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California Government Screening Maps: An Investigation into Geographic Prioritization in Support of State Climate and Planning Goals

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California Government Screening Maps:

An Investigation into Geographic Prioritization in
Support of State Climate and Planning Goals

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16. Abstract The State of California (State) has multiple climate and planning objectives that underscore the importance of coordinating housing and transportation planning to improve air quality, reduce greenhouse gas emissions, and build sustainable communities. This research examines the extent to which the CalEnviroScreen 3.0, Healthy Places Index, Opportunity Area, and Low-Income Priority Populations Maps, which are used by different State agencies to direct housing and transportation resources, support such coordination to help meet State objectives. To the extent that these maps represent climate and planning goals, I examine housing production relative to the different geographic prioritizations as well transportation characteristics of proximity to transit and level of vehicle miles traveled (VMT). I conduct document, spatial, and quantitative analyses to understand the maps and their relationships to each other, housing production, and transportation characteristics. I find no correlation between geographic prioritization and housing production. There is a positive relationship between housing production and transit proximate and low VMT areas which can support coordinated land use and transportation that helps meet State climate and planning objectives. However, none of the maps include indicators related to these transportation characteristics that would intentionally direct resources towards those areas. I also find there is conflict between the maps' conceptual bases which may lead to investments by different State agencies that are inconsistent with each other and/or with State climate and planning objectives. Solutions to these conflicts require a broad, multi-agency discussion around State climate and planning goals, and the existing mapping tools.			
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California Government Screening Maps: An Investigation into Geographic Prioritization in Support of State Climate and Planning Goals

UCLA Institute of Transportation Studies

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Executive Summary

Project Motivation

Maps have long influenced urban form and quality of life. Parcel maps, zoning maps, and redlining maps are just a few examples of maps developed or sanctioned by governments that have and continue to influence public and private decisions that allocate the necessities and amenities of urban life. The communities or neighborhoods that are or are not geographically prioritized experience enduring consequences. It is in this context that I undertake research on government maps used to make planning and investment decisions that support climate and planning goals in the State of California (State). Specifically, I address the following research questions:

- Do California State government maps guide planning and development decisions that help meet climate and planning goals?
- How do these maps conflict or complement each other or State goals and what opportunities might there be to coordinate to support the State's goals?

Background

The State has multiple climate and planning objectives established in legislation and executive orders that are underscored with a recognition of the importance of coordinating housing and transportation planning to improve air quality, reduce greenhouse gas emissions, and build sustainable communities, particularly for communities who have historically been harmed by or excluded from these planning processes. Governor Newsom's Executive Order N-19-19 explicitly calls for state transportation funding to align with climate goals. There are several State agencies individually responsible for developing policies, administering programs, and distributing funding to guide housing and/or transportation planning decisions that advance the State's vision. Among those State agencies is the California Air Resources Board (CARB) which establishes regional and statewide air quality standards, sets regional greenhouse gas reductions (GHG) targets to help achieve reduction goals established by Assembly Bill 32 (AB 32) and Senate Bill 32 (SB 32) pursuant to SB 375, and leads climate change programs, including the State's Cap-and-Trade program and other programs funded by the resulting revenue. Other State agencies administer additional programs related to housing and transportation. To carry out their policymaking, programming, and funding responsibilities in ways that advance planning, climate, and equity objectives, these agencies require tools to identify and/or screen locations that present the most opportunity, vulnerability, or need for targeted investment. As such, maps have become key decision-making tools for these State agencies. I identified the key maps for research to be:

- CalEnviroScreen 3.0 by the Office of Environmental Health Hazard Assessment (OEHHA)

- Healthy Places Index by the Public Health Alliance of Southern California
- Opportunity Maps by the Tax Credit Allocation Committee/Department of Housing and Community Development (TCAC/HCD)
- Low-Income Priority Population Maps by the California Air Resources Board (CARB)

Methods

To analyze the role of the maps in supporting climate and planning goals through coordinated housing and transportation, I break down the main research questions further as follows:

- What is the conceptual basis, purpose, and application of each map?
- What areas are prioritized by each map?
- Where is housing actually being produced, and
 - How do those areas compare to the areas prioritized by each map?
 - Is the housing located such that progress is being made toward climate and planning goals?
- What indicators inform each map as compared to indicators that measure achievement of the State's goals?

The main approach to investigating these questions is understanding the maps and their relation to each other and to metrics of progress toward climate and housing goals. This is carried out through three components of analyses: technical document analysis, spatial analysis, and quantitative analysis.

Findings

The census tracts prioritized by each map are based on their conceptual bases – ranging from environmental justice, health outcomes, to access to opportunity – and methodologies. While each map is unique in its approach to defining priority areas, I find varying levels of overlap in the areas prioritized by each map. Regardless of the level of overlap between census tracts prioritized and the different definitions of priority, there is a strong correlation between the maps.

While maps may share indicators, they each apply different weighting and calculations to the indicators. Therefore, shared indicators do not necessarily indicate priority alignment across maps. What all maps share is a lack of indicators related to transit access or proximity and vehicle miles traveled (VMT).

I find that housing has not been produced in areas that have received priority designation in the maps. Therefore, to the extent that these maps represent climate and planning goals, housing has not been located to help achieve climate and planning goals. However, looking beyond the maps, housing does appear to be located in transit

proximate areas that can potentially support coordinated land use and transportation, and help meet the state's climate goals via reduced vehicle miles traveled.

Conclusion

None of the maps include indicators related to transit access or proximity. With the State's clear goal to coordinate land use and transportation to help achieve climate goals, it is important for geographic prioritization tools, especially those used to make decisions related to housing funding and finance, to support this coordination by including measures of transit access or proximity and VMT.

Despite these findings, I find that each map represents a conceptual basis around which the State should seek to frame its approach to climate and planning. The goals of achieving environmental justice, creating healthy communities, and increasing access to opportunity are important to carry through any planning and investment decisions within the State's direct control.

In as many ways as the maps are similar, they are also different. The reason for this falls heavily on the different definitions of priority that primarily exists between the Opportunity Area Map and the other three maps. This conflict would not carry as much weight if each map was used for different planning purposes. However, with the exception of the Opportunity Area Map which is only used for housing programs, the maps are used for a variety of transportation and housing programs. Ultimately, this means that there are several State programs employing different mapping tools and different geographic prioritizations that may result in conflicting investments across programs. To address this conflict, I recommend a broad, multi-agency discussion around the various State climate and planning goals and the existing mapping tools that considers: consolidation of State housing programs or mapping tools, reconciliation of the State's priorities for housing location, and investigation into the State's decisions around transportation investments and whether these support the State's climate and planning goals.

1. Introduction

Maps have long influenced urban form and quality of life. Parcel maps, zoning maps, and redlining maps are just a few examples of maps developed or sanctioned by governments that have and continue to influence public and private decisions that allocate the necessities and amenities of urban life. The intent and information behind a map's creation bears significantly on the final product and the decisions made by those who wield the map. The communities or neighborhoods that are or are not geographically prioritized experience enduring consequences of harmful investment or disinvestment. It is in this context that I undertake research on government maps used for planning and investment purposes in the State of California (State).

The State has multiple climate and planning objectives established in legislation and executive orders. These directives require reducing greenhouse gas emissions to certain levels by specific deadlines; increasing the supply of affordable housing; aligning transportation investments with housing; coordinating policymaking between air quality, transportation, and housing lead agencies; and ensuring benefits to disadvantaged communities. These requirements underscore a recognition of the importance of coordinating housing and transportation planning to improve air quality, reduce greenhouse gas emissions, and build sustainable communities, particularly for communities who have historically been harmed by or excluded from these planning processes. Governor Newsom's Executive Order N-19-19 explicitly calls for state transportation funding to align with climate goals.

There are several State agencies individually responsible for developing policies, administering programs, and distributing funding to guide housing and/or transportation planning decisions that advance the State's vision. Among those State agencies is the California Air Resources Board (CARB) which establishes regional and statewide air quality standards, sets regional greenhouse gas reductions (GHG) targets to help achieve reduction goals established by Assembly Bill 32 (AB 32) and Senate Bill 32 (SB 32) pursuant to SB 375, and leads climate change programs, including the State's Cap-and-Trade program and California Climate Investments, which are funded with proceeds from Cap-and-Trade. Other State agencies administer additional programs related to housing and transportation. To carry out their policymaking, programming, and funding responsibilities in ways that advance planning, climate, and equity objectives, these agencies require tools to identify and/or screen locations at the statewide scale that present the most opportunity, vulnerability, or need for targeted investment as required by statutes. As such, maps have become key decision-making tools for these State agencies.

There are a number of maps developed and/or used by State government agencies to identify areas of opportunity or disadvantage for targeted housing and transportation planning and investment. These maps are:

- CalEnviroScreen 3.0 by the Office of Environmental Health Hazard Assessment (OEHHA)
- Healthy Places Index by the Public Health Alliance of Southern California
- Opportunity Maps by the Tax Credit Allocation Committee/Department of Housing and Community Development (TCAC/HCD)
- Low-Income Priority Population Maps by the California Air Resources Board (CARB)

Existing research has reviewed and critiqued methodology behind opportunity map construction and the use of opportunity and equity maps in planning and funding processes related to housing and transportation. Previous research has also been conducted specific to California's experience with mapping tools, though that research has focused on their role in advancing environmental justice in California. As yet, no work has been done to evaluate and compare the influence of maps used within California for climate and planning purposes against actual changes in housing production in communities statewide. This knowledge gap needs to be filled if the State is to achieve its climate and planning goals.

This research addresses the following questions:

- Do California State government maps guide planning and development decisions that help meet climate and planning goals?
- How do these maps conflict or complement each other or State goals and what opportunities might there be to coordinate to support the State's goals?

I answer these questions by building understanding of what the maps are presenting, how they are being used, and how they may be more effective tools for the State in meeting climate goals. I present this work in the remainder of the report. First to provide context for this research, I review literature on California's executive and legislative directives on climate, the role of coordinated housing and transportation planning in supporting those directives, the limitations and drivers of housing production, and the utility and limitations of mapping tools to support that planning. Next, I describe data and methodology, a three-pronged analytical approach conducted to answer the research questions. Then, I present the qualitative, quantitative, and spatial analyses conducted. Finally, I end with the findings and conclusions.

2. Literature Review

The following literature review covers four topic areas to provide context for this research: California's executive and legislative directives on climate, land use, transportation, and housing; the connection between land use and transportation; limitations and drivers of housing production, and the role of mapping tools in supporting climate and equity goals.

California's Executive and Legislative Directives on Climate

California has long led the country in taking action mitigate the effects of climate change. In 2006, Governor Arnold Schwarzenegger signed into law the Global Warming Solutions Act (AB 32). AB 32 requires California to reduce greenhouse gas (GHG) emissions to the levels that existed in 1990 by 2020. It places lead responsibility on the California Air Resources Board (CARB) to develop and implement plans and programs to achieve this goal. In 2016, Governor Jerry Brown signed into law Senate Bill 32 (SB 32) which expands the reduction goal to 40% below the 1990 level by 2030.

One of the programs CARB created to help achieve GHG emissions reductions is the Cap-and-Trade program, a price-based mechanism to encourage emitting firms to transition to cleaner fuels and more efficient energy use. The program generates auction revenues placed into the Greenhouse Gas Reduction Fund (GGRF), which serves as one of the main funding sources for implementation of other GHG emissions reduction programs.

In 2012, Governor Jerry Brown signed into law SB 535 which establishes programs in which the GGRF is divided and then distributed to local and regional agencies for GHG emissions reductions projects. SB 535 requires that 25 percent of the GGRF be allocated to projects that provide benefits to disadvantaged communities (DACs) and charged the California Environmental Protection Agency (CalEPA) with identifying those DACs. In 2016, Governor Brown signed into law AB 1550 which requires that 25 percent of the GGRF be allocated to projects *located in* DACs and an additional 10 percent be allocated to low-income communities and households. AB 1550 defines low-income communities and households as census tracts and households that are at or below 80 percent of the statewide median income or at or below the low-income threshold established by the California Department of Housing and Community Development (HCD). To meet the requirements of SB 535, the CalEPA uses the Office of Environmental Health Hazard Assessment's (OEHHA) California Communities Environmental Health Screening Tool (CalEnviroScreen) which scores and ranks communities by census tract based on disproportionate burden and vulnerability to

multiple sources of pollution. CalEPA identifies DACs as those that rank within the top 25 percent scoring census tracts.

In 2008, Governor Schwarzenegger signed into law the Sustainable Communities and Climate Protection Act of 2008 (SB 375) which recognized the importance of coordinated transportation and housing decisions to meeting the State's climate goals. It requires CARB to establish targets for regional emissions reductions from driving for each metropolitan planning organization (MPO), MPOs to prepare sustainable communities strategies (SCS) as part of their regional transportation plans (RTP) to outline how they will achieve their assigned reductions targets. To ensure that future housing production supports development of sustainable communities, SB 375 also requires MPOs to align their Regional Housing Needs Assessment (RHNA) allocation methodologies with their SCSs, and requires local jurisdictions to define a schedule of actions to accommodate their RHNA allocations in their housing elements, including necessary rezoning. SB 375 also defined a transit priority project as one being at least 50 percent residential use, at least 20 dwelling units per acre, and within one-half mile of a major transit stop (rail stop) or high-quality transit corridor (bus corridor with 15-minute headways) and exempted such projects from analysis under the California Environmental Quality Act (CEQA).

Recognizing the need to measure the contributions of SB 375 to achieving the State's climate goals, Governor Brown signed into law SB 150 in 2017 which requires CARB to develop a report every four years to analyze the progress made under SB 375. The first report published in November 2018 concluded that the State is not on track to meeting GHG reduction goals based on the approach guided by SB 375. In fact, the report found that per capita emissions from driving are continuing to rise and will not be course-corrected without significant changes to how we plan, fund, and build communities, including transportation systems.

One such change was initiated in 2013 with SB 743. To better evaluate transportation-related GHG emissions and air quality impacts of new projects and promote multimodal transportation systems and infill development, SB 743 required the Office of Planning and Research (OPR) to update the California Environmental Quality Act (CEQA) Guidelines with new criteria for determining transportation impacts of projects in transit priority areas. The updated CEQA Guidelines approved in 2018 replaces level of service, a measure of traffic congestion, with vehicle miles traveled (VMT) as the metric for evaluating transportation impacts. This change means that projects found to have significant transportation-related impact will be required to implement mitigations that reduce driving rather than make it more convenient to drive.

Other signals of a move towards coordinating land use and transportation are the mandated joint meetings of key State agencies charged with climate, housing, and transportation policies (AB 179 and AB 185). Additionally, Executive Order N-19-19 of 2019 requires the State Transportation Agency to use its more than \$500 billion budget

in alignment with the State's climate goals; reduce vehicle miles traveled by directing discretionary investments to support housing production near jobs and in alignment with the State's smart growth principles, and take public health into account; and fund transportation that improves health and reduces GHG emissions such as transit, walking, and bicycling.

The connection between land use, transportation, and GHG emissions has also been cited in other legislation. In 2017, Governor Brown signed into law the Building Homes and Jobs Act (SB 2). In part based on the finding that long distances between employment opportunities and affordable housing exacerbates GHG emissions, the bill establishes a funding stream to support affordable housing statewide. Additionally, SB 50 proposed but not passed in 2018, acknowledged the detrimental effect of the State's housing crisis on climate goals and would have granted residential developments located within one-half or one-quarter mile of a major transit stop (rail transit station) waivers from traditional zoning limitations such as maximum height, floor area ratio, and parking requirements.

The Housing and Transportation Connection

The State's most recent actions recognize the connections between housing and transportation in the production of GHG emissions and the need to coordinate actions and funding to achieve its climate goals in ways that it has not historically done. In a 2018 white paper reviewing the way California generates and distributes transportation funding, Gian-Claudia Sciara and Amy Lee found that the State's transportation investments have not been aligned with its climate goals.

There is much research supporting the understanding of the symbiotic relationship between land use and transportation. Transportation provides both accessibility – the ease of reaching potential destinations – and mobility – the ability to move between destinations (Hanson, 2017). When there is low accessibility due to spatial separation between different destinations, there is need for more mobility. In many areas in California, urban development has resulted in low accessibility but high mobility facilitated by streets, freeways, and cars. As a result, California sees high levels of VMT and fuel consumption, and the associated GHG emissions.

Much attention has also been paid to ways to improve transportation and reduce VMT. Genevieve Guiliano and Susan Hanson (2017) found that no single policy can change transportation habits, but that there are several policies that may improve urban transportation. These include increasing the cost to own/operate cars, improving public transportation, improving pedestrian and bicyclist safety, introducing new technology, increasing travel flexibility, increasing highway capacity, and increasing development

density. This research supports the approach to coordinate housing and transportation to achieve GHG emission reductions.

