AGENDA ITEM NO. 18-03-4

REGIONAL PLANNING COMMITTEE
MARCH 2, 2018

ACTION REQUESTED: INFORMATION

SAN DIEGO FORWARD: THE 2019-2050 REGIONAL PLAN - WHITE PAPERS

File Number 3102000

Introduction

To help inform the development of San Diego Forward: The 2019-2050 Regional Plan (2019 Regional Plan), a series of white papers were prepared, consistent with the 2019 Regional Plan vision and goals approved by the Board of Directors.

The Emerging Technologies white paper was presented to the Transportation and Regional Planning Committees at their meetings on February 2, 2018. The Public Health, Economic Prosperity, and Climate Change white paper outlines were discussed by the Regional Planning and Transportation Committees at their December 2017 meetings; these white papers have been updated and are included as Attachments 1-3 of this report.

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Attachments:
1. Public Health White Paper
2. Economic Prosperity White Paper
3. Climate Change White Paper

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Public Health

WHITE PAPER

SAN DIEGO ASSOCIATION OF GOVERNMENTS

February 23, 2018

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Introduction

> "Transportation impacts more than just how Americans get from place to place. It influences physical activity, accessibility to goods and services, air pollution, greenhouse gases, stress levels, family budgets, and our amount of leisure time, as well as a host of other lifestyle and health variables…While transportation may not immediately be thought of as a key determinant of health, transportation policies and accompanying land use patterns have far-reaching implications for our risk of disease and injury"[1] – Robert Wood Johnson Foundation's Center to Prevent Childhood Obesity Working Group

As the San Diego Association of Governments (SANDAG) develops regional policies and programs to guide transportation infrastructure investments over the next three decades, an understanding of the public health benefits and impacts of those decisions will support the agency's efforts to create a safe, viable, and efficient transportation system for the San Diego region. The investments, in turn, should support improved public health outcomes.

Public health has been considered in various large-scale SANDAG planning efforts over the years. During the development of San Diego Forward: The Regional Plan (2015 Regional Plan), SANDAG became more fully involved in working to connect the regional planning process to the public health domain through a U.S. Centers for Disease Control (CDC) grant to the County of San Diego. This white paper expands upon previous efforts to identify approaches for achieving public health objectives, and will inform the development of San Diego Forward: The 2019-2050 Regional Plan (2019 Regional Plan).

According to the World Health Organization, health is a state of complete physical, mental, and social well-being and not merely the absence of disease and infirmity. Emphasizing the health benefits derived by improved mobility and access can better realize this comprehensive notion of health.

Evidence suggests that land use and transportation planning and policy have a direct impact on public health. Studies have consistently shown that people who live in compact, mixed-use, and walkable communities are less likely to be obese and hypertensive compared to people who live in auto-oriented communities.[2] Research also has established a clear connection between built environment characteristics and chronic diseases such as heart disease, diabetes, cancer, and asthma, which, in 2007, accounted for at least $4 billion in direct healthcare expenditures in the San Diego region. These costs are projected to rise to $25 billion by 2050 if changes are not made.[3] The transportation decisions made as part of the 2019 Regional Plan provide a significant opportunity to support changes to the built environment that can result in improved health outcomes.

The focus of public health practitioners has shifted away from 20th century infectious diseases, which generally have been controlled, toward chronic diseases, which now account for seven out of every ten deaths in the United States.[4] Land use and transportation planning and policy decisions can influence public health outcomes related to a variety of factors, such as air quality, opportunities for physical activity, risk of injury, jobs, education, and access to everyday necessities such as grocery stores. In addition, both urban planners and public health practitioners are becoming increasingly aware of the need to reduce the incidence of traffic injuries involving people walking and biking as well as health disparities (the difference in health outcomes between people of varying ethnicities, education attainment, and/or income levels).

Over the past several years, there has been an increasing swell of support from a variety of professional organizations and government agencies, ranging from the local to the national levels, to incorporate public health considerations into the planning and development process. As a result, numerous cities, counties, Metropolitan Planning Organizations, other government entities, professional organizations, and non-profits have worked to incorporate techniques that focus on improving public health outcomes into their planning policies, programs, and projects.

This paper includes the following sections: a brief history of public health and urban planning; why public health matters; how the built environment affects public health; a list of current national, state, regional, and local efforts in the San Diego region; a list of available public health data and tools; a summary of the interrelationships between public health and climate change, social equity/environmental justice, economic prosperity, and emerging technologies; and policy considerations for the 2019 Regional Plan. This white paper serves as the basis for further integrating public health considerations into San Diego Forward: The 2019-2050 Regional Plan.

History of Public Health and Urban Planning

Modern urban planning grew out of concerns for public health in early 20th century cities where people lived next to farm animals, butcher shops, and heavy industries. In response to frequent outbreaks of contagious diseases such as tuberculosis and cholera, planners and health advocates established zoning regulations to separate incompatible uses and activities such as tanneries and butcher shops from residential neighborhoods. Shops, restaurants, and schools, however, remained integrated in the neighborhood, and people could still live relatively close to where they worked.[5]

After World War II, many factors, including a growing population, rising standards of living, the increasing popularity of the private automobile as the primary mode of transportation, and federal policies that encouraged homeownership led to a housing boom in the outskirts of existing cities. The construction of the national highway system further fueled a more dispersed land development pattern with employment and other uses leaving the inner cities as well. Single-family suburban homes on large lots became a reality for many middle-class families.

While highways provided convenient access to the suburbs, many of them cut through inner cities, separating and isolating many traditional neighborhoods. Lack of infrastructure investment and a declining population base in the central cities convinced many families that suburban neighborhoods were safer and healthier with cleaner air, lack of crime and blight, wide streets, and new homes.

As a predominant model for urban development, the walkable, compact, mixed-use neighborhoods, built on a grid street pattern with public facilities such as a school or a park at its core, were being replaced by the automobile-oriented suburbs, connected to consolidated retail and employment centers or public facilities by parkways or arterial streets with fast-moving traffic.[6] Today, many people in the United States live in such neighborhoods.[7]

Traffic patterns are in line with this trend. Between 2008 and 2012, across the nation, people who walked to work declined from 5.6 percent to 2.8 percent while those who drove comprised nearly 90 percent.[8] From 1969 to 2009, the number of children who walked or biked to school decreased from 48 percent to 13 percent. This drastic decline in children walking or biking to school may be directly related to growing obesity rates among children in the United States – now more than 33 percent. Parents cited concerns about traffic and safety as the key reasons they preferred to drive

their children to school.[9] Ironically, between 10 percent to 14 percent of the morning commute-time traffic is generated by parents driving their children to school.[10]

Why Public Health Matters

Chronic Diseases

Chronic disease rates among adults and children have reached epidemic levels. Seven out of ten deaths each year are from chronic diseases[11] which include heart disease, asthma, diabetes, and cancer. Both obesity and being overweight are major risk factors for chronic diseases. According to the CDC, the percentage of the population in California that is obese increased from 18.7 percent in 2000 to 25 percent in 2016.[12] The Open Data Network reported that in 2015, 22.6 percent of San Diego County residents were obese.[13] Childhood obesity in the country has more than doubled in the last 30 years.[14] In the San Diego region, more than one-third of fifth, seventh, and ninth grade children enrolled in public schools during the 2014 to 2015 academic year were overweight or obese.[15] As with adults, poor nutrition and a lack of physical activity are cited as the primary causes. The built environment can contribute to obesity when it lacks places where people can be physically active or have access to healthy foods. Therefore, designing a built environment that reduces people's barriers to making healthy choices is a key strategy for addressing the chronic disease epidemic in the San Diego region.

Traffic Fatalities

In addition to chronic diseases, traffic fatalities also have become a major public health issue. In 2016, there were more than 37,000 traffic-related fatalities in the United States.[16]

In 2016, 239 people died in crashes on the roadway in the San Diego region. Of these, 71 were pedestrians.[17] Bicyclists and pedestrians combined represent nearly one-third of all fatalities while they account for only three percent of trips in the region[18] [19]. This disparity has added significance since safety is a primary concern for people when they choose a mode of travel, especially for children travelling to school, or seniors who are dependent upon public transportation.[20] Additionally, the need for safe and accessible bike and pedestrian infrastructure is critical in low-income and minority communities that have low rates of automobile ownership.[21]

Air Quality

While the region's air quality has improved,[22] the health impacts of transportation-related pollutants remain a concern and can have a direct impact on rates of chronic diseases such as asthma and other respiratory diseases, including lung disease, coronary heart disease, and cancer. Children are particularly susceptible to developing respiratory illnesses, especially when exposed to pollutants early in life.[23] Internal combustion engines in vehicles emit a number of air-borne pollutants, which are regulated by state and federal air quality standards to protect public health and safety. The San Diego region has met the federal standards for carbon monoxide, nitrogen dioxide, particulate matter, sulfur dioxide, and lead,[24] and attained the federal 1997 Eight-Hour Ozone standard in 2013; additionally, the region has made progress in attaining the federal 2008 Eight-Hour Ozone Standard—in 2015, eight out of the nine monitoring sites in the County met the standard.[25] The San Diego region is a non-attainment area for the state ozone and particulate matter standards.

At times, air emissions from traffic may become a concern for siting new recreational facilities, such as a trail alongside a freeway or a neighborhood park served by a busy arterial road. In general, the

health benefits of physical activity usually far outweigh the risks from ambient air pollution. Guidelines from the federal Centers for Disease Control and Prevention state that, except for sensitive populations with chronic lung conditions, physical activity should be avoided entirely only under the worst air quality conditions, which rarely occur in the San Diego region. For recreational facilities, emissions from point sources such as roadways should be minimized to the extent possible, however short duration exposures typical of park or trail use do not warrant avoiding such physical activity opportunities except for sensitive populations.[26]

Cost Implications

Poor health outcomes often can have a significant cost burden on society, in part due to premature deaths and absences from work and school. Obesity-related medical care costs are estimated to be 21 percent of total national healthcare spending annually.[27] By 2030, healthcare costs associated with obesity are expected to rise by $48 billion to $66 billion.[28] The California Department of Public Health estimates that obese people spent $1,429 more in medical care costs compared to people of normal weight. In addition, it is estimated that in 2014, the total annual cost to California from obesity-related conditions was $36.2 billion.[29] In 2006, the estimated cost for the San Diego region was approximately $3 billion, or nearly $3,000 per household in annual costs.[30] Identifying opportunities to invest in lower-cost infrastructure, such as bike and pedestrian facilities, could lead to more health-conscious decisions and healthier lifestyles and result in reduced healthcare costs.

How the Built Environment Affects Health

Land-use patterns in many communities make driving a necessity and discourage walking and biking. A decrease in walking and biking results in a decrease in daily physical activity, which is considered a critical factor in the rising obesity epidemic across the United States, especially among children. In light of growing evidence that links land use patterns and transportation infrastructure with public health outcomes,[31] urban planners and public health practitioners have begun collaborating to develop strategies that improve community health and wellness through the design of the built environment. For example, people who live in neighborhoods with sidewalks on most streets are 47 percent more likely to be physically active for at least 30 minutes a day,[32] which is the minimum amount recommended by the U.S. Surgeon General.[33] Some of these strategies are described below.

Active Transportation and Public Transit

Streets that are designed for the safety of multiple users—including pedestrians of all ages, bike riders, people with disabilities, buses, and cars—have been shown to reduce the risk of pedestrian and bike rider injuries.[34] Community design and development patterns that encourage physical activity and educational institutions that support walk and bike to school programs help people meet the Surgeon General's recommendation for daily physical activity.[35] Physical activity includes moderate-intensity exercise such as walking and jogging and varies among individuals depending on age and fitness level.

Using public transit and active transportation options such as walking and biking reduces vehicle miles traveled, vehicle emissions, respiratory disease associated with sedentary lifestyles, and healthcare costs.[36] Proximity to transit also is associated with improved access to healthy food as well as social, medical, employment, and recreational activities, particularly for physically and economically disadvantaged people.[37] Additionally, the nation is experiencing a demographic shift that is resulting in a greater demand by consumers, young professionals in particular, to live in walkable, dense

neighborhoods with active transportation options and easy access to a range of retail and services, public transit, and jobs.[38]

Access to Parks and Recreation

Residents with convenient access to parks are more likely to use them for recreation and physical activity.[39] Quality recreational facilities and programs also can increase physical activity. The health benefits of physical activity include a reduced risk of premature mortality, cardiovascular disease, some cancers, and type 2 diabetes and metabolic syndrome.[40] Regular participation in physical activity can help reduce depression and anxiety, improve mental health and mood, strengthen bones and muscles, and enhance ability to perform daily tasks throughout the life span.[41] Contact and exposure to open spaces also can reduce stress, improve mental health, and facilitate recovery from illness.[42] Furthermore, studies show that increased access to open areas such as parks, recreation space, and wilderness areas is associated with a decreased prevalence of obesity.[43, 44]

There are a number of potential barriers to accessing parks and recreation, especially in low-income and minority communities and including proximity and safety, that if addressed could increase the levels of physical activity and decrease chronic disease and other related negative health impacts within communities. Additionally, ensuring that parks are well-maintained over time is crucial to ongoing use and long-term health benefits.

Complete Neighborhoods

The term "complete neighborhoods" refers to the ability of residents to easily access all of the goods and services needed in daily life by walking. A complete neighborhood encourages walking and biking because goods are nearby, and helps contribute to neighborhood safety by ensuring that many people are out and about throughout the day and into the evenings, helping to keep eyes on the street. Complete neighborhoods also reduce residents' reliance on cars, resulting in fewer automobile trips required. This, in turn, leads to reduced air and noise pollution as well as reduced risk of collisions and injuries.

The availability of medical services throughout the community can reduce vehicle trips with benefits to air quality, community noise, and injuries. The availability of primary medical care has a role in preserving good health and preventing morbidity and hospitalizations from chronic and communicable diseases, including asthma and diabetes.

A combination of land-use and transportation considerations, such as mixed-use or transit-oriented developments that include schools, parks, retail, job access, affordable housing, medical facilities, and other appropriate elements, are components of a complete neighborhood. Complete neighborhoods could strengthen local economies, provide greater access to jobs, and reduce interregional commutes and air pollution, which are key predictors of health status.[45]

Access to Affordable Housing

In a healthy community, residents have access to safe and affordable housing. The lack of adequate affordable housing may result in families living in substandard housing, overcrowded situations, overpaying (i.e., paying more than 30 to 50% of their income for housing), and/or living far from their work and commuting long distances, negatively affecting both physical and emotional health.[46]

Residents of substandard housing are at increased risk for fire, electrical injuries, lead poisoning, rodent infestation, mold, childhood asthma, and other illnesses and injuries. Overcrowded housing conditions can contribute to higher mortality rates, infectious disease, inhibited childhood development, and stress. Excessive rent or housing cost burdens contribute to emotional stress, hunger, and overcrowding.[47] Conversely, lower housing costs result in more disposable income for essential non-housing needs, allowing a more balanced and healthier lifestyle.

Homelessness

Homelessness can lead to exposure of communicable diseases, violence, and malnutrition, and is closely connected to declines in physical and mental health due to lack of access to food and protection from harmful weather, limited resources, and barriers to care. High-stress, unhealthy and dangerous environments and an inability to control food intake often results in visits to emergency rooms and hospitalization.[48]

In San Diego County, homelessness increased by 5 percent from 2016 to 2017, with an approximate 9,116 homeless people countywide in 2017.[49] To address growing concerns of widespread homelessness, the San Diego Regional Task Force on the Homeless administered nearly $3.2 million in grants in the last fiscal year and more than $960,000 to support rapid rehousing programs. Additionally, the San Diego Housing Commission established the "Housing First" initiative over three fiscal years (FY 2018 to FY 2020) to direct $79.7 million in resources for six programs that will provide permanent housing opportunities for 3,000 homeless persons in San Diego.[50]

Environmental Quality

Research suggests that low-income and minority communities are more likely to live near busy roadways and major highways.[51] Studies also have found consistent associations between living in proximity to a busy roadway and respiratory disease symptoms, including asthma and poor lung function. Diesel particulate matter from truck and train engine exhaust has acute short-term impacts and disproportionate effects on the elderly, children, people with illnesses, and others who are sensitive to air pollutants. Health risks increase with closer proximity to high-volume roadways.[52] In addition, truck routes on local streets contribute to traffic congestion, which may lead to unsafe conditions for pedestrians and bike riders. Conversely, in dense communities where mixed use provides access to goods and services, there is a need for delivery trucks which can contribute to traffic congestion and sometimes cause conflicts with pedestrians and bike riders. Trade-offs in the decision-making process for physical health benefits or smart growth developments can sometimes outweigh location near or next to busy roadways.

Traffic also is a significant source of environmental noise. Chronic noise exposure can result in sleep disturbance, cognitive impairment in children and adults, adult hypertension, and stress hormone activation.[53] Except for low-emission and natural gas-powered vehicles, traffic directly contributes to air pollution and greenhouse gas (GHG) emissions. These emissions and other air pollutants, including ozone and particulate matter, are risk factors for cardiovascular mortality and respiratory disease and illness.

Street trees provide multiple benefits and can mitigate some of the negative effects of roads and vehicle emissions. Trees capture air pollution, reduce carbon dioxide, and increase oxygen levels.[54] Trees close to traffic have been found to absorb nine times more pollutants than distant trees. In addition to the numerous environmental benefits, trees in urban areas also provide social benefits.

Studies show that urban street trees can facilitate stress reduction and better mental health.[55] Speeding vehicles can endanger pedestrians and bike riders, posing additional safety concerns in neighborhoods.[56] Street trees have shown to have a calming effect on traffic, causing motorists to slow down.

Access to Healthy Food

The health impacts of a poor diet are costly. In the United States, it is estimated that healthier diets might prevent $84.2 billion per year in medical costs.[57] In San Diego County, 494,439 residents—and one in five children—currently are food insecure (i.e., uncertain of being able to secure sufficient food for self or family).[58] A growing body of research points to the neighborhood food environment as a major contributor to poor dietary choices and ultimately, the poor health of a community. [59] Land-use practices and policies can help increase access to healthy food and improve public health.

There are many strategies for the development of healthy food environments: farmers' markets and farm stands, grocery stores, healthy corner store conversions (modifying existing neighborhood retail establishments to carry a wider variety of healthy foods), community gardens and urban farms, farmland protection, farm-to-institution (i.e., food from local farms to institutions such as schools, government, corporations, hospitals, and colleges in the region), and many other strategies. In order to implement any of these strategies successfully, a community must have supportive business, economic, and land-use policies and regulations. Additionally, policies and regulations should allow for both individual and commercial food production in order to foster community resilience and greater food access for individuals of all backgrounds, cultures, and socioeconomic statuses.

Community gardens and urban agriculture can provide a source of fresh fruits and vegetables for users, increase physical activity, and provide opportunities for social interaction. Locally produced food helps attain other benefits, such as sustaining the local economy and reducing long-distance shipping, thereby decreasing vehicle emissions, which are associated with chronic diseases and global climate change.

The City of San Diego passed model community garden and urban agriculture zoning regulations in 2012. Community gardens are allowed by right in all residential and commercial zones. The urban agriculture zoning ordinance allows for small-scale animal husbandry (i.e., beekeeping or the keeping of chickens or miniature goats), small urban farms of four acres or less, and the sale of local agricultural goods. Regulation changes allow for on-site community garden sales, farmers' markets on both public and private property, and the sale of locally unprocessed, non-valued products in commercial zones on both public and private property.

These practices allow for community residents of all income levels to produce foods in an affordable manner that protects and promotes public health. Additionally, they create economic opportunities for small and medium sized growers.

Farmers' markets can provide another source of fresh, locally produced fruits and vegetables that can help residents meet the recommended daily servings of healthy food. Healthy food is generally low in fat and saturated fat, contains limited amounts of cholesterol and sodium, and provides natural vitamins. Farmers' markets may be particularly important in areas lacking full-service grocery stores.

The presence of a grocery store or food market in a neighborhood correlates with higher fruit and vegetable consumption, reduces the prevalence of being overweight and of obesity, and reduces the incidence of hunger and malnutrition.[60]

Neighborhood studies demonstrate that where there are high numbers of fast food restaurants compared to grocery stores, there also are higher rates of diabetes, cardiovascular disease, and cancer.[61] Increasing the number of full-service grocery stores relative to fast food restaurants in neighborhoods can help to combat these health conditions. The concentration of grocery stores varies throughout the San Diego region. Programs that create opportunities to purchase healthy food options at corner stores can help alleviate the burden to communities with fewer full-scale grocery stores.

For example, Project New Village is a non-profit organization that works to improve fresh food access in southeastern San Diego as part of a broad-based movement to build healthy neighborhoods. Project New Village uses neighborhood-based agricultural cooperatives as strategies of resistance to food insecurity and aims to remove barriers that impede universal access to good food through community/civic engagement and building alternative food ecosystems. Project New Village also operates a farmers' market and community garden to improve access to healthy, fresh foods for residents of southeastern San Diego.[62]

Transportation access to healthy food, including transit, bike, and pedestrian facilities, also is an important consideration, especially in low-income and minority communities.

Access to Regional Food Systems

The development of regional food systems, or "food hubs," supports locally grown and healthy food. Regional Food Hubs are defined as "integrated food distribution systems that address agricultural production and the aggregation, storage, processing, distribution, and marketing of locally or regionally produced food products."[63] Local food hubs have been shown to reduce the redundancy inherent in small-scale food systems by providing a platform for producers to collectively meet consumer demand within a region—primarily prior to the product entering the global market. Although studies have been conducted to examine the feasibility of regional food hubs[64] and advocate for the establishment of more localized food hubs,[65] San Diego County presently lacks its own Regional Food Hub. Instead, the Los Angeles terminal market acts as a proxy wholesale distribution center. A San Diego Regional Food Hub could reduce the redundant transportation miles that are accrued by producers and distributors alike.

San Diego County's propensity toward organic fruit and vegetable production and small farms presents a unique opportunity in the advancement of the local economy, the environment, and public health. Though San Diego County produces more than 200 types of fruit and vegetable crops, each year valued at $630 million, it is estimated that only 10 percent of the fruits and vegetables grown in San Diego County are consumed locally as of 2010.[66]

Further economic gains could be made by exploring expanded land-use policies and regulations across the county that encourage local procurement, using and renovating existing infrastructure, and investing in new technologies to create new market opportunities. Simultaneously, these efforts help increase access to healthy, locally produced foods. Studies continually link farm-to-institution programs with increases in school meal participation and fruit and vegetable selection by students.

In addition to a Regional Food Hub, other food-related businesses such as food processing facilities, commercial kitchens, and shared programs such as "kitchen incubators" have been implemented in other regions to facilitate a more diverse local food system while creating more jobs and entrepreneurial opportunities. These types of businesses also are materializing in the San Diego region.[67] Kitchen incubator programs can lower the cost of entry for entrepreneurs by providing shared kitchen facilities and equipment on an as needed basis to small catering companies, pushcart vendors, bakers, specialty-food makers, and other food-based businesses.[68]

Access to Healthcare Facilities

In a healthy community, residents have adequate transportation access to healthcare facilities. People need to be able to get to many places, including to the doctor, regardless of income or background. The availability of medical services throughout the community, paired with a variety of transportation options to access those services, helps increase access to healthcare facilities. As the region's population continues to age,[69] the need for adequate transportation access to healthcare facilities will continue to grow. Many Metropolitan Planning Organizations, including SANDAG, work with Consolidated Transportation Service Agencies and other specialized transportation providers to coordinate transportation services for seniors and individuals with disabilities, and provide grants for specialized transportation programs to expand mobility options for seniors and the disabled. These programs provide critical services that enhance access to healthcare facilities for our most vulnerable populations.[70] As part of its 2018 Coordinated Plan update, SANDAG is in the process of developing a long-term Specialized Transportation Strategic Plan to address the increasing specialized service needs of seniors and persons with disabilities. This plan was identified as a Near-Term Action for implementation in the 2015 Regional Plan.

The 2015 Regional Plan included a Social Equity Analysis that analyzed the percentage of the population within 15 minutes goods and services (by driving alone, carpooling, taking public transit, and walking) including hospitals, community clinics, and medical offices. The analysis showed that the transportation investments included in the 2015 Regional Plan provided better access to healthcare for seniors, low-income, and minority populations via all transportation modes than without the investments.[71] A similar analysis, as well as continued implementation of specialized transportation services and programs, will be important in the development of the 2019 Regional Plan.

