FUTURES INTERIM REPORT

OPPORTUNITIES AND CHALLENGES

MARCH 2019

HORIZON

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ASSOCIATION OF BAY AREA GOVERNMENTS
METROPOLITAN TRANSPORTATION COMMISSION

PUBLISHED 03.15.2019

REVISED 03.28.2019

CONTENTS

March 2019

In early 2018, the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG) began a new cycle of long-range planning called ***Horizon***. The driving force behind ***Horizon*** is the recognition of the deep uncertainties posing new challenges for the Bay Area's future – from driverless vehicles to the rate of sea level rise. Looking across the interrelated issues of transportation, land use, economic development and resilience, the ***Horizon*** initiative seeks to build a stronger foundation for the region's future generations in advance of ***Plan Bay Area 2050***.

This report should be understood as a key *interim milestone* to help guide a long-range regional blueprint for the region's future growth and investments. The report describes potential future challenges brought about by external forces while setting the stage for an ongoing conversation about regional policies and investments to change the region's trajectory. ***Horizon*** is not intended to serve as a near-term legislative platform or call to action – it is a scenario planning exercise. The futures and policy and investment strategies explored in ***Horizon*** should be considered with this context in mind.

Through this long-range planning work, MTC and ABAG continue to work closely with our partners to ensure that regional planning is building upon successes at the local level. We also continue to seek input from the public at large, members of disadvantaged communities, and key stakeholder organizations to make sure all voices are being heard as we plan the Bay Area's future.

We would also note that a number of important planning and policy discussions may take place alongside ***Horizon***, such as the local outreach related to housing emerging from the CASA initiative. While separate, we will consider going forward what intersections need to be made with these parallel efforts and the ***Horizon*** evaluations ahead.

As a resident of the San Francisco Bay Area, we hope that you find the ***Horizon*** Futures Interim Report to be a compelling discussion of the opportunities and challenges that may face this dynamic region we all call home. We appreciate your participation in the long-range planning process, and we encourage you to get involved to help ensure the sustainability and vibrancy of the Bay Area over the next three decades.

Sincerely,

Therese W. McMillan
Executive Director

INTRODUCTION

When we plan for the future, what sort of future are we planning for?

Disruptive technologies, rising sea levels, economic booms and busts, political volatility and a range of other external forces may fundamentally alter the future of the Bay Area. To explore a range of challenging questions that traditionally have been outside the regional planning process, the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Government (ABAG) developed a new initiative, called **Horizon**, to explore pressing issues and possible challenges Bay Area residents may face through 2050.

Horizon leverages new techniques in exploratory scenario planning, embracing uncertainty as a central element of the planning process. **Horizon** will culminate in fall 2019 by highlighting key insights on effective strategies and investments that prove resilient to a wide range of external forces. These findings will inform decision-making on transportation, land use, economic development and resilience, establishing the foundation of **Plan Bay Area 2050**, a state-mandated, integrated long-range transportation and land use plan slated for adoption in summer 2021.

Horizon is comprised of four core elements:

1. A series of white papers, known as Perspective Papers, are exploring strategies and solutions for issue areas previously outside the scope of past long-range planning processes. Each paper culminates in a set of priority strategies for further exploration in the Futures element of **Horizon** (see #2 below).
2. Central to **Horizon** is the development and study of three divergent what-if "Futures." Futures Planning is a new way of looking at long-range planning, exploring divergent scenarios to identify how a range of forces will potentially shape the region. It opens up previous scenario planning efforts to a greater variety of political, technological, economic and environmental challenges that impact the lives of Bay Area residents. Futures Planning has two rounds of analysis described in detail in the next section.
3. Similar to prior planning cycles, **Horizon** includes a robust Project Performance Assessment for major transportation investments. The assessment will identify costs and benefits of different transportation projects in each of the three Futures mentioned in #2 above. The Project Performance Assessment is designed to help policy makers and stakeholders make data-driven decisions about future transportation investments in an era of uncertainty.
4. Finally, Public and Stakeholder Outreach weaves together all the components of **Horizon**, providing an opportunity for community members to give their input on the most effective strategies and investments to address current and future regional challenges.

Throughout the **Horizon** process, MTC and ABAG are exploring both challenges and opportunities that lie ahead for the region. While this report integrates content from all phases of **Horizon**, it focuses primarily on analysis to date on the three Futures. The information will help guide the public, stakeholders and elected officials in considering the best strategies to improve regional outcomes. Ultimately, these strategies should help ensure the advancement of the **Horizon** Guiding Principles – making the region more affordable, connected, diverse, healthy, and vibrant in the years ahead. These five Guiding Principles were developed through public outreach in spring 2018, and they represent the organizing framework for **Horizon**. For this reason, in this report the opportunities and challenges are sorted by the Guiding Principles.

Futures Planning: How Does It Work?

Planning for an uncertain future requires a new approach – one based on exploratory scenarios that MTC and ABAG refer to as Futures. Humans often struggle to predict the future, which is why **Horizon** instead asked stakeholders to imagine a series of divergent Futures to "stress test" current and potential strategies. The Futures

were defined by external forces – long-term trends or one-time events that affect the Bay Area but for which residents and elected officials have little-to-no influence. Examples include advancements in autonomous vehicle (AV) technology or changes to federal immigration policies: AVs have the potential to significantly change our transportation system and land use pattern whereas immigration policies may impact our labor force and economic vitality. While typically on the global or national levels, these forces also can include the occurrence of natural disasters such as earthquakes and fires.

After analyzing how the region fares under varied external forces contained in the three Futures, stakeholders will identify strategies to improve these outcomes. Strategies may be policies, programs, regulations, or investments for transportation, land use, economic development or resilience. Strategies can be implemented on a local, regional or state level in response to the external forces beyond the Bay Area's control. Finally, strategies are applied to one or more of the Futures under consideration, taking into account the context and initial outcomes forecast for that Future. At the culmination, MTC and ABAG will have a better understanding of which strategies are best positioned to improve regional outcomes across a variety of potential conditions.

Over the 18-month **Horizon** planning process, the Futures Planning element consists of four primary steps:

1. **Collaboratively create three divergent Futures to explore in detail.** (February 2018 through July 2018 – now complete)

Through a daylong peer exchange in April 2018 with experts from across the region, followed by a comment period for **Horizon** stakeholders, MTC and ABAG developed a universe of eleven Futures that were then narrowed down to three divergent Futures for further exploration. Defined by over two dozen external forces, each Future incorporates assumptions about the year 2050, such as changes to the national population growth rate, the rate of adoption of autonomous vehicles and the extent of sea level rise. For more information on the external force assumptions, see Appendix B.

OUTCOME: Three defined Futures to study in Step 2.

2. **Analyze and simulate how the Bay Area would fare in each Future – assuming no changes are made to current regional or local policies.** (July 2018 through February 2019 – now complete)

MTC and ABAG conducted analysis of the three Futures, projecting future conditions through 2050 for the San Francisco Bay Area using the Regional Economic Modeling Inc. (REMI) model, the Bay Area UrbanSim land use model, and MTC's regional travel model. To assist in determining which strategies are most needed in each Future, staff began with a "status-quo" analysis, incorporating the same set of "baseline" strategies in all three Futures. The baseline strategies are those contained in the current long-range plan known as Plan Bay Area 2040 (adopted by MTC and ABAG in 2017). Additional information on the modeling work completed for **Horizon** can be found in Appendix B.

OUTCOME: Futures Interim Report – Opportunities and Challenges.

3. **Identify which strategies would be most effective to address the challenges posed by each Future.** (March 2019 and April 2019 – current phase of the process)

Upcoming outreach events will encourage stakeholders, local governments and the general public to learn about the three Futures and share which strategies they think would improve outcomes in each Future. MTC and ABAG board members also will be briefed on outreach findings and the set of strategies to test in each Future. For more on the opportunities to provide input through the public process, see Appendix A.

OUTCOME: Three sets of strategies (one for each Future) to study in Step 4.

4. **Analyze and simulate the extent to which future outcomes for the Bay Area may improve as a result of selected strategies.** (May 2019 through August 2019)

MTC and ABAG staff will reanalyze the three Futures through computer models, applying the customized strategies. This analysis will help identify the efficacy of the strategies in improving regional outcomes; staff will synthesize the model results into a report that discusses the ultimate findings and recommended strategies for further consideration in Plan Bay Area 2050.

OUTCOME: A final report describing the effectiveness of modeled strategies.

CHAPTER 1

THE THREE FUTURES

THE THREE FUTURES

As explained in the first step above, MTC and ABAG selected three Futures for further exploration:

- **Rising Tides, Falling Fortunes**
- **Clean and Green**
- **Back to the Future**

Each Future is defined by more than two dozen external forces, with assumptions differing significantly across the three Futures. When creating the Futures in the peer exchange workshop, participants worked to create logically cohesive sets of forces, woven together by a unified narrative (see Appendix B for more information on the creation of the three Futures). When selecting which to analyze, staff generally strove to have one Future roughly align with a continuation of trends for a given external force, with the other two Futures exploring divergent bands of possible external conditions. The primary exception is the inclusion of a consistent earthquake in all three Futures – a magnitude 7.0 event in year 2035 on the Hayward fault – to understand how the region might prepare and recover from a major disaster under a wide range of circumstances.

Below, a brief narrative introduces each Future, highlighting the central external forces that influence the long-term trajectory of the world, the United States, and ultimately the San Francisco Bay Area. **Table 1** describes some of the factors that make up the Futures, illustrating the divergence between the three. The external forces that make up the Futures are described in Appendix B.

Rising Tides, Falling Fortunes is defined by relaxed federal regulations and the elimination of federal programs – from social services to infrastructure. In this Future, the federal government implements costly tariff policies as well as tight immigration restrictions. As a result, an era of slow growth begins across the United States, with particularly significant impacts in regions like the Bay Area. Labor constraints mean that the rate of innovation slows; driverless electric vehicles fail to live up to the hype. Finally, a lack of international leadership means that worst-case sea level rise predictions come true – resulting in three feet of sea level rise by 2050.

Clean and Green is defined by an aggressive federal carbon tax to curb carbon dioxide emissions. This Future assumes the policy is implemented in the early 2020s and results in similar commitments worldwide. Consequently, clean technologies thrive. Driverless electric vehicles become nearly universal, with consumers preferring to share rides more frequently. Virtual reality enables more telecommuting and distributed workplace locations, particularly for higher income individuals. Federal infrastructure investment enables the completion of high-speed rail lines across the country, including California High Speed Rail. Yet with high taxes and burdensome regulations, jobs are increasingly automated, boosting productivity but resulting in fewer openings for workers without college degrees.

Back to the Future is defined by a thriving national economy supported by increased public investment in infrastructure, as well as immigration reform that increases the national population and workforce growth rate significantly. In the Bay Area, the technology sector thrives, leading to broad adoption of low-cost driverless vehicles. As a result, coastal metropolitan areas see a new wave of growth as technologies enable longer distance commuting to thriving urban job centers. Silicon Valley technologies remain dominant worldwide in everything from cars to e-commerce. Yet booming growth poses challenges for communities absorbing that growth and their aging infrastructure.

Table 1. Summary of External Forces for the Three Futures

	Rising Tides, Falling Fortunes	Clean and Green	Back to the Future
Immigration and Trade	**Reduced** +20,000 Immigrants Annually	**Similar to Today** +80,000 Immigrants Annually	**Increased** +240,000 Immigrants Annually
National Growth	**Limited** +1.6% Annual Productivity +0.4% Annual U.S. Population	**Similar to Today** +2.8% Annual Productivity +0.7% Annual U.S. Population	**Rapid** +1.1% Annual U.S. Population +1.6% Annual Productivity
National Taxes and Funding	**Lower Funding** Due to Tax Cuts	**Higher Funding** Via Carbon Tax	**Similar to Today**
Land Use Preferences	**Housing More Urban**	**Housing More Urban**	**Housing More Dispersed**
	Similar to Today	**Jobs More Dispersed**	**Jobs More Urban**
National Environmental Policy	**Relaxed Regulations** +3-feet Sea Level Rise 10% Electric Vehicles	**Stricter Regulations** +1-foot Sea Level Rise 95% Electric Vehicles	**Stricter Regulations** +2-foot Sea Level Rise 75% Electric Vehicles
New Technologies	**More Limited** 10% Autonomous Vehicles 10% Telecommute Share	**Widespread** 95% Autonomous Vehicles 30% Telecommute Share	**Widespread** 75% Autonomous Vehicles 15% Telecommute Share
Natural Disasters	**Earthquake** Magnitude 7.0 Hayward Fault	**Earthquake** Magnitude 7.0 Hayward Fault	**Earthquake** Magnitude 7.0 Hayward Fault
LEGEND	LOWER	SIMILAR TO TODAY	HIGHER

Projecting the Futures

Each Future begins from the same 2015 starting point and integrates current conditions in the Bay Area. Current conditions include the composition of the Bay Area economy, the location of jobs and households, and the transportation network as it exists today. The three Futures include and maintain existing policies adopted by cities and other public agencies, such as today's urban growth boundaries and zoning. This first round of analysis on the three Futures also includes the strategies contained in Plan Bay Area 2040 – the region's long-range transportation and land use plan – which go above and beyond existing adopted policies. These range from increases to development capacity in Priority Development Areas (places identified by Bay Area communities as areas for investment, new homes and job growth) to planned investments like BART to Silicon Valley (Phase 2).

In addition to the current conditions and Plan Bay Area 2040 strategies, three unique sets of external force assumptions (summarized in **Table 1** above and in greater detail in Appendix B) are applied – one to each Future. MTC's and ABAG's economic, land use and travel models then work together to project a set of key metrics about each Future in five-year increments, creating projections out to the year 2050. For more information on how the computer models project future conditions, refer to Appendix B.

Important Note on Modeling and Forecasting for Horizon

No model can perfectly predict the future – nor can planners, policymakers, and the public foresee every external force that might come our way as a region. The forecasts in this report reflect the best available data and assumptions as of early 2019 on a suite of evolving topics: automation, electrification, natural disasters and more. The results are intended to spark a robust conversation about the right policies and strategies to advance in the future, rather than simply assuming the future will look identical to today.

Inclusion of Plan Bay Area 2040 in all Futures

An important aspect of the first round of analysis of **Horizon** Futures Planning is the inclusion of the policies and investments in Plan Bay Area 2040. The strategies were incorporated to understand how the region's currently adopted long-range plan would fare in an era of uncertainty. By including them in this step of the process, the analysis will show how far these ideas move the region toward the **Horizon** Guiding Principles, and where today's strategies may fall short – all before beginning the discussion of which strategies to align with which Future.

The most significant Plan Bay Area 2040 policies assumed in the first round of this analysis are:

Land Use

- Assign higher densities than currently allowed by cities to select Priority Development Areas.
- Keep current urban growth boundaries in place.
- Preserve and incorporate office space caps in job-rich cities.
- Assume all for-profit housing developments in cities with Priority Development Areas make ten percent of housing units deed-restricted in perpetuity.
- Reduce the cost of building in Priority Development Areas and Transit Priority Areas through eased parking minimums, streamlined environmental clearance, and subsidies.
- Assess commercial development fee based on vehicle miles traveled to improve jobs-housing ratio and to fund affordable housing in Priority Development Areas.

Transportation

- Commit to operating and maintaining the existing system. Emphasize "fix it first" and funding ongoing operations and maintenance of the transportation system.
- Modernize the existing transit system. Invest in enhancements such as Caltrain Electrification and BART Core Capacity, new bus rapid transit (BRT) corridors, and bus service improvement projects such as Muni Forward.
- Optimize the existing freeway network. Invest in traffic management technology, connected vehicle capabilities, shared mobility programs, interchange and operational improvements at bottlenecks, and expansion of the express lane network by over 200 lane miles.
- Expand the system with strategic investments. Extend BART to downtown San Jose and Santa Clara, Caltrain to downtown San Francisco through the Downtown Extension (DTX), key VTA light rail segments as well as the ferry network with new routes.

The analysis contained in this Futures Interim Report helps the region understand how current regional and local strategies perform in the Futures that have different underlying growth and external force assumptions. This first round of analysis – which assumes no changes are made to current regional or local policies – identifies where the region is on track or falling short across the five Guiding Principles in the year 2050. A second round of Futures Planning analysis will follow the same method but instead apply an updated set of policies, adding to and subtracting from the Plan Bay Area 2040 strategy mix to study how a different package of strategies might improve the affordability, connectedness, diversity, health, and vibrance of the Bay Area. Together, both rounds of analysis will give the Bay Area insight into year 2050 outcomes given existing strategies (round 1 analysis) and with a new set of strategies (round 2 analysis) across three very different Futures.

