Regional Energy Strategy

for the
San Diego Region

December 2009
Updated June 2014

SANDAG

Regional Energy Strategy

for the San Diego Region

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EXECUTIVE SUMMARY

In order to provide updated information and data for San Diego Forward: The Regional Plan, the Regional Energy Working Group (EWG) has discussed and provided input to the development of a technical update of the Regional Energy Strategy (RES). The RES technical update demonstrates progress toward RES goals since it was adopted in 2009, identifies priorities for achieving goals, and updates the existing conditions and future projections data.

The RES technical update consists of two parts: summary reports for each RES goal and the updated RES document. Each of the goal summaries describes progress made since RES adoption in 2009, relevant data and monitoring methods, and recommendations for continued progress toward achieving the RES goal. The updated RES document reflects changes in relevant state policies since 2009, updated existing conditions and future projections data, programs and projects that demonstrate progress toward achieving RES goals, and recommendations described in the RES goal reports.

The data included in the RES is consistent with the 2012 greenhouse gas (GHG) emissions inventory prepared by the Energy Policy Initiatives Center at the University of San Diego. The inventory quantifies regionwide GHG emissions from all sources, including electricity, natural gas, transportation, waste, and water.

The RES technical update, along with the updated GHG emissions inventory and climate change mitigation and adaptation white paper, will inform the development of the energy and climate change components for the Regional Plan.

Both the updated RES document and goal summary reports are available on the SANDAG website at: www.sandag.org/RES.

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Acknowledgements and Disclaimers

Acknowledgements

The Regional Energy Strategy (RES) is available for download at www.sandag.org/RES.

Many individuals aided in the preparation of the RES. In particular, the sustained participation and involvement of the members of the SANDAG Regional Energy Working Group.

Special acknowledgements to the California Energy Commission, Energy Policy Initiatives Center of University of San Diego, School of Law, Center for Sustainable Energy, and San Diego Gas & Electric for providing technical assistance for the preparation of the RES.

Disclaimers

This 2014 technical update of the RES is based upon the 2009 document referenced below:

California Energy Commission
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Legal Notice

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Introduction

Energy is fundamental to the regional economy and the quality of life of San Diego residents. Energy lights, heats, and cools our homes and offices, runs our businesses and industrial machines, moves people and goods, delivers and heats our water, and impacts nearly every facet of daily life. Abundant amounts of electricity, natural gas, and transportation fuels like gasoline and diesel are required to support the region's existing three million residents, one million housing units, and one and a half million jobs. According to the San Diego Association of Governments (SANDAG) 2050 Regional Growth Forecast, regional population is expected to increase by almost one million people, 330,000 housing units, and add 500,000 jobs by 2050, which will increase demand for energy.

The Regional Energy Strategy (RES) builds on and updates past SANDAG energy strategies adopted in 2003 and 1994. The RES serves as an energy policy guide to support decision-making by SANDAG and its member agencies as the region strives to meet the energy needs of a growing population, housing stock, and number of workers while maintaining and enhancing regional quality of life and economic stability.

Benefits of developing a RES include:

- Identifying region-specific energy issues, such as increasing the diversity of energy supply in the region or reducing energy intensity of water and wastewater processes;
- Identifying commonly held principles or unique aspects about the region that may differ from those of state policymakers and utility planners;
- Prioritizing regional energy issues, guiding future actions and decisions in the region;
- Establishing a mechanism to implement regional goals;
- Representing shared regional interests at appropriate proceedings, such as a utility's long-term procurement plan or state regulatory and legislative activities;
- Helping local governments represent their interests in the energy arena and increase energy efficiency; and
- Realizing potential co-benefits of energy policies, such as improved air quality, public health, job creation, and financial savings.

1.1 SANDAG's History of Regional Energy Planning

In 2009, SANDAG updated its 2003 RES in response to the 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. These issues will significantly affect energy-related issues in the San Diego region.

Updates were made to the RES in 2014 in order to reflect progress toward RES goals, account for changes in energy and climate change policy since 2009, and make recommendations for continued progress. These updates also will help to inform San Diego Forward: The Regional Plan, which is the combined update of the Regional Comprehensive Plan (RCP) and the Regional Transportation Plan and its Sustainable Communities Strategy.

The San Diego region has a history of developing energy strategies dating back to 1979, with updates occurring through the 1980s and 1990s. The most recent updates were adopted by the SANDAG Board of Directors (Board) in 2003 and 1994. With adoption of the 2003 RES, the SANDAG Board established the Regional Energy Working Group (EWG) to advise SANDAG on issues related to the coordination and implementation of the RES.

The 2003 RES focused primarily on electricity and natural gas issues and developed a vision for how energy would be produced and consumed in the region. The 2003 RES proposed a series of goals and implementation steps to achieve the goals addressing issues such as regional consensus, peak demand, renewable energy, distributed generation, transmission, per capita electricity and natural gas consumption, and natural gas supply.

The 2003 RES helped the region develop programs for energy efficiency and renewables, set legislative priorities, make recommendations to state regulatory and policy proceedings and the local utility San Diego Gas & Electric (SDG&E), obtain funding, and implement the SANDAG Sustainable Region Program, which helps local governments improve energy efficiency of their operations and throughout their communities.

The 2003 RES is a component of the SANDAG RCP, which provides a long-term strategic planning framework for the region to address the many issues affecting regional quality of life, including energy.

1.2 The SANDAG Regional Comprehensive Plan

The RCP, adopted in 2004, integrates the array of local and regional plans in land use, transportation, and supporting infrastructure like energy that influence the region's

quality of life. The RCP creates a regional vision and provides a broad context in which local and regional decisions can be made that foster a healthy environment, a vibrant economy, and a high quality of life for all residents.

> ***SANDAG***
> ***Regional Comprehensive Plan Vision***
> *"To preserve and enhance the San Diego region's unique features – its vibrant and culturally diverse communities, its beaches, deserts, lagoons, bluffs and canyons, and its international setting – and promote sustainability, economic prosperity, and an outstanding quality of life for everyone."*

The vision balances regional population, housing, and employment growth with habitat preservation, agriculture, open space, energy, and other infrastructure needs. The intent of the vision is to move San Diego toward a sustainable future with more choices and opportunities for all residents. The vision also looks beyond our borders and considers the planning and growth underway in Imperial, Orange, and Riverside Counties as well as in Baja California, Mexico.

The Board adopted the goals and policy direction of the RCP as the strategic planning framework for the region, in conjunction with other plans and strategies. To implement these goals, the RCP calls for the application of principles of "smart growth" and "sustainability." Smart growth means developing the region in a way that creates livable communities by connecting land use and transportation and improving the quality of travel by focusing on better urban design and walkability. The principles of sustainability are based on achieving goals and objectives in three broad areas: a prosperous economy, a healthy environment, and social equity. These "three Es" together provide the foundation for achieving sustainable and livable communities in the San Diego region. The strategy's approach to energy issues has been developed to fit within the larger regional vision and strategic planning framework of the adopted RCP.

1.3 Relationship with other SANDAG Planning Efforts

1.3.1 2050 Regional Transportation Plan and its Sustainable Communities Strategy

The 2050 Regional Transportation and its Sustainable Communities Strategy (2050 RTP/SCS) was adopted in 2011. The RTP lays out a plan for investing an estimated $214 billion in local, state, and federal transportation funds expected to come into the region over the next 40 years. Along with the 2050 RTP, the Board adopted the SCS, which details how the region will reduce greenhouse gas (GHG) emissions to state-mandated levels over time. The inclusion of the SCS is required by Senate Bill 375

(Steinberg, 2008) (SB 375), and the San Diego region is the first in California to produce a regional transportation plan with an SCS. SB 375 requires the RTP to achieve GHG emissions reduction targets from passenger cars and light-duty trucks for 2020 and 2035. The legislation requires the SCS to demonstrate how regional GHG reduction targets, to be established by the California Air Resources Board (CARB), would be achieved through development patterns, transportation infrastructure investments, and/or transportation measures or policies that are determined to be feasible. The SCS also must address housing needs and protection of sensitive resource areas. Both the RES and the Climate Action Strategy informed the development of the first SCS and will inform the preparation of the energy and climate change components of the Regional Plan, which consists of a combined update to the RCP and RTP/SCS.

1.3.2 SANDAG Climate Action Strategy

Although there is overlap between the energy policy guidance provided in the RES and types of policy measures that can reduce GHG emissions, energy and climate change are not synonymous issues. As a result, SANDAG prepared a Climate Action Strategy to accompany the RES that provides regional policy guidance related to climate change. Where applicable, the Climate Action Strategy references the energy policy guidance of the RES.

The primary purpose of the Climate Action Strategy is to provide more in-depth analysis of land use and transportation policy measures that could reduce GHG emissions and help achieve SB 375 targets. With a focus on identifying measures to achieve SB 375 targets for passenger cars and light-duty trucks, it examines potential GHG emissions reductions from land use and transportation policy measures. In addition, it identifies climate change policy measures that SANDAG and its member agencies could implement and support to reduce GHG emissions from other major sectors and activities and adapt to the projected impacts of climate change. The Climate Action Strategy was completed in 2010.

1.3.3 Regional Alternative Fuels, Vehicles, and Infrastructure Report

As part of a partnership with the California Energy Commission (Energy Commission), SANDAG developed a regional assessment of alternative transportation fuels, vehicles, and infrastructure. The report identifies and recommends regional and local government actions to increase the use of alternative fuels and vehicles in the fleets of local governments and their franchisees. While primarily focused on opportunities for local government fleets, the report also provides analysis, tools, and recommendations to facilitate a regional rollout of alternative fuels, vehicles, and infrastructure to the general public.

The report concludes with four sets of recommendations to help local government fleets and the region as a whole increase the use of alternative fuels and vehicles and develop the supportive infrastructure. The Board accepted the final report for distribution at its September 25, 2009, meeting.

1.3.4 San Diego Regional Plug-In Electric Vehicle Readiness Plan

Through the Assembly Bill 118 (Nunez, 2007) program, the Energy Commission awarded grants to metropolitan planning organizations throughout the state to create regional groups to address barriers to Plug-In Electric Vehicle (PEV) deployment. In the San Diego region, SANDAG received a grant to develop the San Diego Regional Electric Vehicle Infrastructure Working Group (REVI). REVI is comprised of public agencies, SDG&E, the California Center for Sustainable Energy, universities, equipment manufacturers, and workforce partners. The group has aided in tackling barriers to PEV infrastructure through the development of best practice fact sheets and a PEV Readiness Plan for the region. The final PEV Readiness Plan was accepted by the Board in January 2014.

1.4 Updating the Regional Energy Strategy

1.4.1 New California Energy Policy Direction

Deregulation of the electricity market and its implications were a major focus for the RES 2003. Since then, the state has established new regulations for utilities like SDG&E, specifically requiring them to resume their role in long-term resource planning. Preparation of the 2003 strategy occurred while a void existed in this area. California also has implemented comprehensive energy policies affecting residents, the economy, and the environment, including landmark legislation to address global climate change, adoption of a preferred loading order for meeting new energy needs and addressing climate change, and recommendations from the state to integrate energy considerations into land use and transportation planning.

As a result, the state, through agencies like the California Public Utility Commission (CPUC) and Energy Commission and utilities like SDG&E, has significant authority over electricity and natural gas end uses (e.g., space and water heating) in the San Diego region. In addition, SANDAG and local governments have significant energy-related authorities through their role in areas like land use planning, transportation planning and funding, and building permitting.

1.4.2 Focus of the Regional Energy Strategy

In light of significant state control over certain energy policy areas like electricity and natural gas, the RES focuses on the multiple opportunities and authorities that SANDAG and its member agencies could take advantage of to address energy issues and achieve

both local and regional goals related to energy and climate change. This includes opportunities for SANDAG to address energy and climate change considerations through San Diego Forward: The Regional Plan, as well as options for local governments through mechanisms like the General Plan. This update looks out to 2050, the horizon year for current adopted regional growth projections.

Although the RES does not make recommendations for specific energy projects (e.g., power plants or transmission projects), it does assess regional need for energy resources and infrastructure. Furthermore, the RES does not replace the long-term electricity plan (i.e., procurement plan) that SDG&E is required to develop by the CPUC, but it can inform decisions made by SDG&E and Public Utilities Commission.

1.4.3 Structure of the Regional Energy Strategy

The strategy provides analysis of existing conditions and projections in the region related to energy, as well as guiding principles, goals, and recommended actions.

2. Guiding Principles for Regional Energy Planning

For the 2009 RES, guiding principles were developed with the involvement of the EWG, Regional Planning Technical Working Group, Board and policy advisory committees, and members of the public. These principles helped to identify a vision for the region that guides regional decision-making on energy-related items in response to key policy drivers and future projections. They also informed the development of goals and recommended actions for the RES.

3. Key Policy Drivers

This section provides more detailed discussion of the main drivers of energy policy across the state : (1) California Integrated Energy Policy Report, (2) California Preferred Loading Order for Electricity Resources, (3) California Long-Term Energy Efficiency Strategic Plan, and (4) California Global Warming Solutions Act (Assembly Bill 32 [Nunez, 2006]) and associated plans and programs to reduce GHG emissions.

4. Existing Conditions and Future Projections

This section provides existing conditions and future projections to 2050 related to consumption of electricity, natural gas, and transportation fuel, as well as the resulting GHG emissions.

5. Regional Energy Strategy Goals

The RES is structured around 11 major energy topics identified during its development. For each topic, the document identifies an overarching goal, a summary of relevant facts and issues, and a set of recommended actions that contribute to the goal. The recommended actions represent options for SANDAG, local governments, other regional entities, or potentially combinations thereof, to contribute to regional energy goals. Achieving many, if not most, of the goals will require actions that go above and beyond existing requirements or would require funding amounts or types not provided through existing programs. Achieving the goals also will require regional and local governments to take active and innovative approaches, not the least of which is securing needed funding.

In 2014, summary reports were prepared for each of the RES goals. These brief reports highlight progress toward the goals from 2009 to 2014, identify data for monitoring progress, and include recommendations for continued progress moving forward. These summary reports are provided under a separate cover and are available online at: www.sandag.org/RES.

Major Topic Areas with Goals in the Regional Energy Strategy

1. Energy Efficiency and Conservation
2. Renewable Energy
3. Distributed Generation
4. Energy and Water
5. Peak Demand
6. Smart Energy
7. Natural Gas Power Plants
8. Transportation Fuels
9. Land Use and Transportation Planning
10. Border Energy
11. Clean Energy Economy

6. Findings

This section identifies priority early actions to implement the RES. Six actions emerged as priorities, or core strategies, essential to meeting the region's energy goals. The EWG will pursue these actions upon completion of the updated RES: some of these actions are already underway. Broad strategies have been identified to implement several RES goals. By implementing these broad strategies, SANDAG and local governments will contribute to achieving these goals.

Priority Early Actions from the Regional Energy Strategy

1. Pursue a comprehensive building retrofit program to improve efficiency and install renewable energy systems
2. Create financing programs to pay for projects and improvements that save energy
3. Utilize the SANDAG-SDG&E Local Government Partnership to help local governments identify opportunities and implement energy savings at government facilities and throughout their communities
4. Support land use and transportation planning strategies that reduce energy use and GHG emissions
5. Support planning of electric charging and alternative fueling infrastructure
6. Support use of existing unused reclaimed water to decrease the amount of energy needed to meet the water needs of the San Diego region

Broad Strategies to Implement Multiple Regional Energy Strategy Goals

1. Identify, secure, or develop funding mechanisms to pay for energy-related projects and programs
2. Educate and engage the general public or other stakeholders
3. Support enabling legislation or policy changes from state or federal government
4. Take early actions that set examples for residents and businesses
5. Develop standardized approaches and programs that can be implemented by

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Guiding Principles for SANDAG Regional Energy Planning

The guiding principles for regional energy planning were developed with the involvement of the Regional Energy Working Group, Regional Planning Technical Working Group, Board and policy advisory committees, and members of the public. These principles helped to identify a vision for the region that guides regional decision-making on energy-related items in response to key policy drivers and future projections. They also informed the development of goals and recommended actions for the Regional Energy Strategy.

Regional Energy Strategy Guiding Principles

Sustainably Meet Future Energy Needs	The region's energy needs are met while maintaining environmental quality by employing resources efficiently, diversifying our fuel mix, and utilizing supplies that minimize cost.
Reduce Greenhouse Gas Emissions from Energy Use	All levels of government are engaged in immediate and sustained cost-effective actions to reduce and mitigate Greenhouse Gas (GHG) emissions and to prepare for the serious impacts of climate change to public health, the environment and the economy.
Promote Education and Consensus-Building	An open, transparent, and inclusive planning process including community and business stakeholders and education programs combined to increase public awareness and responsible energy decision-making in the region.
Foster the Clean Energy Sector	Economic development initiatives and workforce training programs position the region to supply a growing demand for energy-efficient and renewable energy products and services.
Ensure Social Equity and Environmental Justice	Energy planning and programs promote the principles of opportunity, inclusion, and equal access for disadvantaged populations and ensure fair treatment and meaningful involvement for all people regardless of race, ethnicity, gender, income, national origin, or geography.
Implement the State's Preferred Loading Order	Following the state's preferred loading order, new resources come first from energy efficiency, demand response, renewable energy, and distributed generation, all before new transmission and natural gas generation are sought.
Implement the Smart Grid	The deployment of smart devices, controls, and communications modernize our electricity grid to improve reliability, power quality, and detect problems before service is affected.
Pursue Energy Reductions in Existing Residential and Commercial Buildings	Net energy usage and costs from the region's existing building stock are significantly reduced through targeted energy policies, programs, and financing options.

Reduce Energy Demand and Renewable Energy System Cost	Policies and programs promote the integration of energy efficiency at a structure prior to the installation of a renewable energy system in order to reduce the size and cost of the renewable energy system.
Promote State Policy for Zero Net Energy Residential and Commercial Buildings	Consistent with the policy direction of state agencies like the California Public Utilities Code, aggressive strategies, including regulations and incentives, are employed to achieve zero net energy usage in new residential and commercial buildings and communities, and reduce energy usage in existing residential and commercial buildings and communities, through energy efficiency, clean distributed generation, and community planning efforts.
Reduce the Energy Intensity of the Built Environment	The energy intensity of community design, including buildings and travel options, is an integral consideration in land use and transportation planning.
Ready the Region for Wide-Scale Deployment of Alternative Fuel Vehicles	The region has convenient access to alternative transportation fuels that reduce our dependence on foreign oil supply, reduce local economic impacts from oil price volatility, and reduce GHG emissions.

3

Key Policy Drivers

California has promoted energy efficiency, clean energy supplies, and alternative fuels through policies and programs since the 1970s. These policies and programs have made California a leader in the nation and helped keep per capita electricity consumption[1] flat over decades. SANDAG has taken an active role in regional energy planning since 2000 when problems with state electricity restructuring arose.

The Regional Energy Strategy recognizes that the state and federal governments and utilities have significant control over certain energy policy areas. The RES focuses on the opportunities and authorities that SANDAG and its member agencies could take advantage of to achieve both local and regional goals related to energy and climate change.

3.1 California Integrated Energy Policy Report

Since 2003, the California Energy Commission (Energy Commission) adopts an Integrated Energy Policy Report (IEPR) every two years and an update every other year (Senate Bill 1389, [Bowen and Sher, 2002] [SB 1389]). The IEPR serves as the state's energy policy blueprint, similar to the RES for the San Diego region. Over the years, the region has provided input into the state's process and utilized the IEPR in regional policymaking decisions. The IEPR provides energy policies that conserve resources, protect the environment, ensure energy reliability, enhance the state's economy, and protect public health and safety. Through the IEPR, the Energy Commission also performs an independent analysis of each utilities electricity demand forecast, which is used in RES energy forecasting and existing conditions.

3.2 California Preferred Loading Order for Electricity Resources

The California Public Utilities Commission (CPUC) and Energy Commission follow a "preferred loading order" to meet goals for satisfying the state's growing demand for electricity and significantly reducing the level of GHG emissions. The loading order calls for achieving these goals by placing top priority on first increasing energy efficiency and demand response, as shown below. Energy policies that the region chooses to support should be consistent with the "preferred loading order."

[1] Electricity consumption is the amount of energy consumed in a process or system, or by an organization or society. As population continues to grow, the per capita (or per person) amount of energy used in California has remained flat through extensive energy efficiency and conservation measures.

California's Preferred Loading Order

1. Increase energy efficiency.
2. Increase demand response – temporary reduction or shift in energy use during peak hours.
3. Meet generation needs with renewable and distributed generation (DG) resources.
4. Meet new generation needs with clean fossil-fueled generation and infrastructure improvements.

3.3 California Long-Term Energy Efficiency Strategic Plan

In 2008, the CPUC led the development of the California Long-Term Energy Efficiency Strategic Plan to achieve maximum energy efficiency savings across all sectors, including local government. Updated in 2011, this plan identifies four "Big Bold Energy Efficiency Strategies" to help meet Assembly Bill 32 (Nunez, 2006) (AB 32) GHG reduction targets.

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

The plan specifically calls on local governments to do the following:

- At least 5 percent of California's local governments (representing at least 5 percent of California total population) each year adopt "reach" (enhanced energy efficiency) codes.
- By 2020, the majority of local governments have adopted incentives or mandates to achieve above-code levels of energy efficiency in their communities, or have led statewide adoption of these higher codes.
- The current rate of non-compliance with codes and standards is halved by 2012, halved again by 2016, and full compliance is achieved by 2020.
- By 2015, 50 percent of local governments have adopted energy efficiency/sustainability/climate change action plans for their communities and 100 percent by 2020.

The plan identifies the following areas where local government authority can reduce energy use in new and existing buildings:

1. Ensuring compliance and enforcement of the Title 24 energy code for residential and commercial buildings.
2. Adopting building codes beyond Title 24's energy requirements (and potentially other "green" requirements).
3. Supporting highly efficient projects that voluntarily exceed minimum energy codes through favorable fee structures, fast-tracked permitting, and other innovative and locally appropriate approaches.
4. Enacting ordinances with point-of-sale or other approaches that spur efficiency actions in existing, privately-owned buildings.
5. Applying efficiency-related "carrots" and "sticks" using local zoning and development authority.

3.4 California Global Warming Solutions Act (Assembly Bill 32)

The California Global Warming Solutions Act (AB 32) established the 1990 GHG emissions level as the statewide limit for 2020; an approximate 15 percent reduction from the baseline 2006 level. AB 32 called for regulatory and market mechanisms to achieve the GHG reduction target. Many of the state's energy policies and programs are now shaped, at least in part, by the requirements and spirit of AB 32.

AB 32 codified Governor Schwarzenegger's Executive Order (EO) S-03-05 that established the statewide target for reduction of GHG emissions to 1990 levels by 2020. The EO also called for long-term GHG reductions to 80 percent below the 1990 level by 2050. Although not required by AB 32 or the EO, the 2013 Scoping Plan update (described below) begins to explore ways to reduce emissions beyond the 2020 target by continuing to pursue the maximum technologically feasible and cost-effective actions across several economic sectors.

3.4.1 Assembly Bill 32 Climate Change Scoping Plan

In May 2014, California Air Resources Board (CARB) released the First Update to the Climate Change Scoping Plan that builds upon the initial Scoping Plan from 2008, shows progress to date across all economic sectors, and calls for a mid-term target between 2020 and 2050. The Scoping Plan outlines the main strategies for meeting the 2020 target, which include direct regulations, alternative compliance mechanisms, monetary and non-monetary incentives, voluntary actions and market-based mechanisms. The majority of GHG emissions to be reduced derive from three categories: energy, transportation, and Cap-and Trade, as shown in the following table. The biggest policy drivers for these measures are identified below the table.

Meeting the 2020 Emissions Target for California	
Category	2020 $MMTCO_2e$*
AB 32 Baseline 2020 Forecast Emissions (2020 BAU)	**509**
Expected Reductions from Sector-Based Measures	**78**
Energy	25
Transportation	23
High-GWP (Global Warming Potential)	5
Waste	2
Cap-and-Trade Reductions	23**
2020 Limit	**431**

Source: CARB First Update to the Climate Change Scoping Plan, May 2014
*Million metric tons carbon dioxide equivalent ($MMTCO_2e$) is based on the Fourth Assessment Report (AR4) Global Warming Potential (GWP) values.[2]
**Cap-and-Trade emission reductions depend on the emission forecast.

3.4.2 Energy

The state's strategy to reduce GHG emissions from electricity and natural gas involves the coordination of several state agencies including the CPUC, Energy Commission, and CARB. To improve energy efficiency, the AB 32 Scoping Plan calls for maximizing building and appliance standards, pursuing new technologies and policy mechanisms, and continuing investments from electricity providers in energy efficiency programs. To reduce the carbon content of electricity supplies, the state requires significant increases in utility scale renewable energy supplies, as well as smaller scale DG including combined heat and power, fuel cells and solar photovoltaics. A few of the predominant policy drivers are identified below.

Efficiency: Zero Net Energy Goals

Achieving the state's ZNE building goals are important to achieve climate targets. In 2008, the CPUC set forth ZNE goals in the Long-Term Energy Efficiency Strategic Plan discussed earlier in this section. The plan called for all new residential buildings to be ZNE by 2020, new commercial buildings shall be ZNE by 2030, and half of existing commercial buildings shall be retrofitted to ZNE by 2030.

In 2009, AB 758 (Skinner, 2009) created the Comprehensive Energy Efficiency Program to achieve greater energy efficiency in all of California's existing buildings. The Energy Commission was directed to develop an Action Plan for 758, which identifies solutions for energy efficiency issues in California's existing buildings.

[2] International Panel on Climate Change AR4, 2007.

Efficiency: Proposition 39 Funding

In 2012, California voters approved the California Clean Energy Jobs Act (Proposition 39). Subsequently, through SB 73 (Skinner, 2013), the Proposition 39 tax mechanism will provide a significant source of new revenue (an estimated 2.75 billion over five years) to support energy efficiency and clean energy projects in California's public schools (K–12) and community colleges.

Efficiency and Renewable: Property Assessed Clean Energy Financing Programs

One of the six RES priority early actions is to "create financing programs to pay for projects and improvements that save energy." Property assessed clean energy (PACE) programs are a financing mechanism that allow property owners to pay for energy and water efficiency upgrades and renewable energy improvements without having to pay the costs upfront. PACE affords a qualifying home or business owner a loan for eligible upgrades or improvements, which is paid back via their tax bill. AB 811 (Levine, 2008) and SB 555 (Hancock, 2011) provide state legislative authority for commercial and residential PACE programs.

PACE programs are adopted by a local government, thus enabling local residents and/or businesses to apply for project financing. As of June 2014, 18 of the 19 local jurisdictions have adopted at least one PACE program and the remaining jurisdiction is currently assessing the various program options.

Renewable Portfolio Standard

Established in 2002 under SB 1078 (Sher, 2002), accelerated in 2006 under SB 107 (Simitian, 2006) and expanded in 2011 under SB 2X (Simitian, 2011), California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 33 percent of total procurement by 2020. CARB established the Renewable Electricity Standard (Resolution 10-23) in 2010 to require renewable electricity targets for all retail sellers of electricity, including publicly-owned utilities.