Public Safety

Community design affects social interactions, which in turn may affect violence. Violence has a negative effect on the physical and mental health of victims and their families, friends, and neighbors. It also negatively impacts the social and economic well-being of the neighborhood, influencing business investment, job and housing security, educational attainment, resident participation in community development, and community integration.[72] When neighborhoods are well designed, the resulting social cohesion contributes to lower rates of crime and violence and, therefore, better health outcomes.[73]

Design factors associated with levels of perceived and actual neighborhood safety include sidewalk cleanliness and width, street design for pedestrian safety and speed control, street lighting and street trees, number of liquor stores, degree of community isolation, and access to services and housing for low-income persons. Other factors include the presence of drugs or gangs, police presence, availability of weapons, employment, and access to community activities for families and youth.[74]

Many communities are adopting a multi-disciplinary approach, known as "crime prevention through environmental design," to help make their neighborhoods safer through environmental design.[75]

A table discussing built environment strategies, policy considerations, and community health outcomes is included at the end of this white paper.

Existing National, State, Regional, and Local Efforts

A number of existing policies, plans, and programs at the national, state, regional, and local levels support planning and implementation for healthy communities in the San Diego region. Some of the major efforts are described below.

National Plans and Programs

Joint Call to Action to Promote Healthy Communities

The Joint Call to Action brings together eight national organizations and calls on members to collaborate with one another to create healthier, more equitable communities. Signatories include the American Institute of Architects, the American Planning Association, the American Public Health Association, the American Society of Civil Engineers, the American Society of Landscape Architects, the National Recreation and Park Association, the U.S. Green Building Council, and the Urban Land Institute. As signatories, the national organizations work to build relationships, establish health goals, implement strategies to improve health, and share expertise.[76]

American Planning Association, Plan4Health, and Planners4Health Programs

Plan4Health is a partnership between the American Planning Association (APA) and the American Public Health Association that leverages planners' roles as collaborators and conveners to improve health outcomes. Plan4Health includes 35 local coalitions of public health and planners supporting place-based work.[77] Planners4Health is the final iteration of the Plan4Health program and is focused on integrating health into the planning process via local APA chapters. Planners4Health includes more than two dozen local APA chapters, including the local San Diego APA section, building capacity to address health at the chapter level.[78]

American Association of Retired Persons and World Health Organization Network of Age-Friendly Cities and Communities

Nationally, trends show that our country's population is aging. According to the American Association of Retired Persons (AARP), one-third of the population is currently 50 years or older, and by 2030, 20 percent of our nation's population will be 65 years or older. Local trends line up with the national trends. Currently, about 12 percent of the San Diego region's population is 65 or over. By 2050, it is expected that nearly 20 percent of the population will be ages 65 and over.[79] The AARP Network of Age-Friendly Cities includes more than 200 communities in which elected leaders have made the commitment to actively work towards making their city or county a great place for people of all ages. The AARP Network of Age-Friendly Communities is an affiliate of the World Health Organization (WHO) Age-Friendly Cities and Communities Program which was launched internationally in 2006 to help cities prepare for growing aging populations. Local jurisdiction members include the City of Chula Vista and San Diego County.[80] In light of the needs of the aging population, the AARP and the WHO provide toolkits, fact sheets, books, and other resources to help communities become more livable and more age-friendly for all.[81]

State Plans and Programs

General Plan Guidelines

The California Governor's Office of Planning and Research published its updated 2017 General Plan Guidelines that serves as a resource for local cities and counties. The updated guidelines contain significant changes, including a new section on healthy communities that provides strategies and approaches for incorporating health considerations into general plans. In addition, the 2017 General Plan Guidelines emphasize correlations between healthy communities and other required elements in the general plan.[82]

Health in All Policies

Health in All Policies was established by the Public Health Institute to incorporate health considerations into decision-making across sectors and policy areas. The Public Health Institute works with local governments to support the incorporation of a Health in All Policies approach through one-time consultations, trainings, and in-depth partnerships. In 2010, the California Department of Public Health and the Public Health Institute established the Health in All Policies Task Force, which brings together 22 departments, agencies, and offices from across California State Government to identify priority programs, policies, and strategies to improve the health of Californians.[83]

Regional Plans and Programs

San Diego Forward: The Regional Plan

The SANDAG Board of Directors adopted the 2015 Regional Plan on October 9, 2015. The 2015 Regional Plan combines the big-picture vision for how the San Diego region will grow by 2050 with an implementation program to help make that vision a reality.

In an effort to bring greater focus to the new and emerging topic areas of the 2015 Regional Plan, SANDAG staff prepared a series of white papers to help inform the development of the plan. The intent of the white papers was to support and provide background information for the 2015 Regional Plan and to serve as its appendices. Four white papers, focusing on issues related to public health and the built environment, economy, climate change, and technology, were prepared. These topics were consistent with the vision and goals approved by the SANDAG Board of Directors, which centered around Vibrant Economy, Healthy Environment and Communities, and Innovative Mobility and Planning. All of the white papers, including the Public Health White Paper, can be found in Appendix Q of the 2015 Regional Plan. The Public Health White Paper for the 2015 Regional Plan was the first SANDAG-prepared white paper focused on public health, and it included input from the Public Health Stakeholders Working Group, which was established during the development of the 2015 Regional Plan to provide a broad-based foundation for the inclusion of health issues in the regional planning context. This current white paper, prepared in 2018, builds on that first white paper and incorporates information that is new since 2014 in order to help inform development of the 2019 Regional Plan.

TransNet Sales Tax Ordinance

TransNet is the half-cent sales tax for local transportation projects that was first approved by voters in 1988, then extended in 2004 for another 40 years beginning in 2008. Administered by SANDAG, the program has been instrumental in expanding the region's transportation system, reducing traffic congestion, and bringing critical transportation programs to life. During the 60-year life of the

program, billions of dollars will be generated and allocated toward highway, transit, and local road projects in the region.

The *TransNet* extension ordinance approved in 2004 dedicated 2 percent of revenues to the Smart Growth Incentive Program (SGIP) and 2 percent of revenues to the Bicycle, Pedestrian, Neighborhood Safety, and Traffic Calming Program (now the Active Transportation Grant Program, or ATGP). These grant programs provide funding for the planning and construction of street improvements along local corridors and intersections, such as sidewalks, crosswalks, streetscape enhancements, and other pedestrian upgrades, traffic calming measures, and safety measures. The SGIP supports compact, mixed-use development and more housing and transportation choices in the Smart Growth Opportunity Areas located on the SANDAG Smart Growth Concept Map through planning and infrastructure grants.

Since these two programs were launched in 2009, the Board of Directors has awarded more than $50 million in *TransNet* funds, leveraging more than $34 million in local matching funds, for a total investment of more than $80 million throughout the San Diego region. Through the three funding cycles issued to date, more than 100 SGIP and ATGP projects have been awarded funding, including 43 SGIP grants (23 capital grants and 20 planning grants) and 64 ATGP grants (34 capital grants and 30 planning, bike parking, and educational grants). More than 70 percent of the projects have been completed.

A fourth cycle of funding will be awarded in mid-2018, with more than $30 million of funding for allocation. The fourth cycle includes two new eligibility requirements for local jurisdictions. In order to receive funding for smart growth and active transportation projects, jurisdictions need to have adopted Climate Action Plans and Complete Streets Policies. The fourth cycle provides funding to assist jurisdictions to finalize these documents if they have not already adopted them. These new eligibility requirements help the region move toward a more comprehensive network of complete streets, and supports the preparation of local policy documents that further statewide climate planning goals.

Board Policy No. 31: *TransNet* Ordinance and Expenditure Plan Rules, Rule 21, provides guidance on section 4(E)(3) of the Ordinance, which requires routine accommodation of bicyclists and pedestrians in all *TransNet*-funded projects. The guidelines address all aspects of the program, including highways, public transit, and local roads.

Regional Complete Streets Policy

The SANDAG Board of Directors adopted a Regional Complete Streets Policy in 2014. Complete streets planning efforts provide a process to ensure that the transportation system is safe, useful, and attractive for all users of the transportation network. The policy was incorporated into the 2015 Regional Plan. Since the adoption of the policy and its incorporation into the 2015 Regional Plan, SANDAG created a complete streets web page, drafted a certification form template to use when assessing regional transportation projects for compliance with the Regional Complete Streets Policy, developed an initial database/mapping tool for use in completing the certification forms, and prepared a complete streets checklist as an optional resource for use by local jurisdictions.

Active Transportation Implementation Strategy Framework

With the adoption of the 2050 RTP/SCS in 2011, the SANDAG Board of Directors made an unprecedented commitment to Active Transportation. The plan included Safe Routes to School and

Safe Routes to Transit strategies, the Regional Bike Plan, and other related active transportation efforts at SANDAG. Work completed to date, described below, will both inform and address active transportation in the 2019 Regional Plan.

Safe Routes to School Programs

At the local level, a number of jurisdictions have initiated comprehensive Safe Routes to School programs in order to encourage more walking and biking to school. For example, the City of Chula Vista collaborated with education, public health, and community partners on the Healthy Eating Active Communities campaign with the goal of improving access to healthy food and physical activity in schools and neighborhoods.[84] SANDAG approved a Regional Safe Routes to School Strategic Plan to guide future agency involvement in promoting walking and biking to school as safe and attractive travel choices.

Safe Routes to Transit

The Safe Routes to Transit Program identifies projects and programs that provide bike and pedestrian access around existing and planned transit stops and stations. SANDAG will work closely with local jurisdictions to identify opportunities to complement projects and programs identified in their bike and pedestrian plans.

San Diego Regional Bike Plan

The Regional Bike Plan, adopted in May 2010, establishes a network of regional bikeway corridors for intercommunity bike travel and proposes a comprehensive set of programs to support biking in order to make riding a bike a practical transportation choice in the San Diego region. In 2013, the Board of Directors adopted the Regional Bike Early Action Program, which authorized borrowing up to $200 million against future *TransNet* Active Transportation Program funds to accelerate development of the highest priority project in the Regional Bike Plan.

iCommute Transportation Demand Management Program

The goal of the iCommute program is to manage and reduce traffic congestion during peak-times, as well as to reduce GHG emissions and other environmental pollutants that result from commuters driving to work each day alone. iCommute plays a vital role in promoting active transportation through employer outreach; administering the regional bike parking program and regional bike map; bike education programs for schools, community organizations, and employers; and marketing and outreach efforts such as Bike to Work Day. In addition, iCommute administers the GO by BIKE mini-grant program, wherein grants of up to $3,000 are available for programs or projects that promote biking through education and outreach. A reference guide for local jurisdictions, entitled "Integrating Transportation Demand Management into the Planning and Development Process," was completed in May 2012.

Regional Mobility Hub Implementation Strategy

The 2015 Regional Plan included a Near-Term Action to develop a Regional Mobility Hub Implementation Strategy. Mobility hubs are places of connectivity where different modes of travel—walking, biking, transit, and shared mobility—converge, and where there is a concentration of employment, housing, shopping, and/or recreation. Mobility hubs provide an integrated suite of mobility services, amenities, and technologies to bridge the distance between high-frequency transit and an individual's origin or destination. Mobility hubs can promote active forms of travel to and from high-frequency transit services by offering safe and convenient walkways, crossings, and

bikeways; bike parking options; and shared mobility modes like bikeshare and rideables (e.g., electric scooters and motorized boards).

SANDAG recently completed key deliverables of the Regional Mobility Hub Implementation Strategy, which can be found at SDForward.com/RegionalMobilityHub. These deliverables include a Mobility Hub Features Catalog, technical memos that provide guidance on mobility hub implementation and equity considerations, profile sheets for eight mobility hub prototype locations in the region, and conceptual designs for three of the prototype locations. The catalog illustrates the types of services, amenities, and technologies that can work together to make it easier for people to connect to transit while also providing enhanced mobility options. The catalog serves as a resource for jurisdictions, transit operators, and private mobility service providers as they collaborate to design and implement mobility hubs around the region. The prototypes demonstrate how mobility hub services and amenities can be tailored to meet specific community needs. SANDAG is working with the City of Oceanside to develop a three-dimensional mobility hub visual simulation for the Oceanside Transit Center prototype location. Analysis also will be performed to identify a regionwide mobility hub network.

Healthy Works Project

In March 2010, the County of San Diego Health and Human Services Agency (HHSA) received $16.1 million from the federal Centers for Disease Control and Prevention through the American Recovery and Reinvestment Act for the Healthy Works I project/Communities Putting Prevention to Work. The overarching goal of the program was to expand the use of evidence-based, community-wide strategies that focused on environmental systems and policy changes, resulting in increased levels of physical activity, improved nutrition, and decreased prevalence of being overweight and of obesity. To achieve this goal, HHSA partnered with SANDAG on a variety of projects aimed at increasing levels of physical activity and access to healthy food and nutrition. Phase I of the Healthy Works program, which was supported by $3 million in grant funds, was completed in March 2012.

In September 2011, HHSA received another CDC grant, the Community Transformation Grant, and chose to partner with SANDAG again to build on the successes of the Healthy Works Phase I projects. SANDAG and HHSA initiated the Healthy Works Phase II projects in July 2012 to implement a Safe Routes to School Strategic Plan and a Regional Complete Streets Policy, refine the Public Health and Wellness Policy Framework and Performance Measures for consideration in the current regional plan update, establish a monitoring and evaluation program to assist in quantifying outcomes of active transportation projects and programs, and explore and develop new tools and resources to assist agencies throughout the region in conducting health analyses on transportation and land use-related projects.

Public Health Elements for General Plans

A number of jurisdictions in the San Diego region have adopted public health elements as part of their general plan updates. These include the Cities of Chula Vista, Escondido, La Mesa, National City, San Marcos, and Vista. Encinitas and Lemon Grove currently are in the process of developing public health elements for their general plans.

San Diego County Childhood Obesity Initiative

In 2006, the County Board of Supervisors launched the Call to Action: Childhood Obesity Action Plan for San Diego County. Representing a collaborative effort of numerous partners and stakeholders,

the Action Plan paved the way for the funding and formation of the San Diego County Childhood Obesity Initiative (COI), which serves to engage partners and ensure the effective implementation of the strategies outlined in the Call to Action.

The initiative, funded by the County of San Diego and coordinated by Community Health Improvement Partners, is a public/private partnership whose mission is to reduce and prevent childhood obesity in San Diego County by creating healthy environments for all children and families through advocacy, education, policy development and environmental change. COI consists of seven domains, including government, healthcare, schools and after-school, early childhood, community, media, and business. The government domain component addresses health in the built environment.[85]

Live Well San Diego

Live Well San Diego (LWSD) is the County of San Diego's roadmap for the future to achieve the vision of a safe, healthy, and thriving county. To achieve this vision, the County created a framework embracing four main themes: building a better service delivery system, supporting healthy choices, pursuing policy and environmental changes, and changing the culture from within the organization to support positive health outcomes. LWSD is a shared agenda for collaboration and action involving partner organizations in all sectors including government agencies, businesses, schools, healthcare providers, and faith-based and community organizations. The County Board of Supervisors recognizes partners who demonstrate a strong commitment to LWSD principles and who put that commitment into action. SANDAG is a recognized partner of the *Live Well San Diego* vision.

Border Health Program

The County Office of Border Health was established in February 1993 with the goal of facilitating communication and collaboration among local, state, and federal organizations working in the United States-Mexico border region. Local and cross-border health activities include coordinating binational meetings among public health officials and practitioners, organizing binational symposiums on a variety of shared health topics, facilitating communication around communicable disease control and prevention, and preparing for public health emergencies and threats. The Border Health Program's mission is to promote a healthy California-Baja California border region by working together with partners to address the needs of the shared community through streamlined communication, education, resource sharing, and partnerships to prevent disease, empower communities, and assist in responding to health threats and disasters.[86]

Public Health Data and Tools

The California Communities Environmental Health Screening Tool

Senate Bill 535 (De Leon, 2012) directs the California Environmental Protection Agency (CalEPA) to identify disadvantaged communities based on geographic, socioeconomic, public health, and environmental hazard criteria. In order to accomplish this, CalEPA utilizes the California Communities Environmental Health Screening Tool (CalEnviroScreen) to map out environmental, health, and socioeconomic data at a census-tract level across the state. The most recent version, CalEnviroScreen 3.0, includes updates related to information on pollution along the California-Mexico border and the addition of new indicators reflecting health and socioeconomic vulnerability to pollution.[87] Several state agencies use CalEnviroScreen in the implementation of various grant programs. Many of these programs are funded from California's Greenhouse Gas Reduction Fund.

Examples of some statewide grant programs that require the use of CalEnviroScreen to identify disadvantaged communities include the Sustainable Communities Planning Grants and Incentives Program; Affordable Housing and Sustainable Communities Program; and Transit and Intercity Rail Capital Program.

Healthy Communities Data and Indicators Project

The Healthy Communities Data and Indicators project is a collaboration between the California Department of Public Health and the University of California San Francisco, with funding from the Strategic Growth Council, that provides a standardized set of statistical measures and tools that a diverse array of sectors can use for planning healthy communities and evaluating the impacts of plans, projects, and policies on community health. The indicators for this project were based on the Healthy Community Framework developed by the Health in All Policies Task Force.[88]

Live Well San Diego Data Access Portal and Open Performance Dashboard

The *Live Well San Diego* data access portal was developed by the San Diego County Health and Human Services Agency to provide information on the most recent demographic, economic, behavioral, and health data available by communities in the San Diego County. The open performance dashboard is an interactive data tracking and visualization tool that reports progress over time on *Live Well San Diego's* top ten indicators and related measures.[89]

Health-Related Performance Measures in San Diego Forward: The 2015 Regional Plan

The 2015 Regional Plan used performance measures to help evaluate multimodal transportation network scenarios against one another, which were used to show the performance of the network included in the final version of the Regional Plan. For the 2015 Regional Plan, two new performance measures that examined transportation-related physical activity were added to the performance measures included in prior plans. Additional metrics highlight housing and employment near transit and bicycle facilities, access to jobs and higher education, medical care, parks and other destinations, and air quality and climate change measures. The performance measures currently are being updated for the 2019 Regional Plan.

Interrelationships to Other Policy Areas

Public health is related to several other policy areas of the Regional Plan. The following sections describe how public health is interrelated to climate change, social equity/environmental justice, economic, and emerging technology considerations.

Public Health and Climate Change

It is well recognized that global climate change and changing weather patterns have a range of direct and indirect impacts on public health. Health effects from climate drivers such as rising sea-level, changes in precipitation patterns, and rising temperatures include increased injuries and premature deaths related to extreme weather events, changes in the prevalence and geographical distribution of foodborne and waterborne illnesses, and increased respiratory and cardiovascular diseases.[90] Severe weather fluctuations and more intense temperatures worsen drought, wildfire, and air pollution risks. Extreme weather and rising sea levels can result in higher counts of pollen and other aeroallergens that affect an estimated 300 million people with allergies around the world.[91]

San Diego County is expected to see rising temperatures and more frequent heat waves, as well as less frequent and more intense rainfall. It is anticipated that temperatures in 2050 will be 4.8 degrees Fahrenheit hotter than in 1985. Extended heatwaves and less nighttime cooling increase health risks associated with heat-related illness and cardiovascular disease and have greater impacts on vulnerable populations such as the elderly, children, low-income residents, and the chronically ill.[92]

Public Health and Social Equity/Environmental Justice

Health is determined in part by access to social and economic opportunities. Social and economic opportunities impact the resources that are available in communities, the quality of schooling, safety of workplaces, and cleanliness of air, water, and food. Social determinants of health are the conditions in which people are born, live, learn, work, play, and age that affect a wide range of health, functioning, and quality of life outcomes. Resources that enhance quality of life can have a significant influence on population health outcomes. Examples of these resources include safe and affordable housing, access to education, access to healthy foods, and access to emergency and health services.[93]

In San Diego County, substantial differences in health indicators and health-related behaviors exist in different socioeconomic groups. Low-income residents have a life expectancy below the county average, at 78 and 80 years, while residents of all other income groups have a life expectancy greater than the county average of 81 years. In comparison to the overall county, low-income communities are disproportionately affected by injury, chronic disease, communicable disease, maternal and child health indicators, and behavioral health outcomes.[94] The State of Childhood Obesity in San Diego County Report indicated wide disparities in childhood obesity rates by both race/ethnicity and economic status. In the 2014 to 2015 academic year, the childhood obesity rate for Hispanic students (23.1%) was more than double the rate for non-Hispanic students (10.8%) and almost 2.5 times higher than childhood obesity rates among white students (8.9%). In the same year, the prevalence of obesity for economically disadvantaged students (22.9%) was more than twice the rate than for students who were not economically disadvantaged (10.0%). These findings are important because Hispanic students represent approximately half of all public-school students in San Diego County with respect to race/ethnicity; similarly, low-income students account for half of all public-school students in San Diego County with respect to socioeconomic status.

Public Health and Economic Prosperity

The Economic Prosperity White Paper discusses economic conditions and trends in the San Diego region. In addition to the information included in the white paper, it is worth noting that the socioeconomic status of individuals and neighborhoods are intertwined with individual and community health because the local economy affects access to jobs, commerce, schools, healthcare facilities, and other resources that enable families to enjoy economic success and place-based health benefits. Therefore, health is influenced not only by the economic well-being of individuals and households but also by the economic well-being of communities.[95]

The population of San Diego is younger, better-educated, and earns more than the national average.[96] In addition, the region offers a diverse employment base, with the tourism, military, and innovation sectors making up one-third of the economy. Although San Diego offers an attractive economy, associated high costs of living, especially housing costs compared to wages earned, impact residents' quality of life. In the past five years, housing costs have continued to rise sharply while median household income has remained relatively flat, resulting in greater disparities between the

cost of living and income.[97] As such, San Diego County residents are spending more of their income on housing, approximately 28 percent, and have lower rates of homeownership as compared to other major metropolitan areas.[98] Housing affordability is a critical piece of the puzzle when it comes to public health, as well as in relation to the broader economic health of the region.

Public Health and Emerging Technologies

The Emerging Technologies White Paper provides a robust overview of technological and societal trends that have the potential to radically change how the region's transportation system is used in the future, and outlines potential policy considerations that could enable the region to harness the benefits and reduce the negative aspects of these trends. It presents research that demonstrates how technological advancements have the potential to improve safety, mobility, and efficiency, but recognizes that without proactive planning and policy interventions, the technologies could move the region away from its objectives by increasing sprawl, vehicle miles traveled (VMT), and GHG emissions, and by limiting access for disadvantaged communities. The paper also discusses some of the public safety benefits of connected and autonomous vehicle technology for people that walk and ride bikes, as well as the potential benefits of improved air quality with the expansion of Zero Emission Vehicles (ZEVs). Shared mobility options, like bikeshare and rideables, also present opportunities to increase physical activity levels and improve public health.

Additional research beyond the Emerging Technologies White Paper shows that the impact of single-occupancy vehicles on our health is costly. Non-ZEVs produce carbon emissions that pollute our air, contribute to rising GHG emissions, and impact the lives of more than 3,600 people per year in California alone.[99] More than 90 percent of the negative health impacts from cars result from the effects of physical inactivity, sitting, and chronic disease.[100] Urban-design and land-use policies that create disconnected street networks and land uses that reinforce automobile dependency have been shown to cause numerous physical, mental, and social health problems.

Connected and autonomous vehicles, or driverless cars, are an emerging technology that have the potential to remove human error, reduce traffic accidents, and significantly improve safety for all road users. The transition to autonomous vehicles is an opportunity to create more walkable, bikeable, sustainable, and safer cities that provide benefits for both residents and businesses with the right policies in place to guide their deployment. The main health impacts associated with driverless cars are likely to be based on how cities and regions change to accommodate them. In order to capitalize fully on this unique opportunity to create healthier, more sustainable cities, a diverse spectrum of professionals, including public health specialists, should be involved in the planning process.[101]

Policy Considerations

Now more than ever, urban planners and public health professionals understand the extent to which our transportation system, land-use patterns, and community design play a role in determining health outcomes in our communities. How SANDAG invests in transportation infrastructure that maximizes public health benefits, social interaction, and community cohesion is an important policy consideration. The integration of public health policy issues and performance measures into the 2019 Regional Plan will support achievement of the goal of "Healthy Communities and Environment" and track progress over time. Table 1 includes policy considerations for healthy communities.

