

Climate Change

WHITE PAPER

THE SAN DIEGO ASSOCIATION OF GOVERNMENTS

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Introduction

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

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

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

Greenhouse Gas Emissions in the San Diego Region

Periodically, SANDAG completes a comprehensive GHG emissions inventory for the San Diego region. The inventory identifies and quantifies the sources of GHG emissions and allows for monitoring over time. In 2012, emissions totaled approximately 35 million metric tons of carbon dioxide equivalent (MMT CO_2e). As seen in Figure 1, passenger vehicles make up the largest source of GHG emissions in the region, followed by electricity, then natural gas. This inventory will be updated with a 2016 baseline for the 2019 Regional Plan.

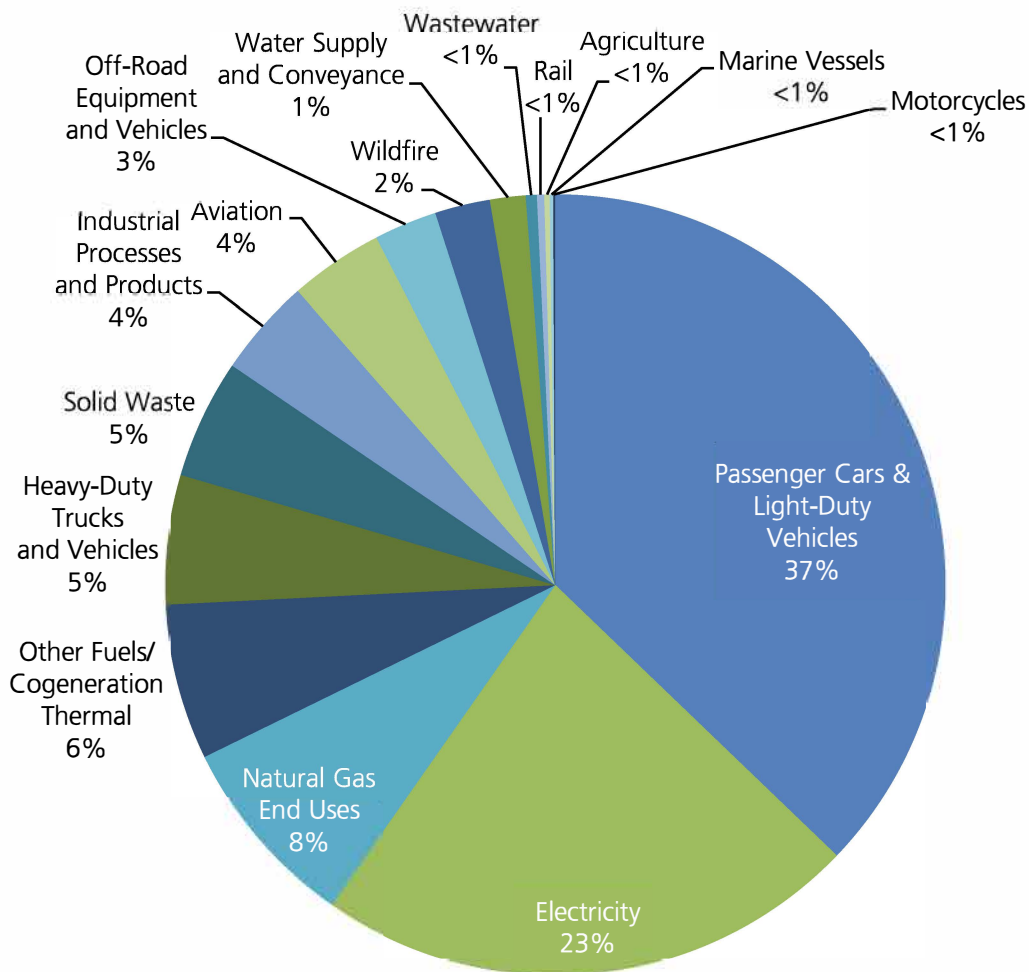


Figure 1: GHG Emissions Inventory for the San Diego Region 2012¹

Climate Change Impacts in the San Diego Region

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

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

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

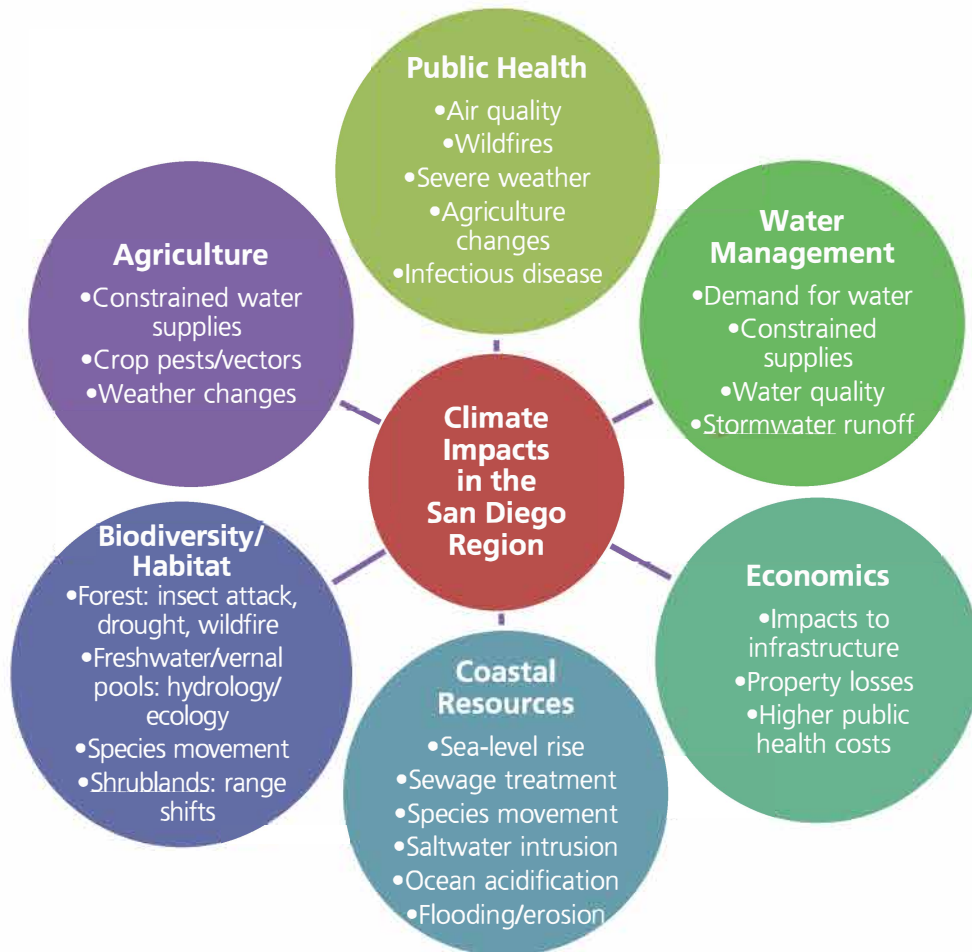


Figure 2: Climate Impacts in the San Diego Region

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

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

California’s Strategy for Reducing Greenhouse Gas Emissions