3.4.3 Transportation

The AB 32 Scoping Plan outlines three key strategies for reducing emissions from the transportation sector:

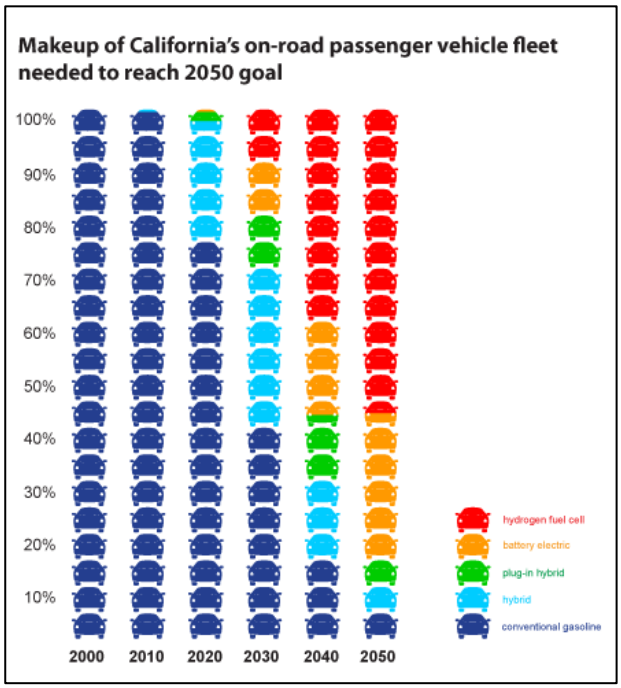
- Reduce the carbon content of the fuels used in the vehicles,
- Increase the efficiency of the vehicles used, and
- Reduce the miles driven by vehicles.

The state's three strategies for reducing transportation emissions are supported by three main policies:

- Low Carbon Fuel Standard (LCFS),
- Pavley Standard and Advanced Clean Cars program, and
- Sustainable Communities Strategies: SB 375 (Steinberg, 2008) (SB 375).

Low Carbon Fuel Standard

The Low Carbon Fuel Standard (LCFS) calls for a reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020. It was established in 2007 through EO S-01-07 and requires producers of petroleum-based fuels to reduce the carbon intensity of their products, beginning with a quarter of a percent in 2011 culminating in a 10 percent total reduction in 2020. The LCFS program is performance-based and allows fuel providers and regulated parties to choose from a mix of strategies to achieve compliance. Strategies include investing in production of low carbon-intensity (low-CI) fuels, purchasing low-CI fuels for blending, purchasing credits from other regulated parties, and banking credits for use in future years.



Source: CARB

Pavley Standard and Advanced Clean Cars Program

The Pavley standard requires GHG emission reductions in new passenger vehicles from 2009 through 2016. The U.S. Environmental Protection Agency granted California the authority to implement GHG emission reduction standards for new passenger cars, pickup trucks, and sport utility vehicles in June 2009. In January 2012, CARB approved a new emissions-control program for model years 2017 through 2025. The program combines the control of smog, soot, and GHG emissions and requirements for greater numbers of zero-emission vehicles (ZEVs) into a single package of standards called "Advanced Clean Cars."

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 (EO B-16-2012). ZEVs include hydrogen and plug-in electric vehicles (PEVs). The chart above demonstrates how California's on-road passenger vehicle fleet is planned to change overtime. In order for the state to meet its clean vehicle goals, new fueling infrastructure to power ZEVs and alternative fuel vehicles must be deployed where little to none exists today. In 2013, the state released a ZEV Action Plan with specific strategies to assist in meeting ZEV goals.

Alternative and Renewable Fuel and Vehicle Technology Program

The Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) was established in 2007 through passage of AB 118 (Nunez, 2007) and reauthorized in 2013 by AB 8 (Perea, 2013) through January 1, 2024. It provides funding to develop and deploy alternative and renewable fuels and technologies, and helps meet California's climate change and petroleum dependence policies. The Energy Commission will invest a total $1.5 billion between 2009 and 2024 to support development and deployment of zero- and low-emission vehicles and low-carbon fuels.

Senate Bill 375 – Sustainable Communities Strategy

SB 375 requires Metropolitan Planning Organizations like SANDAG to create a Sustainable Communities Strategy (SCS) that integrates the transportation network with development patterns in a way that achieves GHG emissions reduction targets from passenger cars and light-duty trucks while meeting housing needs and other regional planning objectives. The SCS must demonstrate how changes to land use patterns, transportation infrastructure investments, funding allocations, policies, or any other measures will achieve the per capita GHG reduction targets established by CARB.

In October 2011, the 2050 Regional Transportation Plan and its Sustainable Communities Strategy (2050 RTP/SCS) laid out a plan for investing $214 billion in local, state, and federal transportation funds expected to come into the region over the next 40 years. The 2050 RTP/SCS includes recommended actions that support energy efficiency, alternative fuels, and GHG reductions. The RES Technical Update will help inform future regional plans including San Diego Forward: The Regional Plan.

3.4.4 Cap-and-Trade Regulation

The Scoping Plan recommended development of a state Cap-and-Trade program that links with other Western Climate Initiative partner programs to create a regional market system. The Cap-and-Trade regulation established a declining cap on approximately 85 percent of total statewide GHG emissions. Under the regulation, CARB issues allowances equal to the total amount of allowable emissions over a given compliance period and distributes these to regulated entities. One allowance equals one metric ton of GHG emissions. Each regulated entity must hold allowances equal to its emissions.

Electric generating utilities, electricity importers, and large industrial facilities became subject to the program beginning in 2013, and fuel distributors are added to the program in 2015. The Cap-and-Trade program works in concert with direct regulatory measures to provide an additional economic incentive to reduce emissions. Cap-and-Trade revenues are to provide a significant source of new revenue to support GHG reduction measures. One of the SANDAG legislative priorities is to pursue resources and funding mechanisms consistent with financial strategies adopted in the 2050 RTP/SCS and Regional Comprehensive Plan (RCP), including but not limited to Cap-and-Trade or equivalent revenues.

Cap-and-Trade Investment Plan and Appropriations

CARB provided its first investment plan for Cap-and-Trade auction proceeds to the Legislature in May 2013. The first investment plan encompasses fiscal years 2013-14 through 2015-16 and identifies priority state investments to help achieve GHG reductions. For 2013-14, California's budget included a one-time loan of $500 million from Cap-and-Trade revenues to the State's General Fund. The state's 2014-15 budget allocates the $872 million in Cap-and-Trade revenues to High-Speed Rail, Low Carbon Transportation, Affordable Housing and Sustainable Communities, Transit Capital and Operations, and other programs related to energy efficiency, water efficiency, sustainable forestry, and waste diversion.

The 2014-15 budget also directs that future years include 35 percent to Sustainable Communities Program, 25 percent for High-Speed Rail, and 40 percent (with specific amounts to be decided each year) to Low Carbon Transportation, Energy Efficiency, Urban Forestry, Water, and Waste.

Through 2020, there will be hundreds of millions of dollars made available to undertake GHG reduction measures that target the energy and transportation sectors. It is expected that the state will extend the Cap-and-Trade program to a mid-term date or to 2050. If so, auction revenues may provide long-term funding to local government, university, and other regional stakeholder climate programs.

4

Existing Conditions and Future Projections

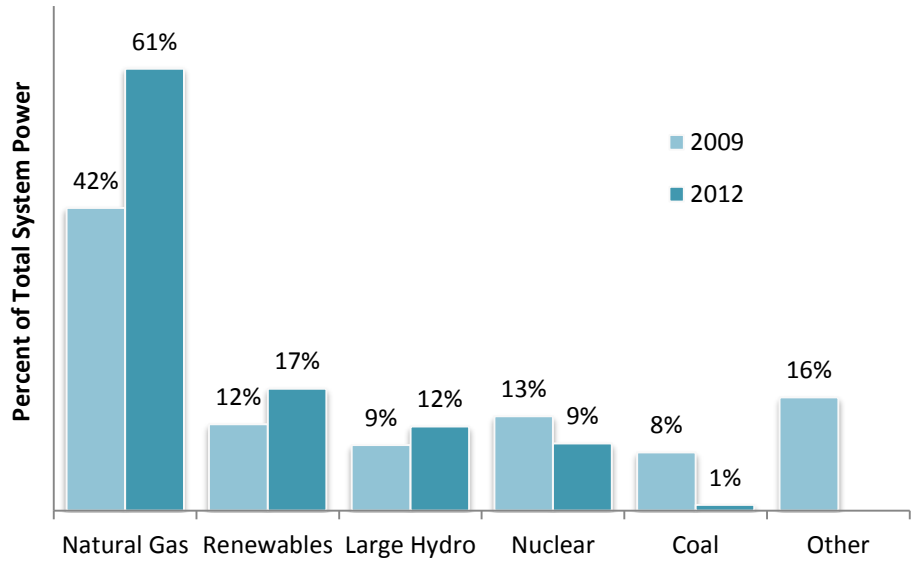
This section presents existing conditions and future projections to 2050 for electricity, natural gas use, transportation fuel, and greenhouse gas (GHG) emissions.

4.1 Electricity

4.1.1 Statewide and Regional Electricity Supply

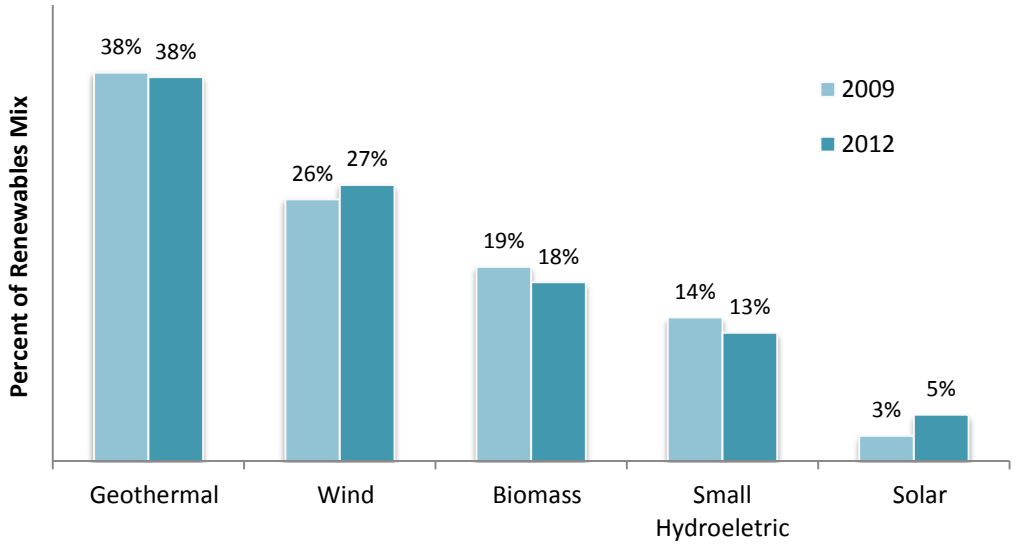
Figure 4-1 illustrates the types of resources that make up the total electricity production for California in 2009 and 2012. Over the last 3 years, electricity generation from natural gas and renewables has increased while coal has declined significantly, due to the California Energy Commission (CEC) banning utilities from signing new contracts with out-of-state coal-fired power plants in 2007, and nuclear has declined due to the shutdown of the San Onofre Nuclear Generating Station. The percentage of generation from renewable sources has increased from 12 percent in 2009 to 17 percent in 2012. Figure 4-2 shows the statewide mix of renewable resources, which are largely geothermal, followed by wind, biomass, small hydroelectric, and solar.

Figure 4-1: Statewide Total Electricity System Power Mix, 2009 and 2012



Source: California Energy Commission

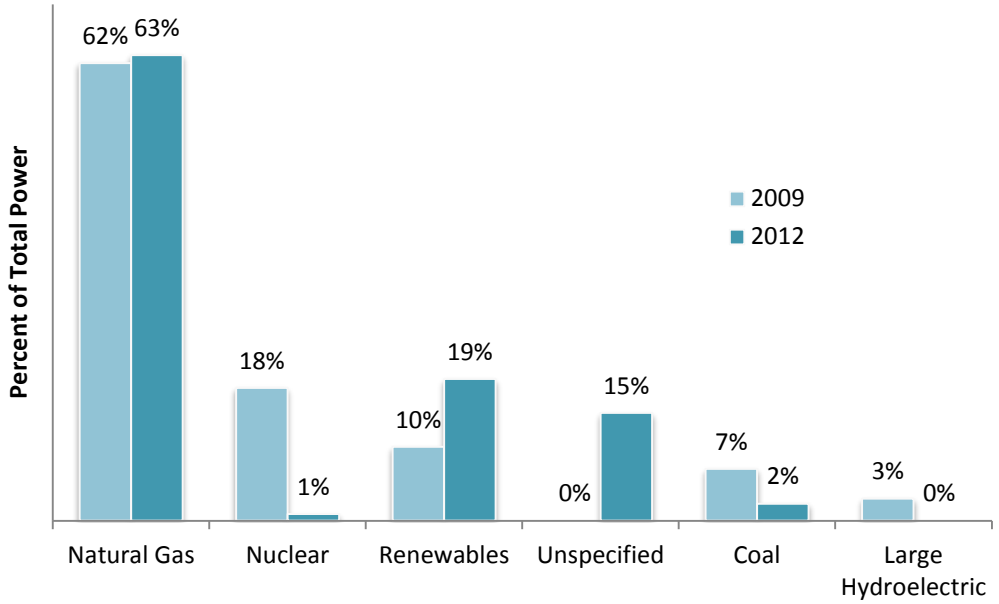
Figure 4-2: Statewide Renewable Power Mix, 2009 and 2012



Source: California Energy Commission

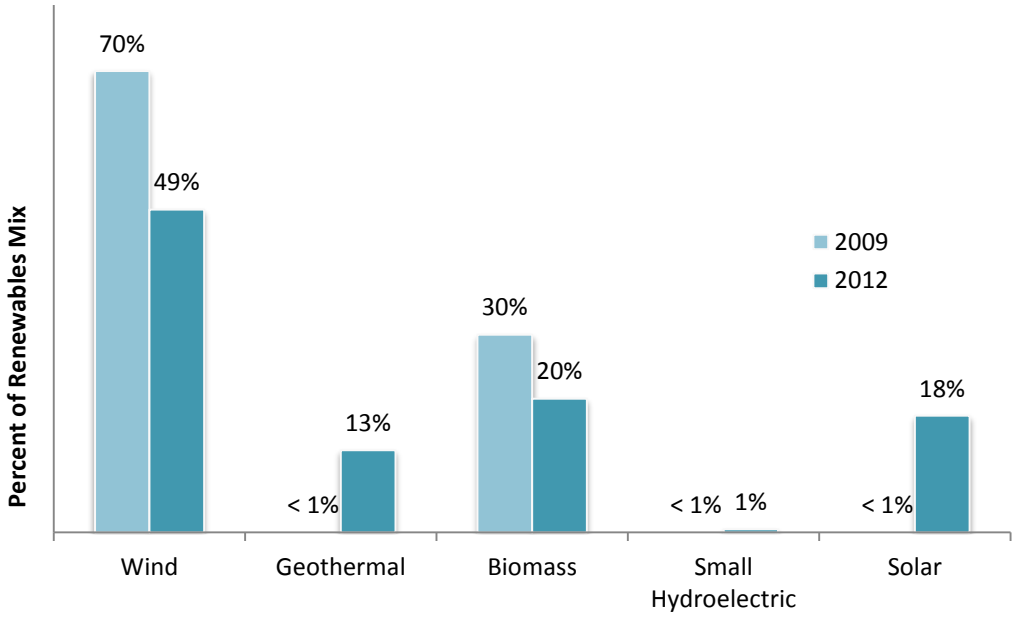
Figure 4-3 shows 2009 and 2012 electricity production for the SDG&E service area, which includes all of San Diego County and a small portion of southern Orange County. (San Diego County accounts for approximately 91 percent of the SDG&E service area.) Much like statewide figures, the SDG&E power mix is dominated by natural gas. In 2012, renewable resources comprised about 19 percent of supply, with wind as the largest component of the renewable portfolio, as illustrated in Figure 4-4.

Figure 4-3: SDG&E Power Mix, 2009 and 2012



Source: San Diego Gas & Electric
Note: The Power Source Disclosure Program was modified in 2009 to allow for "unspecified power," which is generally comprised of short-term market purchases from out-of-state power plants that do not have a contract with the utility.

Figure 4-4: SDG&E Renewable Power Mix, 2009 and 2012

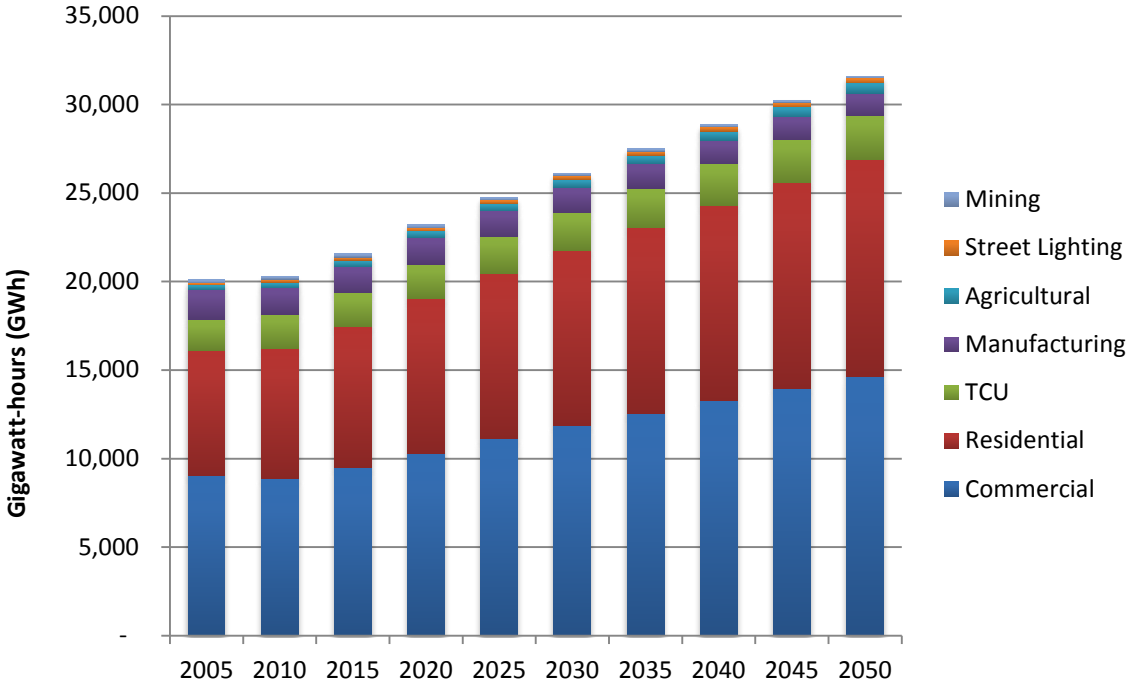


Source: San Diego Gas and Electric

4.1.2 Regional Electricity Consumption Forecast

In 2012, total system power for California was 302,000 Gigawatt-hours (GWh), which is up from 298,000 GWh in 2009. In the San Diego region, total annual system power for the SDG&E service territory has remained relatively constant at around 20,000 GWh, which accounts for about 7 percent of the state's total system power. One GWh is enough electricity to power about 95 homes for one year. Under a business-as-usual scenario (i.e., no change in existing policy, programs, or behavior), the region's total actual electricity consumption in 2010 (20,297 GWh) is expected to increase by about 14 percent by 2020 (to 23,203 GWh) and 55 percent by 2050 (to 31,583 GWh). This increase in total consumption assumes that existing levels of funding for energy efficiency programs administered by the utility continue. Figure 4-5 shows actual electricity consumption for 2005 and 2010 and forecasted consumption for the region by sector through 2050. Residential and commercial sectors are expected to continue to use the most electricity in the San Diego region (and the State). The electricity used to power electric vehicles is accounted for in the electricity end-use categories for residential and commercial consumption. For information on the factors that contribute to electricity consumption, refer to the energy efficiency section of Chapter 5 on Regional Energy Strategy Goals.

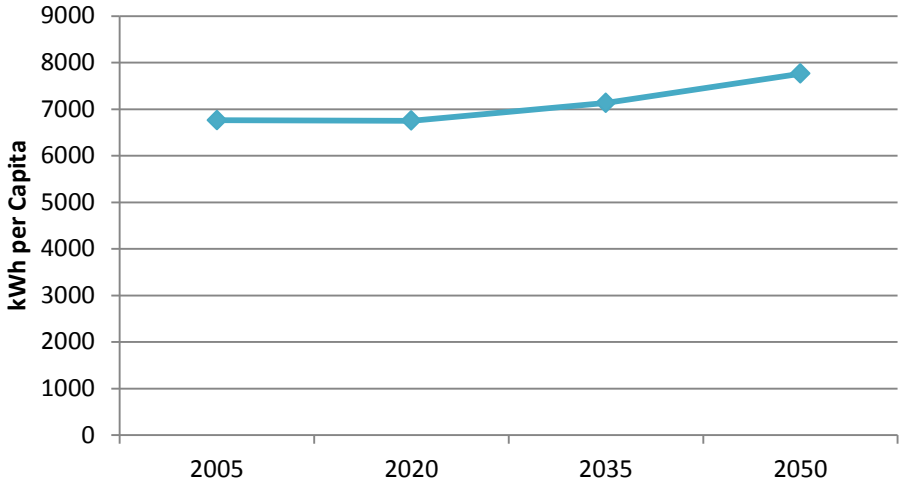
Figure 4-5: Existing and Projected Electricity Consumption for SDG&E Service Territory (GWh), 2005-2050



Source: Energy Policy Initiatives Center, University of San Diego, 2014.

Though current trends indicate that total regional electricity consumption will grow by up to 55 percent by 2050, per capita consumption is projected to remain flat through 2020, then grow by approximately 15 percent by 2050 (as shown in Figure 4-6). Consumers are using more electronic products and appliances today, but energy-saving measures like conservation and energy efficiency standards have been effective in maintaining per capita consumption. The main reason for overall growth in electricity consumption is population growth, anticipated to be on the order of nearly one million additional people between now and 2050 according to the SANDAG regional growth forecast. The region will need sufficient energy supply resources to accommodate this future growth.

Figure 4-6: Existing and Projected Per Capita Electricity Consumption for SDG&E Service Territory (kWh), 2005-2050



Source: California Energy Commission and SANDAG Series 13 Regional Growth Forecast

The RES uses the CEC 2013 Integrated Energy Policy Report (IEPR) as the basis for electricity and natural gas consumption figures. SDG&E also relies on the Energy Commission IEPR forecast for resource planning. Table 4-1 demonstrates the energy reductions derived by various energy saving measures.

Table 4-1: Reductions Derived by Energy Saving Measures in SDG&E Service Territory (GWh)

	Appliance Standards	Energy Efficiency Programs/ Price and Other	2013 Building Standards	Non-PV Self Generation	Photovoltaics (PV)
1990	348	545	399	460	-
2000	964	1,388	676	359	0.1
2010	1,894	1,990	1,025	705	106.3
2012	2,158	2,033	1,103	700	213.6

Source: California Energy Commission, 2013.

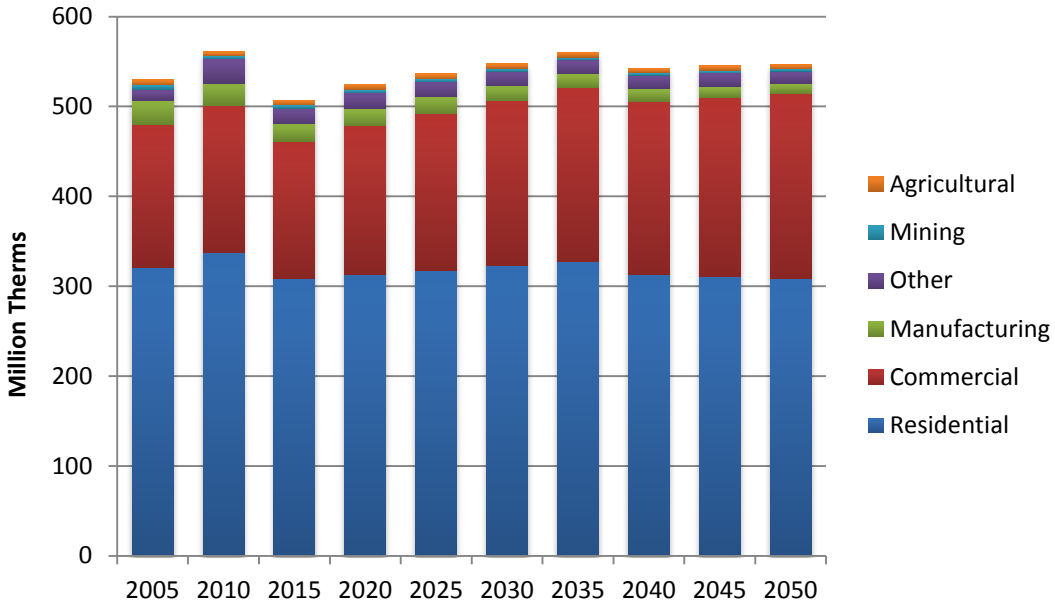
4.2 Natural Gas

The San Diego region consumed approximately 560 million therms of natural gas in 2010 (not including gas used for electricity generation, which is accounted for in the electricity section above). At present, California imports 85 percent of its natural gas needs from out state. Figure 4-8 shows natural gas consumption delineated by end-use sector and similar to electricity consumption, the majority of natural gas end-use

consumption is in the residential and commercial sectors. The natural gas used to power alternative fuel vehicles is accounted for in the natural gas end-use category.

Under a business-as-usual scenario, regional natural gas consumption is not expected to grow significantly over the next several decades as shown in Figure 4-7.

Figure 4-7: Existing and Projected Natural Gas Consumption by Sector for SDG&E Service Territory (Million Therms), 2005-2050



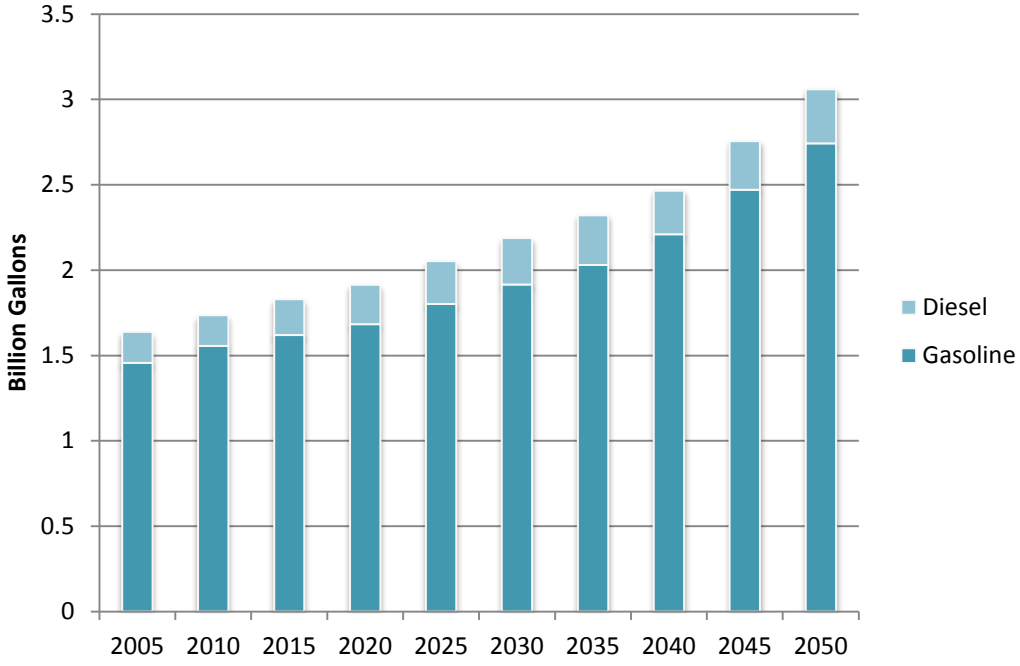
Source: Energy Policy Initiatives Center, University of San Diego, 2014.

4.3 Transportation

4.3.1 On-Road Transportation

The on-road transportation sector is a large consumer of energy, and is almost entirely dependent on petroleum-based fuels (gasoline and diesel). As shown in Figure 4-8, passenger cars and light-duty trucks are by far the largest consumers of transportation fuel, accounting for about 1.6 billion gallons of gasoline and diesel per year, or 85 percent of total consumption by on-road vehicles. Wherever possible, data known about alternative transportation fuels is displayed in the transportation fuels section of Chapter 5: Regional Energy Goals; but the existing conditions and projections only pertain to gasoline and diesel. SANDAG will try to track alternative fuels consumed in the San Diego region to the extent possible.