Table 1: Policy Considerations for Healthy Communities

Built Environment Strategies	Policy Considerations	Community Health Outcomes
Access to active transportation and public transit	• Invest in transportation infrastructure that maximizes public health benefits, social interaction, and community cohesion • Complete streets, pedestrian- and bicycle-friendly neighborhoods, regional and local bicycle routes, safe routes to school and other destinations, traffic calming on neighborhood streets, and safe and convenient public transit within walking distance of homes/work	• Increased physical activity • Lower risk of traffic-related injury, • Reduced air and noise pollution • Lower GHG emissions • Improved neighborhood safety • Greater social cohesion
Access to parks and recreation	• Support parks, recreation, and trails within walking distance of homes/work • Joint-use facilities with school districts and other public agencies	• Increased physical activity • Improved mental health • Improved neighborhood safety • Greater social cohesion
Complete Neighborhoods	• Support development of features that create Complete Neighborhoods, which include healthy, walkable, bikeable, and vibrant communities with a variety of housing choices and access to goods, services, medical facilities, recreation, and jobs • Neighborhood-serving retail and public amenities within walking distance of homes • Retrofit of underutilized retail centers or corridors into mixed-use development	• Increased physical activity • Lower risk of injury • Reduced air and noise pollution • Lower GHG emissions • Improved neighborhood safety • Greater social cohesion • Greater access to goods and services • Reductions in vehicle miles travelled

Built Environment Strategies	Policy Considerations	Community Health Outcomes
Access to affordable housing and support for the homeless	• Promote the availability of a diverse range of housing types close to major job centers to reduce the length of commute trips and combined cost of housing and transportation, especially for lower- and moderate-income households • Continue to support the County of San Diego's efforts to reduce homelessness	• Lower housing costs result in more disposable income for essential non-housing needs, allowing a more balanced and healthier lifestyle • Lower homelessness rates reduce communicable diseases, violence, and malnutrition, as well as declines in physical and mental health
Environmental quality	• Encourage the location of major pollution sources away from sensitive uses, such as parks, homes, and childcare centers • Remediation of contaminated sites • Habitat and open-space preservation, including canyons in urban areas • Urban forests/greening	• Reduced risk of respiratory diseases • Reduced exposure to toxic substances • Improved mental health
Access to healthy food	• Improve access to healthy and affordable food and nutrition while also considering transportation access • Farmers' markets, community gardens, and healthier food options in corner stores	• Improved nutrition • Increased physical activity • Reduced incidence of hunger
Access to regional food systems	• Explore the development of a Regional Food Hub within San Diego County	• Increased food security • Lower GHG emissions
Designing for public safety	• Encourage active uses in streets and public space to promote public safety • Encourage use of crime-prevention through environmental design principles, including adequate street lighting	• Improved neighborhood safety • Greater social cohesion • Improved mental health • Lower risk of injury

Built Environment Strategies	Policy Considerations	Community Health Outcomes
Climate change	• Support efforts to protect residents, especially vulnerable populations such as the elderly, children, low-income residents, and the chronically ill, from health risks such as heat-related illnesses, cardiovascular disease, and premature deaths related to extreme weather events caused by climate change	• Reduced health and social disparities • Lower GHG emissions
Equity/ environmental justice	• Encourage healthy environment features that provide low-income and minority communities equitable access to green spaces, healthy food, complete neighborhoods, transit, housing, and active transportation options	• Reduced health and social disparities • Increased access to healthy food retail environments • Healthy and complete communities
Economic impact/ development	• Encourage greater housing affordability • Consider funding strategies that ensure funds for the development of "complete communities" • Identify the economic impacts of health food retail and agricultural tourism	• Economic well-being of individuals, households, and communities • Increased access to healthy food retail environments • Healthy and complete communities
Emerging technologies	• Involve a diverse spectrum of professionals, including public health specialists, in the transportation planning process	• Increased levels of physical activity • Reduced traffic accidents • Improved safety for all road users

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Economic Prosperity

WHITE PAPER

THE SAN DIEGO ASSOCIATION OF GOVERNMENTS

February 23, 2018

Contents

Introduction

As the San Diego Association of Governments (SANDAG) develops regional policies and programs to guide transportation infrastructure investments over the next three decades, the vision for San Diego Forward: The 2019-2050 Regional Plan (2019 Regional Plan) is "to facilitate the efficient movement of people and goods to support a sustainable and healthy region, a vibrant economy, and an outstanding quality of life for all." To help achieve that vision, the objective of this white paper is to help readers understand the complex interrelationship between the transportation system and the dynamic San Diego economy, and the role that SANDAG plays in both. In sum, it helps illuminate how transportation investments will help improve economic prosperity for the region. This white paper will provide some background for examining economic issues in the context of the 2019 Regional Plan, including background information and summary data on the current economy, a brief discussion of forecast trends, a description of interrelationships between economic prosperity and transportation and other Regional Plan topic areas, discussion of key economic considerations and policies to be included in the 2019 Regional Plan, and a description of the economic analysis to be conducted for the 2019 Regional Plan.

Economies are dynamic; they change, and change constantly. But the San Diego economic system always has been linked to our physical environment: the seaport brought the fishermen and the Navy; the Navy and the quality of life brought the high-tech sector; the proximity to the border enhanced international competitiveness; the beaches and weather brought the tourists. In turn, these industries helped shape the built environment of the region: the industrial waterfront, the military bases, the resorts, the convention center, the border crossings, and beach communities and cities. Overlaid on the local economic framework are factors outside local control. Globalization affects the structure of our economy, and national political decisions affect military and research expenditures and our relationship with Mexico.

The residents and policymakers of San Diego influence much of the region's economy, particularly the decisions that shape the built environment in which the economy functions. As we have come to understand the natural world better, the concept of "habitat" for plants and animals has become familiar. In many ways the infrastructure of our cities and towns—the transportation system, downtowns, industrial areas, public spaces—act as the habitat for our business community. Different businesses, like different species, thrive in various built habitats. These habitats are shaped by cities, planning agencies, counties, states, and the federal government, using tools such as zoning, tax policy, transportation investment, and other means.

The 2019 Regional Plan presents an opportunity to shape our business habitat for the 21st century. Over the next thirty years, billions of dollars will be invested in the San Diego region to create, maintain, and improve transportation and other infrastructure. The 2019 Regional Plan will provide a framework for much of the transportation infrastructure that will help determine how the region will grow and evolve.

This Economic Prosperity White Paper will begin by surveying current economic conditions in San Diego and examining some important concepts in economic development. Next, it will explore the interrelationship between the economy, transportation, and regional planning, with consideration of disadvantaged communities (for the purposes of this paper, low-income populations[1]), and the relationship between the economy and the environment. Lastly, this white paper will explore the

ways the 2019 Regional Plan might influence the regional economy, including a brief discussion of funding sources and opportunities.

Current Economic Conditions in San Diego

Existing Setting

The San Diego region is in an enviable economic position. The population of San Diego is younger, better-educated, and earns more than the national average. Average age is about 35.7, versus 37.9 for the U.S. as a whole; a higher percentage of San Diegans have Bachelor's degrees, Master's degrees, professional degrees, and PhDs than the U.S. generally; and median household income is over $70,000, which is $12,000 higher than the U.S. median.[2] San Diego's unemployment rate trends slightly lower than the national average, but our economy is diversified with sizable high-tech, education, health, military, and tourism sectors. The region also boasts a high quality of life, with excellent weather and one of the shortest average commute times of any major metro area in the U.S.[3] San Diego also has a diverse and multi-cultural population, and the busiest land border crossing in the world connecting it to an important economic partner – Baja California, Mexico.

Of course, the San Diego region also has its share of challenges, among them the high cost of living—particularly housing—compared to prevailing wages, as well as wait times at the border that are estimated to cost the region billions annually in lost output.[4] San Diego has an "hourglass economy" with many higher-paying jobs and many lower-paying jobs and relatively few in between; this type of divergence has been found in the national economy as well.

San Diego also is changing demographically. The region is forecast to get older, and more ethnically diverse, with the white population expected to go from roughly half of San Diego today to less than a third by 2050. By 2050, the region is expected to add almost 700,000 residents, almost half a million new jobs, and a nearly third of a million new housing units. Population growth primarily will consist of natural increase (i.e., births outnumbering deaths) and international immigration.[5]

History of the San Diego Economy

Once characterized as a sleepy Navy town, later as a tourist destination, San Diego's economy has diversified and matured over the last 75 years as the population has increased from under 300,000 to over 3.3 million residents. Before World War II, 70 percent of jobs in the local economy were in traditional sectors such as military, manufacturing, construction, finance, and retail and wholesale trade; today this figure is less than 50 percent. In 1940, The military accounted for about 20 percent of the region's employment. This figure ballooned to nearly half during the early 1950s and remained prominent throughout the Cold War.

The 1960s brought the emergence of the tourism and hospitality industry, the opening of the University of California, San Diego (UC San Diego), which became a key economic engine, and the approval of maquiladoras in Mexico, which allowed U.S. firms access to low-cost manufacturing. By the 1980s, tourism was booming, and the nascent life sciences sector was beginning to take root. Base Realignment and Closure shuttered the Naval Training Center in the early 1990s and helped reduce jobs in the military sector to today's 9 percent despite a steady military presence. The 2000s brought the dot-com bust, the September 11 attacks, and the Great Recession.

San Diego Economy Today

Today, San Diego boasts an economy that is not dominated by any one sector; in fact, no sector accounts for more than 15 percent of the regional economy. Several sectors are "economic drivers," specifically tourism, the military, and the "innovation" sector, which together make up a third of the regional economy. Tourism is an obvious strength, due in part to the weather, the beaches, the San Diego Zoo, and the Convention Center. The military is pivoting toward Asia and has committed to San Diego, as have many military contractors, like General Dynamics (makers of the Predator drone) and ViaSat (satellite communications leaders). Moreover, innovation will continue to drive San Diego's economy, with forward-looking technologies with massive growth potential from companies like QUALCOMM (pioneers in mobile phone technology), Illumina (revolutionized DNA sequencing with tremendous potential to improve healthcare and quality of life), and ESET (cybersecurity experts).

Figure 1

San Diego also fares well in industries like healthcare, education, and a lean government sector. These sectors are generally population-driven—they rise in tandem with population—and, like the economic driver sectors, have proven through the Great Recession to be less affected by economic cycles. In sum, "recession-resilient" sectors account for over 60 percent of the San Diego economy.

As mentioned, the San Diego economy is balanced and not reliant on any one industry, with no single sector accounting for more than 15 percent of regional employment. The diverse distribution of

employment helps buffer San Diego from economic downturns, with 60 percent of regional employment in recession-resilient sectors (i.e., sectors less impacted by national business cycles). The military and tourism provide a stable and diverse employment base, but the economy also is well-positioned for the 21st century, fueled by the next wave of business drivers, our innovation sector, which includes biotech and biomedical, information technology, cleantech, and aerospace jobs.

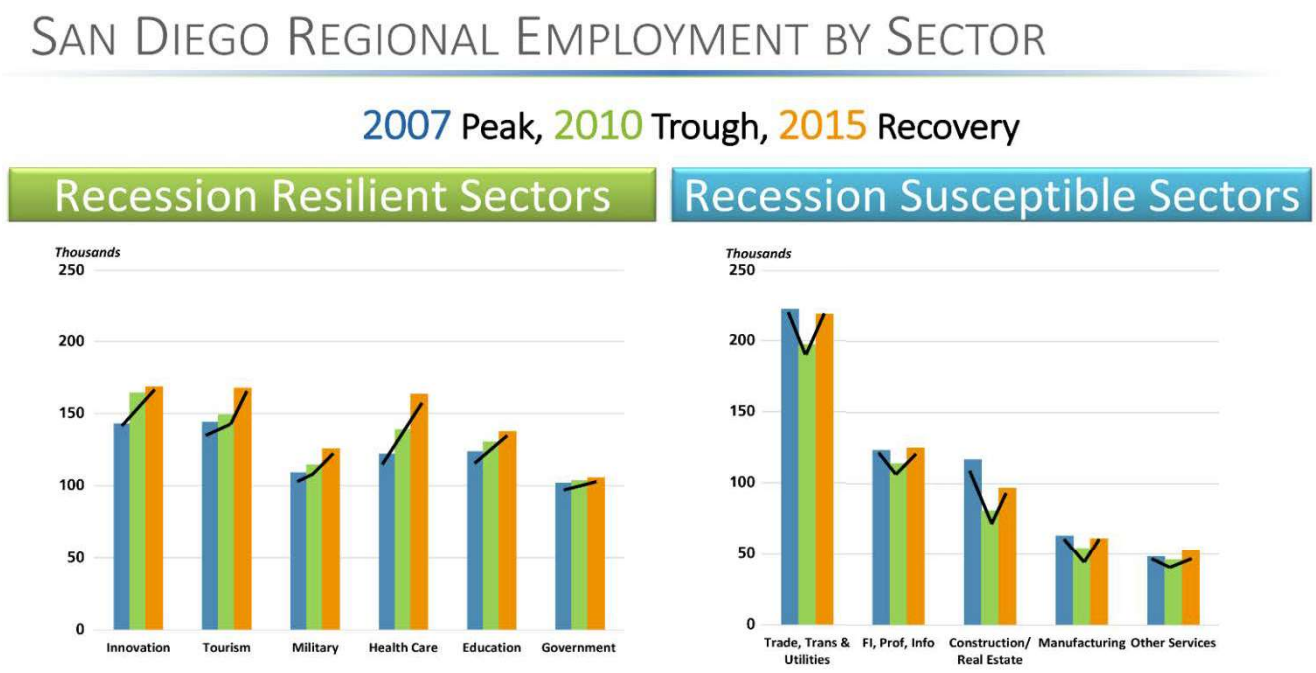

Figure 2

Much of San Diego's forward-looking economy can be traced back to our higher learning institutions and research facilities, like the Salk Institute, Scripps Institute of Oceanography, San Diego State University, the University of San Diego, California State University San Marcos, and UC San Diego. 19 institutions of higher education enroll 270,000 students in the region. UC San Diego specifically is a highly ranked research university that has spawned hundreds of businesses, many of which remain important local employers, and which together employ about 4 percent of San Diego workers. Moreover, UC San Diego's commitment to generating economic opportunity is evident through their business-friendly approach to licensing technologies to new startup companies that simplifies the transfer of copyrights and licenses for a minimal equity in the company.

Incubated by world-class research institutions, San Diego's Innovation sector has grown considerably over the last 25 years, posting a growth rate ten times that of the rest of the economy. It now represents nearly 12 percent of San Diego's local economy and employs almost 170,000 people in high-paying jobs. The innovation sector also is diverse, featuring information and communication technology, biotechnology and biomedical, aerospace and navigation, and "cleantech." San Diego is the third most patent-intensive region in the U.S., the top destination for National Institutes of Health research funding, first in life-sciences laboratory space, and the number one place in the U.S. to launch a start-up.

As noted, San Diego has a long and successful relationship with the military. San Diego's economy will benefit from the decision, dubbed the "Pacific Pivot," to reallocate 60 percent of military assets to the west coast over the next decade. During the next few years, 50 percent more ships will be berthed in San Diego, and billions of dollars will be invested by the Navy in infrastructure like the Navy Seal training facility. The presence of the military attracts $8.4 billion in government contracts each year, and 125,000 San Diegans (approximately 1 in 11) are directly employed by the military or the Department of Defense. Many of these jobs are highly skilled, and all generate indirect employment effects in many other sectors throughout the economy. With a large deepwater port, a dozen military installations, and a well-developed support economy, San Diego is an irreproducible ecosystem for the military.

Many people's first association with San Diego is as a tourism destination, and in large part, they are correct. San Diego is routinely listed as the number one domestic travel destination (e.g., in Money Magazine's 2016 assessment). As a result, San Diego's hospitality sector grew four times as fast as its overall economy during the past 27 years. Nearly 35 million visitors come to San Diego annually, bringing almost $10 billion into the regional economy. While tourism jobs pay slightly less than the average, they provide ample entry-level employment.

San Diego is home to the largest land crossing in the western hemisphere, and the economic impact is significant. Over the past decade (2008 to 2017), the value of trade through the border has risen by nearly a third.[6] The maquiladoras provide highly skilled workers in technologically advanced factories where costs can be a fraction of what they would be in the United States; many San Diego companies rely on this access to high-quality manufacturing.

The diverse and robust San Diego economy has resulted in strong job growth and low unemployment for San Diegans and a regional economy that is less susceptible to traditional business cycles. San Diego's unemployment rate stands, as of December 2017, at an exceptionally low 3.3 percent, lower than both California (4.3%) and the U.S. as a whole (4.1%).

The San Diego region is in the midst of a reassessment of past housing and development practices. In prior eras, it was assumed that housing would continue to spread east into the back-country; but jurisdictions throughout the county have responded to residents' concerns about sprawl and adjusted their general plans to concentrate growth in existing communities. Beneficially, much of the recent development has been in multi-family housing in downtown areas, which generally are less expensive and are attractive to younger, high-skill workers (and some senior buyers) who prefer active, vibrant communities. As open land acceptable for residential development is in short supply, demand continues to outstrip the pace of building, and while San Diego housing costs are less than those of comparable coastal metropolitan areas, prices and rents are higher than California or the U.S. as whole and represent a challenge to additional economic growth and to the economic well-being of many residents. For example, it is estimated that only about a quarter of the San Diego households can afford a median-priced home, despite historically low mortgage interest rates.

The San Diego economy is healthy, but it is tethered to the global, national, and state economies. Globally, the economies of both advanced and emerging nations have begun to retain momentum. According to the Organisation for Economic Co-operation and Development, global growth looks to be in the 3.7 percent range in 2018, which is improvement over previous years. Nationally, growth continues at a slow and steady pace, with the Federal Open Market Committee revising their growth forecast for 2018 up to 2.5 percent, and with the national economy seemingly shrugging off political

tensions. Wage growth also has begun to move forward after a decade of stasis. In California, the economy continues to overcome challenges, with significant growth in the high-tech, healthcare, and tourism sectors more than offsetting lagging sectors.

As the economy improves, the gains are not shared equally. While 130,000 new jobs were created in San Diego from 2010 to 2015, the average salary of new jobs was well was below the average salary for existing jobs, which decreased the average salary in the region. The healthcare sector is a prime example of this phenomenon; while almost 25,000 new jobs were created from 2010 to 2015, they were not primarily highly paid doctors and registered nurses, but home health aides and aides in residential facilities. The average salary in that sector fell from $56,000 to $42,000. Real hourly wages (hourly wages that have been adjusted for inflation) have been flat in San Diego for a decade, while costs, primarily housing costs, have risen precipitously. This stagnation produces circumstances where despite an economy with low unemployment and generally excellent health, many San Diego residents are not able to participate in the prosperity. In the long run, this divide can threaten the city's well-being if San Diego ceases to be an attractive place to live compared with cheaper areas and those with lower incomes see their opportunities dwindle and their economic potential go unfulfilled.

While analysis of the San Diego regional economy is revealing, it is important to note that the San Diego region is diverse and physically large, with 3.3 million residents, 18 municipalities and the County of San Diego, 17 Native American Tribes, a metropolitan area that shares an international boundary with Mexico, with military bases spanning north, central, and southern San Diego, and an area with an abundance of endangered species and sensitive habitat lands. The policies and economic issues that guide Downtown San Diego, for example, differ from those most relevant to the rural east or the beach communities. North County has different challenges than South County and the border area, and the Tribes have unique economic and cultural concerns.

Economic Development Partners

While SANDAG has many responsibilities as the Metropolitan Planning Organization, its primary responsibilities are in regional transportation planning. SANDAG influences local land use and economic policies through regional transportation investments in transit, highways, bike infrastructure, freight corridors, transportation demand management, transportation system management, and supporting programs, and through financial incentives such as grants from the *TransNet* Smart Growth Incentive Program, Active Transportation Grant Program, and Environmental Mitigation Program. SANDAG also influences land use and economic policies through technical assistance via the Smart Growth Toolbox and through localized and customized modeling and forecasting work. As a regional agency, SANDAG is uniquely positioned to bring together decision makers from all areas of the region to discuss issues of mutual concern and coordination.

In both economic research and policy, SANDAG collaborates with a variety of partners, including regional economic development corporations, chambers of commerce, municipal economic development departments, partners in Baja California, Tribal nations, and neighboring counties to strengthen the economy of the region. In addition, many of these groups, as well as local universities, work to understand the structure of the San Diego regional economy and explore ways to improve. The strategy is not about creating a specific economic plan, but about collaboration between stakeholders. These organizations research the region's economic strengths and shortcomings and identify the tools needed to reshape the economy; they also conduct economic studies such as

industry cluster and sector analyses, cross-border and export trade reports, infrastructure plans, and workforce and job training programs.

The San Diego Regional Economic Development Corporation (EDC) enhances regional economic competitiveness and supports the San Diego region's key industries, with policy priorities to improve the region's emerging industries, workforce, infrastructure, transportation, housing, and access to capital. Recent initiatives include a regional strategy to protect and grow San Diego's defense assets; a plan to boost San Diego's international profile; and a program focused on attracting and retaining top talent. The San Diego Regional EDC also works with other regional and local organizations to support research initiatives, including studies on the region's key industries, such as genomics.[7]

The San Diego Workforce Partnership (SDWP) funds job training programs to meet the region's demand for qualified workers, and researches the local labor market to identify goals and strategies designed to meet the needs of both employers and workers in San Diego County. The SDWP recently focused on "priority sectors" where employers need workers and on the roughly 43,000 "opportunity youth" in San Diego—young people between the ages of 16 and 24 who are neither working or in school.

The San Diego Regional Chamber of Commerce coordinates with other regional and local agencies on economic development and business policies, and produces and is a hub for business collaboration. The sub-regional EDCs initiate economic development plans, programs, and policies that build on regional initiatives. The South County Economic Development Council promotes economic development and investment in the southern part of the county, and encourages cooperation with businesses in Baja California. The East County EDC works to strengthen the economic base in the eastern part of the county. Likewise, the San Diego North Economic Development Council works in the northern part of the county to support the business community there. All sub-regional EDCs support localized cluster and sector studies as well as targeted business outreach to those clusters and sectors that support regional and sub-regional growth.

Although most municipal economic development organizations focus on local and site-specific strategies, many of their plans and policies align with regional plans and initiatives. For example, the City of San Diego recently administered the Business Improvement District program to promote local business. The City also operates Civic San Diego, a non-profit that focuses on economic development in underserved neighborhoods.

Emerging Concepts

For much of the last two decades, research in regional planning economics has focused on the effects of "smart growth" (sustainable development), specifically focusing on trends that have reinvigorated the centers of many American cities and metropolitan areas and creating new development in communities and neighborhoods of all sizes. Smart growth is of particular relevance to the urbanized areas of the San Diego region, which grew outward during the era in which automobile transportation was the most accessible option; local jurisdictions are seeking to redevelop many neighborhoods to accommodate population growth.

New research focuses on inequality and housing. By and large, the trends creating compact communities of mixed-use development served by public transit and allowing for active transportation such as walking and cycling are positive for the economy, potentially reducing environmental, transportation, and health costs while creating economic choice and a quality of life

that is attractive, especially to younger, high-skill workers.[8] While this type of growth can occur without significant additional traffic congestion, there are important limits to this type of development in many places, including in San Diego. First, as the dense centers of cities become more attractive, they become more expensive; this has led to skyrocketing housing costs even in the wake of a significant residential construction boom in denser areas of San Diego. The increase in housing costs can push poorer residents away from areas serviced by transit options that lower-income residents often rely on. There is evidence that lower-income residents are switching to private vehicles as they move further from city centers.[9] Second, the San Diego region has a highly dispersed development pattern, with a general lack of density. While the redevelopment of urban centers is positive, the region does not have either the strong central business district or the profusion of compact neighborhoods that make transit and other alternative modes a viable option for the majority of residents.[10]

SANDAG conducted an analysis of the region's commuting patterns,[11] and the results clearly show the dispersed nature of residents' travel patterns. 71 percent of residents commute to work outside of the jurisdiction in which they live. Similar results are true for businesses: the vast majority of their employees tend to come from outside the jurisdiction. As an example, the maps below show the place of work for employed Carlsbad residents (Figure 3), and where employees of Carlsbad businesses live (Figure 4). People live and work in highly diffused patterns—the pattern is clear and holds true for all jurisdictions in San Diego, which makes transit and active transportation challenging.