There have been efforts to monitor progress toward achieving State climate goals based on SB 375. As previously described, SB 150 requires CARB to prepare reports tracking SB 375 implementation. The first report identified twenty metrics for monitoring progress made under SB 375 to achieving climate goals. The California Department of Transportation (Caltrans) pursued research led by Ong et al. to construct a Statewide Monitoring System that measures land-use changes with regard to accessibility and density. The metrics and recommendations identified in these two efforts inform part of the analysis conducted in this research project.

Limitations and Drivers of Housing Production

Restrictive land use regulations and limitations on new housing construction are linked. Paavo Monkkonen et al. (2020) found that housing production in California cities – particularly multifamily housing -- is limited by regulatory prohibitions that reduce cities' zoned capacity. Prohibitions include low density zoning, setback requirements, and other parcel development limits. On the contrary, they did not find regulatory processes that developers are required to undergo to receive development permits to be linked to lower housing production.

Expanding specifically on the limits on multifamily housing, Cecile Murray and Jenny Schuetz (2019) found that cities are spurred by existing single-family homeowners to employ different strategies to restrict apartments, including zoning for lower density, lower building heights, and fewer units per acre. They also disprove traditional urban economic theory that links high density construction to areas where rent and demand is high. That is, areas with more expensive rents did not see more multifamily housing produced.

So where *can* we see housing production? Issi Romem (2018) discovered a trend of “pockets of dense construction in dormant suburban interior” in metropolitan areas nationwide that began to emerge in the 1980s and 1990s. Suburban land can accommodate more housing through infill development up to the point of saturation where further development would violate low density land use policy. When this happens, dense pockets of construction can still occur where density is already existing (e.g. historic downtowns), where housing is sited in non-residential areas, where densification overcomes opposition (e.g. near transit), and in low-income suburban areas with high housing demand and low ability to oppose densification.

The Role of Mapping

It is well understood that there are differential exposures to pollution across the State, and that exposure to multiple sources of pollution has cumulative effects on health. Rachel Morello-Frosch et al. (2011) find that there are higher rates of exposure to environmental hazards among racial/ethnic minority or low socioeconomic status neighborhoods. People living in these neighborhoods also experience intrinsic (biological susceptibility) and extrinsic (social vulnerability) factors that negatively affect their response to those environmental stressors. Together, exposure to environmental health hazards social vulnerabilities lead to cumulative health impact. They argue that environmental policy must address this issue with targeted place-based policies supported by cumulative impact screening tools. CalEnviroScreen represents such a tool.

Maps are a commonly used tool to prioritize investments. In a survey of Metropolitan Planning Organization (MPOs) practices nationwide, Kristine Williams et al. (2019) finds that many MPOs develop definitions of communities of concern, visualize these communities on maps, and then overlay proposed projects to see where they fall in the communities. In this process, MPOs determine whether investments are equitable based on location within or proximity to a community of concern or other indicators of interest.

There has been some academic research evaluating specific mapping tools and California programs aimed at reducing GHG emissions. In evaluating CalEnviroScreen and other state practices in environmental justice mapping and screening, Charles Lee (2020) finds that addressing cumulative impacts with tools such as maps is key to the pursuit of environmental justice and that CalEnviroScreen can help direct investments to promote health and sustainability for historically neglected communities. However, Raoul Lievanos (2018) argues that the omission of racial status from CalEnviroScreen limits its ability to address race-based environmental health vulnerabilities. Yang Ju et al. (2020) undertake an equity analysis of clean vehicle rebate programs partially funded by the GGRF in California and find that rebates were granted to more affluent, White communities with lower pollution burden in the absence of equity-related design elements that address characteristics beyond income.

Recognizing the evidence that neighborhoods have an effect on life outcomes, Carolina K. Reid (2019) investigates the experience of residents living in housing receiving funds from the federal Low-Income Housing Tax Credit (LIHTC) program. LIHTC funds are a significant source of funding for subsidized affordable housing production nationally and within California. The United States Department of Treasury issues a share of tax credits to individual States who then distribute the credits to applicants (i.e. housing developers) according to Qualified Allocation Plans. In California, the TCAC prioritizes LIHTC funds for housing projects located in census tracts designated as “Highest Resource” and “High Resource” according to the Opportunity Area Map. She concludes that the Opportunity Area Maps are not always aligned with how residents of affordable housing actually experience their communities. That is, areas that are designated as “Highest

Resource” which tend to be in suburban areas with low poverty and higher share of non-Hispanic White households may not provide the most opportunity for economic mobility, high quality education, and transportation access when compared to areas that are designated as lower resourced but that residents perceive as providing the quality of neighborhood they prefer and are comfortable with. Her research adds evidence to the problems of defining and measuring opportunity when developing and applying opportunity maps in real life.

Taking a different approach to evaluating the Opportunity Area Map, Edwin Y. Sun (2020) investigates the potential to adjust the map such that it better serves what he identifies as competing State goals to increase housing production, specifically multifamily housing, and to reduce GHG emissions, specifically in the transportation sector. He reviews transit, climate, and equity literature identifying transit as a resource strongly linked with access to opportunity. He notes the lack of transit factors in the Opportunity Area Map may result in new housing located in high opportunity areas but contributing to sprawl and higher VMT because high opportunity areas are typically located in exurban areas where automobile use is higher. He modifies the map with a transit efficiency domain so the tool prioritizes areas that meet both the State’s housing and climate goals. In the Sacramento area, he finds that central corridors are promoted in priority while exurban areas are demoted. He additionally notes that zoning restricted to single family housing remains a barrier even with geographic prioritization, and suggests that policymakers also analyze opportunity maps in relation to jurisdictions’ zoning maps.

Summary of Literature Reviewed

California has lofty climate goals and many actors and initiatives in place to help achieve them. Among the most important strategies is to coordinate housing and transportation planning and investments to reduce VMT and GHG emissions and create sustainable communities with access to opportunities, particularly for those who have historically experienced disproportionate environmental burden compounded by social vulnerability. The State’s planning and investment in this effort is supported by mapping tools that are the subject of this research. Independent of State influence is housing production in California cities. Academic scholarship points to the many drivers of limitations on housing production, but does not explore its relationship to geographic prioritization. Additionally, while there has been some academic analysis and critique of existing mapping tools and the programs which use the tools that highlight the difficulty of developing geographic priorities that are based on comprehensive on-the-ground realities, there has not been a broader review and comparison of the maps that investigates whether we are seeing changes in how we plan, fund, and build communities (i.e. housing production) that match up with areas prioritized in the maps. This is the topic of the remainder of the report.

3. Data and Methods

The objective of this research is to understand the influence and potential of California State government maps for achieving climate goals via coordinated housing and transportation planning and investment. My analysis is guided by the two main research questions with additional sub-questions as follows:

- Do California State government maps guide planning and development decisions that help meet climate and planning goals?
 - What is the conceptual basis, purpose, and application of each map?
 - What areas are prioritized by each map?
 - Where is housing actually being produced, and
 - How do those areas compare to the areas prioritized by each map?
 - Is housing production located such that progress is being made toward climate and planning goals?
- How do these maps conflict or complement each other or State goals and what opportunities might there be to coordinate to support the State's goals?
 - What indicators inform each map as compared to indicators that measure achievement of the State's goals?

The main approach to investigating these questions is understanding the maps and their relation to each other and to metrics of progress toward climate and housing goals. This is carried out through three components of analyses that will observe housing production relative to geographic prioritization through the maps, and transportation characteristics of transit proximity and VMT levels: technical document analysis, spatial analysis, and quantitative analysis. There are five steps to this research:

1. Define scope of analysis
 - a. Identify maps to research
 - b. Identify metrics of progress toward climate and planning goals (i.e. housing production, transit proximity, low VMT)
2. Describe each map's conceptual basis, purpose, and applications
3. Identify and compare map indicators and priorities
4. Compare map indicators and housing production indicators
5. Visualize and compute statistics to determine relationship between housing production and map priority areas

I describe the data and methods I follow for each component of analysis in the next sections.

Define Scope of Analysis

Maps Included in this Research

Prior to beginning any analysis, I identified the maps to analyze as part of this research. Many maps have been developed and/or are used by State agencies to identify areas for targeted housing and transportation planning and investment. To identify the maps to include in this analysis, I performed a web-based search for State agencies that administer programs that provide discretionary financial resources for development of housing and transportation projects. Then, I identified the maps that they developed or use to explicitly screen and/or rank areas of the state for purposes of distributing the resources of the respective program. I reviewed whether they are used to make State funding decisions for transportation and/or housing funding such as grants, loans, and tax credits or whether they were developed as tools for use by local and private planning entities. I also reviewed whether the maps were generated based on an index construction or based on applying thresholds to existing indices/data, or whether they simply display spatial data. The maps are summarized in **Table 1**.

Table 1. Summary of all maps considered for research

Map Name	Agency	Geog. Unit	Uses					Generation and Representation		
			State Funding (any)	State Trans. Funding	State Housing Funding	Local Gov. Planning	Private Planning	Index	Spatial Data	Threshold on Existing Index/Data
CalEnviroScreen 3.0 (CES)	Office of Environmental Health Hazard Assessment (OEHHA)	Census Tract	X	X	X			X		
DAC Mapping Tool (DAC)	Department of Water Resources	Census Tract	X							X
Healthy Places Index (HPI)	Public Health Alliance of Southern California	Census Tract	X	X	X			X		
Important Farmland Map (IFM)	Department of Conservation	Soil Survey Mapping Units	X	X	X				X	

Map Name	Agency	Geog. Unit	Uses					Generation and Representation		
			State Funding (any)	State Trans. Funding	State Housing Funding	Local Gov. Planning	Private Planning	Index	Spatial Data	Threshold on Existing Index/Data
Opportunity Area Maps (OAM)	Tax Credit Allocation Committee/HCD (TCAC/HCD)	Census Tract	X		X			X		
Priority Population Maps (PPM)	California Air Resources Board (CARB)	Census Tract	X	X	X					X
Site Check (live beta) (SC)	Office of Planning and Research	Parcel				X	X		X	X
Statewide Affordable Housing Opportunities Sites (SAHOS)	Department of General Services (DGS), HCD	Parcel								X
VMT Map (VMT)	Caltrans	Trans. Analysis Zone				X	X		X	

Because I am investigating State geographic prioritization, I narrowed the selection to maps that are used by the State to direct resources from transportation and/or housing funding and financing programs. Here, “use” by the State means that the State determines whether proposed projects are priorities for investment based on whether they fall within an area of a map that is designated as a priority area. From this, I screened out the DAC Mapping Tool, Site Check, Statewide Affordable Housing Opportunities Sites, and VMT Maps. I further narrowed the selection to maps that are based on an index because indices communicate rankings or prioritization. From this, I screened out the Important Farmland Map. This resulted in the inclusion of the following four maps in this research:

- CalEnviroScreen 3.0 Map by the Office of Environmental Health Hazard Assessment (OEHHA)
- Healthy Places Index by the Public Health Alliance of Southern California
- Opportunity Map by the Tax Credit Allocation Committee/Department of Housing and Community Development (TCAC/HCD)

- Low-Income Priority Populations Map by the California Air Resources Board (CARB)

Caveats

With the exception of the Opportunity Map, the selected maps were not explicitly developed to prioritize areas of the state for housing development. In fact, they may actually prioritize areas where housing development is undesirable. I discuss this further in the Findings. Still, I include these maps in this research because they are being used by the State to direct financial resources for housing production through various funding and financing programs.

The Site Check map, which is currently in live beta at the time of research, was developed by OPR to accelerate housing production by helping local and private entities make planning decisions based on where streamlining opportunities exist under CEQA. In so doing, it may strongly influence and align with the location of new housing production in the future. However, I exclude it from this research because a final version has not yet been published and the map does not represent geographic prioritization on a Statewide scale.

At the time of research, CalEnviroScreen 4.0 is in draft form. For this research, I use CalEnviroScreen 3.0. The Priority Populations Map includes CalEnviroScreen scores and Low-Income designations. For this research, I focus only on the Low-Income designations of the map (i.e. Low-Income Priority Populations) because I am already analyzing CalEnviroScreen individually.

Metrics of Progress Toward Climate and Planning Goals

As illuminated in the reports prepared by CARB (2018) and Ong et al. (2018) that have identified indicators to track SB 375 progress toward the State's climate goals, there are many unique and overlapping indicators related to housing and transportation.

CARB identified 21 performance indicators, categorized into four categories:

- GHG emissions/VMT
- Other Factors Influencing Personal Vehicle Travel
 - Including: unemployment rate and available jobs, transit service hours per capita, and lane miles built;
- Housing
 - Including new homes built by type, vacancy rate, and housing units permitted compared to RHNA
- Land Use
 - Including acres developed and percentage living near a grocery store.

Within each of these categories, CARB noted the lack of sufficient, statewide public data necessary to reliably track several of the indicators.

Ong et al. identified four baseline indicators and three benchmarking metrics.

- Baseline indicators: housing unit density, access to jobs, access to retail, and access to transit
- Benchmarking metrics: new housing units, change in jobs, and change in retail sales

They noted that the relationship between new housing units and the baseline indicators was clearest to interpret because change in jobs and retail sales may reflect business cycles. Further, they identified that the relationship between new housing units and transit access provides for the clearest assessment of whether progress is being made toward State goals. Similar to the CARB report, Ong et al. identify challenges in securing statewide data that is public or able to be obtained at reasonable cost to keep up with the frequency of progress tracking.

In trying to identify indicators to use to evaluate the influence and potential of State mapping tools on achieving climate and planning goals, I draw from but do not replicate these indicators exactly. Both reports measure new housing production and some type of transportation characteristic. CARB includes VMT and Ong et al. includes transit access. Accordingly, I choose to measure new housing production as well as transportation characteristics including transit access and VMT levels to investigate whether the State maps align with on-the-ground development.

Technical Document Analysis

Data for Document Analysis

To obtain information on each map, I rely on statute, technical documents, and program/policy documents publicly available on State websites. Where applicable, statutes initiate the development of a map and/or inform required components. Map technical documents describe the conceptual basis and methodology, including indicators, employed to create each map. Program and policy documents describe the purpose and applications of the maps. **Table 2** lists the documents available for each maps.

Table 2. Map documents to be analyzed

Map	Statutes	Technical Document(s)	Program/Policy Document(s)
CalEnviroScreen 3.0 Map	SB 535 (De Leon 2012)	<ul style="list-style-type: none"> • <i>CalEnviroScreen 3.0 Report</i> 	<ul style="list-style-type: none"> • <i>Affordable Housing and Sustainable Communities</i>

Map	Statutes	Technical Document(s)	Program/Policy Document(s)
		<ul style="list-style-type: none"> • <i>Response to Major Comments on Draft CalEnviroScreen 3.0</i> 	<i>Program Round 6 Guidelines</i> <ul style="list-style-type: none"> • <i>Transformative Climate Communities Program Round 3 Guidelines</i>
Healthy Places Index	Not applicable	<ul style="list-style-type: none"> • <i>Healthy Places Index Technical Report</i> 	<ul style="list-style-type: none"> • <i>Transformative Climate Communities Program Round 3 Guidelines</i> • <i>2021 Active Transportation Program Guidelines</i>
Opportunity Map	Not applicable	<ul style="list-style-type: none"> • <i>California Fair Housing Task Force Methodology for the 2021 TCAC/HCD Opportunity Map</i> 	<ul style="list-style-type: none"> • <i>2019 Multifamily Housing Program Final Guidelines</i>
Priority Population Map	SB 535 (De Leon 2012) AB 1550 (Gomez 2016)	<ul style="list-style-type: none"> • <i>Identification of Low-Income Communities under AB 1550 Methodology and Documentation for Draft Maps</i> 	<ul style="list-style-type: none"> • <i>2018 Funding Guidelines for Agencies that Administer California Climate Investments</i> • <i>California Climate Investments: Investment Targets for Agencies Administering FY 2020-21 Funds</i>

Data Preparation

I did not alter these documents to prepare them for analysis. I accessed and analyzed them as they were originally published on their respective agency webpages.

Technical Document Analysis

Using the map documents described, I develop a summary of each map including the conceptual basis, purpose, and applications. I also develop a matrix of map indicators. The matrix arranges indicators by category (e.g. Environmental, Socioeconomic, Transportation). I compare the maps to each other in terms of the areas which they prioritize for investment, and their indicators. These comparisons intend to investigate

where the maps overlap or complement each other. I use Spearman's rank-order correlation to analyze the relationship between the different map scores.

I then compare the map indicators against the metrics of housing production, streamlined development, and transit accessible locations to identify whether the maps reflect and lend themselves to supporting the climate and planning goals represented by housing production, streamlined development, and transit accessible locations.

Spatial Analysis

Data for Spatial Analysis

Data used for spatial analysis includes the map tools; geographic boundaries; and metrics of housing production, development streamlining, and transit accessibility.

