strategies within transportation infrastructure and the built environment included in the general plans were related to bicycle infrastructure and/or amenities (22 cities), improving pedestrian infrastructure and access (22 cities), and improving access, connectivity, and functionality of mass transit (22 cities). Other strategies related to climate-friendly infrastructure, such as roundabouts (10 cities), complete-streets programs (9 cities), electric vehicle policies (6 cities), low-carbon/fuel efficiency vehicle policies (7 cities), and autonomous vehicle policies. All 23 cities included other policies that addressed transportation infrastructure and the built environment but that did not fall neatly into one of the category codes. Examples include coordinating construction activity to maximize traffic flow and taking leadership positions in identifying innovative traffic infrastructure designs.

The most common land-use policies in the general plans included zoning for or otherwise encouraging housing development near activity centers (23 cities), addressing affordable housing and jobs–housing balance policies (22 cities), preserving open-space, farmland, and critical environmental areas (22 cities), adding parking requirements (20 cities), encouraging transit-oriented development (17 cities), and implementing infill development policies (17 cities). General plans also commonly included urban growth boundary policies (15 cities), urban forest strategies (14 cities), and port-related policies (11 cities). Twenty-two cities included a variety of other land use policies in their general plans; some examples include providing incentives for the preservation of historic residential structures and supporting sustainability and best practices in green building.

In terms of transportation demand management, 18 included policies regarding education and outreach (e.g., education campaigns to encouraging residents to take public transit), 16 included travel demand management programs for employees (e.g., encouraging telecommuting or carpooling), and 11 included incentive-based programs (e.g., subsidizing fares for sustainable transit for youth, students, seniors, and underserved groups).

Nearly all general plans (22) discussed regional collaboration in some capacity; these policies often discussed the need to work with regional transit authorities and other cities in improving regional transit access and functionality, incentives and fare structures, and infrastructure expansion.

V. MUNICIPAL STRATEGIES TO INCORPORATE INTEGRATED ACTIONS—AND THE POTENTIAL FOR CONFLICTS

Analysis of both the planning documents and the interviews reveals three key themes related to integrated actions: (1) city planners and city planning documents are emphasizing mitigation strategies rather than adaptation efforts; (2) some cities are incorporating integrated actions, but often not explicitly, within the same policy, or within the transportation sector; and (3) potential conflicts exist between transportation-related mitigation and adaptation policies, but these can be ameliorated through coordination with other sectors and within general plans. This chapter expands on each of these themes.

EMPHASIZING MITIGATION STRATEGIES RATHER THAN ADAPTATION EFFORTS

When asked about mitigation and adaptation efforts in their communities, city planners and officials tended to emphasize mitigation efforts rather than adaptation programs. This finding held true even when interviewees were asked about adaptation efforts directly. This emphasis on mitigation could be due in part to the difficulty in parsing whether a certain policy falls under “adaptation” or “mitigation” or both. For example, interviewees mentioned promoting the use of electric vehicles and the installation of solar-powered panels as adaptation efforts, because the policy moves consumers off a fossil-fuel based energy grid to a renewable energy system. However, this policy is also considered a mitigation approach, as fuel-efficient vehicles and renewable energy systems can help reduce greenhouse gas emissions. Another possible explanation for the emphasis on mitigation could be the broader focus on municipalities meeting their community-level GHG emission reduction target goals; as mitigation strategies relate more directly to these targets than adaptation efforts and are more measurable, these strategies might be more familiar to interviewees. For example, interviewees commonly mentioned their municipalities’ successes in reducing GHGs within certain sectors, particularly those with outcomes that are easier to control and measure (e.g., reducing emissions from water treatment facilities).

Despite municipal planners and officials discussing mitigation efforts more often, a majority of interviewees mentioned that they were beginning to think more about adaptation or were looking into possibilities for incorporating adaptation measures (particularly related to responding to sea level rise or implementing climate-friendly infrastructure). When probed to identify adaptation-specific plans related to transportation, the majority of interviewees mentioned that while no examples currently came to mind, there are efforts to think more holistically and innovatively about building more resilient cities. However, one interviewee did mention the need to address parking availability, as current land devoted for parking is likely to be inundated due to sea level rise. Similarly, an interviewee mentioned that current public transportation along shorelines will have to be adapted or changed to account for high tide events and future flooding.

In line with interviewees’ responses, plans tend to frame policies with language that aligns more with mitigation efforts (e.g., to reduce single-occupancy GHG emissions, to mitigate emissions from buildings) than with adaptation goals. Furthermore, within mitigation

strategies, plans tend to emphasize policy or incentive-based policies such as requiring new developments to provide amenities for bicycles, pedestrians, and transit users, assisting businesses and institutions in developing commuter benefits programs, and educating residents, businesses, and city officials to limit idling. Policies focused on changing land-use patterns tend to use zoning tools that emphasize higher-density, transit-oriented, mixed-use development. For example, Hayward's CAP suggested that the city encourage the use of public transit by making parking more difficult, collaborate with regional transit authorities to expand service, pursue hydrogen fueling stations for buses and personal vehicles, and encourage transit-oriented development (TOD) for city buildings. As another example, Oakland promotes policies to support the use of EV and alternative fuel vehicles in their CAP (e.g., expand charging infrastructure) and encourages higher density in the general plan by facilitating the development of accessory dwelling units. The CAP for the city of San Francisco includes policy goals to increase HOV lanes and carpool parking to reduce the number of single-occupancy trips. Similarly, in its general plan, San Francisco aims to reduce driving by providing information that encourages the public to take alternative modes. As another example, Santa Monica's CAP mentions goals to expand public and private EV charging infrastructure by updating the zoning codes and negotiating charging installations in new development agreements as well as increasing access to charging infrastructure for EVs and electric mobility devices (for instance, conducting outreach to renters and lower-income communities and non-profit property owners, developing smart phone/web applications for finding stations, and supporting neighborhood EV car shares in lower-income communities). In this vein, in its general plan, Santa Monica presents strategies for reducing vehicle ownership among residents, such as supporting car-sharing programs and encouraging the pricing of parking separately from housing.

Within city plans, adaptation strategies directly related to transportation were infrequent; the most common examples were adding shelters to transit stops to protect users from rain or sun exposure and adding street tree canopy. For example, Arcata's CAP includes goals to provide covered shelter for bus stops to keep patrons dry from rain while waiting for service. Similarly, Hayward's CAP calls for improving amenities at transit stations by adding shelters and benches for users. As another example of adaptation measures, San Francisco's general plan calls for maintaining and expanding street trees and their supportive infrastructure (e.g., watering systems).

In other sectors, adaptation strategies were still infrequent but were more common. Other adaptation efforts in plans not directly tied to transportation typically included adding urban forest and tree cover to shade buildings and/or lessen the urban heat island effect, promoting less resource-intensive buildings, and requiring the use of high-albedo materials in constructing outdoor surfaces. As an example, Emeryville's CAP states as goals the following: planting trees in areas at risk of the urban heat island effect and planting native and climate resilient trees, preserving existing trees, and increasing overall tree canopy. As another example, the city of Novato mentions its goals to prevent/mitigate the urban heat island in response to increased TOD; their plan requires new development and road infrastructure (sidewalks, parking lots, and so on) to be constructed using high-albedo materials. In addition, their plan calls for the implementation of green building infrastructure and an increase in tree cover, particularly to optimize shading of buildings.

INCORPORATING INTEGRATED ACTIONS

When asked about incorporating integrated efforts in city planning, interviewees most commonly mentioned actions related to building infrastructure, issues of equity, and localized food systems. For example, a policy that requires passive design and energy-efficient buildings both mitigates building-related GHGs (e.g., improving insulation, incorporating passive design, installing solar power) and makes structures better able to withstand extreme heat events. Equity was another lens that interviewees commonly used to conceptualize integrated actions; ensuring that the most vulnerable populations are a focus within planning initiatives (e.g., providing subsidized transit passes, providing affordable housing to limit long commutes) builds adaptive capacity for the city. Finally, planners mentioned implementing integrated efforts with food systems by making them more localized, less resource- and GHG-intensive, and more resilient.