Figure 4-8: San Diego Regional Existing and Projected On-Road Diesel and Gasoline Consumption, 2005-2050



Source: Energy Policy Initiatives Center, University of San Diego, 2014.

Light-duty trucks represent only about 35 percent of vehicle miles traveled (VMT), but due to their relatively low efficiency, account for about half of fuel consumption.

Heavy-duty trucks and buses account for most of the remaining consumption by on-road vehicles, about 170 million gallons or about 11 percent of total on-road fuel consumption. While heavy-duty trucks mostly use diesel fuel, the region's transit agencies operate a substantial number of Compressed Natural Gas (CNG) buses, including CNG-electric hybrids. Passenger cars and light-duty trucks are the largest contributors, generating about 91 percent of emissions from on-road vehicles, while heavy-duty vehicles account for the remainder.

4.3.2 Other Transportation: Aviation, Rail, Watercraft, and Off-Road Equipment

Although small relative to fuel use by passenger cars and heavy-duty vehicles, energy consumed by the civil aviation, rail transportation, water-borne equipment, and off-road sectors is significant. Fuel consumption in these sectors accounts for about 7 percent of GHG emissions in the San Diego region and is primarily petroleum-based.

In 2007, the civil aviation sector, which comprises commercial flights and ground operations at San Diego International Airport, consumed about 210 million gallons of jet fuel, 28,000 gallons of aviation gasoline, and 53 million cubic feet of natural gas. International flights and aviation at other airports and military facilities are not included in this analysis because data could not be obtained. Fuel use in this sector combined to account for about 4 percent of total GHG emissions in the region. The off-road vehicle and equipment category is the next largest consumer of fuel in this sector (primarily gasoline and diesel), accounting for about 3 percent of total GHG emissions. The largest fuel users in this category are construction and mining, industrial, pleasure craft, and agricultural.

The rail transportation category consumes diesel fuel for freight and goods movement, the COASTER commuter rail line, and the SPRINTER light-rail line. The light-rail San Diego Trolley is powered by electricity. The diesel consumption accounts for about 1 percent of the region's carbon footprint, while electricity to power the Trolley accounts for a very small amount of GHG emissions from the region's electricity consumption.

There are many types of water-borne navigation in the San Diego region, but the largest sources of fuel consumption are ocean-going vessels (OGVs) and harbor craft operating within San Diego Harbor. It should be noted that like rail, OGVs are among the most efficient mode of goods movement. The majority of fuel use from OGVs is due to automobile shipments, refrigerated vessels, and passenger cruise ships. The majority of harbor craft fuel use is due to commercial and charter fishing boats. Water-borne navigation accounts for less than 1 percent of total GHG emissions.

4.4 Greenhouse Gas Emissions

4.4.1 Greenhouse Gas Emissions in the San Diego Region

Energy use (including electricity, natural gas, and transportation fuels) in the San Diego region is the largest source of GHG emissions. Table 4-2 shows emissions in the four principal categories established by the United Nations Intergovernmental Panel on Climate Change (IPCC). As it shows, 90 percent of all GHG emissions in the region are related to the production and consumption of energy.

Table 4-2: San Diego County GHG Emissions by IPCC Category

Intergovernmental Panel on Climate Change Category	2012 Emissions (MMT CO_2e)	Percentage of Total
Energy[1]	29.84	90%
Industrial (non-fuel)	1.46	4%
Waste	1.63	5%
Agriculture, Forestry, Land Use	0.24	1%
Total	33.17	100%

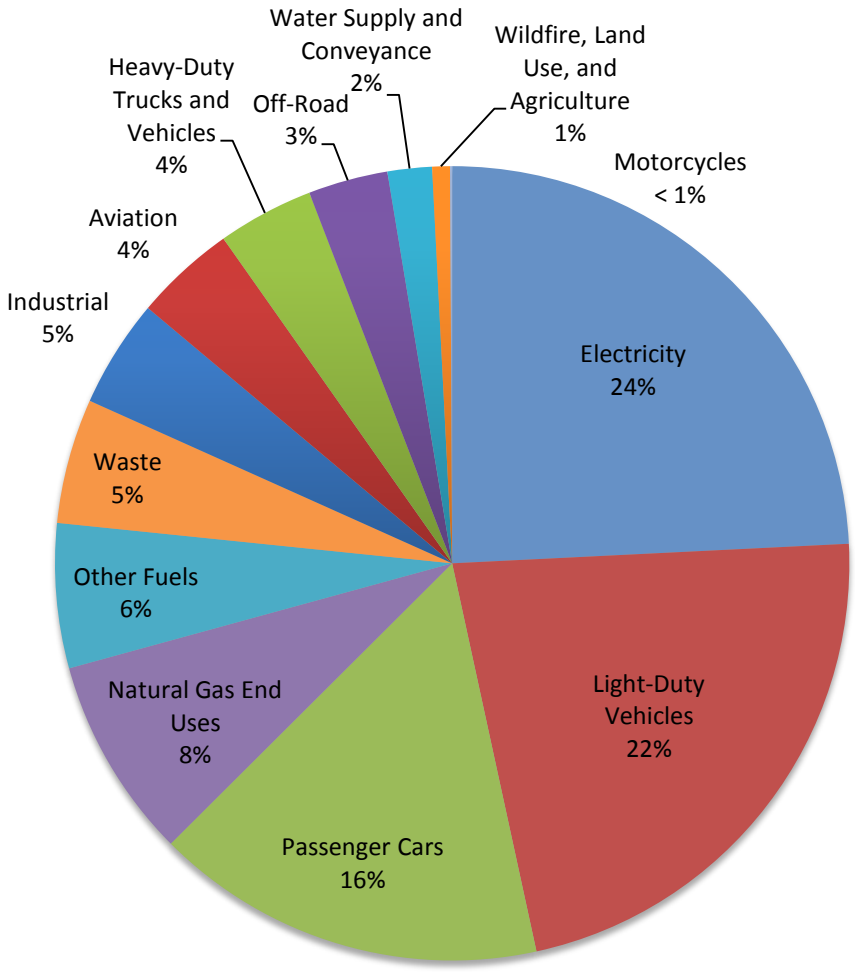
Source: Energy Policy Initiatives Center, University of San Diego, 2014.

[1]Note: "Energy" includes electricity, natural gas, and transportation fuels.

Greenhouse Gas Emissions by End-Use Category

Although many activities consume energy, most of the region's energy consumption and related GHG emissions are caused by three end-use categories of energy consumption: the movement of people and goods in the on-road transportation sector, electricity generation that provides power to homes and businesses, and natural gas for end-uses like space heating and cooking (Figure 4-9).

Figure 4-9: Summary of Greenhouse Gas Emissions by Category, 2012



Source: Energy Policy Initiatives Center, University of San Diego, 2014.

Note: Examples of Light-Duty Vehicles includes sport-utility vehicles, minivans, and pick-up trucks.

Transportation Fuels

The largest GHG emissions category in the region is on-road transportation, which accounts for nearly half of emissions (42%). Moreover, energy consumed by passenger cars and light-duty vehicles (pick-up trucks, sport utility vehicles), primarily gasoline for personal automobile transportation, accounts for about 90 percent of on-road transportation emissions, and about 39 percent of total emissions in the region.

The high level of GHG emissions from on-road transportation is due to the region's dependence on petroleum-based gasoline and diesel fuel, average vehicle efficiency, and levels of driving. On-road transportation also comprises a significant proportion of GHG emissions statewide. In response, the state has enacted several transportation-related laws and regulations calling for petroleum reduction, development of low-

carbon and alternative fuels, increased vehicle fuel efficiency, and improved land use and transportation planning to reduce VMT.

Electricity and Natural Gas End-Use Sectors

Electricity and natural gas end-uses account for about one-third (32%) of GHG emissions in the region. The GHG emissions from electricity generation are influenced by both overall consumption and sources of generation. About two-thirds (63%) of the fuel used to generate the electricity consumed in the region is natural gas. Older and relatively inefficient natural gas power plants, buildings, and end-use equipment also are factors that contribute to the level of emissions from electricity and natural gas.

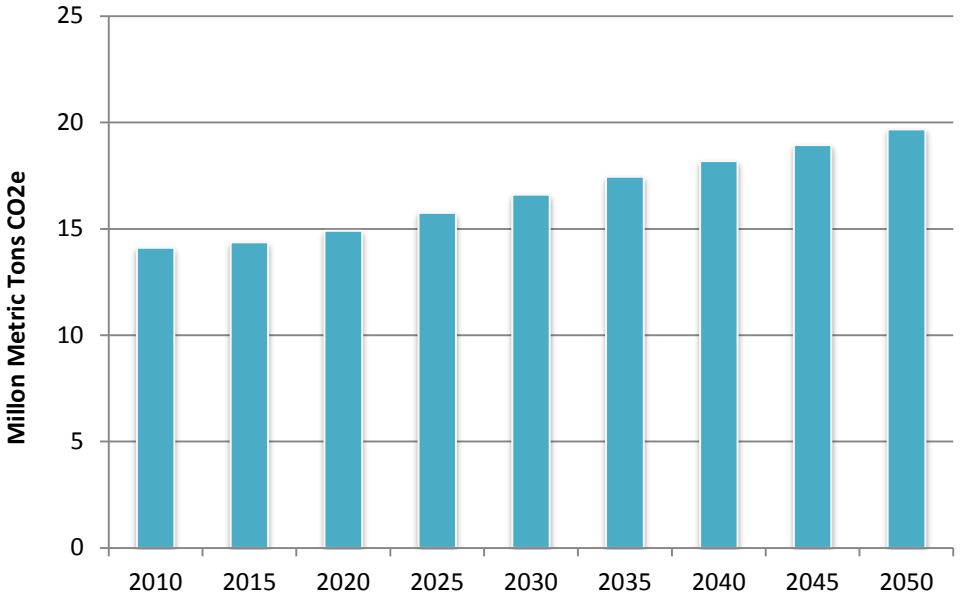
4.4.2 Greenhouse Gas Emission Projections

Under a business-as-usual scenario in which current energy use trends and policies do not change, total GHG emissions in the region will be approximately 35.8 $MMTCO_2e$ in 2020, approximately 8 percent greater than the 2012 level.

While the near-term goal of reducing statewide GHG emissions to the 1990 level by 2020 is ambitious but likely achievable with available policy measures and technology options, the long-term goal described in Executive Order S-3-05 to reduce statewide GHG emissions to 80 percent below the 1990 level by 2050 will require fundamental changes in policy, technology, and behavior.

The projected increases in GHG emissions for on-road transportation, natural gas, and electricity are shown in Figures 4-10, 4-11, and 4-12. Because the following figures are business-as-usual projections depicting the consequences of not taking action, the effect of new federal, state, and local policies is not shown.

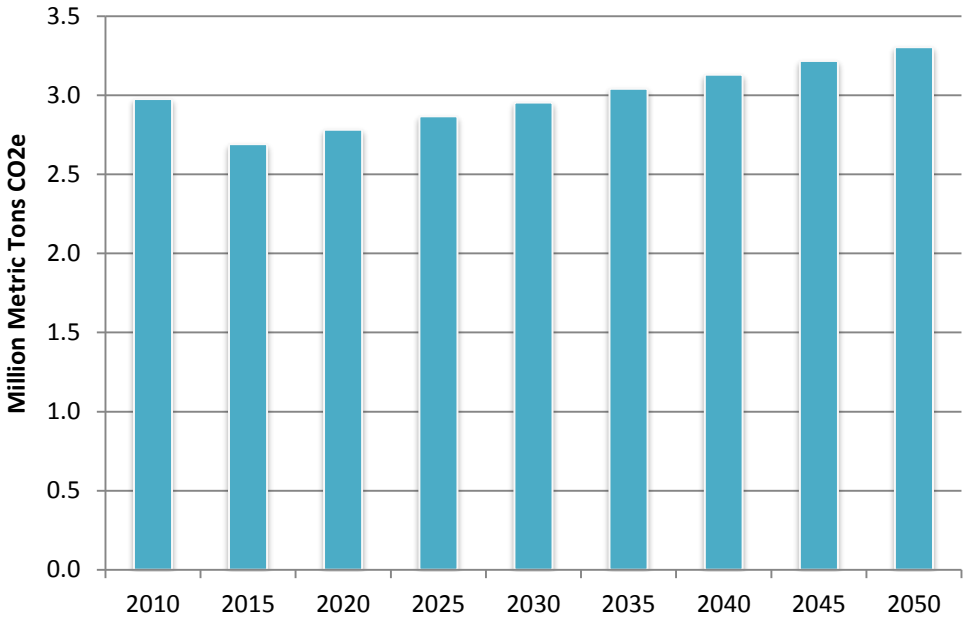
Figure 4-10: Total Projected Regional Greenhouse Gas Emissions from Transportation under Business-as-Usual Scenario, 2010-2050



Source: Energy Policy Initiatives Center, University of San Diego, 2014.

Note: Business-as-usual scenario does not include the effect of new federal, state, and local policies.

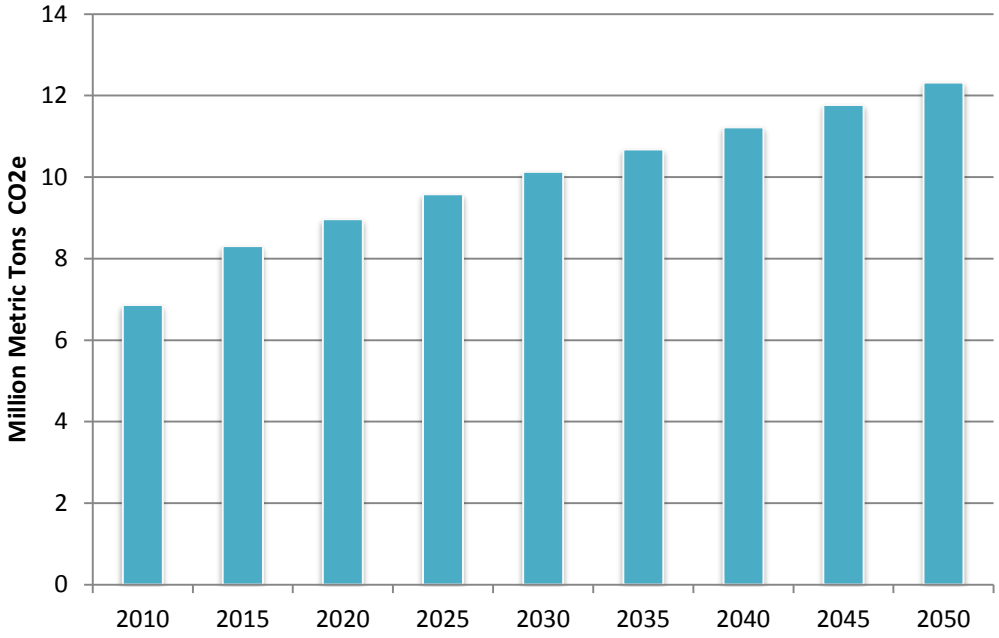
Figure 4-12: Total Projected Regional Greenhouse Gas Emissions from Natural Gas End-Uses under Business-as-Usual Scenario, 2010-2050



Source: Energy Policy Initiatives Center, University of San Diego, 2014.

Note: Business-as-usual scenario does not include the effect of new federal, state, and local policies.

Figure 4-13: Total Projected Regional Greenhouse Gas Emissions from Electricity Generation under Business-as-Usual Scenario, 2010-2050



Source: Energy Policy Initiatives Center, University of San Diego, 2014.

Note: Business-as-usual scenario does not include the effect of new federal, state, and local policies.

4.4.3 The Effect of Climate Change on Energy Needs

Environmental changes caused by climate change are expected to impact energy production and demand. In the San Diego region and statewide, climate change is projected to increase the risk of drought or water shortages during summer months. In addition, winter runoff may increase resulting in heightened risk of flooding. As a result of precipitation changes, hydroelectric power generation may be adversely affected. Lower runoff flows would decrease hydropower generation while higher flows often must be spilled past dams without generating any electricity.

In addition, increased average temperatures and longer and more extreme heat events associated with climate change are expected to increase peak demand for electricity. As a result, demand response strategies will become an even more important part of the region's energy strategy as a result of climate change.

More discussion of the connection between how we use energy, the deep GHG reductions required to address climate change, and the regional impacts of climate change is included in Chapter 3: Key Policy Drivers and in the Climate Change Mitigation and Adaptation White prepared for San Diego Forward: The Regional Plan.

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5

Regional Energy Goals

The Regional Energy Strategy (RES) is structured around 11 major energy topics identified during its development. For each topic, it identifies an overarching goal, a summary of relevant facts and issues, and a set of recommended actions that contribute to the goal. The recommended actions represent options for SANDAG, local governments, other regional entities, or potentially combinations thereof, to contribute to regional energy goals. Achieving many of the goals will require actions that go above and beyond existing requirements or would require funding amounts or types not provided through existing programs. Achieving the goals also will require regional and local governments to take active and innovative approaches, including securing needed funding.

Major Topic Areas with Goals in the Regional Energy Strategy

1. Energy Efficiency and Conservation
2. Renewable Energy
3. Distributed Generation
4. Energy and Water
5. Peak Demand
6. Smart Energy
7. Natural Gas Power Plants
8. Transportation Fuels
9. Land Use and Transportation Planning
10. Border Energy
11. Clean Energy Economy

Priority Early Actions

1. Pursue a comprehensive building retrofit program to improve efficiency and install renewable energy systems
2. Create financing programs to pay for projects and improvements that save energy
3. Utilize the SANDAG-SDG&E Local Government Partnership funding award to help local government identify opportunities and implement energy savings at government facilities and throughout their communities
4. Support land use and transportation planning strategies that reduce energy use and GHG emissions
5. Support planning of electric charging and alternative fueling infrastructure
6. Support use of existing unused reclaimed water to decrease the amount of energy needed to meet the water needs of the San Diego region

Broad Strategies to Implement Multiple Goals

1. Identify, secure, or develop funding mechanisms to pay for energy-related projects and programs
2. Educate and engage the general public or other stakeholders
3. Support enabling legislation or policy changes from state or federal government
4. Take early actions that set examples for residents and businesses
5. Develop standardized approaches and programs that can be

5.1 ENERGY EFFICIENCY AND CONSERVATION

Introduction

> ***Energy Efficiency and Conservation Goal:***
> Reduce per capita electricity consumption by 20% by 2030 in order to keep total electricity consumption flat.

Reducing energy use is the first priority in the state's preferred loading order for meeting new energy needs because it can help meet future energy needs and reduce greenhouse gas (GHG) emissions without significant investment in infrastructure and with little or no environmental impact. From a customer perspective, reducing energy use has direct and measurable benefits including cost savings. Energy use can be reduced by two related strategies: conservation and energy efficiency. Energy conservation refers to behavior changes that decrease energy use, such as turning off lights and changing thermostat settings. Energy efficiency includes programs that require buildings and appliances to be constructed in a manner that uses less energy, provide incentives for purchasing energy-efficient equipment, and provide information and education to encourage people to save energy. Energy efficiency refers to structural changes, such as replacing appliances with more efficient models, replacing incandescent lamps with compact fluorescent (CFL) or light-emitting diode (LED) lamps, or tuning up building systems to improve their energy performance. Efficiency and conservation are necessary and complimentary.

California has promoted energy efficiency through policies and programs that require buildings and appliances to be constructed in a manner that uses less energy, provide incentives for purchasing energy-efficient equipment, and provide information to encourage people to save energy. Since the 1970s, these programs have helped keep per capita electricity consumption flat.[3]

Energy efficiency measures for both electricity and natural gas can significantly reduce GHG emissions. Given the region's relatively low level of industrial activity, the primary focus is on improving energy efficiency, in both the existing building stock and new construction. In particular, the existing building stock presents a significant opportunity to achieve major improvements in energy efficiency. Because buildings typically have a lifespan of several decades, it is important to build in as much efficiency as possible.

[3] Source: California Energy Commission, Tracking Progress Factsheet: Statewide Energy Demand, 2013.
www.energy.ca.gov/renewables/tracking_progress/documents/statewide_energy_demand.pdf

5.1.1 California Energy Efficiency Policy

Key state energy efficiency policies include:

- Assembly Bill 758 (Skinner, 2009) (AB 758) requires the Energy Commission, in collaboration with the California Public Utility Commission (CPUC) and stakeholders, to develop a comprehensive program to achieve greater energy efficiency in the state's existing buildings.
- California's Energy Efficiency Standards for Residential and Nonresidential Buildings were established in 1978 and are regularly updated as relevant cost-effective improvements become available. The latest 2013 standards took effect on July 1, 2014. Local government building departments are responsible for enforcing these mandatory energy efficiency standards for buildings at the time of construction.
- The California "Green Building Action Plan" was developed in conjunction with the signing of Executive Order S-20-04, the "Green Building Initiative," in which the governor calls for state buildings to be 20 percent more energy-efficient by 2015 and encourages similar private sector efforts. Also as a result of the "Green Building Initiative," in 2010, the state adopted the California Green Building Standards Code (or CALGreen) as Part 11 of the California Building Standards Code.
- AB 2021 (Levine, 2006) requires an estimate of all potentially achievable cost-effective electricity and natural gas efficiency savings and establishment of annual statewide targets for energy efficiency savings and demand reduction over 10 years. AB 2021 is a key legislative mechanism for utilities to expand their energy efficiency programs.
- The Climate Change Scoping Plan, which outlines GHG reduction measures in the electricity and natural gas sectors through building and appliance standards, implementing additional conservation and efficiency programs, increasing combined heat and power (CHP), solar water heating systems, and the like.
- The CPUC Long-Term Energy Efficiency Strategic Plan, which provides a roadmap to achieve maximum energy savings across all sectors in the state including local government, and identified four "Big Bold Energy Efficiency Strategies":
    1. All new residential construction in California will be zero net energy (ZNE) by 2020[4];
    2. All new commercial construction in California will be ZNE by 2030;
    3. Heating, ventilation, and air conditioning will be transformed to ensure that its energy performance is optimal for California's climate; and

[4] A ZNE building combines building energy efficiency design features and clean onsite or near-site DG of sufficient quantity on an annual basis to offset any residual purchases of electricity or natural gas from utility suppliers.

4. All eligible low-income customers will be given the opportunity to participate in the low-income energy efficiency program by 2020.

The strategic plan also specifically calls upon local governments to do the following[5]:

- At least 5 percent of California's local governments (representing at least 5 percent of California total population) each year adopt "reach" (enhanced energy efficiency) codes.
- By 2020, the majority of local governments have adopted incentives or mandates to achieve above-code levels of energy efficiency in their communities, or have led statewide adoption of these higher codes.
- The current rate of non-compliance with codes and standards is halved by 2012, halved again by 2016, and full compliance is achieved by 2020.
- By 2015, 50 percent of local governments have adopted energy efficiency/sustainability/climate change action plans for their communities and 100 percent by 2020, with implementation and tracking of achievements.
- The plan also identifies the following areas where local government authority can reduce energy use in new and existing buildings:
    1. Ensuring compliance and enforcement of the Title 24 energy code for residential and commercial buildings.
    2. Adopting building codes beyond Title 24's energy requirements (and potentially other "green" requirements).
    3. Supporting highly efficient projects that voluntarily exceed minimum energy codes through favorable fee structures, fast-tracked permitting and other innovative and locally appropriate approaches.
    4. Enacting ordinances with point-of-sale or other approaches that spur efficiency actions in existing, privately-owned buildings.
    5. Applying efficiency-related "carrots" and "sticks" using local zoning and development authority.

5.1.2 California Energy Efficiency Programs

In September 2009, the CPUC issued a decision to approve energy efficiency programs for 2010 - 2012, establishing a 3-year budget of $3.1 billion for Southern California Edison (SCE), Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), and Southern California Gas Company. This is the largest commitment ever made by a state to energy efficiency. Statewide, these programs surpassed the program goals and achieved an estimated energy savings of 10,500 gigawatt hours, 1,903 megawatts (MGs), and 156 million metric therms of

[5] The CPUC is working with investor-owned utilities like SDG&E to develop a menu of strategies that local governments could implement through local government partnerships to contribute to the Strategic Plan goals.

natural gas. The funding from this decision was estimated to create between 15,000 and 18,000 skilled green jobs statewide. Subsequently, the CPUC approved programs for the 2013-14 transition cycle, establishing a budget of $1.9 billion for the investor-owned utilities (IOUs) and three non-utility programs: two regional energy networks and a community choice aggregator.

The 2010-12 program cycle included the creation of a new statewide program for residential energy efficiency – Energy Upgrade California – the largest and most comprehensive residential retrofit program in the country, aiming to reduce energy consumption by 20 percent for up to 130,000 California homes by 2012. The decision also funded $175 million for innovative programs to deliver ZNE homes and commercial buildings, including design assistance, incentives for "above code" construction, and research and demonstration of new technologies and materials.

The 2010-12 program cycle included over $260 million in funding for 64 cities, counties, and regional agencies for local efforts targeting public sector building retrofits and leading edge energy efficiency opportunities. Over $100 million went to education and training programs at all levels of our educational system to ensure a steady pipeline of skilled blue and white collar energy efficiency professionals.

The American Recovery and Reinvestment Act of 2009 (ARRA) was passed by Congress and signed into law by President Barack Obama on February 17, 2009. The $787 billion economic stimulus package, increased to $840 billion in 2012, provided $355 billion for a variety of sectors, including energy efficiency programs primarily through the Energy Efficiency and Conservation Block Grant Program (EECBG). EECBG funding enabled local governments in the region to implement projects and programs that reduce total energy use and fossil fuel emissions and improve energy efficiency in multiple sectors. The Energy Commission also received an ARRA award of $226 million for the State Energy Program (SEP). The SEP provides grants to states to help address energy priorities and program funding to finance renewable energy and energy efficiency improvements in buildings. The SEP is an important component of the overall strategy for making buildings and industrial facilities more energy-efficient.

5.1.3 Electricity Consumption Overview

Within buildings, lighting usually comprises the largest portion of electricity usage, roughly 20-25 percent of the total. Air conditioning is likely to be the largest single energy user for buildings in hotter climate zones in the region. Central, wall-unit, and so-called “split” air-conditioning systems available today are significantly more energy-efficient relative to older systems.

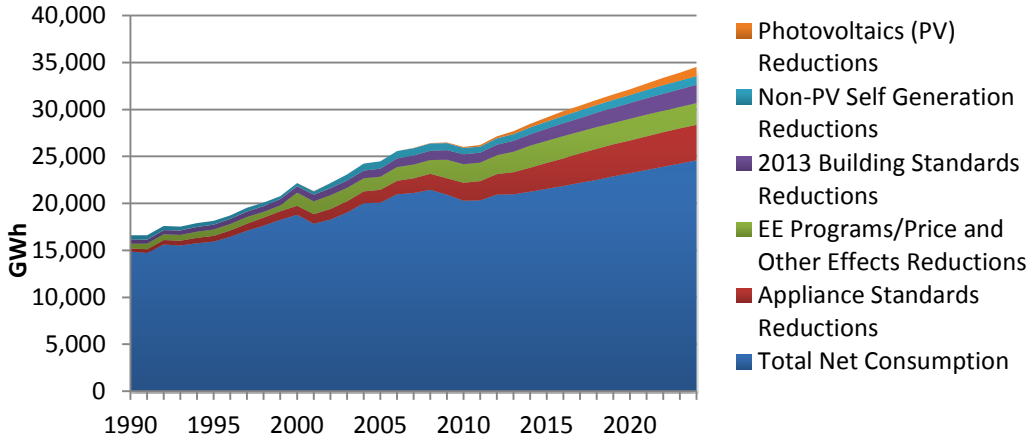
In addition, “plug loads” collectively account for around 25 percent of overall household energy use in California – more than the refrigerator in most homes. Plug loads are smaller electrical devices or appliances that draw power through an electric outlet, such computers and their peripherals; televisions and entertainment systems; and a wide variety of electronics and rechargeable devices. Further, many electronics and electronic components of appliances use electricity even when the device is not being used. Consumers are often unaware that they are of paying higher electricity bills to cover this “phantom” usage (also called “standby” power). Some estimates show standby power to be as much as 10 percent of a home’s electricity consumption. While state and federal governments work with the manufacturing industry to establish and strengthen energy standards for appliances and electronics to reduce demand from plug loads, consumer education about plug loads and efficient appliances in the marketplace can also reduce electricity consumption.