CHAPTER 2

OPPORTUNITIES AND CHALLENGES

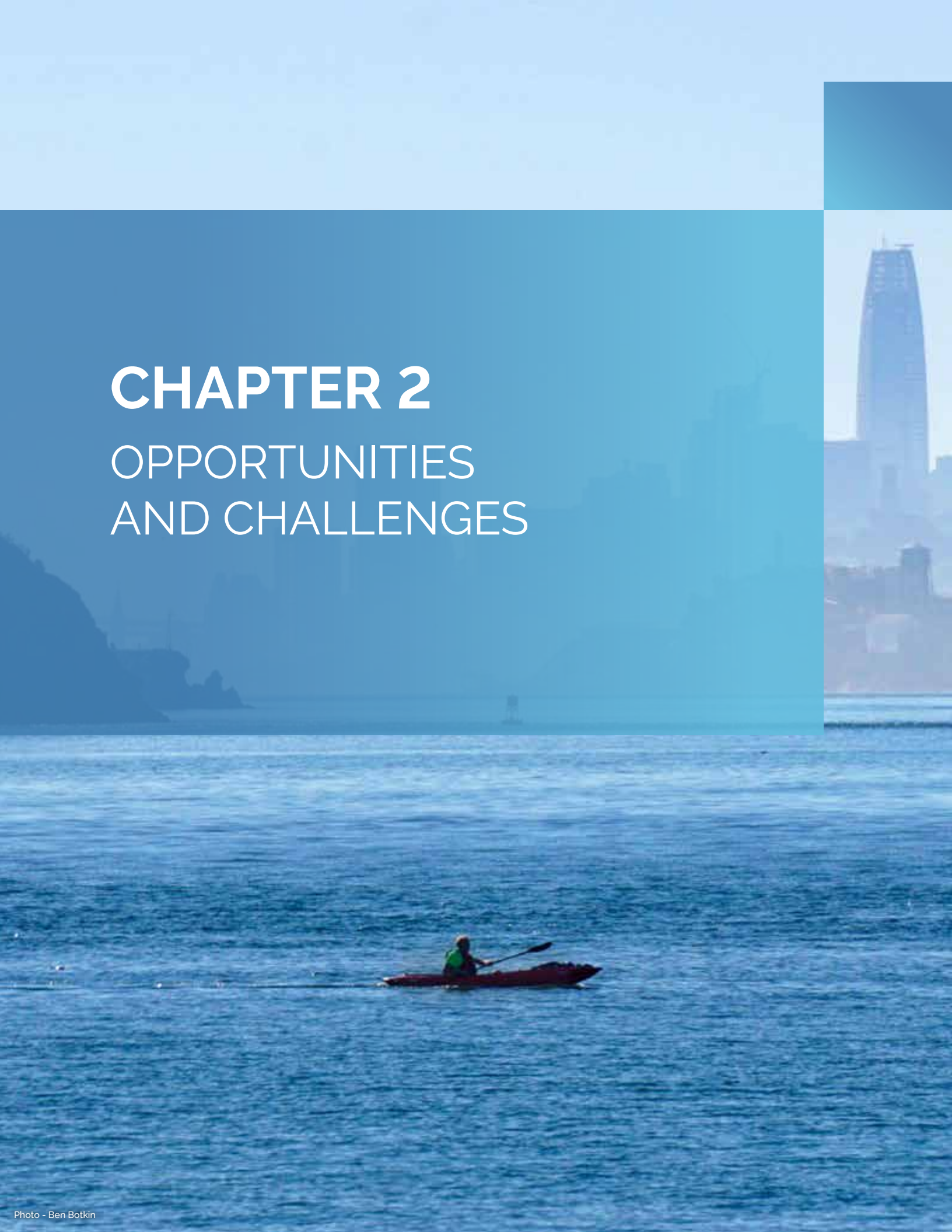


Photo - Ben Botkin

OPPORTUNITIES AND CHALLENGES

Forces beyond the Bay Area's control will create both opportunities and challenges for the region. For example, slow economic growth would reduce demand on the Bay Area's overheated housing market – but it might mean higher unemployment and stagnant wages for many residents. Similarly, a privately operated fleet of driverless vehicles might provide greater mobility for today's transit-dependent populations – but it might also trigger additional traffic congestion and risk a rise in greenhouse gas emissions. This report explores how the three Futures identified for **Horizon** would impact the Bay Area for better or worse, identifying opportunities to incorporate strategies to improve outcomes in each. The next phase of work will integrate strategies found in Appendix C, with the goal of moving the region toward the vision of the Guiding Principles.

The opportunities and challenges are clustered under the five Guiding Principles of **Horizon**, to help understand how external forces would impact regional goals. While some opportunities and challenges are unique to a single Future, others cut across multiple Futures. As such, cross-cutting challenges and opportunities are presented first, with issues unique to a given Future presented subsequently. Graphics are included in each section to illustrate the analytical model outputs. Mapped data is presented across 34 super districts, areas smaller than a county that allow for trends to be seen at a sub-county scale.

Table 2. 2050 Population, Household, and Job Projections for the Three Futures

2050	Rising Tides, Falling Fortunes	Clean and Green	Back to the Future
Population	**8.6 Million (+1.0M)** youth (-0.2M) adults (+0.1M) seniors (+1.1M)	**10.7 Million (+3.1M)** youth (+0.7M) adults (+1.2M) seniors (+1.2M)	**13.6 Million (6.0M)** youth (+1.6M) adults (+3.0M) seniors (+1.4M)
Households	**3.2 Million (+0.5M)** high income (+0.2M) mid-high income (--) mid-low income (+0.1M) low income (+0.2M)	**4.0 Million (+1.3M)** high income (+0.8M) mid-high income (+0.4) mid-low income (--) low income (+0.1M)	**4.8 Million (+2.1M)** high income (+1.1M) mid-high income (+0.5M) mid-low income (+0.2M) low income (+0.2M)
Jobs	**4.5 Million (+0.5M)**	**5.1 Million (+1.1M)**	**6.7 Million (+2.7M)**

Impacts on Affordability

Affordability in the Bay Area is closely linked to the high cost of housing in the region. In 2015, one-third of Bay Area households were characterized as housing-cost burdened, with the burden greater and more common for lower income households. Affordability is explored using these data points: the average percent of income spent on housing, and the overall rate and location of new housing production.

The cost of housing is determined within the Bay Area UrbanSim Land Use Model by several factors, including the regional economy, demand for housing, and the attributes of the units that are built, while average household income is derived from outputs of the Regional Economic Modeling, Inc. (REMI) model.

The amount and the location of where housing is built is largely driven by policies established by local governments, the region and the state – including zoning, fees and subsidies, streamlining, and growth boundaries. In Plan Bay Area 2040, the region and local governments worked together to craft policies to focus most of the future housing growth in Priority Development Areas, including increasing the development capacity in these areas to allow for more focused growth near transit. Local governments across the region continued their commitment to reducing greenfield development outside of urban growth boundaries. In addition to where housing can be built, Plan Bay Area 2040 also assumes a ten percent inclusionary housing policy would help to produce a baseline level of affordable units across the region. The impact of these policies, as well as the larger local zoning policies, are studied across each Future.

Common Trends in all Futures

Opportunity – Priority Development Areas (PDAs) thrive. In each Future, over 80 percent of the regional growth occurs inside PDAs. In Back to the Future, the region grows by 2.1 million new homes – 1.6 million are built inside PDAs. In the case of Rising Tides, Falling Fortunes, more than 100 percent of the growth occurs inside PDAs, as sea level rise and a 2035 Hayward earthquake destroy housing outside of PDAs that is then rebuilt inside PDAs. As part of this shift, the region sees the balance between single-family housing and multifamily housing go from 37 percent multifamily housing in 2015 to 51 percent in Clean and Green and 53 percent in Back to the Future. Multifamily housing is often more affordable than single-family housing and increasing the number of housing units near frequent transit offers lower cost transportation options to more residents.

Challenge – Housing affordability worsens. In every Future, the share of a typical Bay Area household's income spent on housing is projected to worsen for income levels. Despite more high-income households in Clean and Green and in Back to the Future, the cost of housing is expected to go up faster. The lower incomes in Rising Tides, Falling Fortunes also coincide with a less competitive housing market. On a more positive note, the inclusionary zoning policy from Plan Bay Area 2040 results in 11 to 15 percent of the new home growth being permanently deed-restricted affordable housing – although that falls short of the overall need for affordable units.

Unique Trends in Rising Tides, Falling Fortunes

In Rising Tides, Falling Fortunes, the region adds only 400,000 new households by 2050, but it constructs 630,000 new homes, 230,000 of which replace units inundated by sea level rise or destroyed by the 2035 earthquake. Because of the relatively significant rebuilding of damaged housing, the region sees a slight decrease from 2015 in housing units outside of PDAs, with 101 percent of the new growth occurring inside PDAs. In this Future, multifamily developments inside PDAs in San Jose, San Francisco, and the Tri-Valley (Alameda County) are a more affordable recovery option than rebuilding single-family homes in quake-damaged areas outside of PDAs.

Opportunity – While worse off than today, housing is relatively more affordable than in other Futures. By 2050, the average Bay Area household is expected to spend just under half of its income on housing, up from around a quarter of its income in 2015. While this represents a drastic decline in regional affordability, it is unfortunately the best-case scenario of the three Futures. A potential upside to the economic slowdown is a less competitive Bay Area housing market. With employment in high-wage industries cooling off and less demand for housing, housing costs can be expected to slow.

Challenge – 225,000 homes are destroyed by flooding, shaking, and fire. Housing damage is significant, requiring the region to construct 150 percent of the housing units needed for the 30 years of growth. With only 10 percent of Bay Area homeowners covered by earthquake insurance, and the uncertainty about insurance for sea level rise inundation, homeowners and building owners would experience large financial losses. The large percentage of seniors and low-income households in this Future make recovery more challenging.

Unique Trends in Clean and Green

The housing production in Clean and Green is over twice what has been built annually over the past decade. Over 81 percent of the housing constructed between 2015 and 2050 is multifamily, and 88 percent of the total housing is built inside PDAs. Despite a Future with higher average incomes than today, regional unaffordability nearly doubles, with the average Bay Area household spending 50 percent of its income on housing costs.

Opportunity – Job-rich cities add more housing. In this Future, the continued dominance of Silicon Valley results in a South Bay housing boom with two of the three fastest growing housing markets near the high-wage technology jobs. In the northwest portion of Santa Clara County, the heart of Silicon Valley, the jobs-housing balance shifts from 2.8 jobs per household in 2015 to 1.5 in 2050. This drastic shift would nearly return this subregion closer to today's regional average of 1.44 jobs per household.

Challenge – Housing and transportation costs grow significantly. In this Future, a national carbon tax results in an increased cost to drive. The high cost of driving coupled with the growing housing affordability for many in the region results in a high cost of living.

Unique Trends in Back to the Future

Changes in national immigration policies, combined with an overall robust U.S. growth rate, result in a booming population and the need to house nearly six million new residents of our region. To accommodate this accelerated growth, the region would need to add 60,000 units of new housing annually, a rate not seen since the early 1970s. Affordability is the greatest challenge for Back to the Future, perhaps due to the rapid growth in demand for housing and economic growth not being spread evenly across all income levels.

Opportunity – Despite a major earthquake, Oakland booms. The housing market is especially strong in Oakland, which is the heart of the region's fastest growing market in Back to the Future. Even with damage in the 2035 earthquake, Oakland and Alameda see the greatest housing growth of any subregion.

Challenge – Single-family housing production may not alleviate the affordability crisis. An increased preference for suburban living results in double the amount of single-family home development than either of the other two Futures. In the Bay Area currently, most single-family housing is unaffordable for most low-income and moderate-income households, and many of these new market-rate homes may not be attainable for lower income individuals. Furthermore, these homes are often not within walking distance of frequent high-capacity transit services in the region and beyond, due to their dispersed nature.

Figure 1. Affordability – Average Share of Household Income Spent on Housing in the Three Futures

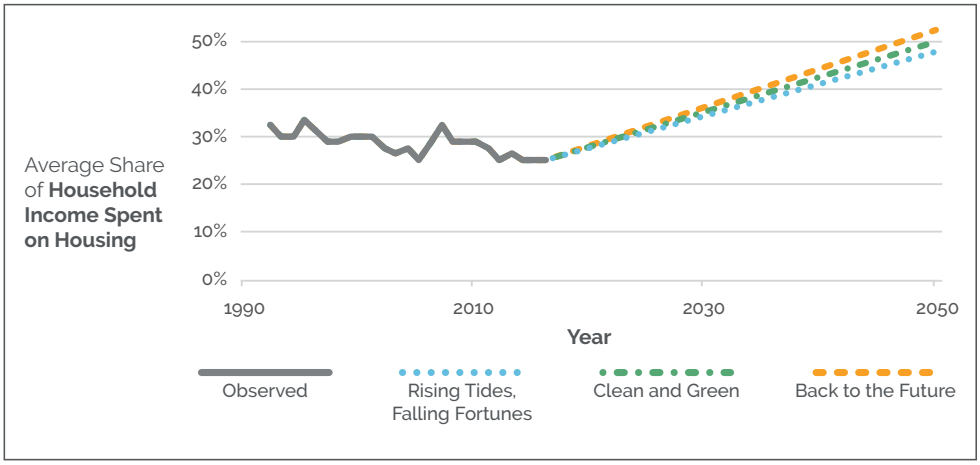
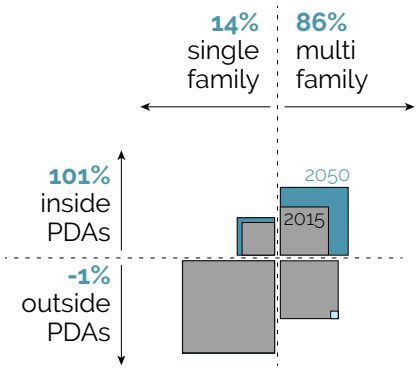


Figure 2. Affordability – Type, Location and Distribution of Housing Growth in the Three Futures

Rising Tides, Falling Fortunes

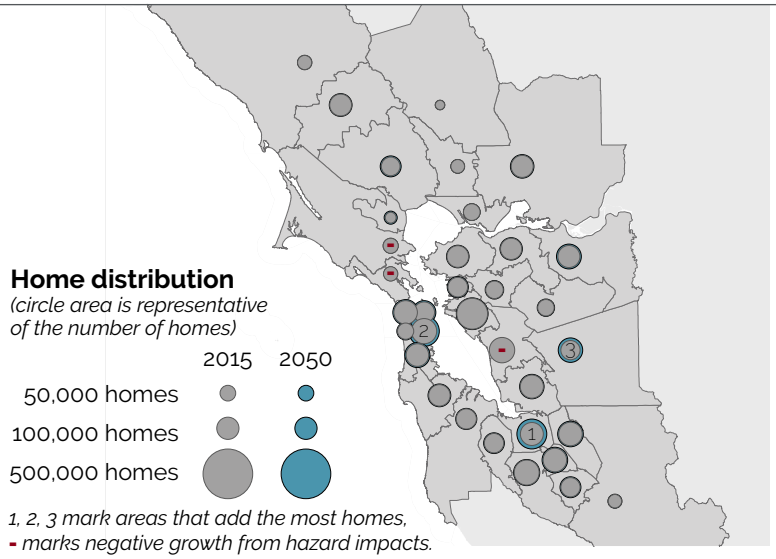
14,000 units added per year

Type and location of home growth



Home distribution

(circle area is representative of the number of homes)

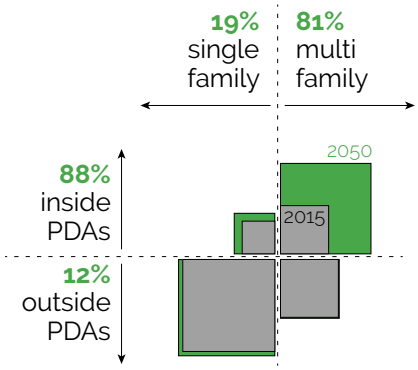


1, 2, 3 mark areas that add the most homes,
- marks negative growth from hazard impacts.