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

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

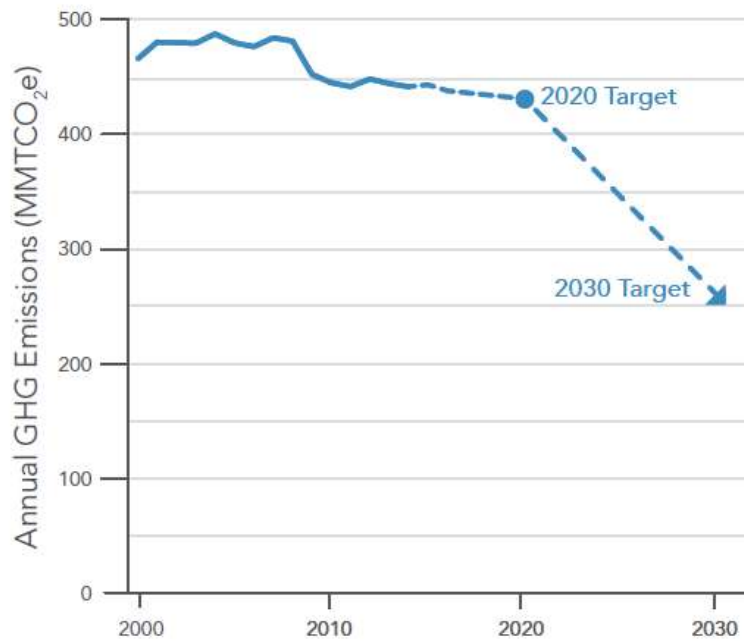


Figure 3: California GHG Emissions and Reduction Targets³

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

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

- Mobile Source Strategy (Cleaner Technology and Fuels Scenario) to reduce GHGs and other pollutants from the transportation sector through transition to zero-emission and low-emission vehicles, cleaner transit systems, and reduction of vehicle miles traveled (VMT):
 - 1.5 million zero-emission vehicles (ZEVs) including plug-in hybrid electric, battery-electric, and hydrogen fuel cell vehicles by 2025; 4.2 million ZEVs by 2030
 - Continue ramp-up of GHG stringency for all light-duty vehicles beyond 2025
 - Reductions in GHGs from medium- and heavy-duty vehicles via the Phase 2 Medium- and Heavy-Duty GHG Standards
 - Innovative Clean Transit: Transition to a suite of innovative clean transit options. Assumed 20 percent of new urban buses purchased beginning in 2018 will be zero-emission buses with the penetration of zero-emission technology ramped up to 100 percent of new bus sales in 2030. Also, new natural gas buses, starting in 2018, and diesel buses, starting in 2020, meet the optional heavy-duty low-oxides of nitrogen (NOx) standard.