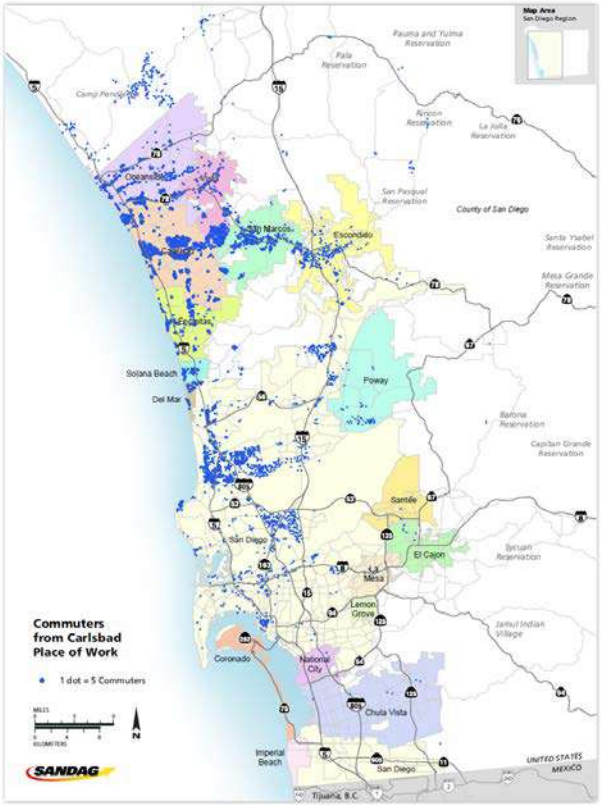

Figure 3

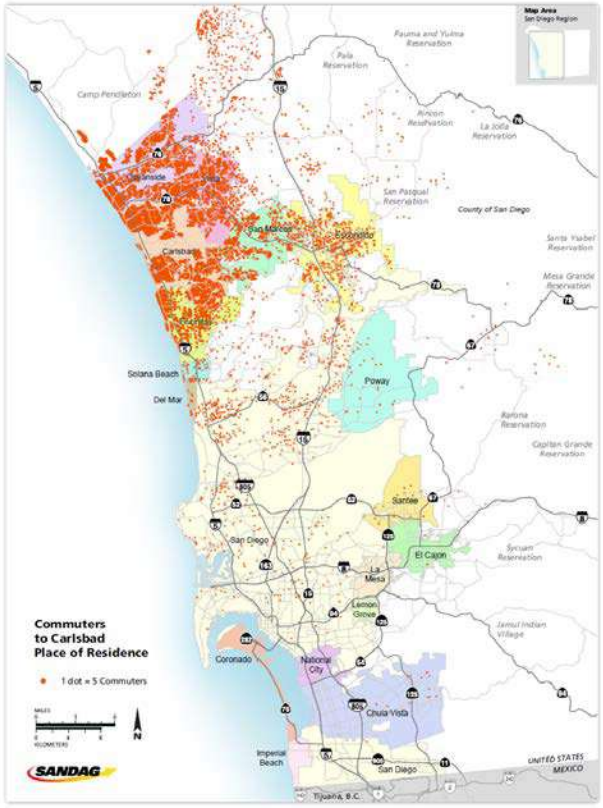

Figure 4

While the development trends of the last 70 years, suburbanization followed by re-emergence of city cores and denser development, offer some insights into how San Diego will continue to change,

emerging transportation technologies will play an increasing role in the transportation system, and will both respond to and help shape San Diego's development pattern, as well as the structure of the economy. Considerable uncertainty surrounds these technologies. Ridesharing services like Uber and Lyft could benefit transit by providing "last mile" solutions, or they could poach riders. Autonomous and connected vehicles could reduce traffic congestion by increasing efficiency, or could exacerbate it by encouraging people to live even further from work and amenities. Technologies to improve telecommuting could finally allow working from home to become common, as has been predicted for decades. Online shopping could reduce the need for personal trips, or could clog the roads with delivery vehicles. Intelligent transportation policy and infrastructure responses to the opportunities and challenges of these emerging technologies will be critical to ensure that the advantages outweigh the disadvantages.

The key point is that development patterns have economic consequences on housing prices, municipal revenues, business location decisions, and residential and employment opportunities. Development patterns also influence transportation options, which have economic consequences, such as the relative costs and benefits of highways and transit, accessibility of jobs and residential areas, traffic congestion and time consumed in commuting, health effects of transportation modes, and business development. Spatial patterns and associated transportation systems also have environmental impacts that have economic ramifications, such as the costs of pollution generated by differing transportation modes, and open-space and habitat-conservation needs. The effects of these patterns should be analyzed so that municipalities and economic development professionals can have the best information available to make complex decisions that affect land use and transportation investments.

By 2050, SANDAG forecasts that there will be roughly 700,000 more residents of San Diego County, nearly half a million new jobs, and almost a third of a million new housing units.[12] These growth numbers are substantially lower than previous estimates, and depend less on an influx of new residents, and more on natural increase (i.e., births outnumbering deaths of current residents). How these additional people, jobs, and houses fit into San Diego will determine the physical shape of the region, the transportation system, and the economy.

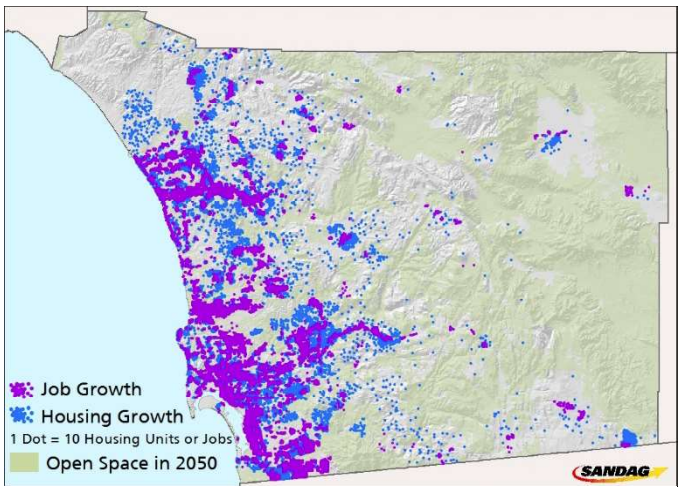

Figure 5

Local general plans have been modified significantly over the last decade to accommodate growth within the most urbanized areas of the region where there is existing and planned public transit. These changes in local plans support and reinforce investments in transportation and housing options

for the region's residents. Figure 5 shows expected job and housing growth to 2050 with job growth in purple and housing growth in blue, showing that the vast majority of development will occur within the already developed footprint.

A key question of the San Diego regional economy in the coming years is: will we successfully invest in transportation to connect the population in San Diego with an adequate supply of well-paying jobs for which they are prepared, and to an adequate supply of housing they can afford?

Interrelationships

How Transportation and Regional Planning Can Influence the San Diego Economy

As noted, the infrastructure of a region, including the transportation infrastructure, forms part of the economic "habitat" in which businesses engage in their fight for survival. As different animal and plant species thrive in different conditions, so do different businesses require a variety of conditions. As thriving ecosystems that support many types of adaptable species are more resilient and rich in a biological sense, diversified economies like San Diego's also are likely to be resilient and prosperous.

In economic terms, public infrastructure is a "public good" in that it loosely meets the definition of being both non-excludable (i.e., difficult to prevent people from using) and non-rivalrous (i.e., one person's use of the good does not inhibit another's). In economic theory, the private market does not provide optimal levels of public goods, and the common solution for this market failure is government provision of the good. As governments seek to make sound investments in provision of public goods, they must weigh competing projects and the expected rates of return (which are difficult to measure in this context) and gauge the optimal level of the resource overall, as businesses do.

The transportation system acts as the economic circulatory system, allowing businesses to access raw materials, ship finished goods, and reach customers and providing a way for employees to get from home to work. A healthy economy requires a healthy circulatory system, and the San Diego region is fortunate to have a system that includes robust freeways and arterials, multiple airports, a seaport, expanding bikeways and active transportation options, a growing transit system, and shared-use mobility services. This transportation system includes connection to Mexico, a critical trading partner, as well as to the surrounding counties and 17 Native American Tribes.

The transportation system does not simply support the economic activity in a region: transportation (and related land-use decisions) influence the economy. To explore these interrelationships, it is instructive to explore patterns of employment and housing in the San Diego region, the economic activity that transportation and land use decisions generate, and the challenges and opportunities facing them.

Many of San Diego's economic sectors are physically clustered in "employment centers," which allow opportunities to develop a more-compact development pattern. Using analysis of travel patterns, regional agencies can plan for improved transportation options, such as the in-progress Mid-Coast Trolley line.

Suburban job centers like Sorrento Valley-Torrey Mesa and Kearny Mesa are major residential and commercial/light industrial areas for which significant jobs and housing growth is likely. Oftentimes, however, areas such as these already see significant traffic delays as they have been designed in largely car-oriented ways. The challenge is to accommodate economic growth and improve traffic, with additional transit and active transportation options. New transportation options can be enhanced by Transit-Oriented Development, which is specifically designed to take maximum advantage of the transit. However, while these are areas of dense employment, retrofitting these areas for provision of transit and active transportation infrastructure is both expensive and challenging, and will only be accomplished over the long term and with consistent effort.

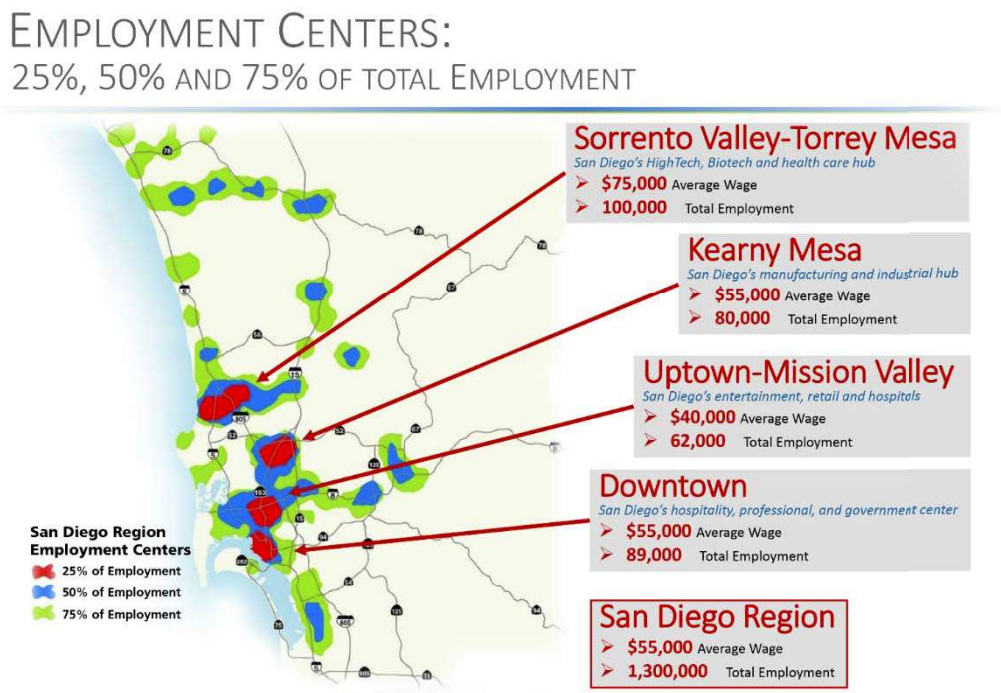

Figure 6

Areas with significant development potential are likely to experience significant increases in intensity of use, whether residential, commercial, or industrial. Areas like these, which often are somewhat distant from the urban core, offer lower land costs and can become employment centers and home to a greater number of residents. The critical issues in areas such as these are creation of transportation infrastructure that fits a variety of needs and balancing plans for industry, new residents, protection of the natural environment, and the needs of current residents. Otay Mesa, for example, is a rapidly developing area in the southern portion of the City of San Diego, for which variety of transit and highway projects, including a new border crossing, are proposed. Eastern Chula Vista is another example of a rapidly growing area of this type.

Redeveloping core neighborhoods, both in large cities and smaller jurisdictions, are primed to absorb a large chunk of the residential and job growth. These areas often are well-served by transit and highways, both existing and planned, and are attractive to residents that desire compact, walkable communities and minimal commuting hassle. Significant economic development, both small (e.g., shops and bistros) and large (e.g., office buildings and regional attractions such as art centers), characterize such areas, and the challenges of development in these areas often are tied to the

difficulty of permitting and financing in often-crowded city areas and in assessing the needs of existing residents and neighboring communities. The East Village section of the City of San Diego, located just east of Downtown San Diego and the Gaslamp Quarter, is an example of this type of area, with many new residential and mixed-use buildings. The Downtown Specific Plan for the City of Escondido, with its vision of "a dynamic, attractive, economically vital city center providing social, cultural, economic, and residential focus" is another example.

Different areas in the San Diego region clearly have different economic needs, goals, and outlooks. The challenge to the region is to plan for a transportation system that facilitates all types of economic development.

Transit allows for density of activity because the large physical space needs of automobiles can be reduced. Transit also allows access to jobs for people who cannot or prefer not to drive: the young, the elderly, and increasingly, professionals attracted to urban-style living. Shared-use mobility services also can supplement transit by improving access to transit. The challenge is to provide transit options in less-dense areas that still are effective and cost-efficient.

The **highways and road network** must be maintained, expanded, and optimized. The road system will continue to be the main mover of people and goods. Given spatial constraints, highway projects will involve more efficient use of limited space, through the construction of "Managed Lanes," through the implementation of advanced technologies, or both. The local road system will need to be designed to optimize traffic flow while accommodating distinct types of business development.

While highways and regional arterial roads are critical to economic needs like goods movement and general measures of accessibility, local and neighborhood-level economic development may depend less on maximizing traffic flow and more on creating and maintaining attractive public spaces. The development of thriving mixed-use areas will require a careful analysis of how to best spend public funds on physical infrastructure.

Encouraging and building infrastructure for **active transportation**, such as walking and cycling, has several benefits. Active transportation can reduce congestion on roads, have a positive effect on public health and associated costs, and help develop neighborhoods. In addition, active transportation provides options and connections to transit for residents that lack automobiles. In this way, active transportation can complement and improve other transit investments.

The San Diego region is home to 12 **airports** that can serve as regional or local economic development generators, though only two are certified by the Federal Aviation Administration for commercial service, and all have physical limitations. The economics of air travel are not generally under local control, and smaller airports have seen airline traffic cuts, but airports will continue to be essential economic hubs, especially for tourism-heavy San Diego. A cross-border facility that links the Otay Mesa area and Tijuana International Airport opened in 2015.

While 98 percent of freight movement in the San Diego region is by truck, the **Port of San Diego** and the **rail system** plan to improve to meet growing demand for freight in an increasingly international economy. At the same time, both are up against significant physical restraints. The importance of trade in providing high-wage jobs that bring investment and revenue from outside of the region means that it is critical to continue to improve the connections of the region to both the southern California "megaregion" and the global economy.

Transportation and land-use decisions can influence economic growth, and can be considered an economic development tool. There is evidence that the physical "clustering" of types of businesses can have positive effects on growth, innovation, and entrepreneurship.[13,14] The life sciences and brewing industries in San Diego provide ready evidence of this effect. If, for example, the San Diego region wants to be a high-tech hub, it must encourage the type of atmosphere that tech firms seek. Economic activity such as retail, manufacturing, freight movement, and residential construction require optimal transportation and land-use habitats as well. Businesses depend on roadways, rails, and ports, but they also depend on sidewalks and parks to attract customers and employees and on the educational system to produce viable employees and educated customers. The economic effects of public investment—including environmental effects, public health effects, social effects, and others in our interconnected economic system—must be considered properly in an economic sense for policymakers to make effective decisions.

To help measure the economic effects of the 2019 Regional Plan, SANDAG is preparing an economic analysis with two primary areas of focus. The first is a Benefit-Cost analysis to measure, using the innovative tool developed for the 2015 Regional Plan, the economic effect of the transportation improvements planned. Such benefits will include travel-time savings, safety improvements, emissions reductions, health effects, and auto-ownership costs, and are directly calculated from the output of the SANDAG Activity-Based Travel Model. In 2015, this analysis showed that for every $1 invested in the Regional Plan, almost $2 of benefits to society were created. The second facet will be an expanded economic impact measure. Traditional economic impact measures focus on the economic stimulus achieved by the construction and operations expenditures, and the SANDAG analysis will include this focus, but also will explore how the increased efficiency of the transportation system translates into increased economic activity by reducing transportation costs for businesses and individuals. A similar analysis in the 2015 Regional Plan showed that these cost reductions would mean tens of thousands of new jobs in the region by 2050 versus a "no-build" scenario. In addition, the analysis will present a detailed look at the regional economy and how the region can maintain its health and diversity. While there are limitations to any economic analysis, the goal of this economic analysis is to present information that will help inform and influence the choices the region will make over the next 30 years.

Equity Concerns from an Economic Perspective

The critical issue for economic vulnerable populations[15] that the 2019 Regional Plan can address is access. Low-income residents in areas without adequate public transit often must spend disproportionate amounts of time and money to access education, jobs, and recreation. A key strategy to address the plight of low-income residents is to improve transportation options. Access is equally important to employers who want to draw from a wide pool of potential employees of varying skill levels. Failing to encourage the economic integration of low-income populations today can have generational impacts and reduce economic mobility in the long run.[16] The importance of transportation options to the economically disadvantaged is difficult to overstate; without access to transportation, it is extremely difficult for individuals living in poverty to improve their economic prospects, as the cost of owning a private vehicle are often prohibitive. With investment in better transportation options, economic opportunity is increased, and these communities can thrive.

While the mandated social equity analysis of the economic impacts of the 2019 Regional Plan has yet to be conducted, the analysis for the 2015 Regional Plan showed that lower-income residents benefitted slightly more than the population as a whole from transportation investments, and that

their access to jobs, education, and amenities increased substantially.[17] It is evident that lower-income communities in the San Diego region have the need and potential for economic development. Many of these communities are relatively close to the core of San Diego, Escondido, and other communities in San Diego County. Like other metropolitan areas around the country, the San Diego region has seen a resurgence in development in the central cities and surrounding neighborhoods, a trend which is likely to continue. Some are concerned that this type of development can lead to gentrification, and argue that it displaces the economically disadvantaged and weakens community identity, but recent research indicates that residents in neighborhoods that have seen substantial increases in housing prices enjoyed improved economic health.[18] The same study indicates that despite high overall costs of housing, San Diego has not experienced a high degree of neighborhoods changing from low-cost to high-cost, though increases are possible, and rapid development often is seen in neighborhoods with good access to public transit.[19] The intent is not to diminish the impact of high housing costs on low-income residents of San Diego; the focus should be on providing more housing, which can lower housing costs for all, with the most benefit for low-income residents who likely pay a large percentage of their income for housing.

Relationships between the Economy and Environment

In economic theory, the inputs to economic production are usually referred to as "land, labor, capital, and raw materials." The environment is not usually considered beyond the land and raw materials nature can provide. However, as the science of economics has advanced, concepts such as pollution as an "externality," or of "ecosystem services," have become more generally understood, and a healthy natural environment is known to be both a cause and a result of economic health; a cause in that economic damage is a hindrance to economic development, and a result in that wealthier economies demand higher environmental quality.

The San Diego region is fortunate to have a quality environment and a healthy economy that is, in many ways, based on that environment. The tourism economy relies heavily on the environment, and the quality-of-life issues that make San Diego such an attractive place to live also hinge on environmental factors. In an economic sense, protecting the environment sometimes means balancing the needs of industry with environmental considerations. Frequently, though, in San Diego and elsewhere, the technologies and approaches that benefit the environment also are beneficial to the economic bottom line when costs and benefits are properly understood.

Environmental regulations have costs and benefits. While costs can be obvious, the benefits of considering the environment in an economic context are twofold. First, the economy as a whole can become more efficient when costs of environmental degradation are reduced with policies that have proven to be strikingly cost-effective for the economy as a whole,[20] and sometimes for the private sector, as in the case of energy efficiency.[21]

Second, a region could become a leader in environmental technologies or strategies that could lead it to develop a comparative advantage over other regions in these products. This is the case in the San Diego region, where over 7,000 jobs with an average wage of over $87,000, are in the "cleantech" sector, which produces products and services related to renewable energy, alternative energy, and energy efficiency.[22] In fact, Cleantech San Diego, an industry group, estimates the numbers to be much higher.[23] The general outlook for these environmental services and technologies is positive, as environmental problems increase globally with population growth.[24]

Many of the region's environmental challenges, while complex, can be dealt with effectively on a case-by-case basis, though cooperative solutions may be preferable. The issue of global climate change, however, is interwoven with most other environmental issues, but also with the structure of the economy and the physical infrastructure of the region. California has enacted aggressive climate change policies that will affect many aspects of the economy and will likely result in both substantial costs and in many business opportunities.

Climate change has the potential to present substantial costs to the San Diego region, from impacts of sea-level rise and increased storm activity on the region's high-value oceanfront and vulnerable transportation infrastructure to the impact on energy needs, agricultural disruption, and public health. There is considerable uncertainty as to the timing and severity of these impacts and to our ability to avoid, mitigate, and/or adapt to them should they occur to any substantial degree. Technological and engineering solutions of varying cost and effectiveness could mitigate or prevent many of the effects, but it is likely that behavioral changes will be required as well.

The positive aspect of taking steps to avoid or mitigate climate change is that they assist with many of the other objectives in the 2019 Regional Plan and can have substantial economic benefits. For example, a push to improve energy and water efficiency, if well-designed, can benefit the San Diego economy, independent of its effect on climate change, by saving money and encouraging efficiency in markets that have not historically had strong conservation incentives. The same is true for air quality; a reduction in carbon dioxide emissions is likely to have associated reductions in pollutants that result in positive health effects. Land use regulations, zoning, and transportation infrastructure intended to reduce transportation carbon dioxide emissions can create denser, mixed-use communities that can be more desirable to the growing populations of younger professionals, singles, and seniors. These steps also can lead to better health outcomes and improved access to schools, jobs, and recreation for those with limited resources, increasing economic opportunity. Assessing and preparing for vulnerabilities of drought and severe weather can have substantial economic benefits, even if the frequency and intensity of these natural phenomena does not increase.

The cost-effectiveness of any climate-change or environmental mitigation strategy may be difficult to quantify using existing analytical tools, but as with all environmental concerns, it is important to remember that the environment and the economy are not separate, but intertwined. To obtain the most accurate picture of the economic effects of policy decisions concerning transportation and land use, it is critical to analyze their impact on the environment.

SANDAG will analyze the environmental and greenhouse gas effects of the 2019 Regional Plan in detail in the Environmental Impact Report.[25]

Future Funding, Trends, and Possibilities

As SANDAG plans for the next 30+ years of transportation investment, one noteworthy uncertainty is the availability of funds to complete these investments. Funding sources—local, state, and federal—rely on policies and priorities determined by political processes over which San Diego has little control. It has been demonstrated locally that even a dedicated funding stream from sales taxes can vary from year to year as economic conditions fluctuate and consumer behavior changes. The effects of state and local tax policy, such as gas tax rates or e-commerce taxation, can have outsize impact on local revenues. The financial details of the plan will be presented in the 2019 Regional Plan's financial report,[26] but the difficulty of forecasting the future economic and political conditions is severe. The

important facts are that transportation infrastructure is critical to our region's economic health and that funding can often be scarce.

The ability of SANDAG to directly influence the region's economy is limited. While transportation planning is critical to the future economic health of the San Diego region, the economy is an amalgam of federal, state, and local rules that guide the complex interactions among the thousands of businesses that call the region home, and between the businesses in our region and the wider economic world. Decisions, issues, and conditions far from San Diego have large impacts in our region, and few of these factors are within control of the residents of the San Diego region.

Despite this, SANDAG, as a region-wide agency, can help the San Diego region succeed in the coming economy, which will be more global, with global trade increasing and with technology increasing the interconnectedness of the world economy. However, the economy may also be more local as the value of community economic development expands and consumers continue to discover the pleasures of locally-produced goods and services.

In addition to helping provide a varied and efficient transportation infrastructure that provides the access to the local and global economy, SANDAG will continue to bring together the San Diego region's business and academic leadership to study the regional economy, and will be a go-to resource for economic data and analysis for the San Diego region. By bringing the tools of economic analysis to bear on issues once considered outside the realm of economics, better decisions can be made.