Map Data Sources

For the maps, I use the Geographic Information System (GIS) shapefiles for each map that are publicly available on the websites of the agencies that developed the maps. Each shapefile contains census tracts and their overall map scores.

Data Preparation

I took the following steps to prepare the data for analysis:

1. Download each map shapefile (or geodatabase in the case of the Priority Population Maps).
2. Create new GEOID fields in the Healthy Places Index and Opportunity Area Maps to standardize census tract identifier fields across all maps
3. For the Opportunity Area Maps, export Rural Areas to new feature class, dissolve block groups by census tracts, average index score to census tract, assign Opportunity Category per map methodology, and append Rural Areas to original shapefile. This step is needed to standardize the scores for analysis as the Opportunity Area Maps provide scores for Rural Areas at the block group level.
4. For each map, join housing production data table
5. Project all maps to NAD_1983_2011_California_Teale_Albers

Geographic Boundaries Data Source

I use U.S. Census Bureau 2019 TIGER/Line Shapefiles for Tracts. This file was released on August 9, 2019 and represents census tract boundaries as of January 1, 2019.

Data Preparation

I took the following steps to prepare the data for analysis:

1. Download shapefile for California Tracts.
2. Project to NAD_1983_2011_California_Teale_Albers

3. Clip Tracts to maps

Housing Production Data Source

Data sources to measure housing production need to be available consistently statewide and allow comparison over time. Data must also be reported at the census tract level in order to be geographically aligned with the units of analysis of the maps. I use the 5-Year American Community Survey (ACS) for the periods 2010-2014 and 2015-2019 to capture a period before the State began to use the maps to make transportation and housing investment decisions (2010-2014) and after (2015-2019). Together, these estimates provide total housing unit estimates by census tract for the most recent ten-year period. I considered other data sources on new housing but did not choose to use them due to a number of limitations as compared to the DOF housing estimates. Namely, no other sources provide data at the census tract level. Using city-level data would require apportioning housing units or building permits to census tracts or aggregating census tracts to the city-level. Census tracts and cities do not consistently share boundaries and there are no reasonable methods to arrive at the geographic alignment necessary to compare the maps and housing production that maintains the integrity of the geographic prioritization designations of each map and accurately attributes housing production. **Table 3** below summarizes the data considered.

Table 3. Housing production data considered

Description (Data Source)	Geography	Availability	Limitations
5-Year American Community Survey (ACS)			
Housing unit estimates derived from a large sample collected over 60 months (U.S. Census Bureau)	Census tract	Time: annually Access: publicly available online and downloadable for the state	<ul style="list-style-type: none"> • Although a large sample, there is potential for sampling error • Multi-year period may obscure any rapid changes from year-to-year
Building Permit Survey			
Number and valuation of new privately-owned housing units authorized by building permits collected from local permit offices by voluntary survey (U.S. Census Bureau)	Permit-issuing place (e.g. city, county), metropolitan area, state	Time: monthly, year-to-date, annually for 1988-2020 Access: publicly available online and downloadable for the west region	<ul style="list-style-type: none"> • Subject to sampling error • Building permits do not indicate whether housing is actually constructed • Geography does not align with unit of analysis of maps.
E-5 Population and Housing Estimates			
Housing unit estimates based on annual information from California cities and counties (California DOF)	City, county, state	Time: annually Access: publicly available online and downloadable for the state	<ul style="list-style-type: none"> • Subject to data input error by reporting agency • Geography does not align with unit of analysis of maps

Description (Data Source)	Geography	Availability	Limitations
Parcel Data			
Parcel information such as size, property value, building characteristics for tax assessment purposes (Local Assessor Offices)	Parcel	Time: monthly, annually Access: public availability online for download or by request depending on the county	<ul style="list-style-type: none"> • Subject to data input error by reporting agency • Varying availability and potential inconsistency across counties • Geography does not align with unit of analysis of maps

Data Preparation

I took the following steps to prepare the data for analysis:

1. Download Table DP04 for the 2010-2014 ACS and 2015-2019 ACS
2. Calculate rate of housing unit growth between the periods 2010-2014 and 2015-2019 for each census tract
3. Join census tract housing unit growth rates to Census Tracts shapefile

Transit Accessibility Data Source

For transit accessibility, I use the geographic boundary shapefile for Tracts previously described and shapefiles of Existing and Planned Major Transit Stops, Existing and Planned High Quality Transit Corridor, and Existing and Planned Stops along High Quality Transit Corridor. These shapefiles are publicly available online as part of the Site Check tool. All files were last modified August 25, 2020.

Data Preparation

I took the following steps to prepare the data for analysis:

1. Download:
 - a. Existing Major Transit Stops, California (Shapefile)
 - i. Description: Points for the transit stops
 - b. Statewide Planned Major Stops, California (Shapefile)
 - i. Description These data are statewide planned (RTP/RTIP) Major Stops by MPO or county in California.
 - c. Statewide Existing Stops along High Quality Transit Corridors (Shapefile)
 - i. Description: These data are statewide bus, rail and light rail stops by MPO or county in California.
 - d. Statewide Planned Stops (Shapefile)
 - i. Description: These data are statewide planned (RTP/RTIP) stops by MPO or county in California.
 - e. Statewide Existing High Quality Transit Corridor (Shapefile)
 - i. Description: These data are statewide High Quality Transit Corridors for California
 - f. Statewide Planned High Quality Transit Corridor (Shapefile)

- i. Description: These data are Planned High Quality Transit Corridors (RTP/RTIP) by MPO or county in California.
2. Join all the shapefiles containing stops to create one stops shapefile
3. Join all the shapefiles containing corridors to create one corridor shapefile
4. Use the Buffer tool to create a quarter mile boundary around the stops and corridors

VMT Levels Data Source

I use a shapefile of VMT by Transportation Analysis Zone (TAZ) from the California Statewide Transportation Demand Model. This shapefile is publicly available online as part of the Site Check tool.

Data Preparation

I took the following steps to prepare the data for analysis:

1. Download shapefile for Statewide Vehicle Miles Traveled
2. Create and calculate where Home-Based VMT per person is less than the Regional Average VMT per person to identify Low VMT TAZs
3. Convert VMT polygon features to point feature
4. Intersect VMT point feature with Census Tracts shapefile with census tract housing unit growth rates

Spatial Analysis

I use GIS to create bivariate choropleth maps to visually represent the relationship between housing production and the prioritization of each map.

I also use GIS to visualize the relationship between housing production and transit proximity and low VMT areas.

Quantitative Analysis

Data for Quantitative Analysis

Data used for quantitative analysis includes the same data as before, but in Excel-based formats.

Map Data Sources

In addition to GIS files, each agency provides an Excel spreadsheet for their map tool that lists the map prioritization scores for all census tracts for which data was available to calculate a score. Additional information varies by map and includes geographic information such as city nearest to each census tract, county, and population, as well as map-specific information such as individual indicator scores, percentile rankings, and qualitative score categories. These files are publicly available on the websites of the agencies that developed the maps.

Data Preparation

I took the following steps to prepare the data for analysis:

1. Download each map Excel file
2. For the Opportunity Area Maps, extract Rural Areas and subtotal by census tract, average index score to census tract, assign Opportunity Category per map methodology, and append to original shapefile. This step is needed to standardize the scores for analysis as the Opportunity Area Maps provide scores for Rural Areas at the block group level.
3. For the Priority Population Maps, the Excel file includes data for census tracts that are designated as disadvantaged per CalEnviroScreen or low-income per income thresholds defined by AB 1550. For this research, I use only the data for census tracts designated low-income because I am already analyzing CalEnviroScreen individually.

Housing Production Data Sources

As before, I use the Total Housing Units values from the 5-Year ACS for the periods 2010-2014 and 2015-2019.

Data Preparation

I took the following steps to prepare the data for analysis:

1. Download Table DP04 for the 2010-2014 ACS and 2015-2019 ACS
2. Calculate the rate of housing unit growth between the periods 2010-2014 and 2015-2019 for each census tract
3. Calculate the net difference in total units between the periods 2010-2014 and 2015-2019 for each census tract

Transit Accessibility Data Source

For transit accessibility, I use the half mile transit stop and corridor buffers I prepared for the spatial analysis.

Data Preparation

I took the following steps to prepare the data for analysis:

1. Use the Intersect tool to determine the tracts that fall within the buffer for stop and corridors, and categorize as Transit Proximate or Not Transit Proximate
2. Export tables to Excel, combine into one spreadsheet, eliminate duplicate census tracts

Quantitative Analysis

Prioritization Coverage

For each map, I sum the population and census tracts that are designated as priority to determine the varying prioritization coverages provided by each map. The math is represented by the formulas below.

$$\% \text{ of State population prioritized by Map X} = \frac{\text{Sum of population of census tracts prioritized by Map X}}{\text{Sum of State population}}$$

$$\% \text{ of State census tracts prioritized by Map X} = \frac{\text{Sum of census tracts prioritized by Map X}}{\text{Sum of State census tracts}}$$

I also sum the population and census tracts that receive overlapping priority designations from all the maps, and different pairs of maps. The math is represented by the formulas below.

$$\% \text{ of State population prioritized by Map X and Map Y} = \frac{\text{Sum of population of census tracts prioritized by Map X and Map Y}}{\text{Sum of State population}}$$

$$\% \text{ of State census tracts prioritized by Map X and Map Y} = \frac{\text{Sum of census tracts prioritized by Map X and Map Y}}{\text{Sum of State census tracts}}$$

Statistical Relationships

To draw relationships between the maps and between the maps and housing production, I use Spearman Rank Correlation. This correlation method provides flexibility for the nonlinearity and existence of outliers present in the data. This method requires that the ranking of interval values (i.e. index scores) within each map. The Low-Income Priority Populations Map is not based on an index score. I created an interval value by first identifying the low-income threshold met by the census tract, and then calculating how far below the threshold the census tract's median household income falls. The resulting percentage is the value for each census tract. For each map, I assigned rankings to scores in accordance with how the maps designate priority. For the CalEnviroScreen and Opportunity Area Maps, I assigned ranks in descending order (i.e. the largest value is ranked first). For the Healthy Places Index and Low-Income Priority Populations Maps, I assigned ranks in ascending order (i.e. the smallest value is ranked first). I used Excel to determine correlations between each map, and between each map and rate of housing production.

Change in Housing Production

For each map, I calculated the absolute and percentage change of new housing units between the periods 2010-2014 and 2015-2019 that are located within census tracts designated as priority and non-priority under each map. I represent this information in

bar graphs. The math is represented by the formulas below, using CalEnviroScreen as an example.

$$\begin{array}{l} \textit{Absolute change in housing} \\ \textit{units within census tracts} \\ \textit{designated as} \\ \textit{Disadvantaged} \end{array} = \frac{\textit{Sum of units in Disadvantaged tracts in 2015-2019} - \textit{Sum of units in Disadvantaged tracts in 2010-2014}}{\textit{Sum of units in Disadvantaged tracts in 2010-2014}}$$

$$\begin{array}{l} \textit{\% change of housing units} \\ \textit{within census tracts} \\ \textit{designated as} \\ \textit{Disadvantaged} \end{array} = \frac{\textit{Absolute change in units within Disadvantaged tracts}}{\textit{Sum of units in 2010-2014}}$$

For transit access, I develop a high level variable for transit proximity by creating a half mile buffer around existing or planned major transit stops or existing or planned high quality transit corridors or stops. I use these transit service definitions and a half mile buffer consistent with established and/or proposed legislation such as SB 375 and SB 50 which define priority transit projects and propose transit proximity thresholds for development streamlining. I categorize a census tract that falls fully or partially within the half mile buffer as “transit proximate.” This does not necessarily confer a determination about whether there are convenient pathways to a transit station that make it accessible to census tract residents. As the exact locations and distribution of new housing units and population within a census tract are not available from the data used, categorization as transit proximate is a high level proxy for transit accessibility. I calculated the absolute and percentage change of new housing units located in transit proximate census tracts. I represent this information in bar graphs.

For Low VMT areas, I designate each census tract as Low VMT or Not Low VMT and calculate the absolute and percentage change of new housing units located in transit proximate census tracts. I represent this information in bar graphs.

I discuss the findings and analysis in the next section.

4. Findings and Analysis

I find that the conceptual bases of the maps include environmental justice, improved health outcomes, and access to opportunity. Geographic prioritization within each map follows accordingly. While each map is unique in its approach to defining priority areas, there are varying levels of overlap in prioritized areas. Regardless of the level of overlap and the different definitions of priority, there is a strong correlation between the maps.

I do not find a correlation between geographic prioritization and change in housing production. While some prioritized areas saw a slightly higher percent change in housing units compared to areas that are not prioritized, they did not overall see more absolute increases in housing units. To the extent that these maps represent climate and planning goals, housing has not been located to help achieve those goals. However, housing does appear to be located in transit proximate and low VMT areas that can support coordinated land use and transportation, and help meet the state's climate goals via reduced VMT.

Finally, I find that the maps share indicators but each apply different weighting and calculations. Therefore, shared indicators do not necessarily indicate priority alignment across maps. What all maps share is a lack of indicators related to transit access/proximity and VMT.

In the following sections, I elaborate on these findings by sub-question.

What is the conceptual basis, purpose, and application of each map?

I provide a description of each map below including the agency that developed the map, the underlying conceptual basis, the purpose for which the map was developed, the methodology behind map construction, the definition of priority, and the applications of the map including State funding and financing programs that use the map. Descriptions of the State funding and financing programs are provided in Appendix A.

CalEnviroScreen 3.0

Agency: Office of Environmental Health Hazard Assessment (OEHHA)

Conceptual basis: Environmental health screening tool for environmental justice

Purpose: CalEnviroScreen (CES) was developed to support implementation of the California Environmental Protection Agency's (CalEPA) 2004 Environmental Justice

Action Plan. The map was first published in April 2013, with subsequent versions published in October 2014 and January 2017. CES is intended to aid in directing state resources and making policy decisions that achieve environmental justice and revitalize disadvantaged communities. CES evaluates the burden of multiple sources of pollution and potential vulnerability to the adverse effects of pollution. The tool scores and ranks census tracts based on potential exposures to pollutants, adverse environmental conditions, socioeconomic factors and prevalence of certain health conditions.

Methodology: CES scores are based on the product of two components: Pollution Burden and Population Characteristics. Pollution Burden is based on 12 indicators of exposure to pollution sources and environmental effects. Population Characteristics are based on 8 indicators of sensitive populations and socioeconomic factors. The criteria for selecting indicators were: measure the relevant component, represent widespread concerns related to pollution in the State, represent the relevant component when considered alongside other indicators, relate to issues that CalEPA can act on, represent demographic factors known to influence vulnerability to disease, available for the entire state at the census tract level or translatable to the census tract level, and be of sufficient quality (complete, accurate, current). Individual indicators scores are calculated to arrive at scores for each component. The components are multiplied to arrive at a final CES score. Higher scores indicate higher environmental health burden. Scores are assigned percentile rankings.

Priority: Priority is designated for Disadvantaged Communities which are defined as census tracts that score within the top 25 percent of all census tracts. This equates to a score of 39.34 or higher. The count of census tracts and population within each designation is below.

Designation	# Census Tracts	Population
Disadvantaged	2,007	9,356,890
Not Disadvantaged	6,028	27,897,066

Applications: Pursuant to SB 535, CES is used to identify disadvantaged communities to receive at least 25 percent of proceeds from the California Climate Investments (CCI). CCI-funded programs require applicants to submit as part of their application materials a map that overlays the proposed project on the CES map. State agencies administering CCI programs evaluate these maps to identify whether proposed projects are located within designated disadvantaged communities. Proposed projects that are located within designated disadvantaged communities are scored higher or receive higher priority for funding, and if funded, count towards fulfilling the requirements of SB 535 and AB 1550. CCI-funded programs relevant to this research that use CES to prioritize funding allocations include:

- Affordable Housing and Sustainable Communities

- Transformative Climate Communities

CES is also used by the State’s Active Transportation Program (ATP).

Healthy Places Index

Agency: Public Health Alliance of Southern California

Conceptual Basis: Social determinants of health

Purpose: The Healthy Places Index (HPI) is intended to help decision makers statewide explore the local factors that predict life expectancy and compare community conditions across the state. The map provides scores and more detailed data on specific policy action areas that shape health, such as housing, transportation, and education.

Methodology: The HPI is comprised of individual indicators organized into eight policy action areas (domains): economy, education, healthcare access, housing, neighborhoods, clean environment, transportation, and social environment. The indicators generally cover data between 2011 and 2015. The criteria for including indicators were: 1) publicly available data for census tracts with a 2010 population of 1500 or more residents and a group quarters population less than 50% of the total population, 2) evidence from the scientific literature linking the indicator to health, 3) "actionability" through policy, systems, and environmental change, 4) continuity with the Health Disadvantage Index, and 5) compatibility with indicator projects sponsored by California Department of Public Health. Each indicator was scaled, standardized, and averaged to compute a domain score. Domains were weighted and domain scores were summed to arrive at the total HPI. The HPI provides both positive and negative framings of the index score to fit the purposes of the decision maker using the map tool.

