

# Appendix Q

## White Papers

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#### White Papers

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- Economic Prosperity White Paper
- Climate Change Mitigation and Adaptation White Paper
- Emerging Technologies White Paper

# White Papers

In an effort to bring greater focus to the new and emerging topic areas of San Diego Forward: The 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 Regional Plan, and to serve as appendices to the Regional Plan.

In total, four white papers were prepared. They focused on issues related to public health and the built environment; economy; climate change; and technology. These topics are consistent with the vision and goals approved by the SANDAG Board of Directors for the plan, centered around Vibrant Economy, Healthy Environment and Communities, and Innovative Mobility and Planning.

In order to prepare the white papers, SANDAG staff developed draft outlines of the proposed content to be included in each paper and solicited input on the outlines from SANDAG Policy Advisory Committees and working groups. The papers built upon feedback from public workshops held earlier in the planning process, as well as upon comments provided on the white paper outlines presented to the Policy Advisory Committees and the various working groups.

Due to a schedule tied closely to grant funding, the Public Health White Paper was finalized in 2013. The remaining draft white papers on Economic Prosperity, Climate Change Mitigation and Adaptation, and Emerging Technologies were released in spring 2014, and were available for a 45-day public review period from April 4 to May 19, 2014, at [sdforward.com](http://sdforward.com). During the review period, staff solicited comments from various working groups on the white papers, held workshops for the network of Community-Based Organizations and the Regional Planning Technical Working Group (the local jurisdictions' planning and community development directors), and sent an e-blast to interested stakeholders to seek feedback on all three white papers. An on-line form was made available for members of the public to provide comments.

Following the public review period in June 2014, staff reported back to the Transportation and Regional Planning Committees summarizing the major themes from the comments received and outlining the types of changes proposed to each white paper. The white papers were then updated and finalized.

The final papers were re-posted to the website in mid-2014. All four white papers are included in this appendix.



## PUBLIC HEALTH WHITE PAPER

### A. SUMMARY

*“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”<sup>1</sup> – Robert Wood Johnson Foundation’s Center to Prevent Childhood Obesity Working Group*

As SANDAG develops regional policies and programs to guide transportation infrastructure investments over the next four decades, an understanding of the public health benefits and impacts of those decisions will support the agency’s efforts in creating a safe, viable, and efficient transportation system for the San Diego region. The investments, in turn should support improved public health outcomes. Public health was an emerging subject area considered in the previous Regional Comprehensive Plan (RCP) adopted in 2004, and the 2050 Regional Transportation Plan and Sustainable Communities Strategy (2050 RTP/SCS), but is currently a focus area in which SANDAG has become more fully involved in through a U.S. Centers for Disease Control (CDC) grant to the County of San Diego. This paper will expand upon previous efforts in defining the most effective approaches for achieving public health objectives.

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 achieve 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.<sup>2</sup> Research also has established a clear connection between these built environment characteristics and chronic diseases, such as heart disease, diabetes, cancer, and asthma, which account for at least \$4 billion in direct healthcare expenditures in the San Diego region.<sup>3</sup> The transportation decisions made as part of the San Diego Forward: The 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 the infectious diseases of the 20<sup>th</sup> century, which have generally been controlled, toward chronic diseases that now account for seven out of every ten deaths in the United States.<sup>4</sup> 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 pedestrians and bicyclists and health disparities (the difference in health outcomes between people of different ethnicities, education attainment, and/or income levels).

The paper includes the following sections: a brief history of public health and urban planning; why public health matters; the rationale for the link between health outcomes and the built environment; a list of current efforts in the San Diego region; and policy considerations for San Diego Forward: The Regional Plan. This white paper will eventually serve as the basis for developing goals, policies, and actions for the regional plan, as well as establishing measures to evaluate progress over time.

## **B. HISTORY OF PUBLIC HEALTH AND URBAN PLANNING**

Modern urban planning grew out of concerns for public health in early 20<sup>th</sup> 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.<sup>5</sup>

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 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.<sup>6</sup> Today, many people in the United States live in such neighborhoods.<sup>7</sup>

Traffic patterns are in line with this trend. Between 1977 and 1995, people who walked to their destination declined by more than 42 percent while those driving increased by about 90 percent.<sup>8</sup> From 1969 to 2001, the number of children who walked or bicycled to school decreased by 68 percent. Concerns about traffic and safety were cited as the key reasons why parents preferred to drive their children to school.<sup>9</sup> Ironically, between 20 percent to 30 percent of the morning commute-time traffic is generated by parents driving their children to school.<sup>10</sup>

## **C. 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<sup>11</sup> 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 less than 10 percent in 1985 to nearly 25 percent in 2008. The San Diego County Health and Human Services Agency reports that in 2007, 33 percent of county residents were overweight and nearly 22 percent were obese.<sup>12</sup> Childhood obesity in the country has more than tripled in the last 30 years.<sup>13</sup> In the San Diego region, more than one-quarter of all children are obese.<sup>14</sup> As with the 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 eliminates barriers to 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 2008, there were more than 37,000 traffic-related fatalities in the United States. Despite improvements in vehicle safety such as seat belts and air bags, roadway design changes, and reductions in drunk driving, the per capita traffic fatality rate has changed very little since 1960, in part because of increases in total vehicle miles travelled (VMT).

In the San Diego region, between 250 and 300 people die in crashes on the roadway every year. Of these, approximately 50 to 60 are pedestrians.<sup>15</sup> Bicyclists and pedestrians combined represent nearly one-quarter of all fatalities while they account for only 3 percent of trips in the region. 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.<sup>16,17</sup> Additionally, the need for safe and accessible bike and pedestrian infrastructure is critical in communities of concern<sup>18</sup> that have low rates of automobile ownerships.

### **Air Quality**

While the region's air quality has improved<sup>19</sup>, 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.<sup>20</sup> 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, and attained the federal 1997 Eight-Hour Ozone standard in 2011; however, it has not met the more stringent federal 2008 Eight-Hour Ozone Standard. The San Diego region is a non-attainment area for the state ozone and particulate matter standards. According to the California Air Resources Board (CARB), attaining the California standards for particulate matter and ozone would prevent about 28 premature deaths annually in the San Diego region.<sup>21</sup>

At times, air emissions from traffic 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, but short duration exposures typical of park or trail use do not warrant avoiding such physical activity opportunities except for sensitive populations.<sup>22</sup>

### **Cost Implications**

Poor health outcomes can often have a significant cost burden on society, in part due to premature deaths and absences from work and school. The CDC estimates that in 2008, obesity-related medical care costs were estimated to be as high as \$147 billion. In 2006, obese people spent \$1,400 more in medical care costs compared to people of normal weight. The California Center for Public Health Advocacy estimated that in 2006, the total annual cost to California from an overweight, obese, and physically inactive population was \$41.2 billion. The estimated cost for the San Diego region was \$3 billion, or nearly \$3,000 per household in annual costs.<sup>23</sup> Identifying opportunities to invest in lower-cost infrastructure, such as bike and pedestrian facilities, could lead to more health conscious decisions, healthier lifestyles, and result in reduced healthcare costs.

### **D. HOW THE BUILT ENVIRONMENT AFFECTS HEALTH**

Land use patterns in many communities today make driving a necessity, and discourage walking and bicycling. A decrease in walking and bicycling 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,<sup>24</sup> 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<sup>25</sup>, which is the minimum amount recommended by the US Surgeon General. Some of these strategies are described below.<sup>26</sup>

## **Active Transportation and Public Transit**

Streets that are designed for the safety of multiple users—including pedestrians of all ages, bicyclists, people with disabilities, buses, and cars— have been shown to reduce the risk of pedestrian and bicycle injuries.<sup>27</sup> Walking or biking to school, work, daily errands and public transit also helps people meet the Surgeon General’s recommendation of daily physical activity.<sup>28</sup> Physical activity includes moderate-intensity exercise, which varies among individuals depending on fitness level, such as walking and jogging.

Using public transit and active transportation options such as walking and biking reduces vehicle miles traveled, vehicle emissions, respiratory disease, and hypertension from exposure to high decibels of traffic noise.<sup>29</sup> Proximity to transit also is associated with improved access to social, medical, employment, and recreational activities.<sup>30</sup> San Diego also 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.<sup>31</sup>

## **Access to Parks and Recreation**

Residents with convenient access to parks are more likely to utilize them for recreation and physical activity.<sup>32</sup> Quality recreational facilities and programs also can increase physical activity. The health benefits of physical activity include a reduced risk of premature mortality, coronary heart disease, hypertension, stroke, some cancers and diabetes mellitus.<sup>33</sup> Regular participation in physical activity can help reduce depression and anxiety, improve mood and enhance ability to perform daily tasks throughout the life span.<sup>34</sup> Contact and exposure to open spaces also can reduce stress, improve mental health and facilitate recovery from illness.<sup>35</sup> 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.<sup>36</sup>

There are a number of potential barriers to accessing parks and recreation, especially in communities of concern, 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 parks are well maintained over time is crucial to on-going use and long-term health benefits.

## **Complete Neighborhoods**

The term “complete neighborhoods” refers to the ability of residents to walk easily to access all of the goods and services needed in daily life. A complete neighborhood encourages walking and bicycling because goods are nearby, and helps contribute to neighborhood safety by ensuring that many pedestrians are on the street throughout the day, helping to keep eyes on the street. Complete neighborhoods also reduce residents’ reliance on cars, with fewer automobile trips required. This in turn leads to reduced air and noise pollution as well as 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 and other appropriate elements, are components of a “complete neighborhood.” Furthermore, 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.

### **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 (paying more than 30 to 50 percent of their income for housing), and/or living far from their work and commuting long distances, negatively affecting both physical and emotional health.

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<sup>37</sup>. Conversely, lower housing costs result in more disposable income for essential non-housing needs, allowing a more balanced and healthier lifestyle.

### **Environmental Quality**

Research suggests that communities of concern are more likely to live in close proximity to busy roadways and major highways. 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, and people with illnesses or others who are sensitive to air pollutants. Health risks increase with closer proximity to high-volume roadways. In addition, truck routes on local streets contribute to traffic congestion, which may lead to unsafe conditions for pedestrians and bicyclists. Conversely, in dense communities where mixed-use provides access to goods and services, there is a need for delivery trucks which too can contribute to traffic congestion and sometimes cause conflicts with pedestrians and bicyclists. 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<sup>38</sup>. With the exception of low emissions and natural gas-powered vehicles, traffic contributes directly to air pollution and greenhouse gas 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 can mitigate some of the negative effects of roads and vehicle emissions and provide multiple benefits. Trees capture air pollution, reduce carbon dioxide and increase oxygen levels.<sup>39</sup> 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<sup>40</sup>. Speeding vehicles can endanger pedestrians and bicyclists, posing additional safety concerns in neighborhoods.<sup>41</sup> Street trees have shown to have a calming effect on traffic, causing motorists to slow down.

Global climate change and changing weather patterns also have a range of direct and indirect impacts on public health. Extreme temperature fluctuations can lead to deaths from heat strokes and higher temperatures can lead to higher counts of pollen and other aeroallergens that affect an estimated 300 million people with allergies around the world.<sup>42</sup> See Attachment 1.

### **Access to Healthy Food**

The health impacts of poor diet are costly. In the United States, it is estimated that healthier diets might prevent \$71 billion per year in medical costs, lost productivity, and the value of premature death.<sup>43</sup> In San Diego County, roughly 446,000 residents are food insecure (uncertainty of being able to secure sufficient food for self or family) and nearly 1 in 3 children are overweight or obese.<sup>44</sup> 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.<sup>45</sup> 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 (food from local farms to institutions such as schools, government, corporations, hospitals and colleges in the region), and many others. In order to successfully implement any of these strategies, 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 status.

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 recently passed model community garden and urban agriculture zoning regulations. Community gardens are allowed by right in all residential and commercial zones. The urban agriculture zoning ordinance allows for small-scale animal husbandry (beekeeping, chickens, miniature goats), small urban farms (4 acres or fewer), and the sale of local agriculture 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, it creates 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 overweight and obesity and reduces the incidence of hunger and malnutrition.<sup>46</sup>

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.<sup>47</sup> 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. Communities of concern often have fewer grocery stores but a greater number of corner stores with limited food options, thereby further limiting their ability to access healthy foods. Programs that create opportunities to purchase healthy food options at corner stores can help alleviate the burden to communities with lower concentrations of grocery stores.

Transportation access to healthy food including transit, bicycle and pedestrian facilities also is an important consideration, especially in communities of concern.

### **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."<sup>48</sup> 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. Presently, San Diego County lacks its own Regional Food Hub while 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 the 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. Producing 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.<sup>49</sup>

Further economic gains could be made by exploring expanded land use policies and regulations across the county that encourage local procurement; utilizing 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. 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.<sup>50</sup>

## **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.<sup>51</sup> When neighborhoods are well designed, the resulting social cohesion contributes to lower crime and violence and therefore better health outcomes.<sup>52</sup>

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, 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.<sup>53</sup>

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

## **E. EXISTING REGIONAL AND LOCAL EFFORTS**

A number of existing policies, plans, and programs at the regional and local level support planning and implementation for healthy communities in the San Diego region. These are described below.

### **Regional Plans and Programs**

#### *San Diego Forward: The Regional Plan*

In May 2012, the SANDAG Board of Directors approved merging the update of the RCP with the next Regional Transportation Plan and Sustainable Communities Strategy (RTP/SCS). This new plan, San Diego Forward: The Regional Plan will combine the update of these two major planning efforts giving citizens a single, easily accessible document that includes an overall vision for the San Diego region and an implementation program to make that vision a reality. In addition, the consolidation

will enhance public participation opportunities, as well as save staff time and resources. See Attachment 2.

### *Regional Comprehensive Plan*

Adopted in July 2004 by SANDAG, the RCP provides a blueprint for managing the region's growth while preserving natural resources and limiting urban sprawl in the San Diego region. A key component of the RCP is the smart growth strategy that promotes compact, mixed-use development in communities that provide a variety of transportation choices. SANDAG supports smart growth development through a Smart Growth Tool Box and a variety of planning and transportation funding programs.

The 2004 RCP states:

Healthy communities are a matter of effective land use distribution, good design, and responsible management of the urban environment. The Centers for Disease Control and Prevention has identified community design as a major contributor to the threefold increase in obesity in the United States over the last 20 years. Healthy communities address this issue by supporting an active lifestyle through zoning that puts commercial and community services within walking and bicycling distances of most residents, and by providing safe, attractive places to walk or ride a bike. Designing for healthy communities also means separating incompatible land uses and providing transition zones and buffers between urban, industrial, and rural lands.

Goal: Create safe, healthy, walkable, and vibrant communities that are designed and built to be accessible to people of all abilities.

Action: Avoid and mitigate incompatible land uses, for example, by establishing buffers or transition zones between housing and industrial uses or major transportation corridors that could pose health risks while encouraging a mix of uses that supports healthy communities such as grocery, community services, office and housing uses.

### *2050 Regional Transportation Plan/Sustainable Community Strategy (2050 RTP/SCS)*

Adopted in October 2011, by SANDAG, the 2050 RTP/SCS is a blueprint for improving mobility in the San Diego region and reducing greenhouse gas (GHG) emissions to meet the targets set by the CARB per Senate Bill 375 (Steinberg, 2008) This long-range plan includes policies, strategies and investments to maintain, manage, and improve the region's transportation system. It also better integrates planning for land use and transportation. The 2050 RTP/SCS included the following public health-related goal and action:

Goal: Increase the use of transit, ridesharing, walking and biking in major corridors and communities

Action: Continue to collaborate with the region's public health professionals to enhance how public health issues are addressed in regional planning, programming, and project development activities.

SANDAG crafted a new vision for public transit as part of the 2050 RTP/SCS through the preparation of the Urban Area Transit Strategy. The goals of the transit strategy were twofold: first, maximize transit ridership in the greater urbanized area of the region; and second, test the role of the transit network to reduce vehicle miles traveled and GHG emissions. The 2050 RTP/SCS also includes a Climate Action Strategy, Regional Energy Strategy, Regional Bicycle Plan, and high-speed rail planning.

Better integrating the connections between land use and transportation into the design of communities provide more opportunities for the development of a variety of modes of travel including light rail, buses, biking and walking. Co-benefits of this integration include reduced VMT, reduced GHG emissions, fuel cost savings, reduced air pollution, decreased obesity, and increased public health through more active transportation.

### *TransNet Ordinance*

*TransNet* is the half-cent sales tax for local transportation projects that was first approved by voters in 1988, and 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, more than \$17 billion will be generated and distributed among highway, transit, and local road projects in approximately equal thirds.

The *TransNet* extension ordinance approved in 2004 dedicated 2 percent of revenues to the Smart Growth Incentive Program, and 2 percent of revenues to the Bicycle, Pedestrian, Neighborhood Safety and Traffic Calming Program (now the Active Transportation Grant Program). 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, and safety measures. The Smart Growth Incentive Program supports compact, mixed-use development, and more housing and transportation choices in the Smart Growth Opportunity Areas located on the Smart Growth Concept Map through planning and infrastructure grants.

To date, the *TransNet* Smart Growth Incentive Program has committed \$15.6 million to local jurisdictions in support of compact, transit-oriented development. In addition, \$15.3 million from the Active Transportation Grant Program have been dedicated to bicycle and pedestrian improvements.

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.

Since taking effect in 2008, the *TransNet* extension has distributed \$215.6 million to the region's 18 cities and the County of San Diego to fix, maintain, and expand local streets. As with the original *TransNet*, the extension program distributes local road revenue yearly to each jurisdiction using a formula based on population and road miles.

### *Active Transportation Implementation Strategy Framework*

With the adoption of the 2050 RTP/SCS in 2011, the Board of Directors made an unprecedented commitment to Active Transportation. The final action by the Board calls for planning for a broad Active Transportation Program within two years of the 2050 RTP/SCS adoption. Staff has begun identifying a proposed framework for this Implementation Strategy, which incorporates Safe Routes to School, Safe Routes to Transit, the Regional Bike Plan, and other related active transportation efforts at SANDAG. This work will both inform and address active transportation in San Diego Forward: The Regional Plan.

### *iCommute Transportation Demand Management (TDM) Program*

The goal of the iCommute program is to manage and reduce traffic congestion during peak-times, as well as reduce greenhouse gas 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 incentive programs, bicycle programs such as Bike to Work Day, and marketing and outreach efforts such as the Walk, Ride and Roll to School Campaign in 22 schools across the region. A reference guide for local jurisdictions entitled, Integrating Transportation Demand Management into the Planning and Development Process was completed in May 2012.

### *San Diego Regional Bicycle Plan*

The Regional Bike Plan, adopted in May 2010, establishes a network of regional bikeway corridors for intercommunity bicycle travel and proposes a comprehensive set of programs to support bicycling in order to make the bicycle a practical means of transportation in the San Diego region.

### *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 (CPPW). 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 overweight and 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 a \$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 again with SANDAG 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.

### *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 bicycling to school. For example, the City of Chula Vista collaborated with education, public health and community partners on the Healthy Eating Active Communities (HEAC) campaign with the goal of improving access to healthy food and physical activity in schools and neighborhoods.<sup>54</sup>

SANDAG approved a Regional Safe Routes to School Strategic Plan to guide future SANDAG involvement in promoting walking and bicycling to school as safe and attractive travel choices. The Strategic Plan is guiding work on an implementation program currently underway and funded through Healthy Works.

### *Safe Routes to Transit*

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

### *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. In addition, Encinitas and Lemon Grove are currently 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 assure 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.<sup>55</sup>

### *Building Better Health*

In 2010, the County Board of Supervisors adopted a comprehensive initiative called *Live Well, San Diego!*. This long-term plan to advance the health, safety and overall well-being of the region is being built with community involvement in three parts. The first component – Building Better Health – was adopted on July 13, 2010, and served as a blueprint for improving community health

and quality of life over the next decade. With input from staff, advisory boards, partners and community stakeholders, Building Better Health 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. A key component in this effort was the CPPW program, mentioned previously.

The second component – Living Safely – was adopted on October 9, 2012, with the overarching goal of protecting residents from crime and abuse, and making communities resilient to disasters and emergencies. To realize a community that is not only healthy and safe, but also economically secure, a third phase – Thriving – will be rolled out in 2014 and will focus on promoting a high quality of life throughout the region.

**G. POLICY CONSIDERATIONS**

Only recently have urban planners and public health professionals come to understand the extent to which our transportation system, land use patterns, and community design play a role in determining health outcomes in our communities. Therefore, 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 San Diego Forward: The Regional Plan will help achieve the goal of “Healthy Communities and Environment” and track progress over time.

**Table 1: Policy Considerations for Healthy Communities**

<i>Built Environment Strategies</i>	<i>Policy Considerations</i>	<i>Community Health Outcomes</i>
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 greenhouse gas emissions; improved neighborhood safety; and greater social cohesion.
Access to Parks and Recreation	Support parks, recreation and trails within walking distance of homes/work; and joint use facilities (with school districts and other public agencies).	Increased physical activity; improved mental health; improved neighborhood safety; and greater social cohesion.