 - Last-Mile Delivery: New regulation that would result in the use of low-NOx or cleaner engines and the deployment of increasing numbers of zero-emission trucks primarily for class 3-7 last-mile delivery trucks in California. This measure assumes ZEVs comprise 2.5 percent of new Class 3-7 truck sales in local fleets starting in 2020, increasing to 10 percent in 2025.
 - Reduction in VMT to be achieved in part by continued implementation of Senate Bill 375 Sustainable Communities and Climate Protection Act (Steinberg, 2008) (SB 375) and regional Sustainable Communities Strategies; forthcoming implementation of Senate Bill 743 Environmental Quality (Steinberg, 2013); and potential additional VMT-reduction strategies not specified in the Mobile Source Strategy, but included in the document “Potential VMT Reduction Strategies for Discussion” in Appendix C.

- Senate Bill 1383 Short-Lived Climate Pollutants (Lara, 2016) (SB 1383) strategy to reduce highly potent GHGs:
 - 40 percent reduction in methane and hydrofluorocarbon emissions below 2013 levels by 2030.
 - 50 percent reduction in anthropogenic black carbon emissions below 2013 levels by 2030.

- California Sustainable Freight Action Plan to improve freight efficiency, transition to zero-emission technologies, and increase competitiveness of California’s freight system:
 - Improve freight system efficiency by 25 percent by 2030
 - Deploy over 100,000 freight vehicles and equipment capable of zero-emission operation and maximize both zero- and near-zero-emission freight vehicles and equipment powered by renewable energy in 2030