Priority: The State uses the HPI in the negative framing. Priority is designated for Disadvantaged Communities which are defined as census tracts that score within the bottom 25 percent of all census tracts. The count of census tracts and population within each designation is below.

Designation	# Census Tracts	Population
Disadvantaged	1,948	9,121,686
Not Disadvantaged	5,845	27,635,289
No Data	264	496,981

Applications: HPI is used in various funding programs that require applicants to submit as part of their application materials a map that overlays the proposed project on the HPI map. State agencies administering such programs evaluate these maps to identify whether proposed projects are located within designated disadvantaged communities.

Proposed projects that are located within designated disadvantaged communities are scored higher or receive higher priority for funding. State funding programs relevant to this research that use HPI include:

- Active Transportation Program
- Transformative Climate Communities

Opportunity Area Map

Agency: California Tax Credit Allocation Committee/Department of Housing and Community Development (TCAC/HCD)

Conceptual Basis: Geography of opportunity

Purpose: Identify areas in every region of the state whose characteristics have been shown by research to support positive economic, educational, and health outcomes for low-income families—particularly long-term outcomes for children. The map is intended to help prevent further segregation and poverty concentration and encourage access to opportunity in the making and implementation of housing policy, programs, and regulations.

Methodology: The Opportunity Area Map seeks to balance regional variation and the need for consistent standards to support fair housing decisions. It does this by setting regional boundaries: Los Angeles, Bay Area, Central Valley, San Diego, Capital, Inland Empire, Orange County, Central Coast, and Rural Areas. Within each region, census tracts receive regionally derived opportunity index scores based on a combination of indicators relating to economic, environmental, and educational measures. The criteria for indicator selection were: the indicator is linked to improved life outcomes for low-income families (based on evidence from peer-reviewed research that), reliable data, publicly available data. The Opportunity Map filters out census tracts that are high-poverty and racially-segregated.

Priority: Census tracts designated as Highest Resource or High Resource are priority areas. The count of census tracts and population within each designation is below.

Designation	# Census Tracts	Population
Highest Resource	1,560	7,311,721
High Resource	1,558	7,069,661
Moderate Resource	1,884	8,877,193
Moderate Resource (Rapidly Changing)	134	561,893
Low Resource	2,025	9,655,886
High Segregation & Poverty	523	2,295,088
No Data	373	1,480,043

Applications: The Opportunity Area Map is used in housing funding programs. These programs require applicants to submit as part of their application materials a map that overlays the proposed project on the Opportunity Area Map. Agencies administering these programs evaluate these maps to identify whether proposed projects are located within designated Highest Resource or High Resource areas. Proposed projects that are located within these areas are scored higher or are eligible for greater financial award. State funding and financing programs relevant to this research that use the Opportunity Area Map include:

- 9% Low Income Housing Tax Credits (LIHTCs)
- CalHome Program
- Infill Infrastructure Grant Program
- Multifamily Housing Program

Low-Income Priority Population Maps

Agency: California Air Resources Board (CARB)

Conceptual Basis: Environmental health screening tool for environmental justice, low-income

Purpose: Pursuant to AB 1550, the Priority Populations Map represents the expansion of the allocation of CCI funds to low-income communities in addition to disadvantaged communities as defined by CES. The map shows disadvantaged communities (per CES 3.0) and low-income communities.

Methodology: For disadvantaged communities, the map identifies census tracts that score within the top 25 percent of all census tracts in CES. For low-income communities, the map establishes two median household income (MHI) thresholds: 80 percent of the statewide MHI and the 2016 HCD Low-income Thresholds for Average Household Size. The latter employs county-specific thresholds for low income. Using the 2012-2015 ACS, the statewide MHI threshold was set at \$49,454. Census tracts that score at or below either threshold are considered low-income.

Priority: Priority is designated for Disadvantaged Communities and Low-Income Communities. Disadvantaged Communities are defined as census tracts that score within the top 25 percent of CES scores. Low-Income Communities are defined as census tracts in which the MHI is less than or equal to \$49,454 or less than or equal to the 2016 HCD Low-income Threshold for Average Household Size. This research focuses on the Low-Income Communities. The count of census tracts and population within each designation is below.

Designation	# Census Tracts	Population
Low-Income	3,873	17,818,190
Not Low-Income	4,184	19,433,295

Applications: CCI-funded programs require applicants to submit as part of their application materials a map that overlays the proposed project on the Low-Income Priority Populations Map. State agencies administering CCI programs evaluate these maps to identify whether proposed projects are located within designated low-income communities. Proposed projects that are located within these communities are scored higher or receive higher priority for funding, and if funded, count towards fulfilling the requirements of AB 1550. CCI-funded programs relevant to this research that use the Low-Income Priority Populations Map to prioritize funding allocations include:

- Affordable Housing and Sustainable Communities
- Low Carbon Transit Operations Program
- Sustainable Transportation Equity Project
- Transformative Climate Communities
- Transit and Intercity Rail Capital Program

The State funding and financing programs using one or more of the maps are summarized in **Table 4**. Altogether, the maps have been used by the State to make decisions to award over \$16 billion of State transportation and housing funding.

Table 4. Summary of State funding and financing programs

Program	Funding Source	Administering State Agency	Map(s) Used	Funding Awarded (000s)
Active Transportation Program	Gas tax	California Transportation Commission	CES, HPI	2,100,506
Affordable Housing and Sustainable Communities	GGRF	Strategic Growth Council	CES, LI-PPM	1,654,462
Low Carbon Transit Operations Program	GGRF	Caltrans	CES, LI-PPM	555,500
Sustainable Transportation Equity Project	GGRF	CARB	CES, LI-PPM	19,500
Transformative Climate Communities	GGRF	Strategic Growth Council	CES, HPI, LI-PPM	187,624
Transit and Intercity Rail Capital Program	GGRF	California State Transportation Agency	CES, LI-PPM	5,440,171
9% Low Income Housing Tax Credits (LIHTCs)	Federal and state	TCAC	OAM	5,498,100

Program	Funding Source	Administering State Agency	Map(s) Used	Funding Awarded (000s)
	budget authority			
CalHome Program	State bonds	HCD	OAM	135,081
Infill Infrastructure Grant Program	State bonds	HCD	OAM	461,611
Multifamily Housing Program	State bonds	HCD	OAM	778,577
Total				16,831,132

Programs using CES, HPI, LI-PPM, and/or OAM, and the funding awarded to date using the maps.

What areas are prioritized by each map?

The census tracts prioritized by each map are based on their conceptual bases and methodology as previously described. While each map is unique in its approach to defining priority areas, I find that there are varying levels of overlap in the areas prioritized by each map.

Prioritization Coverage

Table 5 below shows the number of census tracts receiving priority designation from each map or a combination of maps.

Table 5. Number of census tracts prioritized

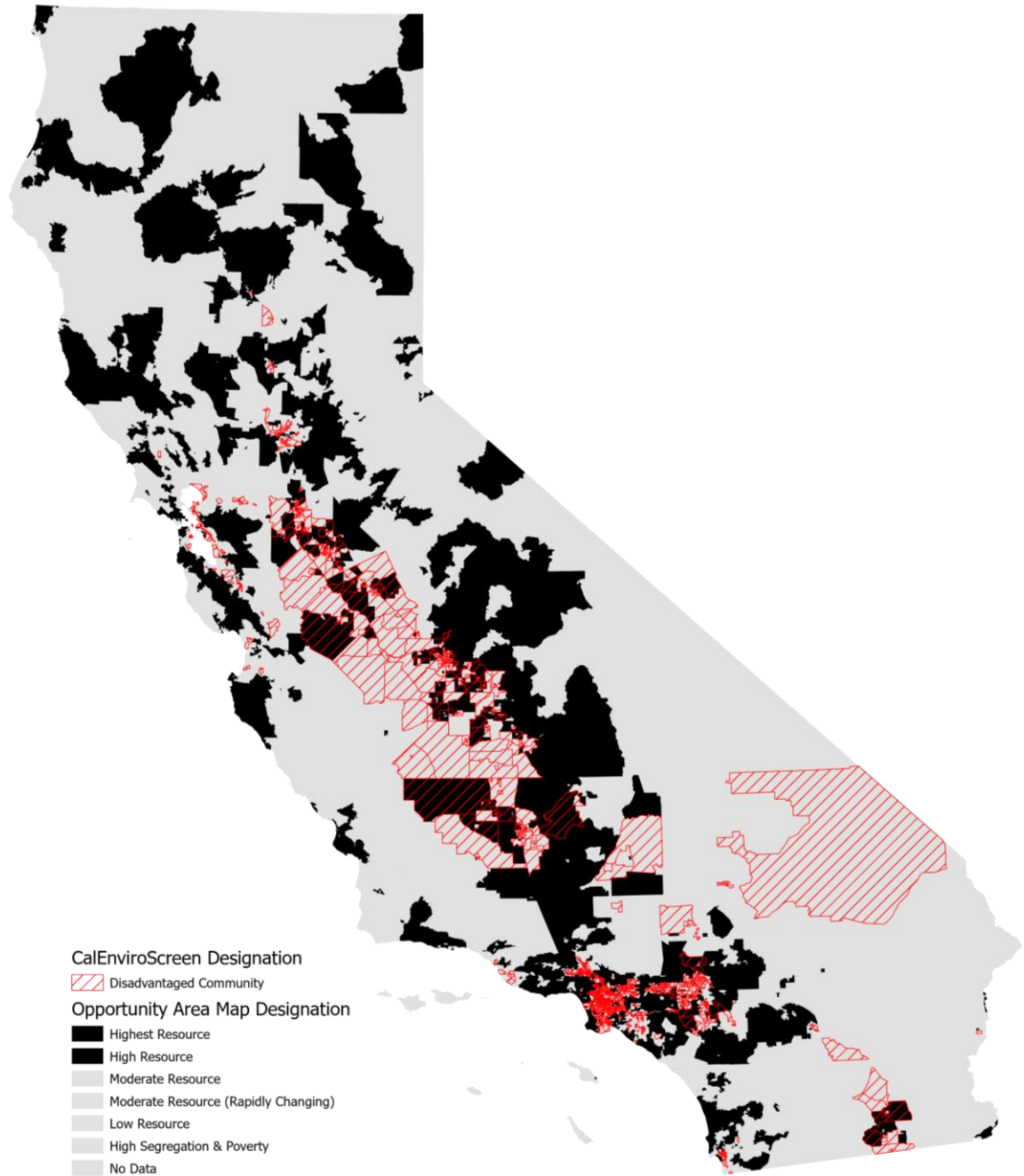
Map	CalEnviro-Screen	Low-Income Priority Populations	Healthy Places Index	Opportunity Area
CalEnviroScreen	2,007 (25%)	Prioritized by all maps: 18		
Low-Income Priority Populations	1,755 (22%)	3,873 (48%)		
Healthy Places Index	1,301 (16%)	1,890 (24%)	1,948 (24%)	
Opportunity Area	135 (2%)	432 (5%)	63 (1%)	3,118 (39%)

Number of census tracts prioritized by each map or combination of maps with percentage of population prioritized in parentheses.

CalEnviroScreen and Healthy Places Index prioritize about the same number of census tracts. Low-Income Priority Populations prioritizes the most census tracts at 3,873. It also shares the most number of prioritized census tracts with other maps. This is likely due to its reliance on a single indicator – income – which allows tracts to be prioritized under two income thresholds. A tract does not have to meet the more restrictive income thresholds in order to be designated as priority.

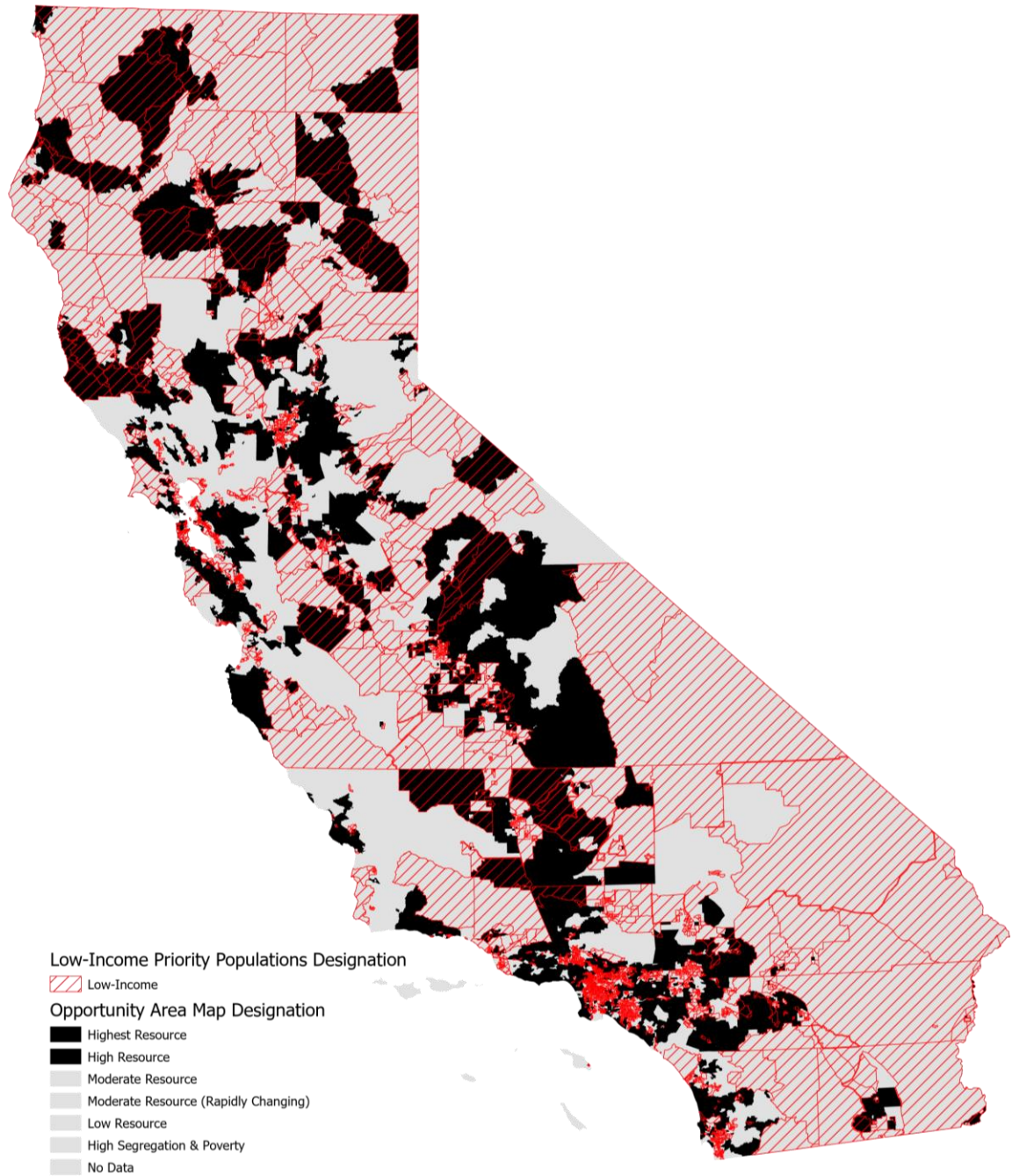
While the Opportunity Area Map prioritizes the second most census tracts at 3,118, it shares the least number of prioritized census tracts with other maps. This is likely due to the different definitions of priority employed by each map. The Opportunity Area Map prioritizes areas with higher income and environmental quality in seeking to establish housing in areas that can result in improved life outcomes. The other three maps prioritize areas with lower income and with higher environmental burden in seeking to allocate resources to communities that have been traditionally burdened environmentally and socially. **Figures 1 through 3** visualize the lack of overlapping priority areas between the Opportunity Area Map and other three maps.