<i>Built Environment Strategies</i>	<i>Policy Considerations</i>	<i>Community Health Outcomes</i>
Complete Neighborhoods	Support development of features that create Complete Neighborhoods, which include healthy, walkable, bikeable, and vibrant communities with a variety of housing choices, access to goods, services, recreation and jobs. Neighborhood-serving retail and public amenities within walking distance of homes; and retrofit of underutilized retail centers or corridors into mixed-use development.	Increased physical activity; lower risk of injury; reduced air and noise pollution; lower greenhouse gas emissions; improved neighborhood safety; greater social cohesion; greater access to goods and services; and reductions in VMT.
Access to Affordable Housing	Promoting 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.	Lower housing costs result in more disposable income for essential non-housing needs, allowing a more balanced and healthier lifestyle.
Environmental Quality	Encouragement of the location of major pollution sources (e.g. major regional highways) away from sensitive uses (such as parks, homes and childcare centers); remediation of contaminated sites; habitat and open space (including canyons in urban areas) preservation; and urban forests/greening.	Reduced risk of respiratory diseases; reduced exposure to toxic substances; and improved mental health.
Access to Healthy Food	Improve access to healthy and affordable food and nutrition while also considering transportation access. Farmer’s markets, community gardens, and healthier food options in corner stores.	Improved nutrition; increased physical activity; and reduced incidence of hunger.
Access to Regional Food Systems	Explore the development of a Regional Food Hub within San Diego County	Increased food security and lower greenhouse gas emissions.
Designing for Public Safety	Encourage active uses in streets and public space to promote public safety. Crime prevention through environmental design; and street lighting.	Improved neighborhood safety; greater social cohesion; improved mental health; and lower risk of injury.

<i>Built Environment Strategies</i>	<i>Policy Considerations</i>	<i>Community Health Outcomes</i>
Access to Water	Consider access to, affordability, and supply of water and the impacts to local farmers / agriculture, tribal lands, and rural communities relying on groundwater supplies.	Improved access, greater reliability and affordability of water sources, especially to agricultural industries
Access to Tobacco Free Environments	Encourage the identification of opportunities to provide greater access to tobacco free environments	Reduced exposure to second-hand smoke, reduced cases of lung disease
Equity/ Environmental Justice	Encourage healthy environment features that provide communities of concern equal access to green spaces, healthy food, complete neighborhoods, transit, housing, and active transportation options.	Reduced health and social disparities.
Economic Impact/ Development	Identify the direct and indirect public health costs of transportation initiatives; consider an infrastructure funding strategy to ensure that sufficient funds are available for the development of “complete communities;” and identify the economic impacts of health food retail and agricultural tourism	Increased access to healthy food retail environments; improved community prosperity and security; and advancing healthy & complete communities.

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## Attachment 1

### Greenhouse Gas Reduction Strategies and Potential Co-Benefits

Strategy to Reduce Greenhouse Gas Emissions	Potential Health/Social Equity Co-Benefits <sup>1</sup>
Reduce vehicle miles traveled	<ul style="list-style-type: none"> <li>Reduce air pollution</li> <li>Increase physical activity</li> <li>Reduce chronic disease (such as asthma and heart disease)</li> <li>Improve mental health</li> <li>Improve access to low-cost alternative transportation options</li> </ul>
Increase fuel efficiency and use of cleaner fuels in vehicles	<ul style="list-style-type: none"> <li>Reduce air pollution</li> </ul>
Reduce emissions through land use changes such as more compact growth	<ul style="list-style-type: none"> <li>Increase physical activity</li> <li>Reduce chronic disease</li> <li>Increase local access to essential services (affordable housing, jobs, amenities)</li> <li>Enhance safety for biking and walking with reduced vehicle speeds and reduced collisions</li> </ul>
Reduce residential building energy and water use	<ul style="list-style-type: none"> <li>Reduce household energy costs (especially beneficial for low-income households)</li> <li>Promote healthy homes</li> <li>Create local green jobs</li> <li>Promote cooler communities through shade trees and cool pavements</li> </ul>
Urban greening	<ul style="list-style-type: none"> <li>Reduce temperature and urban heat island health effects</li> <li>Reduce air pollution</li> <li>Reduce noise</li> <li>Enhance safety</li> </ul>
Biodiversity Conservation	<ul style="list-style-type: none"> <li>Promote ecosystem services (clean air and water)</li> <li>Enhance access to open space and recreation</li> </ul>

<sup>1</sup> California Department of Public Health, *Integrating Public Health into Climate Action Planning*, February 2012

Milestone	2013				2014				2015		
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer
<i>Definition of Healthy Communities</i>	■ ●										
<i>Vision/Goals</i>	■	●									
<i>Policy Objectives</i>		■	● ▲								
<i>Public Health White Paper</i>		■	● ▲	●							
<i>Project Evaluation Criteria</i>			■	● ▲							
<i>Performance Measures</i>				■	● ▲						
<i>Unconstrained Transportation Network</i>						■ ●					
<i>Alternative Transportation Scenarios</i>							■ ●				
<i>Preferred Transportation Network</i>								■ ●	●		
<i>Draft Plan for San Diego Forward</i>										■ ▲	●

Symbols: ■ PHSG Review ● PHSG Comment ▲ PHSG Sub Committee

Throughout the process the Public Health Stakeholder Group also contributed their input from a health perspective on various Policy Issues and Appendices being considered in the Plan including:

- Climate Change
- Economic Prosperity
- Emerging Technologies
- Regional Transit Oriented Development Strategy
- Regional Complete Streets Policy
- Performance Indicators
- Regional Existing Conditions Report & Gaps Analysis
- Healthy Communities Atlas

3/2015





## **ECONOMIC PROSPERITY WHITE PAPER**

July 2014

### **A. INTRODUCTION**

As SANDAG develops regional policies and programs to guide transportation infrastructure investments over the next several decades, an understanding of the economic implications of those decisions will support the agency's efforts in creating a safe, viable, and efficient transportation system for the San Diego region. The investments, in turn, will help improve economic prosperity for the region. Emerging from the most severe economic crisis since the Great Depression, economic issues are in particular focus. This white paper will provide some background for examining economic issues in the context of San Diego Forward: The Regional Plan.

Economies are dynamic; they change, and change constantly. The nature of the San Diego economic system has always 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, 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. And 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.

San Diego Forward presents an opportunity to shape our business habitat for the 21st century. Over the next three and a half decades, hundreds of billions of dollars will be invested in the San Diego region to create, maintain, and improve transportation and other infrastructure. San Diego Forward will do two things to help this; one, it will provide a framework for much of the transportation infrastructure in the region by prioritizing 35 years of regional transportation projects, and second it will provide a cooperative roadmap for the region as a whole to address the way the San Diego region will grow and evolve.

This economic white paper will begin by surveying current economic conditions and economic plans in San Diego, and look at some new ideas in economic development. Next, it will explore the interrelationship between the economy, transportation, and regional planning, with consideration of “communities of concern” (for the purposes of this paper, low income populations<sup>1</sup>), and the relationship between the economy and the environment. Lastly we will look at the ways in which San Diego Forward might influence the regional economy, and what questions remain to be explored.

## **B. 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, versus 37.4 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; Median household income is over \$60,000, \$9,000 higher than the U.S. median.<sup>2</sup>) San Diego’s unemployment rate is about at 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.<sup>3</sup> San Diego also has a diverse and multi-cultural population, and the busiest land border crossing in the world connecting us to a rapidly-developing economic partner, Baja California, Mexico.

Of course, the San Diego region also has its share of challenges, the high cost of living -- particularly housing -- compared to prevailing wages, and wait times at the border that were estimated in 2006 to cost the region \$6 billion annually in lost output.<sup>4</sup> 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 is also 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 roughly a million residents, half a million new jobs, and a third of a million new housing units. Population growth will primarily be natural increase (births greater than deaths) and international immigration; net domestic migration is expected to be negative.<sup>5</sup>

SANDAG, and other institutions around the region, study the performance of the San Diego region’s economy, and offer strategies for improvement. SANDAG, for example, produced the *Regional Economic Prosperity Study* (REPS) most recently in 2008, with the help of a diverse and knowledgeable advisory committee made up of business and government leaders. The REPS identified the major economic challenge of the San Diego region in that the cost of living is outpacing the growth in wages. Cost of living is high due primarily to high housing costs, and the

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<sup>1</sup> “Communities of Concern” also include ethnic and racial minority populations and those over 75 years old, but this paper is focused specifically on economic disadvantages.

<sup>2</sup> San Diego Regional Economic Development Corporation, “Economic Indicator Dashboard”;  
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<sup>5</sup> SANDAG Series 13 forecast

growth of lower-wage jobs has been faster than those in higher-wage industries. The REPS identified 10 strategic goals (and 27 recommended actions intended to accomplish them) to help ensure a prosperous regional economy. The actions included policies to encourage housing growth and education/job training that would help raise the standard of living in the area. Since the REPS was issued in 2008, San Diego and the nation endured a severe economic downturn, and a slow recovery. The effect of the Great Recession was more severe in San Diego than the nation in general primarily due to the collapse of the housing market, which has been a mainstay of the local economy. Reliance on the federal government, particularly defense, for 18 percent of the local gross domestic product (GDP), initially buffered the region from the worst of the recession, but as government spending declined during the recovery, San Diego's regional economy suffered proportionally more than the nation's, despite the relatively strong recovery of housing and tourism.<sup>6</sup> While the recession may have changed both economic perceptions and realities for many San Diegans, the fundamental needs of the economy, and the goals of the REPS, have not altered materially.

SANDAG also produced a study of *Traded Industry Clusters in the San Diego Region* (2012), which examined the interrelated, export-oriented industries that offer higher-wage jobs on average, as well as improve San Diego's ability to thrive in a global marketplace. The *Indicators of Sustainable Competitiveness* (2002 and 2005) report compares San Diego to 19 other metropolitan areas in the "three E's" of economy, environment, and equity, finding that while San Diego does well in environmental measures, and better than average in economic metrics, San Diego is near the bottom in measures of equity.

While studies of the San Diego regional economy generally are revealing, it is important to note that the San Diego region is diverse and physically large, with 3.2 million residents; 18 municipalities and the County of San Diego; 17 Native American Tribes; a metropolitan area that shares an international boundary with Mexico; a region 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.

### **Existing Plans, Programs, and Policies**

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.

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<sup>6</sup> National University System Institute for Policy Research, *Economic Ledger*, February 2014; [http://www.nusinstitute.org/assets/resources/pageResources/Economic\\_Ledger\\_Forecast2014\\_Feb2014.pdf](http://www.nusinstitute.org/assets/resources/pageResources/Economic_Ledger_Forecast2014_Feb2014.pdf)

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, and the local universities, also work to understand the structure of the San Diego regional economy, and explore ways to improve. The strategy isn't about creating a specific economic plan, but of collaboration between stakeholders. These organizations research the region's economic strengths and shortcomings, and identify the tools needed to reshape the economy, as well as 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 partnership between San Diego, Imperial County, and Baja California, Mexico, to promote and enhance R&D and manufacturing; a plan to boost exports; 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 telecommunications and action sports.<sup>7</sup>

The San Diego Workforce Partnership funds job training programs to meet the region's demand for qualified workers, and creates a Five-Year Strategic Plan to identify goals and strategies designed to address workforce challenges in San Diego County.

The San Diego Regional Chamber of Commerce coordinates with other regional and local agencies on economic development and business policies, and produces San Diego Regional Economic Indicators to track the regional economic performance. The Regional Chamber also joined with the City of San Diego to form a Climate Mitigation and Adaption Plan, Water Plans, a Mexico Business Center, and infrastructure priority workshops.

The sub-regional EDCs have economic development plans, programs, and policies that build on regional initiatives. For example, the South County Economic Development Council is leading a Visioning Project in partnership with the San Diego Foundation to determine the key economic strategies for the South County and binational region over the next five years. They are also working with the East County Economic Development Council to qualify for federal Economic Development Administration (EDA) grants, which support business development and entrepreneurship, education and workforce development, and infrastructure in areas that meet unemployment and per-capita income requirements. The East County EDC also supports the strategic Aerotropolis Roadmap, a proposed mixed-use job center surrounding the Gillespie Field Airport, as well as the Connector.com, a jobs buyer-supplier database used for economic development. Likewise, the San Diego North Economic Development Council has participated in sub-regional visioning and completed a report in 2013 called "Prosperity on Purpose". All sub-regional EDCs also support localized cluster and sector studies as well as targeted business outreach to those clusters and sectors that support sub-regional and regional growth.

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<sup>7</sup> San Diego Regional Economic Development Corporation, "Initiatives"; <http://www.sandiegobusiness.org/services/initiatives>

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 presented a new draft economic development plan, “Economic Development Strategy 2014-2016,” including objectives intended to “grow the economy’s ‘base sectors’, increase middle-income jobs, and increase neighborhood business activity, especially in underserved neighborhoods.”<sup>8</sup> The City also completed its General Plan in 2008, which included an element on economic prosperity, with broad main goals.<sup>9</sup> The City of Chula Vista is working to leverage its business assets by determining the business clusters that drive its economic growth, recommend strategies to enhance its growth, and coordinate with other regional, binational, and local entities. The County of San Diego’s Strategic Plan for Fiscal Years 2013-2018 provides a vision, strategic snapshot, strategic initiatives, and required disciplines for excellence to guide the growth and economic prosperity of the County.

One critical factor that will affect the pace and nature of economic development in the San Diego region is the recent dissolution of California’s redevelopment agencies. These agencies, including over a dozen in the San Diego region, received earmarked local property tax revenue to reinvest in communities that lack sufficient traction to attract private development without additional incentives. With redevelopment ending in 2013, new ways to assist underdeveloped neighborhoods are needed. Redevelopment funding and bond financing have historically supported extensive investment in infrastructure, public facilities, rehabilitation of commercial/industrial and residential blocks, and affordable housing development.

### **Emerging Concepts**

Much of the current research in regional planning economics seems to be focused on the effects of and issues around what is often termed “smart growth” or sustainable development, and specifically on the trends that are reinvigorating the centers of many American cities and metropolitan areas, as well as creating new development in communities and neighborhoods of all sizes. This 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; now local jurisdictions are seeking to redevelop many neighborhoods to accommodate population growth.

By and large, it is thought that the several trends of “new urbanism” – compact communities of mixed-use “walkable” development served by public transit and allowing for active transportation such as walking and cycling – are a positive for the economy, potentially reducing transportation, environmental, and even health costs, while creating economic choice and a “quality of life” that is seen as attractive, especially to younger, high-skill workers.<sup>10</sup> This type of growth can allow for the growth of the next 35 years without significant additional congestion and a diminishment of both quality of life and economic prosperity, including for the increasing number of older regional residents who may have varied transportation needs. In developing and redeveloping areas that are served by multiple modes of transportation, it is important to note that the benefits are not simply social or environmental, but economic; multiple transportation options provide improved access to

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<sup>8</sup> “Draft Community and Economic Development Strategy 2014-2016”, City of San Diego, December 2, 2013;

[http://docs.sandiego.gov/councilcomm\\_agendas\\_attach/2013/Rules\\_131211\\_4.pdf](http://docs.sandiego.gov/councilcomm_agendas_attach/2013/Rules_131211_4.pdf)

<sup>9</sup> City of San Diego General Plan, 2008, <http://www.sandiego.gov/planning/genplan/pdf/generalplan/adoptedepelem.pdf>

<sup>10</sup> “Companies Say Goodbye to the ‘Burbs”; Wall Street Journal, December 4, 2013;

<http://online.wsj.com/news/articles/SB10001424052702304281004579222442197428538>

jobs, education, entertainment, and retail for residents, and provide many types of businesses with an improved business climate.

Emerging transportation technologies will also play an increasing role in the transportation system. Technologies, both private and public, such as all electric vehicles and automated roadways could have effects on development patterns, greenhouse gas emissions, infrastructure investments, as well as the structure of the economy, considering that many of the high-tech firms who will develop these technologies are local. These innovations include those that facilitate the “sharing economy,” such as ZipCar or Uber, which are changing both transportation and the wider economy.

The key point is that development patterns have economic consequences on housing prices, municipal revenues, business location decisions, and residential 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 need to 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 roughly a million more residents of San Diego County, half a million new jobs, and a third of a million new housing units.<sup>11</sup> These growth numbers are substantially lower than previous estimates, and depend less on an influx of new residents, and more on natural increase (births greater than deaths) of current residents. How these people, jobs, and houses fit into San Diego will determine the physical shape of the region, the transportation system, and the economy.

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.

So 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?

### **C. INTERRELATIONSHIPS**

#### **How Transportation and Regional Planning Can Influence the San Diego Economy**

As noted, the infrastructure of a region, including the transportation infrastructure that is a primary concern for SANDAG, form part 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, and as thriving ecosystems that support many types of

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<sup>11</sup> SANDAG Series 13 forecast

adaptable species are more resilient and rich in a biological sense, diversified economies are also 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 (difficult to stop people from using the good) and non-rivalrous (one person’s use of the good doesn’t 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, as businesses do, competing projects and the expected rates of return (which are difficult to measure in this context), as well as generally gauging the optimal level of the resource overall.

The transportation system acts as the economic circulatory system, allowing businesses to access raw materials, ship finished goods, 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. It also includes connection to a critical trading partner in Mexico, as well as the surrounding counties and 17 Native American Tribes.

The transportation system doesn’t simply support the economic activity in a region: transportation – and related land-use decisions – *influence* the economy. To explore these inter-relationships, it is instructive to look at several types of development in the San Diego region, the economic activity transportation and land use decisions generate, and the challenges and opportunities they face.

- **Suburban job centers** are major residential and commercial/light industrial areas for which significant jobs and housing growth is likely. Yet often areas such as these already see significant traffic delays. The challenge is to accommodate this economic growth and still improve traffic, with additional transit and active transportation options. New transportation options can be enhanced by Transit-Oriented Development (TOD), specifically designed to take maximum advantage of the transit, but policies must be in place to allow and encourage TOD.
- **Areas with significant development potential** are areas for which big increases in intensity of use, be it residential, commercial or industrial, are envisioned. Areas like these, often somewhat distant from the urban core, offer lower land costs and can become major employment centers and home to a greater number of residents. The critical issue in areas such as these is to create transportation infrastructure that works for a variety of needs, and also to balance plans for industry, residents, protection of the natural environment, as well as 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.
- **Redeveloping urban neighborhoods** are seeing a reversal of the “urban blight” that was common in the latter half of the twentieth century. These areas are often 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 (shops, bistros) and large (convention centers, stadia, shopping centers) characterize such areas, and the challenges of development in these areas are often 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, just east of Downtown and the Gaslamp Quarter is an example of this type of area, with up to 70 percent of the blocks in the neighborhood having the potential for new uses.<sup>12</sup>

Clearly different areas in the San Diego region 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 can also supplement transit by improving access to transit.

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 the spatial constraints, highway projects will involve more efficient use of limited space, either through the construction of “Managed Lanes” or through the implementation of advanced technologies, or both. The local road system will need to be designed to optimize traffic flow, while accommodating various 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 best to 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 is seen as an amenity that can 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 Federal Aviation Administration (FAA) certified for commercial service, and all have physical limitations. The economics of air travel are generally not under local control, and smaller airports have seen airline traffic cuts, but the airports will continue to be essential economic hubs, especially for tourism-heavy San Diego.<sup>13</sup> A crossborder facility that will link the Otay Mesa area and Tijuana International Airport is scheduled to open 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 are also planning to improve to meet growing demand for freight in an increasingly international economy, and yet both are up against significant physical restraints. The importance of the region’s “traded clusters” in providing high-wage jobs that bring investment

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<sup>12</sup>Civic San Diego; “Downtown Community Plan”; [http://www.civicsd.com/images/stories/downloads/planning/dcp/06\\_Neighborhoods\\_and\\_Districts.pdf](http://www.civicsd.com/images/stories/downloads/planning/dcp/06_Neighborhoods_and_Districts.pdf)

<sup>13</sup> “Smaller Airports Take Bigger Hit As Airlines Cut Flights”, NPR, May 8, 2013; <http://www.npr.org/blogs/thetwo-way/2013/05/08/182262805/smaller-airports-take-bigger-hit-as-airlines-cut-flights>



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 businesses can have positive effects on growth, innovation, and entrepreneurship.<sup>14 15</sup> 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 are seeking. Economic activity such as retail, manufacturing, freight movement, and residential construction need their optimal transportation and land-use habitats as well. Businesses depend on roadways, rails, and ports, but they also depend on our sidewalks and parks to attract customers and employees. They also depend on our educational system to produce viable employees and educated customers. The economic effects of public investment must be properly considered in an economic sense for policy-makers to make effective decisions. These economic effects include environmental effects, public health effects, social effects, and others in our interconnected economic system.

To help measure the economic effects of San Diego Forward: the Regional Plan, SANDAG is preparing an economic analysis with three areas of focus. The first is a Benefit-Cost analysis to measure, using the most up-to-date tools, the economic effect of the transportation improvements planned. The benefits will include travel-time savings, safety improvements, emissions reductions, health effects, and auto ownership costs. The second facet will attempt to capture the effects of transportation investment on economic competitiveness; examining how different transportation improvements influence economic development. For this analysis, we propose to analyze the spatial relationship of jobs and households for key industries to gauge the jobs/housing relationships, as well as stakeholder interviews and case studies to consider potential future trends. The third analysis will measure the economic impact of the construction and operations activity of the Plan on the regional economy.