Approach to Meeting the Energy Efficiency Goal

Keeping total electricity consumption in the residential and commercial sectors flat through 2030 will require increased energy conservation and efficiency efforts, above and beyond existing state policy and utility-administered programs described above. As shown in Figure EE-1, additional measures are needed to keep total residential and electricity consumption flat through 2030.

The future electricity projections presented here do not take into account potential growth in electricity consumption due to plug-in electric vehicles (PEVs). As discussed further in Section 5.8. Transportation Fuels, plug-in electric vehicles can help the region meet its goals for reducing GHG emissions, improving air quality, and reducing dependence on imported petroleum fuels. While initial market penetration of PEVs likely can be accommodated by the existing electricity grid, conversion of a substantial portion of the vehicle fleet to plug-in vehicles has the potential to increase total electricity consumption, and interfere with the goal of keeping consumption flat, as well as increase peak demand.

Figure EE-1: Actual and Projected Impacts of Energy Efficiency Measures in the San Diego Region 1990-2024 (above and beyond business as usual)



Source: University of San Diego Energy Policy Initiatives Center, 2014.

Table EE-1 depicts the potential electricity savings from select energy efficiency measures that could be implemented by local governments (except for increased utility program funding and new appliance standards).

Table EE-1: Regional Electricity Savings Targets for Energy Efficiency [1,2]

Measures	2030 Reductions (2007 baseline)	
Increased utility energy efficiency program funding	675 GWh	3.0 %
Comprehensive residential building retrofit program	1482 GWh	6.7 %
Comprehensive commercial building retrofit program	572 GWh	2.6 %
New construction building standards (post-2009 updates)	260 GWh	1.2 %
Appliance standards (post-2009 updates)	447 GWh	2.0 %
Total electricity reduction from above measures	3438 GWh	15.6 %
Reduction in total electricity consumption due to energy efficiency	22 GWh	0.1 %
Reduction in per capita electricity consumption due to energy efficiency	N/A	22.2 %

Source: California Center for Sustainable Energy, 2009. Notes: 1) Energy efficiency measures are above and beyond currently funded energy efficiency programs. 2) Table does not include transportation fuels.

Local governments have the opportunity to use their authority and influence to help achieve the needed additional energy efficiency savings to achieve the goal for 2030. Table EE-1 shows that the retrofits of existing residential and commercial buildings, particularly residential buildings, offer the greatest potential for additional energy efficiency savings. However, there are challenges to increasing the efficiency of existing buildings. The upfront costs of an energy audit and energy improvements can be

expensive. In addition, there is little incentive for renters in the residential sector or lessees in the commercial sector to pay for energy-saving improvements because they do not own the property. At the same time, there is little incentive for an owner to pay for energy improvements because they do not pay the energy bill. This concept is known as the "split incentive."

Also, although numerous energy efficiency programs exist for residential and commercial buildings, they generally focus on individual building components. Longer term and larger energy savings can be achieved through more comprehensive or holistic programs that take an integrated approach to evaluating an entire building and creating prioritized packages of measures. Measures can include lighting, insulation, windows, space and water heating, space cooling, ductwork, weatherization, electronics, appliances, swimming pools, and spas. In general, efficiency upgrades are not required retroactively for existing buildings. As a result, policies and programs, and especially funding mechanisms, are needed to achieve energy efficiency savings in the region's existing building stock.

5.1.4 Pursuing Energy Efficiency in Existing Buildings

To determine how much energy an existing building uses, including the devices plugged into its electrical outlets, an energy audit serves as an essential first step. The audit can identify both energy usage and opportunities where energy can be saved. The "Home Energy Rating System" program, better known as HERS program, is a nationally recognized system to conduct whole-house energy assessments. HERS raters perform a comprehensive audit for existing homes. Building performance contractors are certified to perform audits for residential and nonresidential buildings as well.[6]

An energy audit can discover inefficiencies and provide solutions for increased efficiency. In addition, the audit is an opportune time to assess potential for installing a distributed generation (DG) system, such as rooftop solar photovoltaics (PVs) or a fuel cell, along with or after any energy efficiency improvements have been made. This topic is addressed further in Section 5.3, DG.

[6] However, there is a significant lack of trained HERS raters in the San Diego region, a void that could be addressed through new training programs. These programs could build from previous programs, like the "Healthy Homes" program funded by the City of San Diego and U.S. Department of Housing and Urban Development, which utilized an integrated approach to remediation issues in existing building stock.

Potential Funding Mechanisms for Energy Efficiency

Building owners often need financial assistance to implement energy-saving projects due to upfront purchase and installation costs. Energy efficiency financing mechanisms exist but some are new, not well known, not widely used, or only available to certain customers. Mechanisms include utility on-bill financing, property-assessed financing, low interest loans for energy efficiency improvements, rebates, incentives, and federal and state tax credits. A local workforce of trained contractors also is needed to perform building retrofits and other assessments.

Upfront costs can be offset by participating in an on-bill financing (OBF) program, which allows utility customers to pay for energy-efficient improvements through their monthly energy bills. The utility offers an upfront loan used to pay for the cost of the qualifying measure. The energy savings realized from the improvement are used to pay back the loan through monthly utility bills, and once the loan is paid off, monthly bills are permanently lower. SDG&E offers an OBF program for business and government customers participating in demand response programs.

Property Assessed Clean Energy or "PACE" programs, also commonly referred to as Assembly Bill 811 (Levine, 2008) (AB 811) style programs, can serve as a financing mechanism to implement energy efficiency and renewable energy projects. PACE programs allow local governments to offer sustainable energy project loans to eligible property owners. Through the creation of financing districts, property owners can finance energy efficiency improvements and renewable onsite generation installations through a voluntary assessment on their property tax bills.

AB 811 allows local government entities to offer sustainable energy project loans to eligible property owners. With the creation of assessment financing districts, interested property owners can finance energy efficiency projects, solar PV installations, and possibly other improvements fixed to real property through an assessment on their property tax bills. This mechanism allows property owners to avoid high upfront installation costs and eliminate concern they might sell the property before seeing full return on that high upfront investment. The result is that property owners within AB 811-type financing districts can finance their improvements with reduced financial risk.

Some local governments are developing their own individual municipal financing programs, while others are opting in to programs that serve multiple jurisdictions through a joint powers authority (JPA). Using a JPA allows for the PACE program to aggregate demand from local governments to relieve them of the burden of establishing financing districts and accessing the bond market for funding.

PACE participation throughout the San Diego region varies by jurisdiction. There are four primary PACE finance program providers, which include three JPA programs: CaliforniaFIRST, FigTree, and HERO, and one unique program offered in Chula Vista by Ygrene. Both residential and commercial financing are available through these programs. Participation in available PACE programs in the San Diego region is growing rapidly since PACE became available in 2009. As of August 2014, all 19 local jurisdictions are currently participating in at least one PACE Program.

Another example of a financing mechanism is the energy-efficient mortgage (EEM). An EEM allows new or current homeowners to finance the purchase of a home (or refinance a current mortgage) and include the value of energy saving, cost efficient improvements. EEMs can be used to purchase a new energy-efficient home or to finance new improvements to existing homes (also known as an Energy Improvement Mortgage, or EIM). Because cost-effective energy improvements can result in lower utility bills, making more funding available for a mortgage payment, energy efficiency improvements can be directly included in the EEM without the need to qualify for additional financing. By giving borrowers the opportunity to finance improvements as part of a single mortgage, an EEM can also stretch the debt-to-income qualifying ratio and enable homebuyers to qualify for a larger loan amount (and a more energy-efficient home).

EEMs are sponsored by federally insured mortgage programs and the conventional secondary mortgage market (Fannie Mae and Freddie Mac). Several types of EEM programs are available. Eligibility for individual EEM programs varies, but in general there is no age limit or income level required. Typically, all programs require that a home energy rating be conducted to provide the lender with an estimate of the “Energy Savings Value,” which includes monthly energy savings and the value of existing/planned energy efficiency measures.

5.1.5 SANDAG Local Government Partnership

As part of CPUC funding for local efforts targeting public sector building retrofits, SANDAG was awarded $1.7 million in funding for a Local Government Partnership with SDG&E during the 2010-12 program cycle. The Partnership was extended in 2012 and SANDAG received $1.26 million for the 2013-14 cycle. The Partnership enables SANDAG and SDG&E to make energy planning assistance available to local governments through the Energy Roadmap Program and participate in collaborative regional energy efficiency programs.

Energy Roadmap Program

The Energy Roadmap Program is an expansion of the SANDAG Sustainable Region Program (SRP). The SRP began as a pilot program with the City of Carlsbad from 2005-06. The pilot program identified almost $200,000 in available energy savings through cost-effective energy efficiency measures and the city was able to save 489,571 kWh in energy consumption through local energy efficiency programs. The SRP was later expanded to the cities of Solana Beach and Poway.

Since the cities of Chula Vista and San Diego and the County have individual partnerships with SDG&E, the SANDAG-led initiative is primarily targeted at local governments without full-time energy staff and that have minimally participated or not participated in available energy-saving programs. The energy planning assistance is expected to help local governments save money, use less energy, and reduce GHG emissions.

The Energy Roadmap Program focuses on the identification of energy-saving measures for local government operations, as well as policy measures that local governments could implement to realize energy savings for residents, businesses, and throughout their communities. Within the energy roadmap are eight general categories:

1. Saving Energy in City Buildings and Facilities
2. Demonstrating Emerging Energy Technologies
3. Greening the City Vehicle Fleet
4. Developing Employee Knowledge of Energy Efficiency
5. Promoting Commuter Benefits to City Employees
6. Leveraging Planning and Development Authority
7. Marketing Energy Programs to Local Residents and Businesses
8. Supporting Green Jobs and Workforce Training

The building assessment portion of the Energy Roadmap Program is divided into three phases: Phase 1 includes the completion of facility assessments and rate analysis, and the development of a list of energy conservation measures (ECMs) and the associated energy and cost savings; Phase 2 includes a more in-depth analysis of facilities that require additional research, data-logging, or energy modeling; and Phase 3 focuses on implementation of ECMs that are of interest to a jurisdiction. All cities either have a completed or in-progress Roadmap, the focus during the 2013-14 cycle is to complete remaining Roadmaps and offer implementation assistance to cities with completed Roadmaps.

SANDAG has also partnered with the City of Chula Vista to offer an additional method for Energy Roadmap implementation to the South Bay cities of Coronado,

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

Regional Energy Efficiency Programs

SANDAG coordinates with other SDG&E Local Government Partners, including the cities of San Diego and Chula Vista, County of San Diego, and San Diego Unified Port District on regional energy efficiency programs through the San Diego Regional Energy Partnership. This partnership includes the continuation and expansion of the San Diego Regional Climate Collaborative, the Regional Energy Mapping Project, and other Energy Upgrade California programs previously funded under ARRA or similarly related efforts.

5.1.6 Recommended Actions to Promote Energy Efficiency and Conservation

SANDAG, local governments, or other regional entities can undertake the following actions to support energy efficiency and conservation. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions also would contribute to other energy goals, and the energy efficiency goal would be enhanced by recommended action identified in other topic areas, as described below.

Recommended Actions to Promote Energy Efficiency and Conservation	
SANDAG	**Recommended Action**
EE-1	Provide energy efficiency planning and implementation assistance to local governments through the SANDAG Energy Roadmap Program.
Local Governments	**Recommended Action**
EE-2	Establish building energy rating and disclosure policies that inform building owners of their energy usage.
EE-3	Develop a policy to include energy star appliances in new construction.
EE-4	Exceed Title 24 energy requirements for new construction through regulations or incentives that work toward an overall goal of ZNE new homes by 2020 and ZNE new commercial buildings by 2030.
EE-5	Increase enforcement of building energy requirements to reduce the rate of noncompliance.
EE-6	Adopt policies and engage in existing programs that lead to energy efficiency retrofits in existing buildings (e.g., reduced permit fees, Residential Energy Conservation Ordinance policies).
EE-7	Support increased use of solar water heating in residential, pool, and commercial uses to offset natural gas demand (e.g., pre-plumb policies).
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
EE-8	Develop model language for a range of policies that seek to reduce energy use in existing buildings and new construction.
EE-9	Support implementation of AB 758 through a whole-building retrofit program and efforts to improve energy efficiency in existing residential, commercial, municipal, and other buildings.
EE-10	Establish financing programs (using public or private sources) that residents and businesses can access to conduct energy assessments and make energy efficiency retrofits to existing buildings, as well as other energy-related improvements such as distributed PV installations.
EE-11	Conduct an assessment of the regional residential and commercial building stock to determine the potential magnitude of energy savings, their contribution to the energy efficiency and conservation goal, and geographical concentrations of retrofit opportunities.
EE-12	Provide information and resources to help residents, businesses, developers, builders and others improve energy efficiency and conservation in new and existing buildings.

5.2 RENEWABLE ENERGY

Introduction

After energy efficiency and demand response, the state's preferred loading order calls for meeting electricity needs and reducing GHG emissions with renewable resources, including onsite power systems such as PV solar panels and utility-scale electricity projects that convert solar and wind resources into electricity.

Renewable Energy Goal:
Support the development of renewable energy resources to meet a 33% renewable portfolio standard (RPS) by 2020 and exceed 33% beyond 2020.

This section discusses the need to increase utility-scale renewable energy projects and the potential challenges that arise, such as impacts to sensitive environmental resources and landscapes. Renewable onsite power systems, and clean, nonrenewable onsite power systems are addressed in Section 5.3, DG.

In general, renewable energy resources include:

- Wind (produced in windy locations usually at wind farms to generate electricity),
- Solar (systems powered by the sun to provide heat or generate electricity including PV, concentrated solar power, and solar thermal),
- Geothermal (systems using thermal energy from beneath the earth's surface to provide heat and generate electricity),
- Biogas (captured from landfills and sewage at wastewater treatment plants),
- Biomass (technologies that burn primarily paper, wood, tree trimming, and other similar "green" waste as fuel),
- Hydro power (flowing water that drives a turbine to generate electricity), and
- Offshore wave power (built along shorelines, systems extract energy in breaking waves).

The advantages of utility-scale renewable energy can include lower GHG emissions, energy price stability, and ability to bring large amounts of power online quickly. Many renewables resources such as wind and geothermal are cost-competitive with fossil fuel energy sources and can be carried on existing transmission infrastructure. Renewables also can displace the need for fossil fuel-powered generation.

A mixture of utility-scale renewable resources can support a stable and reliable electricity grid. Resources like biomass, geothermal, and small-scale hydroelectric generation can provide baseload power. Some renewables such as solar thermal technologies have the potential to store energy for an extended period and provide power generation into evening hours (i.e., after the sun goes down). Some renewable technologies like solar thermal also may be able to operate in a hybrid mode as typical natural gas or biomass-fired power plant with characteristics similar to a baseload power plant. Other renewable resources are intermittent such as wind or solar. The integration of large amounts of intermittent generation into the electricity system will require grid improvements to accommodate variation in power availability and improve grid reliability such as improved communications technology, automated demand response, and other modern technologies that would be possible with a smart grid (see Section 6 for further discussion).

Key state policies related to renewable energy production include:

- Senate Bill 1078 (Sher, 2002), which establishes California's Renewables Portfolio Standard (RPS) requiring retail sellers of electricity to procure 20 percent of retail sales from renewable energy by 2017.
- Energy Action Plans I (2003) and II (2005), which recommended accelerating the RPS deadline to 20 percent by 2010, and recommended a further goal of 33 percent renewables by 2020, respectively.
- SB 107 (Simitian, 2006), which accelerated the 20 percent target to 2010 and authorizes a system of tradable renewable energy credits (RECs).
- Executive Order S-06-06 (2006), which established a biomass target for 20 percent within the RPS goals for 2010 and 2020.
- Executive Order S-14-08 (2008), which established accelerated RPS targets (33% by 2020) as recommended in Energy Action Plan II. The order also called for the formation of the Renewable Energy Action Team, comprised of the Energy Commission, Department of Fish and Game, Bureau of Land Management, and U.S. Fish and Wildlife Service. Through the team, the Energy Commission and the Department of Fish and Game are to prepare a plan for renewable development in sensitive desert habitat.
- Executive Order S-21-09 (2009), which directs the CARB to work with the CPUC, the California Independent System Operator (CAISO), and the Energy Commission to adopt regulations increasing California's RPS to 33 percent by 2020. CARB must adopt these regulations by July 31, 2010.

- SB X1-2 (Simitian, 2011), which requires all electricity retailers in the state, including publicly owned utilities, IOUs, electricity service providers, and community choice aggregators to adopt RPS goals of 20 percent by the end of 2013, 25 percent by the end of 2016, and 33 percent by the end of 2020.

Key state policies related to renewable energy and transmission infrastructure include:

- SB 1565 (Bowen, 2004) addresses the need for an official state role in transmission planning with the passage of this bill. SB 1565 directed the Energy Commission to develop a Strategic Transmission Investment Plan, which identifies and recommends actions to stimulate transmission investments to ensure reliability, relieve congestion, and meet future growth in load and generation, including renewable resources, energy efficiency, and other demand reduction measures.
- SB 1059 (Escutia and Morrow, 2006), which continued to develop an integrated, statewide approach to electric transmission planning and permitting to address the state's critical energy and environmental policy goals. This bill provided a bridge between the transmission planning process and the permitting process by designating transmission corridor zones on state and private lands available for future high-voltage electricity transmission projects, consistent with the state's electricity needs identified in the IEPRs and plans.

Many state strategies and programs have been implemented to increase renewable energy generation consistent with these policies, including Energy Commission's Renewable Energy Program, the RPS Program jointly administered by the Energy Commission and CPUC, the Renewable Energy Transmission Initiative, the Desert Renewable Energy Conservation Plan, feed-in tariffs for renewable generators, the Bioenergy Action Plan, and multiple Research, Development, and Demonstration activities.

5.2.1 Renewable Energy Credits

The REC is a certificate representing the environmental benefit of a given unit of renewable energy production. A REC can be sold in either "bundles" with the underlying energy or "unbundled," as a separate commodity for the energy itself, into a separate REC trading market. In California, RECs are used to show compliance with the RPS, and they can be traded in voluntary markets. For the RPS, electric retail sellers must buy eligible renewable energy and associated RECs to comply with the state RPS requirements.

5.2.2 Renewable Energy in the San Diego Region

The renewable energy targets developed for the 2003 RES were considered aggressive at the time. Since then, state laws and policies have called for more aggressive targets. As discussed above, SB X1-2 requires all electricity retailers in the state to achieve a 33 percent RPS by 2020. The state does not currently set policy for the RPS beyond 2020.

Table RE-1: Renewable Energy Targets for San Diego County

Targets	2010	2020	2030
RES Targets from 2003 strategy	15%	25%	40 %
RES Targets for 2009 strategy (% of sales)	20%	33%	45 %

Renewable Energy and Electricity Prices

The CPUC, Energy Commission, and other agencies are conducting financial analyses to learn the cost and benefit impacts of meeting the 33 percent renewable energy target by 2020. Initial CPUC analysis shows that electricity costs will increase in 2020, regardless of renewable resource requirements. As shown in Table RE-2, the preliminary analysis indicates that the cost of producing statewide electricity with a 20 percent RPS in 2020 is comparable to the cost of generating the same amount of electricity with all natural gas. Achieving a 33 percent RPS by 2020, is estimated to cost approximately 7 percent more than using all natural gas generation sources.

Table RE-2: Electricity Costs in 2020 under Renewable Portfolio Standard and Natural Gas Scenarios

	2008	All-Natural Gas Scenario in 2020	20% RPS Reference Case in 2020	33% RPS Reference Case in 2020
Total Statewide Electricity Expenditures	$36.8 billion	$49.2 billion	$50.6 billion	$54.2 billion
Average Statewide Electricity Cost	$0.132 per kWh	$0.154 per kWh	$0.158 per kWh	$0.169 per kWh

Source: CPUC/E3, June 2009

The all-natural gas scenario may grow more costly with passage of federal climate change laws. A greater demand for natural gas may occur in places reliant on coal. The added competition could raise prices (for example, San Diego natural gas prices are

impacted by price spikes in the eastern United States) and reduce available supply. If this scenario occurs, increasing renewable energy supply may help insulate the region from higher-priced finite natural gas resources. Historical average electricity prices by customer class are shown in Table RE-3. However, natural gas prices have been volatile in recent history, and price forecasts have been highly inaccurate. See Section 7. Natural Gas Power Plants, for more discussion of natural gas prices. Renewable energy is expected to provide more price stability than more volatile natural gas.

Table RE-3: Historical Average Electricity Prices by Customer Class (in cents per kilowatt-hour)

Year	Residential		Commercial		Industrial	
	SDG&E	CA	SDG&E	CA	SDG&E	CA
1990	10.7	10.4	9.6	10.6	6.6	7.7
2000	14.1	11.5	14.5	11.5	12.0	7.9
2005	16.4	12.7	17.2	14.7	11.1	10.6
2010	14.1	13.6	14.6	16.5	14.1	12.5

Source: Energy Almanac, California Energy Commission, 2013

Potential Impacts of Renewable Energy

Renewable energy can provide environmental benefits to the region by improving air and water quality and reducing GHG emissions. Adding large amounts of renewables can also present challenges. Conflicts could arise between the broader goal of reducing GHG emissions and the specific environmental impacts of additional renewable infrastructure such as power lines to access renewable resources or renewable energy projects that could impact sensitive habitats or communities. While residents are generally supportive of renewable energy and its environmental benefits, many citizens are concerned about renewable energy projects and transmission lines because of their potential for environmental and aesthetic impacts. For example, proposed solar projects located in the California desert may impact sensitive species habitat or may require large amounts of water, while transmission lines could adversely affect sensitive environmental resources or pristine landscapes. Some desert solar technologies such as PV and dish-Stirling use little water (for cleaning only) while cooling towers could be used for solar thermal power plants to significantly reduce water use. The impacts of solar projects to the landscape can also vary significantly from major grading activity to little-to-no disturbance to the landscape. Wind projects use only a small percentage of

the project site for turbines and service roads, leaving most of the site available for compatible uses.

State Initiatives are already underway to facilitate the early identification and resolution or to avoid land use and environmental constraints to promote timely development of renewable generation resources and associated transmission lines.

Even with the RPS requirements, dispatchable power (most likely natural gas power plants) will provide much of the power supply to the grid. This dispatchable power along with utility-scale renewables to the extent they are equipped with energy storage or hybrid operating characteristics will provide stability and reliability to balance power supplied from renewables that are variable in nature, such as wind and solar. Additionally, there may be need for energy storage and other technologies to provide the kinds of services that electricity and transmission systems need to operate reliably. Although new natural gas plants are more efficient and cleaner burning than older gas plants, some of the efficiency and emission benefits may be lost if such plants are frequently ramped up and down to firm up variable renewables. Many factors will influence the mixture of renewables, fossil fuels, and other sources providing power to the grid including weather conditions, load characteristics, geographic dispersion of renewables, implementation of smart grid technologies, the extent to which PEVs can feed power to the grid, and others.

5.2.3 Barriers to Renewable Energy Development

In order to reach the renewable energy targets, certain permitting barriers must be addressed. Renewable generation facilities must receive a site permit in order to construct a project. The California Energy Commission is responsible for approving permits for thermal power plants 50 MGs and greater. All other projects must receive a county or city permit. Projects on federal land also must receive permits from the appropriate federal agencies, usually the Bureau of Land Management or the United States Forest Service. Most renewable facilities in California require permits from federal and state agencies since renewable resources often are located on lands within federal and state jurisdiction. In recent years, permitting entities have been inundated with applications for new renewable energy facilities, causing project delays. Governor's Executive Order S-14-08, discussed previously, seeks to remove permitting barriers to renewable energy projects. The Energy Commission and Department of Fish and Game also adopted a one-stop permitting process to streamline the process, which has generally reduced application times by half.

Many renewable electrical generation facilities need to be located near the site where geothermal, wind, and solar resources are available, and, therefore, need new transmission lines to connect to existing transmission infrastructure. New transmission

lines often require lengthy permitting processes and, as discussed above, can have the potential to result in significant adverse impacts to conservation areas and landscapes. These factors may impede the development of renewable resources. Potential adverse impacts will need to be weighed against positive impacts such as lower GHG emissions, price stability, and improved air quality.

Connecting to the electricity grid to supply clean power to resource load centers like the San Diego region is generally cost prohibitive for a single renewable energy project. Since multiple renewable projects are often located within a renewable resource area, CAISO is developing a framework for multiple projects within a transmission constrained renewable resource area to share the costs of connecting to the grid. The magnitude and scale of infrastructure necessary for California to meet the 33 percent target for 2020 has never before been planned, permitted, procured, developed, and integrated in such a short time horizon. The CPUC identified several measures that must be implemented in the near-term if achieving a 33 percent RPS by 2020 is to be a top priority, including:

- Planning now for adequate transmission and generation capacity to meet long-term needs for increased generation from renewable energy sources.
- Procuring electricity from resources that are not dependent on new transmission such as distributed solar PV.
- Concentrating renewable development in pre-permitted land that could be set aside for a renewable energy park.

5.2.4 Recommended Actions to Support Renewable Energy

SANDAG, local governments, or other regional entities can undertake the following actions to support the development of renewable energy. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions will contribute to other energy goals, and likewise be enhanced by recommended actions identified in other topic areas, as described below.

Recommended Actions to Promote Renewable Energy	
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
RE-1	Identify potential locations in the region that could accommodate utility-scale renewable energy infrastructure.
RE-2	Explore options to pre-permit zones of appropriate land for renewable energy development.
RE-3	Identify existing barriers to siting large-scale renewable energy installations (e.g., renewable energy parks) in the San Diego region.
RE-4	Support cost-effective transmission access and related infrastructure that will help the region meet or exceed requirements for procuring electricity from renewable resources while protecting environmental and other resources.
RE-5	Monitor related state efforts and consider recommendations in future regional planning.

5.3 DISTRIBUTED GENERATION

Introduction

Distributed Generation Goal: Increase the total amount of clean DG (renewable and non-renewable) to reduce peak demand and diversify electricity resources in the San Diego region.

After energy efficiency and demand response, increased use of renewables and DG systems is the preferred strategy for meeting the state's GHG reduction goals while satisfying demand for energy. Distributed energy systems are complementary to traditional electric power systems, and include small-scale power generation technologies such as PV, small wind turbines, and cogeneration systems located close to where energy is being used. The advantages of distributed energy systems include increased grid reliability, energy price stability, and reduced GHG emissions. The following state policies encourage the use of DG systems:

- AB 1969 (Yee, 2006) authorized feed-in tariffs for small renewable generators of less than 1 MW at public water and wastewater treatment facilities. In July 2007, the CPUC (D. 07-07-027) implemented AB 1969 and expanded the feed-in tariffs to 1.5 MW and included non-water customers in the PG&E and SCE territories (SDG&E territory was included by later legislation). The power sold to the utilities under feed-in tariffs can be applied towards the state's RPS targets.
- AB 2466 (Laird, 2008) Government Renewable Energy Producers, which authorizes a city, county (whether general law or chartered), special district, school district, political subdivision, or other local public agency, if authorized by law to generate electricity to receive a bill of credit to a designated benefiting account for electricity exported to the electric grid by an eligible renewable generating facility. Additionally, the bill requires the CPUC to adopt a rate tariff for the benefiting account.
- AB 811 (Levine, 2008) Public Financing Districts for Energy Improvements, which authorizes a legislative body of any city to determine that it would be in the public interest to designate an area within which authorized city officials and free and willing property owners may enter into contractual assessments to finance the installation of DG renewable energy sources or energy efficiency improvements that are permanently fixed to real property, as specified. The bill would require the resolution of intention to include the kinds of DG renewable energy sources or energy efficiency improvements that may be financed, as well as a statement specifying that it is in the public interest to finance those DG renewable energy sources or energy efficiency improvements.