Most of the interviewees stated that identifying integrated actions in the transportation sector proves more difficult; however, a few of the city planners did provide transportation-related examples of integrated efforts. For one, city planners identified greening public transportation fleets (e.g., implementing zero-emission electric buses) while also adding shade and amenities to streets and public transit stops (to encourage public transit use). In addition, strategies promoting active transit (to move people out of cars) while also encouraging EVs (to move people off of fossil fuels) were considered as including adaptation and mitigation efforts.

A review of the plans indicates that municipalities are incorporating other integrated actions in addition to those examples highlighted by interviewees. However, it is important to note that these integrated actions are not highlighted as being such by the municipality itself: rather, these connections were made through a review of the content of adaptation plans, CAPs, and general plans.

Most commonly, cities outlined the following strategies through policies and programs:

- Encouraging high-density, transit-oriented development in urban cores, while simultaneously incorporating measures for a robust urban forest and/or open-space program;
- Encouraging high-density, transit-oriented development in urban cores, while simultaneously incorporating measures to ensure passive, sustainable building design;
- Improving and expanding active transportation infrastructure (i.e., pedestrian and bicycle modes), while simultaneously incorporating measures to plant trees in medians and preserve open space for cooling and/or stormwater management; and
- Improving and expanding alternative transportation infrastructure (i.e., public transit), while simultaneously incorporating measures to add shelters at transit hubs to protect users from weather events (e.g., increased rain or heat).

It is also important to note that the general plans could offer an avenue for more explicitly tying these integrated efforts together by providing one comprehensive document incorporating the adaptation and mitigation components of all plan types. For example, Berkeley's general plan calls for construction of higher-density housing on major transit corridors, but it also stipulates that this development must align with policies set forth in the city's CAP. Furthermore, their general plan encourages infill development, but it requires that this development incorporates designs that are both architecturally and environmentally sensitive, using principles of sustainable planning and construction. As another example, Fremont's general plan contains a policy that calls for facilities that encourage safe walking and cycling throughout the city, and in the same policy it stipulates that accompanying landscaping should protect residents from climate conditions (e.g., reduce wind and provide shade) and that accompanying street lighting should be energy-efficient. Fremont's general plan also encourages multi-modal, complete street designs (mitigation strategies), while also mentioning the need to build adequate bus shelters for travelers (adaptation strategies). As another example, Hayward's general plan explicitly mentions their CAP in policies addressing multifamily development projects; their general plan mentions the necessity of unbundling costs of parking, ensuring that all new roadway projects and major reconstruction projects provide adequate street tree canopy, and exploring zoning and development standards that help reduce greenhouse gas emissions. Furthermore, while not explicitly tied to their CAP, Hayward's general plan includes other examples of integrated actions, such as minimizing the heat island effect by requiring developments to incorporate landscaping to capture and filter stormwater runoff and shading parking lots with trees or solar panels.

POTENTIAL CONFLICTS BETWEEN TRANSPORTATION-RELATED ADAPTATION AND MITIGATION

A review of the plans highlights several potential conflicts between adaptation and mitigation strategies. Further research is needed to determine the extent, efficacy, and severity of these possible conflicts (e.g., the relationship between density and urban heat islands, personal cars as being necessary for evacuation in emergencies); however, the authors provide them here to provoke greater discussion of incorporating integrated actions in a synergistic, rather than possibly antagonistic, manner. In a review of the city plans, potential transportation-related conflicts tended to fall within the following examples:

- Encouraging higher-density development, without taking measures to mitigate potentially exacerbated urban heat island effect;
- Encouraging higher-density development, without taking commensurate measures for flood protection;
- Changing land-use patterns that might limit mobility for vulnerable populations (e.g., decreasing parking availability), without clearly establishing plans for evacuation in the case of disaster;
- Promoting expansion of electric vehicle charging infrastructure, without accounting for stress to energy grids in the case of extreme weather events; and

- Promoting the expansion of electric vehicle charging infrastructure, without fully examining potential equity issues related to limited grid infrastructure and access to EVs.

Most cities discuss the associated risks of the urban heat island effect and extreme heat events in their adaptation plans; however, most cities are also promoting infill, higher-density, mixed-use, transit-oriented development in downtown cores, without necessarily emphasizing conditions necessary to ameliorate the urban heat island effect. For example, cities can increase tree and vegetation cover, green roofs (i.e., growing a vegetative layer on rooftops), cool roofs and pavements (i.e., using materials that reflect sunlight and heat away from buildings) and encourage more compact building designs to reduce urban heat islands.

Most cities are aware of the flood risks facing their communities. However, cities have primarily relied on metropolitan-level analyses to add density in “Priority Development Areas” (PDAs) that capitalize on existing assets, such as transit stations or walkable neighborhoods. Several interviewees mentioned that the process of determining PDAs at the metropolitan level inherently involved an assessment of flood risks. This claim means that areas that are prone to flooding would not be designated as PDAs. Nevertheless, it is likely that the metropolitan-level analysis masks local vulnerabilities or fails to identify local exacerbated flood risks. Because evaluating and modeling local impacts of climate change is difficult and involves many uncertainties, cities might be reluctant to undertake sophisticated analyses.

Furthermore, while cities discuss in their adaptation plans the vulnerability of residents with limited mobility (e.g., no access to a car or mobility impairments) as being at higher risk when evacuating in the face of a disaster, the majority of cities also highlight policies and programs that can reduce access to personal vehicles (e.g., reduce parking spaces in transit-oriented areas, encourage car-sharing); these policies, while intended to reduce GHGs and VMT, might also make residents vulnerable in the event of needing to evacuate the city.

Finally, many cities call for the expansion of electric vehicle charging infrastructure in residences to promote the adoption of alternative fuel vehicles; however, cities are not explicitly considering vulnerabilities that additional residential energy use might add to energy grids, which become even more vulnerable during heat waves and other high energy demand scenarios. Also, potential equity problems related to the distribution of new grid infrastructure might arise, especially in electricity-constrained jurisdictions with current limited grid infrastructure. It was also mentioned by a few interviewees that affluent communities might consider EVs to be the “silver bullet” solution to the climate problem, which might eventually reduce support for public transportation investments. This issue not only represents a potential conflict, but it also can create equity problems related to the mobility of low-income communities.

It is worth noting, however, that there are examples of general plans addressing some of these potential conflicts. For example, several highlight the need to identify and support vulnerable populations in acquiring shelter and transportation access; related efforts include providing accessible information (e.g., multilingual) regarding transportation options and service; and shuttle buses for the elderly and persons with disability or limited mobility.

As another example, Berkeley's general plan encourages higher-density development by promoting ADUs; however, their general plan stipulates that units should not be built in areas with limited parking and vehicular access or that are especially vulnerable to natural disaster. Menlo Park's general plan encourages higher-density, mixed-use development, while also requiring that developers provide green space for habitat and gardens for growing food.

As another example, the Santa Monica general plan calls for street retrofitting to improve active transit infrastructure, while also providing tree canopy, green space, water conveyance, and stormwater management within the same policy. The Santa Monica plan also calls for infill, higher-density, transit-oriented development; however, the plan also discusses the need for passive building designs (i.e., minimizing the need for energy to heat, cool, and operate) for new construction, while also encouraging the adoption of solar panels and other energy-saving technology in new building construction and in retrofitting existing buildings. In these ways, Santa Monica is implementing adaptation efforts to manage flooding and storm events, to move off of a fossil-fuel energy system, and to provide shade for citizens, while simultaneously reducing GHGs, mitigating the urban heat island effect, encouraging active transit, and encouraging higher-density, transit-oriented development.

VI. STATE ACTIONS TO HELP CITIES INCORPORATE INTEGRATED ACTIONS

The interviews were designed to determine the specific challenges municipal climate professionals face when planning for integrated climate actions. This chapter lays out first the challenges and then the recommended solutions.