There are limitations to any economic analysis, and in many ways the analytical tools that help us define the impacts of transportation investments are in their infancy. But with this economic analysis, the goal is to present information that will help inform and influence the choices the region will make over the next 35 years.

### **Communities of Concern from an Economic Perspective**

The critical issue for economic communities of concern<sup>16</sup> is access. Low-income residents in areas without adequate public transit often have to spend disproportionate amounts of time and money to access education, jobs, and recreation. A strategy to address the “hourglass economy” is to improve transportation options for communities of concern. Access is equally important to

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<sup>14</sup> “Why Today’s Start-Ups Are Choosing Urban Lofts Over Suburban Office Parks”, Atlantic Cities, September 4, 2013; <http://www.theatlanticcities.com/jobs-and-economy/2013/09/why-todays-startups-are-choosing-urban-lofts-over-suburban-office-parks/6311/>

<sup>15</sup> Harvard Business School Institute for Strategies and Competitiveness; <http://www.isc.hbs.edu/econ-clusters.htm>

<sup>16</sup> SANDAG is using 200% of federal poverty level as the threshold for communities of concern in analyzing certain effects of San Diego Forward; other communities of concern include ethnic and racial minorities, and the elderly. The 200% of federal poverty threshold was chosen for the “low income” category of the communities of concern defined in the Regional Plan in recognition of the relatively high cost of living in the San Diego region as compared to the nation as a whole, with input from the SANDAG network of community-based organizations who serve low income populations whose representatives advised using 200 percent of the federal poverty line for analysis.

employers who want to be able to draw from a wide pool of potential employees of varying skill levels. Failing to encourage the economic integration of “communities of concern” today can even have generational impacts and reduce economic mobility in the long run.<sup>17</sup> 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 San Diego Forward is yet to be conducted, it is evident that lower-income communities in the San Diego region have 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. And like other metropolitan areas around the country, the San Diego region has seen resurgence in development in the central cities and surrounding neighborhoods, a trend 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.<sup>18</sup> 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 is often seen in neighborhoods with good access to public transit.<sup>19</sup>

## **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 generally considered beyond the land and raw materials nature can provide. But 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 greater environmental quality.

In the San Diego region, we are fortunate to have both a quality environment and a healthy economy that is based, in many ways, on that environment. SANDAG’s 2011 *Index of Sustainable Competitiveness* report ranked San Diego against 19 other metropolitan economies in measures of economy, environment and equity, with San Diego near the top in environmental indicators, with only air quality holding San Diego back. And while our tourism economy relies heavily on the environment, the “quality-of-life” issues that make San Diego such an attractive place to live also hinge on environmental factors.

Technologies and techniques exist and are being developed that will allow the San Diego region to meet the current needs of its residents without sacrificing the ability of future residents to meet their own needs, which is a commonly used definition of “sustainable.” In an economic sense, this sometimes means balancing the needs of industry with the environment. But frequently, in San Diego

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<sup>17</sup> Harvard University Equality of Opportunity Project; <http://www.equality-of-opportunity.org/>

<sup>18</sup> Hartley, Daniel, “Gentrification and Financial Health”, Federal Reserve Bank of Cleveland, November 6, 2013; <http://www.clevelandfed.org/research/trends/2013/1113/01regeco.cfm>

<sup>19</sup> “The Gentrification Puzzle”, Atlantic Cities, November 21, 2013; <http://www.theatlanticcities.com/neighborhoods/2013/11/why-some-places-gentrify-more-others/7588/>

and elsewhere, the technologies and approaches that benefit the environment are also 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 two-fold. 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,<sup>20</sup> and sometimes for the private sector, as in the case of energy efficiency.<sup>21</sup>

The second way in which environmental consideration can be economically beneficial is for a region to become a leader in environmental technologies or strategies that can lead it to develop a comparative advantage over other regions in these products. This is the case in the San Diego region, where roughly 8,000 jobs, with an average wage of over \$87,000, are in the “Cleantech” sector that produces products and services related to renewable energy, alternative energy, and energy efficiency.<sup>22</sup> As an example, Qualcomm is working on wireless electric vehicle charging.<sup>23</sup> The general outlook for these environmental services and technologies is positive as environmental problems increase globally with population growth.<sup>24</sup>

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 not simply with most other environmental issues, but with the structure of the economy and the physical infrastructure of the region.

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 or 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 or avoid many of the effects, but it is likely that behavioral changes may be required as well.

The plus side of taking steps to avoid or mitigate climate change is that they assist with many of the other objectives in San Diego Forward, and can have substantial economic benefits in that way. For example, a push to improve energy and water efficiency, if well-designed, can have positive benefits to the San Diego economy, independent of the effect on climate change, by saving money and encouraging efficiency in markets that have historically not had strong conservation incentives. The same is true for air quality; a reduction in CO2 emissions is likely to have associated reductions in pollutants that result in positive health effects. Land use regulations, zoning, and transportation

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<sup>20</sup> The Benefits and Costs of the Clean Air Act from 1990 to 2020, U.S. EPA, March 2011; <http://www.epa.gov/air/sect812/feb11/summaryreport.pdf>

<sup>21</sup> Gillingham, Kenneth, et al., “Energy Efficiency Economics and Policy”, Resources for the Future, April 2009; <http://www.rff.org/RFF/Documents/RFF-DP-09-13.pdf>

<sup>22</sup> “Traded Industry Clusters in the San Diego Region”, SANDAG, December 2012; [http://www.sandag.org/uploads/publicationid/publicationid\\_1715\\_15318.pdf](http://www.sandag.org/uploads/publicationid/publicationid_1715_15318.pdf)

<sup>23</sup> Qualcomm Halo; <http://www.qualcommhalo.com/>

<sup>24</sup> “Opportunities for Growth and the Outlook for the Environmental Sector”, The AIC, October 17, 2013; <http://www.theaic.co.uk/aic/news/commentary/opportunities-for-growth-and-the-outlook-for-the-environmental-sector> and *Occupational Outlook Handbook*, U.S. Bureau of Labor Statistics, January 8, 2014; <http://www.bls.gov/ooh/architecture-and-engineering/environmental-engineering-technicians.htm> and *Occupational Outlook Handbook*, U.S. Bureau of Labor Statistics, January 8, 2014; <http://www.bls.gov/ooh/life-physical-and-social-science/environmental-scientists-and-specialists.htm>.

infrastructure intended to reduce transportation CO2 emissions can create denser, mixed-use communities that can be more desirable to the growing populations of younger professionals, singles, and seniors. These steps can also 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 get 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 is engaged in planning for climate change. On October 28, 2011, the SANDAG Board of Directors approved the Sustainable Communities Strategy (SCS) as part of the 2050 Regional Transportation Plan (RTP) for the San Diego region, becoming the first large region in California to prepare an RTP under California climate change legislation (SB 375). The 2050 SCS demonstrates how development patterns and the transportation network, policies, and programs will work together to achieve the greenhouse gas (GHG) emission reduction targets set by the California Air Resources Board for cars and light trucks, and provide a more sustainable future for the region.

The strategy set forth in the 2050 RTP/SCS is to: focus housing and job growth in the urbanized areas where there is existing and planned infrastructure; protect sensitive habitat and open space; invest in a network that gives residents and workers transportation options that reduce GHG emissions; promote equity; and implement the plan through incentives and collaboration.

### **Future Funding, Trends, and Possibilities**

SANDAG's ability 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 here 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. That economy will be more global, with barriers (governmental and technical) to international trade likely to continue to be reduced. But the economy may also be more local, as the value of community economic development expands.

In addition to helping provide a varied and efficient transportation infrastructure that provides the access to the local and global economy, SANDAG should continue to bring together the San Diego region's business and academic leadership to study the regional economy, and recommend actions that can lead to continued economic growth. Meanwhile, it is important to understand that the traditional economic metrics often cited cannot, or don't yet, provide an accurate accounting of the quality of life residents are striving for in terms of social or environmental conditions. By bringing the tools of economic analysis to bear on issues once considered outside the realm of economics, we can make better decisions.

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## **Climate Change Mitigation and Adaptation White Paper**

July 2014

### **A. INTRODUCTION**

Climate change is expected to have significant and widespread impacts on California's environment and economy. Limiting the impacts of climate change requires collaboration and action throughout all sectors of California's economy and governmental agencies. California has taken a proactive stance toward addressing climate change. The State's approach includes strategies that reduce greenhouse gas (GHG) emissions and prepare for climate change impacts through adaptation and resiliency, while also supporting economic prosperity, improving public health and social equity, protecting infrastructure investments, and conserving natural habitat and open space.

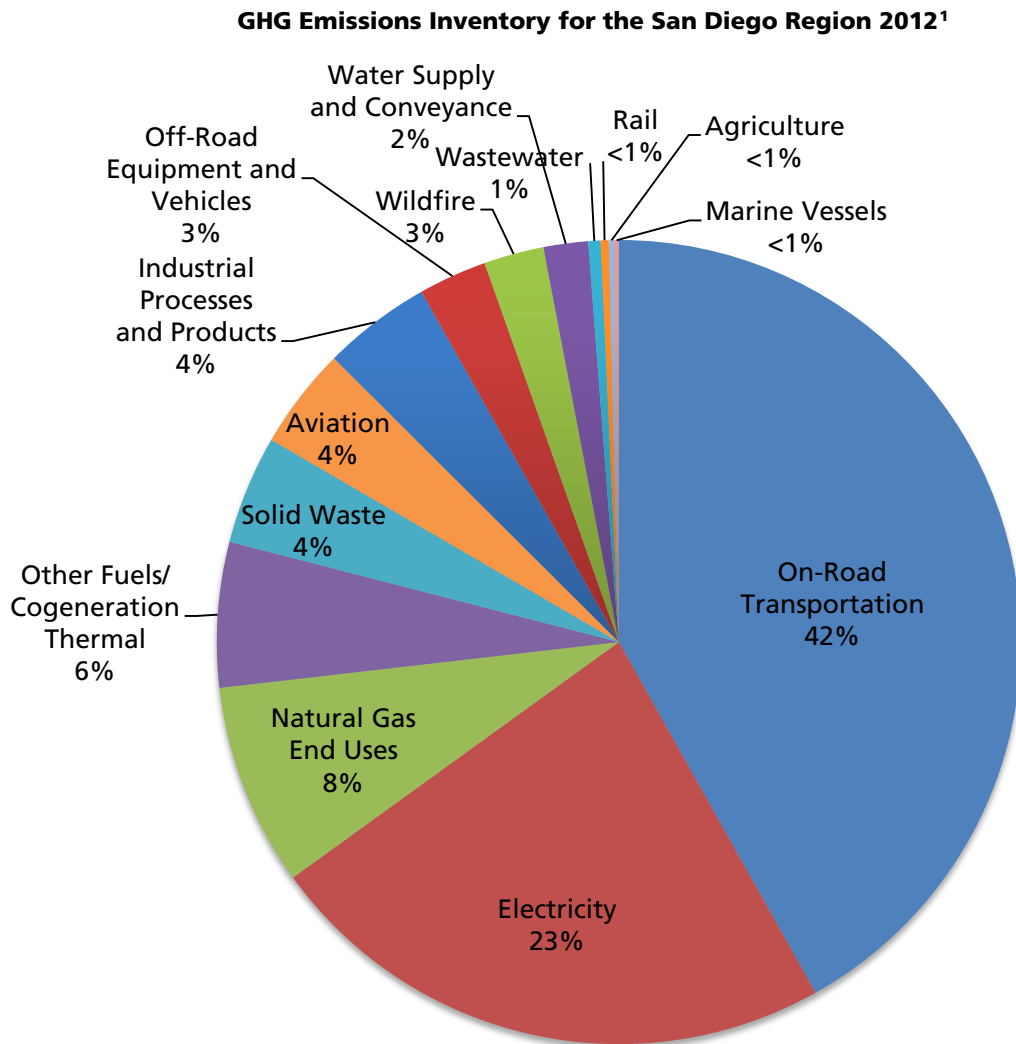
Climate change is a global issue, and while California alone cannot halt climate change, the state is joined in its efforts by several states and countries. The United Nations Framework Convention on Climate Change is an international treaty, signed by 196 countries, that sets an overall framework for intergovernmental efforts to address the challenge posed by climate change. At the national level, President Obama released his Presidential Climate Action Plan in June 2013, which describes a strategy to cut GHG emissions, to prepare the United States for impacts of climate change, and to lead international efforts to address global climate change. Following the Climate Action Plan, in May 2014, the U.S. Global Change Research Program released the Third National Climate Assessment, which summarizes the impacts of climate change on the United States, now and in the future.

The state, along with many local and regional governments throughout California and beyond our international border, is working to create innovative policies, plans, and programs to address climate change. In the San Diego region, local governments, SANDAG, and other regional public agencies are working collaboratively with local non-profits, universities, and businesses to prepare plans and implement programs that complement efforts at the state, federal, and international level.

The purpose of the Climate Change Mitigation and Adaptation White Paper is to inform the development of San Diego Forward: The Regional Plan. The paper includes an inventory of regional GHG emissions, recommendations for a regional approach to address climate change, and a summary of current efforts in the San Diego region. Further analysis regarding climate change will be done as part of the Regional Plan's social equity component and EIR.

## Greenhouse Gas Emissions in the San Diego Region

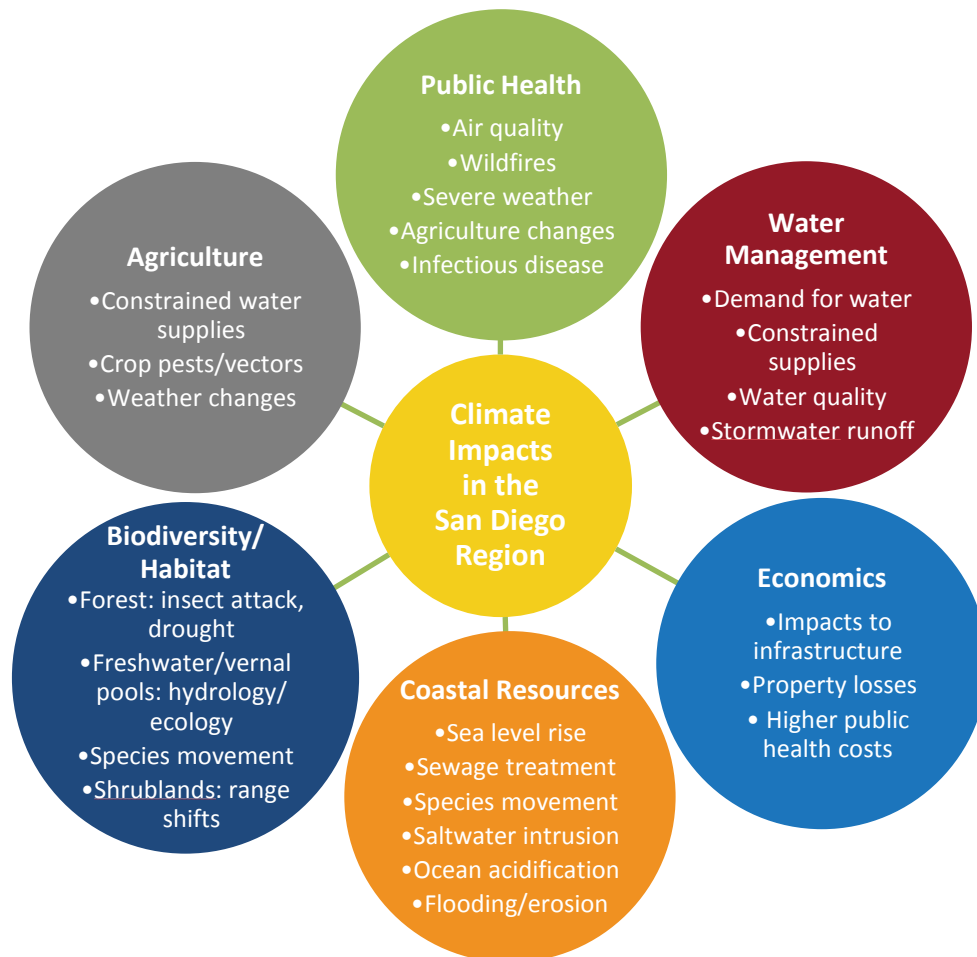
Periodically, SANDAG completes a GHG emissions inventory for the San Diego region. The inventory identifies and quantifies the sources of GHG emissions and allows for monitoring over time. In 2012, emissions totaled 32.9 million metric tons of carbon dioxide equivalent (MMT $\text{CO}_2\text{e}$ ); this represents an 11.5 percent increase compared to 1990 emissions levels (29.5 MMT $\text{CO}_2\text{e}$ ). Transportation makes up the largest source of GHG emissions in the region, followed by electricity, then natural gas. This inventory was developed using the best available data and following the U.S. Community Protocol for Accounting and Reporting of GHG Emissions. The California Governor’s Office of Planning and Research participated as a steering committee member and technical advisor for the protocol and recommends its use in local government planning efforts.



<sup>1</sup> Source: Energy Policy Initiatives Center (EPIC) at University of San Diego, April 2014.

## Climate Change Impacts in the San Diego Region

Even with efforts to reduce GHG emissions, the San Diego region will experience impacts due to climate change, and some of these impacts are already occurring at varying degrees. The potential impacts identified in the SANDAG Climate Action Strategy (2010) are summarized in the diagram below, and include impacts from increased temperatures such as sea level rise and associated high surf events, constrained water supplies, wildfires, loss of native plant and animal species, and severe weather, as well as effects on public health and economics. The section on Interrelationships with Other Policy Areas includes additional information on the connections climate change has with public health and economics.



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 governments, and technical tools to assist governments at every level with climate change adaptation and resilience.

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GHG emissions in 2012 total 32.9 MMTCO<sub>2</sub>e.

Note: For the wildfire category, an annual average emissions value was used based on fires occurring since 1990.



## **B. STRATEGIES TO ADDRESS CLIMATE CHANGE**

Addressing climate change consists of two categories of planning: mitigation, which is reducing GHG emissions, and adaptation, which is preparing communities for impacts of climate change. California has set targets for reducing GHG emissions and strategies to prepare the State for the impacts of climate change. As a metropolitan planning organization (MPO), SANDAG is working with the State and with member agencies, neighboring counties, Mexico, the military, and the tribal nations on climate change.

### **Mitigation - Reducing Greenhouse Gas Emissions**

Several Executive Orders related to climate change have been issued since 2004. All Executive Orders, laws, and regulations are listed on the State's Climate Change Portal<sup>2</sup>. Executive Order S-03-05, 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. The goals in Executive Order S-03-05 as well as the other climate change Executive Orders are ambitious and will require efforts from all sectors in California for implementation.

In 2006, Governor Schwarzenegger signed into law Assembly Bill 32 (AB 32), The Global Warming Solutions Act, which legislates the 2020 target in Executive Order S-3-05 and calls for California to reduce GHG emissions back to 1990 levels by the year 2020. AB 32 also directed the California Air Resources Board (CARB) to develop a Scoping Plan that details the strategies for attaining the 2020 target. The Scoping Plan was completed in 2008, and is currently undergoing an update that is scheduled for adoption in 2014. The key reduction measures outlined in the AB 32 Scoping Plan, and currently being implemented, include:

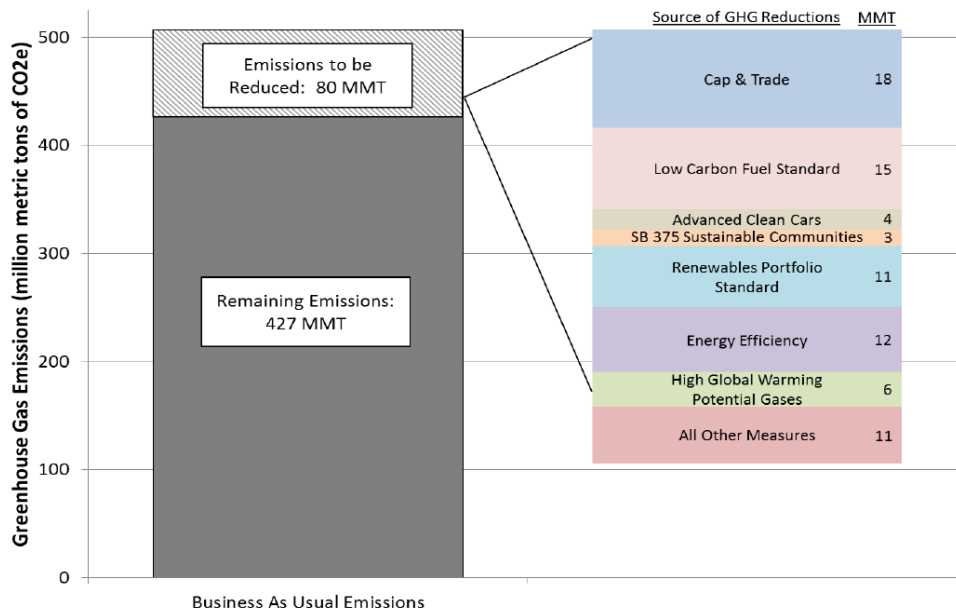
- CARB's GHG Cap-and-Trade Program
- Low Carbon Fuel Standard (LCFS)
- Pavley Clean Car Standards (AB 1493) and Advanced Clean Cars Program
- Transportation-Related GHG Targets and Sustainable Communities Strategies for MPOs (SB 375)
- Renewables Portfolio Standard (RPS)
- Conservation and Energy Efficiency in New and Existing Buildings

The reductions associated with each of these measures and contributions toward the statewide 2020 reduction target are displayed in the chart below. The largest source of GHG reductions is expected to come from the Cap-and-Trade program. The program establishes a firm limit or "cap" on approximately 85 percent of total statewide GHG emissions; the cap declines by approximately 3 percent each year. Under the regulations, CARB issues allowances equal to the amount of allowable emissions over a given compliance period, and distributes these to regulated entities via an allowance auction. One allowance equals one metric ton of GHGs. Each regulated entity must hold allowances equal to its emissions, so companies that emit more must either turn in more allowances or reduce their emissions. Electric generating utilities, electricity importers, and large industrial facilities became subject to the program beginning in 2013, and fuel distributors will be added to the program in 2015. Proceeds from the auctions of allowances under Cap-and-Trade will provide a significant source of new revenue to support GHG reduction measures; activities are currently underway to develop a framework and investment plan for allocating the proceeds.