- AB 920 (Huffman, 2009) Credit for Net Surplus Electricity from Solar and Wind Distributed Generation, which among other things would: require the ratemaking authority of an electric utility to adopt, by January 1, 2011, a net surplus electricity compensation valuation to compensate a net surplus customer-generator, for the value of net surplus electricity generated by an eligible customer-generator and delivered to the grid that is in excess of the amount of electricity that is delivered from the grid to the eligible customer-generator; require the electric utility to offer a standard contract or tariff to eligible customer-generators that includes compensation for the value of net surplus electricity; require the electric utility, upon an affirmative election by the eligible customer-generator to receive service pursuant to this contract or tariff, to either: (1) provide net surplus electricity compensation for any net surplus electricity generated in the 12-month period, or (2) allow the eligible customer-generator to apply the net surplus electricity as a credit for kilowatt hours subsequently supplied by the electric utility to the surplus customer-generator; provide that upon adoption of the net surplus electricity compensation rate and the eligible customer-generator electing to receive net surplus electricity compensation, any renewable energy credit, for net surplus electricity belongs to the electric utility purchasing the electricity and that net surplus electricity counts toward the electric utility's RPS purchasing requirements.
- SB 412 (Kehoe, 2009) Self-Generation Incentive Program: Inclusion of Non-Solar Technologies, which would require the CPUC to require the collection of funding for the self-generation incentive program for non-solar DG resources through December 31, 2011; require that CHP power units meet certain efficiency and emissions requirements, including the GHG emission performance standard, to receive incentives; require the PUC to ensure that DG resources are made available in the program for all ratepayers; prohibit recovery of the costs of the program from ratepayers that participate in the California Alternative Rates for Energy program; delete the authorization for the PUC, in administering the program, to include other ultra-clean and low-emission DG technologies; and, delete the current requirement that the California Energy Commission, by November 1, 2008, and in consultation with the PUC and CARB, to evaluate the costs and benefits of providing ratepayer subsidies for renewable and fossil fuel ultra-clean and low-emission DG.

- SB 380 (Kehoe, 2008) codified CPUC's expanded feed-in tariff to include all RPS-eligible generators 1.5 MW and below. The program cap also was expanded from 250 MW to 500 MW. SB 380 expanded the program to include all IOUs including SDG&E.
- AB 1613 (Blakeslee, 2007), also known as the Waste Heat and Carbon Emissions Reduction Act, was designed to encourage the development of new CHP systems in California with a generating capacity of up to 20 MW, resulting in more efficient use of natural gas and reduced GHG emissions. The bill requires the CPUC and the Energy Commission to establish policies and procedures for the purchase of electricity from eligible CHP systems.
- The CARB Climate Change Scoping Plan set a target of 4,000 MW of CHP that would displace 30,000 gigawatt hours of electric energy from other power generation resources with the overall goal of reducing GHG emissions by 6.7 million metric tons of CO2 equivalent.
- SB 1 (Murray, 2006) enacted the Governor's "Million Solar Roofs" program with the overall goal of installing 3,000 MW of solar PV systems.

To implement SB 1, the state officially launched Go Solar California in 2007 to bring customer awareness to the CPUC California Solar Initiative (CSI) and the Energy Commission New Solar Homes Partnership (NSHP), and solar incentive programs offered by publicly-owned utilities beginning in 2008. The CSI offers rebates to existing homes and non-residential energy customers installing solar systems in IOU service territories. As of October 2013, 1,296.8 MW of new solar systems have been installed statewide and 133.8 MW in the San Diego region as a result of the program. The CSI program is expected to achieve its 2016 goal of 165 MW of PV in the San Diego region ahead of schedule.

The NSHP offers incentives for home builders to construct solar homes. The goals of the program are to achieve 400 MW of installed solar capacity by the end of 2016, create a self-sustaining solar market without the need for government incentives, and foster sufficient market penetration in the new residential market so that 50 percent or more of new housing built by 2016 and, thereafter, will include solar systems. However, with the recent extreme downturn in new home construction, program activity has been slow and is likely to remain so until, if and when, the economy recovers. The NSHP does not allocate available funding on a regional basis, so it is not possible to project the amount of PV that will be installed in the region as a result of the program. As of September 2013, the program has installed 29 MW statewide, with another 35 MW reserved.

Another customer-side strategy is the Self-Generation Incentive Program, which is administered by the CPUC and implemented through the IOUs and provides rebates for customers who install wind turbines and fuel cells. SB 412 revises this program to

provide incentives for certain non-renewable DG systems with the primary purpose of reducing GHG emissions. As of 2012, eligible technologies include wind turbines, pressure reduction turbines, fuel cells, advanced energy storage, waste heat capture and CHP internal combustion engines, microturbines, and gas turbines. As of October 2013, the IOUs have paid more than $934 million in rebates for more than 1,581 projects totaling more than 464 MW of generating capacity (including solar PV incentivized by the Self-Generation Incentive Program during 2001-06).

5.3.1 Feed-In Tariff

The feed-in tariff is intended to help contribute to the state RPS and encourage customers to install renewable energy systems to help meet the state RPS goals. Some smaller renewable energy systems are able to be counted toward the RPS due to the state feed-in-tariff. Feed-in tariffs are fixed, long-term prices for energy. The law initially supported deployment of renewable resources on publicly owned water and wastewater treatment facilities.

The California feed-in tariff was amended by SB 32 (McLeod, 2009), and must be implemented through regulations to be developed by the CPUC. AB 32 allows eligible customer-generators in the residential, commercial, and industrial sectors to enter into 10-, 15-, or 20-year standard contracts with their utilities to sell electricity produced by small renewable energy systems, up to 3 MWs, at time-differentiated market-based prices determined by the CPUC's market price referent, which is an administratively determined rate based on the cost of natural gas generated electricity. Eligible technologies include solar thermal and PV, landfill gas, wind, small hydroelectric, among others.

Time-of-use adjustments will be applied by each utility and will reflect the increased value of the electricity to the utility during peak periods and its lesser value during off-peak periods. Power produced during peak demand times earn the highest rate. Power purchased under the feed-in tariff counts toward the utility's RPS obligations, and RECs (discussed below) transfer to the utility under a feed-in tariff contract. The tariff is available until installed generation equals 750 MW, a portion for which each utility is responsible. Any customer-generator who sells power to the utility under this tariff may not participate in other state incentive programs.

5.3.2 Net Metering

Net metering is another strategy to help increase customer-side DG technologies, particularly PV. Customers who install an onsite renewable energy system can apply for net metering, a special billing arrangement with the utility for electric customers who generate their own electricity. Net metering allows for the flow of electricity both to and from the customer – typically through a single, bi-directional meter. When a customer's generation exceeds the customer's use, electricity flows back to the grid and offsets electricity consumed at a different time. In effect, the customer uses excess generation to offset electricity that the customer otherwise would have to purchase at the utility's full retail rate. Unlike the feed-in tariff, net metering does not involve long-term agreements or prevent the customer from taking advantage of incentives prohibited under the feed-in tariff. The customer's electric meter tracks electricity generated by the renewable system versus electricity consumed, with the customer paying only for the net amount taken from the grid over a 12-month period.

California's net-metering law requires IOUs like SDG&E to offer net metering to all customers for solar, wind, biogas-electric, and fuel cell systems up to 1 MW. Net excess generation (NEG) is carried forward to a customer's next bill. Previous law granted NEG remaining at the end of each 12-month period to accrue to the customer's utility. AB 920 now gives customers the option of rolling over remaining NEG from month-to-month indefinitely or receiving financial compensation from the utility for their remaining NEG. Customers not electing either option will have their NEG granted to the utility at the end of the 12-month period without any compensation. The RECs associated with the electricity produced and used onsite remain with the customer-generator. If, however, the customer chooses to receive financial compensation for the NEG remaining after a 12-month period, the utility will be granted the RECs associated with just the surplus they purchase. The utility can take credit for the surplus purchased under the RPS. AB 510 (Skinner, 2010) increased the net-metering cap from 2.5 percent to 5 percent of an electric utility's aggregate customer peak demand.

5.3.3 Interconnection Policies

Interconnection policies can be a barrier to increased use of DG (further defined below). California applies a standard practice for interconnecting DG systems to the electric grid (Rule 21). Non-standardized interconnection rules create uncertainty and risk for customers interested in using DG technologies and can make this option cost prohibitive. Rule 21 specifies standard interconnection, operating, and metering requirements for specified DG generators.

5.3.4 Distributed Generation in the San Diego Region

For purposes of this strategy, clean DG is small-scale power generation technologies located close to the load being served, capable of lowering costs, improving reliability, reducing emissions, and expanding energy options.

Combining energy efficiency measures with DG is the best way to reduce a customer's energy demand, thereby, properly sizing the distributed system and generally saving the customer the costs of a larger system.

Table DG-1 presents quantified goals for DG technology penetration through 2030 building on several California mandates and recommendations. These market projections were developed for SANDAG by the California Center for Sustainable Energy (CCSE).

Table DG-1: Distributed Generation Targets for 2030

Technology	2008 Level	2030 Base Targets	2030 Stretch Targets
Biogas/Biomass	26 MW	27 MW	31 MW
Solar PV	49 MW	844 MW	970 MW
Combined heat and power	341 MW	398 MW	458 MW
Other (hydro & steam)	11 MW	11 MW	11 MW
Total DG in the Region	427 MW	1,278 MW	1,590 MW
Proportion of Regional Peak Demand			
Targets from 2003 Strategy	12% (2010)	30%	30%
Targets for 2009 Strategy	9% (actual)	21%	24%

Source: California Center for Sustainable Energy, 2009

5.3.5 Solar Photovoltaic Systems

Using the Energy Commission Distributed Generation Roadmap, CCSE projects that the amount of solar PV could increase from 49 MW in 2008 to a base target of 844 MW in 2030. With additional measures, the region could achieve a stretch target of 970 MW. In the San Diego region, solar PV systems have the greatest growth potential among DG technologies. Several regional resources are available that help enable residents to install solar. The City of San Diego partnered with the CCSE to develop an interactive solar mapping tool. The Solar Map identifies solar systems installed in the region and can help a resident determine their own rooftop's viability for solar panels.

Moreover, CCSE manages the CSI incentive program for the region and hosts an annual Solar Energy Week including a Solar Homes Tour and Commercial Solar Sites Tour. In the 2009 Environment California report, California's Solar Cities, the City of San Diego was ranked the number one solar city in California, with the most solar roofs and the highest solar capacity kilowatts installed.

5.3.6 Combined Heat and Power Systems

Using the Energy Commission Distributed Generation Roadmap, CCSE projects that the amount of CHP (also known as cogeneration) could increase from 341 MW in 2008 to a base target of 398 MW in 2030. With additional measures, the region could achieve a stretch target of 458 MW. CHP efficiently converts natural gas to energy by recycling otherwise wasted heat and reusing it for additional electricity or heating and cooling. These systems also can operate on renewable fuels such as biogas. Technologies typically used on a CHP configuration include microturbines, internal combustion engines and fuel cells.

CHP can provide a variety of benefits to end users. Customers that need greater reliability than what the electric grid can supply can use CHP systems. Biotech firms, data centers, telecommunications, and industrial processes are some of the business types that cannot afford power interruptions. CHP can provide premium power onsite, offering end users a higher level of reliability than the electric grid. CHP is often used in industrial processes that take advantage of the electricity and heat. The relatively small amount of industry and manufacturing in the region limits the potential applications for CHP systems.

5.3.7 Distributed Generation System Costs

Although the lifecycle costs of DG systems make them a good choice for many end users, the upfront capital costs can be a barrier to their increased penetration. California offers many financial incentives (e.g., the CSI, New Solar Homes Program, and Self-Generation Incentive Program) to help defray the costs for new and existing buildings.

Some local governments and large businesses use third-party energy providers that can cover the upfront cost of a system through a long-term contract with the jurisdiction.

Since there are a variety of DG systems, customers are able to choose the technology that best serves their needs. DG also benefits the utility by reducing peak demand on the electric grid and benefits businesses by reducing costs associated with peak demand charges. In power constrained areas where outages are common, DG can serve to provide reliable power.

Advanced energy storage (AES) is a distributed energy system that is expected to perform an integral role in future increased use of renewable energy and in improving grid reliability. AES is a technology that converts electricity into another form of energy, stores it, and then converts it back into electricity at another time. By storing energy that can be used or dispatched at a time when it is more useful to the overall electric grid, AES can help make electricity from intermittent resources such as solar and wind more usable to the electricity system. Similarly, AES also can reduce peak demand and save money by storing electricity for use when grid-based electricity is most expensive (e.g., during periods of peak demand).

5.3.8 Recommended Actions to Support Distributed Generation

SANDAG, local governments, or other regional entities can undertake the following actions to encourage an increase in clean DG. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions will contribute to other energy goals, and likewise be enhanced by recommended actions identified in other topic areas, as described below.

Recommended Actions to Support Distributed Generation	
Local Governments	**Recommended Action**
DG-1	Revise, or support revision of, local zoning policies, permitting, and other codes to remove hindrances and promote installation of PV or other distributed renewable energy systems (e.g., require or provide incentives for new construction to pre-wire for PV installation).
DG-2	Explore opportunities and applications for local governments to demonstrate and deploy advanced energy storage with distributed energy resources.
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
DG-3	Combine energy assessments and energy efficiency improvements with installation of distributed energy generation systems to reduce system costs and maximize energy savings.
DG-4	Establish financing programs (using public or private sources) that residents and businesses can access to install distributed energy systems such as PV and CHP systems, as well as conduct energy assessments and make energy efficiency retrofits to existing buildings.
DG-5	Continue to monitor and support policies that will facilitate increased, cost-effective installation of small-scale renewable energy systems like solar PV (e.g., feed-in tariff, net energy metering, rate design).
DG-6	Identify local barriers to DG installations and provide supportable and applicable solutions across jurisdictions to reduce confusion for builders, contractors, and officials, about technologies, costs and benefits.
DG-7	Promote the use of high efficiency DG technologies, and conduct analysis of potential applications for CHP systems in the region (e.g., industrial, hotel, etc.).
DG-8	Encourage local home builders to participate in the New Solar Homes Partnership to install solar PV on new homes in the region.

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5.4 ENERGY AND WATER

Introduction

Energy and Water Goal:
Reduce water-related energy use.

In the San Diego region, water and energy resources – and, therefore, climate change – are closely connected. The amount and ways water is used in the region require large amounts of energy. Water utilities use large amounts of energy to pump, treat, deliver, and recycle water, while residents and businesses use energy to heat, cool, and use the water. Energy is also used to dispose of wastewater and power the large pumps that move water throughout the state. Power plants use a significant volume of water, primarily for cooling, which can impact local water supplies. Water also provides hydroelectricity generation for the region, while pumped storage facilities provide commercially viable electricity storage on a large scale.

Historically, the energy implications of water decisions were not typically considered. Water sources were chosen without consideration of the energy costs; conversely, energy savings were not associated with water conservation and efficiency measures. However, understanding of the nexus between water and energy is beginning to grow. The region can build from this understanding to take actions that save energy and water resources: reducing the energy intensity of water supply and uses will reduce the region's contribution to climate change while using less water will help the region adapt to the reduction in water supply anticipated from climate change. Integrating energy considerations into water planning also can save money and strengthen the economy. California water and wastewater agencies spend more than $500 million annually on energy costs.

California's water systems are highly embedded with energy relative to national averages. The state has major conveyance systems that move water to end users over hundreds of miles and thousands of feet in elevation. The State Water Project (SWP) consumes energy by pumping water 2,000 feet over the Tehachapi Mountains -- the highest lift of any water system in the world. The San Diego region is at the farthest – and, therefore, most energy intensive – end of the SWP and Colorado River Aqueduct. The amount of energy used to deliver water from the SWP to residential customers in Southern California is almost one-third the total average household electric use in the region. The San Diego region currently imports more than 80 percent of its water from these distant sources that are embedded with large amounts of energy; about 18 percent is supplied from local water sources.

As of 2005, water-related energy use annually consumes 19 percent of the state's electricity consumption, 30 percent of non-power plant natural gas consumption, and 88 million gallons of diesel fuel. Statewide water-related electricity consumption alone costs at least $2 billion per year. As water demand grows, so does energy demand. Water demand and associated energy costs will continue to grow if current trends continue. Since population growth drives demand for both resources, water and energy demands are growing at roughly the same rate. Water-related electricity use is expected to grow at a faster rate in the future because of increasing and more energy-intensive water treatment requirements such as those under the Safe Drinking Water Act and Clean Water Act, conversion of diesel agricultural pumps to electric, increasing long-distance water transfers, and changes in crop patterns that require more energy intensive irrigation methods.

Table EW-1: Embedded Energy in the Water Cycle

Water Cycle Segments	Range of Embedded Energy (kilowatt hours/million gallons)		
	Low	High	Typical Southern California Urban Water System
Supply and Conveyance	0	14,000	8,900
Treatment	100	16,000	100
Distribution	700	1,200	1,200
Wastewater Collection and Treatment	1,100	4,600	2,500
Wastewater Discharge	0	400	N/A
Recycled Water Treatment and Distribution	400	1,200	N/A

Source: California Energy Commission, California's Water-Energy Relationship, final staff report, 2005.

Peak demand for water, and energy required to treat and transport that water, coincides with peak demand for electricity. If not coordinated and managed, water-related electricity demand could affect the reliability of the electric grid during peak load periods. Conversely, reliable and adequate electricity supplies are essential for water and wastewater agencies to meet the needs of their customers' need. If electricity infrastructure fails, water system reliability quickly worsens.

5.4.1 Energy and Water in the San Diego Region

The San Diego County Water Authority (CWA) currently supplies about 612,000 acre-feet[7] of water per year (af/year) to water agencies in the region. Supply sources include:

- Metropolitan Water District: 274,000 af/year
- Imperial Irrigation District Transfer: 85,000 af/year
- All American and Coachella Canal Lining: 80,000 af/year
- Conservation: 70,000 af/year
- Local Surface Water: 61,000 af/year
- Recycled Water: 24,000 af/year
- Groundwater: 18,000 af/year

The average energy intensity of the water-energy cycle in the San Diego region is 6,900 kilowatt-hours per acre-foot (kWh/af). Based on these figures, total water-related energy consumption to satisfy current regional water demand is estimated at 4,222,800 megawatt-hours (mWh) per year. The energy intensities for the five stages of the water life cycle in San Diego region are estimated as follows:

1. Sources and conveyance: 2,040 kWh/af,
2. Water treatment: 60 kWh/af,
3. Distribution: 330 kWh/af,
4. End uses: 3,900 kWh/af, and
5. Wastewater treatment: 570 kWh/af.

5.4.2 Energy and Water End Uses

Despite the energy-intensive process of conveying water over long distances and high elevations to the region, water end use applications are the most energy-intensive stages of the water life cycle, accounting for over half (57 percent) of water-related energy use. The same is true for the state as a whole.

Energy efficiency water programs have traditionally focused on either saving energy in water and wastewater treatment facilities or saving energy in end-use applications including water heating, clothes washing and drying or process heating. Water use efficiency programs have similarly focused on saving water in end-use applications. For the most part, these efficiency improvement efforts have occurred separately, although there are some examples of water and energy utility coordination. What appears to be missing is recognition that saving water saves energy throughout the entire water use cycle.

[7] An acre-foot is equal to about 325,850 gallons of water, or enough to cover an acre of land to a depth of one foot.

Understanding the embedded energy of water requires distinguishing between cold and hot water. Conserving a unit of cold water avoids using the energy that would have been needed to supply, treat, deliver, consume, treat, and then dispose of it as wastewater. In San Diego, saving cold water, both indoors and outdoors, saves energy (primarily electricity). Saving outdoor water saves the energy needed to extract, convey, treat, and distribute water to customers. Saving indoor water saves the additional energy (mostly electricity), used to collect, treat, and dispose of the waste water. Saving hot water results in additional energy savings needed to heat the water (usually natural gas).

From an energy perspective, saving cold outdoor water is good, saving cold indoor water is better, and saving hot indoor water will save the most energy. Moreover, saving end-use energy can save water and the energy associated with the applicable portion of the water use cycle. For example, saving electricity of any kind also will save water at power plants that use cooling water.

As shown in Table EW-2, the residential sector in the San Diego region is estimated to be responsible for 58 percent of water end uses in 2010. The commercial, industrial, and institutional sectors are estimated to account for an additional 32 percent, while agriculture will account for about 10 percent. The five largest end use consumers of water are cold outdoor water for residential landscape irrigation (23 percent), cold indoor water for residential toilets and leaks (14 percent), cold outdoor water for commercial/industrial landscape irrigation (12 percent), hot indoor water for residential showers, faucets, and bathtubs (12 percent), and hot and cold indoor water for clothes washers (8 percent). The water end uses with highest embedded energy include water-cooled chillers (67,700 kWh/af), dishwashers (27,200 kWh/af), residential clothes washers and commercial laundries (11,650 kWh/af), showers, faucets, and bathtubs (6,700 kWh/af).

Targeting conservation and efficiency measures toward the largest end use consumers of water and water end uses with the highest embedded energy can reduce the overall energy intensity of water end uses. Renewable or clean distributed energy systems, such as solar hot water heating, also can be used to save energy from the use of hot indoor water.

Table EW-2: Estimated Embedded Energy of Water End Uses in the San Diego Region		
Water Use Category	**Estimated Percent of Total Use in 2010**	**Estimated Energy Intensity (kWh/af)**
Residential	**58%**	**-**
Toilets and leaks	14%	0
Dishwashers	1%	27,200
Clothes washers	8%	11,650
Showers, faucets, and bathtubs	12%	6,700
Landscape irrigation	23%	0
Commercial, industrial, and institutional	**32%**	**-**
Kitchen dishwashers	50%	27,200
Pre-rinse nozzles	20%	6,700
Other kitchen use	1.2%	Not Estimated
Laundries	0.6%	11,650
Onsite wastewater treatment	5.8%	800
Water-cooled chillers	2.4%	67,700
Single pass cooling	2.4%	0
Landscape irrigation	12.1%	0
Other heated water	0.3%	6,700
Other unheated water	6.5%	Not Estimated
Agricultural	**10%**	**Not Estimated**
Totals and weighted average	**100%**	**3,900**

Source: 2005 Integrated Energy Policy Report, California Energy Commission

Energy Considerations for Meeting Future Water Demand

With the population of the San Diego region expected to increase by approximately one million residents by 2030, demand for water will increase. CWA estimates that at least an additional 100,000 af/year will be needed in 2020, and demand for water will continue to grow to 2030 and beyond. CWA must save 80,000 af by 2010, 94,000 af by 2020, and 108,000 af by 2030 to meet the region's water needs, or it must develop or contract additional water supplies. There are various strategies to meet future water demand, including conservation, recycling, and desalination. Imported supplies from the SWP and Colorado River will likely be constrained by various factors including enforcement of the Colorado River Compact, environmental restrictions on water from the SWP, and the impacts of climate change such as reduced snowpack levels in the Sierra Nevada. The energy intensity of each potential strategy varies, as shown in Table EW-3.

5.4.3 Water Efficiency and Conservation

The Energy Commission identifies water conservation and efficiency as the best, most energy-efficient way to serve future demand using the largest available supply—existing water resources. Investment in conservation and efficiency may forestall or avoid larger public investments for drinking water, clean water infrastructure, or power generation facilities, and it will help stretch available public water funds. For example, total energy savings of meeting the next 100,000 af through conservation instead of additional SWP water could be approximately 767 million kWh, enough to provide electricity for 118,000 households for one year. Waste Not, Want Not, a study published by the Pacific Institute in November 2003, estimated that cost-effective urban water conservation measures could save 22 percent of water end uses in the residential, commercial, and industrial sectors, and without technological chance.

Table EW-3: Energy Intensity for Satisfying Additional Water Demand

	Source and Conveyance	Water Treatment (kWh/af)	Distribution (kWh/af)[2]	End Use (kWh/af)[3]	Wastewater Treatment (kWh/af)[4]	Total (kWh/af)
Status quo	2,040	60	330	3,900	570	6,900
Status quo plus scenario[5]						
Conservation	1,780	60	290	3,400	500	6,030
Recycling	1,830	60	330	3,900	500	6,620
Water bag transfer	1,950	60	330	3,900	570	6,810
Imperial Irrigation Direct transfer	60	60	330	3,900	570	6,940
Additional State Water Project	60	60	330	3,900	570	7,100
Seawater desalination	50	60	330	3,900	570	7,260

Source: California Energy Commission. Notes: 1) Conserved water does not need to be distributed, reducing the embedded energy of distribution from 330 to 290 kWh/af delivered. 2) Conservation assumes no energy is conserved when water is conserved, but no energy is expended to conserve water either. 3) Wastewater is not generated by conservation or by recycling if recycled water is used for landscape irrigation, reducing energy intensity from 570 to 500 kWh/af delivered. 4) The scenarios are presented for purposes of comparing energy consumption only. 5) They do not necessarily represent feasible or likely scenarios for satisfying future water demand in the San Diego region.

5.4.4 Reclamation

Water recycling (reclamation) is the next best efficient source of additional water supply. Recycled water is the fastest growing source of new supplies in the state. After treatment to stringent health and quality standards, recycled water can displace offset use of fresh water for power plant cooling, industrial processes, landscape irrigation, and groundwater replenishment.

The San Diego region has made substantial investment in water reclamation. The City of San Diego has constructed two reclamation facilities – North City Water Reclamation Plant (NCWRP) and South Bay Water Reclamation Plant. NCWRP has capacity to produce up to 24 million gallons per day (MGD) of recycled water (about 26,880 acre feet per year), but existing beneficial reuse, consisting mostly of irrigation and some industrial purposes, total only about 6 MGD (about 6,700 acre feet per year) (City of San Diego,

Water Reuse Study [2006]). Although the region has substantial capacity to produce recycled water with adequate quality, actual demand for recycled water has not matched that capacity. None of the recycled water is currently used as potable water.

The cities of Encinitas and Solana Beach, acting as the San Elijo Joint Powers Authority, operate the San Elijo Water Reclamation Facility, a wastewater treatment and water reclamation plant that treats approximately 5.25 million gallons of raw sewage per day. Approximately 1,200 to 1,300 acre-feet is produced and bought annually, equal to over 400 million gallons per year and serving approximately 32,000 people. Two recycled water reservoirs, one underground, and one above, each with a capacity of 750,000 gallons, provide operational storage for the water reclamation program.

In neighboring Orange County, the City of Huntington Beach and the Orange County Water District developed a Groundwater Replenishment (GWR) System, the world's largest advanced water purification project of its kind. The GWR provides about 70 million gallons per day of near-distilled quality water to central and northern Orange County in an effort to offset the effects of future water shortages. The project takes highly-treated sewer water and puts it through a three-step purification process that includes microfiltration, reverse osmosis, and ultraviolet light with hydrogen peroxide. As of 2008, the water produced cost $550 per acre-foot, only slightly more expensive than supplies imported from northern California. In the future, GWR water is forecasted to be more cost-effective due to decrease in the availability of imported water and resulting in an increase in cost. The reclamation process uses less electricity than currently used to import the same amount of water through the state aqueduct system.