CURRENT CHALLENGES FACING CITY PLANNERS AND OFFICIALS

Interviewees mentioned many challenges in incorporating integrated efforts in city planning. The ten most commonly identified are:

1. *Managing the complexities of the transportation sector.* Nearly all of the interviewees characterized the transportation sector as being especially difficult to manage. Transportation projects and issues cross jurisdictions (e.g., city, regional, and state), public sectors (e.g., public works, sustainability, transportation planning), and areas of expertise (e.g., engineering, policy analysis, planning, and environmental justice).
2. *Implementing land use changes.* Although municipalities have significant control over land-use planning within their jurisdictions, interviewees considered effecting changes through land use to be challenging in practice (e.g., a city may be intersected by a highway or experience an influx of regional commuters). Interviewees mentioned that California land-uses favor the automobile; furthermore, public transit infrastructure is costly and requires collaboration across several jurisdictions. As another complication, revenue-generating land-uses (e.g., gas stations) bring revenue into the city but are counterproductive to climate goals.
3. *Changing public perceptions and gaining the public's approval.* Many interviewees discussed difficulties in convincing constituents that certain plans were beneficial and necessary for the community. Increasing densities for communities (especially for those primarily composed of single-family homes) was the most frequently cited example. Other policies, like removing car lanes to make way for bus lines, are also unpopular with residents, as are policies that reduce parking availability and/or charge for parking and road infrastructure.
4. *Changing the status quo and acting innovatively.* Understandably, many city planners mentioned the difficulty of changing behaviors within planning departments, as there are challenges associated with asking staff to change traditional ways of addressing problems. For example, while a planner may be used to planning a project to improve bicycle infrastructure along a certain corridor, a planner may be unfamiliar with conceptualizing a bicycle infrastructure project that also incorporates stormwater management and extensive tree canopy.
5. *Enacting and enforcing regulations and impact fees for developers without hampering development projects.* Many planners expressed that while incorporating regulations for new developments was an important and necessary tool, they also expressed concern for stifling development projects through too many impact fees

and related regulations. Furthermore, enforcing certain regulations adds another layer of complication. For example, many California cities have a pressing affordable housing problem and are thus reluctant to develop or enforce regulations potentially hindering such development.

6. *Coordinating across regions.* Interviewees often discussed challenges inherent in limited regional coordination when implementing mitigation and adaptation efforts. For example, city planners feel that their ability to control regional traffic is difficult (a problem exacerbated by the jobs–housing mismatch), and so they instead focus on city-level problems, even though regional strategies would likely be more effective.
7. *Managing residential and commercial properties.* While city planners mentioned their successes in reducing GHGs associated with city fleets and buildings, they often expressed challenges in encouraging the adoption of mitigation strategies by private residential property owners and commercial property owners.
8. *Coordinating across different planning departments.* Interviewees commonly discussed the inherent challenges of having sustainability planning and transportation planning housed within different planning departments or city sectors; interviewees expressed that coordination and collaboration across departments proves difficult.
9. *Securing funding for planning projects and internal capacity building.* The majority of interviewees mentioned funding as a multifaceted challenge. For one, certain projects were funded prescriptively and discretely, making collaborative, long-term projects more difficult to plan for and implement. On the other hand, interviewees typically mentioned the need for more funding in helping to develop and implement more effective plans and policies. For example, planners mentioned that additional funding would be helpful in preparing plans, particularly in aiding collaboration across departments and gathering outside expertise (for example, sustainability consultants).
10. *Accommodating population growth.* Nearly all interviewees discussed the challenges of mitigating climate impacts and reducing greenhouse gas emissions while simultaneously taking on a growing population. A growing population causes practical challenges for planners in meeting target goals. This is because decoupling population growth and the demand for transportation and energy has proven difficult. As the population goes up, the increased demand for transportation and energy results in housing and transportation infrastructure development. Even if best practices of energy efficiency and emissions reductions are incorporated into these developments, the total emissions can increase. In other words, cities can reduce per capita GHGs but fail to reduce total emissions to meet their target if their population is increasing rapidly.

STATE OPPORTUNITIES FOR IMPROVING INTEGRATED ACTIONS

Interviewees suggested a variety of actions that the State can take to improve the capacity for municipal planners to implement integrated adaptation and mitigation efforts:

1. *Ensure homogenous policies in the entire State through state-level action.* City planners suggested that some policies should be adopted at the state level, so that each municipality does not have to expend the time and cost to independently create such policies. Examples that interviewees mentioned include requiring EV charging infrastructure in grocery stores, gas stations, commercial districts or new developments, and providing bicycle amenities in new housing developments across the entire state.
2. *Boldly address transportation emissions through regulation at the state level.* Some interviewees expressed that the State needs to boldly address transportation in regulations. Planners suggest that the State provide more incentives for purchasing EVs, require more expansive EV charging infrastructure, and enact tighter smog regulations. Perhaps most helpful—yet highly controversial—interviewees mentioned that the State should provide a definitive timeline for when it would impose a ban on the sale and/or use of internal combustion engines.
3. *Strengthen relationships between state administrators and city planners.* Interviewees also mentioned the need for the State to improve its relationship with city planning officials. For example, interviewees mentioned that the State tended to view cities as being antagonistic, instead of welcoming, to increased regulations. In fact, several interviewees expressed frustration with providing the legwork in establishing a more progressive local policy, only to have the State adopt similar standards several years down the line. Instead of adopting more progressive policies after cities spend time and resources investigating them, the State could begin from a collaborative relationship and offer the funding and expertise to cities interested in researching, piloting, and implementing more ambitious sustainability initiatives. Although the State does offer technical support and funding for various climate action planning projects, support for politically or technologically challenging options is key to the success of California's climate action.

A more collaborative relationship between state, local, and regional entities will also help ensure that planners across the State are fully aware of technical and funding resources available to them. On the other hand, a strengthened collaboration would help the State better fill the gaps in the provision of technical support. Interviewees mentioned several difficulties associated with obtaining technical expertise or information. For example, city planners found hiring consultants for collecting climate-related data and providing forecasts challenging at times, despite technical support offered by the State. Also, one interviewee mentioned the difficulty of justifying the relevance of technical resources offered by out-of-state organizations. When possible, state agencies should share user-friendly data to make it easier for cities to better justify climate action and monitor progress towards goals (e.g., giving cities access to Department of Motor Vehicle data listing the number of EVs

owned in a municipality; quantifying the economic and societal impacts of inaction for various regions; offering user-friendly scenario analysis tools).

4. *Provide more resources explicitly designed to help municipalities identify integrated actions.* A review of the adaptation plans reveal that cities have a strong understanding of the complexity of the climate-related risks they face. Furthermore, a review of the CAPs and more recent general plans indicate that cities have a list of innovative and impactful policies in mind for shaping their climate futures. However, there is much more of an emphasis on mitigation efforts and less emphasis on adaptation efforts, despite the numerous possibilities for combining these endeavors in cost-effective and synergistic ways. To help cities identify areas for combining GHG emissions reduction efforts with climate adaptation (or vice versa), the State should offer support in highlighting examples of concrete plans or strategies that integrate mitigation and adaptation. Currently, the State offers technical support for adaptation as well as mitigation efforts; however, integrated actions are not emphasized. It is up to the cities to analyze information offered by the State about mitigation and adaptation and determine potential conflicts and synergies. As an example, the State could provide a checklist aimed at helping city planners determine whether a mitigation plan could be in conflict with adaptation goals (e.g., increasing density has the potential conflict for exacerbating the urban heat island effect without adaptive measures to cool through passive building design or extensive tree canopy). This checklist could also provide a way for planners to select policies that complement mitigation efforts. For example, if a city plans to expand bicycle infrastructure as a means to reduce GHGs and VMT, this resource could provide a list of adaptation measures that could be folded into the same plan (e.g., adding tree cover in street landscaping, improving stormwater drainage systems to help the area better withstand flooding, adding natural features to control stormwater flows such as swales, or all of the above). While providing these resources, the State should be cognizant of the local context, providing examples for actions that cities can take based on region or size.

As adaptation and integration efforts related to transportation seem particularly complicated, the State should provide guidance for cities in implementing these types of programs. Creating a framework that clearly and creatively connects mitigation and adaptation measures could make integrated actions a part of planning discourse and practice and give city planners clear direction in planning these types of efforts.

CITY AND REGIONAL OPPORTUNITIES FOR IMPROVING INTEGRATED ACTIONS

In addition to state level actions, interviewees mentioned several ways that cities and regional authorities can collaborate to improve efforts. For one, larger and smaller cities can improve coordinated efforts to ensure that policies are effective. For example, smaller cities often look to larger cities in the region for examples of strategies to implement in city plans. In the other direction, larger cities often need smaller cities in the region to adopt complementary policies in order for climate policies to be effective. For example, central cities that invest in regional public rail networks need other localities to provide suitable land-uses around stations and enhance local access to stations. Lastly, virtually

all interviewees stressed the central role MPOs play in orchestrating local climate action to enhance climate planning effectiveness and avoid potential conflicts. For instance, interviewees mentioned the need to continue and expand the sharing of ideas and experiences through regional conferences or working groups.