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2018

Climate Change

WHITE PAPER

THE SAN DIEGO ASSOCIATION OF GOVERNMENTS

February 23, 2018

Contents

Introduction

In the San Diego region, as in the rest of the world, global climate change contributes to ongoing, escalating impacts on people, the economy, and the environment. Limiting these impacts requires collaboration and transformative action among the economic, governmental, social, and other institutions of society. In recent years, public agencies in California, including in the San Diego region, have been at the forefront of developing approaches to reduce climate-changing greenhouse gas (GHG) emissions and promote resiliency to the impacts of climate change while also supporting economic growth, social equity, and environmental protection.

While California alone cannot halt climate change, it is joined in its efforts by several other U.S. states as well as most countries of the world. The United Nations Framework Convention on Climate Change is an international treaty signed by 197 countries that sets an overall framework for intergovernmental efforts to address the challenges posed by climate change. Governor Brown also has spearheaded the Under2 Coalition, a global climate agreement among states, provinces, countries, and cities committing to do their part to limit the increase in global average temperatures to below dangerous levels. Signatories include over 200 jurisdictions from 38 countries across 6 continents, representing more than 1.2 billion people.

The purpose of the Climate Change White Paper is to inform the development of San Diego Forward: The 2019-2050 Regional Plan (2019 Regional Plan). This white paper updates the version prepared for San Diego Forward: The 2015 Regional Plan (2015 Regional Plan) to include new information that has become available since the adoption of the 2015 Regional Plan, such as the latest science, the new statewide target for 2030, other new state laws and plans, and the status of local climate action plans (CAPs). This white paper also includes updated descriptions of the many San Diego Association of Governments (SANDAG) climate change plans and programs, as well as collaborative activities underway to address climate change in the San Diego region.

Greenhouse Gas Emissions in the San Diego Region

Periodically, SANDAG completes a comprehensive GHG emissions inventory for the San Diego region. The inventory identifies and quantifies the sources of GHG emissions and allows for monitoring over time. In 2012, emissions totaled approximately 35 million metric tons of carbon dioxide equivalent ($MMTCO_2e$). As seen in Figure 1, passenger vehicles make up the largest source of GHG emissions in the region, followed by electricity, then natural gas. This inventory will be updated with a 2016 baseline for the 2019 Regional Plan.

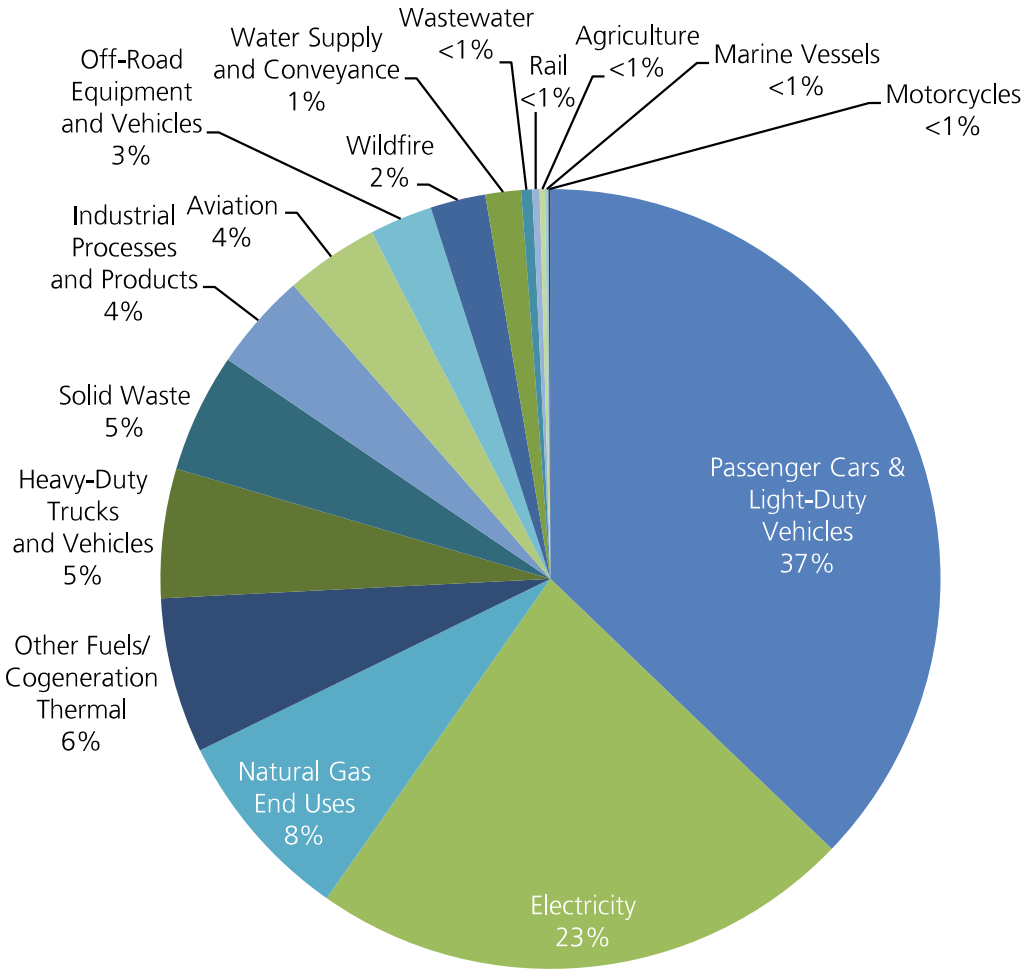


Figure 1: GHG Emissions Inventory for the San Diego Region 2012[1]

Climate Change Impacts in the San Diego Region

Even with efforts to reduce GHG emissions, the San Diego region is experiencing ongoing, escalating impacts from climate change. These impacts, summarized in the diagram below, and described in more detail in the "Strategies to Prepare for Climate Change Impacts" section, are far-reaching and will disrupt several parts of the environment. The region's coastal resources will experience higher sea levels, increased flooding and erosion, and saltwater intrusion; wildfires will become more frequent and increase in severity; local habitat and biodiversity will see shifts in flora and fauna due to temperature changes, as well as a decrease in the region's more sensitive habitats due to increased extreme weather events and fluctuations in temperature; water management will become increasingly constrained as the demand for water competes with more frequent and intense droughts; and the agricultural sector will also be heavily impacted by drought and increased temperatures. The section entitled "Interrelationships with Other Policy Areas" includes additional information on the connections among climate change, public health, and the economy.

Preparing the region for the effects of climate change requires measures to adapt to these changes and create resilient communities. Adaptation is adjusting in response to climate impacts, while resiliency is the capacity of social, economic, and environmental systems to cope with a hazardous

event. At the state level, California has developed policy guidance for decision-makers, planning resources for local and regional agencies, and technical tools to assist with climate change adaptation and resilience, as described in more detail in the "Strategies to Prepare for Climate Change Impacts" section.

Figure 2: Climate Impacts in the San Diego Region

State, Regional, and Local Planning for the Reduction of Greenhouse Gas Emissions

The following sections describe California's overarching strategy to reduce emissions, how climate change was addressed in the 2015 Regional Plan, and local efforts to prepare and implement climate action plans.

California's Strategy for Reducing Greenhouse Gas Emissions

California's strategy for reducing GHG emissions is shaped by legislation, regulations, and Executive Orders. All Executive Orders, laws, and regulations are listed on the State's Climate Change Portal.[2] Executive Order S-3-05, which was issued by Governor Schwarzenegger in June 2005, calls for state agencies to work toward reducing GHG emissions as follows: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; and by 2050, reduce GHG emissions to 80 percent below 1990 levels. Since then, the legislature has codified the 2020 target (in AB 32) and a midterm 2030 target (in SB 32) for statewide emissions reductions.

In 2006, Governor Schwarzenegger signed into law Assembly Bill 32 (AB 32), The Global Warming Solutions Act, which codifies the 2020 target in Executive Order S-3-05 and calls for California to reduce GHG emissions to 1990 levels by the year 2020. In 2016, Governor Brown signed into law Senate Bill 32 California Global Warming Solutions Act (Pavley, 2016), which establishes a GHG reduction target of 40 percent below 1990 levels by 2030. AB 32 and SB 32 also direct the California Air Resources Board (CARB) to develop a Scoping Plan that details the strategies for attaining the 2020 and 2030 targets, respectively. The first Scoping Plan was completed in 2008, and was most recently updated in 2017 to reflect the 2030 statewide GHG reduction target. Based on tracking done by CARB, California is on track to meet the 2020 emissions target; however, attaining the 2030 target will require accelerated emissions reductions. Figure 3 displays actual statewide annual emissions to date and California's 2020 and 2030 reduction targets.

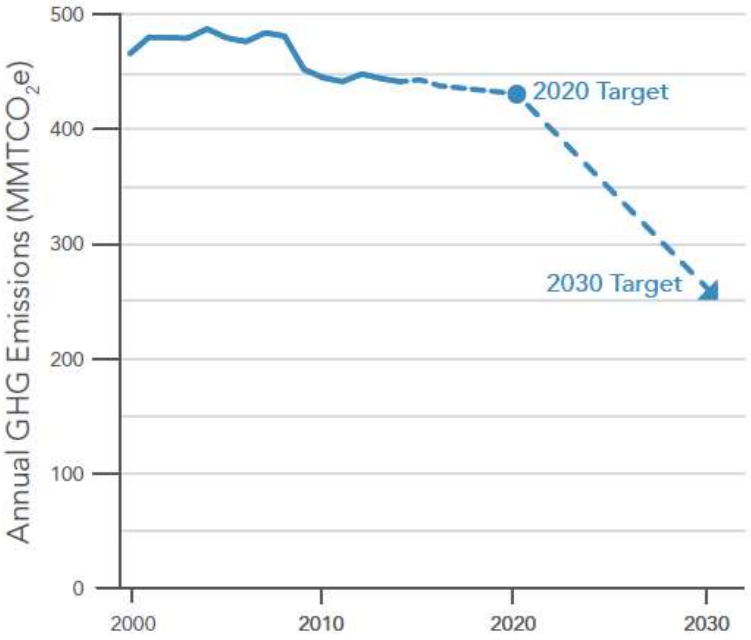


Figure 3: California GHG Emissions and Reduction Targets[3]

The key GHG reduction measures outlined in Table 1 of the 2017 Scoping Plan include:

- Senate Bill 350 Clean Energy and Pollution Reduction Act (De León, 2015) (SB 350) to reduce GHG emissions in the electricity sector through implementation of a 50 percent Renewable Portfolio Standard (RPS), doubling of energy savings, and other actions:
    - Load-serving entities file plans to achieve GHG emissions reductions planning targets while ensuring reliability and meet the State's other policy goals cost-effectively
    - 50 percent RPS
    - Doubling of energy efficiency savings in natural gas and electricity end uses statewide
- Low Carbon Fuel Standard (LCFS) to transition to cleaner/less-polluting fuels that have a lower carbon footprint:
    - At least 18 percent reduction in carbon intensity by 2030

- Mobile Source Strategy (Cleaner Technology and Fuels Scenario) to reduce GHGs and other pollutants from the transportation sector through transition to zero-emission and low-emission vehicles, cleaner transit systems, and reduction of vehicle miles traveled (VMT):
    - 1.5 million zero-emission vehicles (ZEVs) including plug-in hybrid electric, battery-electric, and hydrogen fuel cell vehicles by 2025; 4.2 million ZEVs by 2030
    - Continue ramp-up of GHG stringency for all light-duty vehicles beyond 2025
    - Reductions in GHGs from medium- and heavy-duty vehicles via the Phase 2 Medium- and Heavy-Duty GHG Standards
    - Innovative Clean Transit: Transition to a suite of innovative clean transit options. Assumed 20 percent of new urban buses purchased beginning in 2018 will be zero-emission buses with the penetration of zero-emission technology ramped up to 100 percent of new bus sales in 2030. Also, new natural gas buses, starting in 2018, and diesel buses, starting in 2020, meet the optional heavy-duty low-oxides of nitrogen (NOx) standard.
    - Last-Mile Delivery: New regulation that would result in the use of low-NOx or cleaner engines and the deployment of increasing numbers of zero-emission trucks primarily for class 3-7 last-mile delivery trucks in California. This measure assumes ZEVs comprise 2.5 percent of new Class 3-7 truck sales in local fleets starting in 2020, increasing to 10 percent in 2025.
    - Reduction in VMT to be achieved in part by continued implementation of Senate Bill 375 Sustainable Communities and Climate Protection Act (Steinberg, 2008) (SB 375) and regional Sustainable Communities Strategies; forthcoming implementation of Senate Bill 743 Environmental Quality (Steinberg, 2013); and potential additional VMT-reduction strategies not specified in the Mobile Source Strategy, but included in the document "Potential VMT Reduction Strategies for Discussion" in Appendix C.
- Senate Bill 1383 Short-Lived Climate Pollutants (Lara, 2016) (SB 1383) strategy to reduce highly potent GHGs:
    - 40 percent reduction in methane and hydrofluorocarbon emissions below 2013 levels by 2030.
    - 50 percent reduction in anthropogenic black carbon emissions below 2013 levels by 2030.
- California Sustainable Freight Action Plan to improve freight efficiency, transition to zero-emission technologies, and increase competitiveness of California's freight system:
    - Improve freight system efficiency by 25 percent by 2030
    - Deploy over 100,000 freight vehicles and equipment capable of zero-emission operation and maximize both zero- and near-zero-emission freight vehicles and equipment powered by renewable energy in 2030

- Post-2020 Cap-and-Trade Program to reduce GHGs across largest GHG emissions sources:
    - Continue the existing Cap-and-Trade Program with declining caps to ensure the state's 2030 target is achieved.

The estimated cumulative reductions associated with each of the 2017 Scoping Plan measures from 2021 to 2030 are displayed in Figure 4. The largest source of GHG reductions is expected to come from the Cap-and-Trade program. The program establishes a declining limit, or "cap," on approximately 85 percent of total statewide GHG emissions, including electric generating utilities, electricity importers, large industrial facilities, and fuel distributers. The program has been up and running since 2013 and will continue post-2020 pursuant to legislative direction in Assembly Bill 398 California Global Warming Solutions Act (Garcia, 2017). Proceeds from the auctions of allowances under Cap-and-Trade are deposited into the Greenhouse Gas Reduction Fund and provide a significant source of revenue to support GHG-reduction measures.

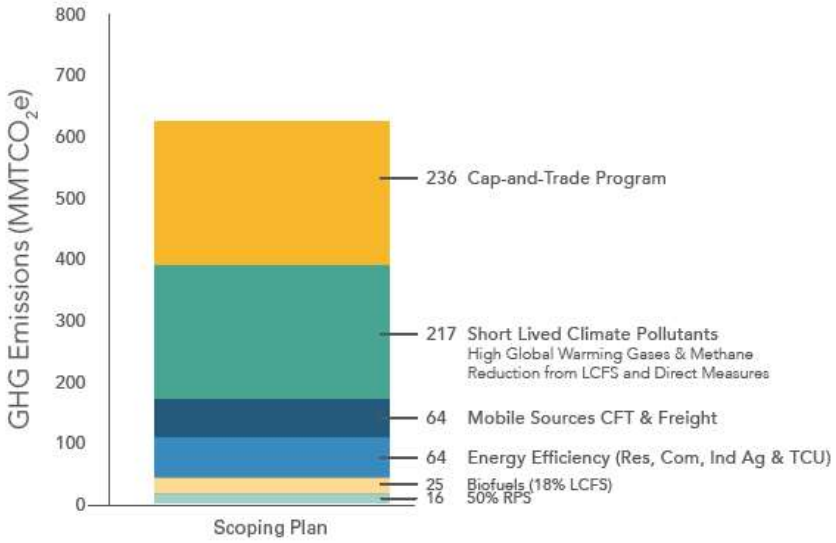


Figure 4: 2017 Scoping Plan Scenario – Estimated Cumulative Reductions by Measure (2021-2030)[4]

State Greenhouse Gas Reduction Goals for the Passenger Vehicle Sector

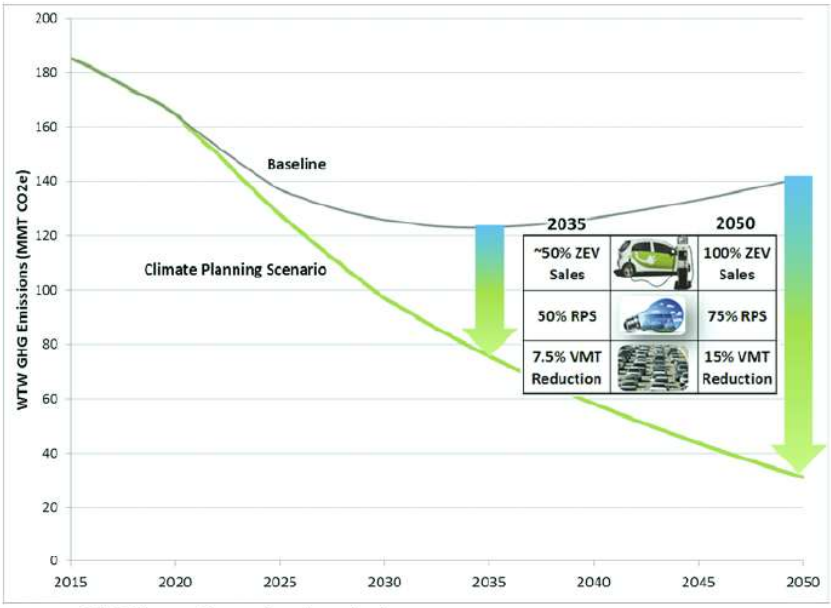
According to a CARB staff report on proposed updates to the SB 375 GHG targets, the 2017 Scoping Plan addresses emission reductions from the transportation sector as a whole, and recommends strengthening SB 375 targets compared to what would occur under currently adopted Sustainable Communities Strategies (SCSs) as one of a suite of measures to achieve greater GHG reductions.[5] In the following discussion, CARB staff describe the roles of SB 375 and State-level VMT-reduction strategies in meeting state GHG reduction goals within the passenger vehicle sector and statewide:

> Updated Final CARB Staff Report, Proposed Update to the SB 375 Greenhouse Gas Emission Reduction Targets, February 2018, pp. 14-16:
>
> The 2017 Scoping Plan relies on strategies in every single sector that are more aggressive than currently adopted regulations and policies. These include substantially greater increases in sales of zero-emission vehicles (ZEVs), greater increases in fuel efficiency standards for gasoline vehicles, continued decarbonization of energy, additional efficiencies in building and industrial energy efficiency, reductions in short lived climate pollutants, continuing the Cap-and-Trade program, and a reduction in growth of statewide VMT.

Figure 1 illustrates the combined contributions of GHG emission reductions envisioned for the passenger vehicle sector. As the figure shows, by 2035 the State will need 50 percent of new cars sales to be ZEVs, 50 percent of transportation fuels will need to come from renewable sources, and a 7.5 percent reduction from 2035 baseline VMT through passenger vehicle activity efforts such as SB 375 and other State strategies. The GHG emission reduction contribution from VMT is comparatively smaller in share than the GHG emission reductions called for by advances in technology and fuels, but necessary for GHG reductions in other sectors, and also are anticipated to lead to important co-benefits such as improved public health.

The 2017 Scoping Plan recognizes the role that reducing growth in VMT plays in supporting other important public health, equity, economic, and conservation goals. The types of strategies associated with reducing VMT growth also influence where and what types of development are put in place, with implications beyond reducing distances traveled and tailpipe emissions. Development pattern choices also play a role in influencing pollutant exposure; accessibility to jobs and services; future transportation, energy, and water infrastructure demand and costs; as well as conversion of natural and working lands; food security; watershed health; and ecosystems.

Stronger SB 375 GHG reduction targets will enable the State to make significant progress toward the 2017 Scoping Plan goals, but alone will not provide all of the reductions needed. While currently adopted SB 375 plans achieve, in aggregate, nearly an 18 percent reduction in statewide per-capita GHG emissions relative to 2005 by 2035, the full reduction needed to meet our climate goals is on the order of a 25 percent reduction in statewide per-capita GHG emissions by 2035.



WTW = well-to-wheel emissions
MMT CO2e = million metric tons carbon dioxide equivalent
RPS = renewable portfolio standard

Figure 6: Statewide On-Road GHG Emissions

Bridging the gap will require a combination of increased SB 375 targets and new State and local VMT-reduction actions. As part of the 2017 Scoping Plan, CARB staff and sister State agencies have included the following recommended new State-level strategies to reduce VMT that they are beginning the process to pursue:[6]

- Developing and expanding funding and financing mechanisms and incentives for infill development and related infrastructure (e.g., low-VMT housing rebate, reduced parking requirements, regional transit-oriented development funds, etc.) and connecting to incentives/support for regional land-conservation strategies (e.g., transfer-development rights, growth boundaries)
- Improving performance measures used to plan and select transportation facilities to ensure that projects help to achieve emission-reduction goals and increase competitiveness of transit and active transportation modes (e.g., via guideline documents, funding programs, or project selection)
- Expanding investments in transit and active transportation, as well as exploring opportunities for increasing shared-mobility transportation options, particularly for automated vehicles
- Developing pricing policies (e.g., based on congestion, road user VMT, low-emission vehicle zones for heavy-duty, and parking)

These State-level strategies to reduce VMT will be expanded upon further through the 2017 Scoping Plan implementation process and CARB's process this year to prepare a report to the legislature in response to Senate Bill 150 (Lara, 2013). The State agencies will continue to gather more detail on the strategies described here, and will develop subsequent actions through separate public processes. As State agencies move forward, the strategies may change or be adjusted or new strategies may be added.

Regional and Local Planning for Climate Change

The 2017 Scoping Plan focuses on the areas where the State can have the greatest impact in reducing GHG emissions; however, it also describes the critical role that regional and local governments play in implementing measures to meet the 2030 GHG reduction target. Regional and local governments each play unique roles in shaping the built environment and reducing GHG emissions. While the 2015 Regional Plan has specific requirements under SB 375 to reduce per-capita passenger vehicle emissions, the 2017 Scoping Plan describes how additional complementary actions are needed at the local and state levels to further reduce VMT and achieve broader statewide GHG reduction goals. As local jurisdictions in the San Diego region prepare CAPs, many of them are considering ways to contribute additional VMT reductions through local actions.

The 2017 Scoping Plan states that "there is a gap between what SB 375 can provide and what is needed to meet the State's 2030 and 2050 goals."[7] In addition to the state-level VMT-reduction strategies described in the 2017 Scoping Plan's Appendix C, CARB recommends that "local governments consider policies to reduce VMT to help achieve these reductions, including: land use and community design that reduce VMT; transit-oriented development; street design policies that prioritize transit, biking, and walking; and increasing low-carbon mobility choices, including improved access to viable and affordable public transportation and active transportation

opportunities."[8] The 2017 Scoping Plan in Appendix B presents a detailed list of potential local actions to help the state achieve its GHG reduction goals.

The next sections describe how climate change was addressed in the 2015 Regional Plan and local climate action planning in the San Diego region.

Climate Change in the 2015 Regional Plan

SB 375 is the only statutory GHG-reduction requirement for Metropolitan Planning Organizations (MPOs), but SANDAG plays a role in reducing GHG emissions in other ways. In accordance with SB 375, SANDAG develops a Sustainable Communities Strategy (SCS) as an element of the Regional Plan. The SCS, among other strategies and goals, demonstrates how the region will coordinate regional transportation planning, regional housing needs allocation, and local land-use planning to meet the passenger-vehicle GHG-emission targets set by CARB if there is a feasible way to do so. These targets do not include reductions from improved vehicle efficiency and cleaner fuels. The per-capita passenger vehicle GHG targets for the 2015 Regional Plan were reductions of 7 percent by 2020 and 13 percent by 2035, from a 2005 baseline year. The 2015 Regional Plan met and exceeded these targets. CARB is expected to adopt new, higher SB 375 GHG-reduction targets for MPOs, including SANDAG, in 2018, and these will be in effect for the 2019 Regional Plan.

The 2015 Regional Plan included many features designed to promote sustainability and reduce GHG emissions in order to be consistent with the intent and goals of SB 375. These features include:

- Emphasis on investments in transit, Managed Lanes, active transportation, Transportation Demand Management (TDM) and Transportation System Management (TSM) that reduce vehicle miles traveled, energy consumption, GHG emissions, and air pollutant emissions.
- De-emphasis of traditional highway investments
- An SCS, based on the regional growth forecast, that exceeds the SANDAG SB 375 GHG-reduction targets.

The 2015 Regional Plan is a balanced approach that provides many choices for people to get to work, school, or play. It does not represent "business as usual" investments in primarily highway expansion, and includes more investment in transit and active transportation than any previous Regional Transportation Plan (RTP).