Currently, a substantial portion of the processed reclaimed water is never utilized. Instead, it is pumped back into the general wastewater lines where it is run through treatment processes again at the Point Loma water treatment facility, and disposed of in the Pacific Ocean. This is an inefficient use of water and the energy used for processing and pumping. Distributing processed reclaimed water to end users via the purple pipe system (i.e., separate system of pipes for transporting reclaimed water) would require investments in water infrastructure such as storage and additional purple pipe system installation. Assessment districts could be established as a means of financing purple pipe system installation.

Another option for the region would be to treat processed reclaimed water to potable standards and distribute via the existing potable water distribution system. Reuse of the processed reclaimed water would save energy to the extent it displaces the embedded energy of water supply that would have otherwise been used to meet water demand.

5.4.5 Desalination

Desalination is another option to meet future water demand. The process removes salt from brackish water (a mixture of salt water and fresh water) or seawater to create potable fresh water. Brackish water desalination is considerably less energy intensive than seawater desalination. The Energy Commission reports that desalinated brackish water and seawater can relieve drought conditions, replace and restore groundwater, and provide a source of water for river and stream ecosystem restoration. The Carlsbad Desalination Project construction is underway and the Project plans to be delivering water by 2016. By 2020, CWA anticipates 56,000 af/year of seawater desalination water in its water supply.

The future demand for additional sources of water and constraints on imported supply require the identification of conservation and efficiency options in all stages of the water-energy cycle, as well as potential sources of local supply. It is important to note that many considerations, are relevant to the selection of water sources to meet future demand in the region. Energy is just one of the considerations. Reliability, impacts to environmental resources, cost, and regional control may be other important considerations relevant to the selection of future water sources to meet regional demand.

5.4.6 Water for Electricity Generation

Several opportunities exist to increase energy supplies from water and wastewater utilities, including hydroelectric power in hydroelectric power plants and pumped storage facilities, water storage for peak shifting, in-conduit hydroelectric generation, biogas cogeneration at wastewater treatment plants, and development of local renewable resources on water and wastewater utilities' extensive watersheds and rights of way.

Opportunities for construction of new hydroelectric plants are very limited. Pumped storage projects involve the transfer of water between two reservoirs or tanks at varying elevations to generate electricity. Water can be pumped from the lower to the higher reservoir during off-peak electricity periods, and then released to the lower reservoir during peak electricity periods to spin a turbine or power an electricity generating unit. This is considered a method of storing renewable electricity, particularly intermittent sources such as wind and solar power. In-conduit generation utilizes the flow of water through pipelines, canals, and the like to generate electricity. Additional in-conduit projects could help offset the embedded energy of the water system or be sold back to the grid. In-conduit projects also could help contribute to the region's goals for renewable power generation.

Wastewater treatment plants use anaerobic digestion to clean wastewater, a process that releases biogas (60 to 90% methane). Biogas can be captured and used for electricity. The Point Loma Wastewater Treatment Plant in the City of San Diego produces enough biogas to run a 4.5 MW generator, which saves millions of dollars in energy costs and produces power for the electricity grid.

There are opportunities at pumping stations to take advantage of downgrade water flow to provide hydroelectric electricity to pumping stations. In addition to hydroelectric power, onsite solar arrays or cogeneration systems at pumping stations can provide energy for water pumping while reducing impacts on the electricity grid. Wind and solar PV facilities are excellent power sources from a water perspective as they do not use water during operation. Distributed energy systems are essentially air-cooled machines that require little to no water for operations. Many water agencies have potential for installation of solar panels on rooftops and structures and on other unused or underutilized land within their control. Water agencies can take advantage of renewable energy opportunities to offset their own electricity load and potentially even send power to the grid and contributing to regional goals for the generation of renewable power (e.g., RPS goals).

5.4.7 Recommended Actions for Energy and Water

SANDAG, local governments, or other regional entities can undertake the following actions to encourage reduced water-related energy use. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions will contribute to other energy goals, and likewise be enhanced by recommended actions identified in other topic areas, as described below.

Recommended Actions for Energy and Water	
Local Governments	**Recommended Action**
EW-1	Increase energy conservation and efficiency of water end-uses in the residential and commercial sectors, with priority on the largest end uses of water (e.g., landscape irrigation, toilets, and showers) and the water end-uses with the most embedded energy (e.g., dishwashers, residential clothes washers and commercial laundries, and showers).
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
EW-2	Identify existing or develop new financing mechanisms that end users can utilize to reduce water-related energy consumption (e.g., purple pipe to support use of reclaimed water), such as those available for energy measures (e.g., on-bill financing [property tax or utility] and low interest loans).
EW-3	Integrate measures that save water and energy into any regional retrofit program(s) to incorporate energy efficiency and DG into the existing building stock.
EW-4	Promote energy efficiency, demand response, and self-generation efforts to local governments that own or operate water pumping stations and water or wastewater treatment facilities.
EW-5	Support or identify opportunities to reuse water and decrease the amount of energy needed to meet the water needs of the San Diego region.
EW-6	Identify and support programs for residential re-use of gray water to decrease the amount of energy needed to meet water needs.
EW-7	Support landscape design educational programs to help residential customers install low water use landscaping, thereby reducing water-related energy use.

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5.5 PEAK DEMAND

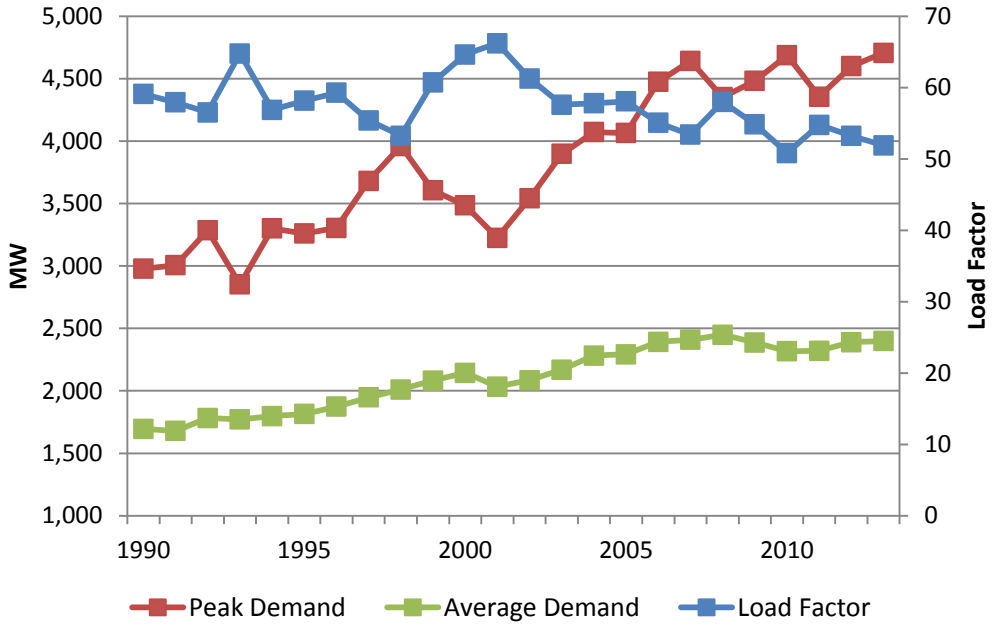
Introduction

> ***Peak Demand Goal:***
> Implement cost-effective steps and incentives to utilize demand response and energy efficiency measures to reduce peak demand.

After energy efficiency, demand response is the next highest priority in the state's preferred loading order for meeting new energy needs and reducing GHG emissions. Like energy efficiency, demand response is given a high priority in the loading order because addressing peak demand can help meet energy needs and lower GHG emissions with measures consumer benefits like cost savings and little or no environmental impact. Lower peak demand can improve air quality for the region, particularly in areas near peak electricity-producing power plants.

Peak demand is the maximum level of electric load, measured in MWs for a specified time period. In contrast, average demand measures the total annual demand over all 8,760 hours in a year. The ratio of average demand and peak demand is called the load factor. This measures how effectively the total capacity of the electrical system is used on average. The higher the load factor, the more effectively the system is being used. A load factor of 100 percent, which is nearly unattainable, would mean the average and peak demand were equal and that system capacity was fully used 100 percent of the time. The RES uses the Energy Commission's peak demand forecast. SDG&E relies on the Energy Commission forecast for its resource planning. Recent trends for peak demand, average demand, and the resulting load factor for the SDG&E service territory are presented in Figure PD-1.

Figure PD-1. Demand Trends in SDG&E Service Territory, 1990 – 2013



Source: California Energy Commission, 2014.

The current regional load factor is approximately 51 percent, lower than the average over the 1990-2013 period (57 percent) and significantly lower than the highest load factor of about 70 percent in 2001. The increased load factor in the early 2000s was primarily the result of decreased demand during the California Energy Crisis. While average demand has modestly increased over this period, peak demand has increased more significantly.

Weather and behavior are major determinants of peak demand. On an annual basis, the region generally experiences high peak demand periods driven by air conditioning use on the hottest days of the year and during continuous heat waves.

Peak demand is a significant concern for energy planners about 80 to 100 hours each year. During that time, when electricity demand increases significantly, base-load electricity supply has been surpassed and electricity prices are at their highest. Increased demand must be offset by increasing supply or reducing demand. Supplemental power plants called “peaking units” or “peaker plants” can be used to increase supply for these short durations. These resources are generally more expensive to operate, less efficient, and have higher emission rates than base-load power. Reducing peak demand and, thus, the need for peaking resources can minimize their impacts.

Measures to Address Peak Demand

5.5.1 Demand Response

In general, demand response means shifting end-user electric use from high demand periods to lower demand periods, when electricity is cheaper and more abundant. Doing so can reduce the overall demand (MW) on the electric system, but does not necessarily reduce overall energy use (MW-hours), so demand response may not lower GHG and other emissions associated with electricity use. Demand response can be achieved by rate designs that provide customers lower electricity prices during most hours in exchange for higher prices during the times of peak demand when supply reserves are small. Traditional energy efficiency programs that result in peak demand reductions are another tool to manage demand. Demand response program also can reduce peak demand by providing customers with incentives for reducing their electric load in response to a call for load reduction by the utility, particularly during critical times like high temperature days. Incentives can include a credit on a utility bill, a dynamic rate, or exemption during a time of rolling blackouts.

Demand response includes new rate designs and incentive programs for on-peak load reductions. New rate designs would provide customers lower electricity prices during most hours in exchange for higher prices during the times of peak demand when supply reserves are small and electricity typically costs more (this is referred to as dynamic pricing).

Demand response programs are available at the retail level primarily through utility programs administered through the CPUC. The Federal Energy Regulatory Commission identifies Demand Response as a high priority and issued Order 719 on October 17, 2008, which directs regional transmission organizations, such as the CAISO, to implement demand response programs. CAISO established a Proxy Demand Resource program to facilitate demand response in wholesale markets. The program was deployed in August 2010.

SDG&E manages several types of demand response programs in which local governments and SANDAG can participate or educate employees, businesses, and residents. Residential programs include “Summer Saver,” which allows SDG&E to install a device on a central air conditioning unit and to cycle the unit on and off during specific summer days. Ratepayers receive an annual bill credit ranging from an average of $46 to $184. Business programs include cash rebate assistance to replace existing equipment with newer high-efficiency models, and capacity bidding, which offers monthly incentives to businesses that commit to reducing power by a pledged amount for the month. SDG&E also offers a variety of third-party programs administered by other contractors under competitive bid contracts awarded by SDG&E.

5.5.2 Distributed Generation

While demand response programs reduce peak demand, DG systems can help meet peak demand. Rooftop solar PV, fuel cells, and CHP systems can produce electricity during peak times and reduce demand on the electricity grid. The amount of peak reduction varies by technology type and operating characteristics. For example, summer peak period in the region occur between 3 to 5 p.m. Solar PVs do not produce at full capacity during that time and may only contribute half of its capacity during the peak. Other technologies such as CHP that generate electricity more hours of the year can contribute more during peak periods. For more on DG, please see Section 5.3, DG.

Energy storage also aids in shifting load to off-peak times. AB 2514 (Skinner, 2010) directed the CPUC to establish an energy storage procurement target to be achieved by each load-serving entity. In October 2013, the CPUC adopted a target of 1,325 MW for PG&E, SCE, and SDG&E by 2020, with installations required by the end of 2024. Energy storage is to contribute to grid optimization including peak reduction, reliability, renewables integration, and GHG reductions.

5.5.3 Advanced Metering Infrastructure

Smart meters and advanced metering infrastructure, can help to reduce regional peak demand by providing customers with detailed information about their energy consumption and charging dynamic rates for electricity. Pilot smart metering projects in the San Diego region and across the state have shown that consumers provided with information about their energy use and the actual cost of electricity based on the time of use, modified their consumption and reduced peak demand.

In addition, smart meters can communicate to smart end-use devices and appliances. This will enable energy consumers to cycle air-conditioning units off and on, set clothes dryers and dishwashers to run at off-peak hours, and manage other energy intensive equipment based on the time of use, the cost, and availability of electricity. The electric utility or the customer will be able to remotely enable demand response programs and measures that could reduce some of the need for new electric generation resources.

Electric Vehicles and Peak Demand Management

The electricity and transportation sectors may converge in the coming decades. Several major automakers are introducing electric vehicles and plug-in hybrid electric vehicles into U.S. auto markets. Use of electricity as a transportation fuel has significant potential to reduce regional GHG emissions, but could require major changes to the existing electrical infrastructure. For example, large numbers of drivers returning home from work on a hot summer day and plug in their cars to charge would increase the existing peak demand. In addition, high concentrations of electric vehicle owners in the same neighborhoods could potentially strain local circuits.

To avoid adverse impacts from PEVs, strategies must be developed to accommodate electric vehicles while ensuring that the grid is not stressed. One potential strategy would be to encourage electric vehicle charging overnight during off-peak hours through pricing incentives. This strategy could be enhanced through smart charging capabilities that would allow the utility to determine the best times for vehicle charging and even out the increase in electric demand caused by electric vehicles.

Electric vehicles also could play a role in helping to control peak demand. In the future, utilities may be able to provide vehicle-to-grid capability in which a plug-in electric car owner can sell electricity from their car battery back to the grid, providing benefits to the electric grid, as well as financial benefits to the car owner. Section 6, Smart Energy offers more discussion of the approaches and measures to address the potentially adverse impacts of PEVs.

For discussion of PEVs, please see Section 5.8, Transportation Fuels.

5.5.4 Recommended Actions to Support Peak Demand Reduction

SANDAG, local governments, or other regional entities can undertake the following actions to support reduced peak demand for electricity. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions also would contribute to other energy goals, and the peak demand goal would be enhanced by the recommended actions identified in other topic areas, as described below.

Recommended Actions to Support Peak Demand Reduction	
Local Governments	**Recommended Action**
PD-1	Participate in peak demand reduction programs and undertake peak demand reduction measures at local government facilities.
PD-2	Exceed Title 24 energy requirements for new construction through policy or incentives that work toward an overall goal of ZNE new homes by 2020 and ZNE new commercial buildings by 2030.
PD-3	Develop policies to reduce energy use in existing buildings.
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
PD-4	Support fair and reasonable rate designs and incentives that encourage customers to reduce electricity consumption during peak demand periods.
PD-5	Support the establishment of building retrofit programs, retrocommissioning, or other mechanisms that can reduce energy consumption during periods of peak demand, such as heating, ventilation and air conditioning (HVAC) systems.
PD-6	Provide information and resources to help residents, businesses, developers, builders, non-profits, agencies, jurisdictions, schools, colleges and universities, and other institutions understand individual and community costs associated with peak electricity demand.
PD-7	Monitor regional peak demand and measure the impacts of efforts to reduce peak demand.

5.6 SMART ENERGY

Introduction

> ***Smart Energy Goal:***
> Modernize the electricity grid with smart meters, smart end-use devices, and interactive communication technologies.

The smart grid concept is generally characterized by increased use of digital communication and control technologies across the entire electric transmission and distribution system. An intelligent electric grid could help the region achieve many of the goals included in this strategy, including increasing renewable energy, integrating electric vehicles, increasing energy efficiency and demand response, and increasing use of DG. Smart grid technologies and strategies also can support other important goals, such as increased power reliability and cost savings for both the utility and end-user. The smart -grid can accurately report power outages to the utility and customers, which may reduce their frequency and duration.

Smart meters and advanced metering infrastructure can automate utility billing, optimize electricity resources connected to the grid, and provide energy consumers with greater information on their electricity use. Smart meters are designed to give consumers access to their previous day's electricity consumption and electricity cost information via the internet. Pilot smart metering projects in the San Diego region and across the state have shown that consumers provided with information about their energy use and the actual cost of electricity based on the time of use modified their consumption and reduced peak demand.

Table SE-1. Summary of San Diego Smart Grid Study Cost-Benefit Analysis Results

Total Annual Benefits	$141 million
System Benefits (20 years)	$1,433 million
Societal (Consumer-side) Benefits (20 years)	$1,396 million
Total Capital Cost	$490 million
Annual Operating and Maintenance Cost	$24 million

Source: Energy Policy Initiatives Center, 2006

Smart grid implementation can occur at a regionwide and smaller or microgrid level. For instance, the University of California, San Diego (UC San Diego) was awarded a U.S. Department of Energy grant to create a campus microgrid combining fuel cells and advanced energy-storage technologies. The campus now operates a 42 MW microgrid and self-generates 90 percent of the annual demand with the following sources: 30 MW natural gas cogenerations plant, 2.8 MW fuel cells, 1.5 MW solar PV. The campus also has installed a 300-kilowatt solar water-heating system.

In 2006, the Energy Policy Initiatives Center (EPIC) of the University of San Diego released the San Diego Smart Grid Study, which included extensive analysis of the technologies, utility and societal costs and benefits as depicted in Tables SE-1 and SE-2, as well as scenarios for implementing a smart grid in the San Diego region.[8]

As the results show, the benefits of modernizing the electric grid through smart grid technologies far outweigh the costs. By supporting implementation of the smart grid, SANDAG and local governments can help residents and businesses save money on energy, increase job creation and regional GDP (Gross Domestic Product), protect environmental resources like air quality and habitat, and reduce peak demand. Smarter communications also will improve reliability and reduce outages, as well as enable electric vehicles, renewable energy, and DG technologies to be accurately integrated into the electricity grid.

SDG&E completed the regionwide installation of smart meters for all electricity customers. The utility undertook a widespread education and outreach program preceding and during the installation process in order to reduce confusion and uncertainty about smart meters. SANDAG provided information to local governments and stakeholders through the Regional Energy Working Group and Energy Roadmap Program about smart meters during the installation period. Even though the installation process is complete, there is still a need for education to consumers regarding the benefits and opportunities for smart meters, appliances, and communication.

With the smart meters, new technological demonstration projects are underway to examine applications with electric vehicle charging and solar PV at locations such as the San Diego Zoo, UC San Diego, and transit facilities.

[8] In the study, societal benefits are those benefits that accrue to non-utility stakeholders (i.e., the region at large) and represent such things as fewer outages resulting in avoidance of lost revenue to local businesses, job growth, and an increase in high-tech businesses that require and value high power reliability (e.g., biotech, pharmaceutical, and research and development) and the resultant economic development attributes. System benefits are those benefits that can be achieved through the operations of the grid system.

Table SE-2: Smart Grid Benefits for the San Diego Region

Benefit Type	Societal Benefits	System Benefits
Reduction in congestion cost	-	$13.1 million
Reduced blackout probability	$1.5 million	-
Reduction in forced outages/interruptions	$38.6 million	-
Reduction in restoration time and reduced operations and management due to predictive analytics and self-healing attribute of the grid	-	$11.3 million
Reduction in peak demand	-	$25.6 million
Other benefits due to self-diagnosing and self-healing attribute of the grid	-	$0.2 million
Increased integration of DG resources and higher capacity utilization	-	$14.7 million
Increased security and tolerance to attacks/ natural disasters	-	$1.2 million
Power quality, reliability, and system availability and capacity improvement due to improved power flow	$1.3 million	-
Regional job creation and increased GDP	$28.3 million	-
Increased capital investment efficiency due to tighter design limits and optimized use of grid assets	-	$0.2 million
Tax benefits from asset depreciation, tax credits, and other	-	$3.1 million
Environmental benefits gained by increased asset utilization	-	$2.4 million
Subtotals	**$69.7 million**	**$71.8 million**
Total	**$141.5 million**	

Source: Energy Policy Initiatives Center, 2006

5.6.1 Recommended Actions to Support Smart Energy

SANDAG, local governments, or other regional entities can undertake the following actions to support the smart grid. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions will contribute to other energy goals, and likewise be enhanced by the recommended actions identified in other topic areas, as described below.

Recommended Actions to Support Smart Energy	
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
SE-1	Support efforts to modernize communications across the electricity grid through implementation of smart grid technologies and strategies in the San Diego region.
SE-2	Encourage installation of smart appliances and automated energy management systems that interface with smart meters.
SE-3	Support rate structures that reflect the real time price of electricity to consumers.
SE-4	Support the rollout of interactive communication technologies that enables electric vehicles, DG systems, and electricity consumption to be accurately monitored by end-users and the utility.
SE-5	Support educational information on the benefits and uses of smart grid technologies.
SE-6	Support regional entities such as universities and the utility in acquiring state and federal funds to implement components of the smart grid in the San Diego region.

5.7 NATURAL GAS POWER PLANTS

Introduction

> ***Natural Gas Power Plants Goal:*** Increase overall efficiency of electricity production and support replacement of inefficient power plants consistent with the state's preferred loading order.

Despite long-term efforts to promote preferred resources like energy efficiency, demand response, DG, and renewable energy, natural gas power plants remain an important source of electricity for the region. State-of-the-art utility-scale natural gas plants will be needed to reduce the GHG intensity of the region's energy supply, at least in the short-term. Natural gas power is needed to promote grid reliability as intermittent renewable resources like wind and solar power are integrated into the electricity mix. Intermittent renewables offset need for fossil fuel power generation, but existing technology does not allow wind and solar to be quickly dispatched to meet peak power needs; natural gas power plants are therefore needed for this crucial function.

While the region mostly uses natural gas to generate electricity, natural gas also is used for end uses like space heating and water heating for homes and buildings, industrial processes, distributed energy systems, and increasingly in the transportation sector. This section focuses on use of natural gas for power plant electricity generation. Other natural gas applications are addressed in the following sections of the RES: 5.1 – Energy Efficiency and Conservation, 5.2 – Renewable Energy, 5.3 – DG, 5.5 – Peak Demand, and 5.8 – Transportation Fuels.

5.7.1 Regional Energy Strategy Approach to Natural Gas Use for Transportation, End-Uses, and Electricity Generation

While it may seem contradictory, the energy strategy calls for increased use of natural gas for certain transportation applications, decreased use of natural gas for end uses like water heating, and more efficient use of natural gas in electricity generation. This reasoning is primarily based on the availability of alternative technologies in these unique sectors. For example, increased use of natural gas in transportation applications like heavy-duty trucks and transit buses can displace petroleum consumption, reduce air pollution, and lower GHG emissions compared to the conventional diesel alternative. For at least the near-term, natural gas is one of the best options in the heavy-duty transportation sector. By contrast, for end uses like water heating, gas can be replaced with proven solar water heating technology, so the RES calls for decreased use of natural gas in these types of applications. And while renewable resources like solar and

wind offer superior environmental benefits for electricity generation, existing technologies do not have the capability of providing the same supply benefits as natural gas-fired power plants. As a result, the RES identifies more efficient natural gas plants as a needed component of the region's electricity resource mix.

5.7.2 California Policies Related to Natural Gas Power Plants

The following key policies affect natural gas power plants:

- State Water Resources Control Board's (SWRCB) Once Through Cooling (OTC) Resolution (2006) seeks to reduce marine impacts from OTC systems used by 21 coastal power plants in California, including natural gas and nuclear plants. This began a coordinated process between several government agencies to phase out the use of OTC (described in further detail in the following section).
- SB 1368 (Perata, 2006) limited long-term investments in baseload generation by the state's utilities to power plants that meet a GHG emissions performance standard (EPS) jointly established by the Energy Commission and the CPUC. The regulations require a baseload standard for generation of 1,100 lbs. CO2 per mWh, roughly equivalent to the emissions of a combined cycle natural gas power plant.
- 2005 and 2007 Energy Commission IEPR Policy on Aging Power Plants recommended that the CPUC require IOUs to procure enough capacity from long-term contracts to allow for the orderly retirement or re-powering of aging plants by 2012. In the 2007 IEPR, the Energy Commission recommended that California's utilities adopt all cost-effective energy efficiency measures for natural gas, including replacement of aging power plants with new efficient power plants. In addition, the 2007 IEPR recommended the Energy Commission, the CPUC, the CAISO, and other interested agencies work together to complete studies on the impacts of retiring, re-powering, and replacing aging power plants, particularly in Southern California.
- The CARB Climate Change Scoping Plan calls for industrial facilities, such as power plants, to implement cost-effective GHG emissions reduction strategies. Specifically, the Climate Change Scoping Plan requires a reduction in GHG emissions from fugitive emissions from oil and gas extraction and gas transmission. The policies directing the state to meet climate change goals, such as the RPS, intend to reduce the state's dependence on fossil fuels—such as natural gas—and replace these with cleaner fuel resources.
- The SWRCB draft policy for addressing OTC calls for replacing existing OTC facilities with some combination of re-powered technologies onsite, new generation located in other areas, and/or upgrades to the transmission system.

5.7.3 Natural Gas Power Plants in the San Diego Region

The major existing natural gas-fueled power plants in the region include the aging and less efficient Encina plant in the City of Carlsbad the newer Palomar plant in Escondido and the newer plant at Otay Mesa. In 2013, the aging South Bay Power Plant was shut down and demolished. There are also a number of smaller plants, including cogeneration facilities, which generate electricity at high overall efficiency rates when use of ancillary heat is taken into account.

Power plants are the region's largest users of natural gas, and some of the older plants are inefficient relative to the latest technology, combined cycle gas turbine plants. Natural gas is a low polluting fossil fuel, and is the primary fuel used for in-state power generation due to its clean burning characteristics and stringent state emissions requirements. Natural gas provides approximately 56 percent of power plant electricity generation in the region. The region will need to rely on natural gas plants for part of its fuel supply for the foreseeable future to provide dispatchable power when the electricity system requires it. In light of the recent shutdown of the San Onofre Nuclear Generating Station, the power from natural gas power plants will remain an important resource for ensuring reliability for the San Diego region.

All natural gas is produced outside of the San Diego region, and some even outside the nation. It is imported into the region through pipelines to end users. SDG&E is the region's distributor of natural gas. A reliable infrastructure system is needed to support the receipt and delivery of adequate supply to the region and keep prices low.

5.7.4 Natural Gas Power Plants and Once Through Cooling

The Encina power plant uses OTC, a process by which water is drawn directly from a source water body, used to absorb heat, and then discharged back into the source water body at elevated temperatures. Because the water is not re-circulated, this process can require millions of gallons of water per day. Marine impacts from OTC power plants are another major environmental concern of natural gas power plants. These plants pump large amounts of ocean, bay, or estuary water each day, impinging on fish, invertebrates, and crustaceans, destroying thousands of fish eggs and larvae, and harming marine organisms with heat discharged water.