VII. CONCLUSIONS

This chapter concludes by summarizing the key study findings, reflecting on the policy implications of those findings, acknowledging the limitations of the study, and proposing future research needs.

SUMMARY OF KEY FINDINGS

Many cities in California have adopted GHG emissions mitigation strategies that offer several valuable co-benefits (including adaptation co-benefits). However, since the first generation of climate action plans focused primarily on GHG mitigation, adaptation strategies have not yet been effectively or fully combined into mitigation plans in many cities. Only the most recent updates (e.g. The City of Santa Monica Climate Action and Adaptation Plan, 2019) emphasize and illustrate the mitigation benefits of adaptation actions.

Although some cities in California are incorporating integrated actions, these efforts are often not conducted explicitly; they may not be contained within the same policy or within the transportation sector. Nevertheless, there is evidence that integrated actions are considered by several cities taking climate action. Most commonly, cities outlined the following strategies for integrated actions through policies and programs:

- Encouraging high-density, transit-oriented development in urban cores, while simultaneously incorporating measures for a robust urban forest and/or open-space program;
- Encouraging high-density, transit-oriented development in urban cores, while simultaneously incorporating measures to ensure passive, sustainable building design;
- Improving and expanding active transportation infrastructure (i.e., pedestrian and bicycle modes), while simultaneously incorporating measures to plant trees in medians and preserve open space for cooling and/or stormwater management; and
- Improving and expanding alternative transportation infrastructure (i.e., public transit), while simultaneously incorporating measures to add shelters at transit hubs to protect users from weather events (e.g., increased rain or heat).

An important benefit of integrated actions is helping cities avoid potential conflicts between mitigation and adaptation. The review of municipal-level plans uncovered numerous potential transportation-related conflicts, such as:

- Encouraging higher-density development, without taking measures to mitigate potentially exacerbated urban heat island effects;
- Encouraging higher-density development, without taking commensurate measures for flood protection;

- Changing land-use patterns (e.g., decreasing parking availability) that might limit mobility for vulnerable populations, without clearly establishing plans for evacuation in the case of disaster; and
- Promoting the expansion of electric vehicle charging infrastructure, without accounting for stress to energy grids in the case of extreme weather events or fully examining potential equity issues related to limited grid infrastructure and access to EVs.

A cross-comparison of climate-related plan content and interview data reveals that cities have typically used their general plan or directions provided by MPOs to avoid some of these conflicts. For example, cities have used priority development areas identified by MPOs to minimize or avoid high-density development in areas prone to flooding or other climate hazards. Nevertheless, relying solely on general plan or MPO guidelines is likely insufficient to avoid all potential conflicts between mitigation and adaptation. For example, in areas where the demand for development and investment in transportation infrastructure is high, conflicts between the needs and requirements of mitigation and adaptation are still possible. These conflicts are more likely to happen where the entire city or region is considered to be at risk of climate hazards, and/or when uncertainties about the magnitude or distribution of impacts are high. In other words, pressures created by a high demand for development and transportation investments may outweigh climate risks—if those risks are perceived to be hard to avoid or difficult to predict.

IMPLICATIONS FOR STATE AND MUNICIPAL POLICY MAKERS

A cross-comparison of all data collected in this study reveals several key implications for state and municipal policymakers.

Most importantly, the State should:

- *Stress the importance of “integrated actions” to tackle transportation emissions while simultaneously enhancing California’s resilience to adverse climate change impacts.* The State should explicitly encourage the development and adoption of integrated actions by:
 - Offering funding for the development and implementation of policy measures and programmatic interventions at local and regional levels that effectively integrate mitigation and adaptation. Although the State currently has several grant programs that integrate climate goals with other community goals, such as grants for housing developments that consider climate impacts, these examples are the exception and not the rule.
 - Providing technical support for programs and projects that produce integrated mitigation and adaptation benefits. Currently, technical support is available for both mitigation (e.g., Cool California) and adaptation (e.g., the Adaptation Clearinghouse), but analysis of integrated actions (i.e., potential synergies and conflicts of mitigation and adaptation) is left out.

- Further supporting research in the area of integrated actions—promisingly, the most recent round of California Strategic Growth Council’s research program encourages research proposals that integrate climate adaptation needs with mitigation efforts. The State should further expand support for research on this subject.
- *Help determine and enact appropriate climate action at various levels of government (state, regional, metropolitan, municipal).* Although local action is key to the success of California’s climate action, certain strategies are more appropriate for other levels of government to develop and/or implement. For example, to ensure effectiveness and equity, several adaptation strategies (e.g., for flood and wildfire protection) are more appropriately addressed at the regional rather than the local level. In this case, the State should ensure that these regional entities have the resources to take appropriate action. Similarly, several mitigation strategies (e.g., stringent fuel efficiency standards, provision of shared electric vehicle charging stations) can be more effectively or equitably addressed at the state level.
- *Boldly and directly address transportation in state-level regulations to meet both climate mitigation and adaptation goals and take the burden off of municipalities.* Examples of policies to consider are mandating electrification of some heavy-duty vehicles, similar to the State’s “Zero Emission Buses” requirements; enacting tighter smog regulations; and providing a definitive timeline for when internal combustion engines will no longer be able to be purchased and/or used. When developing these climate policies, the State should prioritize mitigation actions with adaptation co-benefits or vice versa. For example, encouraging or mandating the use of plug-in electric vehicles will not only help mitigate emissions, but it can also be considered an adaptation strategy (if energy stored in electric vehicles batteries can power energy response systems, such as traffic lights or disaster communication equipment).⁴⁴ State-level actions focusing on strategies that have both mitigation and adaptation benefits will empower cities to take integrated actions and remove the burden of having to enact strict, local policies.
- *Build stronger collaboration between the State and city and regional planning officials, as well as a feedback mechanism for identifying and closing policy, technical, and communications gaps.* Although the State currently provides a substantial amount of technical support for local climate action, the findings of this study suggest that municipal planners may not be fully aware of all resources available or may not find these guidelines helpful or relevant.

To ensure the successful development and implementation of integrated actions, municipalities should:

- *Better link climate mitigation- and adaptation-related plans.* It is key to link various types of municipal climate-related plans (such as general plans, climate action plans, community resilience plans) to avoid potentially counterproductive outcomes and to harness the benefits of integrated actions. For example, the general plan could refer to the climate action plan when appropriate and vice versa.

- *Ensure effective cross-collaboration between various departments in charge of developing, implementing, and monitoring municipal climate-related plans.* For example, when there is substantial overlap between different types of plans, such as hazard mitigation plans and community resilience plans, it is important to ensure entities responsible for implementation are effectively collaborating with each other.

Additionally, as highlighted in the plans and by the interviewees, there are opportunities for municipalities to build adaptive capacity while also mitigating GHGs and reducing VMT. The most salient opportunities related to transportation are as follows:

- Expanding and improving alternative transportation infrastructure and facilities, while simultaneously improving areas' capacity to withstand flooding conditions;
- Expanding and improving alternative transportation infrastructure and facilities, while simultaneously planting vegetation to offset heat effects and provide cooling effects for alternative transportation users;
- Encouraging high-density, transit-oriented development, while simultaneously improving proximal transportation infrastructure to withstand disaster events and/or allow for evacuations;
- Promoting the adoption of EV technology and EV infrastructure across the community, while also promoting green energy use and opportunities for using EVs as battery storage (thus bolstering the energy grid, rather than adding to vulnerability);
- Pairing water and wastewater infrastructure improvements with transportation and land-use planning: for instance, road improvements to expand bicycle paths can be paired with improvements to water drainage conditions; planting trees and other vegetation in addition to adding impervious soils near road infrastructure can capture stormwater, reduce risks of landslides, provide carbon sinks, and promote cooling conditions in the city; and
- Encouraging density near transit without significantly modifying land surfaces to avoid exacerbating urban heat island effects (e.g. repurposing vacant or underutilized buildings near transit for affordable housing; encouraging the development of accessory dwelling units in urban areas).