Transit expenditures make up approximately 50 percent of the expenditures in the 2015 Regional Plan. There are five new light rail transit lines, complete double-tracking of the Los Angeles – San Diego – San Luis Obispo (LOSSAN) Rail Corridor and SPRINTER rail corridor, new express bus services, and increased frequencies for all transit modes. The 2015 Regional Plan also fully funds Active Transportation, TSM, and TDM programs.

The SCS land use pattern demonstrates that the San Diego region is planning for compact, higher density development located near transit and within the already-urbanized areas of the region as envisioned by SB 375. Much of the San Diego region will remain undeveloped in the future because of the designated park, open space, national forest, and habitat lands. More than 80 percent of new housing will be attached multi-family. The land-use pattern accommodates 79 percent of all housing and 86 percent of all jobs within the portion of the region covered by the Urban Area Transit Strategy, where the greatest investments in public transit are focused. Meanwhile, the 2015

Regional Plan will maintain more than 55 percent of the region's land area as open space and parkland.

The estimated per-capita GHG reductions of the 2015 Regional Plan allow for investments in some emerging technology and demand-management programs to complement the benefits derived from a multimodal transportation system. These technological and programmatic elements include telework and employer programs, vanpool incentives, traveler information systems, and carsharing. TSM programs are not quantified in the reductions, although, as described in the "Emerging Technologies and Transportation Systems and Demand Management" section, such efficiencies can result in decreases in both fuel consumption and overall air pollutant emissions. SANDAG also is working with its partner MPOs in California and with ARB to identify further strategies to reduce GHG emissions, such as substantially expanded zero-emission vehicle programs.

While some of the projects in the 2019 Regional Plan will be implemented through funding that SANDAG will receive from the federal, state, and local sources, SANDAG also provides planning tools and funding incentives to implement it. The Smart Growth Toolbox contains a set of tools to help the region realize the vision for a sustainable future. Other tools developed by SANDAG include the Smart Growth Concept Map, smart growth design guidelines, smart growth visual simulations, guidelines for integrating TDM into planning processes, parking management tools, guidelines for planning and designing for pedestrians, a smart growth photo library, the Regional Complete Streets Policy, the Regional Transit Oriented Development Strategy, and competitive grant programs that provide incentive funds for planning and capital projects in smart growth areas and for Active Transportation projects. Furthermore, the *TransNet* Environmental Mitigation program provides funds to protect, preserve, and restore native habitats as offsets to disturbance caused by regional and local transportation projects, as well as additional funding for management and monitoring of existing preserved areas. Descriptions of these tools and programs are available on the SANDAG website and are described later in this white paper.

The 2015 Regional Plan also includes the following actions that support GHG-emissions reductions and climate change adaptation:

- Complete a follow-up study that details ways to reduce GHG emissions by expanding the use of alternative fuels regionwide
- Continue to provide and/or expand incentive programs that support reduction of GHG emissions, protect open space and farmland, and create great places to live, work, and play
- Promote the use of both zero-emission vehicles and alternative fuels and ensure that the region has the infrastructure to support these innovations
- Support the efforts of local jurisdictions to implement their Energy Roadmaps to save energy in their own operations and in their larger communities
- Develop strategies to enhance the region's ability to adapt to the consequences of climate change, including planning and design strategies to help communities cope with hazardous events such as storms, heat waves, wildfires, or ongoing drought

As part of the approval of the 2015 Regional Plan, the SANDAG Board of Directors also adopted many feasible and enforceable mitigation measures for reducing GHG emissions, many to be

implemented by SANDAG (both at a plan level and as part of transportation projects developed by SANDAG), and others to be implemented by other agencies.

- GHG-4A: Allocate Competitive Grant Funding to Projects that Reduce GHG Emissions
- GHG-4B: Adopt a Detailed Regional Mobility Hub Implementation Plan to Reduce GHG Emissions
- GHG-4C: Fund Electric Vehicle Charging Infrastructure
- GHG-4D: Adopt a Plan for Transportation Fuels that Reduce GHG Emissions
- GHG-4E: Assist in the Preparation of CAPs and Other Measures to Reduce GHG Emissions
- GHG-4F: Implement Measures to Reduce GHG Emissions from Transportation Projects (SANDAG)
- GHG-4G: Implement Measures to Reduce GHG Emissions from Transportation Projects (Other Transportation Project Sponsors)
- GHG-4H: Implement Measures to Reduce GHG Emissions from Development Projects
- AQ-2A: Implement Construction Best Management Practices for Fugitive Dust
- AQ-4A: Reduce Exposure to Localized Particulate and/or Toxic Air Contaminants Emissions
- AQ-4B: Reduce diesel emissions during construction from off-road equipment.
- AQ-4C: Reduce diesel particulate emissions from on-road vehicles used in construction
- EN-3B Develop Energy Demand Calculations and Reduce Energy Demand

Climate Action Planning in the San Diego Region

As of February 2018, almost all of the local jurisdictions in the San Diego region are developing or have adopted a CAP. Table 1 summarizes each jurisdiction's climate planning efforts. In addition, the Port of San Diego, the San Diego County Water Authority, San Diego Unified School District, and local universities also have developed CAPs.

Table 1

Local Climate Planning Efforts

Jurisdiction	Climate Action Plan	
	Adopted (year)	Developing
Carlsbad	2015	
Chula Vista	2017	
Coronado		✓
County of San Diego (unincorporated)	2018	
Del Mar	2016	
El Cajon		✓
Encinitas	2018	
Escondido	2012	
Imperial Beach		✓
La Mesa		✓
Lemon Grove		✓
National City	2011	
Oceanside		✓
Poway		
San Diego	2015	
San Marcos	2013	
Santee		✓
Solana Beach	2017	
Vista	2013	

Both the 2017 Scoping Plan and the Governor's Office of Planning and Research's (OPR's) General Plan Guidelines recommend jurisdictions prepare CAPs that include strategies to meet locally adapted goals that align with the state's targets for GHG reduction. While all CAPs set GHG-emissions reduction targets and identify reduction measures to meet those targets, a "qualified" CAP offers streamlining opportunities for future development projects under the California Environmental Quality Act (CEQA) by meeting the requirements of CEQA Guidelines Section 15183.5.

Many jurisdictions have set local reduction targets and baseline years and identified GHG reduction measures to help achieve the State's targets. Many jurisdictions in the region have set targets of 15 percent below a baseline year by 2020 while other jurisdictions with more recently adopted CAPs have set post-2020 (e.g., 2030 or 2035) targets of 40 to 50 percent below a baseline year. Local jurisdictions have used a range of dates between 2005 and the present for their CAP baseline year;

the baseline year is largely dependent on when the CAP was adopted and the data available at the time the CAP was produced.

In addition, the 2017 Scoping Plan recommends that local plans use statewide targets consistent with statewide emission limits and the Under2 Memorandum of Understanding[9] of no more than six metric tons CO_2e per capita by 2030 and more than two metric tons CO_2e per capita by 2050, and that local government "emissions inventories and reduction goals should be expressed in mass emissions, per-capita emissions, and service population emissions." It goes on to explain that local CAPs should be based on "evidence-based local per-capita goals based on local emissions sectors and population sectors" since the statewide per-capita targets are based on all emissions sectors in the state. CARB recommends that the GHG-emissions trajectory within a local CAP "show a downward trend consistent with statewide objectives." CARB's recommendations for community-wide goals expand upon the reduction of 15 percent from "current" (2005 to 2008) levels by 2020 as recommended in the 2008 Scoping Plan.

To achieve their locally identified targets, local CAPs account for GHG reductions from State-level strategies, then identify local reduction measures to meet their targets. These measures vary according to the unique circumstances of local agencies, but typically are identified for the following sectors: transportation and land use, electricity, natural gas, solid waste, water, wastewater, and other categories.

In 2016, SANDAG began offering climate-planning services to 16 cities through the Energy Roadmap Program. The climate-planning services include updated GHG-emissions inventories for all cities at regular intervals as well as customized technical assistance from climate-planning consultants and dedicated SANDAG staff at no cost. As a part of the climate-planning services, SANDAG is developing a Regional Framework for Climate Action Planning (Regional Framework). The Regional Framework is a guidance document that identifies best practices for preparing local CAPs and monitoring their implementation over time. The Regional Framework is consistent with State policy and was created with input from local jurisdictions and agencies involved in CAP development. The Regional Framework includes a series of appendices that cover relevant methodologies, data sources, State legislation, local applications, and emerging issues in significant detail.

Greenhouse Gas Reduction Strategies by Sector

The following sections further describe the State strategy, the role of SANDAG, and the role of local governments in reducing emissions from the following sectors: transportation, land use, electricity, natural gas end use, water, and solid waste. The role of SANDAG is defined by existing programs and policies from adopted plans.

Reducing Emissions from Transportation Sector

As illustrated in the regional GHG inventory, the transportation sector, including both light-duty and heavy-duty vehicles, represents the largest source of GHG emissions (a combined 42% in the San Diego region as of 2012). The 2017 Scoping Plan outlines four goal areas for reducing emissions from the transportation sector:

- Vibrant Communities and Landscapes/VMT Reduction
- Vehicle Technology
- Clean Fuels
- Sustainable Freight

California's Strategy for Reducing Emissions from Transportation

The State's strategies for reducing transportation emissions include implementation of the Mobile Source Strategy, which includes SB 375 and additional State-level VMT reduction strategies, Advanced Clean Cars program, the LCFS, and the Sustainable Freight Action Plan. Most of the transportation GHG reductions in the 2017 Scoping Plan will come from technologies and low-carbon fuels, and a reduction in the growth of VMT also is needed (2017 Scoping Plan, page 75). As mentioned above, the 2017 Scoping Plan also acknowledges that there is a gap between the reductions that SB 375 can provide and what is needed to meet the State's 2030 and 2050 goals. Please also see the "California's Strategy for Reducing GHG Emissions" and "State GHG Reduction Goals for the Passenger Vehicle Sector" sections.

In May 2016, CARB published the 2016 Mobile Source Strategy (Strategy), which outlines an approach for simultaneously meeting air quality standards, achieving GHG-emission reduction targets, decreasing toxics, and reducing petroleum consumption from transportation over the next 15 years. The Strategy, which informs the transportation sector discussions in the 2017 Scoping Plan, provides a coordinated framework to support multiple related planning efforts, including:

- 2017 Scoping Plan
- Sustainable Freight Action Plan
- Short Lived Climate Pollutant Strategy
- State Implementation Plan
- SB 375 Implementation

The Strategy includes a mix of policy tools that vary across four mobile sectors: on-road light-duty, on-road heavy-duty, off-road federal and international sources, and off-road equipment sources.

The policy tools include a mix of incentives and requirements that aim to increase the deployment of zero- and near-zero-emission vehicles along with necessary infrastructure, increase fuel efficiency and engine performance, increase the use of renewable fuels and electricity, reduce passenger VMT, and advance the use of intelligent transportation systems.

The Strategy includes a scenario of cleaner technologies, low-carbon fuels, vehicle efficiencies, and limited VMT growth that support the transformation needed in the on-road sector to meet California air quality and climate goals. In the light-duty sector, the main assumptions include increasing sales of light-duty ZEVs and plug-in hybrid electric vehicles to 100 percent by 2050 and a 15 percent reduction in total light-duty VMT in 2050 compared to baseline 2050 levels. The heavy-duty sector assumptions include low-NOx performance standards (representing 90 percent reduction in overall emissions), efficiency improvements from the Phase 2 GHG standard, a blend of 50 percent biofuels by 2030, and gradual increased use of ZEVs in transit buses and last-mile delivery applications. The roles of local and regional governments under SB 375 and in reducing GHG emissions to achieve the statewide 2030 target are described in the "Regional and Local Planning for Climate Change" section.

The Advanced Clean Cars program works to increase vehicle efficiency by combining the control of GHG emissions and other air pollution requirements into a single package of standards. Under the program, by 2025, 1.5 million ZEVs will be operating in California and 15 percent of new car sales will be ZEVs. In January 2018, Governor Brown issued Executive Order B-48-18, which includes a new target of 5 million ZEVs in California by 2030 and a new eight-year, $2.5 billion initiative to continue clean vehicle rebates and help bring 250,000 vehicle-charging stations and 200 hydrogen fueling stations to California by 2025.

The LCFS calls for a reduction of at least 10 percent of the carbon intensity of California's transportation fuels by 2020 and 18 percent reduction by 2030. The LCFS program is performance-based and allows fuel providers and regulated parties to choose from a mix of strategies to achieve compliance. Strategies include investing in production of low carbon-intensity (low-CI) fuels, purchasing low-CI fuels for blending, purchasing credits from other regulated parties, and banking credits for use in future years.

In response to Executive Order B-32-15, the Sustainable Freight Action Plan was developed with coordination from several state agencies. The plan describes ways for California to improve freight efficiency, transition to zero-emission technologies, and increase the competitiveness of freight system.

SANDAG Role in Reducing Emissions from Transportation

Please see the "Climate Change in the 2015 Regional Plan" section for a discussion of the many strategies in 2015 Regional Plan that support GHG emissions in the transportation sector. SANDAG also supports the State's strategies for ZEVs and low-carbon fuels in the region. Since 2012, SANDAG has provided a forum for local governments and other regional stakeholders to address barriers to deploying alternative fuel vehicles and siting charging and fueling stations. In 2014, SANDAG completed a regional readiness plan for plug-in electric vehicles (EVs) and charging stations.[10] This effort was expanded to planning for all alternative fuels, with a regional alternative fuel plan completed in 2016.[11] With funding from the California Energy Commission, SANDAG is implementing the readiness plan for EVs by providing technical assistance to property owners and other potential EV-charging station hosts and performing a regional needs assessment for publicly

available EV charging through a program called "Plug-in SD." As part of the 2015 Regional Plan, SANDAG also adopted a measure to allocate $30 million for an incentive program for EV-charging infrastructure. The planning for the incentive program is underway and will be provided to the Board of Directors prior to adoption of the 2019 Regional Plan.

Local Government Role in Reducing Emissions from Transportation

Local governments have the ability to influence transportation-related GHG emissions through land use authority, community investments, and municipal operations. In local CAPs, local governments have identified measures to reduce VMT and promote efficient vehicles and alternative fuel use in government operations and throughout the community. Although emissions from government operations make up a small percentage of a jurisdiction's overall emissions, the local government can help to influence changes in the community by taking steps to reduce internal emissions.

In developing a CAP, local jurisdictions can set local goals for VMT reduction and/or increased biking, walking, and transit mode share. These local goals are attained in part by regional transportation projects, but also by implementing measures beyond the transportation investments identified in the 2015 Regional Plan. Some of these measures may include:

- Implementation of a local active transportation plan
- Local programs to promote and/or incentivize biking, walking, and transit
- Alteration of parking requirements
- Updating of land-use plans to facilitate smart growth and VMT reduction

Local CAPs consider ways to increase the use of ZEVs in the community through investments in EV charging, requiring EV-ready buildings, and/or incentives for installing EV charging at homes and businesses.

Reducing Emissions from Land Use

Land use decisions impact nearly all sources of GHG emissions. Smart growth development brings people closer to more destinations and supports low-carbon travel choices (i.e., public transit, carpooling, walking, and biking). Mixed-use, compact developments also result in reduced per-capita demand for electricity, heating, and cooling. There also are co-benefits of land-use and transportation strategies beyond GHG reductions, including preservation of agricultural land, open space, and habitat; improved water quality from reduced development-related pollutant sources; positive health effects; and the reduction of smog-forming pollutants. This section also includes land-use strategies to expand tree planting and other urban greening efforts, which have benefits of carbon sequestration, meaning that trees uptake and store carbon from the atmosphere as they grow.

California's Strategy for Reducing Emissions from Land Use

The 2017 Scoping Plan emphasizes the need for more compact land-use patterns to curb auto trips, minimize energy and water use in the built environment, and maintain natural and working lands as a net carbon sink. CARB also is coordinating with several other state agencies, including the California Natural Resources Agency (CNRA), the California Department of Food and Agriculture, and the California Environmental Protection Agency (CalEPA), to prepare a Natural and Working Lands Climate Change Implementation Plan (Implementation Plan) in 2018. The Implementation

Plan will outline a pathway to increase carbon sequestration and avoid emissions, with a goal of reducing emissions by 15 to 20 $MMTCO_2e$ by 2030, as identified in the 2017 Scoping Plan. The California Natural and Working Lands Carbon Model will be used to analyze the GHG impacts in the Implementation Plan.

SANDAG Role in Reducing Emissions from Land Use

As described in the "Climate Change in the 2015 Regional Plan" section, the SCS in the 2015 Regional Plan consists of land-use patterns and transportation investments that together achieve the region's SB 375 GHG-reduction targets. SANDAG also provides incentives to encourage smart growth development and preserve habitat lands. Through the *TransNet* Smart Growth Incentive Program, SANDAG provides grants to member agencies to support planning and capital projects in areas on the Smart Growth Concept Map, which illustrates the location of existing, planned, and potential smart growth areas. In addition, through the *TransNet* Environmental Mitigation Program (EMP) Land Acquisition Grant Program, over 5,000 acres of property have been acquired and conserved as open space areas in the region. These grant programs help to incentivize compact development and maintenance of open space, resulting in reduced GHG emissions.

Local Government Role in Reducing Emissions from Land Use

Local governments have the authority to decide how and where land is developed to accommodate population and economic growth. Figure 7 below shows the region's projected housing and job growth based upon local general plans in 1999 (left) and 2013 (right). Over 14 years, local plans have been updated to concentrate growth within the urbanized areas of the region, closer to existing and planned transportation infrastructure, while increasing land area dedicated to open space and habitat preservation. These land-use changes help implement the vision and goals set in the 2015 Regional Plan and are reflected in the SANDAG SCS, collectively moving the region toward more compact development, more open-space preservation, and reduced GHG emissions.

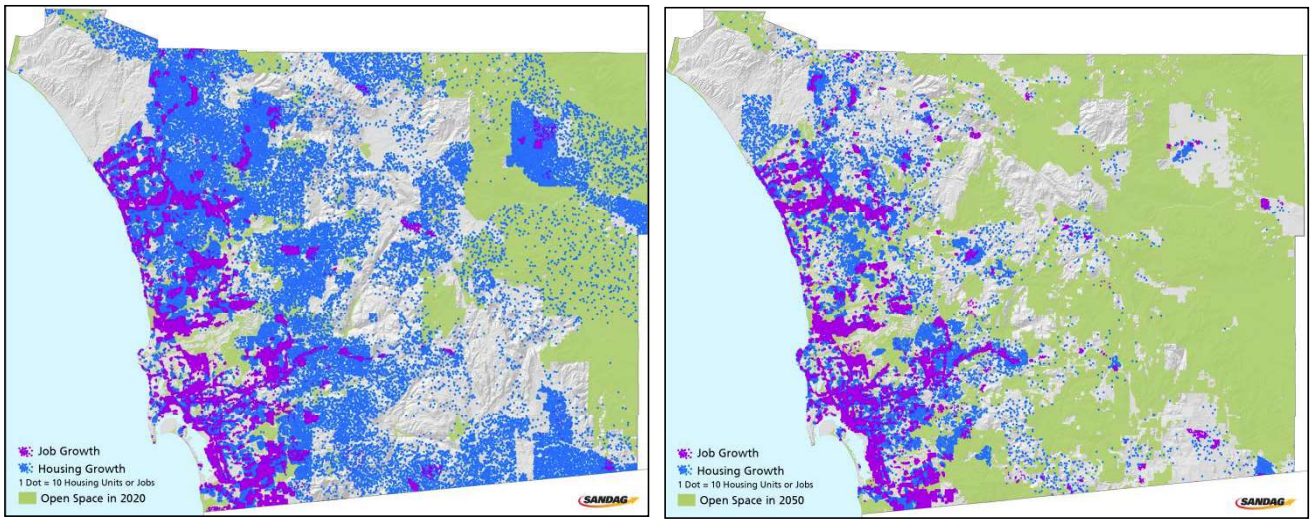


Figure 7: Comparison of Housing and Job Growth Projected in 1999 vs. 2013[12]

In adopted local CAPs, several jurisdictions have highlighted land use-related strategies to reduce GHG emissions, many of which overlap with strategies to reduce VMT described in the previous section. Examples of strategies from adopted CAPs include smart growth development, transit-

oriented development, measures to support transit, biking, walking, and other mobility options to driving alone, increasing the urban tree canopy, and preserving natural and working lands.

Reducing Emissions from Electricity

Electricity use is responsible for approximately 23 percent of the San Diego region's GHG emissions as of 2012. Even prior to climate change policy, California has long been a leader in improving building energy efficiency and promoting the use of renewable energy sources. California's per-capita energy consumption is among the lowest in the country and has remained relatively constant since 1974;[13] this has been achieved through building codes and appliance standards, incentive programs, design and installation training, and public outreach. In 1996, the State began incentivizing customer-side renewable energy technologies, and in 2002 it established the first Renewables Portfolio Standard (RPS) for the investor-owned utilities (IOUs)[14]. In order to achieve energy and climate goals, Californians at all levels will need to play a part. The key strategies to reduce GHG emissions from electricity are consistent with the State's loading order, and include:

- Conservation and energy efficiency in new and existing buildings
- Low carbon distributed generation
- Large-scale renewable energy sources

California's Strategy for Reducing Emissions from Electricity

The State's strategy to reduce electricity-related GHG emissions involves the coordination of several State agencies including the California Public Utilities Commission (CPUC), the California Energy Commission (CEC), and CARB. The high-level goals to reduce GHGs in electricity are to achieve the GHG-reduction planning targets to be set by the State for all load-serving entities, reduce fossil fuel use, and reduce energy demand. SB 350 established specific requirements related to these goals, including:

- Establish GHG-reduction planning targets for the electricity sector and ensure meaningful reductions through Integrated Resource Planning
- Increase RPS to 50 percent of retail sales by 2030
- Establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of statewide energy efficiency savings by 2030

The State's IOUs, regulated by the CPUC, implement energy efficiency programs that target both residential and non-residential sectors. In addition to the utility programs, CEC has continually updated building and appliance standards on a roughly three-year cycle. SB 350 requires CEC and CPUC to establish annual targets to reach the energy efficiency goal. In response to SB 350, CEC updated the Existing Building Energy Efficiency (EBEE) Action Plan in December 2016. The EEBE Action Plan summarizes legislation related to energy efficiency in existing buildings and describes strategies to address the state goals and requirements.

California's renewable energy activities have targeted both small-scale, distributed generation as well as larger, utility-scale renewable generation. Expansion of small-scale distributed generation, including rooftop solar photovoltaic, fuel cells, gas turbines, and advanced energy storage, has been driven primarily by incentive programs. Programs include California Solar Initiative, New Solar Homes

Partnership, Self-Generation Incentive Program, Net Energy Metering, and federal tax credits. Governor Brown set a goal for 12,000 megawatts (MW)[15] of distributed renewable generation by 2020; as of November 2017, 10,520 MW of distributed renewable generation capacity was operating or installed, with an additional 440 MW pending.[16] The RPS establishes increasing renewable energy procurement targets for California utilities with current targets set at 33 percent by 2020 and 50 percent by 2030. The utilities now are collectively at 30 percent renewable, and are on track to reach the 2020 and 2030 targets.

The CPUC and CEC acknowledges that California's electric sector is undergoing unprecedented change due to growth in rooftop solar, Community Choice Aggregation (CCA), and direct access providers, with estimates that potentially more than 85 percent of retail load will be served by sources other than the IOUs by the mid-2020s. In response, the CPUC formed the California Customer Choice Project to examine the issues and produce a report evaluating regulatory framework options in 2018.

SANDAG Role in Reducing Emissions from Electricity

While state agencies have significant authority over electricity programs, SANDAG focuses on opportunities that SANDAG and its member agencies could take advantage of to influence electricity savings and GHG reductions in the region. SANDAG does this through coordinated planning with a variety of stakeholders through the Regional Energy Working Group and provision of resources to member agencies through a Local Government Partnership (LGP) with San Diego Gas & Electric (SDG&E). The SANDAG Regional Energy Strategy (RES) outlines several goals that support the State's efforts to reduce electricity-related GHG emissions while considering other factors such as cost effectiveness and impacts to the power grid. Three of the six Priority Early Actions from the RES are related to electricity:

- Pursue a comprehensive building retrofit program to improve efficiency and install renewable energy systems
- Create financing programs to pay for projects and improvements that save energy
- Utilize the SANDAG-SDG&E LGP to help local governments identify opportunities and implement energy savings at government facilities and throughout their communities

The SANDAG LGP, the Energy Roadmap Program, is one component of SDG&E's portfolio of energy efficiency programs. Through the Energy Roadmap Program, SANDAG prepared custom energy management plans for the 16 member agencies that do not have an LGP. As the Energy Roadmaps were completed for the local jurisdictions in the region, the demand to implement the Roadmaps and to assist in the development and implementation of CAPs increased. In 2016, SANDAG and SDG&E expanded the Energy Roadmap Program into two service areas: energy engineering and climate planning.