Figure 1. Comparison of Opportunity Area Map and CalEnviroScreen priority areas



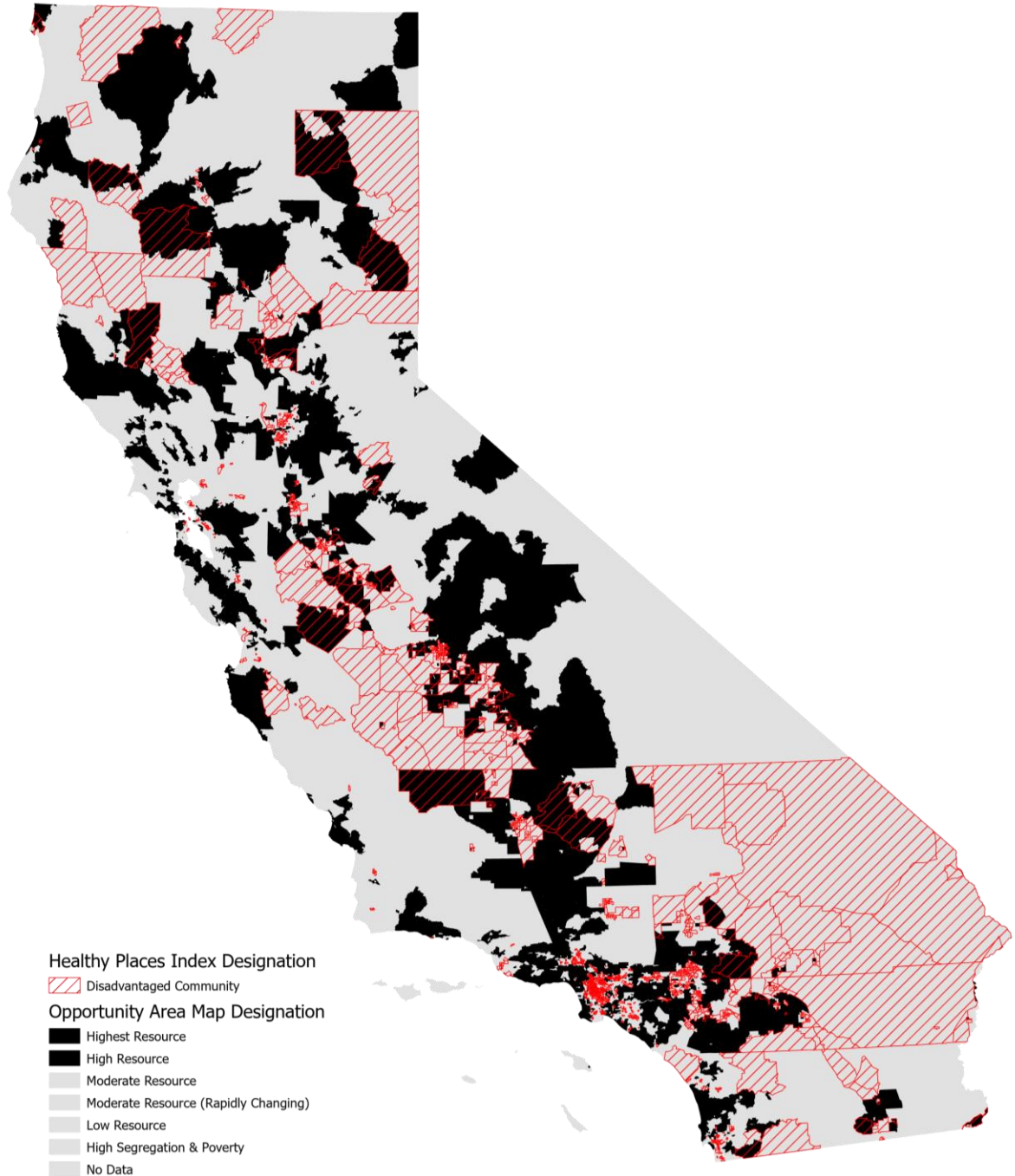
Only 135 census tracts overlap between the Opportunity Area and CalEnviroScreen Maps.

Figure 2. Comparison of Opportunity Area Map and Low-Income Priority Populations priority areas



Only 432 census tracts overlap between the Opportunity Area and Low-Income Priority Populations Maps.

Figure 3. Comparison of Opportunity Area Map and Healthy Places Index priority areas



Only 63 census tracts overlap between the Opportunity Area and Low-Income Priority Populations Maps.

Regardless of the level of overlap between census tracts prioritized and the different definitions of priority, there is a strong correlation between the maps. **Table 6** presents the correlation coefficients for each map pair. As mentioned before, different definitions of priority are employed by each map. In particular, the Opportunity Area Map prioritizes areas with higher income and environmental quality while the other three maps prioritize the opposite. That accounts for the negative direction of the relationship between the Opportunity Area Map and the other three maps.

Table 6. Spearman Rank Correlation between maps

Map	CalEnviro-Screen	Low-Income Priority Populations	Healthy Places Index	Opportunity Area Maps
CalEnviroScreen	1			
Low-Income Priority Population Map	0.44	1		
Healthy Places Index	0.78	0.68	1	
Opportunity Area Maps	-0.64	-0.51	-0.76	1

What indicators inform each map as compared to indicators that measure achievement of the State’s goals?

Altogether, the maps are comprised of 49 indicators which I categorize into six types: Pollution, Health, Housing, Neighborhood, Socioeconomic, and Transportation. Of note, all maps include CalEnviroScreen indicators or scores in some way. For example, the four indicators that are shared between all maps are part of CalEnviroScreen: Diesel PM Emissions, Drinking Water Contaminants for selected contaminants, Ozone Concentration, and PM 2.5 Concentration. No maps include indicators related to race or ethnicity, although the Opportunity Area Map uses race in a Racial Segregation “filter” which identifies tracts with higher concentration of Black, Hispanic, Asian, or all people of color in comparison to the county and excludes them from being scored for prioritization. This is in line with its goal to avoid further segregation in the siting of affordable housing. Additionally, no maps include indicators related to transit accessibility or proximity. The overlap in indicators is presented in **Table 7**.

Table 7. Indicators comprising each map and overlap of indicators

Map	CalEnviro-Screen	Low-Income Priority Populations	Healthy Places Index	Opportunity Area
CalEnviroScreen	20	Indicators shared by all maps: 4		
Low-Income Priority Populations	20	22		
Healthy Places Index	4	4	25	
Opportunity Area	12	12	6	21

I did not find that the degree of overlap of inputs has bearing on the degree of overlap of geographic prioritization. While maps may share indicators, they each apply different weighting and calculations to the indicators. Therefore, shared indicators do not necessarily indicate priority alignment across maps. For example, the Opportunity Area Map determines that high values for the four indicators shared by all maps contributes to undesirable locations for housing and therefore designates such census tracts as lower priority. The opposite is true for the other three maps where high values for those four indicators represent a need for higher priority to address the historical burdens experienced by those communities as a result of those indicators. Appendix B presents all of the indicators used for each map, including the filters used by the Opportunity Area Map.

Where is housing actually being produced, how does that compare to the areas prioritized by each map, and is housing located such that progress is being made toward climate and planning goals?

My findings show that housing has not been produced in areas that have received priority designation in the maps. Of the approximately 394,000 net new housing units produced between 2010-2014 and 2015-2019, only 23%, 18%, 43%, and 36% were produced in census tracts prioritized under the CalEnviroScreen, Healthy Places Index, Opportunity Area, and Low-Income Priority Populations Maps, respectively. For each map, prioritized census tracts also saw lower or only slightly higher percentage increases in housing units than their non-prioritized counterparts.

To explore the possibility that Statewide-level analyses obscured regional variation, I also conducted the same analyses for the Southern California Association of

Governments (SCAG), Association of Bay Area Governments (ABAG), and Sacramento Area Council of Governments (SACOG). I observe similar results to the Statewide-level analyses, with the exception of the relationship between housing production and the OAM within SACOG. In SACOG, census tracts prioritized by OAM, specifically receiving the Highest Resource designation, saw higher absolute and percentage increase in housing units than non-prioritized census tracts. The results of the regional analyses are reported in **Appendix C**.

Therefore, to the extent that these maps represent climate and planning goals, housing has not been located to help achieve climate and planning goals. However, looking beyond the maps, housing does appear to be located in transit proximate and low VMT areas that can potentially support coordinated land use and transportation, and help meet the state's climate goals via reduced VMT.

How does housing production compare to areas prioritized by each map?

First, there is no correlation between the geographic prioritization and the rate of housing production. The correlation coefficients were found as follows:

- CalEnviroScreen: $r_s(8,055) = .06, p < .05$
- Healthy Places Index: $r_s(8,055) = .02, p < .05$
- Opportunity Area: $r_s(8,055) = -.02, p < .05$
- Low-Income Priority Populations: $r_s(8,055) = .07, p < .05$

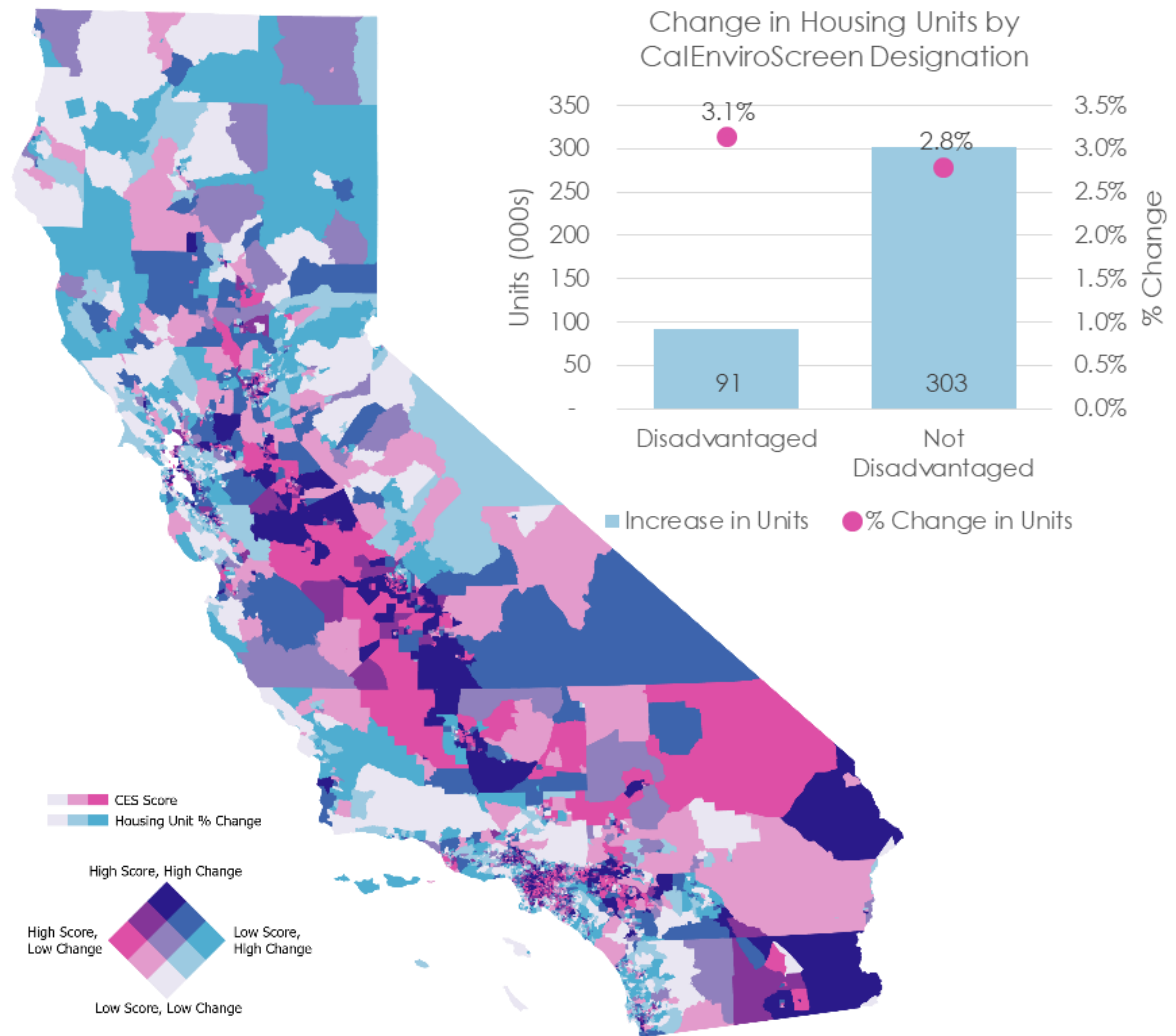
Following, I discuss the lack of a clear relationship between where housing has been produced and where there has been geographic prioritization by each map.

CalEnviroScreen 3.0

CalEnviroScreen supports the State's environmental justice goals, but we do not see housing production in areas designated as disadvantaged environmental justice communities. For CalEnviroScreen, we would expect to see more instances of high scores and high change in housing units if there was a clear relationship between geographic prioritization of environmental justice communities and housing production. In **Figure 4**, we see more instances of either a high score or high rate of change in housing units. That plays out in the number of units produced. Only 23% of new housing units were produced in census tracts designated as disadvantaged. While disadvantaged tracts saw a higher percentage increase in housing units than tracts that are not disadvantaged (3.1% vs. 2.8%), the percentage increase is not significantly higher.

As mentioned earlier, CalEnviroScreen was not developed with intent to identify priority areas for housing production and may actually prioritize areas where housing should not be located. Housing produced in areas prioritized by CalEnviroScreen would face higher pollution burdens, which runs counter to broader State goals for healthy communities. Still, CalEnviroScreen is used in the Affordable Housing and Sustainable Communities and the Transformative Climate Communities Programs which both direct housing investments.

Figure 4. CalEnviroScreen geographic prioritization vs. housing production

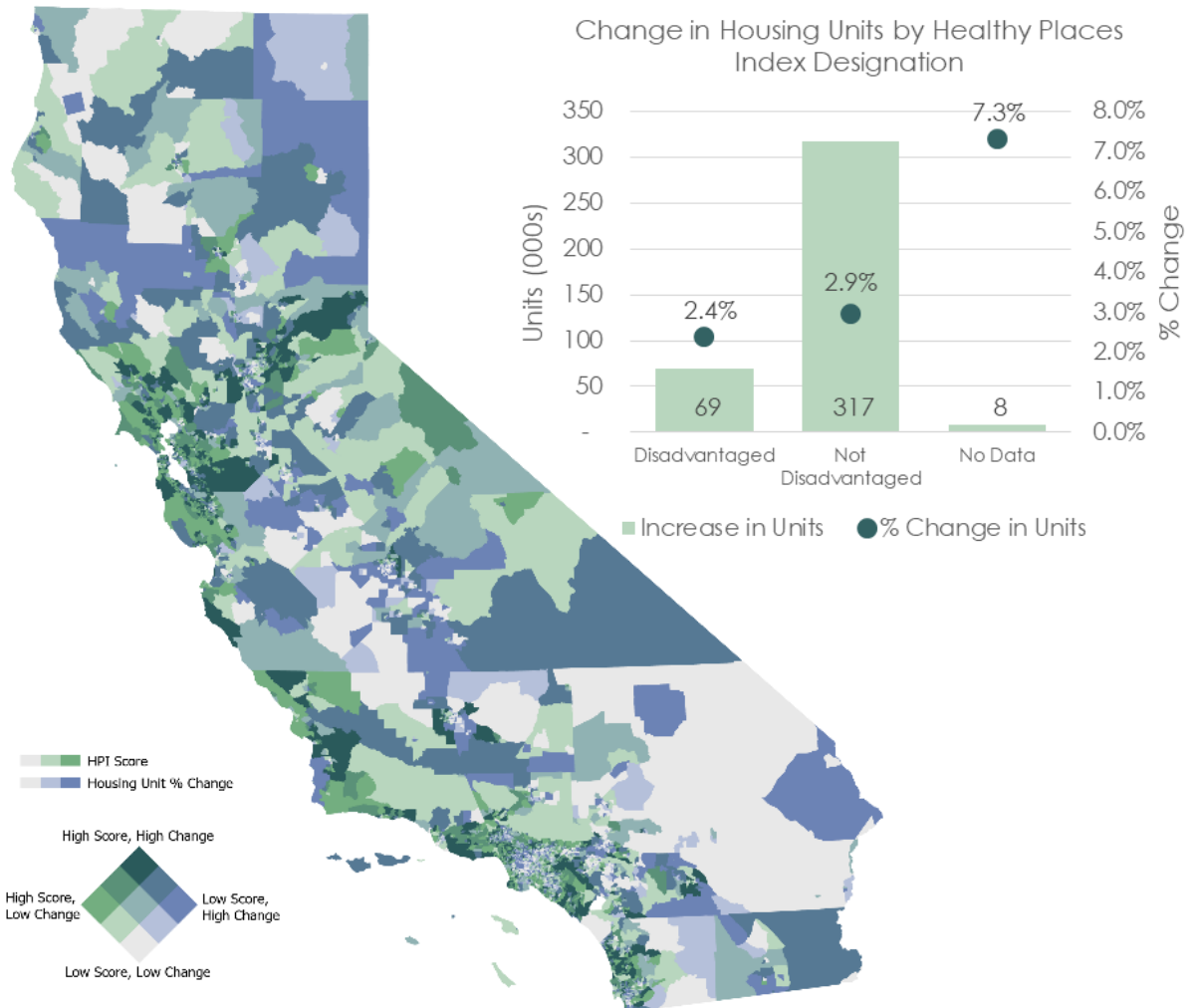


CalEnviroScreen scores vs. rate of housing production, and share of new housing units by prioritization category

Healthy Places Index

The Healthy Places Index supports the allocation of resources to areas that experience health burdens as a result of a variety of social determinants. I do not find that housing production tracks with this approach to allocating resources. For Healthy Places Index, we would expect to see more instances of low scores and high change in housing units if there was a clear relationship between geographic prioritization and housing production. In **Figure 5**, we see more instances of either a high score with low rate of change, or high score and high rate of change in housing units. That plays out in the number of units produced. Only 18% of new housing units were produced in census tracts designated as disadvantaged. Furthermore, census tracts that are not disadvantaged saw a slightly higher percentage increase in housing units.