STUDY LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The findings and conclusions of this study are based on the plans and experiences of 23 cities in California that had developed a climate action plan at least a decade ago. The experiences of these leading cities do not necessarily reflect the challenges and opportunities of municipal climate action in the United States. Nevertheless, the lessons learned can help cities in the process of planning for climate change to consider the benefits of integrated action.

The question of the appropriate level of action (i.e., global, national, state, regional, municipal, organizational, individual) has been debated since concerns about the causes and consequences of climate change were first acknowledged. In the United States, the absence of a robust and steady national-level climate policy has created an impetus for the lower levels of government to take the lead on climate action planning. Local governments and states have played a major role in America's climate action planning efforts, but the metropolitan- and regional-level entities are critical for the success of climate action plans generally and integrated actions specifically. Although several interviewees mentioned the roles and importance of metropolitan and regional organizations, this study has primarily focused on municipal-level actions (and state actions to support municipalities). However, analyzing the dynamics of climate action plan implementation among both local and regional organizations would provide a better understanding of integrated actions in California and beyond.

Lastly, the findings of this research uncover the need for a clear and detailed guide to develop and implement integrated actions. Although this study provides examples of ways cities have incorporated integrated actions into their plans, these strategies do not necessarily represent best practices of integrated actions.

Based on these limitations, the authors recommend that future research:

- Conduct a similar analysis with cities at the forefront of climate action planning outside of California;
- Identify how regional entities (e.g., MPOs, air quality management entities, counties, transit districts) can more effectively support integrated climate planning;
- Explore what role each level of government should play in producing integrated climate plans;
- Identify ways to engage residents in selecting integrated actions appropriate for their community; and
- Develop a detailed guide/handbook that specifically guides local governments in how to plan for integrated actions; this guide could list key integrated actions to consider as well as key conflicts to avoid and could recommend planning processes that will facilitate integrated planning.

APPENDIX A: INTERVIEW PROTOCOL

[After hellos/greetings.]

Just to let you know, I anticipate that our interview will last no more than an hour.

Before I ask my questions, let me remind you about why I'm interviewing you. I'm working with a research team studying local climate change mitigation and adaptation actions related to transportation and land-use. The authors are interested in your experiences in developing and implementing climate action plans. Our goal, broadly, is to identify municipal transportation and land-use policies and programs that support both climate mitigation and climate adaptation goals—so called “integrated actions.” The authors also want to identify state actions that can support cities planning integrated actions to address climate change.

If you are willing, your name and affiliation will appear in the report and other research projects in a list of all our interviewees. There will be more than 20 names in that list. However, the authors will not attribute any specific opinions or quotations to you unless the authors first get your permission to do this, so I hope you will speak freely.

1. Do I have your permission to acknowledge you by name in the report as one of our interviewees?
 - a. [Not whether “yes” or “no”]
2. Do you have any questions about the consent document I shared by email earlier? It explains your rights as a subject of research at SJSU.
 - a. [Answer questions as needed]
3. I would like to record our interview today to be sure I accurately capture your thoughts. Is it ok for me to record the interview?
 - a. [If yes, start Zoom recording]
4. Do you have any questions before the authors begin?
 - a. [If yes, answer them.]

Ok, let's get started.

Interview Questions for City Planners

1. Please tell me briefly about what work related to climate action planning you have personally been involved with at [community x]?
2. Has [community x] explicitly tried to coordinate mitigation and adaptation planning?
 - a. [If yes] How?
 - b. [If no] Why not?

3. To what extent do you think [community X] has been successful in addressing GHG emissions from the TLU sector?
4. Once [community x] started climate action planning, did that process lead to changes in your transportation and land-use plans and policies?
5. To what extent do you think [city X's] climate action planning efforts have enhanced the city/county's adaptive capacity to address climate change impacts?
6. What specific efforts has [community x] made to INTEGRATE mitigation and adaptation in the TLU sector?
 - a. Were these successful? Why or why not?
7. What conflicts between mitigation and adaptation plans has your city experienced?
 - a. How about any conflicts between land-use and transportation planning?
8. Looking forward to the next ten years, what do you think will be the significant opportunities and challenges for cities and counties seeking to integrate mitigation and adaptation?
9. Do you think regional coordination of mitigation and adaptation efforts has the potential to help local governments integrate mitigation and adaptation?
 - a. What kind of regional programs would be helpful?
 - b. What kind of progress do you think these regional efforts would achieve?
 - c. What role or influence has the SCS had in your planning? (note: ask if the interviewee does not talk about SCS)
10. How can the State of California help local governments take integrated climate action more effectively and efficiently?
11. Is there anything else you'd like to add that might help me understand your city's challenges or successes with integrated climate actions related to transportation and land-use?
12. Can you recommend anyone else I should interview for this project?

Thank you very much for sharing your insights with me today.

Interview Questions for State Administrators

1. Tell me about what work you've done at the State of California that relates to climate planning?
2. How has climate change planning in California impacted the State's transportation and land-use planning practices?

3. To what extent have cities in California been successful in addressing GHG emissions from the TLU sector?
4. To what extent have municipal-, regional-, and state-level climate actions enhanced California's adaptive capacity to address climate change impacts?
5. What efforts has the State made to integrate mitigation and adaptation in the TLU sector? Where these successful? Why or why not?
6. What conflicts might arise if mitigation and adaptation efforts at various levels of government are not well-coordinated?
7. Looking forward to the next ten years, what do you think will be the significant opportunities and challenges for cities and counties seeking to integrate mitigation and adaptation?
8. Do you think regional coordination of mitigation and adaptation efforts has the potential to help local governments integrate mitigation and adaptation?
 - a. What kind of regional programs would be helpful?
 - b. What kind of progress do you think these regional efforts would achieve?
9. How can the State of California help local governments take integrated climate action more effectively and efficiently?
10. Is there anything else you'd like to add that might help me understand your organization's challenges or successes with integrated climate actions related to transportation and land-use?
11. Can you recommend anyone else I should interview for this project?

APPENDIX B: LIST OF CITY PLANS REVIEWED

American Canyon

1. *Energy Efficiency Climate Action Plan* (Climate Action Plan)
2. *General Plan for the City of American Canyon* (General Plan)

Arcata

1. *Community Greenhouse Gas Reduction Plan* (Climate Action Plan)
2. *Arcata General Plan: 2020* (General Plan)
3. *City of Arcata Sea Level Rise Risk Assessment* (Resiliency/Adaptation Plan)

Berkeley

1. *City of Berkeley Climate Action Plan* (Climate Action Plan)
2. *Climate Action Plan Update 2017* (Climate Action Plan)
3. *City of Berkeley General Plan: A Guide for Public Decision-Making* (2003) (General Plan)
4. *Resilience Strategy* (Resiliency/Adaptation Plan)
5. *Local Hazard Mitigation Plan: Section 3.8: Climate Change* (Resiliency/Adaptation Plan)

Emeryville

1. *City of Emeryville Climate Action Plan November 2008* (Climate Action Plan)
2. *The City of Emeryville Climate Action Plan 2.0 2016* (Climate Action Plan)
3. *Emeryville General Plan* (General Plan)
4. *Local Hazard Mitigation Plan Update* (Resiliency/Adaptation Plan)

Fremont

1. *City of Fremont Climate Action Plan* (Climate Action Plan)
2. *City of Fremont General Plan* (General Plan)
3. *2016–2021 Local Hazard Mitigation Plan* (Resiliency/Adaptation Plan)

Hayward

1. *Hayward Climate Action Plan* (Climate Action Plan)
2. *Hayward 2040 General Plan Policy Document* (General Plan)
3. *Hayward Shoreline Resilience Study* (Resiliency/Adaptation Plan)
4. *Local Hazard Mitigation Plan 2016* (Resiliency/Adaptation Plan)

Los Angeles

1. *Green LA: An Action Plan to Lead the Nation in Fighting Global Warming* (Climate Action Plan)
2. *pLAn 3rd Annual Report 2017–2018* (Climate Action Plan)
3. *City of Los Angeles General Plan: OurLA20240* (General Plan)
4. *Resilient Los Angeles* (Resiliency/Adaptation Plan)
5. *2017 Local Hazard Mitigation Plan* (Resiliency/Adaptation Plan)