Energy engineering services include:

- Energy audits of municipal facilities
- Project management support for energy efficiency retrofits
- Technical support and procurement assistance

- Training and recognition
- Project analysis and recommendations and/or feasibility studies
- Performance monitoring

Climate planning services include:

- GHG inventories and projections
- Monitoring reports
- CAP development
- CAP implementation assistance
- Reduction measure calculations and analyses
- Benefit-cost analysis
- Implementation cost assessments
- CEQA assistance
- Trainings

Local Government Role in Reducing Emissions from Electricity

Local CAPs recognize the role that energy efficiency and renewable energy play in reaching GHG reduction goals. The EBEE Action Plan includes a specific strategy related to Local Government Leadership and introduces the CEC's Local Government Challenge program that would provide funding for energy efficiency programs that advance goals in adopted climate or energy action plans. ECEE Action Plan describes other programs and opportunities for local governments to demonstrate leadership, including LGPs, the Cool California City Challenge, voluntary reach standards, building energy saving ordinances, and climate action planning.

The EBEE Action Plan also describes ways that local governments are partners in meeting the State's goals in areas such as:

- Benchmarking and reporting
- Building efficiency standards for existing buildings
- Permitting compliance
- Purchasing and procurement power
- Engagement with the real estate industry
- Financing of energy efficiency upgrades

In the San Diego region, the following agencies have an LGP with SDG&E: the Cities of San Diego and Chula Vista, the County of San Diego, the Port of San Diego, and SANDAG (offering services to

non-LGP member agencies). Through their LGPs, public agencies retrofit their facilities, facilitate green business networks, train government staff on energy concepts and building code updates, develop electricity components of CAPs, and participate in regional collaborative programs.

Some CAPs have set a goal for 100 percent renewable electricity to be achieved through a partnership with SDG&E, CCA, or another similar program. CCA, also known as Community Choice Energy was authorized under Assembly Bill 117 (Migden, 2002) and allows local governments to offer electricity procurement service to customers within their jurisdictional boundaries. In communities with CCA, the incumbent utility continues its role with transmission and distribution, metering, and billing for customers; the CCA only is involved in the electrical generation decision-making. Across the state, there currently are nine operational CCAs with several more cities and counties exploring and/or pursuing CCA. In the San Diego region, the City of Solana Beach completed a CCA technical study and is moving forward with program development and launch. Other jurisdictions exploring CCA include the Cities of Carlsbad, Del Mar, Encinitas, Oceanside, and San Diego.

Reducing Emissions from Natural Gas End Use

Natural gas end uses account for 8 percent of GHG emissions in the San Diego region, the third largest source after transportation and electricity. These emissions primarily come from natural gas combustion for hot water, space heating, cooling, cooking, and other uses in residential and commercial buildings. GHG emissions associated with power generation from natural gas power plants are accounted for in the electricity sector data.

California's Strategy for Reducing Emissions from Natural Gas End Uses

The 2017 Scoping Plan emphasizes that GHG reduction strategies in the natural gas sector should focus on efficiency, reducing leakage from wells and pipelines, transitioning to cleaner heating fuels, and studying the potential for renewable gas fuel switching. In particular, in order to achieve the goals for zero net energy buildings, transitioning to renewable gas, solar thermal, and electrification of end uses in residential, commercial, and industrial sectors will be necessary.

Combined heat and power (CHP), or cogeneration, is another state priority for reducing GHG emissions and using natural gas as efficiently as possible. CHP systems, which generate on-site electricity and useful heat in a single system, typically are used in industrial, commercial, and institutional applications where both electricity and steam are required. Governor Brown set a goal for 6,500 MW of additional CHP capacity by 2030 in the State's Clean Energy Jobs Plan.

SANDAG Role in Reducing Emissions from Natural Gas End Uses

The RES has a goal related to efficiency of natural gas power plants; however, the goal currently does not address natural gas end uses. In the 2014 technical update of the RES, one of the recommendations is to broaden the natural gas goal to address end-user energy efficiency and other pertinent issues. Through the Energy Roadmap Program, SANDAG works with local governments to identify strategies to reduce natural gas use in their own facilities and in the community.

Local Government Role in Reducing Emissions from Natural Gas End Uses

For reducing emissions from natural gas end-uses, strategies are similar to those described above for electricity efficiency. Measures from local CAPs include revising building codes to require energy

audits and/or retrofits, offering financing and incentive programs, increasing use of solar hot water heating, and switching various natural gas end uses to electricity.

Reducing Emissions from Water Sector

Emissions generated from water use are primarily accounted for in the electricity and natural gas sectors of the GHG inventory resulting from electricity used for transport, distribution, treatment, and pumping of water, and natural gas used for heating water. One percent of the region's overall emissions come from emissions associated with the conveyance of water from outside sources to the San Diego region. Because of the close relationship between energy and water, strategies that save water generally save energy as well. This is especially true for the San Diego region since most of the region's water is imported from either the Colorado River or from northern California via the State Water Project; both sources require large amounts of energy to transport the water across long distances.

California's Strategy for Reducing Emissions from Water Sector

The State's overall goal is to promote efficient use of water and use cleaner energy sources to move and treat water. The 2017 Scoping Plan recognizes that water conservation is critical to making the State's water supply more reliable and drought-resistant, and encourages efficient use and reuse to meet future water demands while adapting to climate change impacts. California's 2009 Water Conservation Act (Senate Bill x7-7) set a goal to reduce per capita water use by 20 percent by 2020; Executive Order B-37-16 calls for new water-use targets to increase water conservation statewide. Senate Bill 555 (Wolk, 2015) sets performance standards for water loss and minimizes water system leaks. The State also has set goals for increasing recycled water and stormwater usage, which have been supported by over $1.15 billion in infrastructure grant and loan programs. Additional investments from the State have supported regional collaborative efforts to develop water-management plans, diversify regional water portfolios, and increase self-reliance. The State also recognizes that efforts to conserve water are critical for both reducing GHG emissions and building resilience to impacts of climate change, such as high temperatures and severe drought. Per Senate Bill 1425, the GHG emissions that result from the transport and use of water will be tracked and registered by CalEPA.

SANDAG Role in Reducing Emissions from Water Sector

The San Diego County Water Authority (SDCWA) is the agency responsible for ensuring reliable supplies of water to the San Diego region. SANDAG coordinates with SDCWA to ensure consistency among the various regional planning efforts. Through the Energy Roadmap Program, SANDAG also provides resources to local governments on the water-energy nexus and ways to save water and energy, including incorporating water conservation measures into local CAPs. The RES has a goal to reduce water-related energy use, and the SDCWA has participated in discussions on the topic at Regional Energy Working Group meetings. In addition, the San Diego region has an Integrated Regional Water Management (IRWM) plan which outlines how the region will develop long-term water supply reliability, improve water quality, and protect natural resources. SANDAG is a member of the IRWM Regional Advisory Committee, which plays a critical role in shaping and developing key elements of the IRWM plan.

Local Government Role in Reducing Emissions from Water Sector

Local governments can leverage their authority and encourage residents and businesses to conserve water by adopting building codes and landscape ordinances with increased water efficiency,

coordinating with the local water district and/or SDCWA on programs and incentives available to residents and businesses, and demonstrating leadership by saving water in municipal facilities. Some jurisdictions already require residents to update water fixtures to low-flow models at point of sale or during building renovations.

Reducing Emissions from Solid Waste

Solid waste contributes five percent to the San Diego region's total GHG emissions. This figure includes methane emissions at landfills and wastewater treatment. The State has a goal (set by Assembly Bill 341 in 2011) for diverting 75 percent of waste from landfills (through recycling, composting, or source reduction) by the year 2020 and capturing methane from landfills to further reduce GHG emissions. Assembly Bill 1826, passed in 2014, requires businesses that generate a specific amount of organic waste per week to arrange for recycling services for that waste, according to a tiered implementation schedule; in 2016, local governments were required to implement an organic waste recycling program to divert organic waste generated by businesses and multi-family residential dwellings. SB 1383 of 2016 requires methane emissions at landfills to be reduced by reducing landfill disposal of organic waste 75 percent below 2014 levels by 2025.

The role that SANDAG plays in waste management is limited, as it is not responsible for any landfills in the region. In keeping with State waste reduction goals, SANDAG has established internal measures to significantly lessen the amount of paper printed for internal and external meetings and works with the building owner to implement a comprehensive recycling program. Local governments can adopt codes and standards that increase construction waste diversion, recycling, zero-waste or green-waste programs, and composting. Many local governments have contracted waste services for their jurisdiction and can work with the waste service provider on strategies to reduce GHG emissions. Local governments that operate landfills can work to use captured methane for cogeneration or other applications.

Strategies to Prepare for Climate Change Impacts

Even with the efforts to reduce GHG emissions described in the previous sections, the current levels of GHGs in the atmosphere already have resulted in changes to the climate and will continue to do so. California recognizes the need to prepare communities for the effects of climate change by identifying ways to adapt or change in response to climate impacts, especially those already occurring, and make communities resilient. The State is a leader in providing guidance for identifying vulnerabilities and addressing the major impacts of climate change at the state, regional, and local level. The sections below describe impacts to the San Diego region based on the latest science, California's climate adaptation planning activities, SANDAG efforts to prepare for climate change, and the ways local governments are considering adaptation in their planning efforts.

Climate Change Impacts to the San Diego Region

The San Diego region is already experiencing impacts of climate change, including changes in temperature and rainfall patterns, extended wildfire season, and extreme heat events. The table below summarizes the expected impacts of climate change in the San Diego region by 2050, as described in "San Diego, 2050 is Calling: How Will We Answer?", a 2015 report from Climate Education Partners, and "Rising Seas in California: An Update on Sea-Level Rise Science," published by the Ocean Protection Council in 2017.

Expected Climate Impacts to the San Diego Region by 2050

Temperature	+4.8°F in annual average temperature
Precipitation	16 percent fewer rainy days, and 8 percent more rainfall during the biggest rainstorms
Water Resources	12 percent decrease in the runoff and streamflow due to less snowpack and greater evaporation
Sea-Level Rise	0.7 to 1.2 feet of sea-level rise[17]
Wildfires	Longer and less predictable fire season, larger and more catastrophic fires, and higher number of poor air quality days as a result
Habitat	Threats to coastlines and beaches, wetlands, and unique plants and animals
Public Health	Seven times as many days of extreme heat per year

California Climate Adaptation Planning

In 2008, Governor Schwarzenegger issued Executive Order S-13-08 which directed the CNRA, in coordination with other state agencies, to complete the first California Sea-Level Rise Assessment Report, develop a state Climate Adaptation Strategy, and coordinate with the OPR to provide land-use planning guidance related to sea-level rise and other climate change impacts. The 2009 California Climate Adaptation Strategy was the result of a coordinated effort among several state agencies and used the best available science to describe the impacts, risks, and strategies for climate adaptation.

In 2014, the CNRA released an update to the 2009 strategy called "Safeguarding California: Reducing Climate Risk." In 2018, CNRA released an update of Safeguarding California that included a public review process.[18] The 2018 update focuses on the following ten sectors:

- Emergency Management
- Energy
- Land Use and Community Development
- Public Health
- Transportation
- Agriculture
- Biodiversity and Habitat
- Forests
- Ocean and Coasts
- Water

In addition to CNRA, other State agencies have prepared guidance documents, including the California Adaptation Planning Guide (2012), for considering climate change adaptation in planning and decision making at the local and regional level. The following sections describe the best practices identified by the State for climate adaptation with regards to ocean and coastal resources, extreme heat, wildfire, biodiversity/habitat, and water management.

Senate Bill 246 (Wieckowski, 2015) established the Integrated Climate Adaptation and Resiliency Program (ICARP). ICARP is housed within OPR and allows for coordination on state, regional, and local adaptation efforts, reporting to a Technical Advisory Council.

To assist with understanding the statewide impacts and vulnerabilities of climate change, CNRA, in collaboration with the OPR and the Climate Action Team Research Working Group, is developing the Fourth Climate Change Assessment (Assessment). The Assessment will address California-specific policy questions related to energy (e.g., grid vulnerability and extreme heat) and natural resources (e.g., natural infrastructure options for sea-level rise adaptation) and will be completed in 2018. Additionally, the CNRA is coordinating a series of regional reports, including one focused on the San Diego region, for inclusion in the Assessment.

Ocean and Coastal Resources

The Ocean Protection Council is scheduled to adopt the State of California Sea-Level Rise Guidance: 2018 Update at their March 14, 2018, meeting. This guidance provides a science-based methodology for state and local governments to analyze and assess risks associated with sea-level rise and incorporate sea-level rise into their planning, permitting, and investment decisions. The guidance is based on the findings from "Rising Seas in California: An Update on Sea-Level Rise Science," authored by the California Ocean Protection Council Science Advisory Team Working Group, which includes the

following sea-level rise projections for the San Diego region based on data collected at the La Jolla tide gauge.[19]

- 2030: 0.4 to 0.6 feet (4.8 to 7.2 inches)
- 2050: 0.7 to 1.2 feet (8.4 to 14.4 inches)
- 2100: 1.1 to 3.6 feet (13.2 to 43.2 inches)

In coordination with the other state adaptation strategies, the California Coastal Commission (CCC) adopted Sea Level Rise Policy Guidance in August 2015, which recommends steps for addressing sea-level rise in CCC planning and regulatory actions. The Policy Guidance describes the best available science and provides step-by-step guidance on how to address sea-level rise in new and updated Local Coastal Programs and Coastal Development Permits, which are the fundamental land-use planning and regulatory governing mechanisms in the coastal zone. In addition, the CCC released Draft Residential Adaptation Policy Guidance in 2017, which builds on the CCC's 2015 Sea Level Rise Policy Guidance and provides a more in-depth discussion of sea-level rise adaptation policies specifically related to residential development, as well as sample policy language that jurisdictions could modify for use in different community and geologic contexts.

Extreme Heat

Most of the research on climate change and extreme heat for California has come from the Scripps Institution of Oceanography at University of California, San Diego. Currently, San Diego experiences an average of 2 extreme heat days per year. Projections for the San Diego region include annual temperature increases of up to five degrees and up to 15 extreme heat days by 2050. These heat events will have considerable health risks to the population. In order to prepare and safeguard the community for extreme heat events, the CA Adaptation Planning Guide (2012) offers the following recommendations:

- Incorporate cooling strategies for indoor and outdoor environments into building design, including porous materials and green infrastructure
- Consider potential heat health risks posed by climate change in state and local hazard mitigation plans, improve heat alerts, improve community resiliency (ability to withstand climate impacts), particularly in vulnerable communities, and protect the energy grid
- Increase preparedness of the health care system and protect workers at risk of extreme heat

Wildfire

Southern California already experiences wildfire, and changes to the frequency and severity will depend on factors including shifts in vegetation, Santa Ana wind behavior, temperature increases, and decreased moisture due to longer periods of drought.[20] The CA Climate Adaptation Strategy (2009) recommends firefighting agencies include climate change impact information in fire program planning. The Fourth Climate Change Assessment (2015) and Safeguarding California Plan (2018) include recommendations for emergency management as it relates to wildfires. Enhanced wildfire risk from climate change likely will increase public health and safety risks, property damage, fire suppression and emergency response costs, and impacts to air quality, water quality, and vegetation/habitat.

Biodiversity/Habitat

Impacts of climate change such as sea-level rise, loss of wetlands, wildfire, warmer temperatures, and drought can dramatically alter terrestrial and freshwater aquatic habitats and the species that depend on them. The California Department of Fish and Wildlife offers planning resources for minimizing negative effects of climate change on the state's fish, wildlife, and habitat through its Climate Science Program, and the CA Adaptation Planning Guide identifies strategies for addressing climate impacts on biodiversity and habitat and recommends local agencies work with their communities to:

- Identify and protect locations where native species may shift or lose habitat
- Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas
- Use purchase of development rights or conservation easements to protect vulnerable habitats

The Safeguarding California Plan (2018) builds on these recommendations by encouraging the State to continue incorporating climate considerations into investment decision-making as it relates to biodiversity, and also to provide educational opportunities to public agency staff regarding climate impacts and adaptation choices for various ecosystems. The State Wildlife Action Plan is a plan for conserving the state's fish and wildlife and their habitats that, in part, addresses climate change.[21]

Water Management

Climate impacts on water management include altered timing and amount of precipitation as well as increased temperatures that influence the availability of water supply. A number of State resources are available regarding risk and exposure from a changing climate on water resources including the CA Adaptation Strategy (2009), the Safeguarding California Plan (2018), the CA Water Plan update (2017 draft), and the CA Water Action Plan (2016 update). The CA Adaptation Planning Guide describes strategies for limiting community exposure to threats, such as flooding or landslides, as well as measures to reduce local water use in response to water supply limits from reduced snowpack, reduced precipitation, or drought. The Guide recommends that local jurisdictions update General Plan safety elements and local hazard mitigation plans to reduce potential losses of life and property from flooding and landslide risk. Senate Bill 379 (Jackson, 2015) (SB 379) requires climate adaptation and resiliency strategies in General Plan Safety Elements. Strategies to conserve water work as both mitigation and adaptation strategies and include implementing a recycled water program, using pricing to reduce consumption demand, and restoring natural groundwater supplies for water storage.

SANDAG Adaptation Planning Efforts

The 2015 Regional Plan recognizes that the region is and will continue to be affected by the impacts of climate change and identifies the following action to support implementation:

- Develop strategies to enhance our region's ability to adapt to the consequences of climate change, including planning and design strategies to help communities cope with hazardous events such as storms, heat waves, wildfires, or ongoing drought

Considering Climate Change Impacts on Transportation Infrastructure

SANDAG has begun to consider impacts of climate change as projects are designed, built, and maintained, recognizing the importance of protecting infrastructure investments. To inform the

North Coast Corridor Program, SANDAG and Caltrans commissioned the San Diego Region Coastal Sea Level Rise Analysis Report.[22] The Report describes future scenarios for sea-level rise along the region's coastline based on the latest and most relevant scientific reports and guidance, offers design water level guidance for local projects, an adaptive management strategy, and general conclusions and recommendations. In December 2017, SANDAG was awarded funding through a Caltrans adaptation planning grant to create a sea-level rise adaptation guidance document for regional transportation facilities. The project will build on the work already being conducted at the local level to assess how sea-level rise will impact the region's transportation network and how adaptation measures can be utilized to mitigate these impacts.

In January 2017, the California Transportation Commission adopted the 2017 RTP Guidelines for MPOs. A section of the RTP Guidelines focuses on adaptation of the regional transportation system to climate change. This section highlights resources for MPOs and states that MPOs "should begin to address climate change adaptation in their long-range transportation plans in collaboration with State agencies, as transportation infrastructure projects that do not consider the impacts of climate may not be eligible to receive state funds."

Shoreline Preservation

Recognizing the need for regional coordination to address beach erosion issues along the coastline, SANDAG facilitates the regional shoreline monitoring program which measures the changes in beach width over time, documents the benefits of sand-replenishment projects, and helps to improve the design and effectiveness of beach fills. The Shoreline Preservation Working Group helps to inform SANDAG on issues related to the implementation of the Shoreline Preservation Strategy and sea-level rise adaptation measures such as beach replenishment opportunities. Beach replenishment is just one of the adaptation strategies noted in the CCC Sea Level Rise Policy Guidance for addressing impacts of sea-level rise on shorelines.

Habitat Conservation

The *TransNet* EMP funds habitat-related environmental mitigation activities required to implement projects from the RTP including purchasing, conserving, and restoring native habitats as offsets to disturbances caused by transportation projects. The EMP also is helping to fund research and regional coordination on ways to build resiliency among species and habitats. The San Diego Management and Monitoring Program completed the Management Strategic Plan for Conserved Lands in Western San Diego County (MSP) in 2013, providing a comprehensive approach for management of multiple plant and animal species. A component of the MSP addresses regional threat and stressor management, including fire, invasive species, urban edge, habitat fragmentation, human use of preserves, nitrogen deposition, and cumulative stressors. Many of these threats and stressors are either directly or indirectly related to climate change, and the MSP offers goals and objectives for building resiliency to these effects of climate change.

Local Government Role in Adaptation Planning

Local governments play a key role in assessing vulnerabilities to climate change in their communities and identifying and implementing strategies to prepare communities for these impacts. While most CAPs are focused on strategies to reduce GHG emissions, some local governments are recognizing that preparing for inevitable impacts of climate change is equally important and have started to consider how adaptation measures may mitigate future impacts from climate change. Strategies included in

CAPs related to adaptation include reducing urban heat island impacts through planting shade trees, and identifying and offering cool zones to prepare for extreme heat events.

In addition to the adaptation strategies included in CAPs, several local governments are addressing climate change adaptation through vulnerability assessments and/or updates to their Local Coastal Programs (LCPs). These documents often take a "triggered" approach, outlining implementation phases for policies, regulations, and projects that would come into effect after being "triggered" by specific sea-level rise and weather events.

Strategies included in LCPs and other similar adaptation plans include (but are not limited to):

- Beach and dune nourishment
- Sea wall and revetment improvements
- Sand retention measures
- Reservoir management
- Sensitive habitat expansion/restoration
- Regulations to raise or remove structures or alter building setbacks

Adaptation strategies can also be incorporated into other planning-level documents, including General Plans and hazard mitigation plans. SB 379 requires jurisdictions to begin to include climate adaptation and resiliency strategies within their General Plan Safety Element. This includes updated goals and policies per a vulnerability assessment and identifying climate risks posed to the local jurisdiction. OPR's 2017 General Plan Guidelines provide detailed guidance on how to revise General Plans to integrate adaptation planning under SB 379.

Interrelationships to Other Policy Areas

Climate change is related to several other policy areas of the 2019 Regional Plan, and these interrelationships offer co-benefits—where strategies to address climate change also benefit other policy goals—however, there are some areas where strategies to address climate change could conflict with other policy goals. The following sections describe how climate change is interrelated with economics, public health, and social equity considerations.

Economics and Climate Change

Taking steps to mitigate climate change can assist with many of the other objectives in the 2019 Regional Plan and can result in substantial economic benefits. For example, changes in land-use regulations, zoning, and transportation infrastructure intended to reduce transportation GHG emissions can create denser, mixed-use, multimodal communities that can serve the growing populations of younger professionals, singles, and seniors. These changes also can lead to better health outcomes and easier access to schools, jobs, and recreation, thereby increasing economic opportunities for those with limited resources. Efforts to improve energy and water efficiency can have substantial positive benefits to the San Diego economy by saving money and stimulating job creation in the energy contractor and engineering fields, since the improvements must be installed and maintained by a local workforce. Benefits to job growth also come from the "cleantech" sector, which produces products and services related to renewable energy, energy efficiency, clean transportation, and smart grid. In the San Diego region, roughly 7,300 jobs with an average wage of $87,000 are within the "cleantech" sector.[23]

Businesses are taking steps to reduce their own GHG emissions while saving money and increasing competitiveness. Businesses that are becoming more energy efficient are seeing savings in energy costs, reduced maintenance costs, and reduced exposure to risk from volatile energy process. The 2017 Scoping Plan states that California produces 55 percent more economic value for every unit of electricity used compared to the rest of the country. As renewable energy technologies continue to decline in price, they become more cost-competitive to sources of fossil fuels, and these avoided energy costs are pumped back into the economy elsewhere.

Assessing and preparing for vulnerabilities of drought and severe weather now can have substantial economic benefits in the future. Climate change has the potential to present substantial costs to the San Diego region, from severe impacts of sea-level rise and increased storm activity on the region's oceanfront to the impact on energy-needs, agricultural disruption, and public health. There is considerable uncertainty as to the timing and severity of these impacts, and to our ability to avoid them, mitigate them, and/or adapt to them should they occur to any substantial degree. Technological and engineering solutions of varying cost and effectiveness could mitigate many of the effects, but it is likely that behavioral changes may be required as well. To begin analyzing the cost effectiveness of various coastal adaptation strategies, the Resilient Coastlines Project of Greater San Diego[24] partnered with Nexus Planning to road-test a National Oceanic and Atmospheric Administration (NOAA) cost-benefit evaluation tool for sea-level rise scenarios at the local level. Weighing the varying costs, benefits, and economic impacts of coastal resilience strategies may help inform local decision-making and justify early and cost-effective investments to protect coastal communities from future sea-level rise and storm impacts.