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<sup>2</sup> California Climate Change Portal website: <http://www.climatechange.ca.gov/>

### Statewide 2020 Greenhouse Gas Emissions and Sources of GHG Reductions<sup>3</sup>



These AB 32 reduction strategies focus on the areas where the State can have the greatest impact; however, the Scoping Plan also describes the critical role that regional and local governments play in implementing these and other measures in order to meet the 2020 GHG reduction target. SB 375 is the only mandated GHG reduction requirement for MPOs, but SANDAG plays a role in reducing GHG emissions in other ways. The following table summarizes the roles that the State, SANDAG, and local governments each play in implementing the key AB 32 reduction strategies and while not exhaustive, provides an overview.

#### Roles in AB 32 Reduction Strategies

State Role	SANDAG Role	Local Government Role
<b>Low Carbon Fuel Standard (LCFS)</b>		
<ul style="list-style-type: none"> <li>• LCFS regulations</li> <li>• Alternative and Renewable Fuel and Vehicle Technology Program (AB 118)</li> </ul>	<ul style="list-style-type: none"> <li>• Provide forum to address barriers to alternative fuel vehicles and infrastructure</li> <li>• Energy Roadmap Program: fleet assessments</li> </ul>	<ul style="list-style-type: none"> <li>• Expand availability of alternative fuels</li> <li>• Integrate alternative fuel vehicles into gov't and contracted fleets</li> </ul>
<b>Pavley Clean Car Standards (AB 1493) and Advanced Clean Cars Program</b>		
<ul style="list-style-type: none"> <li>• Vehicle emissions standards</li> <li>• Clean Vehicle Rebate Project incentives for consumers</li> <li>• Alternative and Renewable Fuel and Vehicle Technology Program (AB 118)</li> </ul>	<ul style="list-style-type: none"> <li>• Regional readiness planning for electric vehicles and alternative fuels</li> <li>• Installation of electric vehicle charging at transit facilities</li> <li>• Energy Roadmap Program: fleet assessments</li> </ul>	<ul style="list-style-type: none"> <li>• Streamline permitting for electric vehicle charging stations</li> <li>• Integrate electric vehicles into gov't fleet</li> <li>• Improve traffic flow and efficient driving</li> </ul>

<sup>3</sup> Source: California Air Resources Board, *Annual Report to the Joint Legislative Budget Committee on Assembly Bill 32*, January 2013. Note: The 2013 Scoping Plan Update updates the 2020 limit from 427 to 431 MMTCO<sub>2</sub>e and modifies the GHG reductions associated with these strategies. The new 2020 limit is based on updated global warming potentials of GHGs in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report.

State Role	SANDAG Role	Local Government Role
<b>Transportation-Related GHG Targets and Sustainable Communities Strategies for MPOs (SB 375)</b>		
<ul style="list-style-type: none"> <li>• Set regional targets for per capita GHG reductions from passenger vehicles</li> <li>• Accept SCSs developed by MPOs</li> </ul>	<ul style="list-style-type: none"> <li>• Develop SCS in accordance with SB 375 reduction targets</li> <li>• Provide VMT data to support local climate action planning</li> <li>• Offer smart growth incentives and resources</li> <li>• Energy Roadmap Program: reducing energy through planning and development</li> </ul>	<ul style="list-style-type: none"> <li>• Implement smart growth principles in targeted areas</li> <li>• Expand active transportation facilities</li> <li>• Implement TDM strategies</li> <li>• Use parking strategies to reduce VMT</li> <li>• Revise zoning, standards, and design guidelines</li> </ul>
<b>Renewable Portfolio Standard (RPS)</b>		
<ul style="list-style-type: none"> <li>• RPS targets for utilities: <ul style="list-style-type: none"> <li>○ 20% by 2010</li> <li>○ 33% by 2020</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Coordinated planning with variety of stakeholders via the Regional Energy Working Group</li> <li>• Regional Energy Strategy Goals and actions</li> </ul>	<ul style="list-style-type: none"> <li>• Identify/remove barriers to large-scale renewables</li> <li>• Support grid modernization</li> </ul>
<b>Conservation and Energy Efficiency in New and Existing Buildings</b>		
<ul style="list-style-type: none"> <li>• Update building energy codes</li> <li>• Comprehensive Energy Efficiency Program for Existing Buildings (AB 758)</li> <li>• Long-Term Energy Efficiency Strategic Plan</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinated planning with variety of stakeholders via the Regional Energy Working Group</li> <li>• Regional Energy Strategy Goals and actions</li> <li>• Energy Roadmap Program: custom management plans, implementation assistance, technical resources</li> </ul>	<ul style="list-style-type: none"> <li>• Retrofit gov't facilities</li> <li>• Green business networks</li> <li>• Staff training</li> <li>• Revise building codes</li> <li>• Perform energy audits</li> <li>• Offer financing programs</li> </ul>

In May 2014, CARB adopted the *First Update to the Climate Change Scoping Plan*. This update highlights California’s progress to date in achieving the goals of AB 32 and lays the foundation for continued reductions in GHG emissions beyond 2020. The Update describes the need to establish a mid-term statewide emissions reduction target and how every major economic sector will need to play a role in sustaining reductions into the future. Some of these sector-specific actions include:

- Expand policy frameworks in areas like energy efficiency, demand response, renewable energy generation, energy storage, and smart grid technologies, and develop a comprehensive GHG reduction plan for the State’s electric and energy utilities.
- Continue building on efforts to put more low- and zero-emission vehicles on the road, increase reductions in carbon content of fuels, and invest in building clean, advanced systems and infrastructure to move people and goods.
- Use more precise irrigation techniques, capture methane, and prepare for climate impacts in the agricultural industry.
- Use integrated policy design to maximize efficiency and conservation in the water sector, and put in place mandatory measures to reduce GHG emissions and maintain water reliability during drought periods.

In the San Diego region, all 19 jurisdictions have completed inventories of GHG emissions from government operations and from the community as a whole. In addition, the Border Environment Cooperation Commission (BECC) has worked with the Center for Climate Strategies to complete GHG inventories for all six Mexican border states. Each inventory identifies sources of emissions, and sets a baseline for evaluating potential reductions. More than half of the local jurisdictions, representing over 75 percent of the region’s population, are developing or have adopted a climate action plan (CAP). A CAP typically includes mitigation measures to reduce GHG emissions toward an identified target, and offers streamlining opportunities for future development projects under the California Environmental Quality Act (CEQA). In conjunction with its CAP, the County of San Diego developed Guidelines for Determining Significance for Climate Change under CEQA. The Guidelines were developed using regional data, inclusive of San Diego County cities, and offer an approach that may be used by other lead agencies in the San Diego region for assessing significance of projects under CEQA. The table below summarizes each jurisdiction’s climate planning efforts. In addition to the efforts of the 18 cities and the County of San Diego, the Port of San Diego, and the San Diego County Water Authority also have developed GHG inventories and CAPs.

### Local Climate Planning Efforts

Jurisdiction	% of 2012 Regional Population	GHG Inventory	Climate Action Plan	
			Adopted (year)	Developing
<b>Chula Vista</b>	7.9	✓	2000, 2008	Update underway
<b>Encinitas</b>	1.9	✓	2011	
<b>Escondido</b>	4.6	✓	2012	
<b>National City</b>	1.9	✓	2011	
<b>San Diego</b>	42.0	✓	2005	Update underway
<b>County of San Diego</b> (unincorporated)	15.8	✓	2012	
<b>Vista</b>	3.0	✓	2012	
<b>Carlsbad</b>	3.4	✓		✓
<b>Del Mar</b>	0.1	✓		✓
<b>La Mesa</b>	1.9	✓		✓
<b>San Marcos</b>	2.7	✓		✓
<b>Santee</b>	1.7	✓		✓
<b>Solana Beach</b>	0.4	✓		✓
<b>Coronado</b>	0.7	✓		
<b>El Cajon</b>	3.2	✓		
<b>Imperial Beach</b>	0.8	✓		
<b>Lemon Grove</b>	0.8	✓		
<b>Oceanside</b>	5.4	✓		
<b>Poway</b>	1.5	✓		

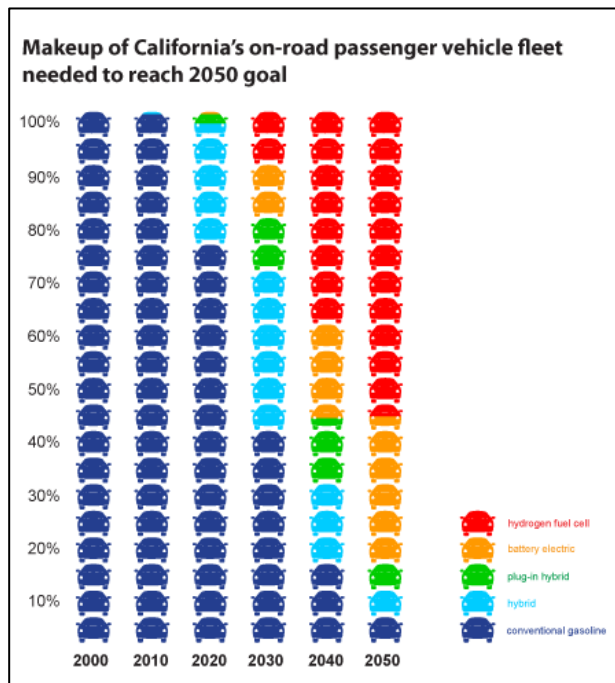
The following sections further describe the State strategy, the current and potential role of SANDAG, and the role of local governments in reducing emissions from the following sectors: transportation, land use, electricity, natural gas end use, water, and solid waste.

### **Reducing Emissions from Transportation Sector**

As illustrated in the regional GHG inventory, the transportation sector represents the largest source of GHG emissions (42% in the San Diego region). The AB 32 Scoping Plan outlines three key strategies for reducing emissions from the transportation sector:

- Reduce the miles driven by vehicles
- Increase the efficiency of the vehicles used
- Reduce the carbon content of the fuels used in the vehicles

#### *California’s Strategy for Reducing Emissions from Transportation*



The State’s three strategies for reducing transportation emissions are supported by three main policies: Senate Bill 375 (SB 375), Advanced Clean Cars program, and Low Carbon Fuel Standard (LCFS).

SB 375 addresses the strategy to reduce vehicle-miles traveled (VMT) by setting targets for MPOs to reduce their region’s GHG emissions from passenger vehicles and light-duty trucks. Each MPO must prepare a “Sustainable Communities Strategy” as part of their federally-mandated Regional Transportation Plan to demonstrate how the region would coordinate land use and transportation planning to meet the targets assigned by CARB.

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 zero-emission vehicles (ZEVs) will be operating in California and 15 percent of new car sales will be ZEVs. The chart above demonstrates how California’s on-road passenger vehicle fleet is planned to change overtime. In order for the State to meet its clean vehicle goals, new fueling infrastructure to power ZEVs and alternative fuel vehicles must be deployed where little to none exists today.

The LCFS calls for a reduction of at least 10 percent in the carbon intensity of California’s transportation fuels by 2020. 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.

### *SANDAG Role in Reducing Emissions from Transportation Planning*

In accordance with SB 375, SANDAG developed a Sustainable Communities Strategy (SCS) as an element of the 2050 Regional Transportation Plan (RTP). Although the State's estimate is that only three percent of GHG reductions are expected to come from all of the California MPOs' SCSs, SANDAG understands its efforts are an important piece of the overall reduction strategy. The 2050 RTP/SCS describes how the region will meet the per capita GHG reduction targets for passenger vehicle emissions set by CARB. It is important to note that CARB's targets for MPOs are focused only on the reductions that could come from transportation planning for passenger vehicles, not those reductions that can come from technology improvements made by vehicle manufacturers or cleaner fuels. The passenger vehicle GHG targets for SANDAG are a reduction of 7 percent by 2020, and 13 percent by 2035, from a 2005 baseline year.

The five building blocks of the 2050 RTP/SCS, which was adopted by the SANDAG Board of Directors in 2011, are:

1. A land use pattern that accommodates the region's future employment and housing needs while protecting habitat and resource areas
2. A transportation network of public transit, managed lanes and highways, local streets, bikeways and walkways
3. Transportation demand management strategies to reduce traffic during peak periods
4. Transportation system management to maximize efficiency of the transportation network
5. Innovative pricing policies and other measures to reduce VMT

The 2050 RTP/SCS lays out the strategy to reduce passenger vehicle GHG emissions through several SANDAG programs. These programs include iCommute commuter services and planning studies, San Diego Regional Bicycle Plan and early action program implementation, transit planning, *TransNet* Smart Growth Incentive Program and Active Transportation Grant Program, a regional transit-oriented development strategy, and a regional complete streets policy. These programs also help local governments implement their CAPs.

In addition to activities to reduce VMT, the 2050 RTP/SCS addresses the role of SANDAG in supporting the State's strategies for efficient vehicles 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 necessary fueling stations. In 2014, SANDAG completed a regional readiness plan for plug-in electric vehicles and charging stations<sup>4</sup>. This effort has expanded to planning for all alternative fuels with a regional alternative fuel plan to be completed in 2016. Through the Energy Roadmap Program, SANDAG has partnered with the San Diego Regional Clean Cities Coalition to offer member agencies customized fleet assessments that evaluate alternative fuel vehicle options available, as well as monetary and environmental implications.

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<sup>4</sup> San Diego Regional Plug-in Electric Vehicle Readiness Plan is available at: [http://www.sandag.org/uploads/publicationid/publicationid\\_1817\\_17061.pdf](http://www.sandag.org/uploads/publicationid/publicationid_1817_17061.pdf)

### *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. Even though emissions from government operations make up a small percentage of a jurisdiction's overall emissions, the local government can be a leader and help to influence changes in the community by taking steps to reduce internal emissions.

To date, seven jurisdictions in the San Diego region have completed a CAP, while an additional six jurisdictions are in the process of developing one. All of the completed CAPs include one or more measures to reduce VMT in the community. Measures from adopted CAPs in the San Diego region include:

- Expand and improve the transit network and accessibility
- Promote bicycle use by preparing a bicycle master plan and encourage employers to offer bicycle lockers and other facilities
- Work with employers to promote iCommute services and TDM strategies including telework and alternative work schedule options, the guaranteed ride home program, and incentives for alternative commuters
- Reduce parking requirements in smart growth areas and prioritize parking for high-occupancy vehicles
- Implement improvements to smooth traffic flow, reduce idling, and encourage efficient driving techniques

In addition to the measures to reduce VMT with the community, several local governments include measures to reduce VMT associated with employee commutes. These measures include:

- Offer car sharing and/or bike sharing for employees
- Promote the use of the iCommute Guaranteed Ride Home program
- Offer the use of telework or alternative work schedules
- Offer incentives to employees that use alternative commutes

Beyond VMT reduction measures, local government CAPs also address ways to support the state goals for efficient vehicles and alternative fuels. These measures include:

- Replace vehicles in government fleets and fleets of contractors with alternative fuel and hybrid vehicles
- Streamline permitting for electric vehicle charging stations
- Expand the availability and use of alternative fuel vehicles and fueling infrastructure

### ***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 (public transit, carpooling, walking, and biking). Mixed use, compact developments also result in reduced per capita demand for electricity, heating, and cooling. There are also 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 trees uptake and store carbon from the atmosphere as they grow.

#### *California's Strategy for Reducing Emissions from Land Use*

AB 32 and SB 375 emphasize the need for more compact land use patterns to achieve GHG reductions, but recognize that land use planning and urban growth decisions are areas where implementation of the Scoping Plan relies on local governments. Given local land use authority, the State's primary strategy for influencing land use and transportation planning to reduce GHG emissions is to support the MPOs and local jurisdictions' efforts to meet the SB 375 targets. Additionally, the Scoping Plan outlines a strategy to promote sustainable forests by using sustainable management practices and investing in tree-planting.

#### *SANDAG Role in Reducing Emissions from Land Use*

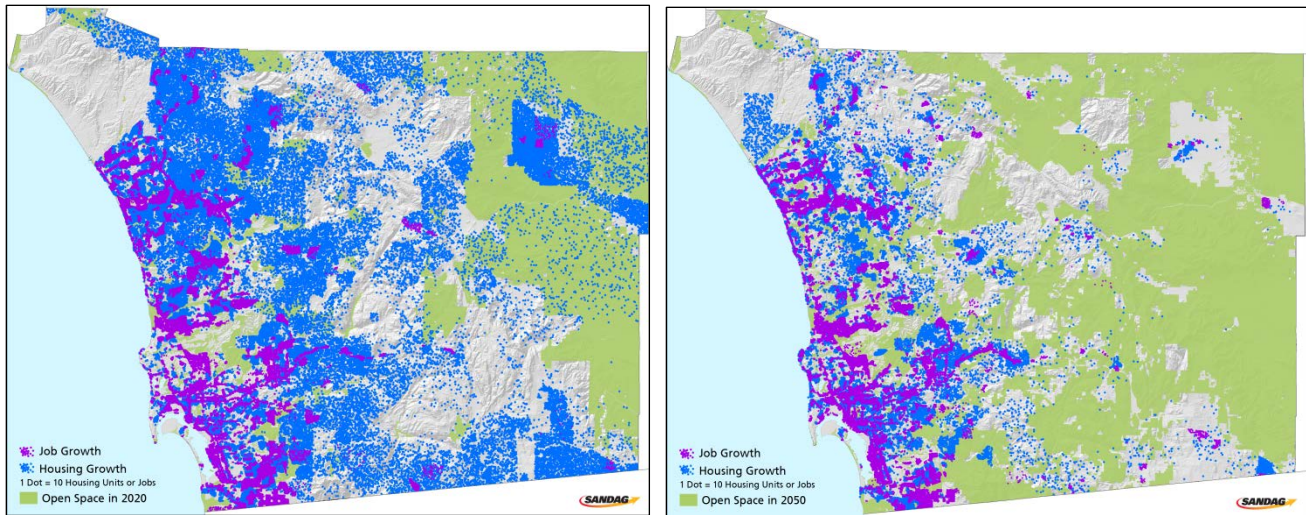
The SANDAG Regional Comprehensive Plan (RCP), adopted in 2004, is based on principles of smart growth and sustainability, which focuses on better urban design, walkability, and compact growth near transit. A key goal of RCP implementation is to provide incentives and assistance to local member agencies with land use authority to encourage smart growth development in areas on the Smart Growth Concept Map. Through the Smart Growth Tool Box, the *TransNet* Smart Growth Incentive Program, the *TransNet* Active Transportation Grant Program, and transportation investments included in regional transportation plans, SANDAG provides planning and financing tools to local jurisdictions. Grant funding criteria addresses several project elements, including sustainability, which encourages energy conservation and sustainable landscaping in project design. Additionally, through the Energy Roadmap Program, SANDAG provides resources to reduce energy use through planning and development.

#### *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 growth. The figures below show 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 implement the vision and goals set in the RCP, adopted by SANDAG in 2004, collectively moving the region toward more compact development, more open space preservation, and reduced GHG emissions.



## Comparison of Housing and Job Growth Projected in 1999 vs. 2013<sup>5</sup>



In 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:

- Implement smart growth design principles in targeted areas, such as transit stations, mixed use areas, and near retail and employment centers
- Revise zoning designations, development standards, and design guidelines to promote sustainable and smart growth land use patterns
- Develop and offer incentives, such as reduced parking requirements or expedited permit processing, for mixed use, transit-oriented, and affordable housing projects in designated SANDAG Smart Growth Opportunity Areas
- Preserve and increase the amount of urban forest and tree planting

### ***Reducing Emissions from Electricity***

Electricity use is responsible for 23 percent of the San Diego region's GHG emissions. 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;<sup>6</sup> 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, established the first Renewable Portfolio Standard (RPS) for the investor-owned utilities (IOUs)<sup>7</sup>. In order to achieve energy and climate goals,

<sup>5</sup> Projected housing and job growth in 1999 (left) and 2013 (right) based upon the SANDAG Series 9 and 13 Regional Growth Forecasts.

<sup>6</sup> California Energy Commission, Comprehensive Energy Efficiency Program for Existing Buildings: <http://energy.ca.gov/ab758/>

<sup>7</sup> California IOUs are San Diego Gas & Electric (SDG&E), Pacific Gas & Electric (PG&E), Southern California Electric (SCE) and Southern California Gas (SCG).