Clean and Green

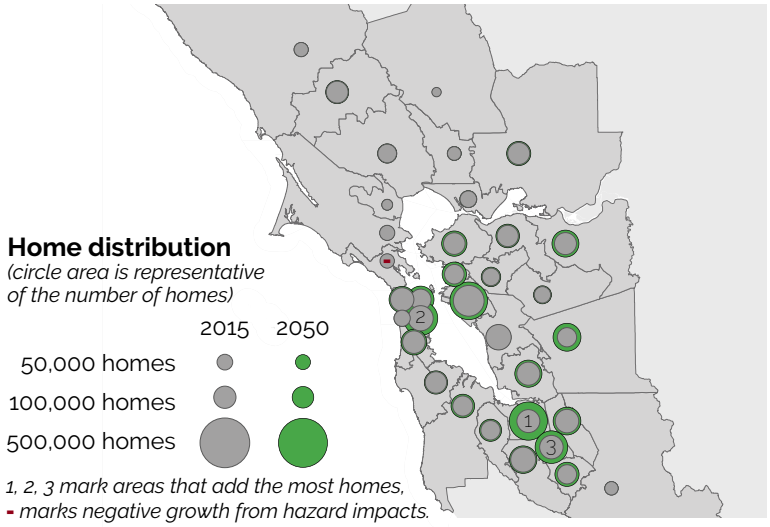
38,000 units added per year

Type and location of home growth



Home distribution

(circle area is representative of the number of homes)

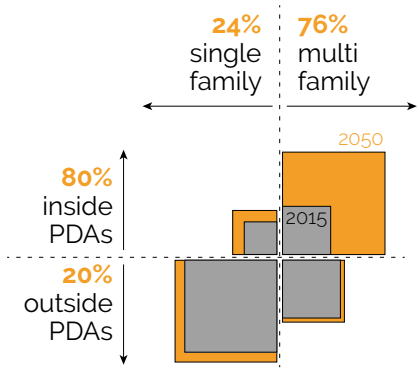


1, 2, 3 mark areas that add the most homes,
- marks negative growth from hazard impacts.

Back to the Future

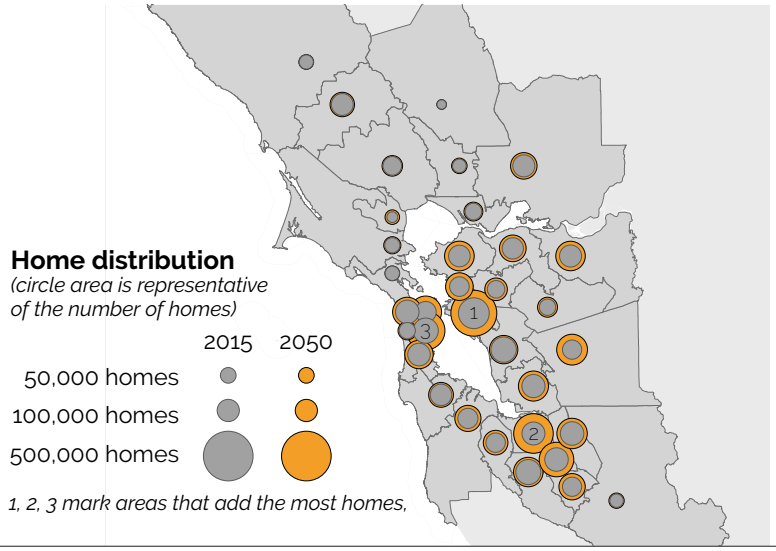
60,000 units added per year

Type and location of home growth



Home distribution

(circle area is representative of the number of homes)



1, 2, 3 mark areas that add the most homes,

Impacts on Connectivity

The connectivity of the region is defined by Bay Area residents' ability to move around the region. Time spent commuting, congestion on the roadways, and the mode share between auto, transit, walking, bicycling and telecommuting are used to understand the connectedness of the region in this Future. Several external forces drive varying levels of connectivity in the region. Assumptions about the cost of driving, the preference for sharing a vehicle and the availability of new autonomous transportation options are all key in understanding how the region will move in 2050. In addition to these assumptions, outputs from economic and land use computer modeling, such as regional population, economic strength, and regional land use pattern, drive transportation outcomes.

In each Future, much of the region's existing transportation system is assumed to exist as it does today, with planned investments added to the mix over the next 30 years. Major investments include modernization projects like BART Core Capacity and Caltrain Modernization, which yield moderate increases in transit capacity; new bus rapid transit lines on El Camino Real on the Peninsula and along San Pablo Avenue in the East Bay; and Bay Area Forward's technological improvements to Bay Area freeways. All the Futures also include expansion projects like BART to Silicon Valley, Caltrain's downtown San Francisco extension to the Salesforce Transit Center, and the addition of approximately 450 miles of new express lanes across the region. While the region's transportation system is maintained and operated under normal conditions, the system is assumed to be impacted by both sea level rise and an earthquake with slightly different impacts in each Future. Those unique elements are discussed below.

Common Trends in all Futures

Opportunity – Transit demand increases in all Futures. Even with a high penetration of autonomous vehicles, public transit remains a crucial element of the region's transportation system. Growth focused in Priority Development Areas, often served by the region's most frequent services, helps to support transit ridership, even in Back to the Future with its low-cost autonomous mobility. Importantly, capacity investments would be necessary to accommodate growing demand and avoid overcrowding on specific lines. Micromobility improvements, such as increasingly popular e-scooters, could further reduce demand for driving and support last-minute connections to public transit.

Challenge – Commute times are worse in all Futures. Across the board, Bay Area residents are expected to see commute times increase in the three Futures. Increased congestion on the roads is a big cause for slower times in Back to the Future, while road and transit closures resulting from sea level rise and the earthquake slow times in Rising Tides, Falling Fortunes. It isn't all bad news, though. With increased telecommuting, which is not reflected in the average commute time calculation, fewer workers will experience these travel times in the first place.

Unique Trends for Rising Tides, Falling Fortunes

With driverless vehicles not living up to the hype – and electric vehicles failing to reach widespread adoption – the transportation conditions for this Future are surprisingly similar to today. The biggest changes include a weak economy and a greater share of lower income residents, which lead to a slightly higher share of residents taking public transportation. Sea level rise and earthquake impacts further fragment the region's transportation system, requiring many BART passengers to board shuttle buses and some highway travelers to divert to parallel facilities.

Opportunity – Slower economic growth means less demand for new infrastructure. Given that financial resources would be much more constrained in this Future, it is fortunate that the demand for new transportation infrastructure is somewhat less than the other two Futures. With an older population, there would be fewer mandatory trips taken by 2050. Additionally, as autonomous vehicles do not become widely popular in this Future, communities do not have to contend with a large quantity of zero-occupant vehicles clogging up roadways.

Challenge – Substantial portions of today's transportation system are damaged. Three feet of permanent sea level rise results in significant impacts across the region, with closures of U.S. Highway 101 in Marin and on the Peninsula affecting the greatest number of travelers. The damage to highway overpasses and several East Bay BART lines from the 2035 Hayward Fault earthquake is assumed to still exist 15 years later; this is due to the federal government no longer funding disaster recovery assistance, and the region and state having no backup revenue to repair damaged infrastructure.

Unique Trends for Clean and Green

With the cost of driving doubling within the next decade due to the implementation of a national carbon tax, transportation choices in Clean and Green are radically transformed. New technologies, such as shared autonomous vehicles and next-generation virtual reality, allow a significant share of Bay Area residents to shed their cars and reduce their mileage traveled. Still, even shared autonomous vehicles have unintended consequences and the increased cost of transportation results in those with the least means experiencing the greatest impacts.

Opportunity – New technologies enable a transformational shift to transit and telecommuting. Driven largely by a high cost of driving in this Future – and paired with a breakthrough in virtual reality – Bay Area residents turn to transit and telecommuting in record numbers, despite the emergence of driverless vehicles. Though the number of jobs increase by 27 percent, the number of commute trips increase by 13 percent, largely due to a quintupling of telecommuting. These shifts cut emissions, limit increases in traffic congestion and make housing development adjacent to transit stations more desirable.

Challenge – Today's transit system is not designed for this level of demand. Major Bay Area rail and bus networks are stretched beyond their capacity, even given current and planned capacity improvements such as BART Core Capacity, Muni Forward, and Caltrain Electrification. Without these investments, passengers would experience extended wait times due to over-capacity transit, and intolerable levels of crowding, especially in high-demand corridors like the Transbay Corridor. Most of the region's major operators would require dramatic capacity investments to accommodate ridership nearly three times that of today.

Unique Trends for Back to the Future

With nearly 14 million people in the Bay Area, and hundreds of thousands more commuting in from San Joaquin County and the Sacramento region each morning, it is not surprising that Bay Area highways are much more congested in Back to the Future. While transit ridership is significantly higher than today – primarily a result of a growing population – on a per-person basis, it is lower than the other two Futures.

Opportunity – Low-cost autonomous electric vehicles make mobility more affordable. With technological transformations making it less expensive to get from point A to point B, drivers across the Bay Area benefit – especially those who are lower income and thus more sensitive to price. While travel times grow significantly due to overcrowded roadways, driverless vehicles make it possible to be productive while traveling to work, school or other destinations.

Challenge – Traffic congestion reaches new extremes, in part due to the high level of individual ownership for autonomous vehicles. While low-cost autonomous mobility might provide benefits to individuals, these vehicles could create huge challenges for the region's capacity-constrained transportation network. Nearly all growth in miles traveled is caused by zero-occupant vehicles, either relocating to park (individually-owned vehicles) or heading to pick up their next passenger (fleet vehicles).

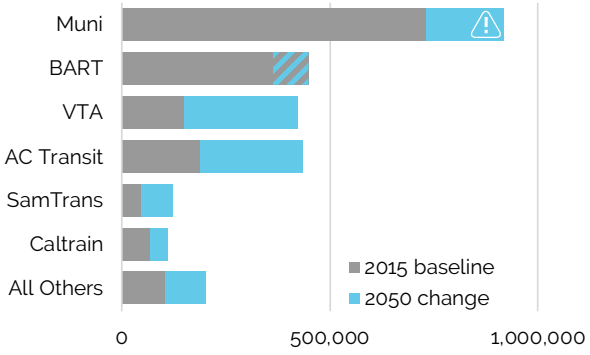
To support a growing economy fueled by 2.7 million new jobs will require across the board reinvestment in utility and transportation infrastructure. In particular, this will require improvements to regional gateways to accommodate significant growth in demand. Transportation facilities, especially for gateways connecting Sacramento and San Joaquin County to the Bay Area, would be particularly overcapacity with the emergence of a robust Northern California megaregion.

Figure 3. Connected – Commute Mode Share and Daily Transit Demand in the Three Futures

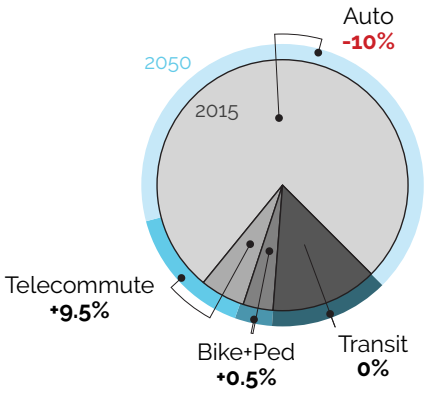
Rising Tides, Falling Fortunes

Daily Transit Demand Across Largest Systems

Demand is measured by capacity-unconstrained boardings for a typical weekday. ⚠ icon represents systems that are extremely overcapacity in 2050. The 2015 displayed data is observed data.



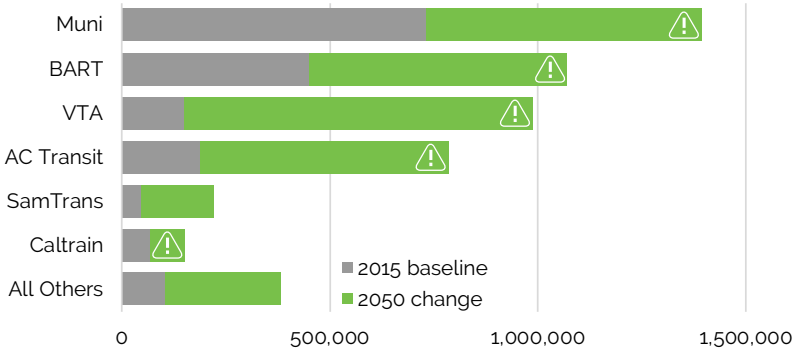
Change in Commute Mode Share



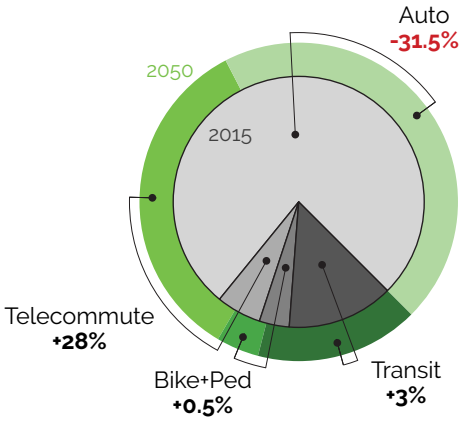
Clean and Green

Daily Transit Demand Across Largest Systems

Demand is measured by capacity-unconstrained boardings for a typical weekday. ⚠ icon represents systems that are extremely overcapacity in 2050. The 2015 displayed data is observed data.



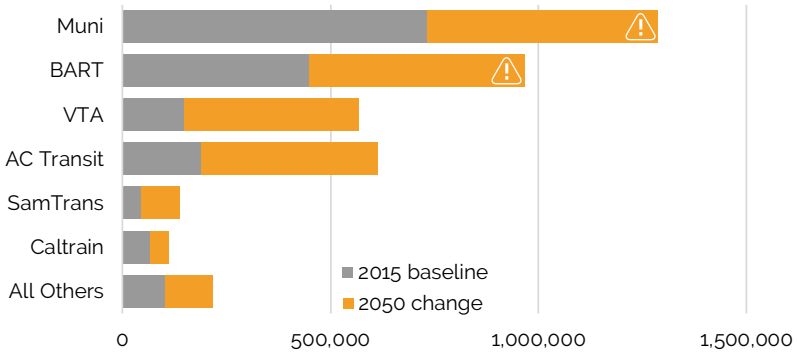
Change in Commute Mode Share



Back to the Future

Daily Transit Demand Across Largest Systems

Demand is measured by capacity-unconstrained boardings for a typical weekday. ⚠ icon represents systems that are extremely overcapacity in 2050. The 2015 displayed data is observed data.



Change in Commute Mode Share

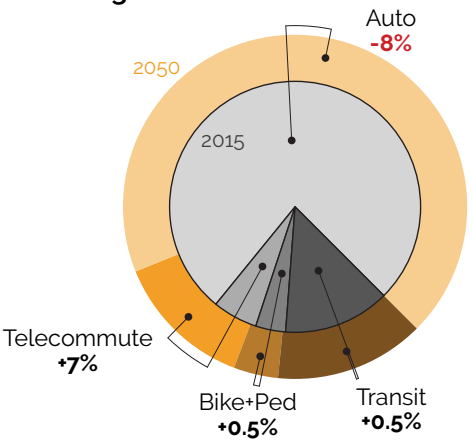


Figure 4. Connected – Highway Conditions and Vehicle Miles Traveled in the Three Futures

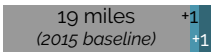
Rising Tides, Falling Fortunes

Cost to drive one mile - $0.20
Autonomous vehicle share - 10%

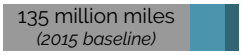
Vehicle Miles Traveled (VMT) per day

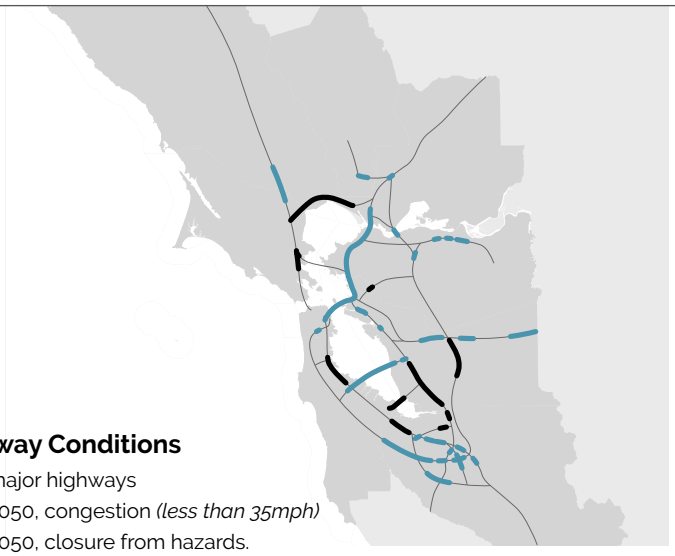
- *2015 VMT*
- *2050 VMT change in auto travel with passengers.*
- *2050 VMT change in auto travel <u>without</u> passengers.*

Per-Capita VMT (2050 - 21 miles)



Total VMT (2050 - 175 million miles)





Highway Conditions

- major highways
- 2050, congestion *(less than 35mph)*
- 2050, closure from hazards.