Figure 5. Healthy Places Index geographic prioritization vs. housing production

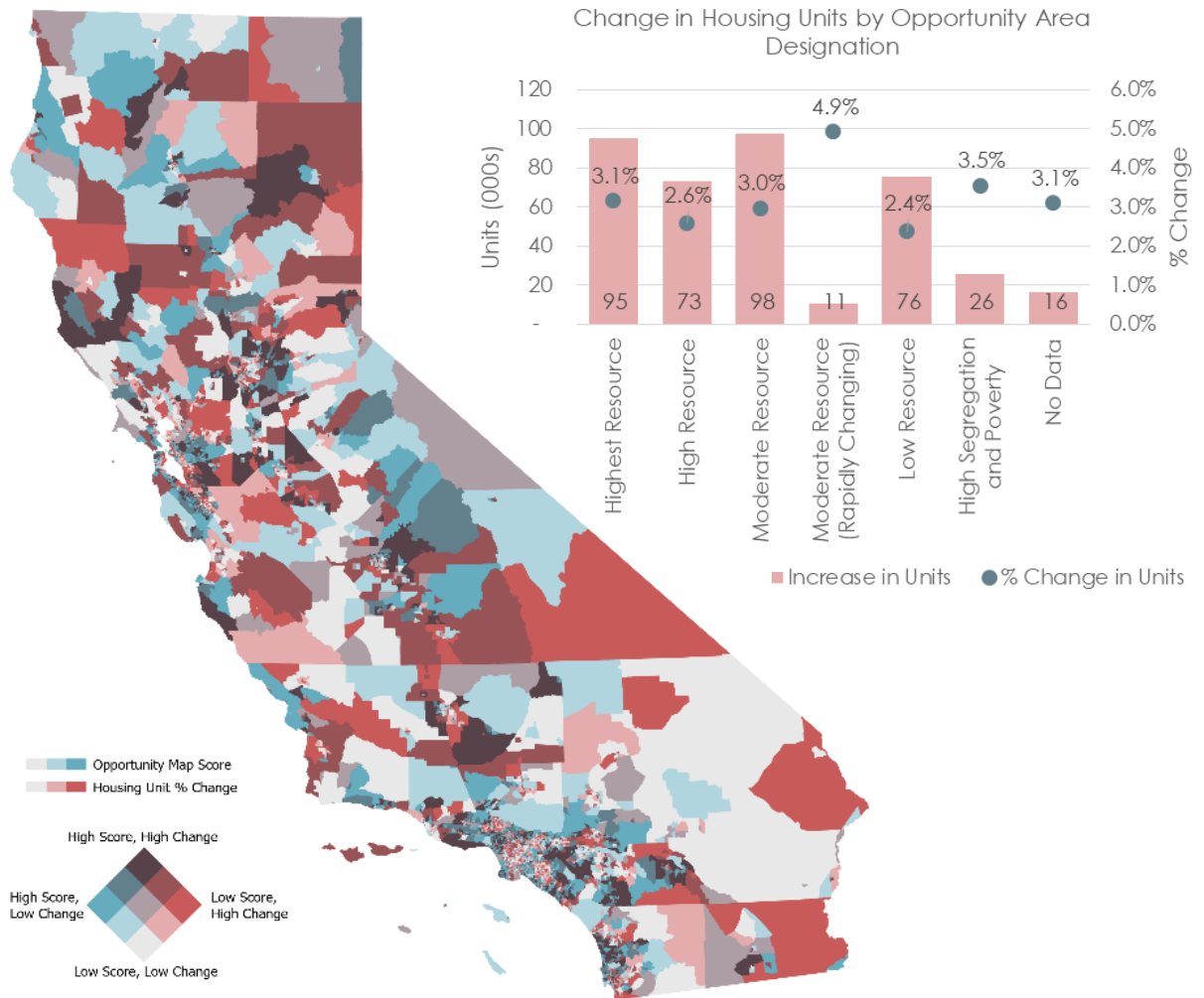


Healthy Places Index scores vs. rate of housing production, and share of new housing units by prioritization category

Opportunity Area Map

The Opportunity Area Map represents the State's goal to prevent further segregation and concentration of poverty while supporting positive economic, educational, and health outcomes in the siting of affordable housing. I find that while a sizable amount of housing has been produced in areas prioritized by this map, there has been more housing produced in areas that run counter to the goals of the map. For the Opportunity Area Map, we would expect to see more instances of high scores and high change in housing units if there was a clear relationship between geographic prioritization and housing production. In **Figure 6**, we see more instances of either a high score or high rate of change in housing units. That plays out in the number of units produced. Only 43% of new housing units were produced in census tracts designated as highest or high resource. This represents a higher share of housing production in priority areas than the other maps, but there is still a significant share of housing produced in areas that are lower resource or even high segregation and high poverty. The percentage increase in housing units is also not significantly higher in the priority areas.

Figure 6. Opportunity Area Map geographic prioritization vs. housing production

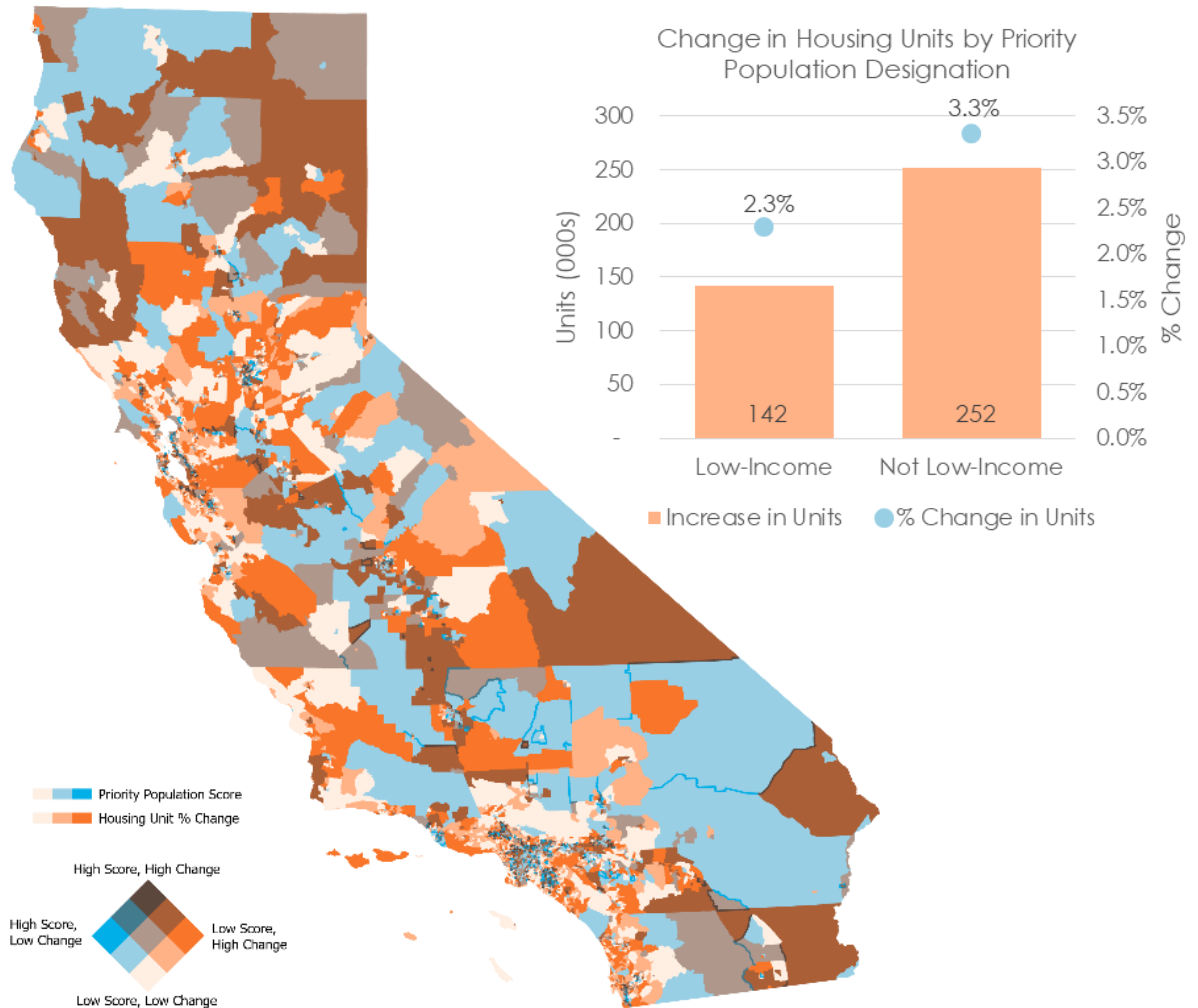


Opportunity Area Map scores vs. rate of housing production, and share of new housing units by prioritization category

Low-Income Priority Populations Map

For the Low-Income Priority Populations Map, we would expect to see more instances of high scores and high change in housing units if there was a clear relationship between geographic prioritization and housing production. In **Figure 7**, we see more instances of either a high score or high rate of change in housing units. That plays out in the number of units produced. Only 36% of new housing units were produced in census tracts designated as low-income. Furthermore, non low-income census tracts saw a 1% higher increase in housing units than low-income census tracts.

Figure 7. Low-Income Priority Populations geographic prioritization vs. housing production



Low-Income Priority Populations Map scores vs. rate of housing production, and share of new housing units by prioritization category

Is housing located such that progress is being made toward climate and planning goals?

Where there appears to be a relationship to housing production is transit proximity and VMT levels. I determined that only 40% of the state’s census tracts as transit proximate, but found that 52% of new housing units were produced in these tracts. These tracts also saw a higher percentage increase in housing units than tracts that are not transit proximate (3.9% vs. 1.4%). **Figure 8** represents the housing produced in these census tracts. In **Figure 9**, I found similar positive relationship between housing production and

low VMT areas: 81% of new housing units were produced in low VMT areas, and there is only a slightly lower percentage increase in housing units in low VMT areas compared to areas with higher VMT.

Figure 8. Housing unit increase by transit proximity

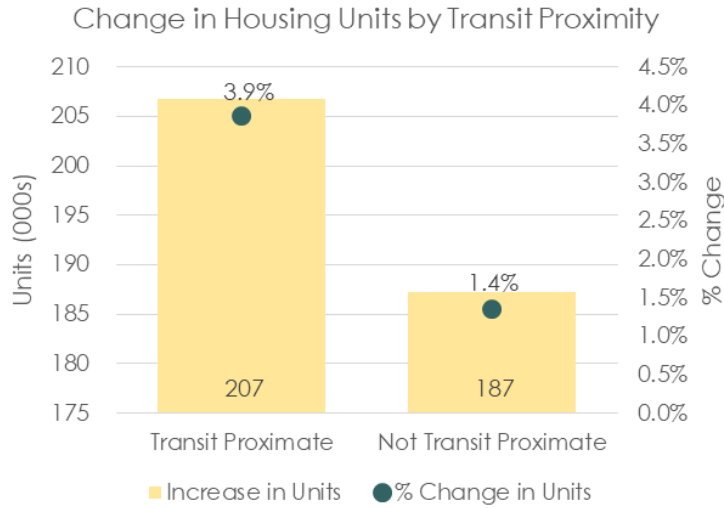
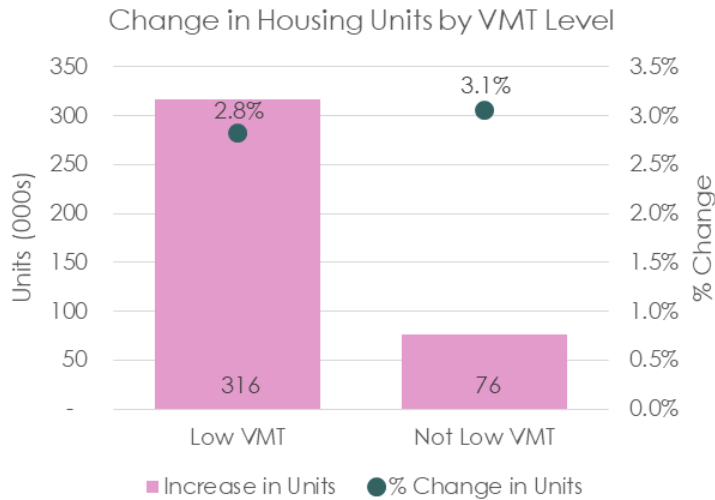


Figure 9. Housing unit increase by VMT level



These findings signal that housing has been produced in areas that are served by a major rail transit stop or high quality bus transit and as a result, have lower levels of VMT. Housing legislation that seeks to streamline housing production based on such transit service definitions would support the housing production trends observed in this research. As none of the maps include indicators relating to transit or VMT currently, they do not lend themselves to supporting this trend. As Sun found in his study of the

Opportunity Area Map, absence of such indicators may inadvertently lead to State-funded growth in areas that work against making progress toward the State's climate goals.

Overall, new housing production has not been located in areas that have received geographic prioritization from the four map tools but has been located in areas with transportation characteristics (i.e. proximate to transit and with low VMT) that indicate progress toward climate and planning goals. **Table 8** summarizes housing production between the periods 2009-2014 and 2015-2019 in designated priority areas by map, and areas with transportation characteristics supportive of climate change goals.

Table 8. Housing production in priority areas by map and transportation characteristics

Map/Characteristic	Housing Units Produced	% of New Housing Units Produced in Priority Area
CalEnviroScreen Map: Disadvantaged Communities	91,486	23%
Low-Income Priority Populations Map: Low-Income Communities	141,718	36%
Healthy Places Index: Disadvantaged Communities	69,192	18%
Opportunity Area Map: Highest and High Resource Areas	168,214	43%
Transit Proximate	206,770	52%
Low VMT Level	316,263	81%

Share of the 394,047 new housing units between 2009-2014 and 2015-2019 located in areas that received geographic prioritization under each map, or that exhibit transportation characteristics supportive of progress toward meeting climate change goals.

5. Conclusion

To conclude, I return to the central research questions.

Do California State government maps guide planning and development decisions that help meet climate and planning goals?

I did not find a strong relationship between housing production and geographic prioritization under CalEnviroScreen, the Healthy Places Index, the Opportunity Area Map, and the Low-Income Priority Populations Map both at the Statewide level and at the regional level. This may indicate that there is no discernible signal being sent by these maps to housing producers, but may also speak to the small share of housing production that is subject to the prioritization designated by these maps. That is, State funding and finance programs for housing support a small share of housing production statewide.

One significant finding is that none of the maps include indicators related to transit access or proximity. While housing production between 2010-2014 and 2015-2019 has been located in transit proximate and low VMT area in spite of these omissions, it likely largely the result of private decision-making on the part of housing producers. For the transportation and housing funding directly controlled by the State such as funds from the Affordable Housing and Sustainable Communities Program and LIHTC, it is important that tools used to make allocation decisions do not prioritize areas that work against climate goals by encouraging driving. The State's geographic prioritization tools should support coordination of transportation and housing by including indicators of transit access/proximity and VMT in current and future State government map tools. An example to follow is OPR's Site Check map which is expected to be finalized in 2021. As it shows parcels where CEQA streamlining may be available under SB 375 or SB 743, it has potential to influence the location of housing in transit accessible/proximate and low VMT areas in the future.

Despite these findings, I find that each map represents a conceptual basis around which the State should seek to frame its approach to climate and planning. The goals of achieving environmental justice, creating healthy communities, and increasing access to opportunity are important to carry through any planning and investment decisions within the State's direct control.

How do these maps conflict or complement each other or State goals and what opportunities might there be to coordinate to support the State's goals?

The maps provide overlapping prioritization, are highly correlated with each other, and share much of the same indicators. In as many ways as they are similar, they are also different. The reason for this falls heavily on the different definitions of priority that primarily exists between the Opportunity Area Map and the other three maps. This conflict would not carry as much weight if each map was used for different planning purposes. However, with the exception of the Opportunity Area Map which is only used for housing programs, the maps are used for a variety of transportation and housing programs. Ultimately, this means that different State housing programs are employing different mapping tools and different geographic prioritizations.