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. To improve energy efficiency, the AB 32 Scoping Plan calls for maximizing building and appliance standards, pursuing new technologies and policy mechanisms, and continuing investments from electricity providers in energy efficiency programs.

In 2008, the CPUC led the development of the California Long-Term Energy Efficiency Strategic Plan (LTEESP) to achieve maximum energy efficiency savings across all sectors, including local government. Updated in 2011, LTEESP identifies four "Big Bold Energy Efficiency Strategies" to help meet AB 32 GHG reduction targets:

1. All new residential construction in California will be zero net energy (ZNE) by 2020
2. All new commercial construction in California will be ZNE by 2030
3. Heating, ventilation, and air conditioning (HVAC) will be transformed to ensure that its energy performance is optimal for California's climate
4. All eligible low-income customers will be given the opportunity to participate in the low income energy efficiency program by 2020

The State's IOUs, regulated by the CPUC, implement energy efficiency programs that target both residential and non-residential sectors in support of LTEESP. Additional programs that support the LTEESP include AB 758 (Skinner, 2009) and the State's Building Energy Efficiency Standards<sup>8</sup>. AB 758 requires the CEC to develop and implement a comprehensive energy efficiency plan for all existing residential and commercial buildings. The Building Energy Efficiency Standards are updated on a roughly three-year cycle and become more stringent and closer to ZNE buildings with each revision. Additional funding to support energy efficiency came in 2012 when voters approved the California Clean Energy Jobs Act (Proposition 39). Proposition 39 money will be used to support energy efficiency and clean energy projects in California's K-12 public schools and community colleges pursuant to SB 73 (Skinner, 2013).

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 (PV), fuel cells, gas turbines, and advanced energy storage, has been primarily driven by incentive programs. Programs include California Solar Initiative, New Solar Homes Partnership, and Self-Generation Incentive Program. Governor Brown has set a goal for 12,000 megawatts<sup>9</sup> (MW) of distributed renewable generation by 2020; so far, 4,400 MW<sup>10</sup> has come online.

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<sup>8</sup> Title 24, Part 1, Chapter 10 and Part 6, and affected provisions in Part 11 (Cal. Green Building Standards Code)

<sup>9</sup> 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.

The Renewable Portfolio Standard (RPS) is another key measure for achieving the AB 32 target; it required California utilities to serve 20 percent of their customers' electricity needs with large-scale, clean renewable energy by 2010, which has been achieved, and 33 percent by 2020.

#### *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 providing 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 offers custom energy management plans for member agencies that do not have an LGP. Nearly all member agencies have a completed Roadmap, and several are working on implementation. To support cities with implementation of the energy conservation measures identified through the Roadmap program, SANDAG has an energy engineering firm under contract to offer assistance to cities with energy efficiency project specifications, procurement, and applications for rebates, incentives, and financing. SANDAG serves as a resource for local governments that do not have energy or climate change staff.

#### *Local Government Role in Reducing Emissions from Electricity*

The State's LTEESP describes goals for local governments to be leaders in energy efficiency by leveraging their authorities and opportunities to lead by example and influence their communities. These goals have been supported by investment in LGPs from utility energy efficiency programs. In the San Diego region, the following agencies have an LGP with SDG&E: cities of San Diego and Chula Vista, County of San Diego, 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.

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<sup>10</sup> California Air Resources Board, *First Update to the Climate Change Scoping Plan: Building on the Framework*, May 2014.

Local CAPs recognize the role that energy efficiency and renewable energy play in reaching GHG reduction goals. Examples of strategies from CAPs to reduce electricity-related emissions include:

- Revise building codes to require new and renovated buildings to increase their energy efficiency and meet statewide green building standards
- Encourage solar PV on new homes and commercial buildings
- Perform energy audits of existing buildings by utilizing key trigger points such as time of sale
- Offer financing programs to help offset upfront cost of energy retrofit and renewable energy projects
- Support modernization of the power grid to provide more real-time information to consumers
- Establish requirements for energy efficiency and renewable energy at municipal facilities
- Promote SDG&E rebate and incentive programs for all customers
- Identify and remove barriers to large-scale renewable energy production

### ***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 Use*

In the AB 32 Scoping Plan, the State sets a target for reducing natural gas use by 800 million therms from business as usual through energy efficiency. Several of the strategies described above for improving electricity efficiency in buildings also apply to natural gas savings. One key source of natural gas emissions is heating hot water. Solar hot water heating is one technology that has been identified to implement the State's targets for ZNE buildings. Solar hot water heating systems offset the use of natural gas, and typically reduce the need for conventional water heating by about two-thirds. The Solar Hot Water and Efficiency Act of 2007 authorized a ten year, \$250-million incentive program with a goal of 200,000 systems installed by 2017.

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, are typically 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, which builds upon the Scoping Plan's goal of 4,000 MW of new CHP by 2020.

#### *SANDAG Role in Reducing Emissions from Natural Gas End Use*

The RES has a goal related to efficiency of natural gas power plants; however, the goal does not currently 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 Use*

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

- Revise building codes to require new and renovated buildings to increase their energy efficiency and meet statewide green building standards
- Perform energy audits of existing buildings by utilizing key trigger points such as time of sale
- Offer financing programs to help offset upfront cost of energy retrofit and renewable energy projects
- Promote SDG&E rebate and incentive programs for all customers
- Support increased use of solar hot water heating in residential, pool, and commercial uses

### ***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. Two 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 AB 32 Scoping Plan recognizes that water conservation is critical to making the State's water supply more reliable and drought resistant. California's 2009 Water Conservation Act (Senate Bill x7-7) sets a goal to reduce per capita water use by 20 percent by 2020. The state has also 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.

### *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. 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.

### *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 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 government facilities. Some cities already require residents to update water fixtures to low-flow models at point-of-sale. Other measures to reduce water-related GHG emissions in local CAPs include:

- Promote use of low-flow fixtures, dual flush toilets, and water efficient appliances
- Encourage water rate structures that support water conservation
- Promote water conserving landscaping such as turf lawn conversion and drought tolerant plants
- Coordinate with local water districts on outreach programs and use of rain barrels and gray water systems
- Expand reclaimed water use in landscaping and/or purified recycled water use to replenish drinking water reservoirs

### **Reducing Emissions from Solid Waste**

Solid waste contributes 4 percent to the San Diego region's total GHG emissions, which comes from 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. 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, 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.

### **Adaptation - Preparing for Impacts of Climate Change**

Even with the mitigation measures described in the previous sections, the current levels of GHGs in the atmosphere have already resulted in changes to the climate and will continue to do so. California has recognized the need to prepare communities for the effects of climate change by identifying ways to adapt and make communities resilient to climate impacts. The State has taken a leadership role 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 potential impacts to the San Diego region, California's climate adaptation planning efforts, the role that SANDAG plays in preparing for climate change, and the ways local governments are considering adaptation in their climate action planning efforts.

## **Climate Change Impacts to the San Diego Region**

The San Diego region is already seeing impacts of climate change, including changes in temperature and rainfall patterns. The table below summarizes the expected impacts of climate change in the San Diego region, as described in *San Diego, 2050 is Calling: How Will We Answer?*, a report from the San Diego Foundation and Climate Education Partners.

### **Expected Climate Impacts to the San Diego Region by 2050**

Temperature	+4.8° F in annual average temperature
Precipitation	16% fewer rainy days, and 8% more rainfall during the biggest rainstorms
Water Resources	12% decrease in the runoff and streamflow due to less snowpack and greater evaporation
Sea Level Rise	5 to 24 inches of sea level rise
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	7 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 California Natural Resources Agency, 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 Governor's Office of Planning and Research (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 the following sectors:

- Public Health
- Biodiversity and Habitat
- Ocean and Coastal Resources
- Water Management
- Agriculture
- Forestry
- Transportation and Energy Infrastructure

In December 2013, the Natural Resources Agency released an update to the 2009 strategy called *Safeguarding California: Reducing Climate Risk*. After the public review process, the Safeguarding California Plan is expected to be adopted in 2014. In addition to the Natural Resources Agency, 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.

### *Ocean and Coastal Resources*

In March 2013, the Coastal and Ocean Working Group of the California Climate Action Team released guidance and policy recommendations for incorporating sea level rise (SLR) projections into planning and decision making for projects. The guidance is based on the findings of the June 2012 National Research Council (NRC) report: *Sea-Level Rise for the Coasts of California, Oregon, and Washington*, which include the following ranges over three time horizons for areas south of Cape Mendocino:

- 2000-2030: 4 to 30 cm (0.13 to 0.98 ft.)
- 2000-2050: 12 to 61 cm (0.39 to 2.0 ft.)
- 2000-2100: 42 to 167 cm (1.38 to 5.48 ft.)

In coordination with the other state adaptation strategies, the California Coastal Commission (CCC) released *Draft Sea-Level Rise Policy Guidance* in October 2013 that recommends steps for addressing SLR in CCC planning and regulatory actions. The Policy Guidance describes the best available science on SLR and provides step-by-step guidance on how to address SLR 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.

### *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 5 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<sup>11</sup>. The *CA Climate Adaptation Strategy* (2009) recommends firefighting agencies include climate change impact information in fire program planning. Enhanced wildfire risk from climate change will likely increase public health and safety risks, property damage, fire suppression and emergency response costs, and impacts to water quality and vegetation/habitat.

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<sup>11</sup> California Emergency Management Agency and Natural Resources Agency, *California Adaptation Planning Guide: Understanding Regional Characteristics*, July 2012.



### *Biodiversity/Habitat*

Impacts of climate change such as SLR, loss of wetlands, wildfire, warmer temperatures, and drought can dramatically alter terrestrial and freshwater aquatic habitats and the species that depend on them. The CA 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

### *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)*, *Safeguarding California (2013 draft)*, *CA Water Plan update (2013 draft)*, and *CA Water Action Plan (2014)*. 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. 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 Role in Adaptation Planning***

The 2050 RTP/SCS recognizes that the region is and will continue to be affected by the impacts of climate change. Specifically, the SCS chapter identifies the following actions to support implementation:

- To the extent possible, address climate adaptation issues in the design of new projects, and when improvements are made to existing infrastructure
- Evaluate the feasibility of developing preliminary maps that identify transportation infrastructure that could be vulnerable to environmental changes to climate change, including precipitation, heat, and sea level rise

Recognizing that climate impacts extend beyond jurisdictional and international boundaries, the 2009 and 2010 binational seminars, supported by the Committee on Binational Regional Opportunities (COBRO) focused on climate change and opportunities for crossborder collaboration. The seminars resulted in recommendations on ways to continue collaborative work on climate change by agreeing on priority actions and sharing information on local and regional efforts.

### *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. In order to inform the North Coast Corridor Program, SANDAG and Caltrans commissioned a *San Diego Region Coastal Sea Level Rise Analysis Report*. The Report describes future scenarios for SLR 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 February 2013, Caltrans released a guide for MPOs and Regional Transportation Planning Agencies (RTPAs) in *Addressing Climate Change Adaptation in Regional Transportation Plans*. The guide describes the need for considering long-term impacts of climate change on transportation infrastructure projects, which typically have long service life, as well as condition and vulnerability of existing facilities. The guide identifies impacts to transportation infrastructure of SLR, increase in intense precipitation events, and higher temperatures and extreme heat events. The SLR impacts include coastal erosion, coastal and inland tidal zone road flooding, bridge scour, and railway flooding. Impacts from intense precipitation events comprise railway and roadway flooding, landslides, and bridge scour. Impacts from higher temperatures and extreme heat include highway asphalt rutting, asphalt and rail buckling, concrete deterioration, limits on periods of construction activity, increased thermal expansion of bridges, vegetation/biodiversity changes, and increase in wildfires and mudslides. Caltrans recommends that MPOs identify locations of roadway, bridges, and railway vulnerable to these impacts and address the vulnerabilities in transportation plans, design, and operations/maintenance.

### *Shoreline Preservation*

Recognizing the need for regional coordination to address beach erosion issues along the coastline, SANDAG facilitates collaboration on beach building and maintenance through the shoreline management program. The Shoreline Preservation Working Group helps to inform SANDAG on issues related to the implementation of the Shoreline Preservation Strategy and beach replenishment opportunities. The CCC Draft Sea Level Rise Policy Guidance identifies beach replenishment and nourishment as an adaptation strategy for addressing impacts of SLR on shorelines.

### *Habitat Conservation*

The *TransNet* Environmental Mitigation Program (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 is also helping to fund research and regional coordination on ways to build resiliency among species and habitats. The San Diego Management and Monitoring Program recently completed a *Management Strategic Plan (MSP) for Conserved Lands in Western San Diego County*, 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. Strategies included in CAPs related to adaptation include:

- Reduce urban heat island impacts through cool paving, shade trees, green/cool roofs, and reflective materials
- Decrease water use through low impact development, water recycling, landscape ordinances, and education for residents
- Prevent stormwater pollution through landscape and construction site water waste reductions and designing stormwater structures to accommodate future precipitation regimes
- Prepare for wildfires through outreach and education to residents, updating emergency response plans and hazard mitigation plans to consider climate change, encourage fire retardant materials and plants, and improve development standards to reduce fire risk at the urban/wildland interface
- Prepare the public for extreme heat events through air quality and extreme heat notifications, targeting vulnerable communities, and offering cool zones for residents
- Use existing species conservation planning processes to protect biodiversity and habitats that are threatened by climate change
- Update environmental review procedures to consider sea level rise in coastal developments

In addition to individual CAP measures, local governments have worked collaboratively to address impacts of climate change via the San Diego Regional Climate Collaborative. Specifically, the local governments that border the San Diego Bay worked together to complete the *Sea Level Rise Adaptation Strategy for San Diego Bay* in January 2012. The steering committee for the study included representatives from the five cities around the bay (Chula Vista, Coronado, Imperial Beach, National City, and San Diego), as well as the Port of San Diego and the San Diego County Regional Airport Authority. The strategy includes a vulnerability assessment and list of comprehensive strategies to assess the vulnerabilities.

### **Interrelationships to Other Policy Areas**

Climate change is related to several other policy areas of the 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 to 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 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, multi-modal communities that can serve the growing populations of younger professionals, singles, and seniors. These changes can also lead to better health outcomes and to easier access to schools, jobs, and recreation; 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 8,000 jobs, with an average wage of over \$87,000, are in the “Cleantech” sector<sup>12</sup>.

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 updated *Climate Change Scoping Plan* states that California produces twice as much 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 fossil fuels sources, 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 SLR 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 or 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.

**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 of the key strategies for reducing GHG emissions can also improve health and have the potential to increase quality of life for all people regardless of age, race, color, national origin, income, or physical agility. These strategies and co-benefits are summarized in the following table.

**GHG Reduction Strategies and Potential Co-Benefits**

Strategy to Reduce GHG Emissions	Potential Health/Social Equity Co-Benefits <sup>13</sup>
Reduce vehicle miles traveled	<ul style="list-style-type: none"> <li>• Reduce air pollution</li> <li>• Increase physical activity</li> <li>• Reduce chronic disease (such as asthma and heart disease)</li> <li>• Improve mental health</li> <li>• Improve access to low-cost alternative transportation options</li> </ul>
Increase fuel efficiency and use of cleaner fuels in vehicles	<ul style="list-style-type: none"> <li>• Reduce air pollution</li> </ul>

<sup>12</sup> SANDAG, *Traded Industry Clusters in the San Diego Region*, July 2012

<sup>13</sup> California Department of Public Health, *Integrating Public Health into Climate Action Planning*, February 2012

Reduce emissions through land use changes such as more compact growth	<ul style="list-style-type: none"> <li>• Increase physical activity</li> <li>• Reduce chronic disease</li> <li>• Increase local access to essential services (affordable housing, jobs, amenities)</li> <li>• Enhance safety for biking and walking with reduced vehicle speeds and reduced collisions</li> </ul>
Reduce residential building energy and water use	<ul style="list-style-type: none"> <li>• Reduce household energy costs (especially beneficial for low-income households)</li> <li>• Promote healthy homes</li> <li>• Create local green jobs</li> <li>• Promote cooler communities through shade trees and cool pavements</li> </ul>
Urban greening	<ul style="list-style-type: none"> <li>• Reduce temperature and urban heat island health effects</li> <li>• Reduce air pollution</li> <li>• Reduce noise</li> <li>• Enhance safety</li> </ul>
Biodiversity Conservation	<ul style="list-style-type: none"> <li>• Promote ecosystem services (clean air and water)</li> <li>• Enhance access to open space and recreation</li> </ul>

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; in particular, the health impacts of climate change may disproportionately affect vulnerable populations including: children, the elderly, people with chronic illness, low-income, 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 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.

## **Recommendations**

Based on the State's strategy and the roles that SANDAG and local governments have in addressing climate change, there are opportunities for regional collaboration on strategies to coordinate on a consistent approach to climate change in the San Diego region. The following recommendations describe ways that SANDAG can work together with member agencies and other stakeholders to reduce GHG emissions, prepare for climate impacts, and increase education and awareness.

### ***Reducing GHG Emissions***

- Ensure that efforts to reduce VMT at the regional and local level are done in a coordinated manner and that the SCS and local CAPs are complementary
- Make jurisdictional VMT data accessible to local governments and assist in identifying VMT reduction strategies for local CAPs that are consistent with the SCS and leverage other SANDAG plans and programs
- Integrate regional planning for plug-in electric vehicles and alternative fuels into local CAPs
- Continue to provide planning resources to support local governments efforts to implement smart growth and technical support for demonstrating associated GHG emission reductions
- Continue and expand the Energy Roadmap Program to offer resources to local governments on ways to save energy in government operations and in the community
- Coordinate with SDCWA to provide resources for local governments on the water-energy nexus and strategies to save water and energy that implement CAPs
- Collaborate on education, outreach, and consistent messaging on ways residents and businesses can help reduce GHG emissions

### ***Preparing for Climate Impacts***

- Use the Caltrans guide, *Addressing Climate Change Adaptation in Regional Transportation Plans*, to identify locations of infrastructure vulnerable to climate impacts and address the vulnerabilities in transportation plans, design, and operations/maintenance
- Replicate the process that was used to create the Sea Level Rise Adaptation Strategy for the San Diego Bay for other areas of adaptation and resiliency, such as sea level rise along the shoreline, wildfires in inland areas, and water conservation
- Partner with other regional entities such as the SDCWA, bordering counties, Mexico, military, and tribal nations on adaptation and resiliency, and agree on priority aspects of climate change collaboration, including mitigation, adaptation, and education strategies
- Integrate climate change considerations into existing planning processes, such as habitat planning, emergency response, hazard mitigation, and public health planning
- Coordinate with the state and utilize state planning documents as needed on climate risk reduction efforts
- Collaborate on education and outreach for the general public on impacts of climate change in communities and on ways to prepare for impacts

## **C. ADDRESSING CLIMATE CHANGE IN THE SAN DIEGO REGION**

There are many efforts underway in the San Diego region that are planning and implementing strategies to address climate change. This section further describes 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 taking action on climate change.

### **SANDAG Plans and Programs**

#### *2050 Regional Transportation Plan/Sustainable Communities Strategy (2011)*

The 2050 RTP/SCS demonstrates how development patterns and the transportation network, policies, and programs can work together to achieve the GHG emission targets for cars and light trucks established by CARB. The SCS also contains additional energy and climate actions that go beyond the transportation emission reductions required by SB 375.

#### *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 of developing an energy strategy going back to 1979, 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 San Diego Forward: The 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. The Strategy identifies a range of potential policy measures – “tools in the toolbox” – for consideration as SANDAG updates long-term planning documents like the Regional Transportation Plan and Regional Comprehensive Plan, 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 greenhouse gases from passenger cars and light-duty trucks as part of the development of a Sustainable Communities Strategy for the 2050 RTP/SCS in compliance with Senate Bill 375. 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 greenhouse gases from their operations.

#### *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 Plan describes the regional bicycle network as a component of the multimodal regional transportation system included in the RTP/SCS 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 SCS 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, SchoolPool, and support for teleworking. Public outreach increases awareness about the variety of transportation choices through events such as Bike to Work Day, Rideshare Week, Dump the Pump, and through direct outreach to employers, community groups, schools, and agencies.

#### *San Diego Region Intelligent Transportation Systems (ITS) 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.

#### *Regional Alternative Fuel Planning*

One of the six priority early actions identified in the Regional Energy Strategy and actions included in the SCS 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 2050 RTP/SCS. In 2014, SANDAG began a regional planning effort to address infrastructure needs for alternative fuels, expanding on the electric vehicle planning described next.

### *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 California Energy Commission 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 March 2012, and members include 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. Efforts begun by REVI will be continued through another grant from the CEC for SANDAG to develop a regional readiness plan for all alternative fuels.

### *Energy Roadmap Program*

The Energy Roadmap Program is a collaboration between SANDAG and San Diego Gas & Electric 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. The Energy Roadmap Program also offers cities support towards achieving the energy savings identified within their Roadmaps. Implementation activities include:

- Project analysis and selection
- Project feasibility studies
- Development of product/technology specifications
- Support for contractor procurement
- Completion and submittal of financing requirements
- Planning support for plan, policy, and regulatory needs
- Assistance with community outreach events
- Identify available staff training opportunities

### *SANDAG Green Operations Manual (2014)*

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 reduce GHG emissions and help implement the 2050 RTP/SCS. 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. The SGIP awards two percent of the annual *TransNet* revenues (\$9.6 million in 2013) to local governments through a competitive grant program to support projects that will help better coordinate transportation and land use in the San Diego region.