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

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

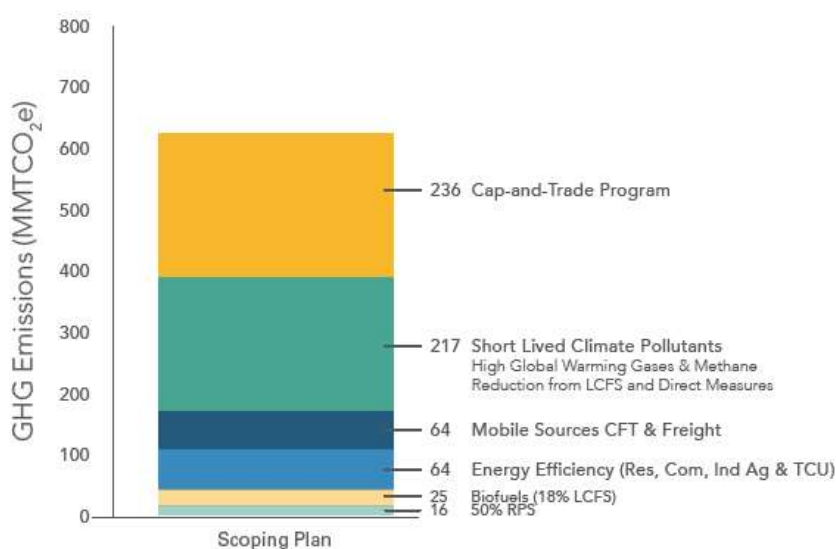


Figure 4: 2017 Scoping Plan Scenario – Estimated Cumulative Reductions by Measure (2021-2030)⁴

State Greenhouse Gas Reduction Goals for the Passenger Vehicle Sector

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

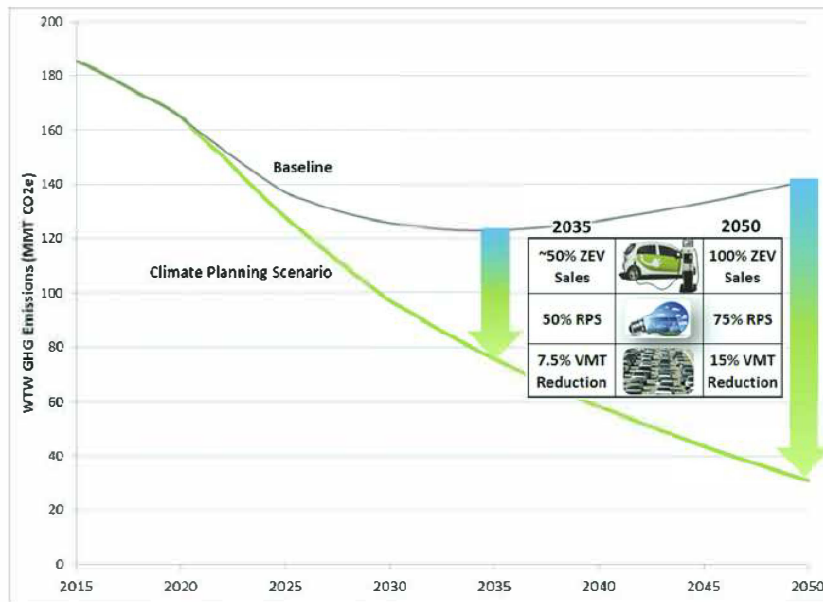
Updated Final CARB Staff Report, Proposed Update to the SB 375 Greenhouse Gas Emission Reduction Targets, February 2018, pp. 14-16:

The 2017 Scoping Plan relies on strategies in every single sector that are more aggressive than currently adopted regulations and policies. These include substantially greater increases in sales of zero-emission vehicles (ZEVs), greater increases in fuel efficiency standards for gasoline vehicles, continued decarbonization of energy, additional efficiencies in building and industrial energy efficiency, reductions in short lived climate pollutants, continuing the Cap-and-Trade program, and a reduction in growth of statewide VMT.

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

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

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



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

Figure 6: Statewide On-Road GHG Emissions

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

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

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

Regional and Local Planning for Climate Change

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

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

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

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

Climate Change in the 2015 Regional Plan

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Climate Action Planning in the San Diego Region

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

Table 1

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

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

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

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

In addition, the 2017 Scoping Plan recommends that local plans use statewide targets consistent with statewide emission limits and the Under2 Memorandum of Understanding⁹ of no more than six metric tons CO₂e per capita by 2030 and more than two metric tons CO₂e per capita by 2050, and that local government "emissions inventories and reduction goals should be expressed in mass emissions, per-capita emissions, and service population emissions." It goes on to explain that local CAPs should be based on "evidence-based local per-capita goals based on local emissions sectors and population sectors" since the statewide per-capita targets are based on all emissions sectors in the state. CARB recommends that the GHG-emissions trajectory within a local CAP "show a downward trend consistent with statewide objectives." CARB's recommendations for community-wide goals expand upon the reduction of 15 percent from "current" (2005 to 2008) levels by 2020 as recommended in the 2008 Scoping Plan.