Menlo Park

1. *City of Menlo Park Climate Change Action Plan 2009* (Climate Action Plan)
2. *General Plan: City of Menlo Park* (General Plan)
3. *ConnectMenlo* (General Plan Update)

Napa

1. *City of Napa Sustainability Plan* (Climate Action Plan)
2. *Envision Napa 2010* (General Plan)

Novato

1. *Climate Change Action Plan* (Climate Action Plan)
2. *City of Novato General Plan 1996* (General Plan)
3. *City of Novato General Plan 2035* (General Plan Update)
4. *City of Novato Hazard Mitigation Plan* (Resiliency/Adaptation Plan)

Oakland

1. *City of Oakland Energy and Climate Action Plan* (Climate Action Plan)
2. *City of Oakland Energy and Climate Action Plan* (Updated March 2018) (Climate Action Plan Update)
3. *Envision Oakland* (General Plan)
4. *Resilient Oakland* (Resiliency/Adaptation Plan)
5. *Oakland Preliminary Sea Level Rise Road Map Fall 2017* (Resiliency/Adaptation Plan)

Palo Alto

1. *Sustainability and Climate Action Plan* (Climate Action Plan)
2. *Sustainability Implementation Plan* (Climate Action Plan)
3. *City of Palo Alto Comprehensive Plan 2030* (General Plan)
4. *Santa Clara Operational Area Hazard Mitigation Plan* (Resiliency/Adaptation Plan)

Rohnert Park

1. *City of Rohnert Park Greenhouse Gas Emissions Reduction Action Plan Analysis* (Climate Action Plan)
2. *General Plan - Our Place... Rohnert Park 2020 - A Plan for the Future* (General Plan)
3. *City of Rohnert Park 2017: Local Hazard Mitigation Plan* (Resiliency/Adaptation Plan)

Saint Helena

1. *City of St. Helena Greenhouse Gas Emissions Reduction Plan Analysis* (Climate Action Plan)
2. *City of St. Helena 1993 General Plan* (General Plan)
3. *City of St. Helena Draft General Plan* (General Plan Update)

San Diego

1. *City of San Diego Climate Action Plan Annual Reports: 2016 Annual Report* (Climate Action Plan)
2. *City of San Diego Climate Action Plan Annual Reports: 2017 Annual Report* (Climate Action Plan Update)
3. *City of San Diego General Plan 2008* (General Plan)
4. *City of San Diego Climate Mitigation and Adaptation Plan* (Resiliency/Adaptation Plan)

San Francisco

1. *Climate Action Plan for San Francisco* (Climate Action Plan)
2. *San Francisco Climate Action Strategy* (Climate Action Plan Update)
3. *San Francisco General Plan* (General Plan)
4. *San Francisco's Climate and Health Adaptation Framework 2017* (Resiliency/Adaptation Plan)
5. *Resilient San Francisco: Stronger Today, Stronger Tomorrow* (Resiliency/Adaptation Plan)
6. *City and County of San Francisco Hazard Mitigation Plan; San Francisco Sea Level Rise Action Plan* (Resiliency/Adaptation Plan)

San José

1. *Climate Smart San José: A People-Centered Plan for a Low-Carbon City* (Climate Action Plan)
2. *Envision San José 2040* (General Plan)

San Rafael

1. *City of San Rafael Climate Change Action Plan* (Climate Action Plan)
2. *San Rafael 2020* (General Plan)
3. *San Rafael Local Hazard Mitigation Plan* (Resiliency/Adaptation Plan)

Santa Cruz

1. *Climate Action Plan* (Climate Action Plan)
2. *Climate Adaptation Plan Update 2017–2022* (Climate Action Plan Update)
3. *City of Santa Cruz 2030 General Plan* (General Plan)
4. *City of Santa Cruz Local Hazard Mitigation Plan Five Year Update 2017–2022* (Resiliency/Adaptation Plan)

Santa Monica

1. *15 × 15 Climate Action Plan: 15 Measures to Reduce Emissions 15% by 2015 Final Report* (Climate Action Plan)
2. *City of Santa Monica's General Plan* (General Plan)
3. *Hazard Mitigation Plan City of Santa Monica, CA* (Resiliency/Adaptation Plan)

Santa Rosa

1. *Climate Action Plan* (Climate Action Plan)
2. *Municipal Operations Climate Action Plan* (Climate Action Plan)
3. *Santa Rosa General Plan 2035* (General Plan)
4. *City of Santa Rosa Local Hazard Mitigation Plan* (Resiliency/Adaptation Plan)

Windsor

1. *Town of Windsor Greenhouse Gas Emissions Reduction Action Plan Update* (Climate Action Plan)
2. *Greenhouse Gas Emissions Reduction Action Plan Update 2008* (Climate Action Plan)
3. *Town of Windsor 2040 General Plan* (General Plan)
4. *Local Hazard Mitigation Plan* (Resiliency/Adaptation Plan)

Yountville

1. *Town of Yountville Climate Action Plan* (Climate Action Plan)
2. *Yountville General Plan* (General Plan)

ABBREVIATIONS AND ACRONYMS

AB 32	Assembly Bill 32: The Global Warming Solutions Act of 2006
APS	Alternative Planning Strategy
CAP	Climate Action Plan
CARB	California Air Resources Board
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CSGC	California Strategic Growth Council
EV	Electric vehicle
GHG	Greenhouse Gas
MPO	Metropolitan Planning Organization
OPR	Office of Planning & Research
SB 375	Senate Bill 375: The Sustainable Communities and Climate Protection Act of 2008
SCS	Sustainable Communities Strategy
TLU	Transportation and land-use
VMT	Vehicle miles traveled

ENDNOTES

1. "2017–18 Cap-and-Trade Expenditure Plan," California Legislative Analyst's Office, updated August 24, 2017, <http://www.lao.ca.gov/handouts/resources/2017/Senate-Cap-and-Trade-Expenditure-Plan-082417.pdf>.
2. "GHG Current California Emission Inventory Data," California Air Resources Board, updated 2019, <https://ww3.arb.ca.gov/cc/inventory/data/data.htm>.
3. "Electric Vehicles and Emergency Response," National Association of State Energy Officials (NASEO), June 2016, <https://naseo.org/data/sites/1/documents/publications/iREV%20EV%20Case%20Study.pdf>.
4. Richard J.T. Klein, E. Lisa F. Schipper, and Suraje Dessai, "Integrating Mitigation and Adaptation into Climate and Development Policy: Three Research Questions," *Environmental Science & Policy* 8 (2005): 579–588; Thomas J. Wilbanks and Jayant Sathaye, "Integrating Mitigation and Adaptation as Responses to Climate Change: A Synthesis," *Mitigation and Adaptation Strategies for Global Change* 12 (2007): 957–962; G. Robbert Biesbroek, Rob J. Swart, and Wim G.M. Van der Knaap, "The Mitigation–Adaptation Dichotomy and the Role of Spatial Planning," *Habitat International* 33 (2009): 230–237; Thomas J. Wilbanks et al., "Possible Responses to Global Climate Change: Integrating Mitigation and Adaptation," *Environment: Science and Policy for Sustainable Development* 45 (2003): 28–38; Julia Laukkonen et al., "Combining Climate Change Adaptation and Mitigation Measures at the Local Level," *Habitat International* 33, no. 3 (2009): 287–292; Sally Kane and Jason F. Shogren, "Linking Adaptation and Mitigation in Climate Change Policy," in *Societal Adaptation to Climate Variability and Change*, eds. Sally M. Kane, and Gary W. Yohe, 75–102 (Dordrecht: Springer, 2000).
5. "Climate Change," California Climate Investments, 2018, <http://www.ebudget.ca.gov/2018-19/pdf/BudgetSummary/ClimateChange.pdf>.
6. "2017–18 Cap-and-Trade Expenditure Plan," California Legislative Analyst's Office, updated August 24, 2017, <http://www.lao.ca.gov/handouts/resources/2017/Senate-Cap-and-Trade-Expenditure-Plan-082417.pdf>.
7. "Climate Change 2001: Mitigation," Working Group III of the Intergovernmental Panel on Climate Change, 2001, https://www.ipcc.ch/site/assets/uploads/2018/03/WGIII_TAR_full_report.pdf.
8. Serena E. Alexander, "From Planning to Action: An Evaluation of State Level Climate Action Plans," PhD dissertation, Cleveland State University, 2016: ProQuest Dissertations Publishing (ID: TN_proquest1897481247).
9. "Sources of Greenhouse Gas Emissions," The United States Environmental Protection Agency, updated September 13, 2019, <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>.