The goal of the Active Transportation Grant Program 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.

### *Regional Transit Oriented Development (TOD) Strategy*

SANDAG is preparing a Regional TOD Strategy to promote and incentivize sustainable development. More specifically, the strategy will assist the region in creating TOD projects and neighborhoods that will reduce GHG emissions; increase transit ridership, walking, and biking; and provide a greater mix of housing and employment opportunities for all residents of the region. This project will include a review and potential 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 is scheduled for completion in spring 2015.

## **Local Government Plans and Programs**

### *Local Government Partnerships*

SDG&E, along with the other IOUs in California, have included local government partnerships (LGPs) as part of their energy efficiency portfolios since 2006. The IOUs have formed LGPs with local governments, regional governments, and public agencies. They also offer institutional partnerships to colleges, universities, and other institutions. The LGP proposals are submitted by SDG&E to the CPUC as part of its overall portfolio of energy efficiency programs. SANDAG, the City and County of San Diego, the City of Chula Vista, and the San Diego Unified Port District (Port) currently have LGPs with SDG&E. The city and county LGPs with SDG&E were established in 2006, while the SANDAG and Port programs began in 2010. Since then the LGPs have provided municipal and community energy-saving programs. The existing LGP programs are to be extended through 2015.

### *South Bay Energy Action Collaborative*

Since 2013, SANDAG has partnered with the City of Chula Vista to offer an additional method for Energy Roadmap implementation to the South Bay Cities of Coronado, Imperial Beach, and National City. Chula Vista is leading this pilot program, called the South Bay Energy Action Collaborative (SoBEAC). SoBEAC offers a "peer to peer" or "neighboring city to neighboring city" approach to Roadmap implementation. SoBEAC objectives are focused on three categories: municipal energy management, building and development processes, and community outreach. SANDAG plans to share and expand successful components of SoBEAC efforts with all Roadmap cities.

## **Collaborative Regional Efforts**

### *San Diego Regional Climate Collaborative*

The San Diego Regional Climate Collaborative<sup>14</sup> (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, County of San Diego, Port of San Diego, University of San Diego, and SANDAG. Additional Climate Collaborative members include the San Diego Foundation, San Diego County Regional Airport Authority, and cities of Oceanside and Encinitas. 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.

### *San Diego Regional Energy Partnership*

SANDAG coordinates with other SDG&E LGPs, including the Cities of San Diego and Chula Vista, County of San Diego, and 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 Regional Energy Mapping Project, and other Energy Upgrade California or similarly related efforts.

### *Sea Level Rise Adaptation Strategy for the San Diego Bay (2012)*

The Adaptation Strategy was prepared by ICLEI Local Governments for Sustainability through a collaborative, regional stakeholder process that included most of the public agencies and private sector representatives with a major interest in the future of San Diego Bay. Over the course of multiple workshops, stakeholders and technical advisors developed common assumptions and consensus-based recommendations that should form the basis of the region's climate adaptation planning going forward. The Adaptation Strategy is a living document that can be implemented by local agencies and re-evaluated as new information becomes available in the coming years.

### *Climate Understanding and Resilience in the River Valley (CURRV) – Tijuana River National Estuarine Research Reserve*

The overarching goal for CURRV is to begin a regionally committed process of adapting to climate change within the context of other environmental and socioeconomic changes. In order to achieve this goal, the Tijuana River National Estuarine Research Reserve (TRNERR) is collaborating with a diverse stakeholder group from San Diego and Baja California, Mexico, to conduct a vulnerability assessment that informs the development of an Adaptation Strategy addressing the impacts of climate change, specifically sea level rise and river flooding.

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<sup>14</sup> San Diego Regional Climate Collaborative website: [www.sdclimatecollaborative.org](http://www.sdclimatecollaborative.org)

### *The San Diego Foundation Climate Initiative*

The San Diego Foundation educates and supports all of the region's communities in addressing climate change through research, strategic investments, and collaborations with community leaders and policymakers. The Foundation participates in several regional projects including the San Diego Regional Climate Collaborative and Climate Education Partners. The Foundation also helps to fund research to build a scientific foundation for effective public policy, reports include:

- Focus 2050 Study for the San Diego Region (2008)
- Local Government Greenhouse Gas Emissions Inventories (2009-2011)
- Regional Public Opinion Research on Climate Change (2010)
- Sea Level Rise Adaptation Strategy for the San Diego Bay (2012)
- Climate Action Planning Progress in the San Diego Region (2013)

### *Energy Policy Initiatives Center at University of San Diego*

The Energy Policy Initiatives Center (EPIC) is a non-profit academic and research center of the University of San Diego's School of Law that studies energy policy issues affecting the San Diego region and California. EPIC has developed several reports and tools to aid local governments in their climate planning efforts, including an Excel-based climate planning tool that allows local governments to calculate GHG emissions in their jurisdiction and evaluate the GHG reduction potential of various mitigation measures. EPIC completed the 2008 regional GHG emissions inventory for the 2050 RTP/SCS and completed the updated 2012 GHG emissions inventory for San Diego Forward: The Regional Plan.

### *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, EPIC, 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. With funding for an additional five years, Climate Education Partners are working to develop education materials and implement educational programs. Climate Education Partners released a report, *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
AB 758	Assembly Bill 758 (2009), Comprehensive Energy Efficiency Program for Existing Buildings
AB 1493	Assembly Bill 1493 (2002), Clean Car Standards
BECC	Border Environmental Cooperation Commission
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
COBRO	Committee on Binational Regional Opportunities
CPUC	California Public Utilities Commission
CURRV	Climate Understanding and Resilience in the River Valley
EMP	Environmental Mitigation Program
EPIC	Energy Policy Initiatives Center
GHG	Greenhouse Gas
HVAC	Heating, ventilation, and air conditioning
IOU	Investor-owned utility
IPCC	Intergovernmental Panel on Climate Change
ITS	Intelligent Transportation Systems
LCFS	Low Carbon Fuel Standard
LGP	Local Government Partnership
Low-CI	Low carbon-intensity
LTEESP	Long-Term Energy Efficiency Strategic Plan
MMTCO <sub>2e</sub>	Million metric tons of carbon dioxide equivalent
MPO	Metropolitan Planning Organization

MSP	Management Strategic Plan
MW	Megawatt
NRC	National Research Council
OPR	Governor’s Office of Planning and Research
PEV	Plug-in electric vehicle
PV	Photovoltaic
RCP	Regional Comprehensive Plan
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
RTPA	Regional Transportation Planning Agency
SB x7-7	Senate Bill x7-7 (2009), California’s Water Conservation Act
SB 73	Senate Bill 73 (2013), Proposition 39 Implementation
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
SLR	Sea level rise
SoBEAC	South Bay Energy Action Collaborative
TDM	Transportation Demand Management
TRNERR	Tijuana River National Estuarine Research Reserve
VMT	Vehicle miles traveled
ZEV	Zero-emission vehicle
ZNE	Zero net energy

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## Emerging Technologies White Paper

July 2014

### A. INTRODUCTION

Technology influences where we work and live, how we communicate with each other, and the personal choices we make. This paper explores emerging technologies as they affect and influence transportation infrastructure for consideration in San Diego Forward: The Regional Plan. Additionally, this paper discusses technology trends and how those trends affect our everyday lives.

This paper examines vehicle technology, infrastructure or roadway technology, as well as personal technology, to inform the public and policymakers on investment opportunities, potential policies, and timing, so that as a region we can make informed choices, maximize the positive application of both transportation technologies and general technology trends, and include relevant information and recommendations in San Diego Forward: The Regional Plan that will shape our future.

### B. INTELLIGENT TRANSPORTATION SYSTEMS

Intelligent Transportation Systems (ITS) is the application of technology to transportation systems including vehicles, roadways, intersections, transit, traveler information, bike and pedestrian networks, and payment systems with the goal to maximize efficiency of those services while increasing vehicle- and person-throughput, reducing congestion, and providing quality information to the commuting public and to people traveling at all times of the day. The application of ITS technologies can influence transportation choices across all modes of travel.

SANDAG has had a regional ITS Program in place for some time, which provides a solid foundation from which to incorporate emerging technological advances. The SANDAG ITS program focuses on the following areas of emphasis.

- Planning – Both long range and project level planning, including Performance Monitoring and Management
- Implementation – Implementation of stand-alone projects and as integrated into a larger capital improvement
- Deployment – Development, improvement, expansion and upgrade of ITS investment areas
- Operations – Facilitation of the integration of new ITS systems into on-going operations and maintenance



## **ITS Planning / Transportation System Performance Monitoring and Management**

A fundamental emerging technological need that remains constant during regional transportation planning cycles is determining whether the region is maximizing the benefits of transportation project improvements. To assess and realize the progress and transportation performance benefits of existing and planned project investments requires the application of a comprehensive and sound statistical evidence gathering and analytical process to determine facts, trends, quality of services, and optimal system efficiency. Under transportation system management, this is achieved through transportation system performance monitoring and management.

ITS planning places emphasis on improving data collection, analysis, and management in two key areas: (1) transportation performance monitoring, and (2) transportation system performance management.

### *Transportation Performance Monitoring*

Getting the most out of our transportation investments requires observing the system's performance, to (1) provide current and on-going information on how well the transportation system is performing; (2) identify opportunities for near-term improvements; and (3) assess the impacts of future improvements. Priority activities for improving performance monitoring are focused on continued development for enhancing the region's ability to automate the data collection, data analysis, and data management systems for all modal networks regardless of data collection technology. Transportation System Performance Monitoring is guided by the following principles:

- Improved Traveler Information – Focus on the region's ability to provide better information on speeds, travel times, travel options, or congestion-related information to the traveling public.
- Improved Performance Monitoring and Reporting – Focus on enhancing support for on-going or new efforts that support and align with local, regional, and federal performance monitoring and reporting programs and initiatives.
  - Transportation performance monitoring needs to be automated and uniformed across networks. This will reduce costs and provide more frequent data collection and allow for data collection, analysis, and reporting to be consistent year to year.
  - Transportation performance monitoring needs to reflect the multimodal nature of our transportation system by focusing on all modes of travel.
  - Data availability, accuracy, and management should be carried out to supplement and support on-going performance management and operations efforts including the development of decision support systems and real-time proactive corridor management approach.

## **Implementation and Project Delivery: Deployment Timeframes**

Project delivery follows system engineering principles and accepted project management processes as detailed by the Project Management Institute. Of all the technologies presented in this white paper, only connected or automated vehicles are not currently available as described. All other technologies are available in one form or another, at different maturity levels. San Diego Forward: The Regional Plan will contain funding for emerging technologies, broken down by decade. At this time, all technologies described in this paper, other than connected or automated vehicles, are anticipated for deployment in the short term (next 5 to 10 years), and connected / automated vehicles are anticipated for deployment in the longer term (10 to 30 years).

## **ITS Operations**

SANDAG ITS has deployed several modal programs, systems, and regional communications networks that transition from implementation into pilot or normal operations. These systems require on-going support for operations, administration, and maintenance to ensure that the systems perform as expected and deliver mobility services to the public.

Services such as real time traveler information, 511, and the newly developed 511 mobile application for the Interstate 15 (I-15) corridor require being designed, from the start, as robust systems that function 24 hours a day, seven days a week in order to maintain high usage and credibility by the user. To accomplish this, the ITS team develops support plans, best practices, documentation, and administration strategies while the project transitions from implementation to production. Once proper administration tools and practices are applied, the completed project can be supported by a traditional Information Technology department and thus transferred to the appropriate support team within the regional network of partners for day-to-day operations.

## **C. EMERGING TRANSPORTATION TECHNOLOGIES**

Personal technology has changed the landscape in the last five to ten years and has started to significantly deliver the ability to access the 'virtual' office, classroom, and doctor's office to name just a few. Today's world of universal communication and instant access to information paints a picture of what our future holds.

Advances in technology have the potential to lower travel demand by reducing the need to make as many trips to work, school, or medical appointments. Technology can reduce single occupancy car trips; however, there is also the potential that technologies such as the autonomous vehicle could raise the number of overall vehicle trips by increasing access to self-driving cars. On the other hand, technological advances also have the potential to increase the share of trips made by transit, biking, and walking due to better access to real-time information and services such as car/bike-sharing.

Emerging technologies that are under consideration or have already been developed and are in use in whole or part include the following:

- Emerging Vehicle Technologies
- Zero Emission Vehicle Readiness
- Multi-Modal Management
- Smart Parking
- Mobility Hubs

- Unified Transportation Payment
- Other Emerging Technology Trends
- Policies and Investments

## D. EMERGING VEHICLE TECHNOLOGIES

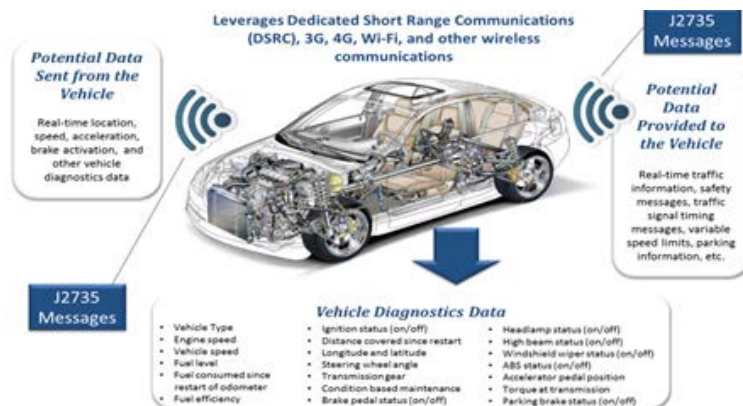
### Autonomous and Connected Vehicle Technology

One cannot escape the terms “Connected” or “Autonomous” when discussing the future of transportation technologies. Autonomous or Automated Vehicles would operate independently from other vehicles and utilize internal sensors to survey and respond to one’s surroundings. Connected Vehicles or vehicles that wirelessly communicate with other connected vehicles and the roadway could operate cooperatively to reduce congestion, decrease fuel consumption and promote increased safety. Ultimately, it is envisioned that fully autonomous vehicles (driverless cars) could replace conventional cars with autonomous cars projected to be available by 2025. It also is projected that autonomous vehicles would reach 50 percent market penetration by 2035, based on current vehicle lifecycle trends. Infrastructure investment to meet this changing vehicle profile could include the development of protected autonomous lanes with barrier separation along with necessary communications network enhancements. Driverless taxis would enable users to request a ride using smartphone applications, without having to search for and walk a great distance to access a vehicle; and such autonomous vehicles enable carsharing companies to seamlessly reposition vehicles to better match demand.

With formal direction now set by the National Highway Traffic Safety Administration (NHTSA) on both *connected* and *autonomous* vehicles, this section of the Emerging Technologies Whitepaper seeks to provide the reader with information used in answering the question “*how real is it?*”

The NHTSA, under the United States Department of Transportation (U.S. DOT), was established by the Highway Safety Act of 1970, as the successor to the National Highway Safety Bureau, to carry out safety programs under the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966. In their announcement confirming that connected vehicles did indeed provide the postulated safety

benefits put forward by almost ten years of Research and Development, NHTSA commented that “America is at a historic turning point for automotive travel. Motor vehicles and drivers’ relationships with them are likely to change significantly in the next ten to twenty years, perhaps more than they have changed in the last one hundred years. Recent and continuing advances in automotive technology and current research on and testing of exciting vehicle innovations have created completely new possibilities for improving highway safety, increasing environmental benefits, expanding mobility, and creating new economic opportunities for jobs and investment. The United States is on the threshold of a period of dramatic change in the capabilities of, and expectations for, the vehicles we drive. In fact, many are inspired by the vision that the vehicles will do the driving for us.



Although this statement focuses on the enormous safety potential of these new technologies, they offer an even wider range of possible benefits. Vehicle control systems that automatically accelerate and brake with the flow of traffic can conserve fuel more efficiently than the average driver. By eliminating a large number of vehicle crashes, highly effective crash avoidance technologies can reduce fuel consumption by also eliminating the traffic congestion that crashes cause every day on our roads. Reductions in fuel consumption, of course, yield corresponding reductions in greenhouse gas emissions. To the extent vehicles can communicate with each other and with the highway infrastructure, the potential for safer and more efficient driving will be increased even more. Drivers—or vehicles themselves—will be able to make more intelligent route selections based on weather and traffic data received by the vehicle in real time. Mobility for those with a range of disabilities will be greatly enhanced if the basic driving functions can be safely performed by the vehicle itself, opening new windows for millions of people.

Preventing significant numbers of crashes will, in addition to relieving the enormous emotional toll on families, also greatly reduce the enormous related societal costs—lives lost, hospital stays, days of work missed, and property damage—that total in the hundreds of billions of dollars each year. Moreover, these dramatic changes will offer significant new opportunities for investments in the underlying technologies and employment in the various industries that develop, manufacture, and maintain them.” [1]

### Definitions

For the remainder of this white paper, a **Connected Vehicle** is defined as a vehicle that has specific wireless communications technology providing additional safety features to both the vehicle and driver; with 360-degree situational awareness to address crash situations – including those, for example, in which a driver needs to decide if it is safe to pass on a two-lane road (potential head-on collision), make a left turn across the path of oncoming traffic, or in which a vehicle approaching at an intersection appears to be on a collision course. In those situations, Vehicle-to-Vehicle (V2V) communications can detect threats hundreds of yards from other vehicles that cannot be seen, often in situations in which on-board sensors alone cannot detect the threat. [2]

**Autonomous Vehicles** are those in which at least some aspects of safety-critical control function (e.g., steering, throttle, or braking) occur without direct driver input. Vehicles that provide safety warnings to drivers (forward crash warning, for example) but do not perform a control function are, in this context, not considered automated, even though the technology necessary to provide that warning involves varying degrees of automation (e.g., the necessary data are received and processed, and the warning is given, without driver input). Automated vehicles may use on-board sensors, cameras, global positioning system (GPS), and telecommunications to obtain information in order to make their own judgments regarding safety-critical situations and act appropriately by effectuating control at some level. Accordingly, for



Figure 2: Connected Vehicle Projects in North America  
Source: CAR 2012

### Connected Vehicle Projects in North America [20]

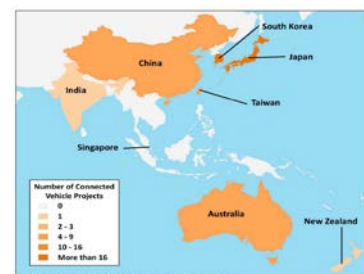


Figure 10: Connected Vehicle Projects in Asia and Oceania  
Source: CAR 2012

### Connected Vehicle Projects in Asia and Oceania [20]

purposes of this discussion, vehicles equipped with V2V technology that provide only safety warnings are not automated vehicles, even though such warnings by themselves can have significant safety benefits and can provide very valuable information to augment active on-board safety control technologies. In fact, the realization of the full potential benefits and broad-scale implementation of the highest level of automation may conceivably rely on V2V technology as an important input to ensure that the vehicle has full awareness of its surroundings. [1]



Figure 15: Connected Vehicle Projects in Europe and the Middle East  
Source: CAR 2012

### Connected Vehicle Projects in Europe[20]

#### *Current State of these Emerging Technologies*

To understand the global nature of the transportation industry, one needs only look at the nations that are currently engaged in connected and autonomous vehicle research. A brief summary of the work being undertaken or completed by the Federal Governments of the United States, European Union, United Kingdom, Japan, Taiwan, Korea, and Australia is provided.

There are multiple Original Equipment Manufacturers (OEM) working together across the continents pictured above to further define the approach for implementing connected and autonomous vehicle programs. One of the earliest examples of these pre-competitive teams can be found in 2005, when the “Crash Avoidance Metrics Partnership” (CAMP) formed as a consortia of seven OEMs, charged with working together to provide input to the U.S. Federal Government on issues from technology to policy. [3]

The SANDAG Board of Directors was informed at the 2014 Board Retreat by Jim Pisz of Toyota that the development timeline for OEMs is between five and seven years. To date, the global automotive industry has completed more than ten calendar years of in-vehicle-development, communications protocol standardization, human factors research, application analysis and testing, and finally field testing of the entire connected technology ecosystem.

To better understand the impetus behind the current national interest in connected and autonomous vehicles, one may look to the remarks made to the “House Committee on Transportation and Infrastructure Subcommittee on Highways and Transit,” by the Director of the University of Michigan’s “Transportation Research Institute” (UMTRI). UMTRI, located in Ann Arbor, are uniquely positioned to encapsulate the international perspective on connected and autonomous vehicles. They work closely with the “Big Four” OEMs through industry directed grant funding [4]; have recently completed the world’s largest field operational test of over 3,000 connected vehicles (funded by the U.S. DOT Research and Innovative Technology Administration [RITA]); and most recently have provided crucial support to the implementation of a “fake city center” in downtown Detroit for the 2014 International World Congress on Intelligent Transportation Systems. Here they will demonstrate the capabilities of multiple manufacturers’ autonomous vehicles to over 10,000 transportation professionals from around the globe.