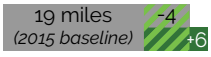
Clean and Green

Cost to drive one mile - $0.40
Autonomous vehicle share - 95%

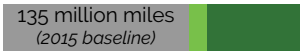
Vehicle Miles Traveled (VMT) per day

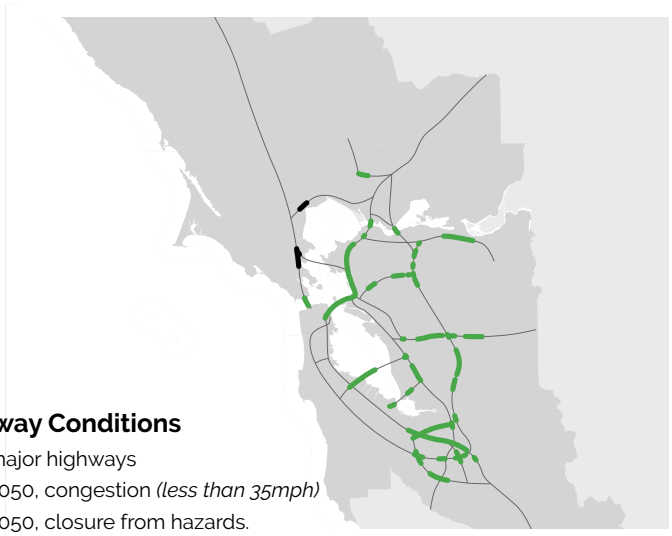
- *2015 VMT*
- *2050 VMT change in auto travel with passengers.*
- *2050 VMT change in auto travel <u>without</u> passengers.*

Per-Capita VMT (2050 - 21 miles)



Total VMT (2050 - 225 million miles)





Highway Conditions

- major highways
- 2050, congestion *(less than 35mph)*
- 2050, closure from hazards.

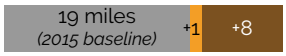
Back to the Future

Cost to drive one mile - $0.10
Autonomous vehicle share - 75%

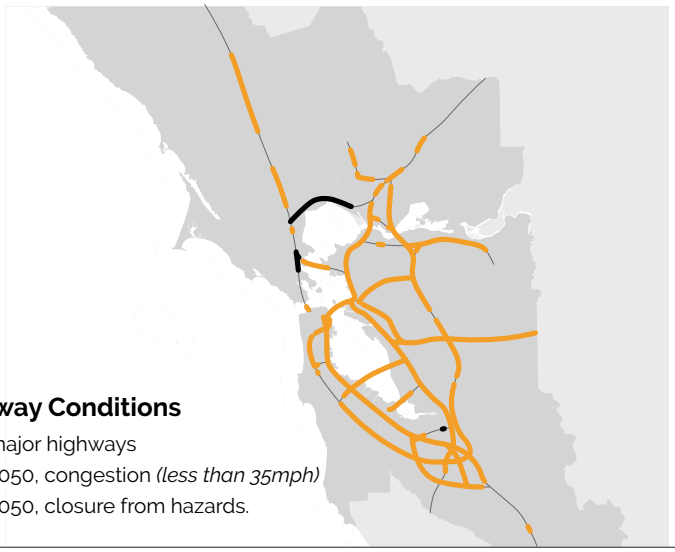
Vehicle Miles Traveled (VMT) per day

- *2015 VMT*
- *2050 VMT change in auto travel with passengers.*
- *2050 VMT change in auto travel <u>without</u> passengers.*

Per-Capita VMT (2050 - 28 miles)



Total VMT (2050 - 375 million miles)



Highway Conditions

- major highways
- 2050, congestion *(less than 35mph)*
- 2050, closure from hazards.

Impacts on Diversity

For the purposes of **Horizon**, we look at the racial, age and income composition into the future. The composition of the region across the three Futures is driven by assumptions on the rate of immigration and birth and survival rates. Slightly different assumptions are made about birth rates and average lifespan in each Future based on the rate of technological advancements, but the rate of immigration is the key assumption that drives divergence. While immigration to the Bay Area from abroad varies widely from 20,000 annually (roughly one-quarter of today's level) in Rising Tides, Falling Fortunes to 240,000 annually (roughly three times higher than today's level) in Back to the Future, one trend of the past three decades continues in all Futures: most immigrants originate from Latin America and Asian countries.

The region also is striving to maintain the rich culture of communities that are here today. In recent years, displacement risk has spread from the region's core to all nine counties as rents have skyrocketed. Using a methodology that flags neighborhoods with decreasing numbers of lower income households, the share of lower income residents at risk of displacement has been projected in each Future. Reducing displacement risk helps ensure that households and communities of all income levels are able to continue to call the Bay Area home.

Common Trends in all Futures

Opportunity – The region is more racially diverse. Another three decades of immigration, combined with slightly higher birth rates among recent immigrants, result in a more diverse region in all three Futures. The continued trend of high percentages of Latin American and Asian immigrants drives significant growth in Hispanic and Asian populations.

Challenge – The African American community continues to shrink. In every Future, the African American population shrinks as a share to 5 percent, down from 6 percent today and 9 percent in 1980. It should be noted that the decrease in population share is not due to the African American population shrinking; rather, it remains roughly the same size into the Future, with other populations experiencing growth.

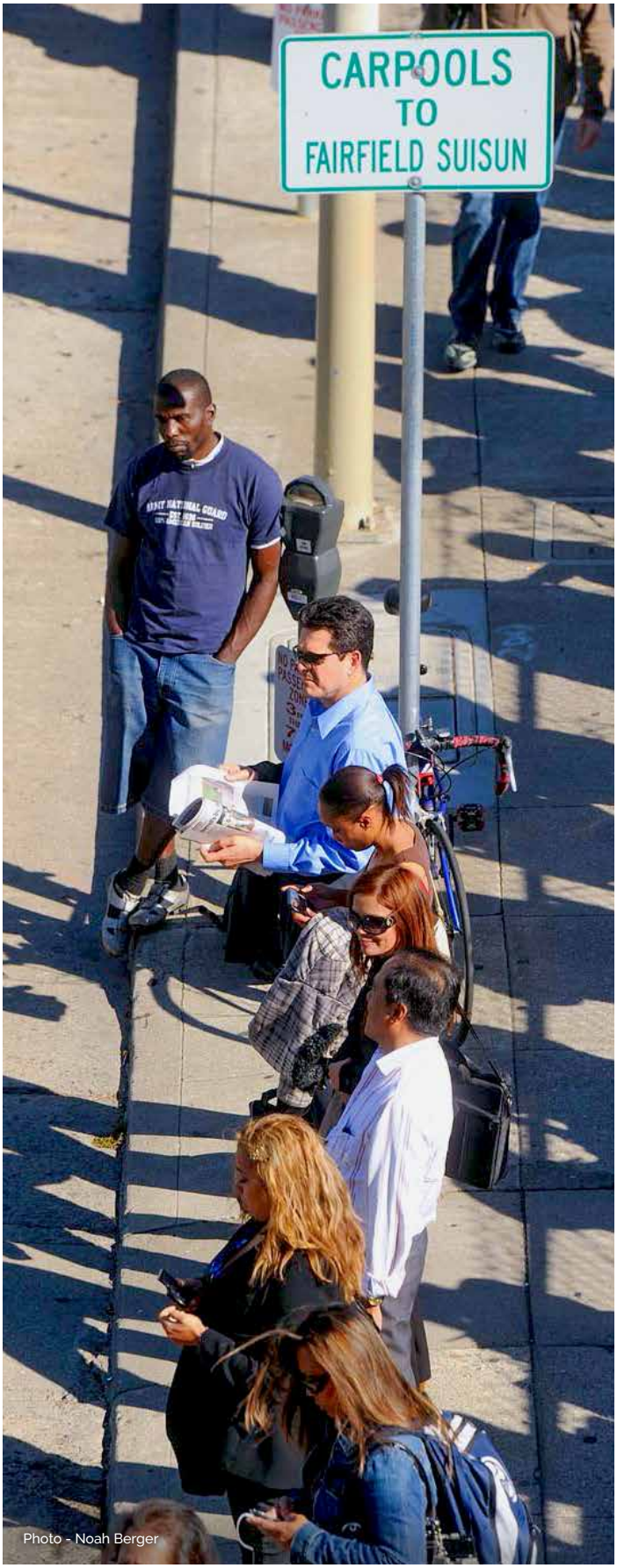


Photo - Noah Berger

Unique Trends in Rising Tides, Falling Fortunes

The growth in this Future is almost entirely driven by existing residents aging in place, while the rest of the age groups remain nearly constant. This is a Future with fewer youth in part because of an assumed continued decline in birth rates and in part because of fewer immigrating families to the region. The stagnant economy and the near doubling of retirees result in many more low-income households.

Opportunity – There is a lower risk of displacement. The risk of displacement is half what it is today for lower income households. With the majority of household growth in the lower income categories, there is less housing pressure from higher income earners than we see occur in the other two Futures.

Challenge – Households are less prosperous. Rising Tides, Falling Fortunes is a Future with a higher percent of low-income households than exist today. As a result, the region has fewer locally generated financial resources to improve outcomes across any Guiding Principle. Worse, this Future assumes the federal government cuts social services – which would have significant impacts on growing lower income and elderly populations.

Unique Trends in Clean and Green

In Clean and Green, a national shift to clean and green technologies reduces air pollution, increasing the health and subsequently the average lifespan for Bay Area residents as a whole. As a result, this Future has the greatest number of ninety-year old residents at over 300,000 – nine times the number in the region today. With the region experiencing similar rates of immigration as seen today, the region continues a growth trend similar to the one projected in Plan Bay Area 2040. The strong regional economy, driven by professional sector jobs, results in a much greater share of high-income households. This is an exciting shift if existing low-income households are experiencing upward income mobility, but it is a challenge if new residents moving to the region are the sole beneficiaries.

Opportunity – More households are prosperous. Clean and Green is the most prosperous Future with nearly all the household growth occurring in the medium-high- and high-income categories. Every area of the region sees an increase in share of high-income households, with many of the poorest areas in 2015 seeing the greatest increase in the share of high-income households.

Challenge – A booming tech-focused economy risks displacement of lower income households. As the region is comprised of more high-income earners, a greater share of the remaining low-income households are at risk of displacement. The Clean and Green Future has double the extent of displacement risk compared to Back to the Future, and triple the displacement risk of Rising Tides, Falling Fortunes.

Unique Trends in Back to the Future

As the region swells with six million new residents, there are many new faces. In Back to the Future, every racial group increases in size, but the large increase in immigration rates from existing areas of high immigration results in a region that is 30 percent Hispanic, 40 percent Asian and Other (includes unlisted races, and persons with two or more races), with White and Black rounding out the remaining 30 percent.

Opportunity – Growth is balanced across youth, workforce and senior demographics. The high rate of growth is well-balanced across youth, workforce and retirees. This ensures that the elderly population of tomorrow should be well supported by a large workforce.

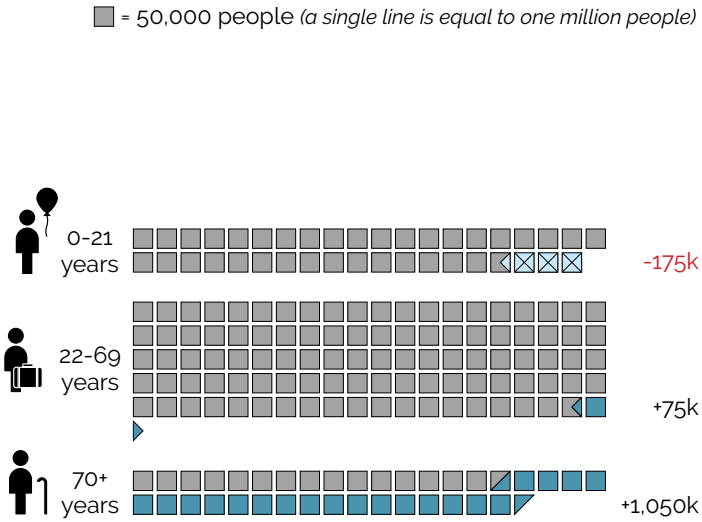
Challenge – Schools will need to accommodate growing student population. With more youth in this Future, school districts will have to consider how to accommodate more students in a Future where land is a premium with equal pressure for housing and job growth. With the student population nearly doubling by 2050, the region will have to consider what schools look like in 2050.

Figure 5. Diverse – Age Cohorts in the Three Futures

Rising Tides, Falling Fortunes

+ 20,000 new immigrants annually (25%of today's rate).

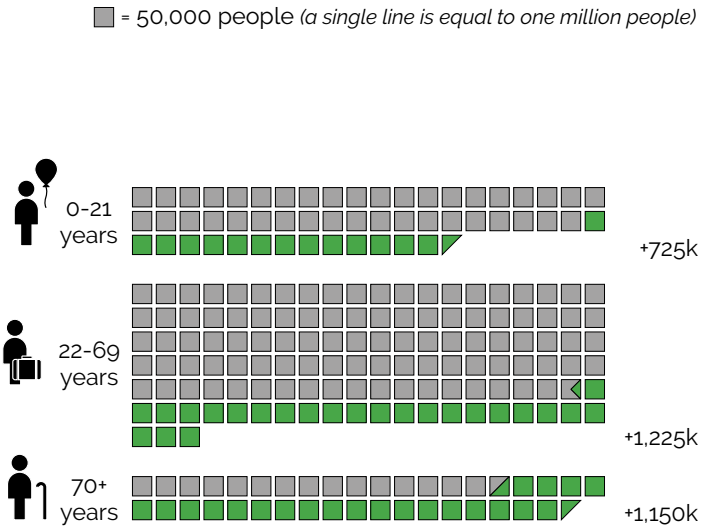
2015 Population	7.6 million
2050 Population	8.6 million
Population Growth	**0.95 million**



Clean and Green

+ 80,000 new immigrants annually (same as today's rate).

2015 Population	7.6 million
2050 Population	10.7 million
Population Growth	**3.1 million**



Back to the Future

+ 240,000 new immigrants annually (300% of today's rate).

2015 Population	7.6 million
2050 Population	13.6 million
Population Growth	**5.95 million**

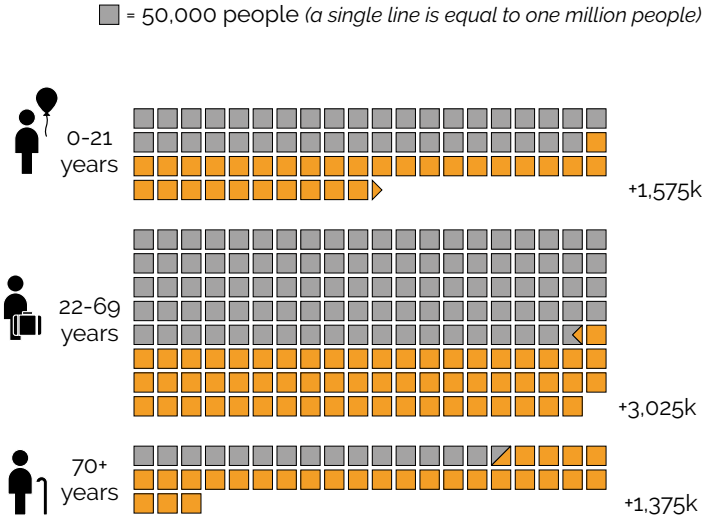


Figure 6. Diverse – Racial Share, Household Income, and Risk of Displacement in the Three Futures

Rising Tides, Falling Fortunes

+ 20,000 new immigrants annually (25% of today's rate).
+ 0.95 million new residents.
+ 0.5 million new households.

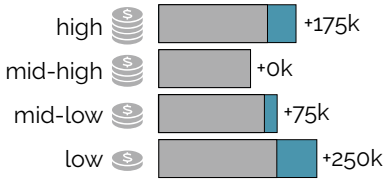
14%

of Lower-Income Households at Risk of Displacement in 2050

Displacement risk is the share of lower-income households living in census tracts with declining lower-income populations.

Change in Household Income

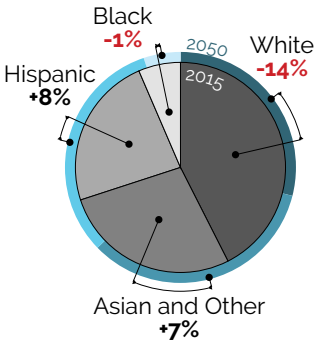
2015 in gray, 2050 change in blue.