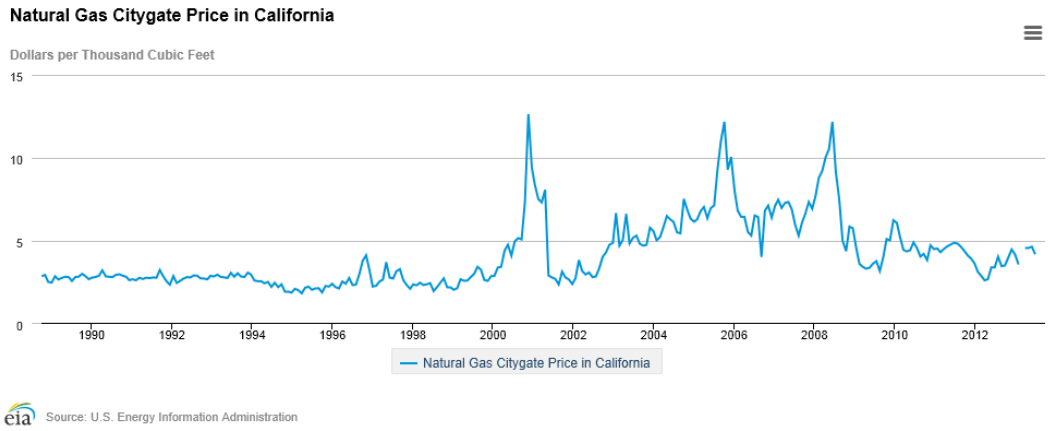
As part of an interagency working group, the Energy Commission, CPUC, and CAISO have been working with the SWRCB to outline a proposal to maintain electric grid reliability while reducing OTC coastal power plants, including those in the San Diego region. The SWRCB has issued a compliance schedule for retiring, refitting, or re-powering OTC plants to comply with federal water policy.

New generating capacity will be needed to replace OTC power plants. The SWRCB draft policy calls for replacing existing OTC facilities with some combination of re-powered technologies onsite, new generation located in other areas, and/or upgrades to the transmission system. In addition, demand response programs (discussed in Section 5) can offset the need for some natural gas peaker plants. Replacement power sources will have to meet local air quality requirements. In some cases emission offsets will have to be obtained before replacement power can be built, which can be challenging. For example, in order to cite the Otay Mesa power plant, Calpine agreed to replace over 100 Waste Management diesel-powered trash haulers with liquefied natural gas (LNG) vehicles and construct an LNG fueling station in the City of El Cajon. The emission reduction credits earned through the cleaner-burning LNG vehicles and fueling station allowed construction of the needed power plant.

5.7.5 Natural Gas Prices

At present, California imports about 87 percent of its natural gas needs from out of state, and at the same time in-state production is decreasing. Natural gas markets have been proven to be very volatile over the last decade, thus most price forecasts are unreliable. Federal changes in energy policy will likely impact natural gas markets, creating some uncertainty for California and the San Diego region regarding access to stable, reasonably priced supply. For example, the establishment of federal carbon caps or laws to reduce GHG emissions will likely cause many states that rely heavily on coal for electricity generation to switch to natural gas power plants. What effect federal policy changes will have on supply that currently comes to California is not known. Natural gas prices and volatility also are affected by factors such as supply and demand imbalances, infrastructure (storage and pipeline) issues, the weather, regional and global economic conditions, speculative trading, market manipulation, and unreliable data and drilling technologies and rig deployment.

Figure NG-1: Monthly Natural Gas Citygate Price in California



Recent technological advancements in exploration, drilling, and hydraulic fracturing have transformed shale formations from marginal natural gas producers to substantial and expanding contributors to the nation's natural gas portfolio. Recoverable shale reserve estimates range as high as 842 trillion cubic feet, a 37-year supply for the U.S. at today's consumption rates. However, while natural gas production from shale formations has significantly increased domestic production, there is ongoing investigation of potential environmental concerns related to shale gas development, including the potential for increased GHG emissions and groundwater contamination from the activities required to extract the gas.

Past efforts to forecast natural gas prices have been highly inaccurate compared to actual prices, even when price volatility was largely dominated by traditional, physical market factors. Recent natural gas price volatility is at least partially explained by evolving, less traditional, financial market factors that are complicating efforts to accurately forecast future natural gas prices. Additionally, as the United States continues moving to a carbon-constrained economy, GHG policies will further complicate these efforts, likely rendering future natural gas price forecasts even less accurate and more uncertain. The uncertainty associated with predicting major input variables and the resulting natural gas price forecasts brings into question the value in producing date specific, single-point natural gas price forecasts.

5.7.6 Recommended Actions for Supporting Replacement of Inefficient Natural Gas Power Plants

SANDAG, local governments, or other regional entities can undertake the following actions to support replacement of inefficient natural gas power plants using OTC technology, consistent with state policy. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions will contribute to other energy goals, and likewise be enhanced by recommended actions identified in other topic areas, as described below.

Recommended Actions to Support Natural Gas Power Plants

SANDAG, Local Governments, or other Regional Entities	Recommended Action
NG-1	Support the re-powering, replacement, or removal of older, inefficient coastal power plants in the region with the most efficient natural gas technology or renewable sources in other areas, or transmission upgrades, as needed -- consistent with state policy direction to address aging power plants and those with OTC.
NG-2	Monitor the availability and price of natural gas.
NG-3	Monitor and evaluate regional natural gas storage and pipeline capacity to accommodate future demand.
NG-4	Support policies that reduce regional exposure to natural gas market volatility.

5.8 TRANSPORTATION FUELS

Introduction

Transportation Fuels Goal: Substantially increase the deployment of alternative transportation fuels and vehicles.

The region can improve air quality, promote public health, protect against petroleum price volatility and supply uncertainty, reduce GHG emissions, and benefit the economy by substantially improving the transition to alternative fuel vehicles in the region. Passenger vehicles, heavy-duty trucks and buses, aircraft, watercraft, off-road vehicles, and rail transportation can each improve the efficiency of fuel consumption or operate fully, or in part, on fuels other than gasoline or diesel.

Alternatives to petroleum-based fuels include:

- Biofuels (ethanol and biomass-based diesels), electricity, hydrogen, natural gas, and liquefied petroleum gas (LPG or propane);
- Electricity, which can displace the most petroleum and reduce GHG emissions (electric drives are able to utilize renewable energy as a fuel source, and existing electricity infrastructure in the region would facilitate the deployment of this alternative fuel faster than others);
- Hydrogen and renewable biofuels, which also offer significant GHG emission and petroleum reduction benefits, but significant economic and technological barriers must be overcome before these fuels can be deployed on a large scale; and
- Natural gas and propane, which can also achieve economic and environmental benefits for the region, but of a more modest nature.

Please consult the SANDAG Regional Alternative Fuels, Vehicles, and Infrastructure Report for a detailed assessment and comparison of petroleum-based and alternative fuels, vehicle technologies, and infrastructure.

Alternative fuels and vehicle technologies, although generally offering more benefits than petroleum, are not without potential drawbacks. For example, natural gas is a finite fossil fuel, as is propane, with many other important applications including electricity generation, residential and commercial end uses like space and water heating, as well as the raw material in fertilizers critical to food production. Electric vehicles, deployed on a large scale, would have a potentially significant impact on the electricity grid. In addition, there is a limited amount of land to produce feedstocks for biofuels, and hydrogen fuel must be created from another energy source like natural gas or electricity. Moreover, production of alternative fuel vehicles is an energy-intensive

process that requires the extraction of raw materials, industrial assembly, and typically long-distance distribution to customers. A careful, holistic approach to the use of alternative transportation fuels will help the region minimize the unintended consequences of a transition to alternative fuels and vehicle technologies.

State and federal energy policy provides significant opportunities for the region to increase the deployment of alternative fuel vehicles and infrastructure, including funding and tax credits. Moreover, a variety of alternative fuel vehicles in multiple vehicle classes are available now or will be in the near future, including factory-made and commercially available vehicles from major automobile manufacturers and after-market vehicle conversions and retrofits. Much government funding, research, and private sector investment is focused on the development of plug-in hybrids, electric vehicles, and biofuels. Hydrogen, natural gas, and propane are also the focus of public and private sector research and dollars.

Government funding sources include the Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act (AB 118). As part of the AB 118 Investment Plan, the Energy Commission performed a gap analysis to help determine where best to apply state funding for alternative fuels. They found that overall funding from federal, state, and private sources totaled about $35 billion per year and that biofuels was the most funded fuel category. Of the $35 billion, research and development expenditures totaled about $11 billion per year with most funding focused on biofuels, followed by fuel cells and batteries.

Overall, federal funding for alternative fuels has focused on three primary areas: next generation biofuels processes and pilot plant construction; energy storage; and plug-in hybrid electric vehicles. The federal stimulus bill allocates $3 billion for transportation programs and an additional $2 billion to transportation-related tax incentives. The Energy Commission has stated it will work with the Department of Energy to leverage AB 118 funds and support projects in the clean energy sector that provide long-term economic benefits and promote sustainability.

SANDAG has developed relationships with a variety of regional stakeholders regarding alternative fuels, including the San Diego Regional Clean Cities Coalition and the Clean Transportation Program at SDG&E. SANDAG also partnered in the ARRA-funded project between eTec and Nissan North America (The EV Project) to deploy all-electric vehicles and private and publicly accessible charging points in the San Diego region. In winter 2010, the Nissan Leaf was released, and infrastructure deployment through the EV Project began. As of March 2013, infrastructure from the EV Project in the San Diego region totaled 731 residential Level 2, 64 nonresidential Level 2, 302 publicly available Level 2, and 3 DC fast chargers.

It should be noted that the future of alternative fuels in general, as well as individual technologies, is uncertain. While this strategy attempts to identify broad future trends in alternative transportation fuels, the many variables that affect these trends can be unpredictable, including but not limited to national and global economic conditions, the price and availability of crude oil and natural gas, national and global energy policy, technological developments, and levels of state and federal funding and support. This alternative fuels strategy should be revisited and revised as needed in the case that any of these or other important variables change significantly.

Increasing efficiency and reducing the growth in vehicle travel demand are also essential components of a comprehensive approach to achieving goals for air quality, climate change, public health, and energy security. Measures to reduce vehicle travel demand are discussed in Section 5.9 (Land Use and Transportation Planning).

5.8.1 Passenger Cars and Light-Duty Trucks

California has developed a 2050 vision for alternative fuels and vehicles based on fair-share GHG emission reductions from passenger vehicles. Although transportation accounts for a larger proportion of regional than statewide emissions and a fair-share approach is not established by statute, the vision illustrates the magnitude of change the region must undergo over the next four decades. Major attributes of the state's 2050 vision include:

- By 2025, 1.5 million zero emission vehicles (ZEVs) will be operating in California and 15 percent of new car sales will be ZEVs;
- Average vehicle fuel economy of 60 miles per gallon (mpg); 80 mpg equivalent for electric vehicles, significantly higher than current average of about 22 mpg;
- Fuel mix consisting of 40 percent electricity and hydrogen, 30 percent biofuels, and 30 percent petroleum-based fuels, substantially different than existing supply of nearly 100 percent petroleum;
- Carbon intensity reductions of 90 percent below today's gasoline vehicles for electricity and hydrogen, 80 percent for biofuel vehicles, and at least 10 percent for other fuel and vehicle types;
- Per-capita VMT of about 8,200, approximately 20 percent lower than projected statewide for 2050 without change in policy or behavior (about 14 percent lower than the regional 2030 projection); and
- Transportation measures complemented by changes to land use policies in order to realize full GHG reductions.

The Regional Alternative Fuels, Vehicles, and Infrastructure Report provides a detailed analysis of alternative fuels and vehicles, including recommendations for passenger cars and light-duty trucks. For passenger vehicles, plug-in hybrids and electric vehicles are the priority alternative fuel and vehicle recommendations for the region. Electricity can achieve significant GHG and petroleum reductions, and electric charging points are relatively inexpensive. Before 2011, there was only one PEV on the market, in 2013 there are now 16 vehicle types available. While hydrogen and biofuels (when produced from renewable sources) show potential to significantly reduce petroleum consumption and GHG emissions, there are technological and economic barriers to making these alternative fuel sources commercially viable. The cost and availability of infrastructure and fuel production (as well as vehicles for hydrogen) currently makes hydrogen and renewable biofuels uncompetitive with other alternative fuels. If these technologies become commercially viable on a large scale, they could offer benefits of a similar level to plug-in hybrids and electric vehicles. Natural gas and propane can help the region achieve modest near-term benefits, although not of equal magnitude to plug-in hybrids and electric vehicles. Long-term, natural gas and propane will comprise a minor portion of the passenger vehicle fleet. Government coordination of public access to electric charging and alternative fueling infrastructure is required to support private sector rollout and purchase of vehicle and fuels in the San Diego region.

5.8.2 Heavy-Duty Trucks and Buses

Although heavy-duty trucks and buses represent a small portion of transportation fuel consumption relative to passenger vehicles, there are opportunities to reduce petroleum energy consumption from the movement of people and goods by transitioning heavy-duty trucks and buses to alternative fuels. Other heavy-duty vehicles such as trash haulers and street sweepers can operate on alternative fuels and efficient vehicle technologies. The emerging fuels and vehicle technologies included in this analysis are renewable diesel, hydraulic hybrids, battery-electric hybrids, full-electric vehicles, hydrogen fuel cells, propane, compressed natural gas (CNG), and LNG.

The state's 2050 vision for heavy-duty vehicles foresees CNG, LNG, propane, biodiesel and hybrid technologies with the greatest potential for displacing petroleum-based fuels and improving efficiency. Biodiesel blends up to B20 can be used in most existing vehicles and equipment, when consistent with manufacturer warranty. Changes in diesel engines may allow the use of blends greater than B20, while efforts to produce biodiesel from renewable feedstocks like algae and waste may be commercially viable within the timeframe of the RES. Natural gas is recommended for heavy-duty trucks and buses: CNG is best suited for short- and medium-haul applications, while LNG is better suited for longer distances. Both propane and natural gas can be applied to more medium-duty vehicles like vans and cargo trucks. Hybrid electric and hydraulic hybrids are viable options for a variety of medium and heavy-duty applications like refuse

trucks, drayage trucks, and utility trucks as well as transit and school buses. Where opportunities arise to incorporate electricity and hydrogen fuels into the heavy-duty vehicle sector, the region should take advantage of them. However, electricity and hydrogen will play an important, but likely smaller role in the heavy-duty truck and bus sector.

Additional information on statewide goods movement goals and policies is available in the California Goods Movement Action Plan. SANDAG also participated in the development of the Multi-County Goods Movement Action Plan along with five other Southern California counties.

It should be noted that, after air transport, heavy-duty trucks are the least efficient form of goods movement. Rail and ocean-based goods movement are more energy-efficient modes than heavy-duty trucks.

5.8.3 Regional Planning for Alternative Fuels and Vehicles

Siting alternative fueling stations, electric charging points, vehicle maintenance facilities, and other infrastructure in coordination with vehicle availability and purchases is of critical importance to a successful transition to alternative fuel vehicles in the on-road transportation sector. Such coordination is needed to provide customers like fleet managers and the general public with a level of certainty that infrastructure will be available to support their investment in an alternative fuel passenger vehicle. Planning for truck stop electrification and anti-idling measures can help save energy from heavy-duty trucks in the goods movement sector. Outfitting the region with electric charging points and alternative fuel infrastructure can also help attract private investment associated with alternative transportation to the region.

SANDAG is a logical entity for coordinating the planning of alternative fuel infrastructure and identifying suitable locations for infrastructure. As a regional planning agency, SANDAG can ensure that alternative transportation considerations are integrated with development of the regional transportation network and recommend specific alternative fuel and vehicle technologies for different transportation sectors that are tailored to the unique characteristics of the region. In addition, SANDAG can facilitate vehicle and infrastructure deployment through actions such as development of a unified regional vision, identification of funding opportunities and coordination of funding applications, and development of standardized guidelines for infrastructure siting, permitting, and education.

Through the AB 118 program, the California Energy Commission awarded grants to metropolitan planning organizations throughout the state to create regional groups to address barriers to PEV deployment. In the San Diego region, SANDAG received a grant to develop the San Diego Regional Electric Vehicle Infrastructure Working Group (REVI). REVI is comprised of public agencies, SDG&E, the CCSE, universities, equipment manufacturers, and workforce partners. The group has been tackling barriers through the development of best practice fact sheets and a PEV Readiness Plan for the region. The final PEV Readiness Plan was accepted by the SANDAG Board of Directors in January 2014.

5.8.4 Recommended Actions to Support Increased Use of Alternative Transportation Fuels

SANDAG, local governments, or other regional entities can undertake the following actions to support increased use and deployment of alternative transportation fuels and technologies. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions will contribute to other energy goals; likewise, the alternative transportation fuel goal can be enhanced by recommended actions identified in other topic areas, as described below.

Recommended Actions to Support Increased Use of Alternative Transportation Fuels	
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
TF-1	Create an action plan that incorporates alternative fuel vehicles into SANDAG and local government-owned vehicle fleets, and the vehicle and equipment fleets of contractors and funding recipients, such as the vehicle fleet for the SANDAG vanpool program or for local government trash haulers.
TF-2	Use the Regional Alternative Fuels, Vehicles, and Infrastructure Report and the RES as tools to support the integration of alternative transportation options into local government fleets, planned regional transportation projects, and regional planning efforts.
TF-3	Develop a regional approach to infrastructure planning and vehicle deployment for alternative fuels by facilitating continued development of a public-private strategic alliance.
TF-4	Support electricity and gas alternative fuel tariffs that encourage their use as transportation fuels.
TF-5	Develop streamlined permitting requirements and standardized design guidelines and siting criteria for all types of electric charging stations (e.g., single- and multi-family residential, commercial, public access, etc.) and alternative fueling stations.
TF-6	Accelerate the transition to plug-in hybrid electric and battery electric vehicles by developing a regional plan for the installation of a public access electric car charging network, as recommended in the Regional Alternative Fuels, Vehicles, and Infrastructure Report.
TF-7	Analyze the potential impacts of widespread plug-in hybrid and electric vehicle deployment on the electricity grid.

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5.9 LAND USE AND TRANSPORTATION PLANNING

Introduction

5.9.1 Energy and the Built Environment

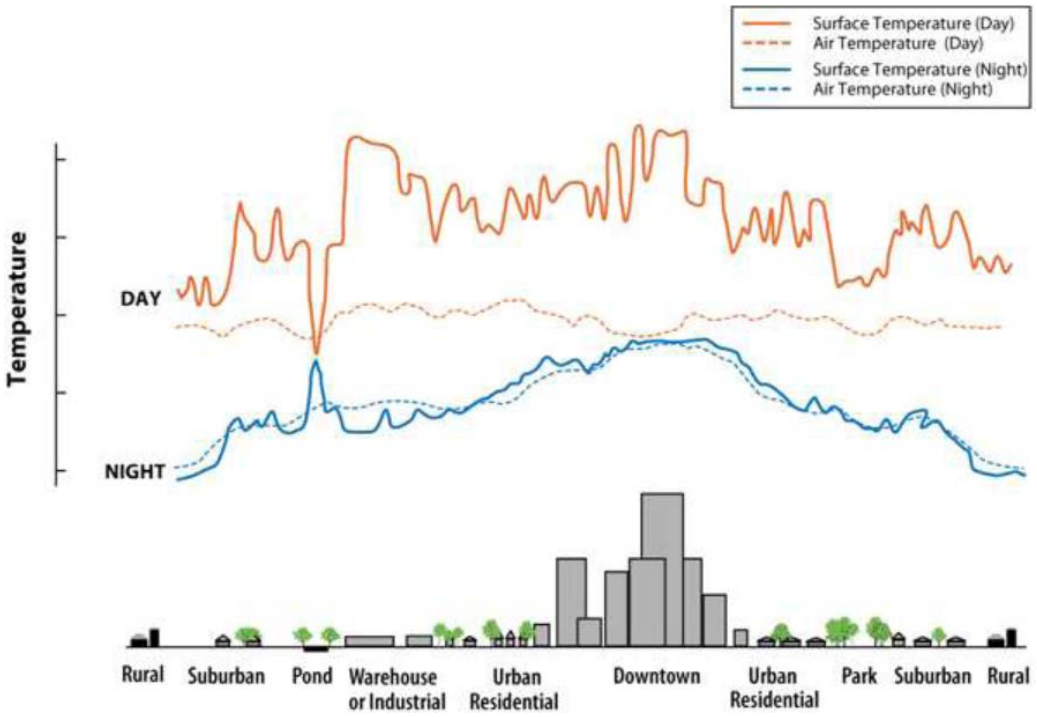
Land Use and Transportation Planning Goal:
Reduce the energy demand of the built environment through changes in land use and transportation planning.

Regional energy consumption is strongly related to urban form, the physical features and composition of the built environment. The built environment is comprised of the building stock, land use pattern, transportation network, open space system, and distribution of other public facilities such as parks and schools. In turn, the energy demand of the built environment is strongly dependent upon the design and orientation of buildings, distribution and density of development, types of transportation infrastructure and policies, and the design of public facilities. Although there is considerable variation throughout the region, the existing built environment generally features segregation between land uses and transportation systems and policies and urban design that favor the automobile over biking, walking, and public transit. In addition, many existing buildings are relatively energy-inefficient compared to requirements for new construction, particularly those buildings constructed prior to the 1980s. To a large degree, these factors influence the amount of energy residents of the San Diego region consume in everyday activities by influencing travel modes and distances and the type and amount of energy they use.[9] In fact, personal vehicle use (e.g., passenger cars; sport utility vehicles; pick-up trucks), residential electricity use and natural gas consumption together account for about 56 percent of total GHG emissions in the region, while the commercial and industrial sectors account for about 21 percent and 11 percent of total GHG emissions, respectively.

Exposed urban surfaces like roofs and pavement absorb heat and cause surface and air temperature in the built environment to become warmer than less developed or undeveloped areas through a process known as the urban heat island effect (Fig. LUTP-1). Several negative impacts are associated with urban heat islands, including increased energy demand for cooling during summer months, particularly during periods of peak electricity demand.

[9] As of 2008, international travel into or out of Baja California, Mexico accounts for about 3% of total regional VMT. This figure is expected to increase to four percent by 2030.

Figure LUTP-1: The Urban Heat Island Effect



Source: U.S. Environmental Protection Agency.

5.9.2 Government Influence Over the Built Environment

Local governments and SANDAG can influence the built environment, including the amount of energy consumed, through their ability to regulate, provide incentives, collaboratively plan, and make infrastructure investments that affect land use patterns, the transportation system, and other public infrastructure investments. Local governments' ability to influence building energy use, efficiency, distributed energy systems is discussed in Section 1 – Energy Efficiency and Conservation.

In addition, local governments can contribute to regional energy goals for increased DG and large-scale renewable power by considering the spatial requirements of energy infrastructure in local land use plans, ranging from onsite and DG systems to larger- and utility-scale renewables, power plants, substations, and transmission lines requiring larger areas of land. The RES provides policy guidance for local governments in their consideration of these issues. The approach of SANDAG and local governments to these issues will influence regional energy consumption, GHG emissions, types of available energy sources, and overall quality of life.

5.9.3 Land Use and Transportation Planning in the San Diego Region

In accordance with SB 375, SANDAG developed a Sustainable Communities Strategy (SCS) as an element of the 2050 Regional Transportation Plan (RTP). The 2050 RTP/SCS describes how the region will meet the per capita GHG reduction targets for passenger vehicle emissions set by CARB. It is important to note that CARB's targets for multiple planning organizations are focused only on the reductions that could come from transportation planning for passenger vehicles, not those reductions that can come from technology improvements made by vehicle manufacturers or cleaner fuels. The passenger vehicle GHG targets for SANDAG are a reduction of 7 percent by 2020, and 13 percent by 2035, from a 2005 baseline year. The five building blocks of the 2050 RTP/SCS, which was adopted by the SANDAG Board of Directors in 2011, are:

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

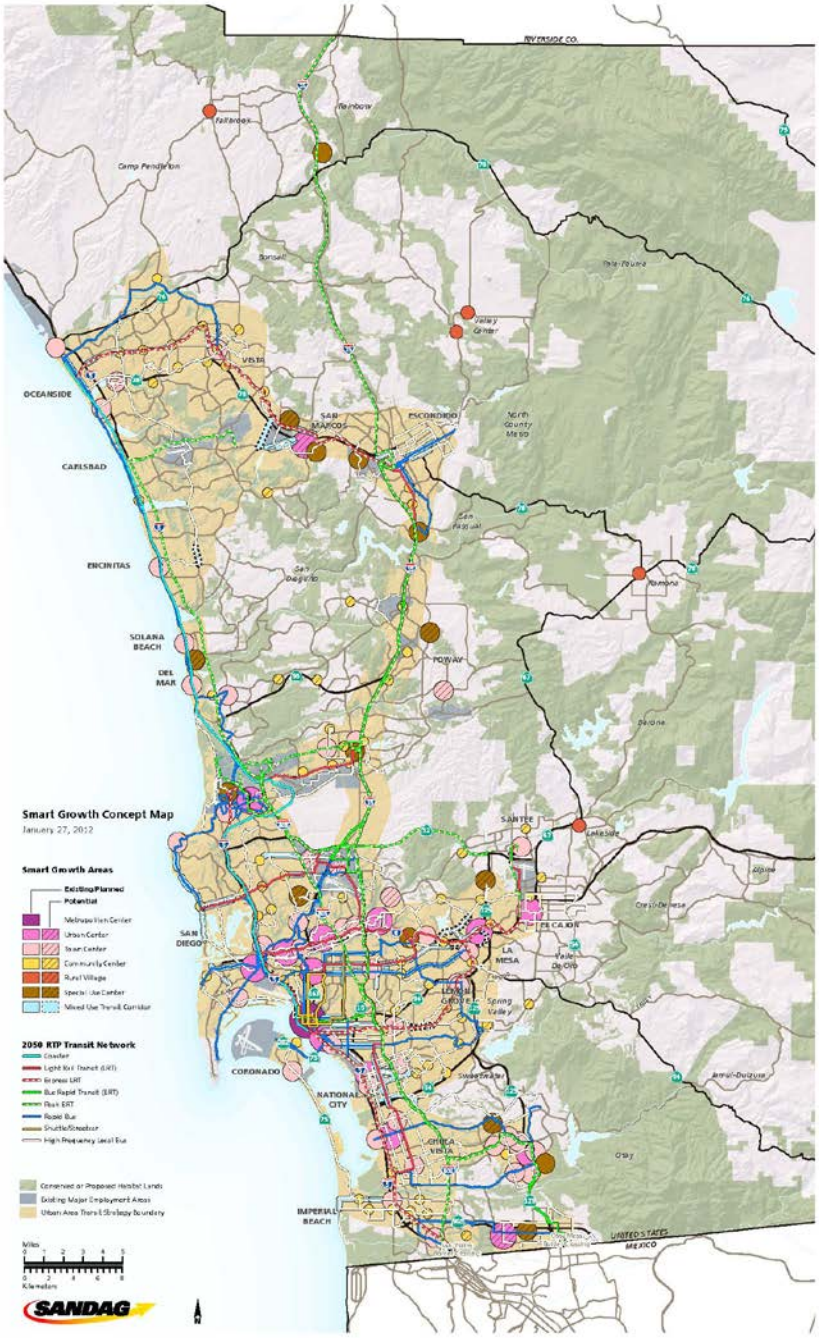
The 2050 RTP/SCS lays out the strategy to reduce passenger vehicle GHG emissions through several SANDAG programs. These programs include iCommute commuter services and planning studies, San Diego Regional Bicycle Plan and early action program implementation, transit planning, *TransNet* Smart Growth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

5.9.4 Existing Smart Growth Planning Efforts

SANDAG and the local jurisdictions, through a collaborative process, have developed a strategy to accommodate projected growth based on an adopted smart growth policy. Under smart growth principles adopted by the SANDAG Board of Directors, smart growth opportunity areas are identified as places that could accommodate higher residential and employment densities within pedestrian-friendly activity centers connected to other activity centers by public transit. By promoting walking, bicycling, and public transit as viable alternatives to driving, and creating shorter vehicle trips, smart growth leads to lower total VMT. The Smart Growth Concept Map (Figure LUTP-2) illustrates the nearly 200 locations of existing, planned, and potential smart growth

opportunity areas in seven smart growth place type categories, reflecting the notion that smart growth is not a "one-size-fits-all" concept. The map also shows the relationship between smart growth areas and existing, planned, and potential public transit service. SANDAG uses the map to provide funding for transportation and transportation-related infrastructure improvements and planning efforts that support smart growth development through the *TransNet* Smart Growth Incentive Program.