In his submission to the House Committee, the UMTRI Director, Mr. Peter Sweatman, stated that the OEMs continue to work collaboratively with governments, standards bodies, and other OEMs. The desire to do so was driven by the fact that;

*"Historically, the auto industry has focused much of its safety effort on mitigating the impacts of a crash after it happens, and these efforts have been very successful at reducing traffic fatalities and injuries. Significant efforts have also been made to influence driver behavior, but the number of these preventable tragedies each year is still far too high, at approximately 33,000. The next giant leap in reducing the number of fatalities and injuries on our nation's roads is to prevent crashes before they happen."*[5]

Furthermore, KPMG's 2012 Report on the "Self-Driving Cars: The Next Revolution" expanded on Dr. Sweatman's comments by identifying that an additional benefit of having a National fleet of vehicles capable of avoiding accidents could mean that *"vehicles could also be significantly lighter and more energy efficient than their human-operated counterparts as they no longer need all the heavy safety features, such as reinforced steel bodies, crumple zones and airbags. (A 20% reduction in weight corresponds to a 20 percent increase in efficiency)."*[6]

The Safety Pilot, a \$14.9 million dollar Federal Highway Administration's Research and Innovative Technology Administration-funded project executed between 2011 and 2013, was conducted by the University of Michigan Transportation Research Institute. The "Safety Pilot's" stated intention was to aid the NHTSA in its determination of the effectiveness of the safety applications in real-world tests using the general population to provide feedback. The recent regulatory decision announcement, made by the NHTSA [2], indicates that under the highest levels of technical scrutiny, connected vehicle technologies have corroborated their safety benefit hypothesis.

The reader may draw from these very short paragraphs that struggle to do justice to the thousands of smaller steps that took over a decade to perform and demonstrate within the context of a full NHTSA analysis approach that would be used in the determination of whether to proceed with a regulatory recommendation to Congress or merely to add a lesser self-regulation standards guideline to the New Car Assessment Program (NCAP). That NHTSA has made the decision to proceed with the more formal regulation recommendation to Congress was summarized by NHTSA Administrator David Friedman when he stated "Decades from now, it's likely we'll look back at this time period as one in which the historical arc of transportation safety considerably changed for the better, similar to the introduction of standards for seat belts, airbags, and electronic stability control technology." [2]

Parallel to the national level "Safety Pilot" test, the Center for Automotive Research (CAR) conducted a scan on international best practices in connected and automated vehicle technologies and has registered 85 entries for Asia, 159 for Europe, and 149 for North America [7]. This report provides a summary of many of the larger projects across both Europe and Asia. Most notable of these is the European Commission-funded CAR2X project, and the scan also found that academic institutions in more than ten states across the nation have either completed or were undertaking additional research regarding particular aspects of the connected vehicle application ecosystem. Although not stated, it is intimated in this report that the federal expansion of the University Transportation Center funding [8], administered from RITA, has had the desired effect of engaging with the next generation of professionals who are likely to engage in a highly connected transportation safety, mobility and the environment vision of the future through ITS "software" to optimize our existing infrastructure.

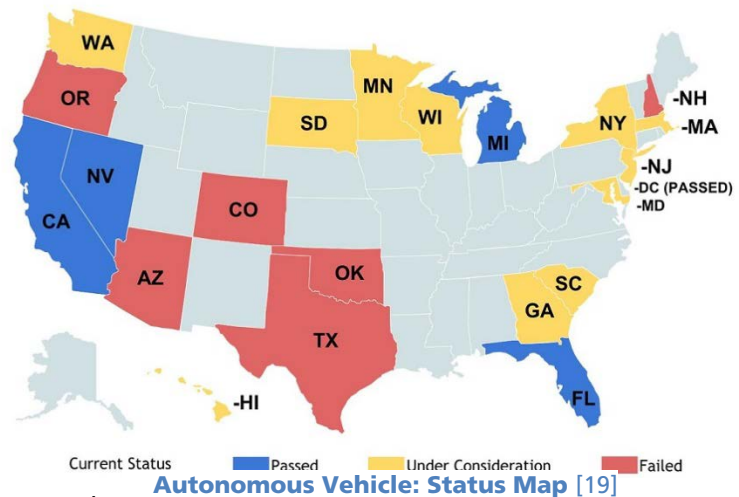
Following the successful outcomes of the CAMP consortia 'pre-competitive' role to advance the state of transportation, they have now moved on to initiate and complete the work required to

take vehicles that are connected and make them autonomous. Their preliminary program of development was recently presented at the SAE 2014 Government/Industry Meeting “Technical Session” (Code: G101)[9]. Based on the work that CAMP has undertaken and successfully completed in connected vehicle technologies, it may be conservatively estimated that similar collaboration and success will be experienced in delivering autonomous vehicle technologies.

### Public Acceptance

The advent of the autonomous vehicle is more recent in practicality. Although it could be argued that San Diego is the birthplace of the current connected and autonomous programs, after congress mandated that the “Automated Highway System” test be conducted on San Diego’s then fledgling I-15 Reversible Lanes network back in 1997; others would say that the Defense Advanced Research Projects Agency (DARPA) seeded the thoughts of achievability with their “DARPA Grand Challenge” that ran between 2004 and 2007.

An autonomous fleet of vehicles has already been widely demonstrated to hold the promise of better utilizing the capacity of our existing infrastructure. Perhaps not right immediately, but as the 1.9 million vehicles in two to three decades when the penetration rates of these technologies is high enough for technologies such as Cooperative Adaptive Cruise Control [10].



The SANDAG Board does not stand alone in its interest in delivering safer, more mobile and measurable environmental benefits to the region through the deployment of these two classes of emerging technologies. To date, 23 states have passed or are sitting in consideration of legislation to regulate the “testing” of autonomous vehicles. With the passage of Senate Bill No. 1298 (SB 1298), the California Department of Motor Vehicles (DMV) Vehicle Code was modified thusly *“This bill would authorize the operation of an autonomous vehicle, as defined, on public roads for testing purposes, by a driver who possesses the proper class of license for the type of vehicle being operated if specified requirements are met, including that the driver be seated in the driver’s seat, monitoring the safe operation of the autonomous vehicle, and capable of taking over immediate manual control of the autonomous vehicle in the event of an autonomous technology failure or other emergency.”* [11]

The DMV continues to garner public comment on the subject, with SB1298 requiring DMV to adopt regulations no later than January 1, 2015. To date, the DMV has conducted four “public comment” hearings to solicit feedback on the regulatory text. The current regulation addresses many of the insurance requirements, driver requirements, and vehicle requirements. It does however exclude heavy vehicles from testing (e.g., buses, trucks), which may prove to be at odds with the federal program for connected vehicles which is focused on the attributes of professional drivers and regulatory environment as being desirable as first deployable scenarios.



## San Diego Regional Discussion

The San Diego region, now in its third decade of recognition as a national and international market leader in the use of ITS solutions to manage traffic congestion, has at times been seen as an incubator for emerging technologies. Our region's cohesiveness at all layers, the Board's commitment to investigate emerging technologies, and our regional partnerships that have delivered results, is nationally recognized. [12]

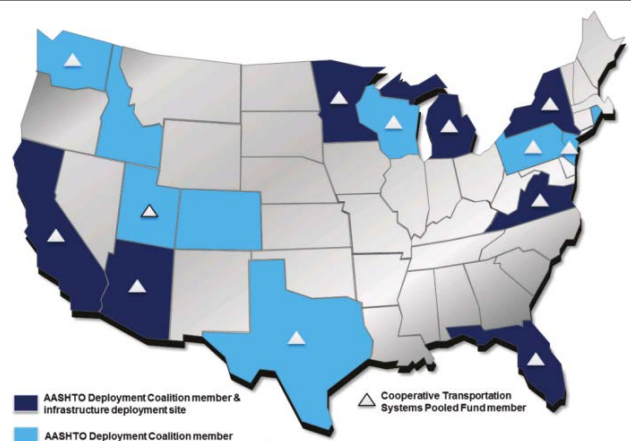
The discussion above presents a picture of the connected and autonomous technologies that may easily misconstrue the overall program as highly mature, and potentially even full of practice-ready solutions. This is not the case, and people intimately involved recognize the difficulties of the next five to ten years in continuing to mature and ever broadening set of scenarios that must reach automotive grade engineering, and be proven to be practice-ready through the six federally funded "Affiliated Test Bed" sites.

SANDAG recognizes that the pull for this technology will come partly from the bottom up. Traffic engineers who struggle with insufficient detection technologies, built upon 30-year old technology are prone to undervaluing the need to track the performance. [13] This white paper will not serve to provide the level of detail that these bottom-up decision makers will require in the future, but more information on these matters can be found by viewing a partnership between the U.S. DOT's Office of Operations and the American Association of State Highway and Transportation Officials (AASHTO) that seeks to resolve this gap.

The AASHTO "Footprint Analysis" will provide greater insight into the connected vehicle field infrastructure that may be deployed through the development of approximately ten engineering design concepts. These concepts will likely include illustrations of typical deployments at signalized intersections, urban freeways, rural roadways, international border crossings, and other locations intended to provide agencies with a better understanding of the type of systems and equipment that may be implemented. The design concepts will not serve as the plans, or specifications that agencies will ultimately require as they begin actual deployment

To be completed in October 2015, this will provide a concept for a national connected vehicle field infrastructure footprint that includes:

- Prioritized applications for state and local agencies including the data, communications, security, roadside equipment, and information service needs of each agency
- A set of design concepts and deployment gaps for approximately ten of the highest priority applications, with sufficient engineering detail to describe an operational system
- A range of scenarios that illustrate how different government entities—state, county, or municipal—would approach deployment



**State Participants in Connected Vehicle Infrastructure Planning and Deployment [21]**



- A preliminary national footprint for Connected Vehicle field infrastructure created by expanding the deployment scenarios
- An initial strategy for coordinated, phased deployment based on the scenarios and national footprint, high- lighting interoperability and institutional challenges and opportunities
- A set of deployment cost estimates including equipment, operations and maintenance, and training and staff development

Critical to the maturing of AASHTO’s deployment concepts will be the rapid and equal maturing of mobility and the environmental applications. The Federal Highway Administration’s Research and Innovative Technology Administration has established two research programs each charged with developing ten high-priority concepts, validating the achievability of these with practitioner input, simulating the application effectiveness in the scenarios detailed in the AASHTO document, and then working with the existing six research institution-based “Affiliated Test Bed” to evaluate the program outcomes in the real-world [14].



**National Affiliated Test Bed Locations**

These programs are:

- The Dynamic Mobility Applications Program: seeks to identify, develop, and deploy applications that leverage the full potential of connected vehicles, travelers and infrastructure to enhance current operational practices and transform future surface transportation systems management; [15] and
- The Applications for the Environment: Real Time Information Synthesis (AERIS) Program: has the objective to generate and acquire environmentally-relevant real-time transportation data, and use these data to create actionable information that support and facilitate “green” transportation choices by transportation system users and operators.



An important note to capture at this point is that as the global automotive community moves towards a more connected vehicle environment, the future of ITS solutions will also move towards using more transportation software that should be managed as a renewable resource able to provide adaptable strategic solutions.

As such, San Diego businesses found within the “Information Communications and Technology” (ICT) traded cluster [16] could receive a boost. This shift within our region positions ICT to grow significantly as a local transportation technology incubator, as businesses build around the local incumbents already setting the stage to take advantage of this global shift (e.g., “Qualcomm” paid

\$3.1 billion in a Merger & Acquisition for Atheros). Atheros owned the rights to the wireless technology that underpins the Connected Vehicle program (namely Dedicated Short Range Communications or DSRC [17]; and “DENSO”: one of the world’s largest suppliers of advanced automotive technology systems and components, whose North American Research and Development Laboratories are recognized Nationally as a “Connected Vehicle Qualified Product,” and their Vice President serves as the Chair of ITS America’s “Connected Vehicle Committee”). To date, ICT traded cluster demonstrates significant employment here in the region, and although dropping slightly in the latest SANDAG study, the desirable cluster attributes are seen as delivering a vibrant economy.

*Application of Connected Vehicle Technology to Public Transit*

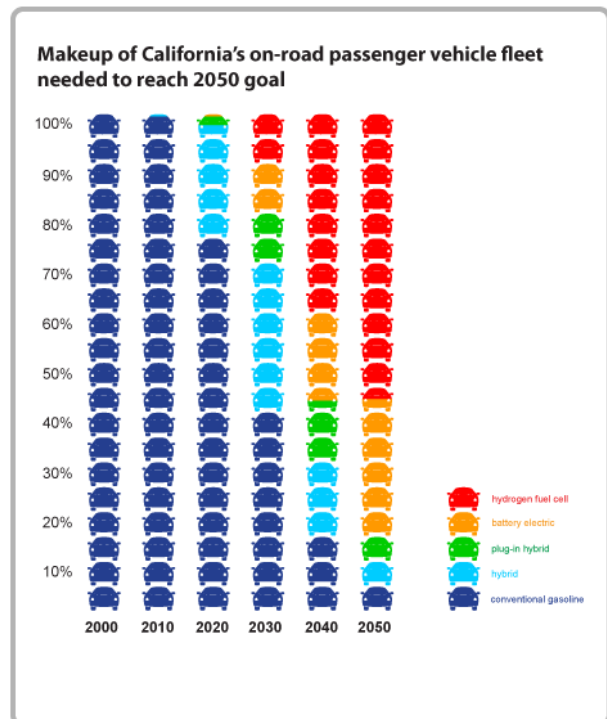
The overarching goal of the Transit Connected Vehicle for Mobility program is to improve public transportation by increasing transit productivity, efficiency, and accessibility; mitigating congestion in an integrated transportation environment; and providing travelers with better transportation information and transit services. Transit-oriented connected vehicle mobility applications support dynamic system operations and management, enable a convenient and quality travel experience, and provide an information-rich environment to meet the needs of travelers and system operators across all modes.

The following three mobility applications have been selected by the federal transit administration as high-priority applications and are collectively identified as the Integrated Dynamic Transit Operations “bundle.”

- **Connection Protection (T-CONNECT):** Enables public transportation providers and travelers to communicate to improve the probability of successful transit transfers.
- **Dynamic Transit Operations (T-DISP):** Advances the concept of demand-responsive transportation services utilizing the GPS and mapping capabilities of personal mobile devices to enable a traveler to input a desired destination and time of departure tagged with their current location when requesting transit service.
- **Dynamic Ridesharing (D-RIDE):** Makes use of in-vehicle and hand-held devices to allow dynamic ride-matching, thereby reducing congestion, pollution, and travel costs to the individual with a low initial investment.

**Alternative Fuel Vehicles**

Technology advances, market trends, consumer behavior, and government politics could lead to significant changes in California’s fuel mix by 2020. Currently, petroleum comprises 92 percent of California’s transportation energy sources, but several state policies and regulations to improve vehicle efficiency, reduce petroleum dependence, and expand the use of alternative fuels will alter this landscape. Chart 1 demonstrates how California’s



**Chart 1. California On-Road Passenger Vehicle Fleet**

on-road passenger vehicle fleet is planned to change overtime. The state goal is for 95 percent of vehicles on California roadways to be powered by alternative fuels by 2050. Car, SUV and pick-up drivers will be using vehicles powered from natural gas, electricity, biofuels and hydrogen fuel cells.

Chart 2<sup>1</sup> displays the largest greenhouse gas (GHG) reduction measures identified in the California Air Resources Board (CARB) Assembly Bill 32 Climate Change Scoping Plan. Alternative fuel and high efficiency vehicles are expected to account for 87 percent of the transportation sector’s GHG reductions statewide. In order for the state to meet its clean vehicle goals, regional planning and actions are necessary to incorporate alternative fuel infrastructure where little to none exist today.

The deployment of alternative fuel infrastructure (e.g., fueling stations and electric vehicle [EV] chargers) will need to become a consideration when planning the region’s transportation network. Recognizing this, the SANDAG Board included several recommended actions in the 2050 Regional Transportation Plan/Sustainable Communities Strategy (2050 RTP/SCS) (adopted in 2011) to begin planning for an increase in alternative fuel vehicles. Specifically, SCS Actions 21, 22 and 24 addressed alternative fuels, the transportation network, and the need for adequate infrastructure.

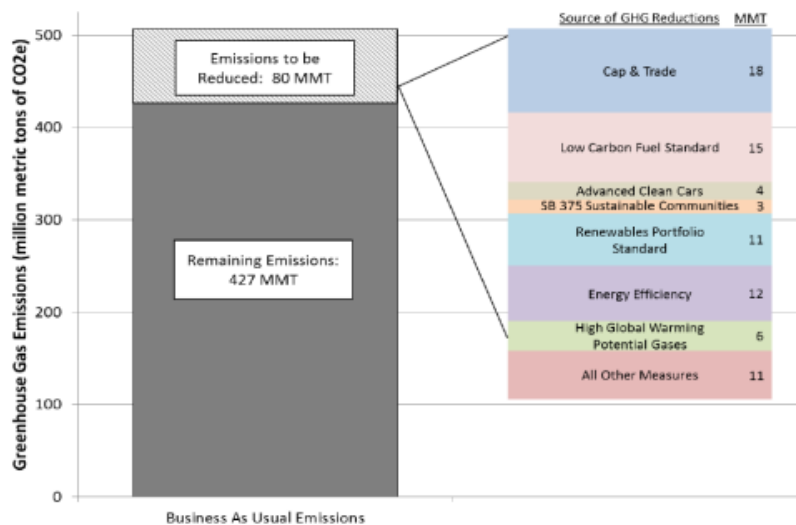
**SCS Action 21** Support planning and infrastructure development for alternative fueling stations and plug-in EV chargers.

**SCS Action 22** Develop or facilitate a regional approach to long-term planning for alternative fuel infrastructure that includes the continued development of public-private strategic alliances.

**SCS Action 24** Integrate alternative fuel considerations into the development of the regional transportation network by, for example, integrating infrastructure for EV charging into regional park-and-ride lots and transit stations.

Aside from plug-in EVs and chargers, for which the San Diego region is recognized as a national leader, the region currently has very few alternative fuel stations. Currently there are 3 stations that offer biodiesel, 8 with compressed natural gas, 1 providing liquefied natural gas, and 14 with propane in San Diego County.

As automakers offer greater numbers of vehicles powered by a variety of fuels, infrastructure must keep up to enable this market growth. For example, Honda, Toyota, General Motors, Daimler,



**Chart 2.** Statewide 2020 Greenhouse Gas Emissions and Sources of GHG Reductions

<sup>1</sup> Note: The Draft 2013 Scoping Plan Update slightly modifies the GHG reductions associated with the strategies in this chart. It will be updated when CARB releases the revised figure in spring 2014.

Hyundai, and Nissan have stated that they plan to bring hydrogen fuel cell vehicles to market in the 2015-2017 timeframe. Currently there are nine hydrogen fueling stations that are operational and open to the public in California. Support to increase alternative fuel infrastructure in the region would enable local drivers to purchase new and emerging vehicle technologies, receive state rebates, and reduce dependence on petroleum. It also could result in the most significant reduction in GHG emissions from the transportation sector.

Federal Department of Energy grants and California Energy Commission grants are available to offset costs for both alternative fuel vehicles and fueling stations. California's Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP), established in 2007 and reauthorized in 2013, will invest \$1.5 billion between 2009 and 2024 to support development and deployment of zero- and low-emission vehicles and low-carbon fuels. Utilization of the ARFVTP can help local businesses, public agencies, and universities receive a fair share of state funding.

## **E. ZERO EMISSION VEHICLE READINESS**

With California investing \$1.5 billion between 2009 and 2024 to support development and deployment of zero- and low-emission vehicles and low-carbon fuels, it can be expected that some or all of future autonomous vehicles will be powered by alternative fuels. Although fuel type will have no impact on the autonomous functions of a vehicle, access to fuel will need to be considered for these future cars, trucks and SUVs to utilize the region's roadways.

It is projected that by 2025, there will be 1.5 million zero-emission vehicles (ZEV) on California roads, creating the need for major infrastructure deployment of EV chargers and hydrogen fueling stations. Strategies to support ZEV readiness could include deploying EV charging stations at residential, commercial, public sites, and along highway corridors.

With this in mind, Washington and Oregon have created the "West Coast Electric Highway," a network of DC fast charging stations for PEVs located every 25 to 50 miles along Interstate 5 (I-5). The creators of this concept would like the Electric Highway to span the I-5 from British Columbia through California to Baja California, Mexico.

New and innovative technologies are available today that could address corridor electrification while mitigating impacts to the electric grid, GHG emissions, and economic costs for charger installations and access to adequate power. For instance, there are EV supply equipment options that can be combined with energy storage and solar canopies to create EV charging stations powered completely by the sun.

One design of this combination is having a solar canopy that provides shade for one parking space and enough solar electricity for a Level 2 charger. Another design could utilize a larger solar canopy that provides shade for eight parking spaces and enough electricity for a DC fast charger. Because the batteries are included, these EV chargers can be operated 100 percent off the electric grid and by multiple drivers every day. The San Diego County Regional Airport Authority demonstrated this technology combination in its cell phone lot in November 2013. This type of wireless charging coupled with a renewable power supply and battery storage could be utilized at park-and-rides, rest areas and other readily accessible sites along the region's freeways.

### *SANDAG's Role*

Integrating infrastructure considerations into regional transportation planning, could encourage cohesiveness among regional plans, and provide guidance on high priority locations for infrastructure such as airports, near public transportation, and alongside major routes and freeways.