-
10. “GHG Current California Emission Inventory Data,” California Air Resources Board, updated 2019, <https://ww3.arb.ca.gov/cc/inventory/data/data.htm>.
 11. “Climate Impacts on Transportation,” The United States Environmental Protection Agency, updated December 22, 2016, <https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-transportation.html>.
 12. “Cap and Trade Basics,” Center for Climate and Energy Solutions, <http://www.c2es.org/content/cap-and-trade-basics/>.
 13. Robert Shaw, Michelle Colley, and Richenda Connell, “Climate Change Adaptation by Design: A Guide for Sustainable Communities” (London, UK: Town and City Planning Association, 2007); Claire L. Walsh, et al., “Assessment of Climate Change Mitigation and Adaptation in Cities,” *Proceedings of the ICE—Urban Design and Planning* 164 (2011): 75–84.
 14. Stephen M. Wheeler, “State and Municipal Climate Change Plans: The First Generation,” *Journal of the American Planning Association* 74 (2008): 481–96.
 15. Michael R. Boswell, Adrienne I Greve, and Tammy L Seale, “An Assessment of the Link Between Greenhouse Gas Emissions Inventories and Climate Action Plans,” *Journal of the American Planning Association* 76 (2010): 451–62.
 16. Ellen Bassett, and Vivek Shandas, “Innovation and Climate Action Planning,” *Journal of the American Planning Association* 76 (2010): 435–450.
 17. Sierra C. Woodruff, and Missy Stults, “Numerous Strategies but Limited Implementation Guidance in US Local Adaptation Plans,” *Nature Climate Change* 6 (2016): 796–802.
 18. Sierra C. Woodruff, Sara Meerow, Missy Stults, and Chandler Wilkins, “Adaptation to Resilience Planning: Alternative Pathways to Prepare for Climate Change,” *Journal of Planning Education and Research* (2018), 0739456X1880105.
 19. “2018 Progress Report: California’s Sustainable Communities and Climate Protection Act,” California Air Resources Board, November 2018, https://ww2.arb.ca.gov/sites/default/files/2018-11/Final2018Report_SB150_112618_02_Report.pdf.
 20. Ibid., 5.
 21. Michael R. Boswell, and Susan G. Mason, “Regional Climate Planning and Local Outcomes in California Planning,” in *Climate Change in Cities: Innovations in Multi-Level Governance*, eds. Sara Hughes, Eric K. Chu, and Susan G. Mason, 59–76 (Cham: Springer International Publishing, 2018).
 22. “Exploring California’s Climate Change Research,” Cal-Adapt, updated 2019, <https://cal-adapt.org>.
-

-
23. “The Basics of SB 375,” Institute for Local Government, updated 2015, <http://www.ca-ilg.org/post/basics-sb-375>.
 24. “Integrated Climate Adaptation and Resiliency Program,” California Governor’s Office of Planning and Research, updated 2019, <http://opr.ca.gov/planning/icarp/>.
 25. “California Climate Policy Dashboard,” The University of California, Berkley Law, updated 2019, <https://www.law.berkeley.edu/research/clee/research/climate/climate-policy-dashboard/>.
 26. “Cap-and-trade Auction Proceeds: 2019 Annual Report,” California Air Resources Board, updated 2019, https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/2019_cci_annual_report.pdf.
 27. “Cap-and-trade Auction Proceeds: 2019 Annual Report,” California Air Resources Board, updated 2019, https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/2019_cci_annual_report.pdf.
 28. “Affordable Housing and Sustainable Communities Program (AHSC),” California Department of Housing and Community Development, updated 2019, <https://www.hcd.ca.gov/grants-funding/active-funding/ahsc.shtml>.
 29. “State of Local Climate Action: California 2016,” California Statewide Energy Efficiency Collaborative, updated 2016, http://californiaseec.org/wp-content/uploads/2016/10/State-of-Local-Climate-Action-California-2016_Screen.pdf.
 30. “CoolCalifornia.org,” California Air Resources Board, <https://coolcalifornia.arb.ca.gov>.
 31. “General Plan Guidelines,” California Governor’s Office of Planning and Research, updated 2019, <http://opr.ca.gov/planning/general-plan/>.
 32. “California Climate Action Portal (CAP-Map),” California Air Resources Board, <https://webmaps.arb.ca.gov/capmap/>.
 33. “California Climate Investments Technical Assistance Program,” California Strategic Growth Council, updated 2019, <http://sgc.ca.gov/programs/tech/>.
 34. “Five Milestones for Emissions Management,” ICLEI USA—Local Governments for Sustainability, updated 2019, <http://icleiusa.org/programs/emissions-management/5-milestones/>.
 35. Edward Kaiser and David Godschalk, “Twentieth Century Land Use Planning: A Stalwart Family Tree,” *Journal of the American Planning Association* (1995): 365.
 36. Philip Berke, Galen Newman, Jaekyung Lee, Tabitha Combs, Carl Kolosna, and David Salvesen, “Evaluation of Networks of Plans and Vulnerability to Hazards and Climate Change: A Resilience Scorecard,” *Journal of the American Planning Association* 81 (2015): 287–302.
-

-
37. Michael R. Boswell, Adrienne I. Greve, and Tammy L. Seale, *Local Climate Action Planning* (Washington, D.C.: Island Press, 2012).
 38. Michael R. Boswell, Adrienne I. Greve, and Tammy L. Seale, "An Assessment of the Link Between Greenhouse Gas Emissions Inventories and Climate Action Plans," *Journal of the American Planning Association* 76 (2010): 451–62.
 39. Michael R. Boswell, Adrienne I. Greve, and Tammy L. Seale, *Local Climate Action Planning* (Washington, D.C.: Island Press, 2012).
 40. Stephen M. Wheeler, "State and Municipal Climate Change Plans: The First Generation," *Journal of the American Planning Association* 74 (2008): 481–96.
 41. Sierra C. Woodruff and Missy Stults, "Numerous Strategies but Limited Implementation Guidance in US Local Adaptation Plans," *Nature Climate Change* 6 (2016): 796–802.
 42. Sierra C. Woodruff, Sara Meerow, Missy Stults, and Chandler Wilkins, "Adaptation to Resilience Planning: Alternative Pathways to Prepare for Climate Change," *Journal of Planning Education and Research* (2018).
 43. Ibid.; Andrew P. Kythreotis, and Gillian I. Bristow, "The 'Resilience Trap': Exploring the Practical Utility of Resilience for Climate Change Adaptation in UK City-regions," *Regional Studies* 51 (2017): 1530–1541.
 44. "Electric Vehicles and Emergency Response," National Association of State Energy Officials (NASEO), June 2016, <https://naseo.org/data/sites/1/documents/publications/iREV%20EV%20Case%20Study.pdf>.