Public Health, Social Equity, and Climate Change

Public health, social equity, and climate change are policy areas that are closely connected. Goals and objectives for creating a healthy community and improving quality of life for all residents closely align with those for addressing climate change. Many key strategies for reducing GHG emissions also can improve health and have the potential to increase quality of life for all people regardless of age, gender, race, color, national origin, income, or physical agility. The 2017 Scoping Plan quantifies the health benefits in 2030 from the plan, including 3,300 avoided premature deaths, $1.2 billion to $1.8 billion in avoided health impacts, and $1.9 billion to $11.2 billion of avoided damages based on the social cost of carbon. Examples of these strategies and co-benefits are summarized in the following table.

Greenhouse Gas-Reduction Strategies and Potential Co-Benefits

Strategy to Reduce Greenhouse Gas Emissions	**Potential Health/Social Equity Co-Benefits[25]**
Reduce vehicle miles traveled	• Reduce air pollution • Increase physical activity • Reduce chronic disease such as asthma and heart disease • Improve mental health • Improve access to low-cost alternative transportation options
Increase fuel efficiency and use of cleaner fuels in vehicles	• Reduce air pollution
Reduce emissions through land-use changes such as more compact growth	• Increase physical activity • Reduce chronic disease • Increase local access to essential services such as affordable housing, jobs, and amenities • Enhance safety for biking and walking with reduced vehicle speeds and reduced collisions
Reduce residential building energy and water use	• Reduce household energy costs (especially beneficial for low-income households) • Promote healthy homes • Create local green jobs • Promote cooler communities through shade trees and cool pavements
Urban greening	• Reduce temperature and urban heat island health effects • Reduce air pollution • Reduce noise • Enhance safety
Biodiversity conservation	• Promote ecosystem services (clean air and water) • Enhance access to open space and recreation

While there are many co-benefits among strategies that reduce GHG emissions, improve public health, and address social equity, there are some important considerations that must be made in order to avoid negative impacts on public health and social equity:

- Use of zero-emission or fuel-efficient vehicles reduces GHG emissions, but has no change on sedentary lifestyles that contribute to chronic disease and does not address the needs of the populations that do not drive or cannot afford to own and operate a vehicle
- Increasing density must be coupled with addressing green space and tree canopy needs in order to avoid the unintended consequence of increasing urban heat island effects, as well as increased housing costs and gentrification of existing communities
- Implementation of building efficiency standards must also consider adequate ventilation and other components of healthy housing
- Increasing renewable energy sources for electricity must also consider impacts to electricity costs, particularly on low-income residents

Impacts to public health from climate change include increased heat-related illnesses; increased asthma, allergies, and other cardiovascular and respiratory diseases due to poor air quality; disruption in food and water supply due to drought and severe weather; and population displacement due to wildfire or sea-level rise. Impacts from climate change will not affect all communities in the same way; the health impacts of climate change may disproportionately affect vulnerable populations including children, the elderly, people with chronic illness, low-income populations, and those unable to afford food or fuels for cooling and transportation. Working to create healthy communities builds a foundation for resiliency to climate impacts that benefits all segments of the population, including vulnerable populations.

Auction proceeds from CARB's Cap-and-Trade program will help to benefit disadvantaged communities. Senate Bill 535 (De León, 2012) requires that CARB identify disadvantaged communities based on geographic, socioeconomic, public health, and environmental hazard criteria, and that at least 25 percent of auction proceeds be allocated to projects that benefit these communities. Additionally, at least 10 percent of the proceeds must be allocated to projects located in the disadvantaged communities. Assembly Bill 1550 (2016) increased the percent of funds from 10 percent to 25 percent and added a focus on investments in low-income communities.

Emerging Technologies

Technology adoption has rapidly increased over the last several decades and influences nearly every aspect of daily life. Technological advancements have the potential to dramatically influence GHG emissions from the transportation and electricity sectors in particular. California depends on the transition to clean energy and clean transportation technologies to meet the statewide GHG-reduction goals for the coming decades. Planning and policy interventions are critical to ensuring technology is supportive and not detrimental to reducing GHG emissions.

In the electricity sector, technology influences the energy-related behavior of individuals, facilities, and the design of the grid itself. Costs of clean power sources continue to decline more quickly than previously predicted, which increases access to these technologies. In addition, technologies such as energy storage, smart inverters, and renewable-fueled fuel cells help to balance the variability of

renewable energy production and are similarly declining in cost and penetrating the market very quickly.

The following table describes the key mobility trends and considerations related to transportation-sector GHG emissions; these are more fully described in the Emerging Technologies White Paper.

Key Mobility Trends and Greenhouse Gas-Related Considerations

Key Mobility Trends	Description	Greenhouse Gas-Related Considerations
Mobility as a Service	• On-demand rideshare • Bikeshare • Carshare • Public transit • Microtransit	• Decreased vehicle ownership • Shared mobility trips replace single-occupant trips *and* transit trips • VMT impacts are unclear
Vehicle Technologies	• ZEVs • Autonomous vehicles (AVs) • Connected vehicles	• AVs could increase VMT and urban sprawl without policy intervention • Automakers intend to produce electric AVs • Roads may accommodate more vehicles
Smart Cities and Transportation Systems	• Transportation System Management and Operations	• Collection and distribution of data • Integration of energy, transportation, and other systems

SANDAG Plans and Programs and Collaborative Regional Activities to Address Climate Change

There are many efforts underway in the San Diego region that are planning and implementing strategies to address climate change. This section further describes some of the ways SANDAG and local governments are addressing climate change in the San Diego region, both individually and collaboratively. In addition to the plans and programs described below, there are numerous private and non-profit organizations that are acting on climate change.

SANDAG Plans and Programs

Regional Energy Strategy (2009, 2014 Technical Update)

The RES establishes goals for the San Diego region to be more energy efficient, to increase use of renewable energy sources, and to enhance the region's energy infrastructure so that we are able to meet growing energy demand. The San Diego region has a history going back to 1979 of developing an energy strategy, with updates occurring through the 1980s, 1990s, and in 2003. The 2009 RES was developed in response to increasing scientific and policy focus on global climate change and in light of the significant policy changes and implementation programs affecting the electricity, natural gas, and transportation sectors. In order to inform the 2015 Regional Plan, SANDAG undertook a technical update of the RES which demonstrates progress since 2009 toward RES goals, identifies data and monitoring methods for each goal, and provides recommendations for continued progress.

Climate Action Strategy (2010)

The Climate Action Strategy is a guide for SANDAG on climate change policy, based on information available at the time of its preparation in 2010. The Strategy identifies a range of potential policy measures—"tools in the toolbox"—for consideration as SANDAG updates long-term planning documents, and as local jurisdictions update their General Plans and other community plans. The Strategy helped SANDAG identify land-use, transportation, and related policy measures and investments that could reduce GHG emissions from passenger cars and light-duty trucks. Potential policy measures also are identified for buildings and energy use, protecting transportation and energy infrastructure from climate impacts, and to help SANDAG and local jurisdictions reduce GHG emissions from their operations. Preparation of new energy efficiency and climate change strategies is proposed to support preparation of the 2019 Regional Plan and would replace existing SANDAG energy and climate strategies.

Riding to 2050, the San Diego Regional Bicycle Plan (2010) and Bike Early Action Program

The San Diego Regional Bicycle Plan is a strategy for making the bicycle a more useful form of transportation for everyday travel. The San Diego Regional Bicycle Plan describes the regional bicycle network as a component of the multimodal regional transportation system included in the Regional Plan, as well as the programs that are necessary to support the network. Implementation of the plan is key to achieving the GHG reduction goals of the 2019 Regional Plan and supporting improved public health through active transportation.

When the SANDAG Board of Directors adopted the 2050 RTP/SCS, it committed to developing an early action program for projects included in the Regional Bicycle Plan. In September 2013, the Board approved the Regional Bike Plan Early Action Program with the overall goal to implement

Bike Plan Network High Priority Projects within 10 years, and execute programs to support the network investments.

Transportation Demand Management Program, iCommute Commuter Services

Transportation Demand Management (TDM) refers to programs and strategies that manage and reduce traffic congestion by encouraging the use of transportation alternatives. SANDAG coordinates a number of programs that are increasing the number of commuters who carpool, vanpool, take transit, bike, walk, and telework. These activities are facilitated through the iCommute program. The goal of iCommute is to manage and reduce traffic congestion, as well as reduce GHG emissions and other environmental pollutants that result from commuters driving alone each day. Managing the demand for our roadways is a cost-effective method for improving the daily commute while also improving the quality of life across the region.

SANDAG works closely with Caltrans, the Metropolitan Transit System, North County Transit District, and all 19 jurisdictions within the region. Programs and services provided by iCommute include free, online ridematching, a vanpool subsidy program, transit solutions, bicycle encouragement programs, the Guaranteed Ride Home program, and support for teleworking. Public outreach increases awareness about the variety of transportation choices through events such as Bike to Work Day and Rideshare Week and through direct outreach to employers, community groups, schools, and agencies.

San Diego Region Intelligent Transportation Systems Strategic Plan (2011)

The San Diego Region ITS Strategic Plan defines a ten-year vision for the effective use of technology to support intelligent transportation operations and management goals, and identifies key strategies that the region can implement to address critical technical and institutional needs. The purpose of the Plan is to provide policy guidance and a common vision for ITS applications to improve mobility, safety, efficiency, and reliability. One guiding principle of the plan is to prioritize funding for projects that help the region achieve GHG reduction targets and preserve natural resources. The Plan was included as an appendix in the 2015 Regional Plan.

Regional Alternative Fuel Planning

One of the six priority early actions identified in the Regional Energy Strategy and actions included in the Regional Plan are to support planning for electric vehicle charging and alternative fueling infrastructure. Strong regional support for alternative fuels can communicate to the market that the San Diego region is committed to, and seeks to attract, investment in alternative fuel vehicles and infrastructure.

Infrastructure needs were identified in a 2009 assessment of how to accelerate deployment of alternative fuel vehicles in and around San Diego entitled the Regional Alternative Fuels, Vehicles, and Infrastructure Report. The report recommended public-private partnerships and collaborative approaches to infrastructure planning and increasing alternative fuels in fleets. Its findings were incorporated into the regional energy and climate strategies, and informed actions for implementation identified in the 2015 Regional Plan. In 2014, SANDAG began Refuel, a regional planning effort to address infrastructure needs for alternative fuels. Refuel helped to streamline and address barriers to alternative fuel adoption, as well as provide best practices and real-time learning and sharing across jurisdictions and develop plan summarizing these concepts. The San Diego Regional Alternative Fuel Readiness Plan was accepted by the SANDAG Board of Directors on February 26, 2016.

Regional Plug-in Electric Vehicle Planning

The San Diego region is at the forefront of plug-in electric vehicle (PEV) deployment, and the region's early PEV experiences identified barriers to widespread PEV adoption. In order to address these barriers, the CEC awarded SANDAG a grant to form the San Diego Regional Electric Vehicle Infrastructure Working Group (REVI) and develop a regional PEV readiness plan. REVI held its kick-off meeting in 2012, and members included representatives from local governments, regional agencies, EV charging manufacturers, local colleges and universities, workforce training programs, and non-profits. The San Diego Regional PEV Readiness Plan was accepted by the SANDAG Board of Directors on January 24, 2014. Activities identified in this plan were implemented through Plug-in SD, a program funded through the CEC. In partnership with the Center for Sustainable Energy, Plug-in SD provides local stakeholders strategic and technical guidance to ensure that the San Diego region is PEV-ready. These outreach efforts have continued, as Plug-in SD was extended due to additional CEC funding.

Energy Roadmap Program

The Energy Roadmap Program is a collaboration between SANDAG and SDG&E that began in 2010. It is funded primarily by California utility customers under the auspices of the California Public Utilities Commission, while SANDAG funds the transportation components. The Energy Roadmap Program provides free energy assessments and energy management plans, or "energy roadmaps," to SANDAG member agencies. Each energy roadmap provides a framework for a local government to reduce energy use in municipal operations and in the community, and can result in economic savings and environmental benefits. As the Energy Roadmaps were completed for the local jurisdictions in the region, the demand to implement the Roadmaps and to assist in the development and implementation of CAPs increased. In 2016, SANDAG and SDG&E expanded the Energy Roadmap Program into two service areas: energy engineering and climate planning.

Energy engineering services include:

- Energy audits of municipal facilities
- Project management support for energy efficiency retrofits
- Technical support and procurement assistance
- Training and recognition
- Project analysis and recommendations and/or feasibility studies
- Performance monitoring

Climate planning services include:

- GHG inventories and projections
- Monitoring reports
- CAP development
- CAP implementation assistance

- Reduction measure calculations and analyses
- Benefit-cost analysis
- Implementation cost assessments
- CEQA assistance
- Trainings

Sub-Regional Energy Action Collaboratives

Since 2013, SANDAG has offered a "peer to peer" or "neighboring city to neighboring city" approach as an additional method for Energy Roadmap implementation. The objectives of these sub-regional collaboratives are focused on three categories: municipal energy management, building and development processes, and community outreach.

The sub-regional energy action collaboratives are:

- The South Bay Energy Action Collaborative (SoBEAC): founded in 2013 and comprises the Cities of Chula Vista, Coronado, Imperial Beach, and National City. SoBEAC is led by the City of Chula Vista
- The North Coast Energy Action Collaborative: founded in 2015 and comprises the Cities of Del Mar, Solana Beach, Encinitas, Carlsbad, and Oceanside
- Inland Cities Energy Collaborative: founded in 2016, and comprises the Cities of Poway, Escondido, Vista, and San Marcos
- East County Energy Action Collaborative: founded in 2017, and comprises the Cities of Lemon Grove, La Mesa, Santee, and El Cajon

SANDAG Green Operations Manual

The SANDAG Green Operations Manual, completed in March 2014, examines programs and projects that the agency oversees or influences, office space, and internal operations, as well as actions that employees can take to save energy and reduce GHG emissions. Development of the manual was made possible through the SANDAG Local Government Partnership with SDG&E. GHG reductions can come from energy efficiency measures, renewable energy options, alternative fuel use, petroleum-reduction practices, and active transportation efforts.

TransNet Smart Growth Incentive Program and Active Transportation Grant Program

The *TransNet* Smart Growth Incentive Program (SGIP) funds transportation-related infrastructure improvements and planning efforts that support smart growth development. SANDAG administers the SGIP using regional *TransNet* half-cent sales tax dollars to fund local governments projects through a competitive grant process that promotes better coordinated transportation and land-use planning in the San Diego region. Through the first three grant cycles of the SGIP and Active Transportation Grant Program (ATGP), more than $22.5 million in federal funds and more than $55 million in *TransNet* and Transit Development Act funds have been distributed to the cities and the County of San Diego to complete scores of planning and capital projects.

The goal of the ATGP is to encourage local jurisdictions to plan and build facilities that promote multiple travel choices for residents and connectivity to transit, schools, retail centers, parks, work, and other community gathering places. The grant program provides both capital funding for projects and non-capital funding for plans, bicycle parking, education, encouragement, and awareness programs that support pedestrian and bicycle infrastructure.

In 2017, SANDAG revised the *TransNet* SGIP and ATGP for the fourth grant cycle to require locally adopted CAPs and complete street policies in order to be eligible for grant funding, to allow local jurisdictions to apply for competitive funding for preparation of a CAP and/or complete streets policy if they do not have one, and to add new GHG Emission Reduction Evaluation Criteria to all SGIP and ATGP grant programs. The most recent Call for Projects for the SGIP/ATGP was released in December 2017 and will distribute up to $27 million in SGIP funds and $3.6 million in ATGP funds.

Regional Transit-Oriented Development Strategy

SANDAG prepared a Regional Transit-Oriented Development (TOD) Strategy to promote and incentivize sustainable development. More specifically, the strategy focuses on creating TOD projects and neighborhoods that will reduce GHG emissions; increasing transit ridership, walking, and biking; and providing a greater mix of housing and employment opportunities for all residents of the region. This project includes a review and update of the Smart Growth Concept Map and Smart Growth Incentive Program, and other strategies/policies to facilitate development associated with the region's network of public transit. The Strategy was included as an appendix in the 2015 Regional Plan.

Regional Collaborations

San Diego Regional Climate Collaborative

The San Diego Regional Climate Collaborative[26] (Climate Collaborative) is a network for public agencies that serve the San Diego region by sharing expertise, leveraging resources, and advancing comprehensive solutions to facilitate climate change planning. By partnering with academia, non-profit organizations, and business and community leaders, the Climate Collaborative also works to raise the profile of regional leadership on addressing potential impacts from climate change. The Climate Collaborative was established as part of the CPUC-funded LGPs among SDG&E and the Cities of Chula Vista and San Diego, the County of San Diego, the Port of San Diego, the University of San Diego, and SANDAG. Additional Climate Collaborative members include the San Diego Foundation, the San Diego County Regional Airport Authority, and several local jurisdictions within the region. The Climate Collaborative hosts trainings, workshops, and networking opportunities for local governments to share best practices and information about climate initiatives across the region and state.

Climate Science Alliance – South Coast

The Climate Science Alliance is a partnership between public agencies, conservation organizations, businesses, researchers, artists, educators, and community groups that works to promote climate resiliency within the South Coast eco-region (ranging from Santa Barbara through Baja California). The Climate Science Alliance leads education-based activities to promote increased awareness of climate change-related issues. Recent Climate Science Alliance programs include Climate Kids, which provides youth education on climate change through science, storytelling, and art, and Dial-A-Scientist, which allows partners to contact scientists to support climate science and build a foundation of trust within the community.

Resilient Coastlines Project of Greater San Diego

Funded by the NOAA and convened by the San Diego Regional Climate Collaborative, the Resilient Coastlines Project of Greater San Diego (Resilient Coastlines)[27] brings together local sea-level rise initiatives to share lessons learned and fills existing knowledge gaps. Work began on the Resilient Coastlines project in early 2016, and project deliverables are expected to be completed in spring 2018. The Resilient Coastlines project has produced a legal risk analysis and economic framework for sea-level rise adaptation strategies, facilitated local workshops on living shoreline strategies, and assisted local jurisdictions with technical assistance and information from the United States Geological Survey on their Coastal Storm Modeling System. Coastal resilience activities occurring in the San Diego region are displayed on an interactive map on the project's website and include local initiatives undertaken by the Cities of Oceanside, Carlsbad, Del Mar, Encinitas, Solana Beach, and Imperial Beach, the County of San Diego, the United States Navy, the San Diego County Regional Airport Authority, the Tijuana River National Estuarine Research Reserve, the Port of San Diego, and other entities surrounding the San Diego Bay.

Regional Sea-Level Rise Working Group

At its core, the Resilient Coastlines project is supported by a Regional Sea-Level Rise Working Group (Working Group). The Working Group integrates and coordinates coastal resilience activity across the region by serving as a central hub to leverage expertise and resources, share technical information, develop consistent planning frameworks, and enhance the overall effectiveness of regional resilience strategies. Although the Resilient Coastlines project is expected to complete all project deliverables in spring 2018, it is expected that the Working Group will continue to coordinate on local sea-level rise planning initiatives to continue leveraging resources and knowledge to support ongoing planning efforts.

San Diego Regional Energy Partnership

SANDAG coordinates with other SDG&E LGPs, including the Cities of San Diego and Chula Vista, the County of San Diego, and the San Diego Unified Port District on regional energy efficiency programs through the San Diego Regional Energy Partnership. This partnership includes the continuation and expansion of the San Diego Regional Climate Collaborative, the launch of the San Diego Regional Green Business Network, and other energy efficiency related efforts.

Climate Education Partners

Climate Education Partners is a project funded by the National Science Foundation to develop climate change education strategies. Climate Education Partners is a collaboration of partners that bring together expertise in climate science, social psychology, law, policy, and communications from the University of San Diego, Energy Policy Initiatives Center, California State University San Marcos, Scripps Institution of Oceanography, the San Diego Foundation, and the Steve Alexander Group. The project has conducted public opinion surveys as well as interviews with influential people in the San Diego region in order to understand their views of climate science and the impacts of climate change. Using Geographic Information System Story maps, Climate Education Partners has developed a community toolbox focused on local impacts of climate change for regional leaders and their communities. Climate Education Partners also released a report, entitled "San Diego, 2050 is Calling: How Will We Answer?", which builds off the 2008 Focus 2050 report from the San Diego Foundation on impacts of climate change in the San Diego region.

Acronyms

AB 32	Assembly Bill 32 (2006), The Global Warming Solutions Act
CAP	Climate Action Plan
CARB	California Air Resources Board
CCC	California Coastal Commission
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CHP	Combined heat and power
CPUC	California Public Utilities Commission
EMP	Environmental Mitigation Program
GHG	Greenhouse gas
IOU	Investor-owned utility
ITS	Intelligent Transportation Systems
LCFS	Low Carbon Fuel Standard
LGP	Local Government Partnership
Low-CI	Low carbon-intensity
$MMTCO_2e$	Million metric tons of carbon dioxide equivalent
MPO	Metropolitan Planning Organization
MSP	Management Strategic Plan
MW	Megawatt
OPR	Governor's Office of Planning and Research
PEV	Plug-in electric vehicle
RES	Regional Energy Strategy
REVI	San Diego Regional Electric Vehicle Infrastructure Working Group
RPS	Renewable Portfolio Standard

RTP	Regional Transportation Plan
RTP/SCS	2050 Regional Transportation Plan and Sustainable Communities Strategy
SB 375	Senate Bill 375 (2008), Transportation-Related GHG Targets and Sustainable Communities Strategies for MPOs
SCS	Sustainable Communities Strategy
SDCWA	San Diego County Water Authority
SDG&E	San Diego Gas & Electric
SGIP	Smart Growth Incentive Program
TDM	Transportation Demand Management
VMT	Vehicle miles traveled
ZEV	Zero-emission vehicle

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[5] California Air Resources Board, 2018. Updated Final Staff Report, *Proposed Update to the SB 375 Greenhouse Gas Emission Reduction Targets*, February 2018, p. 14.

[6] See California Air Resources Board, Public Meeting to Hear Proposed Update to Senate Bill 375 Greenhouse Gas Emission Reduction Targets – Staff Presentation, March 23-24, 2017, Slides 27-34, https://www.arb.ca.gov/board/books/2017/032317/17-3-7pres.pdf.

[7] California Air Resources Board, *California's 2017 Climate Change Scoping Plan*, November 2017, p. 101.

[8] California Air Resources Board, *California's 2017 Climate Change Scoping Plan*, November 2017, p. 101.

[9] The Memorandum of Understanding on Subnational Global Climate Leadership (Under2 MOU) brings together states and regions willing to commit to reducing their GHG emissions by 80 to 95 percent, or to limit emissions to 2 metric tons CO_2-equivalent per capita, by 2050. As of October 2017, 188 jurisdictions had joined California in the Under2 MOU.

[10] San Diego Regional Plug-in Electric Vehicle Readiness Plan is available at: http://www.sandag.org/uploads/publicationid/publicationid_1817_17061.pdf.

[11] San Diego Regional Alternative Fuel Readiness Plan is available at: http://www.sandag.org/uploads/projectid/projectid_487_20274.pdf.

[12] Projected housing and job growth in 1999 (left) and 2013 (right) based upon the SANDAG Series 9 and 13 Regional Growth Forecasts.

[13] California Energy Commission, Comprehensive Energy Efficiency Program for Existing Buildings: http://energy.ca.gov/ab758/.

[14] California investor-owned utilities are San Diego Gas & Electric, Pacific Gas & Electric, Southern California Electric, and Southern California Gas.

[15] A megawatt is equal to 1,000 kilowatts or one million watts. One megawatt is enough electrical capacity to power about 1,000 average homes in California.

[16] California Energy Commission. December 2017. Tracking Progress. Renewable Energy – Overview. http://www.energy.ca.gov/renewables/tracking_progress/documents/renewable.pdf.

[17] This figure references the "likely range" of sea-level rise for 2050 based on data from the La Jolla tide gauge, Table 1(c) from *Rising Seas in California: An Update on Sea-Level Rise Science*.

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