For example, the CalEnviroScreen and Low-Income Priority Populations Maps are used in the California Climate Investments Programs such as the Affordable Housing and Sustainable Communities and Transformative Climate Communities Programs which both provide funding for housing of which at least 25 percent must be allocated to projects located in and benefitting disadvantaged communities, 5 percent must be allocated to projects located in and benefitting low-income communities, and 5 percent must be allocated to projects located in and benefitting low-income households or low-income communities within a half mile of a disadvantaged community. Accordingly, the two maps prioritize areas facing high environmental burden and low-incomes which are often in the urban centers of the major regions of the State. In contrast, the Opportunity Area Map is used for LIHTC and several HCD housing programs. The map prioritizes areas with lower exposure to pollution and low poverty which are often the peripheries of major regions of the State.

There are two resulting issues: conflict between maps leading to conflicting investments, and maps conflicting with State goals. First, there is conflict in the allocation of State housing resources between areas that help achieve environmental justice and areas that provide access to opportunity. This conflict leads to overall housing funding being distributed to both types of areas, essentially negating the effect of State geographic prioritization.

Second, and embedded in the first conflict, is the opposite propensity of those areas to support the State's climate and planning goals. As noted, the areas prioritized by maps with environmental justice and healthy communities underpinnings are often in urban centers which support more sustainable transportation options. Although investing in these historically underserved communities is key to achieve justice, however, would growing housing stock in these areas maintain or increase environmental and health burdens? On the other hand, areas prioritized by the Opportunity Area Map are often

suburban and encourage driving. Should the State invest in areas that provide access to opportunity if that means unsustainable growth? The current absence of indicators relating to transit or VMT in all maps presents universal risk that State funding decisions made using the maps moves in the opposite direction of the State's climate and planning goals tied to coordinated transportation and housing.

The solutions to these conflicts require a broad, multi-agency discussion around the various State climate and planning goals, and the existing mapping tools. CARB, HCD, and the California Transportation Commission already hold joint meetings pursuant to AB 179 and AB 185 and have established interagency working groups to discuss the intersection of their climate, housing, and transportation policies and programs. Future meetings of these groups may consider discussing specific topics such as:

- Consolidation of housing programs and/or application of a single mapping tool that advances consistent and complementary principles for geographic prioritization
- State's priorities for housing location: high opportunity areas vs. disadvantaged communities
- State decisions around transportation investments and whether these support the State's climate and planning goals

Coordinating housing and transportation planning to improve air quality, reduce greenhouse gas emissions, and build sustainable communities is critical to advancing the State's climate and planning objectives. The State currently has mapping tools to help guide these efforts, but they represent different conceptual goals and lack key indicators needed to ensure that the way we plan, fund, and build communities aligns with desired outcomes. I hope that the findings of this research can be used to generate discussion and inform the work needed to coordinate the State's efforts in these areas.

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Appendices

Appendix A. Description of State Funding and Financing Programs

Program	State Agency	Funding Source	Map(s) Used	Description
Active Transportation Program	California Transportation Commission	Gas tax	CES, HPI	Competitive grant program for projects that increase use of active modes of transportation. At least 25% of funds must benefit Disadvantaged Communities.
Affordable Housing and Sustainable Communities	Strategic Growth Council	GGRF	CES, LI-PPM	Competitive grant program for land-use, housing, transportation, and land preservation projects that reduce GHG emissions through infill and compact development. 50% of available funds are set aside for Affordable Housing Developments, and 50% of available funds are set aside for projects benefitting Disadvantaged Communities.
Low Carbon Transit Operations Program	Caltrans	GGRF	CES, LI-PPM	Funding for transit operating and capital assistance to reduce GHG emissions. Provided to transit agencies by formula. Transit agencies whose service area includes disadvantaged communities must expend at least 50% of funds on projects that will benefit Disadvantaged Communities.
Sustainable Transportation Equity Project	CARB	GGRF	CES, LI-PPM	Pilot competitive grant program for planning, clean transportation, and other supporting projects that reduce GHG emissions. Purpose is to increase transportation equity in Disadvantaged and Low-Income Communities.
Transformative Climate Communities	Strategic Growth Council	GGRF	CES, HPI, LI-PPM	Competitive grant program for community-led development and infrastructure projects that produce environmental, health, and economic benefits in Disadvantaged Communities. Prioritizes communities ranking in the top 10% of CES.
Transit and Intercity Rail Capital Program	California State Transportation Agency	GGRF	CES, LI-PPM	Competitive grant program for projects that modernize intercity rail, bus, ferry, and rail transit systems to reduce GHG emissions. At least 25% of funds must benefit Disadvantaged Communities.
9% Low Income Housing Tax Credits (LIHTCs)	TCAC	Federal and state budget authority	OAM	Federal and state tax credits to encourage private investment in affordable rental housing (new construction or rehabilitation of existing properties) for households meeting certain income requirements. Applications for projects within Highest and High Resource Areas per the Opportunity Area Map can receive bonus points.

Program	State Agency	Funding Source	Map(s) Used	Description
CalHome Program	HCD	State bonds	OAM	Competitive grant program for local public agencies and nonprofit developers to assist first-time homebuyers. Applications for projects within Highest and High Resource Areas per the Opportunity Area Map are incentivized in the Selection Criteria.
Infill Infrastructure Grant Program	HCD	State bonds	OAM	Competitive grant program for Capital Improvement Projects that are part of or necessary for development of infill projects or housing within an infill area. Applications for projects within Highest and High Resource Areas per the Opportunity Area Map can receive bonus points.
Multifamily Housing Program	HCD	State bonds	OAM	Competitive loan program for new construction, rehabilitation, and preservation of permanent and transitional rental housing for lower income households. Applications for projects within Highest and High Resource Areas per the Opportunity Area Map can receive bonus points and are eligible for higher loan amounts.

Appendix B: Indicator Matrix

Indicator	Indicator Type	Data Source(s)	PPM	CES	HPI	OAM
Cleanup Sites	Pollution	EnviroStor Cleanup Sites Database (Department of Toxic Substances Control)	X	X		X
Groundwater Threats	Pollution	GeoTracker Database (SWRCB)	X	X		X
Hazardous Waste	Pollution	EnviroStor Hazardous Waste Facilities Database and Hazardous Waste Tracking System (DTSC)	X	X		X
Impaired Water Bodies	Pollution	303(d) List of Impaired Water Bodies (SWRCB)	X	X		X
Solid Waste Sites and Facilities	Pollution	Solid Waste Information System and Closed, Illegal, and Abandoned Disposal Sites Program California Department of Resources Recycling and Recovery), Hazardous Waste Tracking System (DTSC)	X	X		X
Diesel PM Emissions	Pollution	CARB Grid-based Emission Estimates	X	X	X	X
Drinking Water Contaminants for selected contaminants	Pollution	Drinking Water Systems Geographic Reporting Tool (CDPH), Public Water System Location Data Permitting/Inspections/Compliance/Monitoring/Enforcement database (CDPH), Water Quality Monitoring Database (CDPH), Domestic Well Project, Groundwater Ambient Monitoring and Assessment Program (SWRCB), Priority Basin Project, SWRCB)	X	X	X	X
Ozone Concentration	Pollution	Air Monitoring Network (CARB)	X	X	X	X
Pesticide Use	Pollution	Pesticide Use Reporting (DPR)	X	X		X
PM 2.5 Concentration	Pollution	Air Monitoring Network (CARB)	X	X	X	X
Toxic Release from Facilities	Pollution	Risk Screening Environmental Indicators (US EPA), Mexico Registry of Emissions and Pollutant Transfer	X	X		X
Traffic Density	Pollution	California Environmental Health Tracking Program, California Department of Public Health, US Department of Transportation, US Customs and Border Protection,	X	X		X

Indicator	Indicator Type	Data Source(s)	PPM	CES	HPI	OAM
		San Diego Association of Governments				
Poverty: Tracts with at least 30% of the population falling under the federal poverty line	Filter	American Community Survey (US Census Bureau)				X
Racial Segregation: Tracts with a racial Location Quotient of higher than 1.25 for Black, Hispanic, Asian, or all people of color in comparison to the county	Filter	2010 Decennial Census				X
Asthma Emergency Department Visits	Health	California Office of Statewide Health Planning and Development, California Environmental Health Tracking Program, California Department of Public Health	X	X		
Cardiovascular Disease	Health	California Office of Statewide Health Planning and Development, California Environmental Health Tracking Program, California Department of Public Health	X	X		
Low Birth-Weight Infants	Health	California Department of Public Health	X	X		
Percent of adults age 18-64 currently insured	Health	American Community Survey (US Census Bureau)			X	
Housing Burdened Low Income Households	Housing	Housing and Urban Development Comprehensive Housing Affordability Strategy American Community Survey (US Census Bureau)	X	X		
Percent of households with complete kitchen facilities and plumbing	Housing	American Community Survey (US Census Bureau)			X	
Percent of households with less or equal to 1 occupant per room	Housing	American Community Survey (US Census Bureau)			X	

Indicator	Indicator Type	Data Source(s)	PPM	CES	HPI	OAM
Percent of low income homeowners paying more than 50% of income on housing costs	Housing	HUD Comprehensive Housing Affordability Strategy			X	
Percent of low income renter households paying more than 50% of income on housing costs	Housing	HUD Comprehensive Housing Affordability Strategy			X	
Percent of occupied housing units occupied by property owners	Housing	American Community Survey (US Census Bureau)			X	
Combined employment density for retail, entertainment, and educational uses (jobs/acre)	Neighborhood	US EPA			X	
Percent of the population living within 1/2 mile of a park, beach, or open space greater than 1 acre	Neighborhood	GreenInfo			X	
Percent of the population residing within 1/4 mile of an off-site sales alcohol outlet	Neighborhood	ABC			X	
Percent of the urban and small town population residing less than 1/2 mile from a supermarket/ large grocery store, and the percent of the rural population living less than 1 miles from a	Neighborhood	USDa			X	

Indicator	Indicator Type	Data Source(s)	PPM	CES	HPI	OAM
supermarket/large grocery store						
Population-weighted percent of the census tract area with tree canopy	Neighborhood	NLCD			X	
Percent of family households with children under 18 with two parents	Socioeconomic	American Community Survey (US Census Bureau)			X	
Percent of registered voters voting in the 2012 general election	Socioeconomic	UC Berkeley			X	
Educational Attainment	Socioeconomic	American Community Survey (US Census Bureau)	X	X		
Linguistic Isolation	Socioeconomic	American Community Survey (US Census Bureau)	X	X		
Poverty: Percent of the population living below two times the federal poverty level	Socioeconomic	American Community Survey (US Census Bureau)	X	X		
Unemployment	Socioeconomic	American Community Survey (US Census Bureau)	X	X		
2016 State Income Limits	Socioeconomic	HCD	X			
Employment	Socioeconomic	American Community Survey (US Census Bureau)			X	
Median home value of owner-occupied units	Socioeconomic	American Community Survey (US Census Bureau)				X
Median Household Income	Socioeconomic	American Community Survey (US Census Bureau)	X		X	
Number of jobs filled by workers with less than a BA that fall within a given radius of each census tract population-	Socioeconomic	2017 LEHD LODES				X

Indicator	Indicator Type	Data Source(s)	PPM	CES	HPI	OAM
weighted centroid						
Percent of adults age 20-64 who are employed in the civilian labor force or in the armed forces	Socioeconomic	American Community Survey (US Census Bureau)				X
Percent of population with an income exceeding 200% of federal poverty level	Socioeconomic	American Community Survey (US Census Bureau)			X	X
Percent of 15-17 year olds enrolled in school	Socioeconomic	American Community Survey (US Census Bureau)			X	
Percent of 3 and 4 year olds enrolled in pre-school	Socioeconomic	American Community Survey (US Census Bureau)			X	
Percent of 4th graders who meet or exceed literacy standards	Socioeconomic	California Department of Education				X
Percent of 4th graders who meet or exceed math proficiency standards	Socioeconomic	California Department of Education				X
Percent of high school cohort that graduated on time	Socioeconomic	California Department of Education				X
Percent of population over age 25 with a bachelor's education or higher	Socioeconomic	American Community Survey (US Census Bureau)			X	X
Percent of students not receiving free or reduced-price lunch	Socioeconomic	California Department of Education				X
Percent of households with access to an automobile	Transportation	American Community Survey (US Census Bureau)			X	

Indicator	Indicator Type	Data Source(s)	PPM	CES	HPI	OAM
Percent of workers (16 years and older) commuting by walking, cycling, or transit (excluding working from home)	Transportation	American Community Survey (US Census Bureau)			X	

Appendix C: Regional Analyses

To explore the possibility that Statewide-level analyses obscured regional variation in the alignment of housing production against State maps and transportation characteristics, I also conducted regional quantitative analyses for the Southern California Association of Governments (SCAG), Association of Bay Area Governments (ABAG), and Sacramento Area Council of Governments (SACOG). I selected these regions because they represent major regions of the state that include urban and rural areas.

Methodology

I create region-specific datasets by filtering the statewide datasets by county as follows:

- SCAG: Imperial, Orange, Los Angeles, Riverside, San Bernardino, Ventura
- ABAG: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, Sonoma
- SACOG: El Dorado, Placer, Sacramento, Sutter, Yolo, Yuba

I then use the same methodology for quantitative analysis as for the Statewide-level analysis.

Results

In terms of geographic prioritization under the four State maps, I generally observe similar results to the Statewide-level analyses. That is, a smaller share of housing has been produced in areas receiving geographic prioritization than in areas not receiving geographic prioritization. The relationship between housing production and the OAM within SACOG is an exception, where more housing was produced in Highest and High Resource Areas than other non-prioritized areas.

In terms of transportation characteristics, I observe similar results to the Statewide-level analyses. That is, a larger share of housing has been produced in transit proximate and low VMT areas. One exception is within SCAG, where less housing was produced in transit proximate areas than non-transit proximate areas. Another exception is within SACOG where less housing was produced in low VMT areas than in non-low VMT areas.

Table 9 provides a comparison between Statewide and regional shares of new housing units between 2009-2014 and 2015-2019 located in areas that received geographic prioritization under each map, or that exhibit transportation characteristics supportive of progress toward meeting climate change goals.

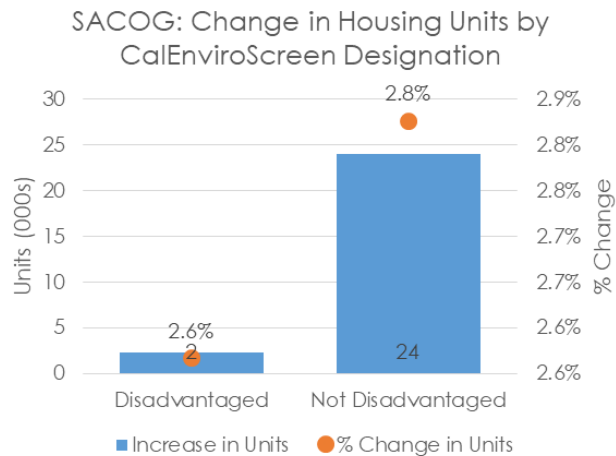
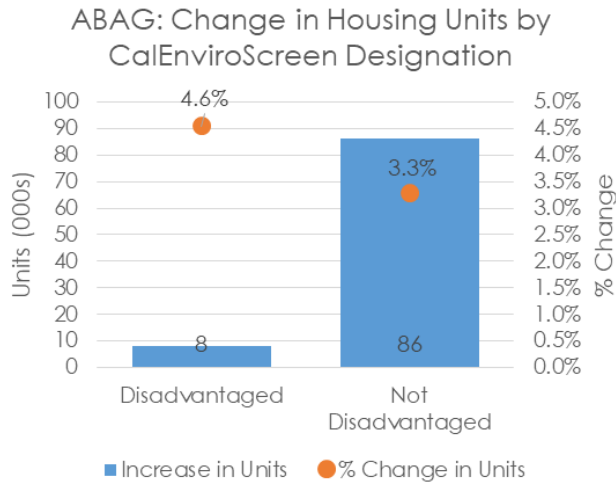
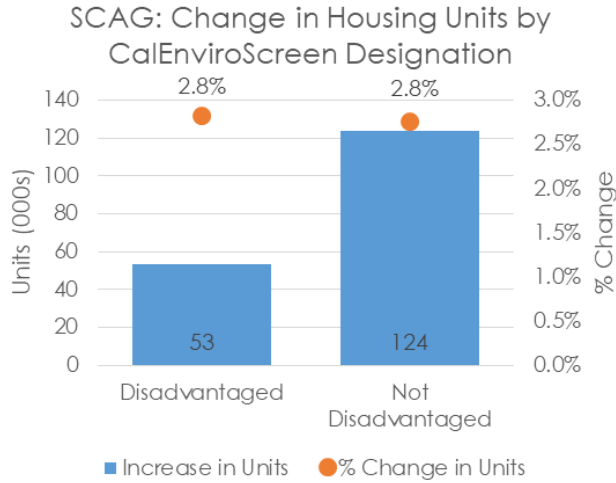
Table 9. Comparison between Statewide and regional housing production in priority areas

Map/Characteristic	Statewide	SCAG	ABAG	SACOG
CalEnviroScreen Map: Disadvantaged Communities	23%	30%	8%	9%
Low-Income Priority Populations Map: Low-Income Communities	36%	40%	33%	22%
Healthy Places Index: Disadvantaged Communities	18%	24%	5%	8%
Opportunity Area Map: Highest and High Resource Areas	43%	43%	30%	60%
Transit Proximate	52%	46%	75%	79%
Low VMT Level	81%	85%	81%	36%

I provide the results of regional analysis for each map and transportation characteristic on the following pages.