In 2050, 45% of households will be high or mid-high.

Change in Racial Share

2015 in gray, 2050 change in blue. Circle area is representative of population size.



Clean and Green

+ 80,000 new immigrants annually (same as today's rate).
+ 3.1 million new residents.
+ 1.3 million new households.

60%

of Lower-Income Households at Risk of Displacement in 2050

Displacement risk is the share of lower-income households living in census tracts with declining lower-income populations.

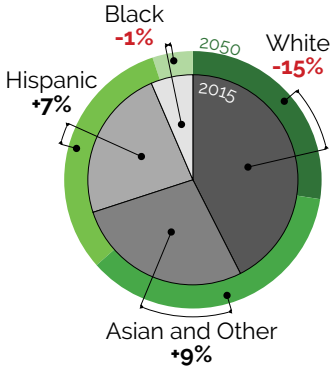
Change in Household Income

2015 in gray, 2050 change in green.

In 2050, 63% of households will be high or mid-high.

Change in Racial Share

2015 in gray, 2050 change in blue. Circle area is representative of population size.



Back to the Future

+ 240,000 new immigrants annually (300% of today's rate).
+ 5.95 million new residents.
+ 2.1 million new households.

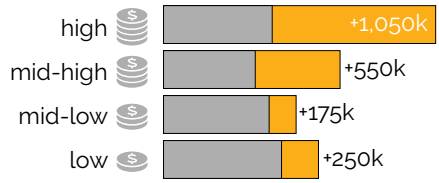
28%

of Lower-Income Households at Risk of Displacement in 2050

Displacement risk is the share of lower-income households living in census tracts with declining lower-income populations.

Change in Household Income

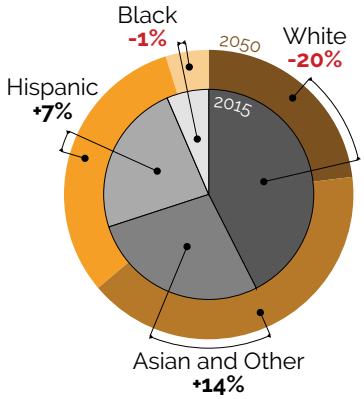
2015 in gray, 2050 change in orange.



In 2050, 61% of households will be high or mid-high.

Change in Racial Share

2015 in gray, 2050 change in blue. Circle area is representative of population size.



Impacts on Environmental Health

The environmental health of the region is defined by both the region's progress in reducing impacts on the environment, and its ability to adapt to and mitigate the impact of hazards. Two primary ways the region aims to reduce human impact on the environment is to reduce greenhouse gas emissions and limit development on existing greenfield and agricultural lands. Each Future projects the per capita emission from transportation sources and the rate of greenfield development. Additionally, two hazards, sea level rise and earthquakes, are applied to the Futures. Sea level rise, a slow onset force with impacts at specific locations, is applied at varying rates in each Future. A magnitude 7.0 earthquake on the Hayward Fault in the East Bay is used to study the severe localized damage a single event can have and the recovery challenges afterwards. A range of impacts from the hazards are studied generally to understand how the region can prepare for, respond to, and recover from any shock the region might face – whether it is a flood, earthquake, or fire.

Common Trends in all Futures

Opportunity – The Bay Area sees a reduced human impact on the environment. There is a projected decline in per capita greenhouse gas emissions from transportation sources and a major reduction in the amount of greenfield development compared to historical trends. Electric vehicle adoption, which is assumed to be especially high in Clean and Green and Back to the Future, results in a significant reduction in transportation emissions. Urban growth boundary policies greatly reduce new development outside existing urbanized areas. While reducing emissions is the right direction, the region will not have reached a carbon-neutral transportation system in 2050, and there is no guarantee that other sectors will decarbonize. This greenhouse gas emission reduction is a result of highly focused growth in Priority Development Areas, higher population levels, modal shifts (including from telecommuting), and assumptions in electric vehicle adoption. Note that this reflects actual emission forecasts as opposed to the more narrowly scoped Senate Bill 375 definition of greenhouse gas emission targets for cars and light-duty trucks, for which most emission reductions from electric vehicle adoption cannot be counted.

Challenge – Environmental shocks and stresses hit the region. The region experiences significant impacts from flooding, earthquake shaking and fire following earthquake. The earthquake, which is a constant in all three Futures, impacts roughly 200,000 homes, mostly in the East Bay where the magnitude 7.0 event's epicenter is located. While an earthquake could happen along any number of faults in the region, modeling shows the multi-decade recovery in hard-hit areas – a challenge any community in the Bay Area could face following a damaging earthquake, flood or fire. With even just one foot of sea level rise, 200 square miles of natural baylands across the region could be flooded. Of course, all of this is contingent on businesses remaining committed to growing their presence in the region, particularly in the years immediately after a major disaster.

Photo - Karl Nielsen

Unique Trends in Rising Tides, Falling Fortunes

This Future in many ways is defined by its impact on the Guiding Principle related to Environmental Health. A global failure to curb greenhouse gas emissions, driven in part by travel behaviors similar to today and limited adoption of electric vehicles, means emissions are still significant in this Future. In this sense, Rising Tides, Falling Fortunes reflects "business as usual" policies when it comes to action (or lack thereof) on driving down carbon dioxide emissions.

This failure has downstream impacts with sea levels rising three feet, cutting off major highways in the North Bay and on the Peninsula, and flooding over 85 percent of the region's natural baylands, among other impacts. The weak underlying economy means many East Bay communities affected by the Hayward Fault earthquake do not fully recover by 2050.

Opportunity – Greenfield development is curbed. With less underlying market pressure, the region has the lowest level of greenfield development in this Future. At an average increase of just 240 acres annually, the region urbanizes greenfield lands at its lowest rate since the gold rush.

Challenge – 225,000 homes are affected by sea level rise or an earthquake. As three decades pass, the United State fails to make significant progress on reducing greenhouse gas emissions. The failure to curb emissions across the globe results in quick impacts with one foot of sea level rise by 2030, two feet by 2040, and three feet by 2050. Coupled with an earthquake, one quarter of a million Bay Area households lose their home to natural hazards over the 30 years.

Unique Trends in Clean and Green

The national carbon tax and related global climate action envisioned in this Future limit the rate of climate change, reducing the severity of sea level rise impacts. A shift in transportation habits, driven largely by the carbon tax driving up the cost of driving, pushes more residents toward less carbon-intensive travel modes. These shifts and the nearly complete shift to electric vehicles result in an 80 percent reduction in transportation related carbon emissions. In this Future, more so than in any other, the region will struggle to find enough construction workers to rebuild after the 2035 earthquake, unless huge productivity and automation changes adjust the per-worker output for that industry.

Opportunity – Low carbon emissions limit the rate of sea level rise. Because global emissions are curbed, the region buys more time to adapt to sea level rise, with one foot of sea level rise not occurring until 2045. The slower onset of impacts, as well as likely slower subsequent sea level rise, also means protective measures along the shoreline may not need to be as large.

Challenge – A small construction workforce could slow earthquake recovery. A massive earthquake recovery may be hindered by carbon taxes on building materials, and the smallest projected construction workforce of the three Futures. Productivity and automation are elements of this Future, which if applied to the construction industry, may allow for a reasonable recovery timeline.

Unique Trends in Back to the Future

The much higher rate of electric vehicles assumed in this Future lessen the impact of a region that drives longer distances than in 2015. With the region making modest progress on per capita emissions, the region experiences two feet of sea level rise by 2050. The underlying strong economy and housing growth across the region buoy recovery from both the earthquake and sea level rise.

Opportunity – The region quickly recovers from an earthquake. The robust economy and growing population spur rapid recovery, with all portions of the region rebuilt by 2050 (the fastest of the three Futures). The area that includes Oakland, despite losing over 40,000 homes in the 2035 earthquake, nearly rebuilds all lost units in the first five years.

Challenge – Bay Area natural and recreational resources may be overburdened. With six million new residents, the region's parks and open space systems will have many more users. New parks, or increased management of open space programming, may be needed to keep the region's high open space and outdoor recreation standards of today.

Figure 7. Healthy – Sea Level Rise and Earthquake Affects in the Three Futures

Rising Tides, Falling Fortunes

2035 Hayward Fault earthquake
3 feet of sea level rise

225,000
homes affected by
sea level rise & an earthquake

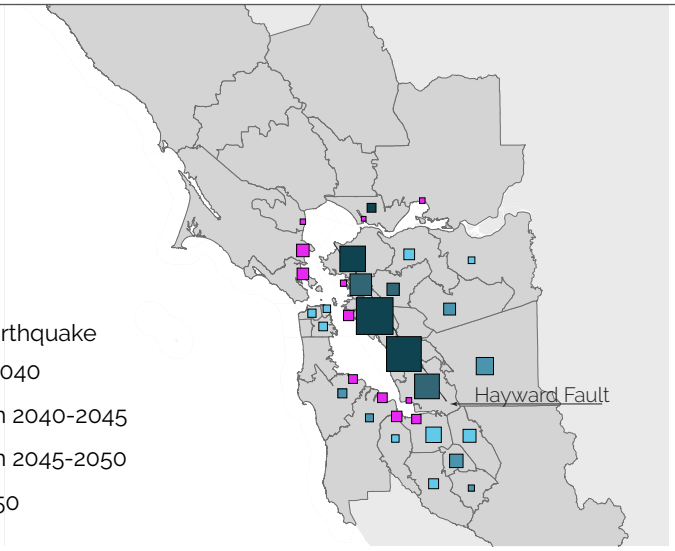
30,000 from Sea Level Rise

1k 10k

195,000 from a Hayward Fault earthquake

Recovered before 2040
Recovered between 2040-2045
Recovered between 2045-2050
Recovered after 2050

1k 10k 40k



Clean and Green

2035 Hayward Fault earthquake
1 foot of sea level rise

215,000
homes affected by
sea level rise & an earthquake

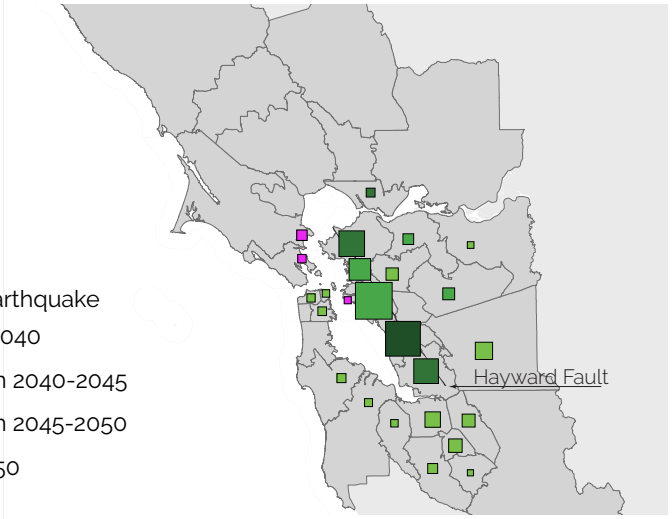
10,000 from Sea Level Rise

1k 10k

205,000 from a Hayward Fault earthquake

Recovered before 2040
Recovered between 2040-2045
Recovered between 2045-2050
Recovered after 2050

1k 10k 40k



Back to the Future

2035 Hayward Fault earthquake
2 feet of sea level rise

220,000
homes affected by
sea level rise & an earthquake

15,000 from Sea Level Rise

1k 10k

205,000 from a Hayward Fault earthquake

Recovered before 2040
Recovered between 2040-2045
Recovered between 2045-2050
Recovered after 2050

1k 10k 40k

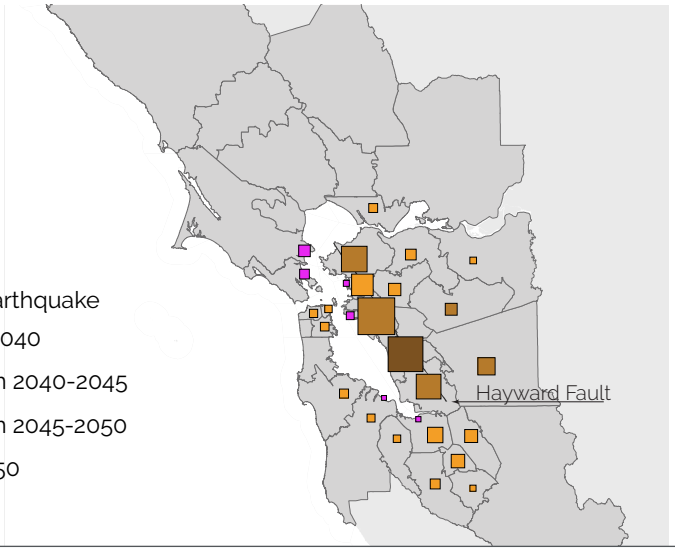


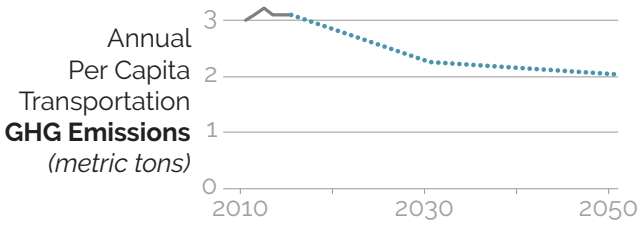
Figure 8. Healthy – Greenhouse Gas Emissions and Natural Land Impacts in the Three Futures

Rising Tides, Falling Fortunes

10% electric vehicle share
3 feet of sea level rise

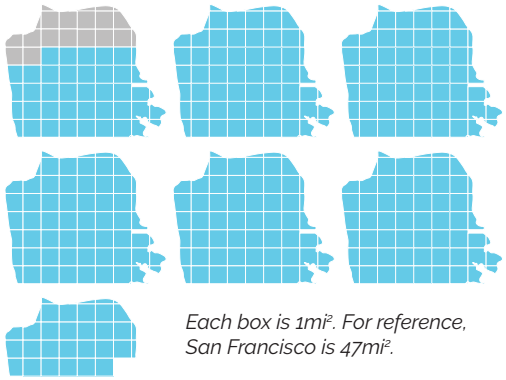
30%

Reduction in 2015 Per Capita Greenhouse Gas Emissions from Transportation Sources



Natural lands equivalent to 6.5 times the size of the city of San Francisco are permanently inundated regionwide.

x 13 square miles of new urbanization
x 300 square miles of sea level flooding



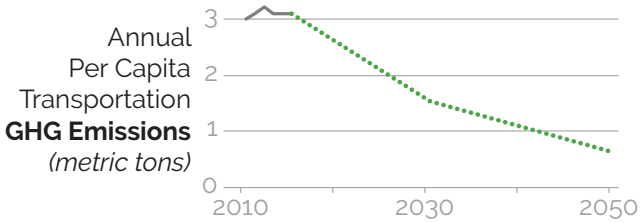
Each box is 1mi². For reference, San Francisco is 47mi².

Clean and Green

95% electric vehicle share
1 foot of sea level rise

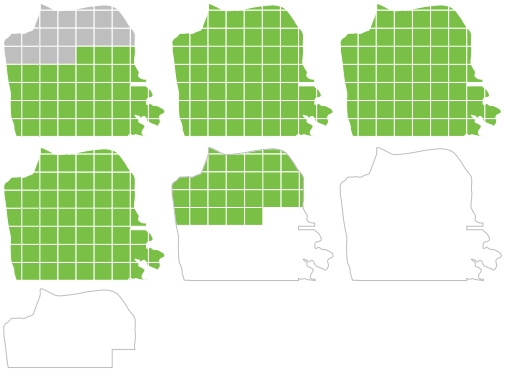
80%

Reduction in 2015 Per Capita Greenhouse Gas Emissions from Transportation Sources



Natural lands equivalent to 4.5 times the size of the city of San Francisco are permanently inundated regionwide.

x 16 square miles of new urbanization
x 200 square miles of sea level flooding

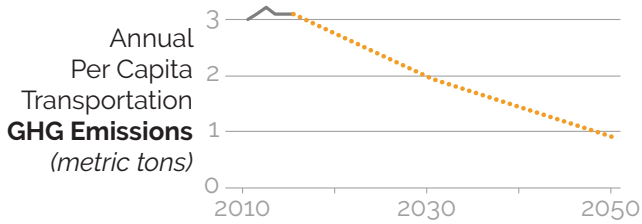


Back to the Future

75% electric vehicle share
2 feet of sea level rise

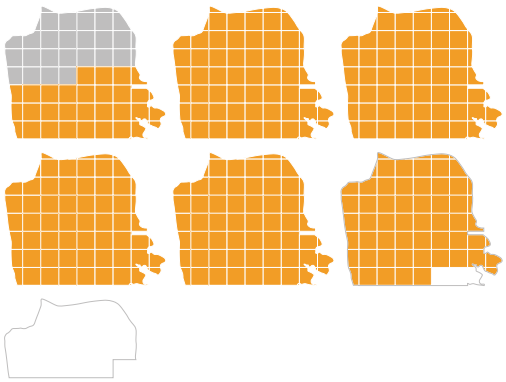
70%

Reduction in 2015 Per Capita Greenhouse Gas Emissions from Transportation Sources



Natural lands equivalent to 5.9 times the size of the city of San Francisco are permanently inundated regionwide.

x 23 square miles of new urbanization
x 260 square miles of sea level flooding



Impacts on Economic Vibrancy

The vibrancy of the regional economy is defined by both the growth in economic output as well as the opportunity for all residents to have upward mobility in the future. Over the past two decades, the Bay Area economy grew by 40 percent driven partly by a larger workforce, but mostly by an increasingly productive region with a greater share of high-wage jobs. While the overall economy has grown, the region continues to lose jobs in middle-wage industries. In each Future, the size of the economy and the percent of jobs in middle-wage industries are projected. The projected size of the regional workforce and assumptions about the productivity of workers drive the three distinct Futures.