Through the California Energy Commission's ARFVTP, SANDAG received a \$200,000 grant in 2012 to work with local governments and stakeholders to prepare a regional readiness plan for electric vehicles. Subsequently, SANDAG has received a \$300,000 grant to expand the EV planning effort and develop a regional readiness plan for all alternative fuels. The San Diego Regional EV Readiness Plan was accepted by the SANDAG Board in January 2014, and the alternative fuel readiness plan is anticipated to be completed in summer 2016.

In addition to alternative fuel planning, SANDAG could partner with local public and/or private stakeholders to bring additional ARFVTP funds to the San Diego region for infrastructure. Electricity, natural gas, propane, biofuels and hydrogen are the fuels automakers are using in next generation vehicles. Planning for this infrastructure will grow in importance as more vehicles are introduced to the market.

### **Solar Roadways**

An area of emerging technology that has developed over the last several years is the concept of utilizing the public right-of-way for energy generation, storage, and as a distribution system. The concept uses existing transportation right-of-way as a facility to generate energy via wind, solar, or even geo-thermal production. The Federal Highway Administration (FHWA) is leading the research and development on several fronts, including using the actual roadway as a solar array, transmission medium, and storage platform. One such pilot project that is underway at the writing of this paper includes a pilot project that uses solar panels constructed as the road material. These solar roadways collect, store and distribute electricity that can be used for road applications or can be put back into the grid as an offset for future energy consumption.

Although this is a new area of research, the potential benefits could hold promise, up to and including wireless or inductive charging of plug-in electric vehicles. One potential strategy the region could invest in is transit electric vehicles and placing re-charging stations at major transit stops and/or layovers. This would allow the region to test infrastructure charging on a limited or pilot basis, and prove that the concept has merit prior to deploying it on a larger scale for passenger vehicles.

## **F. MULTI-MODAL SYSTEM MANAGEMENT**

It is well known that this region's ground transportation network includes the collection of our freeways, arterials, local roads, transit systems, bike paths, and sidewalks. Although these elements can be identified separately, they are inter-reliant and require a comprehensive management approach to provide the foundation for managing and operating the transportation system as a unified and comprehensive network regardless of modal networks and jurisdictional/institutional boundaries.

Expanding the Regional Communications Network, a high speed inter-governmental data network, will support the San Diego region with defining, designing, and deploying specific projects (tactics).

It will also improve mobility by assessing travel conditions and providing options and feedback to the public. Expanding the Regional Communications Network would:

- Deploy Dedicated Short-Range Communications (DSRC) to support future Vehicle Infrastructure Integration (VII);
- Provide enhanced data collection for regional arterials, bike paths, and pedestrian facilities for performance monitoring; and
- Enhance the California Freeway Performance Measurement System (PeMS) to support both transit and arterial performance.

An emerging technology within Multi-modal System Management is the development and implementation of real-time multi-modal modeling and simulation applications. These applications are designed to simulate and evaluate traffic patterns and multiple/cross jurisdictional operational strategies simultaneously and produce results in minutes. The benefits from this technology include having the ability to forecast traffic patterns and recommend operational changes to minimize delays and congestion. The forecasting and real-time analysis allows transportation system managers to take proactive measures such as: modifying traffic signal timing and ramp meters, providing travelers with enhanced transit information or route information, and travel options during recurring congestion or during incidents; as well as analyzing and developing new transportation system management strategies and multi-modal action plans. Other benefits of Multi-modal System Management include:

- **Improve Situational Awareness:** Operators will realize a more comprehensive and accurate understanding of underlying operational conditions considering all networks and modes in a corridor or system.
- **Enhance Response and Control:** Operating agencies within a corridor or system will improve management practices and coordinate decision-making, resulting in enhanced management and response for minimizing congestion levels.
- **Better Inform Travelers:** Travelers will have actionable multi-modal information resulting in more personally efficient mode, time of trip start, and route decisions.
- **Improve Corridor or System Performance:** Optimizing networks at the corridor and system level will result in an improvement to multi-modal corridor performance, particularly in high travel demand and/or reduced capacity conditions.
- **Establish and develop institutional and organizational commitments** for assuring that a corridor or system is managed and operated in a multi-modal performance-based approach.

The region is working to demonstrate the benefits of this concept through the Integrated Corridor Management (ICM) Program. Specifically, under the I-15 ICM project, SANDAG has been working with its local partners (the Cities of San Diego, Poway, Caltrans, Escondido, and the Metropolitan Transit System) to maximize the use of modal networks across the I-15 corridor to improve travel times and corridor reliability. The I-15 ICM project focuses maximizing the operations and management of the I-15 corridor with ramp meters, arterial signals, and the BRT system. This project

includes integration of all transportation modal management systems currently used to operate the freeway, arterial, and transit systems along the I-15 Express Lanes corridor. Key benefits expected through the I-15 ICM project include:

- Improved corridor travel times, throughput, and reliability by allowing the implementation of coordinated, multi-agency, and modal response plans
- Improved efficiency of the transportation system by allowing all transportation modes to be managed and operated in a way in which they work together
- Enhanced real-time traveler information to include travel options and modes
- Pro-active management/prevention of congestion impacts by predicting traffic breakdowns and providing coordinated real-time response plans.

The I-15 ICM project began operations in February of 2014, and its findings and corresponding ICM applications will serve as the foundation for pursuing similar deployments along other regional corridors as part of SANDAG ICM program. Our commitment of an ICM program is a fundamental and core component of our Multi-modal System Management approach.

## **G. SMART PARKING**

The application of the Smart Parking concept is to utilize existing or emerging technologies to deliver a parking inventory management system that provides the ability to disseminate real-time parking availability information to the public, and use such information to maximize the use of parking facilities. This concept can be achieved by collecting, analyzing, and reporting parking data to attain a better understanding of how transit parking facilities are being used as a means for providing enhanced traveler information and for better managing the availability of parking in parking facilities, or particular parking spaces. The concept is a key transportation system management strategy as it places emphasis on better tracking the use of existing transit parking facilities and future transit parking facilities being considered in the San Diego Forward: The Regional Plan, and therefore providing the foundation for developing operational, management, or institutional strategies to best maximize the use and efficiency of such facilities.

The core concept of smart parking is to monitor and collect information about available parking spaces and provide such information to travelers either before they start a trip or at key decisions points along their trip. With such information, travelers can make informed decisions which all revolve around knowing if a parking space is available at a selected destination, including for example, when to start their trip, what transit service route to take, or what travel route to take.

The overall goals of smart parking can include:

- Reduce unnecessary trips for finding a parking space. This can result in time savings to travelers and reduction in fuel consumption. Any reduction in time spent driving around looking for a space can provide benefits in reducing overall transportation emissions.
- Provide travelers with improved traveler information. The ability to provide real-time parking information will supplement readily available transit data including transit route arrival and departure times and thus enhance the convenience and reliability of transit use.

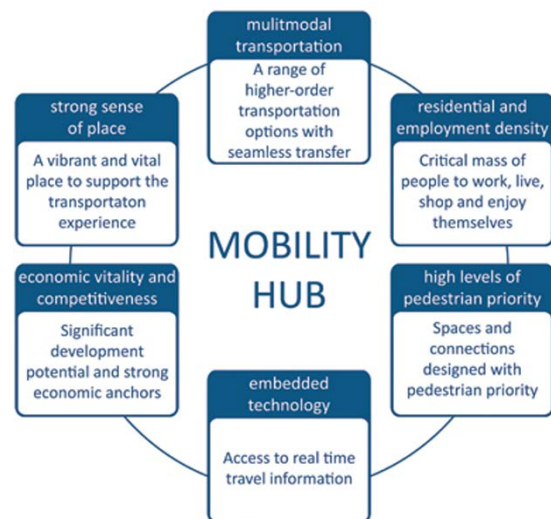
- Improve parking management capabilities through the delivery of actual parking utilization data. Understanding how to maximize the use of existing and future parking infrastructure at a minimum requires the deployment of parking infrastructure monitoring systems. The information collected through such system can be used to assess the demand of the facility and implement parking management strategies that optimize the use of the parking facility.
- Improve financial sustainability of parking operations. The ability to monitor the use of parking demand will provide the ability to gather and assess historical trends on utilization which can serve as background data for development of parking management demand based parking fee business models.

Like all transportation system management strategies, the application of Smart Parking concepts could be considered as part of and logical extension of basic transit station design efforts to assure that the initial infrastructure platform is in place and allow for the next natural step of determining how to best utilize and maximize the use of the region’s transportation infrastructure.

## H. MOBILITY HUBS

Mobility Hubs are transportation centers located at major transit stations that can provide an integrated suite of mobility options, amenities, and urban design enhancements that bridge the distance between transit and an individual’s origin or destination. They can include, but are not limited to, bikeshare, carshare, neighborhood electric vehicles, bike parking and support services, dynamic parking strategies, real-time traveler information, way finding, real-time ridesharing, and improved bicycle and pedestrian connectivity.

The Greater Toronto and Hamilton Area Regional Transportation Plan, “The Big Move,” calls mobility hubs much more than a transit station, but a seamless part of the landscape. A strategically located center of activity combining opportunities for work, play, and life that are connected to other centers with key aspects as illustrated in the Mobility Hub graphic below.



**The Big Move Mobility Hubs**

community which includes retail, shopping, restaurants, and entertainment, all part of a wider connection to service of the region at large through commuter rail, light rail or bus rapid transit.

Some of these first / last mile solutions could include shared use vehicles such as bikes, electrified cars, or other single-person conveyances.<sup>2</sup>

<sup>2</sup> The Big Move, The Regional Transportation Plan of Greater Toronto and Hamilton. 2008, updated 2014, Metrolinx. <http://www.metrolinx.com/en/>



## **I. UNIFIED TRANSPORTATION PAYMENT**

A unified or universal transportation account combines all forms of public transportation payment including transit fares, municipal parking, and toll collection into a single user-friendly interface. The goal is to influence mode shift from a single occupancy commute to a transit ride by incentivizing the user through the use of rewards, toll discounts, or gamification – a method of challenging the user where points are earned for reach a goal.

This is a single platform that links and coordinates all multi-modal transportation-related activities (parking, tolls, smart cards, transit passes, bank issued IDs, transponders, smartphone, license plates, etc.) in one open payment account system, making for a seamless and convenient commuting experience. Such a platform could facilitate mobility on demand, and reduce the friction that sometimes prevents commuters from periodic use of travel alternatives, thus enabling users to select the mode of travel that best fits their needs for a particular trip, through a convenient and common payment system. The platform could evolve to support the distribution and use of incentives, enabling a user to amass reward credits, based on usage of a particular travel mode (e.g., bikeshare) and used at a later time for a trip on public transit.

A Universal Transportation Account can be at the heart of a connected city concept where the transportation user is in constant connection with the transportation network and is given the best options for traveling based on criteria that are most important to that user whether that is cost, convenience, speed, or environmental impact.

## **J. CURRENT AND EMERGING TECHNOLOGIES FOR TRANSIT AND ACTIVE TRANSPORTATION**

### **Transit Signal Priority**

Transit Signal Priority (TSP) uses GPS along with bus route schedules and real-time performance data to request priority treatment at particular intersections, as necessary. For example, if a transit vehicle is running behind schedule, the TSP system will request priority treatment at equipped intersections to speed up the service. The benefits of TSP include a more reliable transit trip by giving the transit vehicle an extended green light or a truncated red light at the intersection. (Nasar, 2013) [22].

### **Transit / Pedestrian Collision Warning**

Fatal collisions between buses and pedestrians have seen a sharp uptick in the last decade. While the causes for such an increase are varied, one primary source of the trend is the rise of a phenomenon known as "distracted walking," which occurs when pedestrians are distracted from the primary task of walking by such devices as iPods, cell phones, and other forms of electronics.

GPS signals and onboard gyroscopes and accelerometers can be integrated to analyze the bus motion during turning. These sensors together with various sensor technologies such as laser detectors, sound detectors, and conventional cameras, will be evaluated to provide better detection and distance estimation of nearby pedestrians.

## **Bicycle Assist Technologies**

Bicycle assist technologies, such as bike electrification or particular bike-lift systems, could make this alternative mode of transportation more accessible to all populations, and particularly older populations and very young populations, given the hilly terrain of the San Diego region.

Electric bikes include a range of technologies from full-time powered bikes using batteries and electric motors to assistive technologies that can be employed under certain conditions, such as climbing hills. Different than electric bikes, bike-lift systems are seen as measures to make certain streets or roads more accessible to all types of self-powered bicycles. For example, a bike-lift system is installed as part of a steep roadway and the bicyclist attaches their bike to the conveyance for the duration of the lift to make hill-climbing easier. These bicycle assist technologies can help provide greater access to a wide variety of localized land uses, as well as to transit station areas that can help facilitate longer-distance multi-modal trips.

## **K. OTHER EMERGING TECHNOLOGY TRENDS**

This section explores other emerging technologies, technologies that as the transportation planning agency, SANDAG and the region typically do not have responsibility for delivering. However, this category of emerging technologies could have an impact on transportation demand, travel choices, and system accessibility.

### **Virtual Office**

Over the last decade, technologies and tools have advanced to make teleworking a viable reality. Continued advances in communication, virtual reality, and possibly 3D printing will make remote working even more of a reality. A possible future could have teams of workers collaborating in much greater ways beyond sharing files and video conferencing; able to physically interact with objects over distances. Advancements in this area could further reduce travel demand and lessen the need for additional transportation infrastructure.

### **Parking Guidance**

Major advances in parking guidance and parking management systems have been made over the past several years. Valuable time and energy is expended in finding available parking in urban cores. One category of emerging technology combines real-time parking inventory data with personal technology such as smart phones to guide transportation users to available parking. Using sensors, new meters, and real-time park data feeds will help derive efficiencies, reduce time and wasted fuel spent idling or circling city blocks to find an available space. One study has indicated an increase in parking utilization during peak hours and decrease of up to 56 percent vehicle carbon emissions by people that are able to quickly and efficiently locate, reserve, and secure a parking spot.<sup>3</sup>

### **Traveler Information**

Traveler information systems have advanced significantly in the last several years and include real-time and predicative data delivered directly to a user's smart phone or tablet in an easy to read

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<sup>3</sup> Source: Park Assist, 2014, <http://www.parkassist.com/>

format – typical with an interactive map. Emerging technology in this field could have greater depth of information, customized to alert travelers both prior to start of commute or while in route to increase travel reliability and reduce overall congestion. SANDAG completed a Border Wait Times Study and market assessment to identify commercially available ITS technologies capable of automatically measuring, monitoring, and reporting border crossing wait times of commercial vehicles. Strategize and expand on the previous study to deploy ITS technologies that can be used to measure, monitor, and report border wait times at U.S./Mexico border crossings and provide real-time information updates to travelers. Available data could be much more than mode or route choices, and include personal options such as cost, availability, travel times, and energy consumption.

### **Shared-use Mobility**

Shared-use mobility is a convenient alternative for closing first mile/last mile gaps and providing commuters who use alternative transportation with a reliable option to make other trips. The “shared” in shared-use mobility refers to shared ownership of the service or program versus individual ownership (i.e., individual car or bike ownership.) Examples of shared use mobility include carsharing, bikesharing, real-time ridesharing, Transportation Network Companies (like Uber, Lyft, and Sidecar) that provide on-demand ride services that users can request by using smartphone applications, scooter share, shared electric vehicles, and shuttle services.

### **Personal / Wearable Technology**

This emerging technology category has seen significant growth in the last few years with advent of smart phones, tablet computers, and most recently with the Google Glass® project. The increased computing power combined with ever-present high-speed data communication and information is now more than ever delivering readily-available traveler information, virtual or enhanced reality, and services that could impact travel demand. SANDAG and local government role could consist of supporting open data access, promoting telework options, or encouraging development of travel specific applications and programs.

## **L. POLICIES AND INVESTMENTS**

The following are potential policy or investment scenarios that could capitalize on emerging technologies in a manner that reduce travel demand and energy consumption, all while promoting the safety of the transportation network.

### **Transportation Demand Management**

Managed by SANDAG, iCommute is the Transportation Demand Management (TDM) program for the San Diego region. TDM refers to programs and strategies that manage and reduce traffic congestion by encouraging the use of transportation alternatives rather than driving alone, such as walking, biking, taking transit, carpooling, vanpooling, working flexible schedules, and teleworking. These programs reduce overall vehicle miles traveled, make more efficient use of the existing transportation network, and maximize movement of people and goods. An individual traveler’s mode choice - be it auto, carpool, vanpool, transit, walking, or biking - is significantly influenced by how communities are designed and developed. Smart growth development can reduce the need for vehicle travel for daily trips, and available parking supply and/or pricing can encourage the use of alternative modes of transportation.

Inclusion of TDM in the local planning and development process offers a broad range of economic, environmental, and public health benefits. TDM:

- *Maximizes returns on infrastructure investments* – TDM reduces the need for new or widened roads, which are costly to construct and maintain. Additionally, TDM is a cost-effective way to build capacity in a community’s transportation system by expanding use of alternative modes (carpools, vanpools, transit, biking, walking, and teleworking).
- *Reduces parking demand* – TDM, when incorporated into development, reduces single occupant vehicle (SOV) trips and parking demand, decreasing the cost and burden for jurisdictions and developers to provide more parking capacity.
- *Helps meet environmental and air quality goals* – TDM improves air quality by encouraging commute alternatives to the SOV, which in turn reduces traffic congestion and corresponding vehicle-related emissions. TDM also can help to preserve green space by reducing the amount of land needed for roads and parking facilities, encouraging more efficient land use patterns, and decreasing storm water management costs.
- *Is adaptable and dynamic* – TDM can be customized for specific events, neighborhoods, corridors, worksites, and timeframes. Unlike new infrastructure, TDM programs can easily adapt and respond to economic and population changes

Technology plays a key role in delivering TDM solutions including car and vanpool ride matching software, mode choice driven by traveler information, parking reservation and guidance systems, reservation and payment for shared-use vehicles, just to name a few. As technology continues to grow and evolve, more innovative means of offsetting travel demand can be deployed with less cost and impact as compared to traditional capacity increasing capital infrastructure projects.

### **Active Transportation**

One of the commitments from the 2050 RTP/SCS calls for planning a broad Active Transportation program, including a regional bike network, Safe Routes to School and Safe Routes to Transit. In April 2013, staff presented to the Transportation Committee a proposed framework for this program. The strategy proposed to identify active transportation components associated with SANDAG transit and freeway corridor projects for consideration in the Regional Plan. This approach would help to maximize investments in transit and highway infrastructure, by enhancing safety, and improving bicycle and pedestrian access to transit. The Unconstrained Active Transportation program includes the Regional Bike Plan projects, regional programs, local bike projects, local pedestrian/safety/traffic calming projects, Safe Routes to School, Safe Routes to Transit, and retrofit projects for Safe Routes to Transit and highway interchanges.

Emerging technologies can play a role in promoting Active Transportation including SANDAG complete streets initiatives. This can begin with enhanced detection at the intersection for pedestrians, bicycles, or other forms of non-motorized transportation. Given advanced detection, specialized signal treatments can be added such as queue-jumping for pedestrians or cyclists.

## **Open Data**

In the last several years there has been a concerted effort to move government-developed proprietary management system to an open data platform. The reasoning behind this move is two-fold. First, open data standards promotes competition for transportation technology systems allowing those system to more seamlessly and easily upgrade as those system reach end-of-life. Second, by adopting open-data standards, agencies such as SANDAG move from the application development role into a data management role allowing the private industry to use the wealth of available information to provide robust publically available applications. One good example of this trend is in the General Transit Feed System, developed by Google, which is quickly replacing multiple transit agencies proprietary systems for public time tables publishing allowing third-parties including Google to reach a wider audience all while providing world-class applications.

In January 2014, the Transportation Research Board hosted a transportation open data conference titled "TransportationCamp DC 2014" in hopes of stimulating the development of programs and applications by the private industry for the benefit of the traveling public.

SANDAG and the region could adopt Open Data Principles geared around these concepts which could include the following as provided by the Government Open Data Consortium<sup>4</sup>:

- Data Completeness
- Primary Data from Direct Sources
- Data Timeliness
- Data Accessibility
- Machine Processable Data
- Data Availability
- Non-Proprietary Data
- Data without Licensing

## **Parking Management Toolbox**

The goal of the Parking Management Toolbox is to provide a resource to local jurisdictions that will evaluate the effectiveness of a wide range of parking management strategies for addressing specific challenges in varied community types and special uses. The toolbox will feature a range of case studies that provide best practices for managing parking in a variety of urban and suburban settings. The toolbox will ultimately be developed into an interactive, web-based resource that will assist interested jurisdictions with designing customized parking management strategies.

The draft Parking Management Toolbox is expected to be completed by the summer of 2014 and will delineate the design and structure of a future website that translates the document into an interactive, web-based tool. The web-based tool is expected to be deployed by December 2014.

The toolbox could be leveraged to develop regional and sub-regional parking policies that maximize available locations' utilization. Technology can be used to offer access to available parking and, if payment is part of the transaction, can be managed as part of a universal transportation account.

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<sup>4</sup> Source: Open Government Data Principles, 2008, <http://opengovdata.org/>

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