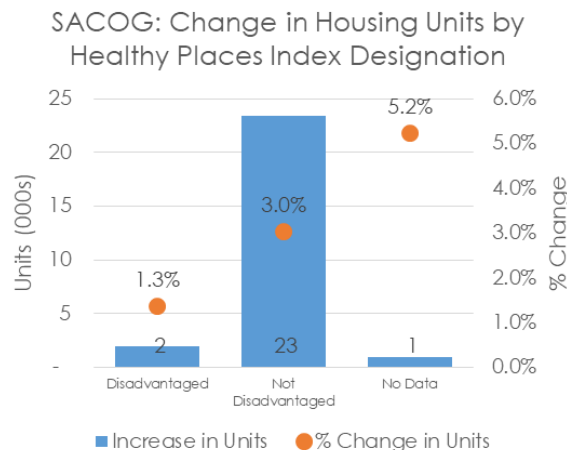
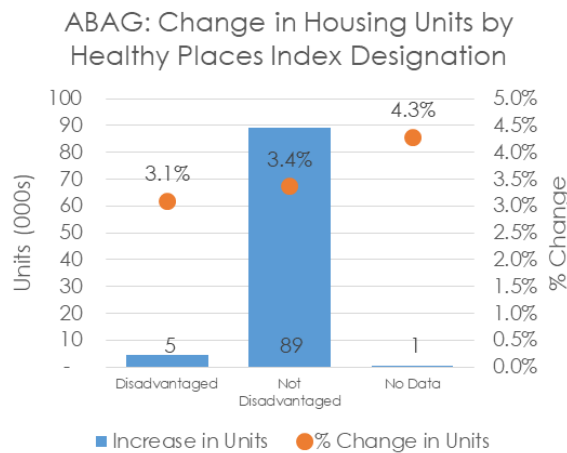
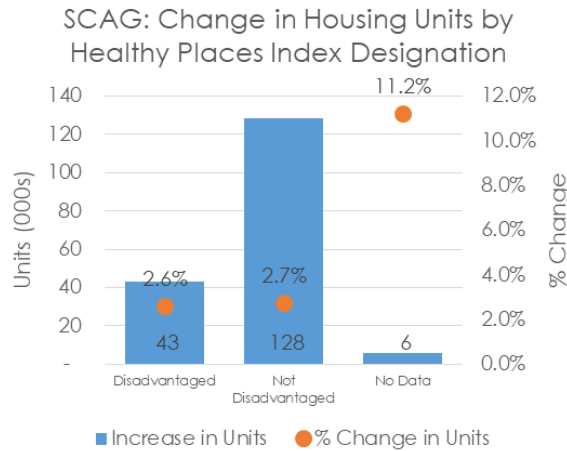
CalEnviroScreen Regional Analysis

Consistent with the Statewide analysis, less absolute housing has been produced in Disadvantaged Communities. The SCAG and SACOG regions differ from the Statewide analysis, in that the percent change in housing production in Disadvantaged Communities is the same or lower, respectively, than in non-Disadvantaged Communities.



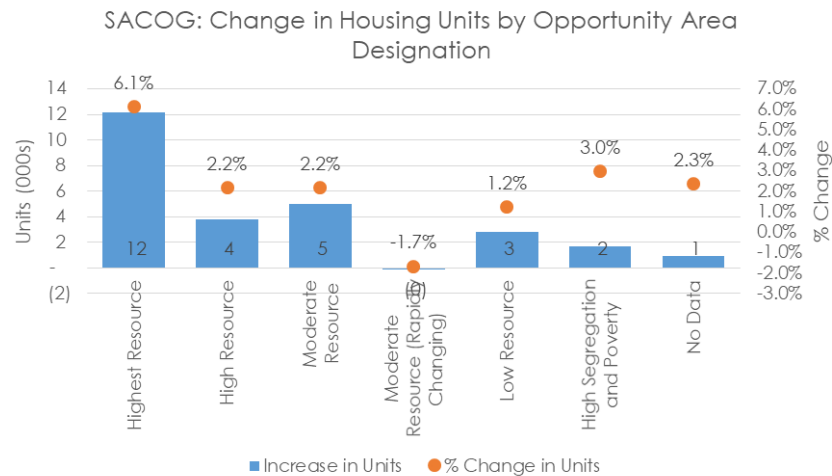
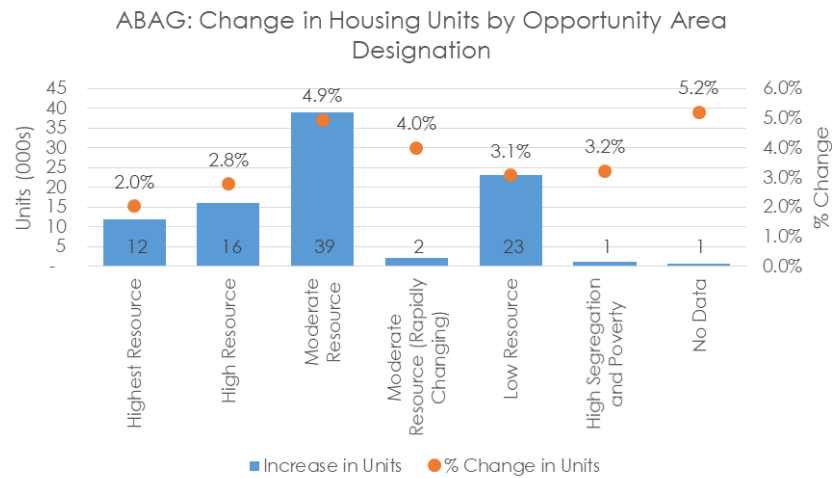
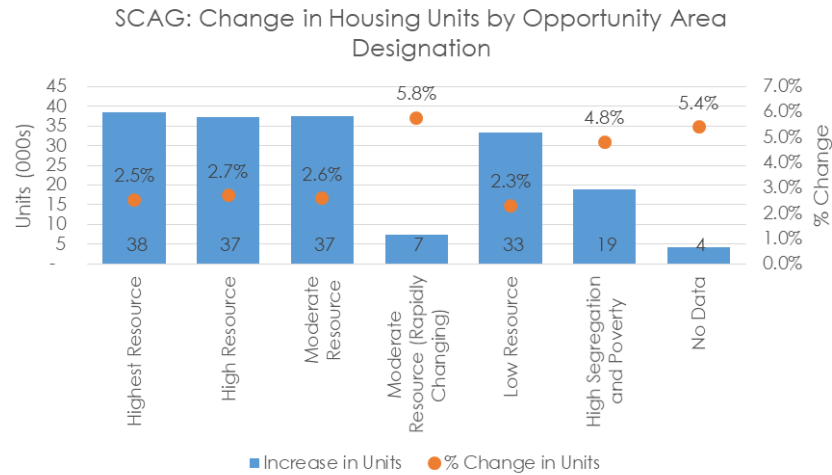
Healthy Places Index Regional Analysis

Consistent with the Statewide analysis, less absolute housing has been produced in Disadvantaged Communities. Also consistent with Statewide analysis, the percent change of housing in Disadvantaged Communities is lower than in non-Disadvantaged Communities.



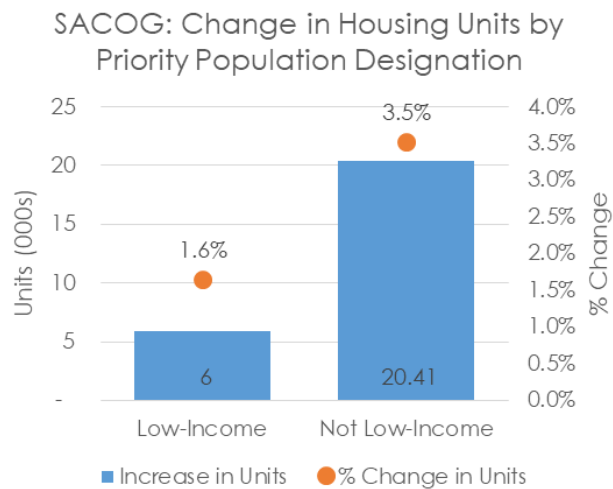
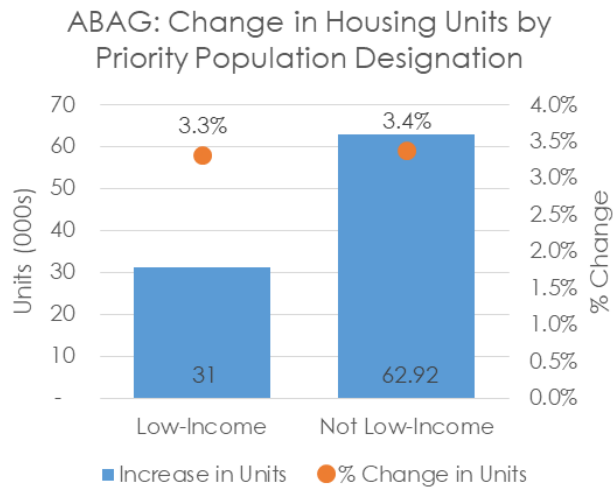
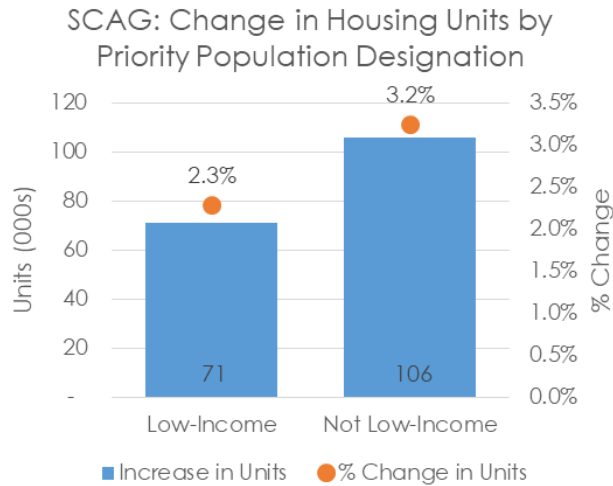
Opportunity Area Map Regional Analysis

Consistent with the Statewide analysis with the exception of SACOG, less absolute housing has been produced in Highest and High Resource Areas. Also consistent with Statewide analysis with the exception of SACOG, the percent change of housing in Highest and High Resource Areas is generally lower than in other areas.



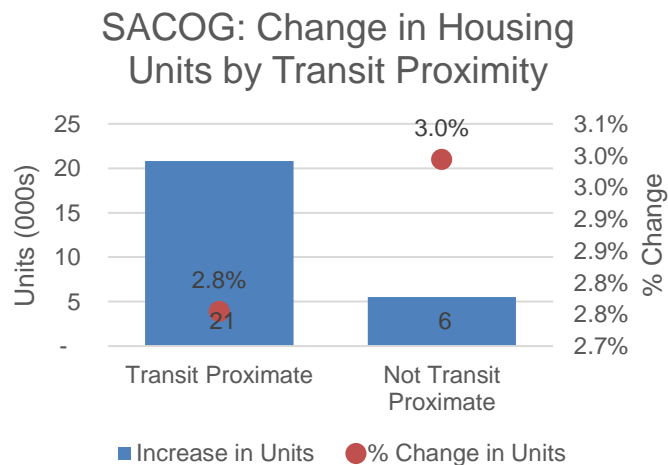
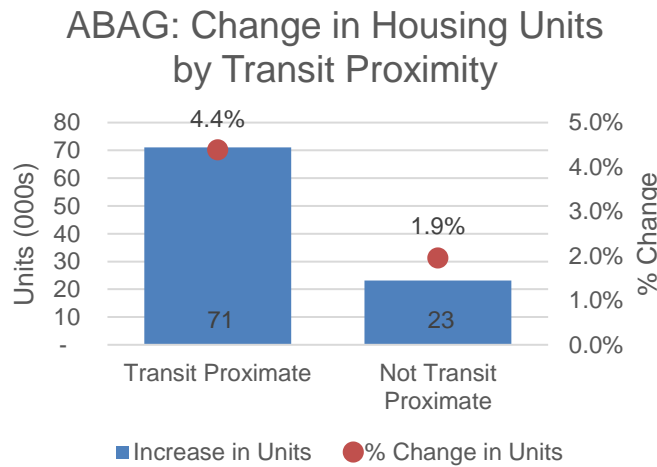
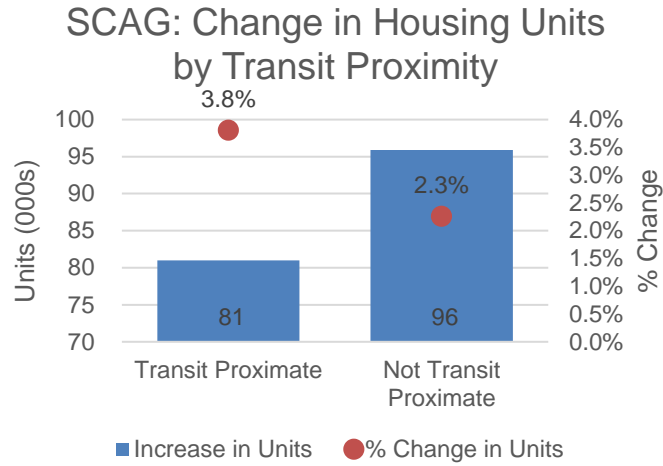
Low-Income Priority Populations Regional Analysis

Consistent with the Statewide analysis, less absolute housing has been produced in Low-Income Communities. Also consistent with Statewide analysis, the percent change of housing in Low-Income Communities is lower than in non- Low-Income Communities.



Transit Proximity Regional Analysis

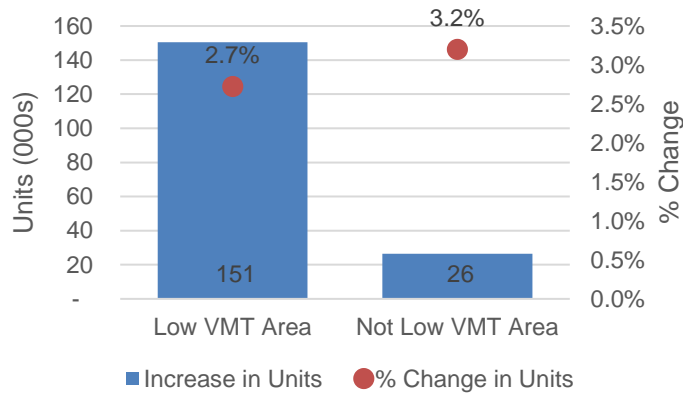
Consistent with the Statewide analysis with the exception of SCAG, more absolute housing has been produced in Transit Proximate Areas. Also consistent with Statewide analysis with the exception of SACOG, the percent change of housing in Transit Proximate Areas is higher than in Non-Transit Proximate Areas.



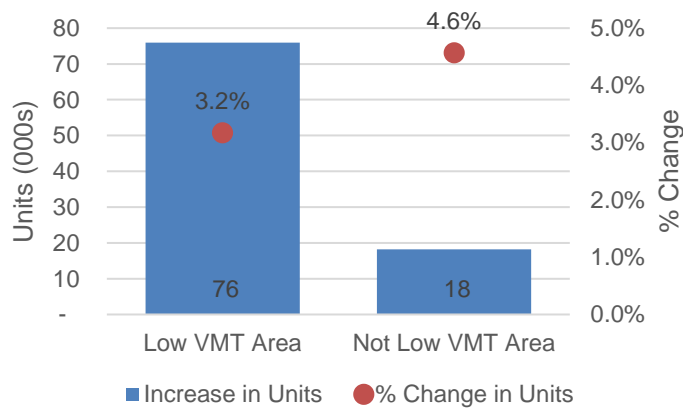
Low VMT Regional Analysis

Consistent with the Statewide analysis with the exception of SACOG, more absolute housing has been produced in Low VMT Areas. Also consistent with Statewide analysis, the percent change of housing in Low VMT Areas is lower than in Non-Low VMT Areas.

SCAG: Change in Housing Units by VMT Level



ABAG: Change in Housing Units by VMT Level



SACOG: Change in Housing Units by VMT Level