New jobs tend to locate in areas with existing concentrations of jobs, a phenomenon known as agglomeration. This occurs for several reasons, including the preexistence of infrastructure – office buildings, roadways, utilities, and the like – and the efficiencies of being located near related businesses, suppliers, and buyers. External forces, such as preferences for jobs located centrally or throughout the region, and policies carried over from Plan Bay Area 2040, also shape the landscape of jobs. For example, existing caps on job growth, such as San Francisco's Proposition M and similar measures in several other jobs-rich cities, limit the number of new jobs that can locate in those jurisdictions. This result is a shift in job sites to other parts of the Bay Area, to other existing employment centers – particularly in more housing-rich locations.

Common Trends in all Futures

Opportunity – Despite headwinds in some Futures, the Bay Area economy grows in all three Futures. In all three Futures, the economy expands – by varying degrees – through the year 2050. In Clean and Green and Back to the Future, the economy grows at an aggressive rate, while in Rising Tides, Falling Fortunes, the growth is slower than we have seen in the past 30 years. The three Futures offer vastly different assumptions about the national economy and regulatory structure. This in turn bolsters or hampers the local economy, as well as shaping migration flows, the size of the labor force, the productivity of industries, and household incomes in 2050. **Figure 9** illustrates the economic drivers for each Future, highlighting the different paths of economic strength in Clean and Green and Back to the Future, and the relative slow economic growth in Rising Tides, Falling Fortunes.

Challenge – Jobs in middle-wage industries may continue to disappear. In every Future, the downward employment trend for jobs in middle-wage industries seen over the past four decades continues. Manufacturing is hit particularly hard in each Future. In both Clean and Green and in Rising Tides, Falling Fortunes, in addition to manufacturing representing a smaller share there is an overall reduction in manufacturing jobs. Similar shifts from middle-wage to high-wage jobs will require new workforce and education programs if existing residents are to fill the new jobs envisioned in each Future.

Unique Trends in Rising Tides, Falling Fortunes

This economy sees very slow growth, adding fewer jobs in the next 30 years than were added during the five years between 2010 and 2015. Because the regional economy is no longer supported by new immigrants into the region, the workforce participation rate increases for both youth and seniors, as Bay Area residents work more years compared with the other two Futures. Nearly all growth in economic output in this Future is driven by the assumed moderate increase in worker productivity. The economic growth is slowed further for much of the region with three in five new jobs in this Future locating in San Francisco, and sea level rise and the earthquake resulting in an overall job loss in Marin, the East Bay, and the Peninsula.

Opportunity – The Bay Area has the infrastructure it needs to support modest growth. The slow economic growth means the region's supporting infrastructure is not likely to have growing pains as seen over the past decade of economic expansion. With the current slate of expansion and capacity improvements, the Bay Area should have the infrastructure it needs to support a more modest 2050 economy, that is, if the region can afford to adapt and rebuild what gets flooded and shaken.

Challenge – Fewer opportunities are available for upward economic mobility. In the past, portions of the Bay Area offered the greatest opportunity for upward mobility for lower income children. With slow job growth and fewer high-wage opportunities, the opportunities for a more prosperous future for many may decline.

Unique Trends in Clean and Green

Assumptions about rapid worker productivity growth in this Future – a result of increasing automation of the labor force – spur the largest regional economic output of the three Futures, despite a smaller workforce than envisioned in Back to the Future. High productivity of the labor force, combined with an increase in the share of traditionally high-wage jobs, results in the higher income quantiles swelling to 63 percent in this Future. The overall jobs-housing balance improves the most in this Future. Existing jobs-rich locations like downtown San Francisco and northern Santa Clara County add housing at a faster rate than jobs, whereas markets in Concord and Santa Rosa see slight increases in their jobs-housing balance.

Opportunity – The region is prosperous and well resourced. A strong economy, driven by high-wage and high-value industries, keeps the Bay Area a resource-rich region. These resources could support large reinvestments in regional infrastructure.

Challenge – Rapid automation could adversely impact middle-wage manufacturing jobs. Economic opportunity in this Future is heavily weighted toward the professional class in the expanding technology sector. When combined with the impacts of a national carbon tax, workers in carbon-intensive industries like manufacturing and distribution could experience job displacement and lower earnings in this highly-automated future. Additionally, the jobs-housing balance decreases from 1.4 today to 1.2 in 2050, reflective of the region adding many fewer jobs compared with the population it adds.

Unique Trends in Back to the Future

In this Future, the booming economy is the result of equal parts job growth and productivity growth. The income distribution in Back to the Future mirrors trends in Clean and Green with slightly less middle-high and high-income households. The region sees significant job growth across the region, with San Jose sharing job growth with the cities of Santa Clara and Mountain View. The fast-growing economy also helps fuel Oakland's recovery – adding 300,000 jobs despite the 2035 earthquake.

Opportunity – Downtown San Jose emerges a primary employment hub, on par with Downtown San Francisco. In this Future, the region adds nearly three million new jobs over the next 30 years with one in three jobs locating in the area that includes both downtown San Jose and North San Jose. This stands in contrast to today, where the city of San Jose overall has a relatively low jobs-housing balance. As San Jose swings from a housing-rich city to a more jobs-rich one, today's major employment hubs in San Francisco and Silicon Valley transition to more balanced areas.

Challenge – The East Bay and North Bay continue to experience jobs-housing imbalances. Figure 10 highlights the trend across all the futures. The entire West Bay has an average to above-average jobs-housing balance. In Back to the Future, despite the opportunity presented by 2.7 million new jobs, the East Bay and North Bay are unable to make significant progress in adding jobs, with the imbalance more pronounced further east into the region. In part, this may be due to low-cost autonomous mobility making it easier to endure traffic congestion to reach existing job centers in the South Bay, for example.

Figure 9. Vibrant – Economic Conditions and Job Distribution in the Three Futures

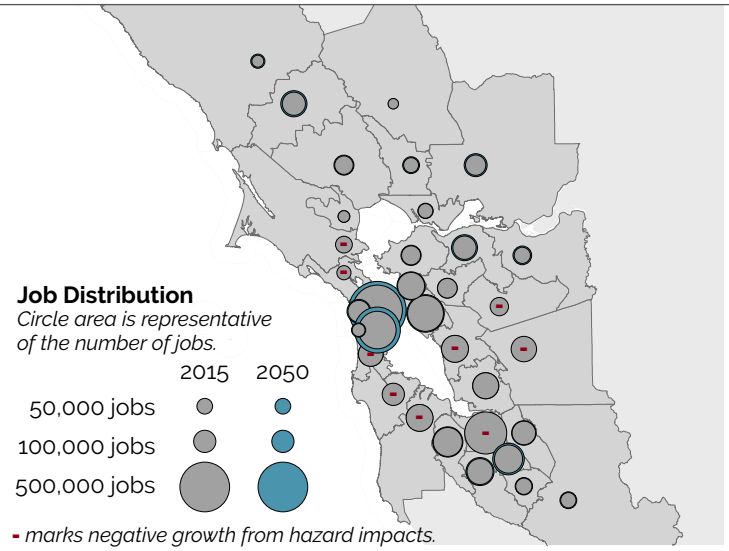
Rising Tides, Falling Fortunes

Add 0.5 Million Jobs by 2050
2015 - 4.0 Million Jobs
2050 - 4.5 Million Jobs (*13% increase*)

63% Increase in Worker Productivity
Assumes a 1.6% annual increase for 30 years.

The area around the job represents the increase in productivity.

Add $0.5 Trillion to Economic Output by 2050
2015 - $0.6 Trillion Economy
2050 - $1.1 Trillion Economy (*84% increase*)



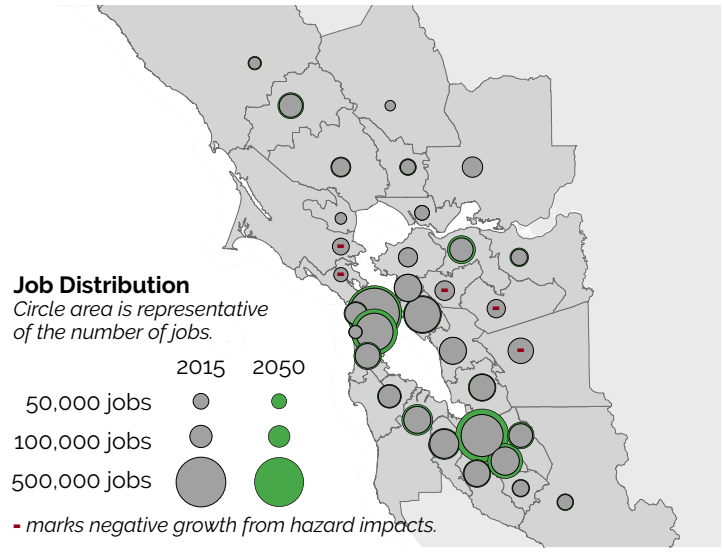
Clean and Green

Add 1.1 Million Jobs by 2050
2015 - 4.0 Million Jobs
2050 - 5.1 Million Jobs (*27% increase*)

135% Increase in Worker Productivity
Assumes a 2.8% annual increase for 30 years.

The area around the job represents the increase in productivity.

Add $1.5 Trillion to Economic Output by 2050
2015 - $0.6 Trillion Economy
2050 - $2.1 Trillion Economy (*243% increase*)



Back to the Future

Add 2.7 Million Jobs by 2050
2015 - 4.0 Million Jobs
2050 - 6.7 Million Jobs (*67% increase*)

63% Increase in Worker Productivity
Assumes a 1.6% annual increase for 30 years.

The area around the job represents the increase in productivity.

Add $1.3 Trillion to Economic Output by 2050
2015 - $0.6 Trillion Economy
2050 - $1.9 Trillion Economy (*203% increase*)

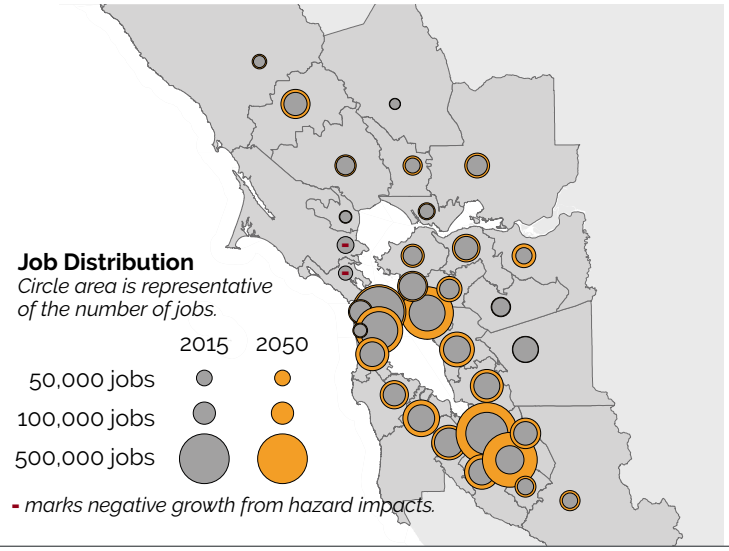


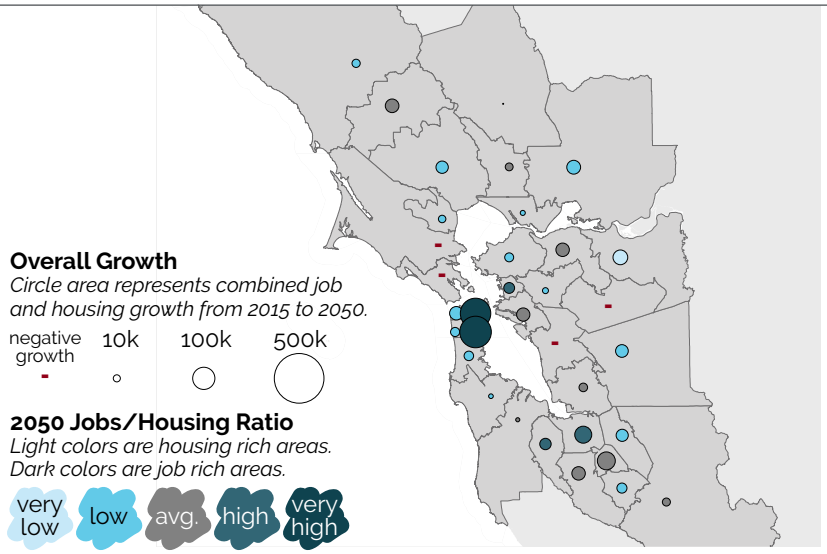
Figure 10. Vibrant – Jobs-Housing Balance in the Three Futures

Rising Tides, Falling Fortunes

+0.5 million homes; +0.5 million jobs
Jobs-housing balance: 2015 = 1.4; 2050 = 1.4

Jobs/Housing Balance

Largest Ratio Changes	2015	2050	chg.
1. N. Santa Clara County	3.3	1.9	-1.4
2. Tri-Valley	1.7	1.0	-0.7
3. S. Contra Costa County	1.2	0.9	-0.3
2050 Very High Ratios			
Downtown San Francisco	5.7	6.0	
Eastern San Francsico	2.2	2.3	
2050 Very Low Ratios			
E. Contra Costa County	0.5	0.6	

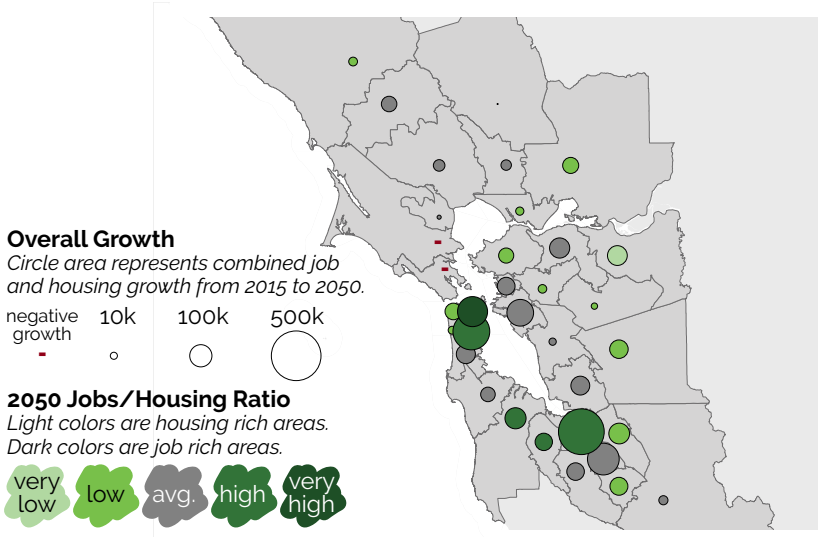


Clean and Green

+1.3 million homes; +1.1 million jobs
Jobs-housing balance: 2015 = 1.4; 2050 = 1.2

Jobs/Housing Balance

Largest Ratio Changes	2015	2050	chg.
1. Downtown San Francisco	5.7	4.1	-1.6
2. N. Santa Clara County	3.3	1.9	-1.4
3. Tri-Valley	1.7	0.7	-1.0
2050 Very High Ratios			
Downtown San Francisco	5.7	4.1	
2050 Very Low Ratios			
E. Contra Costa County	0.5	0.5	