BIBLIOGRAPHY

- Alexander, Serena E. "From Planning to Action: An Evaluation of State Level Climate Action Plans." PhD dissertation, Cleveland State University, 2016. ProQuest Dissertations Publishing (ID: TN_proquest1897481247).
- Bassett, Ellen, and Vivek Shandas. "Innovation and Climate Action Planning." *Journal of the American Planning Association* 76 (2010): 435–450. doi: 10.1080/01944363.2010.509703
- Berke, Philip, Galen Newman, Jaekyung Lee, Tabitha Combs, Carl Kolosna, and David Salvesen. "Evaluation of Networks of Plans and Vulnerability to Hazards and Climate Change: A Resilience Scorecard." *Journal of the American Planning Association* 81 (2015): 287–302. doi: 10.1080/01944363.2015.1093954
- Biesbroek, G. Robbert, Rob J. Swart, and Wim G.M. Van der Knaap. "The Mitigation–Adaptation Dichotomy and the Role of Spatial Planning." *Habitat International* 33 (2009): 230–237. doi: 10.1016/j.habitatint.2008.10.001
- Boswell, Michael R., Adrienne I. Greve, and Tammy L. Seale. *Local Climate Action Planning*. Washington, D.C.: Island Press, 2012.
- Boswell, Michael R., Adrienne I. Greve, and Tammy L. Seale. "An Assessment of the Link Between Greenhouse Gas Emissions Inventories and Climate Action Plans." *Journal of the American Planning Association* 76 (2010): 451–62. doi: 10.1080/01944363.2010.503313
- Boswell, Michael R., and Susan G. Mason, "Regional Climate Planning and Local Outcomes in California Planning." In *Climate Change in Cities: Innovations in Multi-Level Governance*, edited by Sara Hughes, Eric K. Chu, and Susan G. Mason, 59–76. Cham: Springer International Publishing, 2018. doi: 10.1080/17535069.2019.1670410
- Cal-Adapt. "Exploring California's Climate Change Research." 2019. Accessed September 26, 2019. <https://cal-adapt.org>.
- California Air Resources Board. "2018 Progress Report: California's Sustainable Communities and Climate Protection Act." November, 2018. Accessed November 11, 2019. https://ww2.arb.ca.gov/sites/default/files/2018-11/Final2018Report_SB150_112618_02_Report.pdf.
- California Air Resources Board. "Cap-and-trade Auction Proceeds: 2019 Annual Report." 2019. Accessed September 26, 2019. https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/2019_cci_annual_report.pdf.
- California Air Resources Board. "California Climate Action Portal (CAP-Map)." Accessed September 26, 2019. <https://webmaps.arb.ca.gov/capmap/>.

- California Air Resources Board. "CoolCalifornia.org." Accessed September 26, 2019. <https://coolcalifornia.arb.ca.gov>.
- California Air Resources Board. "GHG Current California Emission Inventory Data." 2019. Accessed September 26, 2019. <https://ww3.arb.ca.gov/cc/inventory/data/data.htm>.
- California Climate Investments. "Climate Change." Accessed February 7, 2018. <http://www.ebudget.ca.gov/2018-19/pdf/BudgetSummary/ClimateChange.pdf>.
- California Department of Housing and Community Development. "Affordable Housing and Sustainable Communities Program (AHSC)." 2019. Accessed November 11, 2019. <https://www.hcd.ca.gov/grants-funding/active-funding/ahsc.shtml>.
- California Governor's Office of Planning and Research. "General Plan Guidelines." 2019. Accessed September 26, 2019. <http://opr.ca.gov/planning/general-plan/>.
- California Governor's Office of Planning and Research. "Integrated Climate Adaptation and Resiliency Program." 2019. Accessed September 26, 2019. <http://opr.ca.gov/planning/icarp/>.
- California Legislative Analyst's Office. "2017–18 Cap-and-Trade Expenditure Plan.: August 24, 2017. Accessed February 8, 2018. <http://www.lao.ca.gov/handouts/resources/2017/Senate-Cap-and-Trade-Expenditure-Plan-082417.pdf>.
- California Statewide Energy Efficiency Collaborative. "State of Local Climate Action: California 2016." 2016. Accessed September 26, 2019. http://californiaseec.org/wp-content/uploads/2016/10/State-of-Local-Climate-Action-California-2016_Screen.pdf.
- California Strategic Growth Council. "California Climate Investments Technical Assistance Program." 2019. Accessed September 26, 2019. <http://sgc.ca.gov/programs/tech/>.
- Center for Climate and Energy Solutions. "Cap and Trade Basics." Accessed November 11, 2019. <http://www.c2es.org/content/cap-and-trade-basics/>.
- ICLEI USA—Local Governments for Sustainability. "Five Milestones for Emissions Management." 2019. Accessed September 26, 2019. <http://icleiusa.org/programs/emissions-management/5-milestones/>.
- Institute for Local Government. "The Basics of SB 375." 2015. Accessed September 26, 2019. <http://www.ca-ilg.org/post/basics-sb-375>.
- Kaiser, Edward, and David Godschalk. "Twentieth Century Land Use Planning: A Stalwart Family Tree." *Journal of the American Planning Association* (1995): 365. doi: 10.1080/01944369508975648

- Kane, Sally, and Jason F. Shogren. "Linking Adaptation and Mitigation in Climate Change Policy." In *Societal Adaptation to Climate Variability and Change*, edited by Sally M. Kane, and Gary W. Yohe, 75–102. Dordrecht: Springer, 2000.
- Klein, Richard J.T., E. Lisa F. Schipper, and Suraje Dessai. "Integrating Mitigation and Adaptation into Climate and Development Policy: Three Research Questions." *Environmental Science & Policy* 8 (2005): 579–588. doi: 10.1016/j.envsci.2005.06.010
- Kythreotis, Andrew P., and Gillian I. Bristow. "The 'Resilience Trap': Exploring the Practical Utility of Resilience for Climate Change Adaptation in UK City-regions." *Regional Studies* 51 (2017): 1530–541. doi: 10.1080/00343404.2016.1200719
- Laukkonen, Julia, Paola Kim Blanco, Jennifer Lenhart, Marco Keiner, Branko Cavric, and Cecilia Kinuthia-Njenga. "Combining Climate Change Adaptation and Mitigation Measures at the Local Level." *Habitat International* 33 (2009): 287–292. doi: 10.1016/j.habitatint.2008.10.003
- National Association of State Energy Officials (NASEO). "Electric Vehicles and Emergency Response." June 2016. Accessed December 13, 2019. <https://naseo.org/data/sites/1/documents/publications/iREV%20EV%20Case%20Study.pdf>.
- Shaw, Robert, Michelle Colley, and Richenda Connell. *Climate Change Adaptation by Design: A Guide for Sustainable Communities*. London, UK: Town and City Planning Association, 2007.
- The United States Environmental Protection Agency. "Climate Impacts on Transportation." December 22, 2016. Accessed September 26, 2019. https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-transportation_.html.
- The United States Environmental Protection Agency. "Sources of Greenhouse Gas Emissions." September 13, 2019. Accessed November 11, 2019. <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>.
- The University of California, Berkeley Law. "California Climate Policy Dashboard." 2019. Accessed September 26, 2019. <https://www.law.berkeley.edu/research/clee/research/climate/climate-policy-dashboard/>.
- Walsh, Claire L., Richard J. Dawson, Jim W. Hall, Stuart L. Barr, Michael Batty, Abigail L. Bristow, Sebastian Carney, Athanasios S. Dagoumas, Alistair C. Ford, Colin Harpham, Miles R. Tight, Helen Watters, and Alberto M. Zanni. "Assessment of Climate Change Mitigation and Adaptation in Cities." *Proceedings of the ICE—Urban Design and Planning* 164 (2011): 75–84. doi: 10.1680/udap.2011.164.2.75.

-
- Wheeler, Stephen M. "State and Municipal Climate Change Plans: The First Generation." *Journal of the American Planning Association* 74 (2008): 481–96. doi: 10.1080/01944360802377973
- Wilbanks, Thomas J., and Jayant Sathaye. "Integrating Mitigation and Adaptation as Responses to Climate Change: A Synthesis." *Mitigation and Adaptation Strategies for Global Change* 12 (2007): 957–962. doi: 10.1007/s11027-007-9108-3
- Wilbanks, Thomas J., Sally M. Kane, Paul N. Leiby, Robert D. Perlack, Chad Settle, Jason F. Shogren, and Joel B. Smith. "Possible Responses to Global Climate Change: Integrating Mitigation and Adaptation." *Environment: Science and Policy for Sustainable Development* 45 (2003): 28–38. doi: 10.1080/00139150309604547
- Working Group III of the Intergovernmental Panel on Climate Change. "Climate change 2001: Mitigation." 2001. Accessed September 26, 2019. https://www.ipcc.ch/site/assets/uploads/2018/03/WGIII_TAR_full_report.pdf.
- Woodruff, Sierra C., and Missy Stults. "Numerous Strategies but Limited Implementation Guidance in US Local Adaptation Plans." *Nature Climate Change* 6 (2016): 796–802. doi: 10.1038/nclimate3012
- Woodruff, Sierra C., Sara Meerow, Missy Stults, and Chandler Wilkins. "Adaptation to Resilience Planning: Alternative Pathways to Prepare for Climate Change." *Journal of Planning Education and Research* (2018). doi: 0.1177/0739456X18801057

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