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

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

Greenhouse Gas Reduction Strategies by Sector

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

Reducing Emissions from Transportation Sector

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

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

California's Strategy for Reducing Emissions from Transportation

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

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

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

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

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

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

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

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

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

SANDAG Role in Reducing Emissions from Transportation

Please see the “Climate Change in the 2015 Regional Plan” section for a discussion of the many strategies in 2015 Regional Plan that support GHG emissions in the transportation sector. SANDAG also supports the State’s strategies for ZEVs and low-carbon fuels in the region. Since 2012, SANDAG has provided a forum for local governments and other regional stakeholders to address barriers to deploying alternative fuel vehicles and siting charging and fueling stations. In 2014, SANDAG completed a regional readiness plan for plug-in electric vehicles (EVs) and charging stations.¹⁰ This effort was expanded to planning for all alternative fuels, with a regional alternative fuel plan completed in 2016.¹¹ With funding from the California Energy Commission, SANDAG is implementing the readiness plan for EVs by providing technical assistance to property owners and other potential EV-charging station hosts and performing a regional needs assessment for publicly

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

Local Government Role in Reducing Emissions from Transportation

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

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

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

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

Reducing Emissions from Land Use

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

California's Strategy for Reducing Emissions from Land Use

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

Plan will outline a pathway to increase carbon sequestration and avoid emissions, with a goal of reducing emissions by 15 to 20 MMTCO₂e by 2030, as identified in the 2017 Scoping Plan. The California Natural and Working Lands Carbon Model will be used to analyze the GHG impacts in the Implementation Plan.

SANDAG Role in Reducing Emissions from Land Use

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

Local Government Role in Reducing Emissions from Land Use

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

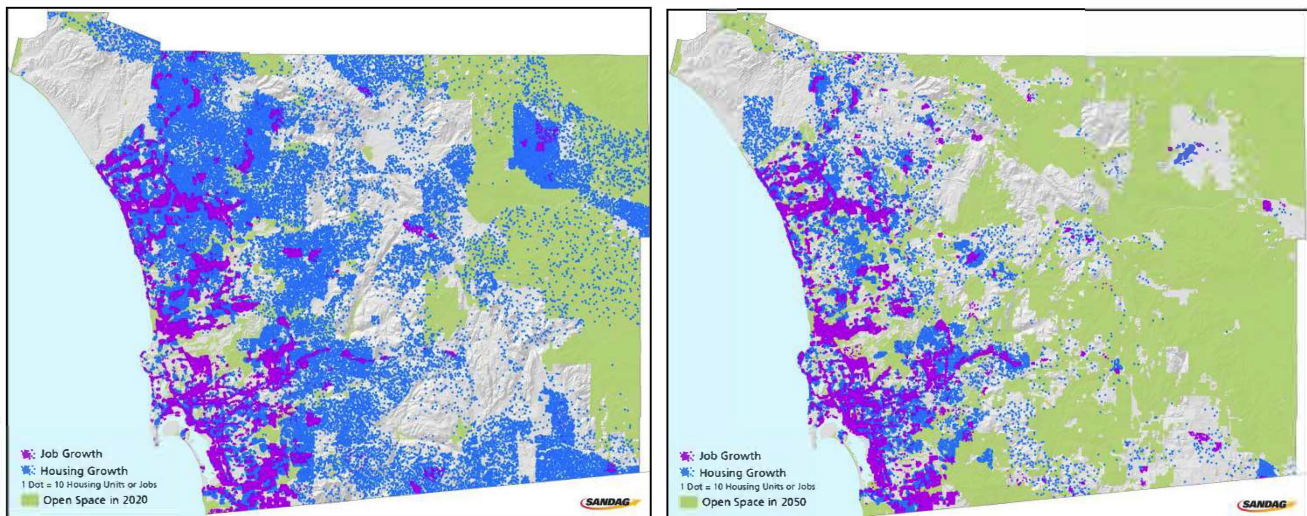


Figure 7: Comparison of Housing and Job Growth Projected in 1999 vs. 2013¹²

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

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

Reducing Emissions from Electricity

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

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

California's Strategy for Reducing Emissions from Electricity

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

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

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

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

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

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

SANDAG Role in Reducing Emissions from Electricity

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

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

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

Energy engineering services include:

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

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

Climate planning services include:

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

Local Government Role in Reducing Emissions from Electricity

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

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

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

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

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

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

Reducing Emissions from Natural Gas End Use

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

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

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

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

SANDAG Role in Reducing Emissions from Natural Gas End Uses

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

Local Government Role in Reducing Emissions from Natural Gas End Uses

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

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

Reducing Emissions from Water Sector

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

California's Strategy for Reducing Emissions from Water Sector

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

SANDAG Role in Reducing Emissions from Water Sector

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

Local Government Role in Reducing Emissions from Water Sector

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

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

Reducing Emissions from Solid Waste

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

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

Strategies to Prepare for Climate Change Impacts

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

Climate Change Impacts to the San Diego Region

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

Expected Climate Impacts to the San Diego Region by 2050

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

California Climate Adaptation Planning

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

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

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

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

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

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

Ocean and Coastal Resources

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

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

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

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

Extreme Heat

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

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

Wildfire

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

Biodiversity/Habitat

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

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

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

Water Management

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

SANDAG Adaptation Planning Efforts

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

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

Considering Climate Change Impacts on Transportation Infrastructure

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

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

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

Shoreline Preservation

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

Habitat Conservation

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

Local Government Role in Adaptation Planning

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

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

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

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

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

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

Interrelationships to Other Policy Areas

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

Economics and Climate Change

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

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

Assessing and preparing for vulnerabilities of drought and severe weather now can have substantial economic benefits in the future. Climate change has the potential to present substantial costs to the San Diego region, from severe impacts of sea-level rise and increased storm activity on the region’s oceanfront to the impact on energy-needs, agricultural disruption, and public health. There is considerable uncertainty as to the timing and severity of these impacts, and to our ability to avoid them, mitigate them, and/or adapt to them should they occur to any substantial degree. Technological and engineering solutions of varying cost and effectiveness could mitigate many of the effects, but it is likely that behavioral changes may be required as well. To begin analyzing the cost effectiveness of various coastal adaptation strategies, the Resilient Coastlines Project of Greater San Diego²⁴ partnered with Nexus Planning to road-test a National Oceanic and Atmospheric Administration (NOAA) cost-benefit evaluation tool for sea-level rise scenarios at the local level. Weighing the varying costs, benefits, and economic impacts of coastal resilience strategies may help inform local decision-making and justify early and cost-effective investments to protect coastal communities from future sea-level rise and storm impacts.

Public Health, Social Equity, and Climate Change

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

Greenhouse Gas-Reduction Strategies and Potential Co-Benefits

Strategy to Reduce Greenhouse Gas Emissions	Potential Health/Social Equity Co-Benefits²⁵
Reduce vehicle miles traveled	<ul style="list-style-type: none"> • Reduce air pollution • Increase physical activity • Reduce chronic disease such as asthma and heart disease • Improve mental health • Improve access to low-cost alternative transportation options
Increase fuel efficiency and use of cleaner fuels in vehicles	<ul style="list-style-type: none"> • Reduce air pollution
Reduce emissions through land-use changes such as more compact growth	<ul style="list-style-type: none"> • Increase physical activity • Reduce chronic disease • Increase local access to essential services such as affordable housing, jobs, and amenities • Enhance safety for biking and walking with reduced vehicle speeds and reduced collisions
Reduce residential building energy and water use	<ul style="list-style-type: none"> • Reduce household energy costs (especially beneficial for low-income households) • Promote healthy homes • Create local green jobs • Promote cooler communities through shade trees and cool pavements
Urban greening	<ul style="list-style-type: none"> • Reduce temperature and urban heat island health effects • Reduce air pollution • Reduce noise • Enhance safety
Biodiversity conservation	<ul style="list-style-type: none"> • Promote ecosystem services (clean air and water) • Enhance access to open space and recreation