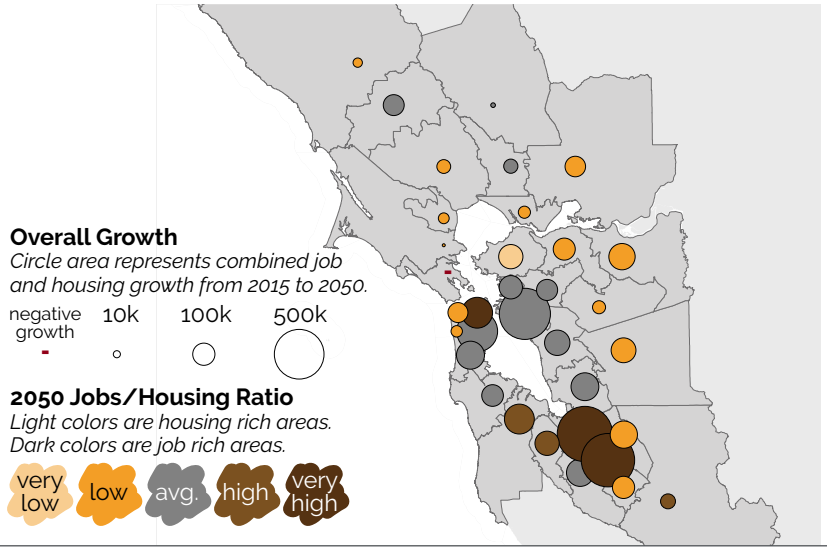


Back to the Future

+2.1 million homes; +2.7 million jobs
Jobs-housing balance: 2015 = 1.4; 2050 = 1.4

Jobs/Housing Balance

Largest Ratio Changes	2015	2050	chg.
1. Downtown San Francisco	5.7	2.9	-2.8
2. Downtown San Jose	1.4	2.5	+1.1
3. Tri-Valley	1.7	0.7	-1.0
2050 Very High Ratios			
Downtown San Francisco	5.7	2.9	
N. Santa Clara County	3.3	2.4	
Downtown San Jose	1.4	2.5	
2050 Very Low Ratios			
W. Contra Costa County	0.8	0.6	



CHAPTER 3

REVENUES AND POLITICAL SUPPORT TO IMPROVE THE FUTURE

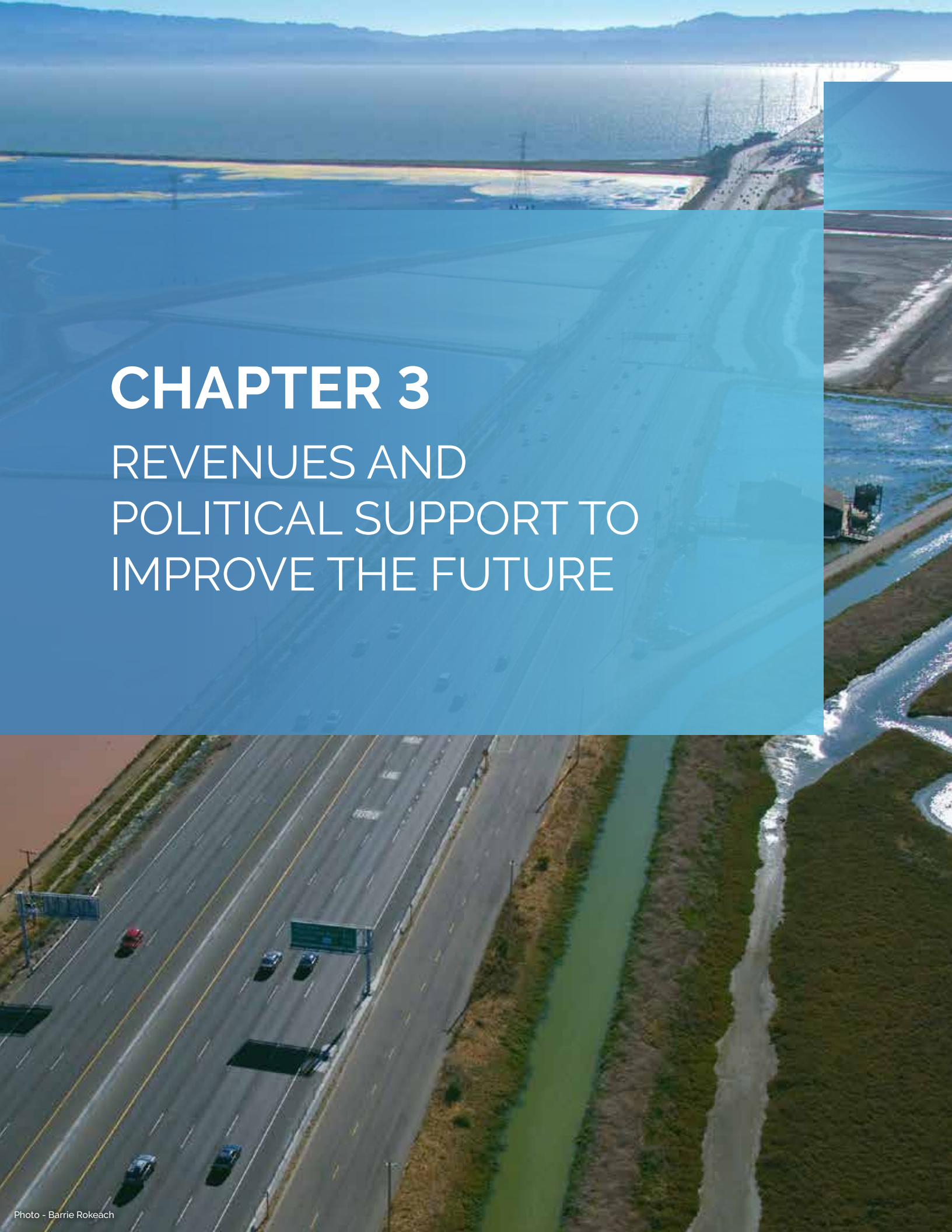


Photo - Barrie Rokeach

REVENUES AND POLITICAL SUPPORT TO IMPROVE THE FUTURE

The opportunities and challenges presented in this first round of analysis are based on the assumption that the region makes no adjustment from its present course to respond to new issues that emerge. In the upcoming months, staff will work with stakeholders to select strategies to analyze in each Future and test the effectiveness of strategies in moving the Bay Area onto a more affordable, connected, diverse, healthy and vibrant track in all three Futures. The process is designed to understand how the region can choose the right strategies to succeed, regardless of how external forces may propel or stall our region's trajectory.

Regardless of which strategies are best for transportation, land use, economic development and resilience, both funding and political support are necessary to succeed. While political support cannot be easily quantified, staff have begun to explore the revenues available to the region under each Future. These revenues will set up constraints on the number of strategies to consider in the next phase of analysis.

Available Revenues for Transportation

As part of past Plan Bay Area processes, the Bay Area projects transportation revenues from all levels of government 30 years into the future to develop a fiscally constrained plan of investments. Using a similar methodology for **Horizon**, staff have calculated how different population growth rates, household incomes, and gas tax revenues might increase or decrease the region's resources in the future. Financial projections under each Future are described below. Additional discussion this spring will focus on how best to optimize available revenues and prioritize specific investments in the three Futures.

Rising Tides, Falling Fortunes

A slower population growth rate and decreased support from the federal government result in a significant loss of projected revenues. The influence of the reduced federal funding (an external force) in Rising Tides, Falling Fortunes is apparent, with $15 billion in federal funding in 2050 under Rising Tides, Falling Fortunes compared to $73 billion in federal funding for both Clean and Green and Back to the Future. Federal funding comprises 5 percent of revenue in Rising Tides, as compared to 16 percent in Clean and Green and Back to the Future.

While Rising Tides, Falling Fortunes has the smallest federal funding share, it does have the largest state funding share, driven largely by its much larger $24 billion in tax revenue – 50 percent higher than Clean and Green and Back to the Future. Despite being only a fraction of total regional vehicle miles traveled, the high percentage of combustion-engine gas-fueled automobiles result in the largest gas-tax revenues of the three Futures.

Clean and Green

The revenues available in Clean and Green are the greatest on a per capita basis. In addition to larger federal funding in this future than the region has received in recent years, the region also benefits from increased transit fare collection, a result of the much higher ridership, as well as a much greater sales tax revenue, a result of both a larger population and a more prosperous region that spends. The local contribution to the region's infrastructure is greatest in Clean and Green, $15 billion higher than Back to the Future, despite having half the population growth.

Table 3. Transportation Revenue Forecast and Existing Needs Assessment for the Three Futures

FUTURE	REVENUE FORECAST (2021 to 2050)	EXISTING NEEDS* (2021 to 2050)	AVAILABLE FUNDING** (2021 to 2050)
Rising Tides, Falling Fortunes	$300	$350	-$50
Clean and Green	$440	$355	$85
Back to the Future	$450	$355	$95

* Draft estimates of needs for transportation operations and maintenance (to achieve a state of good repair for all asset categories)
** Funding available for transportation modernization and expansion, including Plan Bay Area 2040 projects and new investment priorities

Back to the Future

The Future with the most people has the most revenue, but only slightly. While the region has the most money in Back to the Future, it actually has slightly less money on a per capita basis compared with Rising Tides, Falling Fortunes. In Back to the Future, growth in revenues associated with larger populations (e.g., sales tax, property tax) occur as well as one associated with increased highway travel. Auto user fees (e.g., bridge and express lane tolls) are greatest in Back to the Future; $38 billion is generated by these fees, ten billion dollars greater than both Rising Tides, Falling Fortunes and Clean and Green.

Available Revenues for Housing and Resilience

Starting this spring, staff at ABAG and MTC are working to expand the above transportation revenue assessment for housing and resilience issue areas. In Plan Bay Area 2040, these issues were called out for expansion in future long-range plans. Staff plans to have these new revenue assessments ready in time for the development of Plan Bay Area 2050.

Strategies

In each Future, there are exciting opportunities to leverage and difficult challenges to address. In the next phase of Futures Planning, a new set of strategies will be applied to each Future to study how proactive actions may improve outcomes in our region by the year 2050. Because each Future has unique impacts and needs, different strategies might be more appropriate for one Future over another.

A set of 44 strategies (roughly nine per Guiding Principle) have been included from recent plans, policy studies and regional initiatives. The **Horizon** Perspective Papers are a major source of strategies, as are regional initiatives like CASA, the Bay Conservation Development Commission's Adapting to Rising Tides program, and ABAG's Comprehensive Economic Development Strategy. Appendix C provides a brief introduction to all 44 strategies and Appendix B provides a list of opportunities for stakeholders and residents to share which strategies they think should be prioritized for each Future.

As a reminder, strategies are intended to represent a range of policy ideas for discussion with stakeholders, policymakers, and members of the public. They are not approved or adopted strategies of MTC/ABAG.

Summary and Next Steps

Primary Opportunities and Challenges

The Futures Interim Report highlights a suite of major challenges ahead for the Bay Area. Growing traffic congestion and ongoing dependence on the automobile threaten quality of life and environmental goals. Growing housing unaffordability requires considering policies beyond those included in previous long-range plans. The decline of jobs in middle-wage industries could see inequality in decades ahead. And the high likelihood of a major earthquake, combined with at least one foot of sea level rise by 2050, puts tens of thousands of homes at severe risk. The two tables on the following pages summarize the opportunities and challenges discussed in the report.

Table 4. Summary of Opportunities

All Futures	Rising Tides, Falling Fortunes	Clean and Green	Back to the Future
AFFORDABLE			
Priority Development Areas thrive in all Futures.	While worse than today, housing is more affordable than in other Futures.	Job-rich cities add more housing.	Despite a major earthquake, Oakland booms.
CONNECTED			
Transit demand increases in all Futures.	Slower economic growth means less demand for new infrastructure.	New technologies enable a shift to transit and telecommuting.	Low-cost autonomous electric vehicles make mobility more affordable.
DIVERSE			
The region is more racially diverse.	There is a lower risk of displacement.	More households are prosperous.	Growth is balanced across youth, workforce, and senior demographics.
HEALTHY			
The Bay Area sees a reduced human impact on the environment.	Greenfield development is curbed.	Low carbon emissions limit the rate of sea level rise.	The region quickly recovers from an earthquake.
VIBRANT			
Despite headwinds in some futures, the Bay Area economy grows.	The Bay Area has the infrastructure it needs to support modest growth.	The region is prosperous and well resourced.	Downtown San Jose emerges as a primary employment hub.

Table 5. Summary of Challenges

All Futures	Rising Tides, Falling Fortunes	Clean and Green	Back to the Future
AFFORDABLE			
Housing affordability worsens in all Futures.	225,000 homes are destroyed by flooding, shaking and fire.	Housing and transportation costs grow significantly.	Single-family housing production may not alleviate the affordability crisis.
CONNECTED			
Commute times are worse in all Futures.	Substantial portions of today's transportation system are damaged.	Today's transit system is not designed for this level of demand.	Traffic congestion reaches new extremes.
DIVERSE			
The African American community continues to shrink.	Households are less prosperous.	A booming economy risks displacement of lower income households.	Schools will need to accommodate growing student population.
HEALTHY			
Environmental shocks and stresses hit the region.	225,000 homes are affected by sea level rise or an earthquake.	A small construction workforce could slow earthquake recovery.	Natural and recreation resources may be overburdened.
VIBRANT			
Jobs in middle-wage industries may continue to disappear.	Fewer opportunities are available for upward economic mobility.	Rapid automation could adversely impact middle-wage manufacturing jobs.	The East Bay and North Bay remain jobs-housing imbalanced.

Table 6. Futures Scorecard of Trends in the Three Futures

	INDICATOR	2015	Rising Tides, Falling Fortunes 2050	Clean and Green 2050	Back to the Future 2050
Housing Affordability	Share of Household Income Spent on Housing and Transportation	26%	48%	50%	52%
AFFORDABLE					
Housing Production	Average Annual Units of Housing Built	16,000	14,000	38,000	60,000
Commute Mode Choice	Share of Auto Commutes	75%	67%	45%	69%
CONNECTED					
Commute Time	Median Commute Time (in minutes)	31	34	36	40
Displacement Risk	Share of Lower-Income Households At Risk of Displacement	38%	14%	60%	28%
DIVERSE					
Income	Share of Lower-Income Households	50%	54%	37%	39%
Greenfield Development	Average Annual Greenfield Development (in acres)	1,200	300	300	500
HEALTHY					
Greenhouse Gas Emissions	Annual Per-Capita Emissions From Transportation (in metric tons)	3.0	1.9	0.7	1.2
Economic Output	Per-Capita Gross Regional Product (in 2015 dollars)	$95,000	$145,000	$210,000	$150,000
VIBRANT					
Middle-Wage Jobs	Share of Jobs in Middle-Wage Industries	21%	18%	17%	19%

Next Steps

This Futures Interim Report documents all of the findings developed through the first round of analysis – of Futures Planning.

In March and April of 2019, the process pivots to the third phase, where strategies to improve each Future are considered. Strategies are defined as specific actions at the state, regional or local levels that could be taken to improve outcomes for Bay Area residents and businesses. While no individual government agency can implement a cross-cutting suite of policy solutions, it is reasonable to assume that, through the democratic process, Bay Area residents have moderate-to-significant influence in advancing policies for these three levels of government. These could range from significant shifts in zoning to accommodate a rapidly growing population to construction of new infrastructure to harden our shoreline against rising sea levels. Similar to external forces, policies and strategies are model inputs for the fourth and final phase of the Futures Planning element of **Horizon**.

Appendix A has a list of many ways you can contribute your voice to the policy and strategy discussion. The input from community members and stakeholders over the next two months will help MTC and ABAG plan for better outcomes in all three Futures.

It is important to note that neither this report, nor the findings from upcoming outreach, are intended to serve as policy recommendations for legislation on the federal or state levels. Rather, the feedback received will help planners and analysts prioritize strategies for further analysis through September 2019 in the second round of Futures Planning. This will allow staff to identify which strategies are the most effective – and advise MTC and ABAG which might be most appropriate to consider in Plan Bay Area 2050.

More Information

Appendix B, Key Futures Assumptions and Modeling Process, has more information on the external force assumptions used to craft the three Futures as well as more information on the computer modeling process. Appendix C, 44 Strategies to Improve the Future, will support the next round of Futures policy and strategy discussions.

For questions about the **Horizon** planning process overall, feel free to contact Dave Vautin at dvautin@bayareametro.gov; for specific questions about the **Futures Interim Report - Opportunities and Challenges**, please contact Michael Germeraad at mgermeraad@bayareametro.gov.