Figure LUTP-2: SANDAG Smart Growth Concept Map



sandag.org/smartgrowthconceptmap

The SANDAG Regional Comprehensive Plan – the blueprint for the region's growth – describes the importance of better integrating smart growth development with transportation planning. SANDAG is currently undertaking a combined update of the Regional Comprehensive Plan and 2050 RTP/SCS through the development of San Diego Forward: The Regional Plan, scheduled for adoption in 2015.

Addressing Energy and Climate Change through Land Use and Transportation Planning

5.9.5 Land Use and Transportation Strategies

In the past, energy-related criteria like gasoline and diesel consumption and GHG emissions were not explicit factors in land use and transportation planning in the region, in many other metropolitan regions of California, or in the United States. However, past investments and decisions that shaped the region's land use patterns and transportation systems are major determinants of current and future energy consumption. Once in place, land use patterns and transportation infrastructure will likely remain part of the built environment and influence travel behavior and energy consumption for several decades, perhaps longer. As a result, it is imperative that future planning take into account the energy and climate change implications of transportation infrastructure and land use investments for the duration of their useful lives. This is important because transportation and land use choices made today will affect the region several years and decades into the future.

Past decisions and investments in areas like smart growth planning, public transportation, and demand management contribute to energy savings and climate change objectives. The connection between past and current these and other land use and transportation strategies and energy and climate change goals should be made explicit. Likewise, land use and transportation strategies that do not save energy or contribute to climate change objectives also must be recognized and understood. Generally speaking, segregated, low-density land use patterns and automobile-oriented transportation investments and urban design do not contribute to energy savings or GHG reduction.

There are many land use and transportation-related policy measure options available to help the region save energy and achieve the level of GHG reductions required by state policy and demanded by climate science. These options address vehicle travel, and primarily seek to save energy and lower GHG emissions by decreasing the total amount of driving or VMT. Policy measure options to lower VMT include:

- Enhancing or expanding investments in public transportation, walking, and bicycling infrastructure;
- Increasing development of compact, mixed use projects and communities in which walking, bicycling, and public transit are convenient transportation options and vehicle trips are shorter; and
- Reducing transportation demand through policies like telecommuting, alternative work schedules, congestion, road, and parking pricing, and parking reform.

Land use and transportation-related policy options that address energy and GHG emissions, but not necessarily VMT include:

- Measures to optimize the efficiency of vehicle travel by reducing congestion and limiting excessive vehicle speeds, and
- Installing publicly accessible infrastructure to support alternative fuel vehicle charging and fueling.

Further analysis of these broad land use and transportation policy measures is needed prior to their potential implementation to understand a variety of issues including their potential for fuel savings, contribution to near- and long-term cuts in GHG emissions, possible barriers to regional or local implementation, and their potential for regional economic, financial, environmental, and social costs and benefits. Preliminary analysis of the policy measures is included in the Climate Action Strategy, while additional analysis is included in the 2050 RTP/SCS.

5.9.6 Non-Transportation Strategies

Land use plans and tools could more broadly address energy demand, supply, and infrastructure issues by broadening the smart growth planning efforts to include a comprehensive package of energy saving strategies. Some of the non-transportation related strategies that could fall under a broader definition of smart growth and produce significant energy savings within the region include:

- Increasing onsite production of renewable energy;
- Using distributed electricity generation;
- Orienting residences in relation to the sun;
- Increasing shading and incorporating roofs and pavements that reflect heat;
- Producing food locally;
- Improving energy efficiency in new construction and through existing building retrofits; and
- Smart community strategies (including the use of information technology to change how a community uses its physical space, which also may reduce the energy demand of the built environment by reducing the amount of vehicle travel).

A review of the region's existing land use and transportation planning strategies against the following general characteristics of low-energy demand built environments, at a minimum, would ensure that energy considerations are more fully integrated into the region's land use and transportation planning efforts. The SANDAG Smart Growth Design Guidelines include some discussion of important energy considerations such as renewable energy technologies like distributed PV, building orientation to promote solar access and natural ventilation, green building, and using tree planting and other techniques to minimize the urban heat island effect. The guidelines also discuss the energy saving and GHG reduction benefits of smart growth land use and alternative transportation choices like walking, bicycling, and public transportation.

General Characteristics of a Low-Energy Demand Built Environment

1. Building stock featuring energy efficiency, DG, and solar orientation.
2. Compact land use patterns with convenient access to public transit, a mixture of land uses and a person's daily needs, and jobs-housing balance.
3. Transportation infrastructure and policies that reduce the amount of VMTs and support high levels of use for energy-efficient transportation choices like walking, bicycling, and public transit, as well as alternative fuel vehicles.
4. Public realm designed to reduce urban heat island effect (e.g., increased tree and vegetative cover; cool pavements) and convey a scale and character that supports convenient access and energy-efficient transportation choices.
5. Smart community strategies that deploy information technology to change how a community uses its physical space to save energy (e.g., telecommuting to avoid vehicle trips).
6. Consideration of spatial requirements of small- and large-scale energy infrastructure.

Since the existing built environment is the result of several decades of land use development and transportation investments, reducing energy demand within the region will likely be incremental in the near-term. However, by 2030, land use and transportation planning decisions made to accommodate future growth will likely have a large impact on the amount of energy consumed, the distribution of land uses, efficient access to destinations, the design of the public realm, and how people travel. The evolution of the built environment will not only affect achievement of energy and climate change goals, but the region's ability to maintain and enhance residents' quality of life through co-benefits like improved public health and air quality. The region can lower the energy demand of the built environment through continued smart growth development, increased energy efficiency and DG, improved urban design, and transportation planning and investments that reduce energy consumption.

5.9.7 Local Government Planning Efforts

Local governments in the San Diego region also have worked to integrate energy and climate change into their own jurisdiction's planning efforts. As they update their General Plans, energy demand reduction in land use and transportation planning has become a component. In addition, the region's 19 local governments have all performed GHG emissions inventories, seven have adopted a climate action plan, and five have climate action plans under development. SANDAG has helped to support these efforts through the Energy Roadmap Program by including a chapter on planning and development with sample policies and recommendations to integrate energy savings into planning and development review.

Collaboration on energy and climate change planning has helped to coordinate across jurisdictions on these efforts. The San Diego Regional Climate Collaborative was formed in 2012 in order to provide a forum for peer-to-peer discussions and resources sharing.

Additional areas have been identified for further resources and coordination to advance local government energy and climate change planning, these include:

- Assistance with preparing climate action plans, implementation plans, inventories, and identified projects
- Access to VMT, energy, and emissions data for GHG inventories
- Sources of funding
- Guidance on California Environmental Quality Act thresholds for GHG emissions

5.9.8 Recommended Actions for Land Use and Transportation Planning

SANDAG, local governments, or other regional entities can undertake the following actions to facilitate reduced energy use in the built environment. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions will contribute to other energy goals, and likewise be enhanced by recommended actions identified in other topic areas, as described below.

Recommended Actions for Land Use and Transportation Planning	
SANDAG	**Recommended Action**
LUTP-1	Continue to encourage and assist local governments in implementing smart growth development (e.g., incorporating Potential Smart Growth Opportunity Areas into adopted land use plans, identifying new areas, and developing Planned Opportunity Areas) in part as a means to lower total VMTs, save energy, and lower GHG emissions.
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
LUTP-2	Support policy measures that promote the general characteristics of a low-energy demand built environment (described above), energy-efficient transportation choices, and alternative fuels and vehicles in future updates of the Regional Transportation Plan, and Regional Comprehensive Plan, such as: • Investments in pedestrian, bicycle, and public transit travel. • Measures to reduce transportation demand like telecommuting, congestion, and road pricing, as well as parking pricing and reform. • Compact, walkable, mixed-use, and human-scale smart growth community design. • Measures to optimize the efficiency of vehicle travel conditions. • Infrastructure to support alternative fuel vehicle charging and fueling.
LUTP-3	Coordinate public investments related to transportation, energy, water supply, parks, and open space and others in a manner that supports energy savings and climate change goals.
LUTP-4	Explore opportunities to support one or more demonstration projects in the region that exemplify adopted smart growth principles along with comprehensive energy saving strategies such as distributed PV installation and energy-efficient improvements in building retrofits or new construction.
LUTP-5	Include comprehensive estimates of energy consumption and GHG emissions for land use and transportation planning scenarios at the regional, local, and project levels.

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5.10 ENERGY AND BORDERS

Introduction

> ***Energy and Borders Goal:*** Integrate energy considerations into existing and future collaborative border initiatives.

Energy supply, usage, and conservation in the San Diego region are impacted by actions of its neighbors and vice versa. San Diego County borders include Orange, Riverside, and Imperial Counties, Mexico, and 17 tribal governments[10] (the most in any county of the United States). Collaborative efforts are underway among SANDAG, its member agencies, and its neighbors on various issues including transportation congestion management and goods movement. SANDAG and its member agencies can take steps to further integrate energy considerations into its border planning activities as the region strives to diversify its fuel sources, expand renewable energy resources, and address environmental and climate-related pollutants from transportation. The region cannot be successful in any of these areas without the involvement of its neighbors. Through its Borders Committee, SANDAG addresses policy issues related to cross-border planning from three perspectives—tribal, interregional, and binational.

5.10.1 Tribal Governments

The tribal governments in San Diego County and SANDAG are working together to develop and implement innovative government-to-government strategies to address transportation and other regional planning issues. Existing tribal coordination includes goals, policy objectives, and actions focused on improving communication and collaboration with tribal governments in areas of regional importance such as economic development, transportation, housing, and water supply. Energy can be integrated into these discussions in terms of transportation fuels, mobility choices, efficient building design and retrofits, renewable energy development, and water-energy issues.

In 2009, under a SANDAG-administered Caltrans Environmental Justice grant, the Reservation Transportation Authority (RTA) representing Southern California tribal governments completed a tribal TDM project to (1) facilitate staff training in TDM

[10] Federally recognized tribal nations in San Diego County: Barona Band of Mission Indians, Campo Kumeyaay Nation, Ewiiaapaayp Band of Kumeyaay Indians, Inaja-Cosmit Band of Mission Indians, Jamul Indian Village, A Kumeyaay Nation, La Jolla Band of Luiseño Indians, La Posta Band of the Kumeyaay Nation, Los Coyotes Band of Cahuilla/Cupeño Indians, Manzanita Band of the Kumeyaay Indians, Mesa Grande Band of Mission Indians, Pala Band of Mission Indians, Pauma-Yuima Band of Luiseño Indians, Rincon Luiseño Band of Indians, San Pasqual Band of Diegueño, Mission Indians of California, Santa Ysabel Band of Diegueno Indians, Sycuan Band of the Kumeyaay Nation, Viejas Band of Kumeyaay Indians.

management practices; (2) develop a business plan for a tribal transportation management association (TMA); (3) develop a marketing strategy; (4) develop marketing materials, including a website; (5) assess and survey the transportation and commuting needs of tribal enterprise staff in six locations; and (6) develop a collaborative TDM strategy with SANDAG with the potential establishment of a tribal TMA. A report was produced highlighting the work effort and partnership between SANDAG, RTA, and participating tribal government administrations. Because transportation staff capacity is often limited within most tribes, SANDAG can act as a regional partner bringing together the interests of diverse tribes and enabling the sharing of resources and information to address common transportation goals.

5.10.2 Interregional Coordination

During the 1990s, the San Diego region's average annual population growth rate paralleled the national average. However, growth rates in neighboring Orange, Riverside, and Imperial Counties during the same period were substantially higher. Through interregional coordination, neighboring councils of government and transportation planning agencies have begun to develop collaborative strategies in economic development, transportation, and housing. These collaborations will improve the quality of life for residents in each county by reducing the impacts of interregional commuting, creating more jobs in housing-rich areas and more housing in job-rich areas. SANDAG and its member agencies can foster the integration of energy considerations into existing interregional efforts, such as the voluntary partnership between western Riverside and San Diego region centered on the two-county commute corridor along the Interstate 15 (I-15). The I-15 Interregional Partnership (I-15 IRP) has completed three phases of work with notable products including identification of transit priority treatments and transit infrastructure development to support possible future Bus Rapid Transit (BRT) and commuter express on the I-15 and I-215 corridors, and creation of a pilot Smart Growth Opportunity Area Map for selected cities in western Riverside modeled after the SANDAG Smart Growth Concept Map.

5.10.3 Binational Coordination

Given San Diego’s unique position as an international gateway, binational coordination already exists to address economic development, homeland security, and other pressing cross-border issues. In 2008, SANDAG hosted its annual binational event in which participants met to discuss smart growth issues, including climate change. The 2009 event focused solely on climate change initiatives on both sides of the border, and explored opportunities to share information and work together to address climate change. Continued coordination between California and Baja California can help identify common issues, interdependencies, and policies and actions to address energy planning and infrastructure on both sides of the border.

5.10.4 Recommended Actions for Energy and Borders

SANDAG, local governments, or other regional entities can undertake the following actions to further integrate energy considerations into binational planning efforts. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions will contribute to other energy goals; likewise, the energy and borders goal can be enhanced by recommended actions identified in other topic areas, as described below.

Recommended Actions for Energy and Borders	
SANDAG	**Recommended Action**
EB-1	Encourage regional coordination on energy and climate change issues in the international and regional border regions that come within the purview of SANDAG including the Borders Committee, Committee on Binational Regional Opportunities, and the Regional Energy Working Group.
EB-2	Support measures related to cross-border goods movement that reduces petroleum use and GHG emissions from heavy-duty vehicles.
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
EB-3	Support the integration of energy-saving measures for buildings, transportation, and overall project design for the (re)development of the land Ports of Entry between San Diego and Baja California.
EB-4	Encourage conservation, energy efficiency, and peak demand reduction in San Diego, Baja California, and tribal nations that relieve stress on the shared regional electricity system.
EB-5	Support coordination with binational stakeholders to explore opportunities for developing renewable energy that benefits the binational region.

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5.11 CLEAN ENERGY ECONOMY

Introduction

> ***Clean Energy Economy Goal:*** Collaborate with workforce entities, employers, and labor unions to identify and expand local job placement mechanisms in the Clean Energy Sector.

According to the California Economic Strategy Panel, green products and practices, including those in the Clean Energy Sector, can be found in the same industries as conventional products and practices. As such, an economic analysis of the type and amount of clean energy jobs (sometimes referred to as green jobs) and investment based primarily on tracking business and employment growth by industry is difficult to quantify. Table CEE-1 shows the types of industries and jobs that comprise the Clean Energy Sector.

Clean Energy Sector jobs are defined as blue or white collar positions that:

- Preserve, restore, or improve the environment.
- Help save energy, advance new energy-efficient technologies, or foster a more sustainable regional and national energy system.
- Have been updated to adopt sustainability as a core segment of the job description.
- Provide career pathway opportunities leading to sufficient income to support a household and potential for advancement.

Opportunities and advantages to the region from expanding the Clean Energy Sector:

- Creating new jobs or retraining the unemployed and under-employed in a time of economic downturn.
- Providing opportunities for career advancement in the sustainability fields.
- Reducing our dependence on foreign oil, and strengthening national security.
- Promoting the use of domestic renewable energy resources.
- Reducing high utility costs of energy-inefficient public buildings and public housing.
- Mitigating climate change by cutting GHG emissions.

Table CEE-1: Sample Jobs and Industries in the Clean Energy Sector

Strategies for Green Economic Investment	Representative Jobs
Building Retrofitting	Electricians, Heating/Air Conditioning Installers, Carpenters, Construction Equipment Operators, Roofers, Insulation Workers, Carpenter Helpers, Industrial Truck Drivers, Construction Managers, Building Inspectors
Mass Transit/Freight Rail	Civil Engineers, Rail Track Layers, Electricians, Welders, Metal Fabricators, Engine Assemblers, Bus Drivers, Dispatchers, Locomotive Engineers, Railroad Conductors
Smart Grid	Computer Software Engineers, Electrical Engineers, Electrical Equipment Assemblers, Electrical Equipment Technicians, Machinists, Team Assemblers, Construction Laborers, Operating Engineers, Electrical Power Line Installers and Repairers
Wind Power	Environmental Engineers, Iron and Steel Workers, Millwrights, Sheet Metal Workers, machinists, Electrical Equipment Assemblers, Construction Equipment Operators, Industrial Truck Drivers, Industrial Production Managers, First-Line Production Supervisors
Solar Power	Electrical Engineers, Electricians, Industrial Machinery Mechanics, Welders, Metal Fabricators, Electrical Equipment Assemblers, Construction Equipment Operators, Installation Helpers, Laborers, Construction Managers
Advanced Biofuels	Chemical Engineers, Chemists, Chemical Equipment Operators, Chemical Technicians, Mixing and Blending Machine Operators, Agricultural Workers, Industrial Truck Drivers, Farm Product Purchasers, Agricultural and Forestry Supervisors, Agricultural Inspectors

Source: Political Economy Research Institute, University of Massachusetts-Amherst, 2008

Through 2019, significant investment will be injected into the Clean Energy Sector through the ARRA of 2009. Nationally, ARRA provided $787 billion of stimulus funding, with most made available in 2009-11. As of June 2009, energy-related allocations to California are listed in Table CEE-2 below.

In the San Diego region, ARRA-funded programs related to energy efficiency retrofits included the County of San Diego's GETUP Program, contractor training in the region, and Home Energy Rater and building performance trainings at CCSE and SDG&E.

Table CEE-2: California ARRA Energy Funding as of June 2009

Program	Agency	Allocation
State Energy Program	California Energy Commission	$226 million
Energy Efficiency and Conservation Block Grants	U.S. Dept. of Energy and California Energy Commission	$352 million
Weatherization Assistance Program	CA Dept. of Community Services & Development	$185 million
Science	U.S. Department of Energy	$184 million
Environmental Management	U.S. Department of Energy	$62 million
Biomass	U.S. Department of Energy	$111 million

Source: California Energy Commission, 2009.

5.11.1 Growing Investment in the Clean Energy Sector

Even without ARRA funds, the Clean Energy Sector is expected to grow. Clean Edge, which tracks the growth of clean-tech markets, reports that global revenues for solar PV, wind power, and biofuels expanded from $75.8 billion in 2007 to $115.9 billion in 2008, an increase of about 53 percent. Clean Edge's 2009 energy trends study identified a 30 percent growth of clean energy venture capital investments as a percentage of total venture capital investments in U.S.-based companies from 2007 (9.1%) to 2008 (11.8%). In 2000, clean energy venture capital comprised only 0.6 percent of the total.

5.11.2 Job Creation by Clean Energy Sector

The influx of federal stimulus funding creates the potential for significant growth in the Clean Energy Sector. Various levels of job creation are identified in economic studies from the U.S. Environmental Protection Agency, American Council for an Energy-Efficient Economy (ACEEE), American Solar Energy Society (ASES), U.S. Council of Mayors, University of California Berkeley, among others. In 2008, a comprehensive analysis of national energy efficiency and energy supply investments by ACEEE found that since 1970, energy efficiency and energy productivity gains have met 75 percent of new energy service demands in the U.S., while new energy supplies contributed 25 percent. A summary of revenues and job creation in the U.S. renewable energy and energy efficiency industries is provided in Table CEE-3.

Table CEE-3: Summary of U.S. Renewable Energy and Energy Efficiency Industries in 2006			
Industry	**Revenues**	**Direct Jobs Total**	**Jobs Created (direct and indirect)**
Renewable Energy	$39.2 billion	196,000	452,000
Energy Efficiency	$932.6 billion	3,498,000	8,046,000
Total	$971.8 billion	3,694,000	8,498,000

Source: Bezdek, Management Information Services, Inc. for ASES, 2007

Existing Building Retrofits and Green New Construction

Generally, green construction, retrofit, and conventional construction projects are bid and worked on by similar contractors. In construction, some of the differences between green and conventional renovations are the composition of materials used in the process, where and how the materials are produced and how waste is addressed. Continual training and continuing education programs can provide the knowledge needed about green construction for contractors, architects, inspectors, permitters, and marketers that communicate with customers.

Renewable Energy and Smart Grid Workers

Similar to construction, many workers in renewable energy also fall under the traditional job classifications of the construction trades. Increasing demand for energy efficiency and renewable energy systems can be expected to generate new employment opportunities for electricians, HVAC technicians, carpenters, inspectors and permitters, plumbers, roofers, laborers, and insulation workers, among others. Comprehensive home and commercial building programs also would increase demand for green building materials, and would stimulate associated manufacturing industries. Training and retraining of existing workers is integral to expanding the region's clean energy sector. Table CEE-4 shows the job creation potential of investments in clean energy industries.

Table CEE-4: Clean Energy Investment and Resulting Job Creation

Level of Investment	Job Creation
$1 million in renewable energy systems	5 full-time employment component manufacturing jobs
$1 million in energy efficiency programs	3-4 building material manufacturing jobs 5 energy-efficient appliance manufacturing jobs
1 direct manufacturing job	2.9 indirect jobs (finance, transportation, supply chains, installers, and other related businesses) (EPI 2003)

Sources: Apollo Alliance Green Manufacturing Action Plan, 2009, Economic Policy Institute

Clean Transportation

Continuing and rapid changes in transportation technology to improve vehicle or system operation efficiency, to switch from petroleum-based to alternative fuels, to reduce environmental emissions, and to effectively integrate transportation systems also have resulted in major changes in skill requirements. Some of these skills are enhancements of existing ones; however, there is a substantial difference between working on a diesel-powered vehicle and one powered by natural gas. Hybrid vehicles require advanced electrical training and biodiesel requires a working knowledge of chemistry. Training and retraining of existing workers is critical to reducing petroleum use and limiting adverse environmental emissions.

5.11.3 San Diego Economic Impact Studies

In 2011, CleanTECH San Diego, a private, non-profit member organization, commissioned SANDAG to prepare economic impact reports for six key clean tech sectors:

- Biofuels
- Clean Transportation
- Clean Energy Storage
- Energy Efficiency
- Smart Grid
- Solar Energy Generation

Table CEE-5 summarizes the direct economic impact from the six sectors. The direct impacts reflect jobs and expenditures that are directly related to each sector. The economic activity from these industries also supports other local industries; these are the indirect impacts that are reported in the full reports.

Table CEE-5: San Diego Economic Impact Studies			
Clean Tech Sector	**Jobs**	**Wages**	**Economic Activity**
Algal Biofuels	466	$41.1 million	$80.9 million
Clean Transportation	1,050	$92.6 million	$311.3 million
Clean Energy Storage	561	$56.3 million	$133.9 million
Energy Efficiency	1,013	$89.6 million	$299.8 million
Smart Grid	460	$37.2 million	$91.5 million
Solar Energy Generation	1,133	$143.2 million	$517.6 million

Source: CleanTECH San Diego and SANDAG, 2011

5.11.4 Regional Clean Energy Job Development Opportunities

Leverage state and federal resources such as California's Green Collar Jobs Council (formed by passage of AB 3018 [Nunez, 2008]) and Clean Energy Workforce Training Partnership, which was formed to best utilize ARRA funding to stimulate quality job growth.

The Green Jobs Guidebook prepared by the Environmental Defense Fund provides detailed job descriptions for renewable energy and energy efficiency related jobs in California for employment year 2008-09. Links to apprenticeship programs and job placement programs are included.

Job training and assistance are also available through the California Clean Energy Workforce Training Program (CEWTP), a partnership between the Energy Commission and a number of state agencies, educational institutions, local workforce investment boards, community organizations, and employers to deliver 21st century training programs for workers with all levels of experience. The goal of the CEWTP is to promote the use of industry sector strategies as the framework for addressing the need for skilled workers in the industries related to energy efficiency, water-efficiency, renewable energy (DG and utility-scale), and alternative and renewable transportation technologies.

5.11.5 Recommended Actions for Clean Energy Economy

SANDAG, local governments, or other regional entities can undertake the following actions to expand the clean energy economy. In some cases, active collaboration among multiple jurisdictions will be needed to implement the recommended actions. The following recommended actions will contribute to other energy goals, and likewise be enhanced by recommended actions identified in other topic areas, as described below.

Recommended Actions for Clean Energy Economy	
SANDAG, Local Governments, or other Regional Entities	**Recommended Action**
CE-1	Promote the integration of Clean Energy workforce training initiatives into existing workforce systems.
CE-2	Support existing and future pathways to provide technical training for clean energy jobs to help integrate students and newly trained workers into the local workforce.
CE-3	Support the development and implementation of clean energy workforce training programs amongst the region's private and governmental organizations and labor unions.
CE-4	Support local workforce training and education on HERS rating and whole-building improvements.
CE-5	Support training and education to building officials and associated building trades on energy codes.
CE-6	Collaborate with regional economists to identify metrics for measuring the clean energy economy, such as levels of investment, number of businesses, total jobs, etc.
CE-7	Support economic development of the clean tech industry in the San Diego region.

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6

Findings

6.1 Priority Early Actions from the Regional Energy Strategy

During the 2009 update, stakeholders, elected officials, and members of the public identified actions that, if implemented, would go a long way toward helping the San Diego region meet its energy goals. While all of the recommended actions identified in the RES are considered important, the following six have emerged as priorities, or core strategies, that are essential to meeting the regional goals. These are implementation actions that can be pursued upon completion of the strategy; indeed, efforts related to most of these actions are already underway. SANDAG and local governments can play an integral role in implementing each of the following priority actions, and in many cases, coordination and collaboration amongst many jurisdictions and stakeholders will be needed to ensure successful implementation.

Since 2009, progress has been made on each of these Priority Early Actions. More information is included in the summary reports for each goal. For Actions 1-3, see the Energy Efficiency and Conservation Goal; for Action 4, see the Land Use and Transportation Goal; for Action 5, see the Transportation Fuels Goal; and for Action 6, see the Energy and Water Goal.

Priority Early Actions

1. Pursue a comprehensive building retrofit program to improve efficiency and install renewable energy systems;
2. Create financing programs to pay for projects and improvements that save energy;
3. Utilize the SANDAG-SDG&E Local Government Partnership to implement the RES at the local level. SANDAG will work with local governments to identify opportunities and implement energy savings at government facilities and throughout their communities;
4. Support land use and transportation planning strategies that reduce energy use and GHG emissions;
5. Support planning of electric charging and alternative fueling infrastructure throughout the region; and
6. Support use of existing unused reclaimed water to decrease the amount of energy needed to meet the water needs of the San Diego region.

6.2 Broad Strategies to Implement Multiple Regional Energy Strategy Goals

During preparation of the RES, broad strategies were identified with overarching connections to several regional energy goals. By implementing these broad strategies, SANDAG and local governments will contribute to achievement of most, if not all of the goals identified.

Broad Strategies to Implement Multiple Regional Energy Strategy Goals

1. Identify, secure, or develop funding mechanisms to pay for energy-related projects and programs;
2. Educate and engage the general public or other stakeholders;
3. Support enabling legislation or policy changes from state or federal government;
4. Take early actions that set examples for residents and businesses; and
5. Develop standardized approaches and programs that can be implemented

7

Conclusion

The goals and recommended actions of the Regional Energy Strategy (RES) will help the San Diego region meet its energy needs while beginning and making substantial progress on a path to a clean, low carbon energy future. Moreover, the RES identifies actions that can improve air quality, reduce traffic congestion, save money, create jobs, increase the use of alternative fuels, expand transportation alternatives, ensure an adequate energy supply to meet growth projections, and improve the region's quality of life.

The core strategies for implementing the region's energy goals will be pursued upon completion of this strategy. The Energy Working Group will continue to coordinate the implementation of the RES and advise the SANDAG policy committees and Board in this regard. SANDAG and local governments can play an integral role in implementing each of the following priority actions, and in many cases, coordination and collaboration amongst many jurisdictions and stakeholders will be needed to ensure successful implementation.