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

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

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

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

Emerging Technologies

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

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

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

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

Key Mobility Trends and Greenhouse Gas-Related Considerations

Key Mobility Trends	Description	Greenhouse Gas-Related Considerations
Mobility as a Service	<ul style="list-style-type: none"> • On-demand rideshare • Bikeshare • Carshare • Public transit • Microtransit 	<ul style="list-style-type: none"> • Decreased vehicle ownership • Shared mobility trips replace single-occupant trips <i>and</i> transit trips • VMT impacts are unclear
Vehicle Technologies	<ul style="list-style-type: none"> • ZEVs • Autonomous vehicles (AVs) • Connected vehicles 	<ul style="list-style-type: none"> • AVs could increase VMT and urban sprawl without policy intervention • Automakers intend to produce electric AVs • Roads may accommodate more vehicles
Smart Cities and Transportation Systems	<ul style="list-style-type: none"> • Transportation System Management and Operations 	<ul style="list-style-type: none"> • Collection and distribution of data • Integration of energy, transportation, and other systems

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

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

SANDAG Plans and Programs

Regional Energy Strategy (2009, 2014 Technical Update)

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

Climate Action Strategy (2010)

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

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

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

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

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

Transportation Demand Management Program, iCommute Commuter Services

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

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

San Diego Region Intelligent Transportation Systems Strategic Plan (2011)

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

Regional Alternative Fuel Planning

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

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

Regional Plug-in Electric Vehicle Planning

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

Energy Roadmap Program

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

Energy engineering services include:

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

Climate planning services include:

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

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

Sub-Regional Energy Action Collaboratives

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

The sub-regional energy action collaboratives are:

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

SANDAG Green Operations Manual

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

TransNet Smart Growth Incentive Program and Active Transportation Grant Program

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

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

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

Regional Transit-Oriented Development Strategy

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

Regional Collaborations

San Diego Regional Climate Collaborative

The San Diego Regional Climate Collaborative²⁶ (Climate Collaborative) is a network for public agencies that serve the San Diego region by sharing expertise, leveraging resources, and advancing comprehensive solutions to facilitate climate change planning. By partnering with academia, non-profit organizations, and business and community leaders, the Climate Collaborative also works to raise the profile of regional leadership on addressing potential impacts from climate change. The Climate Collaborative was established as part of the CPUC-funded LGPs among SDG&E and the Cities of Chula Vista and San Diego, the County of San Diego, the Port of San Diego, the University of San Diego, and SANDAG. Additional Climate Collaborative members include the San Diego Foundation, the San Diego County Regional Airport Authority, and several local jurisdictions within the region. The Climate Collaborative hosts trainings, workshops, and networking opportunities for local governments to share best practices and information about climate initiatives across the region and state.

Climate Science Alliance – South Coast

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

Resilient Coastlines Project of Greater San Diego

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

Regional Sea-Level Rise Working Group

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

San Diego Regional Energy Partnership

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

Climate Education Partners

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

Acronyms

AB 32	Assembly Bill 32 (2006), The Global Warming Solutions Act
CAP	Climate Action Plan
CARB	California Air Resources Board
CCC	California Coastal Commission
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CHP	Combined heat and power
CPUC	California Public Utilities Commission
EMP	Environmental Mitigation Program
GHG	Greenhouse gas
IOU	Investor-owned utility
ITS	Intelligent Transportation Systems
LCFS	Low Carbon Fuel Standard
LGP	Local Government Partnership
Low-CI	Low carbon-intensity
MMTCO ₂ e	Million metric tons of carbon dioxide equivalent
MPO	Metropolitan Planning Organization
MSP	Management Strategic Plan
MW	Megawatt
OPR	Governor's Office of Planning and Research
PEV	Plug-in electric vehicle
RES	Regional Energy Strategy
REVI	San Diego Regional Electric Vehicle Infrastructure Working Group
RPS	Renewable Portfolio Standard