Photo - Levi Bare, unsplash.com

APPENDICES

Photo - Ronan, unsplash.com

APPENDIX A

Opportunities to Provide Input on Strategies

Identifying the right strategies to test in the **Horizon** Futures Planning process requires input from stakeholders, residents, and elected officials across the Bay Area. As we begin the process of aligning strategies to advance the Guiding Principles in each future, we need your help. Consider attending one of the **Horizon** public events or submitting your input through our online tool in March 2019:

1. **Horizon Stakeholder Workshop:** Transform the Future
   Monday, March 11 - 8:30 AM to 1:30 PM – 375 Beale St, San Francisco
2. **Horizon Public Workshop:** Transform the Future
   Tuesday, March 12 – 6:00 PM to 8:00 PM – 101 8th St, Oakland
3. **Horizon Public Workshop:** Transform the Future
   Thursday, March 14 – 6:00 PM to 8:00 PM – 200 E Santa Clara St, San Jose
4. **Horizon Public Workshop:** Transform the Future
   Saturday, March 16 – 10:00 AM to 12:00 PM – 320 N McDowell Blvd, Petaluma
5. **Horizon Public Workshop:** Transform the Future
   Tuesday, March 19 – 6:00 PM to 8:00 PM – Tanforan Mall, San Bruno
6. **Horizon Public Workshop:** Transform the Future
   Wednesday, March 20 – 6:00 PM to 8:00 PM – 253 Georgia Street, Vallejo
7. **Horizon Public Workshop:** Transform the Future
   Date/Time TBD – Contra Costa County (*Location, TBD*)
8. **Horizon Digital Engagement:** Futures on Vital Signs
   Submit input online throught late April 2019 – http://vitalsigns.mtc.ca.gov/horizon
9. For the most up-to-date information, go to http://mtc.ca.gov/horizon.

At the completion of this outreach cycle, staff will report back on prioritized strategies to MTC/ABAG board members at April committee meetings. Staff will also continue working with stakeholders to refine the strategies assigned to each future throughout the month of April, with a goal of beginning the second round of modeling for **Horizon**'s Futures Planning element in May 2019.

APPENDIX B

Key Futures Assumptions and Modeling Process

The first phase of Futures Planning was the development of Futures, comprised of two dozen external forces outside the control of Bay Area policy makers. The external forces include environmental, political, economic, land use and transportation assumptions about the future. Each Future was crafted by stakeholders and experts from the various topic areas of **Horizon** – transportation, land use, economic development and resilience – to imagine different conditions on the global and national levels in the coming decades. The table below is a summary of these external forces. The next section focuses on the analytic approach, including computer modeling tools used to study how these external forces shape the region.

EXTERNAL FORCES

FUTURES | AUGUST 2018

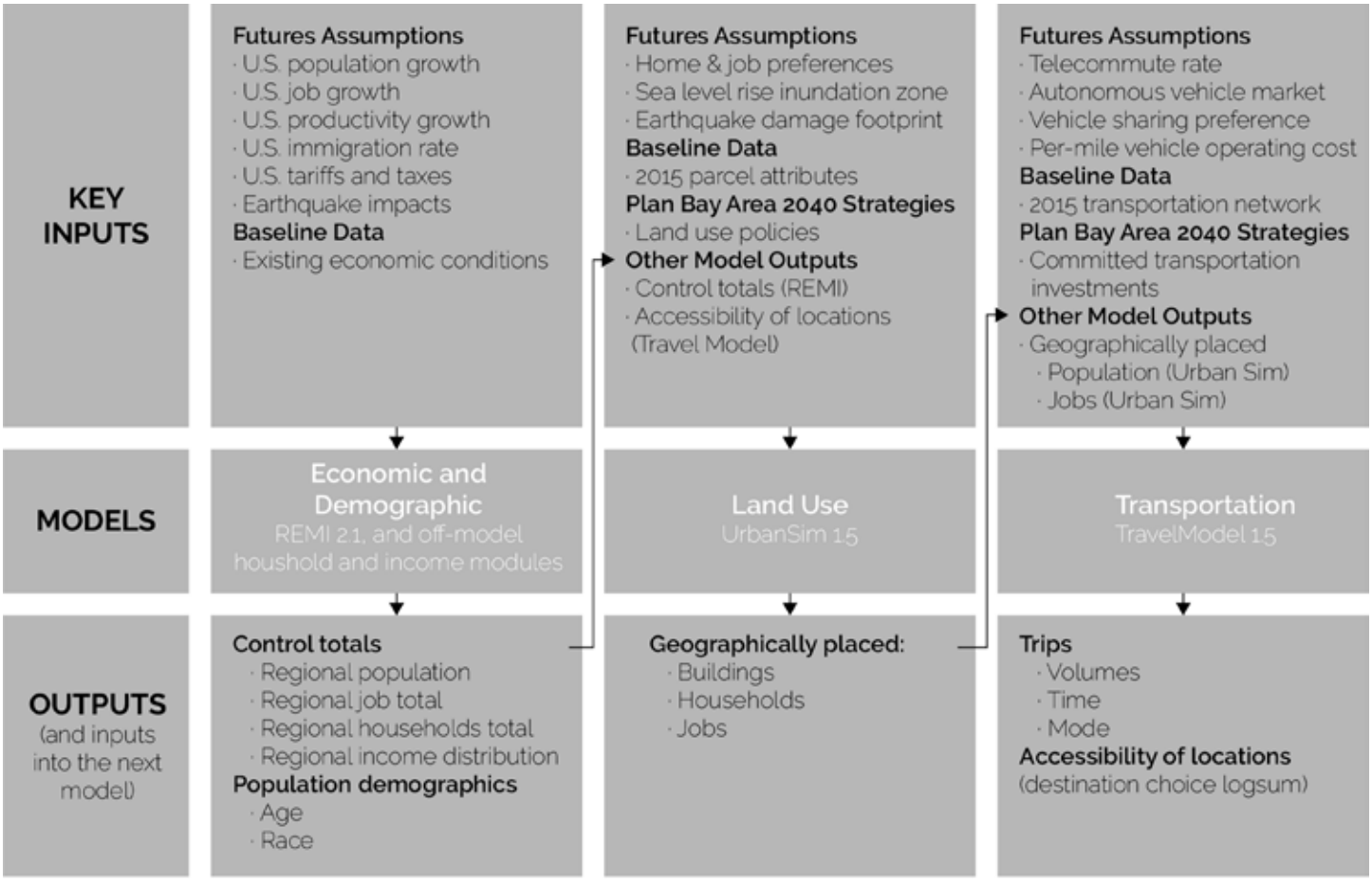
External Forces			A Clean and Green	B Rising Tides, Falling Fortunes	C Back to the Future
Environmental	1	Sea Level Rise	1 Foot	3 Feet	2 Feet
	2	Natural Disasters	2035 Hayward Fault Earthquake (magnitude 7.0)	2035 Hayward Fault Earthquake (magnitude 7.0)	2035 Hayward Fault Earthquake (magnitude 7.0)
Political	3	U.S. Political System	Healthy Democracy	Flawed Democracy	Healthy Democracy
	4	U.S. Standing in the World	Multiple Superpowers	Declining Power	Preeminent Global Power
	5a	U.S. Tax Rates	Higher Tax Rates	Lower Tax Rates	Similar to Today
	5b	U.S. Tax Structure	Carbon Tax	Income Tax (Similar to Today)	Income Tax (Similar to Today)
	6a	U.S. Spending Levels	Higher Expenditures	Lower Expenditures	Similar to Today
	6b	U.S. Spending Distribution	Similar Share to Today	Reduced Share for Metro Areas	Larger Share for Metro Areas
	7	Immigration Policy	80,000 Annual Immigrants (to Bay Area)	20,000 Annual Immigrants (to Bay Area)	240,000 Annual Immigrants (to Bay Area)
	8	Trade Policy	3% Average Tariff Rate	10% Average Tariff Rate	0% Average Tariff Rate
	9	Environmental Policy	Increased Regulations	Reduced Regulations	Similar to Today
Economic	10	U.S. Population Annual Growth Rate	0.7%	0.4%	1.1%
	11	U.S. Jobs Annual Growth Rate	0.4%	0.5%	1.1%
	12	U.S. Jobs Distribution	*available upon request*	*available upon request*	*available upon request*
	13	U.S. Productivity	2.8%	1.6%	1.6%
Land Use	14	Housing Preferences	Greater Preference for Urban Housing	Greater Preference for Urban Housing	Greater Preference for Dispersed Housing
	15	Workplace Preferences	Greater Preference for Dispersed Employment Centers	Similar Preference to Today	Greater Preference for Urban Employment Centers
	16	Telecommute Share	30%	15%	6%
	17	E-Commerce Market Share	50%	20%	50%
	18	Interregional Volumes	Limited Growth Rates	Current Growth Rates	Faster Growth Rates
Transportation	19	Transportation Technologies	High Speed Rail, Autonomous Rail and Buses, Freight Aerial Drones	Autonomous Buses	Hyperloop, Autonomous Rail and Buses, Freight Aerial Drones, Lower-Cost Helicopter Transport
	20	Autonomous Vehicle Market Share	95%	10%	75%
	21	Electric Vehicle Market Share	95%	10%	75%
	22	Sharing Preferences	Greater Preference	Similar Preference to Today	Reduced Preference
	23	Per-Mile Vehicle Operating Cost	$0.40 per Mile	$0.20 per Mile	$0.10 per Mile
	24	Annual Federal Transportation Funding (Bay Area)	$2.5 Billion	$0.5 Billion	$2.5 Billion

Computer Modeling and Analytic Tools

The Futures Interim Report is based on findings from analytic results and the output of computer modeling tools. **Horizon** builds on the past analytical work of Plan Bay Area and Plan Bay Area 2040, using Futures Planning as an opportunity to build out new computer modeling functions. At the heart of MTC and ABAG analysis are three analytic stages: a regional level economic and demographic analysis (REMI 2.1 and other tools), a land use model (Urban Sim 1.5), and a transportation model (Travel Model 1.5). The three analytic stages use data on the current conditions of the Bay Area and add in assumptions about future conditions to project what the region would look like in future years should those conditions occur.

These analytic stages work together, with key data outputs from one phase passing on as inputs into the next one. Some information flows through feedback loops, but generally data outputs flow from the economic and demographic analysis, to the land use model, to the travel model. **Figure B1** provides a simplified illustration of the inputs and outputs for each model, and the relationships between them. Below is more background information on the models, the upgrades to the models made as part of Futures Planning, and the modeling assumptions for the key external forces.

Figure B1. Models Used to Forecast Future Regional Characteristics



Economic and Demographic Modeling

Development of population, employment, and household forecasts for **Horizon** builds upon the framework established for Plan Bay Area 2040, applying the Bay Area version of the REMI model as well as the MTC and ABAG household and income distribution off-model analysis. Regional Economic Models Inc. (REMI) creates comprehensive economic models of regional economies, which the user can customize to reflect the unique characteristics of their area. For Plan Bay Area 2040, staff modified version 1.7.8 of the REMI model to capture the region's innovative position in a range of tech- and social media-based sectors as well as the baseline conditions of very high housing prices. Household numbers are driven from the demographic characteristics of the adult population, while income distribution considers industry and demographic trends.

The REMI version 2.1 model and in-house modules were used to model the three divergent Future forecasts for the Bay Area. These forecasts were based on the external forces that undergird the Futures element of **Horizon**; external forces are defined as shifts on the global or national levels (beyond the control of the state or region) that affect the region's trajectory. For example, external forces include the rate of national productivity growth, the magnitude of global climate change, and the level of immigration allowed by the federal government. These external forces were defined by stakeholders early in the planning process.

Key external force assumptions that vary for each of the three Futures drove the economic and demographic modeling outputs. These were:

- **U.S. population growth rate,**
- **U.S. job growth rate,**
- **U.S. productivity growth rate,**
- **U.S. immigration rate,**
- **U.S. government spending level,**
- **U.S. tariffs and taxes, and**
- **The occurrence of a 2035 regionally significant earthquake.**

The regional forecast consists of growth totals for the entire nine-county region, whose ultimate distribution to counties, cities, and parcels can be influenced by market conditions and policy interventions (e.g., zoning, subsidies, development requirements) in the UrbanSim 1.5 context. The regional growth forecast outputs become the inputs into the Bay Area UrbanSim 1.5 (discussed below), which then forecasts localized growth patterns based on the overall regional allocation.

Land Use Modeling

Bay Area UrbanSim 1.5 is a spatially explicit economic model that forecasts future firm and household locations. MTC and ABAG used a version of the Bay Area UrbanSim 1.0 model to inform the environmental assessment for the first Plan Bay Area (adopted in 2013) and both the Plan process and the environmental assessment for the second -Plan Bay Area 2040, adopted in 2017.

Bay Area UrbanSim 1.5 forecasts future land use change (e.g., development or redevelopment) starting from an integrated (across different source data) base year database containing information on the buildings, households, firms and land use policies within the region. Running in five-year steps, the model predicts that some households will relocate, and a number of new households will be formed or enter the region (as determined by the adopted regional growth forecasts developed above). The model system micro-simulates the behavior of both these types of currently unplaced households and assigns each of them to a currently empty housing unit. A similar process is undertaken for businesses. During the simulation, Bay Area UrbanSim 1.5 micro-simulates the choices real estate developers make on how much of, what, and where to build. This adds additional housing units and commercial space in profitable locations (i.e., land use policies at the site allow the construction of a building that is profitable under forecast demand).

In this way, the preferences of households, businesses and real estate developers are combined with the existing landscape of parcels and policies to generate a forecast of the overall land use pattern in future years. The land use policies in place in the base year can be changed later in Futures Planning (e.g., allowable zoned residential density could be increased) and Bay

Area UrbanSim 1.5 responds by forecasting a different land use pattern consistent with the constraints or opportunities resulting from the change. For each period, the model produces a zonal output file for the transportation model that contains household counts by income and employee counts by sector. This provides the travel model with information on land use intensity in different locations and the spatial distribution of origins and destinations within the region.

Key improvements between Bay Area UrbanSim 1.0 and Bay Area UrbanSim 1.5 include the following:

- New modeling features that allow for simulation of natural disasters and sea level rise.
- Improved implementation of accessibility changes from Travel Model 1.5 into land use pattern shifts.

The following key external force assumptions were incorporated into the model and influenced the land use modeling outputs:

- The preference of households to locate in lower or higher density areas,
- The cost of development associated with changing needs for parking provision in Futures with sharing preferences and autonomous vehicles,
- The proliferation of e-commerce to redevelop aging malls and redistribute the locations of firms,
- The occurrence of a 2035 regionally significant earthquake, and
- The occurrence of sea level rise inundation.

Travel Modeling

Travel Model 1.5 is an updated version of Travel Model 1.0, which was used for Plan Bay Area 2040. Travel Model 1.5 is a regional activity-based travel model for the Bay Area. This model is a set of individual models that perform different functions leading to forecasts of Bay Area travel data. In addition to exogenous variables highlighted below, Travel Model 1.5 takes land use inputs from UrbanSim 1.5 for the location of housing and jobs by travel analysis zone (TAZ).

Key improvements between Travel Model 1.0 and Travel Model 1.5 include the following:

- Incorporation of transportation network company (TNC) services – such as Uber and Lyft – as well as the ability to incorporate different levels of autonomous vehicle market penetration,
- Updated calibration and validation for year 2015 using observed data for the new baseline year.

Key external force assumptions that drove the travel modeling outputs were:

- The assumed telecommute rate,
- The availability of autonomous vehicles, the impact they have on roadway capacities and travelers' in-vehicle travel time sensitivities,
- TNC fares and passenger occupancy,
- Zero passenger vehicle travel by TNCs and autonomous vehicles
- Sharing preferences,
- Per-mile operating costs
- The occurrence of a 2035 regionally significant earthquake, and
- The occurrence of sea level rise inundation.

APPENDIX C

44 Strategies to Improve the Future

In parallel to the Futures Planning element of **Horizon**, which identifies many challenges for the Bay Area, MTC and ABAG staff are developing a series of white papers known as Perspective Papers that explore strategies and solutions for issue areas previously outside the scope of past long-range planning processes. Using the Perspective Papers and other regional planning and policy initiatives, staff developed a list of 44 potential strategies to improve outcomes in each Future. At the outreach events described in Appendix A, staff will work with stakeholders to identify the key challenges in each Future and develop a set of strategies to apply to each Future in the second phase of Futures Planning analysis.

The 44 strategies can be found at this link:

https://mtc.ca.gov/sites/default/files/Horizon_Transform_the_Future_Strategy_Booklet.pdf