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

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- ⁴ California Air Resources Board, *California's 2017 Climate Change Scoping Plan*, November 2017.
- ⁵ California Air Resources Board, 2018. Updated Final Staff Report, *Proposed Update to the SB 375 Greenhouse Gas Emission Reduction Targets*, February 2018, p. 14.
- ⁶ See California Air Resources Board, Public Meeting to Hear Proposed Update to Senate Bill 375 Greenhouse Gas Emission Reduction Targets – Staff Presentation, March 23-24, 2017, Slides 27-34, <https://www.arb.ca.gov/board/books/2017/032317/17-3-7pres.pdf>.
- ⁷ California Air Resources Board, *California's 2017 Climate Change Scoping Plan*, November 2017, p. 101.
- ⁸ California Air Resources Board, *California's 2017 Climate Change Scoping Plan*, November 2017, p. 101.
- ⁹ The Memorandum of Understanding on Subnational Global Climate Leadership (Under2 MOU) brings together states and regions willing to commit to reducing their GHG emissions by 80 to 95 percent, or to limit emissions to 2 metric tons CO₂-equivalent per capita, by 2050. As of October 2017, 188 jurisdictions had joined California in the Under2 MOU.
- ¹⁰ San Diego Regional Plug-in Electric Vehicle Readiness Plan is available at: http://www.sandag.org/uploads/publicationid/publicationid_1817_17061.pdf.
- ¹¹ San Diego Regional Alternative Fuel Readiness Plan is available at: http://www.sandag.org/uploads/projectid/projectid_487_20274.pdf.
- ¹² Projected housing and job growth in 1999 (left) and 2013 (right) based upon the SANDAG Series 9 and 13 Regional Growth Forecasts.
- ¹³ California Energy Commission, Comprehensive Energy Efficiency Program for Existing Buildings: <http://energy.ca.gov/ab758/>.
- ¹⁴ California investor-owned utilities are San Diego Gas & Electric, Pacific Gas & Electric, Southern California Electric, and Southern California Gas.
- ¹⁵ A megawatt is equal to 1,000 kilowatts or one million watts. One megawatt is enough electrical capacity to power about 1,000 average homes in California.
- ¹⁶ California Energy Commission. December 2017. Tracking Progress. Renewable Energy – Overview. http://www.energy.ca.gov/renewables/tracking_progress/documents/renewable.pdf.
- ¹⁷ This figure references the “likely range” of sea-level rise for 2050 based on data from the La Jolla tide gauge, Table 1(c) from *Rising Seas in California: An Update on Sea-Level Rise Science*.
- ¹⁸ Safeguarding California (2018), Available at: <http://resources.ca.gov/climate/safeguarding/>.
- ¹⁹ These projections reference the “likely range” of sea-level rise based on data from the La Jolla tide gauge, Table 1(c), from *Rising Seas in California: An Update on Sea-Level Rise Science*. The 2100 estimates reference projections from three future GHG emission scenarios (RCP 2.6, 4.5, and 8.5).
- ²⁰ California Emergency Management Agency and Natural Resources Agency, *California Adaptation Planning Guide: Understanding Regional Characteristics*, July 2012.
- ²¹ State Wildlife Action Plan. Available at: <https://www.wildlife.ca.gov/SWAP/Final>
- ²² North Coast Corridor Public Works Plan/Transportation and Resource Enhancement Program. Appendix D. Draft Final, November 2013. Available at: http://www.dot.ca.gov/dist11/Env_docs/I-5PWP/Appendices/AppendixD_SanDiego_Region_Coastal_Sea_Level%20Rise%20Analysis.pdf.
- ²³ San Diego Association of Governments, *Traded Industry Clusters in the San Diego Region: 2016 Data Update*, March 2016.

²⁴ More information available at: <http://www.resilientcoastlines.org/>.

²⁵ California Department of Public Health, *Integrating Public Health into Climate Action Planning*, February 2012.

²⁶ San Diego Regional Climate Collaborative website: www.sdclimatecollaborative.org.

²⁷ Resilient Coastlines Project: <http://www.resilientcoastlines.org/>.